

**XLIII National Congress of the  
Italian Society for the History of  
Physics and Astronomy**



**Book of Abstracts**

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Contribution ID: 1

## **Bernardo Dessau. Physicist, scientist, teacher**

*Wednesday, 6 September 2023 09:45 (20 minutes)*

This talk intends to retrace the human and scientific affair of Bernardo Dessau, a scientist of German origin and of Jewish tradition, who lived in Italy between the late 1800s and mid-1900s. From the degree in physics with Kundt in Strasbourg in 1886 to the research work on the generation and detection of electromagnetic waves and on wireless telegraphy, as assistant of prof. Augusto Righi, at the University of Bologna, for fifteen years. Here he acted as a very efficient link between German physics and Righi's research in Bologna and obtained his habilitation in 1897. Then he got the position of professor of experimental physics and moved to University of Perugia in 1904. It is important to underline his fame as a scientist and popularizer, his contribution to the development of Italian physics and the CNR, his ability to accompany as a great teacher, not only university students, but also the general public, the amazing discoveries and innovations on the front of atomic physics, quantum mechanics and telecommunications. Alongside scientific successes, however, he had to suffer vicissitudes and discrimination due to his German origin and his being Jewish, experiencing the impact of the tragic events that shook the "short century", on both himself and his family members. The above aspects will be explored during the seminar, trying to do some justice to a largely forgotten and underestimated scientist, who died alone and ill in 1949, and wanted the following inscription on his grave: "Bernardo Dessau. Physicist, scientist, teacher".

**Author:** CARLOTTI, Giovanni (University of Perugia - Dept of Physics and Geology)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 2

## **Whitehead's relational formulation of relativity**

*Tuesday, 5 September 2023 17:10 (20 minutes)*

Regarding physics, Alfred North Whitehead (1861-1947) is practically known only among few general relativistic theorists for his sort of special-relativistic theory of gravitation, formulated in opposition to general relativity. However, in my opinion, the greatest work of Whitehead is just a physical one, even if it has very important philosophical and mathematical implications. And it is not his theory of gravitation, but it is his relational formulation of special relativity, that is completely independent of his gravitation theory and also of his trials to link the world of experience and of perceptual representation and the world of physics at a foundational level. Indeed, Whitehead has given a solution to Ockham, Al Ghazali and Kalam school, and Leibniz' major problem of constructing a relational theory of space, time and motion, and so of geometry, by defining all the fundamental concepts and formulating (special) relativity in terms of event-particle relations: a relational theory of space and time should describe the principles of geometry in terms of sensible entities. Russell noted that indeed right lines and planes are not such entities, whereas, on the contrary, metrical (distance) relations are.

**Author:** GIANNETTO, Enrico (Università di Bergamo)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond

Contribution ID: 3

## **Free-energy calculations in soft and hard matter: From Hamiltonian thermodynamic integration to early applications of umbrella sampling**

*Wednesday, 6 September 2023 10:45 (20 minutes)*

Free energy is a thermodynamic potential that plays a pivotal role in comprehending the behavior of energy processes and transformations in matter. However, the development of accurate methods to calculate it has been a significant challenge for scientists involved in analytical and computer simulation approaches, spanning several generations. This presentation seeks to provide an analysis of the most significant works related to free-energy calculations, along with a chronology and primary-source collection that is valuable for gaining historical insights. The period under review commences with the analytical studies of John Kirkwood in 1935, which laid the foundations for the Hamiltonian thermodynamic integration, and extends to the emergence of umbrella sampling in 1977. The focus will be on simulative techniques and the major challenges that molecular simulation practitioners faced. Despite some references in natural-science literature, a systematic documentation of the history of free-energy calculations is lacking. Hence, this talk aims at presenting the initial few strides made in this direction.

**Author:** MACUGLIA, Daniele (Università di Pechino)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 4

## **On the Grimaldi Phenomenon**

*Thursday, 7 September 2023 10:15 (20 minutes)*

This communication deals with a short but exhaustive historical development of two different viewpoints about the diffraction phenomenon. This foreword to introduce the first and dramatic phenomenology observed since the end of the XVII century. Pedagogical observations are revisited about this first phenomenon observed. Impetus to this paper was given by a critical question posed by a student when Author was teaching some Optics experiments.

**Author:** GANCI, Salvatore (Independent Researcher)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 5

## **An Essay in Counterpoint: Wheeler, Schwinger, and “Conflicts in Physics”**

*Thursday, 7 September 2023 12:30 (20 minutes)*

J.A. Wheeler (1911-2008) and J.S. Schwinger (1918-1994) are two towering figures in 20th-century physics. Despite partially common interests, they also embodied two separate worlds: one characterized by conviviality, the other by isolation; one believing that science is born out of conversation, the other working alone; one putting physics at the service of atomic and hydrogen bombs, the other outspokenly proud of not having taken part to the Manhattan Project. If, however, we look, thanks to his private notes, at a less explored facet of Wheeler, that of the “seeker” who held the “herd instinct” of physicists in contempt, we may appreciate some resonance in attitude with Schwinger, when they both were trying to carve their own paths “far from the particle crowds”. These were, as expected, two quite different paths, but both physicists resorted to a common strategy worth some attention: an “oblique” use of history, or the use of historical masks to give voice – a different voice – to themselves. In this paper, I will address how they both, under historical “disguise”, took their stance against the mainstream of particle physics in different moments. This can also show how such quasi-historical evocations ended up reflecting, in Schwinger’s case, his ever-increasing and scornful isolation, but at the same time an empathic opening towards “colleagues” who were distant in space or time. In Wheeler’s case, instead, it reveals his ability to navigate a number of epistemic, geopolitical or military tensions and conflicts, even turning them into a resource.

**Author:** FURLAN, Stefano (Max-Planck-Institut für Wissenschaftsgeschichte)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century



Contribution ID: 6

## Atoms of Fire: Galileo's Unachieved Theory of Heat and the Early Beginnings of Thermometry (c. 1603-1638)

Wednesday, 6 September 2023 11:25 (20 minutes)

Galileo never developed a systematic theory of heat, nor of the atomic structure of matter. All we know about can be derived from his correspondence with Giovan Francesco Sagredo (1612-1615), from *Il Saggiatore* (1623), from Benedetto Castelli's letter to Ferdinando Cesarini (1638), and from Vincenzo Viviani's *Racconto istorico* (1654). The limits and unresolved issues of Galilean atomism have already been discussed by scholars. My paper is focused on Galileo's mechanistic-corpuscular account of heat and related phenomena as effects produced by subtle, sharp, and mobile *minima* of fire penetrating the inter-atomic *vacua* of material substances. The hypothesis was not original, the connection between heat and motion at microscopic level belonging to the tradition of ancient and early-modern corpuscularianism. Galileo's specific contribution is to be found in his indirect quantification of heat released or acquired by a material body, given the impossibility of a direct method to measure the amount of fire corpuscles emitted or absorbed. Such an attempt exposed Galileo to challenging objections from his contemporaries: if hot bodies did not seem to be heavier than cold ones, heat must not be identified with fire itself, but with the effects of igneous atoms streaming through larger particles. The conceptual shift towards studying the action of fire on material bodies in terms of measuring their temperature, by means of the already-known phenomenon of thermal dilatation, was the key step leading to Galileo's thermoscope (c. 1603) and to its first medical application as graduated (proto-)thermometer by Sanctorius in the 1610s.

**Author:** SALVIA, Stefano (University of Pisa)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 7

## Galileo's experiments with Arduino

Friday, 8 September 2023 12:10 (20 minutes)

Galileo's experiments are fascinating examples of how the scientific method works. Despite this, some scientists and historians assert that Galileo did not make experiments. During the school year 2022-23 in a III Liceo class, talking about classical physics and Galileo, I proposed an analysis of a fundamental Galileo experiment on parabolic motion re-working in a modern key through the use of Arduino. In 1607 Galileo talks about motion with a manuscript (Folio 116v) in which he reports the experimental results whose interpretation is very important: Galileo assumes that velocity is a continuously variable quantity and is proportional to time and asserts that the velocities of bodies, falling from a certain height, are in the same ratio as the square roots of the distances. This result is fundamental for classical physics. The experimental device used by Galileo, and reconstructed with Arduino by a group of students, was a plane 30° inclined placed at a height of 828 points (77.7 cm) respect to the reference. This height allows to have, for a fall on the inclined plane from 300 points height, a range of 800 points. The attempt results of some launches are marked in the manuscript both by a calculated value ("doveria") and by a measured value, evidence that the experiment was carried out by Galileo. The study of this original source has allowed the students to relive a key moment of science history and the birth of experimental method through Galileo works, impossible to exclude from any high school path.

**Author:** TORRE, Matteo (Liceo "G. Peano", Tortona (AL))

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 8

## **From the Earth to the Sun: the quest for the Astronomical Unit by means of the 1761 and 1769 Venus transits**

*Wednesday, 6 September 2023 12:25 (20 minutes)*

In the mid-eighteenth century, one of the most urgent astronomical problems was to determine the exact value of the Earth-Sun distance (the so-called Astronomical Unit, AU), necessary to establish the real dimension of the entire solar system. The most promising methods for measuring the AU, due to Edmond Halley (1656-1742) and Joseph-Nicolas Delisle (1688-1768), were both taking advantage of a rare phenomenon: Venus transit over the Sun, expected to occur in 1761 and 1769. According to those methods, observers – spread all over the two Earth hemispheres – taking simultaneous and accurate measurements of the transit would have enabled derivation of the solar parallax and hence of the AU (with an uncertainty of less than 1%, at least in Halley's intent). Thus, in a world torn apart by the Seven Years War (1756-1763) and the subsequent struggles for colonial hegemony, more than 250 astronomers and scholars from different nations, animated by a common purpose in the spirit of Enlightenment, gave life to an incredible joint venture, never attempted before, which is considered the first international scientific collaboration. Among them, was the Italian scientist Giovanni Poleni (1683-1761), who observed the 1761 transit from Padua. Padua looks then the right location in which the story of the two Venus transits can be told. A story that was not only an incredible astronomical enterprise but also a masterful example of how science had and has still today the power to overcome national boundaries and hostilities.

**Author:** LOVISETTI, Luisa (University of Milan, Department of Physics)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond

Contribution ID: 9

## **The Gregorian calendar formulated by Luigi Lilio and the supposed influence of Copernicus**

*Wednesday, 6 September 2023 10:25 (20 minutes)*

During the 16th century, the disagreement between the dates of the Julian calendar, which had been in use since 46 BC, and the vernal equinox necessitated a correction to the computational rules used to regulate the flow of time. Luigi Lilio using imprecise astronomical data contained in "The Alfonsine Tables", was able to elaborate a calendar that has stood the test of time: the Gregorian calendar. In a famous letter written by Galileo Galilei to the Grand Duchess of Tuscany Cristina of Lorraine, he states that Copernicus had been summoned to Rome from far away Germany in order to participate in the reform. Galileo Galilei, to protect himself from controversy with Church regarding his discovery of the heliocentric system, states that with "...the new doctrine not only has the calendar been regulated, ....". This sentence, over the centuries, has contributed to generating confusion. Copernicus did not participate directly in the reform but, as noted in the list of correspondence written by Paul of Middelburg, attached to the conclusive report that he sent to Leone X who wanted to correct the calendar, Copernicus was called to give his opinion. The content of the letter is not known but probably summarizes his knowledge and opinions regarding the effective duration of the tropic year. In this presentation, the supposed influence of Copernicus in the reform of the Gregorian calendar will be discussed.

**Author:** VIZZA, Francesco (CNR-ICCOM)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos

Contribution ID: 10

## Science Images. Reinventing science within an ever-changing world

Thursday, 7 September 2023 10:35 (20 minutes)

Science. Anciently defined as “knowledge”, but nowadays it is associated with pragmatism, dogmatism and technological advance within itself. Something, some say, impossible to reach.

In 1623, Galileo thought of creating a widespread scientific community where everyone could make science freely. But how can someone teach and divulge science in an ultra-technological world and moreover, fight a continuous loss of interest from students and a narrow-mindset given by universities?

How can someone spread and share curiosity and passion for science and history too whilst pseudoscience is gradually making a comeback? How can science address itself towards learning disabilities, ADHD, plusdoted, and autism audiences?

Through the stories and experiences of Dr. Carl Sagan, Dr. Stephen Hawking, and Dr. Margherita Hack alongside a first-hand museum experience towards physics and astronomy, we will try to understand how to shape up and reinvent the scientific world so one day it can build within dreams, leaving out the dogmas of our society.

**Author:** BERCIGLI, Erika (Università degli Studi di Bologna)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 11

## Galileo’s Reception and Rework of the “Optical Theory” of Comets

Tuesday, 5 September 2023 11:45 (20 minutes)

In 1618 Galileo and his student Mario Guiducci argued that comets were hot and dry exhalations illuminated by the Sun and carried forward by the revolution of the heavens. They endorsed the account according to which cometary phenomena were nothing more than mere appearances or, as he put it, “wandering glimmers” of reflected light. How could they ever come to elaborate such a peculiar account? The thesis, also known as “*optical theory*” of comets (as defined by Peter Barker), has been considered in that context either as straightforwardly Aristotelian or implicitly anti-Aristotelian, or even Stoic in its essence. In my contribution I rather argue that Galileo actually grounded his work on a long tradition of Aristotelian studies on the subject, as well as on a good amount of the Sixteenth century cometary and meteorological literature, which he partially followed and developed in his own account since the time of his studies in the new star of 1604, but only in so far as that tradition was functional to *overturn* the Aristotelian physics on a deeper and more undermining level. In my diachronic analysis, the pseudonymous treatise *Considerazioni d’Alimberto Mauri*, recently attributed to the pen of Galileo Galilei, will be also taken into account. The mature view on the “optical theory” of cometary transients presented by Galileo’s *Saggiatore* will be thus understood on the ground of a new set of sources, and on the background of a higher number of preparatory steps, for a fuller understanding of the scientific strategies underneath.

**Author:** COSCI, Matteo (University Ca’ Foscari Venice)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 14

## **The rise of multi-messenger astrophysics and the pro-social function of models**

*Friday, 8 September 2023 10:45 (20 minutes)*

Following Ian Hacking's (1989) investigation in the history of gravitational lensing, many studies have considered the role of models in astrophysics, particularly the so-called "models of data", i.e., the use of numerical methods to infer an expected output from statistics about an input dataset. This has led to emphasize that much research appears "model driven": models shape the researchers' expectations, support their guesses about which objects they will observe next and suggest what kind of experiments is needed to check the guesses and to expand the theory.

In this paper, I argue that the emergent field of multi-messenger astrophysics — i.e., the combined study of radiation from the cosmos conveyed by mediators different in nature: neutrinos, photons in all frequencies, gravitational waves, and cosmic rays — allows to appreciate a special feature of models that has largely been overlooked. Here not only models shape theoretical expectations and guide the experimental effort. They also suggest that experiments will generally need a plurality of cooperating researching actors, thus narrowing the scientists' choice about what kind of social behavior they should adopt to pursue their research. With that, models in multi-messenger astrophysics exemplify an intriguing case in which the scientists' attitude toward cooperation is not mainly due to social or economic constraints but motivated, not to say determined, by epistemic requirements.

**Author:** GUZZARDI, Luca (Università degli Studi di Milano)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: History and epistemology of physics

Contribution ID: 15

## **Logical Interpretation of Pierre Curie's Paper on Symmetries (1894)**

*Wednesday, 6 September 2023 11:25 (20 minutes)*

Curie's 1894 paper is examined on the basis of the recent discovery of a theoretical organization which is alternative to the deductive-axiomatic one. In agreement with it, the text presents many doubly negated propositions that belong to intuitionist logic, including its celebrated "propositions"; which therefore are recognized as heuristic in nature, not axioms. A rational re-construction of Curie's paper according to a new model of theoretical organization shows new aspects of his theory, i.e. ad absurdum proofs and the application of the principle of sufficient reason. However, maybe because wanting to present the subject at a theoretical level comparable with that of the dominant Newtonian paradigm, Curie appealed to the metaphysics of "causes" and hence to a deductive theory. Ultimately, Curie's paper results to be a mixture of characteristic elements of both kinds of theoretical organizations, because he was obliged by the subject to argue in a heuristic way. In conclusion, the paper shows that symmetry is a mathematical technique which is to be merged within the specific theoretical organization based on a problem, leading to a final predicate which has to be subjected to two constraints (indirectly suggested by Markov).

**Author:** DRAGO, Antonino (Dept. Physical Sciences, University Federico II Naples)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: History and epistemology of physics

Contribution ID: 16

## **Scientific Phenomenological Realism and the Physics of Unobservables: Einstein, Husserl, and Neelamkavil**

*Wednesday, 6 September 2023 11:45 (20 minutes)*

Despite various positions and ideologies, scientists construct unobservable entities from certain indicative manifestations of a possible existent. From this point of view, Husserl's phenomenology is presented as a possible philosophical framework to elucidate the meanings of foundational theoretical terms in relativistic physics, emphasizing their a priori character, its linguistically contingent aspect and the intersubjectivity of intelligible unobservables. Assuming the phenomenological consideration of the phenomenon-subject-object trinomial in General Relativity, the manifestations of an existent (based on Raphael Neelamkavil's irreducibly physical-ontological universals and intersubjective essences in Husserl), we approach the processual character of the subject, object, and Reality through the ontological Categories of Extension-Change in Neelamkavil with respect to Einstein's Theory.

**Authors:** CASTILLO, Ruth (University of Roma Tre); NEELAMKAVIL, Raphael

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: History and epistemology of physics

Contribution ID: 17

## **Innovations and inventions from the Nobel family in the late nineteenth and early twentieth centuries.**

*Thursday, 7 September 2023 10:55 (20 minutes)*

In the following, some important inventions and innovations are described, as created from 1840 until the 1917 revolution by Immanuel and his sons Robert, Ludwig, and Alfred, the last representatives of the Nobel family. Alfred's invention of dynamite was born from Immanuel's research into underwater mines and new explosives. Robert was fascinated by the city of Baku in Azerbaijan while on a business trip to purchase walnut wood for rifle stocks. Realizing the big business that would stem from the emerging industry of oil extraction, he decided to buy some parcels of oil-rich land and a small refinery. Thus the Russian oil industry was born and with it the development of all technologies related to the extraction, conservation, and transportation of the black gold, such as the construction of tank wagons, oil tankers, pipelines, and railway lines.

Ludwig, the leader of the Nobel industries, was an innovator for the modernity of the products and for the special relationship between the management and the workers; he thus managed, for some time, to make the Russian economy independent of foreign imports. Alfred's legacy is still used today to reward the research and those who work to achieve peace in the world.

**Author:** FRANCHINI, Laura (Associazione Amici di Città della Scienza Napoli)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 18

## **Old quantum physics for cultural education**

*Wednesday, 6 September 2023 18:15 (20 minutes)*

Personal culture can be considered as that rich knowledge that makes people able of a broad vision, new ideas, and personal reflections about reality. With social culture, instead, we mean those habits, values and behaviours adopted by a given society. But we can also consider disciplinary culture, i.e., the one “identified” by a disciplinarily differentiated group, like physicists. It is from this last point of view that often scientists complain of a lack of diffuse scientific culture. This fact comes from the observation that, indeed, few people think physics is able to touch, besides people’s minds, also people’s hearts. However, even scientists themselves rarely wonder why, and in what sense, science should really be a cultural part of the whole society.

The Physics Education Research Group of the University of Milan strongly believes that awareness of the importance of cultural aspects of physics should be highlighted, and placed at the base of physics education. In this talk, we will mainly focus on our work on the historical-philosophical- educational aspects related to the birth of quantum physics, the challenges it generates and the perspectives it opens up for a general overview of the problem. We will discuss motivations, proposed methods, and tools to manifest physics as culturally strongly intertwined with the vision of the world and of life of each of us.

**Authors:** GILIBERTI, Marco (Università degli studi di Milano); LOVISETTI, Luisa (University of Milan, Department of Physics)

**Presenter:** GILIBERTI, Marco

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 19

## **Celestial micro-mechanics 1916-17: Einstein vs. Schwarzschild, Sommerfeld, Epstein**

*Wednesday, 6 September 2023 10:25 (20 minutes)*

I compare two research programmes from the late years (1916-) of the old quantum theory. In three texts from 1917, Einstein proposes an apparently Hamiltonian micro-mechanics – on a torus designed to ‘Riemannize away’ problematic dynamical multi-valuedness – characterised by surprisingly modern invariances: ‘point’ (diffeomorphic) and homotopic. The rival programme (Schwarzschild, Sommerfeld, Epstein etc.), which is genuinely canonical, produces its own tori through action-angle variables and uses perturbations (Zeeman, Stark, relativity) to eliminate awkward coordinate ambiguities which would affect quantisation itself.

**Author:** AFRIAT, Alexander (Université de Bretagne Occidentale)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 20

## **Observatory INTEGRAL in the geopolitical perspective**

*Thursday, 7 September 2023 12:10 (20 minutes)*

A heavy launch vehicle Proton carrying the International Gamma-Ray Astrophysics Laboratory INTEGRAL was launched from Baikonur Cosmodrome on 17 October 2002. The project had been developed by the European Space Agency (ESA) for more than 10 years. INTEGRAL required an Arian 5 rocket, the cost of which became ever more problematical and which would not be available until the late 1990s. Russians offered their Proton rocket since their own observatories were nearing the end of their working life and with no money to fund new missions. Rather than charge a launch fee for Integral, Russia offered a free launch in exchange for 25 percent observing time. Russian scientists called INTEGRAL the first Russian National Observatory. This meant that any Russian researcher could apply for a specific observation in a bid organised by ESA. Specifically for the INTEGRAL project, the Russian Scientific Data Centre was established at the Space Research Institute of the Russian Academy of Sciences in 1997 to receive, store, primarily process and disseminate among Russian scientists the scientific information obtained during the experiment.

I will analyse this case study from a geopolitical perspective by placing it in the broader context of Russian-European cooperation in space, of the political situation in Russia during the transition period and, finally, of the socio-economic consequences of the collapse of the USSR. This presentation is a part of the larger research on Soviet/Russian-European relationship based on ESA Archives, Soviet and Western free press, memoirs, and interviews with testimonies.

**Author:** DUBROVINA, Olga (University of Padua)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 21

## **Natural electricism in Giuseppe Maria Giovene's researches**

*Wednesday, 6 September 2023 16:55 (20 minutes)*

In the second half of the Eighteenth century, a large number of physicists dealt with atmospheric phenomena. It was generally acknowledged that meteorological conditions could have a great influence on the life of humans and animals, as well as on the plant growth. A considerable amount of quantitative data was collected, using hygrometers, rain gauges, electrometers, etc. In Apulia, one of the first to develop these researches was the naturalist Giuseppe Maria Giovene (1753-1837). He published his data from 1788 to 1797. Giovene also tried to understand how some meteorological phenomena were generated, giving much importance to the effects of atmospheric electricity. In his work "Osservazioni elettrico-atmosferiche e barometriche insieme comparate" (*Observations of atmospheric electricity compared with barometric ones*), published in 1799, he illustrated the relationship that he identified between the intensity of atmospheric electricity and pressure variation. As Giuseppe Saverio Poli did, he found a correlation between electricity and magnetism in atmospheric phenomena. Giovene's main merit was that he treated meteorology as a statistical science.

**Author:** DE FRENZA, Lucia (Seminario di Storia della Scienza - Università degli Studi di Bari)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries



Contribution ID: 22

## **The “Meetings with Nature” Giuliano Romano and Don Paolo Chiavacci**

*Wednesday, 6 September 2023 15:55 (20 minutes)*

Giuliano Romano’s meeting with Don Paolo Chiavacci in the 1970s: the story of a friendship on the slopes of Grappa between the cosmologist of the University of Padua and the prophetic priest of the environment in love with God and Nature. A forward-looking vision of the founder of the current Center of Spirituality and Culture, dedicated to him, in a search between the infinitely large and the infinitely small of the beauties of nature for an understanding of what surrounds us as a cure for our “common home”. With Giuliano Romano, the dissemination and teaching of astronomy began at the Center, viewing knowledge as a tool to love, appreciate, and safeguard our fragile planet.

### **Gli “Incontri con la Natura” Giuliano Romano e don Paolo Chiavacci**

L’incontro negli anni ‘70 di Giuliano Romano con don Paolo Chiavacci: storia di un’amicizia sulle pendici del Grappa tra il cosmologo dell’università di Padova con il prete profeta dell’ambiente innamorato di Dio e della Natura. Una lungimirante visione del fondatore dell’attuale Centro di Spiritualità e Cultura, a lui dedicato, in una ricerca tra l’infinitamente grande e l’infinitamente piccolo delle bellezze della natura per una comprensione di quanto ci circonda come cura per la nostra casa “comune”. Con Giuliano Romano inizia la divulgazione e la didattica dell’astronomia al Centro: il conoscere come strumento per amare, apprezzare e tutelare il nostro fragile pianeta.

**Author:** BERTOLLO, Laura (Centro di Spiritualità e Cultura /Associazione Incontri con la natura don Paolo Chiavacci\_ Pieve del Grappa (Tv))

**Session Classification:** In Memoria / Commemoration of Giuliano Romano (1923-2013)

Contribution ID: 23

## **A geo-historical itinerary: evidence of the time measurement in Padua**

*Friday, 8 September 2023 09:45 (20 minutes)*

Within Padua’s historic center, there are several prestigious and lesser-known clocks and sundials, some easily visible, while others remain hidden from the inattentive observer. This study aims to identify a route through Padua’s historic center, where one can pause and observe the timekeeping instruments. It examines sundials, meridians, and clocks found on the city walls, carefully studying their construction characteristics. Each instrument’s history is considered, along with the history of the building it is housed in, as well as the practical and social functions for which it was built. Furthermore, the study delves into the scientific and technological advancements at the time of its creation.

**Author:** MARCON, Luigi (Independent Researcher)

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections



Contribution ID: 24

## **In Memory of Prof. Giuliano Romano**

*Wednesday, 6 September 2023 15:35 (20 minutes)*

Professor Giuliano Romano was one of the most important and charismatic figures in Italian astronomy. He held a prominent position in the cultural landscape of his hometown and in the academic world of the University of Padua. Not only was he a respected scientist, but also an exceptional science communicator, often referring to himself as a passionate sky observer. As someone who had the privilege of being his student, collaborator, and sincere friend, I am retracing the scientific journey of this illustrious native of Treviso, highlighting his unforgettable contributions to the field of popular science.

**Author:** VANZIN, Enio (Independent Researcher)

**Session Classification:** In Memoria / Commemoration of Giuliano Romano (1923-2013)

Contribution ID: 25

Type: **Invited**

## **The Bureau des longitudes (1795-1932), an academy of astronomical sciences internationally open**

*Friday, 8 September 2023 09:15 (30 minutes)*

Created during the French Revolution to “regain control of the seas from the British”, the Bureau des Longitudes still exists nowadays. Initially composed of ten members (2 surveyors, 4 astronomers, 2 ex-navigators, 1 geographer and 1 ‘artist’), it functioned as a small “academy of astronomical sciences” (covering fields such as celestial mechanics, cosmology, metrology, physical and earth sciences, geodesy, etc.), acting as a spokesman for French science and technology for the international scene. However, its history remains little known to the public and even to historians.

Research carried out within the framework of the ANR (French funding agency for project-based research) BDL 1795-1932 project, which ended at the end of March 2022, has made it possible to enhance the archival corpus of meeting minutes: 21,602 sheets with their full transcripts now available on a dedicated website (<http://bdl.ahp-numerique.fr/>). These archives retrace the life and activities of the Bureau week by week, contain the correspondence and technical-scientific dossiers submitted to it, some of which are unpublished. These archives are exceptionally rich, allowing us to follow the activities and evolution of science between professionalisation and patronage, confrontation with peers and personal relationships.

In this talk, I aim to consider the traces of ‘Italians’ (i.e., unified Italy) in the minutes of the Bureau des Longitudes. Who are they? Why mention them? What can we learn by studying their traces? By dwelling on a few emblematic cases, I will show the depth of these archives and highlight the possibility of developing research in the history of science from a perspective taking more into account different societies and cultural contexts.

**Author:** SCHIAVON, Martina (Université de Lorraine)

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections

Contribution ID: 27

## Was Galileo accurate in recording Moon's images in *Sidereus Nuncius*?

Tuesday, 5 September 2023 12:25 (20 minutes)

The four different Moon's images in the *Sidereus Nuncius* were analysed by Guglielmo Righini with purely astronomical methods. The first image represented the waxing Moon on the fourth or fifth day after the new Moon. For dating the second and the third image G. Righini used a very original method. He claimed that lunar libration was detectable in Galileo's images. Gingerich criticised these results as they refer to images which were too inaccurate for a quantitative analysis. Drake moved Righini's date October 2, 1609 to January 1, 1610, and accepted other G. Righini's dates. Whitaker confirmed Righini's dates for the second and fourth images; for the third image, he confirmed Righini's date if for "shortly before the last quarter" we mean one day before. For the first image, Whitaker proposed a different date: November 30, 1609. Gingerich and Van Helden took Whitaker's chronology as definitive, except for the date of the second image (December 2, 1609 instead of December 3, 1609). More recently A. Righini revised G. Righini's dates, using the JPL Horizon project website and the Stonyhurst disc, and corrected G. Righini's date of the first image from October 2, 1609 to December 1, 1609, with a mean absolute error of 2.5% in units of lunar diameter. In my communication, I will point out that the analysis of the images carried out with astronomical methods highlights how they are accurate enough to allow quantitative predictions. The results are consistent with dates obtained by other methods.

**Author:** TUCCI, Pasquale (retired, Università degli Studi di Milano)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 28

Type: **Invited**

## The Assayer Assayed (keynote)

Tuesday, 5 September 2023 09:45 (45 minutes)

Galileo's *Saggiatore* has the reputation of a pioneering work in the methodology of science. It no doubt contains scattered remarks that, when assembled, support an alternative to the school philosophy as taught in Jesuit colleges. Most of the book, however, is devoted not to promoting a new methodology but to obfuscating what little science it presents. It was a clever, tedious, unfair, inconclusive polemic in an argument of interest primarily to a narrow circle of Roman savants and literary men who liked clever word play and disliked the Jesuits. I shall try to explain why Galileo wrote in this way and to locate where, in its literary history, the *Saggiatore* gained the reputation it now bears and may deserve.

**Author:** HEILBRON, John (University of California, Berkeley)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 29

## Music in Holland: Consonances According to Simon Stevin

Wednesday, 6 September 2023 12:05 (20 minutes)

The 17th century was a gold century for Dutch science in general and in particular for the theory of music, still belonging to the physical mathematical disciplines. Beekman, Stevin and Huygens produced important writings on the subject. In the present paper, the conception of consonance for musical intervals of Simon Stevin is presented. A quite strange conception according to most historians of music because Stevin contested the shared opinion for which consonance of two notes occurs for ratios of their pitches expressed by simple integer numbers. For instance, the fifth, one of the most consonant intervals, was unanimously associated to the ratio  $3/2$  ( $= 1.5$ ). According to Stevin, this was instead a quite crude approximation, as the correct value of this interval should be  $2^{(8/12)}$  ( $= 1.587$ ). The paper does not pronounce about Stevin's approach. It rather wants to discuss one of the proofs appearing in Stevin's musical treatise, *Vande spiegeling der singkonst*. The few historians that commented Stevin's proofs sustained that his reasoning was not so stringent and faulty of paralogism. It will be shown that this not the case; and if Stevin's result was wrong, this depended by experimental errors only.

**Authors:** CAPECCHI, Danilo (Sapienza Università di Roma (retired)); CAPECCHI, Giulia (Basel Schola Cantorum)

**Presenter:** CAPECCHI, Danilo

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 30

## Exchange interactions between Europe and Japan in the 1930s: Tomonaga, Yukawa and the birth of nuclear theory

Wednesday, 6 September 2023 17:15 (20 minutes)

The concept of exchange interactions was introduced by W. Heisenberg in 1926 in connection with the quantum mechanical description of systems of identical particles, and it was soon fruitfully applied to many problems in atomic, molecular, and condensed matter physics. After the discovery of the neutron in 1932, it found application also in nuclear physics, with the theories of nuclear structure developed, among others, by Heisenberg and E. Majorana. Then, it entered the domain of quantum field theory, leading to the modern understanding of fundamental forces as mediated by virtual particle exchange. An important intermediate step in this development is Fermi's theory of beta-decay. H. Yukawa and S. Tomonaga, who already had been exposed to the principles of the new quantum mechanics by attending a cycle of lectures given by Heisenberg and Dirac in Japan in 1929, and spent long periods in Europe, were strongly influenced by these works. Within a few years, Yukawa conceived his crucial idea of an interaction mediated by virtual mesons, while Tomonaga investigated the range of proton-neutron interactions. In this contribution, we reconstruct the role played by Japanese physicists in building the modern understanding of fundamental forces in the 1930s and relate it to research performed in Europe.

**Authors:** DI MAURO, Marco (University of Trento); ESPOSITO, Salvatore (INFN - Sezione di Napoli); NADDEO, Adele (INFN, Sezione di Napoli)

**Presenter:** DI MAURO, Marco (University of Trento)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 31

## **“LOOK UP!” A virtual exhibition about the historical astronomical atlases**

*Friday, 8 September 2023 11:30 (20 minutes)*

The new technologies are changing every aspect of our life, socially and workwise. In the same way, digital tools are becoming increasingly important to protect, preserve, and valorise cultural heritage. The digitalization of the archive's documents and ancient books, the realization of augmented reality apps for museums, or even the creation of virtual realities set in cultural or landscape environments that are protected or not open to visitors, are examples of the use of the new technology in the field of cultural heritage.

In this context, the projects “Cosmic Pages” and “Touch the Sky” were developed. One of the main goals of these projects was the realization of the virtual exhibition “Look Up!”. It is an effective virtual tool aimed at enhancing and giving maximum dissemination of the collection of the star atlases, cometographies, and selenographies preserved in the Observatories of the Italian National Institute for Astrophysics. This virtual exhibit was conceived and realized allowing the visitors to discover, explore, and understand how our knowledge of the cosmos, the Moon, and the planets has evolved and changed with the time. Using the most advanced technologies, virtual reality,

3D models, videos, etc., visitors can explore the scientific and cultural contents of the star and cartographic atlases.

**Author:** DI GIACOMO, Federico (Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 32

Type: **Invited**

## **Giuliano Romano and the archaeoastronomy**

*Wednesday, 6 September 2023 15:05 (30 minutes)*

In the landscape of Italian archaeoastronomy Giuliano Romano has been the scholar that opened the road in this research field. His first contributions go back to 1980, e in the subsequent years he organized or collaborated to the organization of meetings and seminars that were a model not just for Italy. Some publications in collaboration with A. Aveni were of particular relevance. His works on the orientation of churches and sacred buildings were a reference for many Italian scholars. In the last decades, he performed research on pre-columbian civilizations, in particular on Mayan mathematics and astronomy. The opportunity of the presentation at the SISFA meeting will allow us to make also an excursus dedicated to a short analysis of the basic difficulties of archaeoastronomy, that are related to the problems of the interaction between physical sciences and humanistic sciences.

**Author:** ANTONELLO, Elio (Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** In Memoria / Commemoration of Giuliano Romano (1923-2013)

Contribution ID: 33

## **Bologna Bottles revisited with unexpected links to war events**

*Thursday, 7 September 2023 10:55 (20 minutes)*

The interest in physical properties of glass is a constant in scientific literature and when the United Nations General Assembly declared 2022 to be the International Year of Glass, a number of researches gained new impetus. Material scientists paid increasing attention to some curious glass behaviors, known for centuries and apparently of historical interest, being now possible to obtain useful information for studying non-equilibrium phenomena thanks to modern techniques. An example is that of the so-called ‘Dutch or Batavian tears’ or drops of Prince Rupert (PRD), known since the seventeenth century, resistant to hammer blows but which are pulverized by breaking the tail. Other curiosities of the same period have much in common with the “drops”, such as for example the ampoules (also called philosophical vials or bottles) of Bologna, less known than the PRD but, according to an 1825 city guide, “well known to physicists”. Apparently unbreakable if struck from the outside, they shatter by introducing a grain of flint inside. Starting from their discovery, perhaps fortuitous, for more than two centuries they were the subject of academic debates, encyclopaedia articles, learned exchanges of letters, and magic tricks (the bottles of the Devil) to arrive at today’s educational laboratories. The PRD have been discussed in a recent paper, but the

‘Bologna Bottles’, related history and the theories explaining their mechanical behavior will be exposed in the course of the present communication, together with some unexpected comparisons with current events.

**Author:** TADDIA, Marco (Alma Mater Università di Bologna)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 34

Type: **Invited**

## **The scientific legacy of via Panisperna. History, experiences, and perspectives of the Enrico Fermi Museum**

*Thursday, 7 September 2023 09:45 (30 minutes)*

The Enrico Fermi Museum is located in the historical building at via Panisperna in Rome, once the “Royal Physical Institute”. Here, in the 1930s, Enrico Fermi and a group of young physicists led the famous experiments on radioactivity induced by neutrons, fundamental for understanding the structure of the atomic nucleus (Nobel Prize 1938). The Museum retraces the significant stages of Fermi’s life and his discoveries, combining traditional objects and panels with modern multimedia technologies in an innovative way. The visit is particularly interesting to all those interested in understanding how the explorations of the matter have intertwined with the historical events of the 1900s. Schools are the Museum’s target audience, but it is also open to the general public. Convinced of the centrality of the concept of ‘citizen science’, the goal we pursue is to be able to disseminate science in a new way, using the emotional and entertainment aspect to bring the public closer to scientific content in a simple and captivating way. Museum experiences are extraordinarily memorable and remain etched in the memory for a long time, thus becoming a driving force for learning. The Museum activities are accompanied by outreach actions and tour labs. The goal is to make the visit to the Fermi Museum and to the monumental complex of via Panisperna, which is a place of historical memory linked to Enrico Fermi and his collaborators, “the boys of via Panisperna”, a unique experience, in a continuous dialogue between history, teaching, and dissemination of physics.

**Authors:** FOCACCIA, Miriam and GARBINI, Marco (Museo Storico della Fisica e Centro Studi e Ricerche ‘Enrico Fermi’)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 35

## **The first astronomical observations through the photographs collected in Inaf-Oar archive. Study to support conservative recovery**

*Friday, 8 September 2023 10:25 (20 minutes)*

The first astronomical images, preserved at Inaf-Oar archive, are three daguerreotypes taken by Angelo Secchi in 1851 to the Collegio Romano Observatory, on the occasion of the total solar eclipse. During the same eclipse, at the Royal Observatory of Königsberg in Prussia, Julius Berkowski obtained the first daguerreotype of the totality. Afterward, in 1857, Angelo Secchi undertook to photograph the different phases of the Moon, obtained with the Collegio Romano Merz equatorial telescope. They used collodion glass plate negatives printed on albumen paper. The *Fasi lunari* photographs represent the first photographic atlas of the Moon, presented on 28th August 1858 to the 'Parisian Academie des Sciences', and then to the London Observatory of Greenwich. In 1860, Angelo Secchi observed the solar eclipse, during an expedition in Las Palmas de Gran Canaria. During the eclipse, he found three solar prominences and it was the first proof of their existence. The image of the totality of the solar eclipse was fundamental to prove that the corona belongs to the sun rather than to the moon. These photographs, salted papers, albumen prints, daguerreotypes, collodion glass plate negatives, are the first historical photographic technique, as well as among the first astronomical observations through photography.

Historical study and diagnostic analyses of these photographs, to characterize the nature of the compounds and the state of degradation, will enrich knowledge in both historical and scientific fields, and it will support the future restoration, that it will take place according to some collaboration with Universities, teaching on conservation.

**Author:** MACALUSO, Tiziana (Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections

Contribution ID: 36

## **The Copernican and Astronomical Museum of the INAF-Astronomical Observatory of Rome: Heritage and Research**

*Thursday, 7 September 2023 12:10 (20 minutes)*

It was 1873 when the Roman celebrations of the 4th centenary of the birth of Copernicus were organized at La Sapienza University. Domenico Berti, professor of Philosophy, proposed to Minister of Education Antonio Scialoja the foundation of a museum dedicated to the astronomer. It was to be hosted by the Observatory of Collegio Romano and directed by the Polish historian Artur Wołyński, an exile and scholar of Copernicus and Galileo. The man possessed a collection of materials related to those astronomers and encouraged his countrymen to donate Copernican relics to the new Institution. Among donors there were renowned artists such as Viktor Brodzki, Aleksander Lesser and Henryk Siemiradzki. Wołyński, appointed conservator of the Museum, donated his collection to the Italian state in 1882. In 1935, the Copernican Museum and its Historical Archive and Library were transferred in Rome Astronomical Observatory in Monte Mario and since then they have been preserved there, enriched by the instrumentation and the documents of Roman Astronomy. After a period of renovation and a pandemic pause, the Museum has reopened on March 2023 to the public, re-establishing a connection between Rome and the Father of Modern Astronomy. We will present the main holdings of the original collection, illustrating even some Copernican research recently done at the Observatory.

**Authors:** GANDOLFI, Giangiacomo; ANTONELLI, Lucio Angelo; DANIZI, Roberto; FACCINI, Marco; MACALUSO, Tiziana; POPPI, Francesco (Istituto Nazionale di Astrofisica (INAF) – OA Roma)

**Presenter:** GANDOLFI, Giangiacomo

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections



Contribution ID: 37

## **Giuseppe Bianchi astronomer of the Restoration in the Estense State**

*Wednesday, 6 September 2023 17:15 (20 minutes)*

I intend to focus my attention on Giuseppe Bianchi (Modena 1791-1866), an astronomer and mathematician whose versatile culture made him a protagonist of Modena's scientific culture from the Restoration of the Austro-Estense Dukes in the Estense State. To the Dukes he owed his training in Milan at the Brera Observatory from 1814 and the prestigious assignments they entrusted him with in Modena until 1859 in the Estense State. Returning to Modena in 1818, he was given the teaching of Theoretical Astronomy at the University, to which was linked the creation of the Modena Observatory, which he strongly supported. His conspicuous and little-researched epistolary preserved in the Biblioteca Estense Universitaria in Modena may allow us to investigate interesting aspects of scientific studies in the first half of the 19th century. The aim of my presentation is to investigate, through the letters of his teachers at the Brera Observatory, their contribution to the development of Bianchi's studies and research and to the creation of the Modena Astronomical Observatory in the east tower of the Ducal Palace between 1826 and 1827. He was in direct contact with Giovanni Angelo Cesaris from 1816 to 1822 and longer with Barnaba Oriani, from 1817, by then at the end of his Milanese education, until 1830, two years before Oriani's death. His relations with Francesco Carlini were long-lasting: started as early as 1815, a year after Bianchi's arrival in Milan, they lasted, as can be seen from a hundred letters, until the year Carlini died in 1862.

**Author:** CORRADINI, Elena (Università di Modena e Reggio Emilia)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 38

## **The work of Abbot Giuseppe Conti in the Kingdom of the Two Sicilies**

*Wednesday, 6 September 2023 17:55 (20 minutes)*

This study aims to reconstruct the work of Abbot Giuseppe Conti during his time in Naples. Born in Pellegrino Parmense, distinguished himself in the study of scientific disciplines. After completing the usual course of studies, he received holy orders. In 1801 he obtained the chair of repeater of experimental physics and mathematics at the local Lalatta College. The notoriety of his lectures attracted the attention of Marshal Pèriguon, the high official serving the French king Joachim Murat, who requested him in Naples to teach his own children. Appointed corresponding member of the Royal Institute of Encouragement to Natural Sciences and professor of experimental physics and chemistry and mineralogy in the school of application of the General Directorate of Bridges and Roads, Conti also served as member of the commission for the reform of the system of weights and measures. During the years from 1815 to 1845, Conti worked as an inventor and technician with the restored Bourbon monarchy. For his industrious works he received from the King of the Two Sicilies numerous patents, public esteem, and medals of honor. In 1846 the director of the Royal Cabinet of Physics commissioned him to test a hydrostatic balance, manufactured by machinist Bonaventura Banieri. This balance, which turned out to be the most accurate in the Kingdom, is now conserved in the Museum of Physics at the Museum Center of the Federico II University.

**Authors:** DEL MONTE, Rosanna (Museo di Fisica Università di Napoli Federico II); AUTERI, Azzurra

**Presenter:** DEL MONTE, Rosanna

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 39

## **Enrico Federico Jest: a skilled scientific instrument maker in Turin during the first half of the 19th century**

*Tuesday, 5 September 2023 17:30 (20 minutes)*

Enrico Federico Jest was the progenitor of an important family of scientific instrument makers who remained active in Turin until 1900. His career as a “mécanicien” began in 1810. In 1814 he became the “machinist” of the Physics Cabinet at the University. He held this position until 1849. In 1852 he handed it over to his son Carlo. Handwritten documents reveal Enrico’s intense mechanical activity. As well as cleaning the machines, Enrico had to repair them and build new ones, all while trying to keep costs within an annual budget. His most frequent task was to prepare and carry out the public and private experimental physics experiments that took place once a week. Over the years, Enrico took on new roles outside the university. Some sources mention him in Turin as a machinist in Arsenal’s Physics Cabinet and some technical schools. In the 1830s, Jest set up his own business making scientific instruments for schools and private customers. In Turin, his workshop and warehouse were located in Via Po, near the “Palazzo della Università”. In 1939 Enrico, assisted by his son Carlo, was the first to introduce the daguerreotype in Piedmont. He probably first proposed the sale of photographic material in Italy in one of his commercial catalogues. Jest is also remembered for being the first to introduce in Italy the Armstrong hydro-electric machine, invented in England in 1840. A beautiful machine signed “E. Jest in Torino 1844”, is now in the “Giovanni Poleni” University Museum in Padua.

**Authors:** MANTOVANI, Roberto (University of Urbino Carlo Bo); LA GUIDARA, Elena (Liceo Artistico “Aldo Passoni”, Torino)

**Presenter:** LA GUIDARA, Elena

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond

Contribution ID: 40

## **Fermi’s Early Work on Quantum Mechanics**

*Wednesday, 6 September 2023 16:35 (20 minutes)*

Fermi’s approach to quantum mechanics passes through the study of collision processes. He obtains a first important result in 1924, still within the framework of the old quantum theory, but anticipating the method of virtual photons. In 1926, following, within a few months the advent of wave mechanics, and exploiting his knowledge of diffraction gratings, Fermi finds an elegant quantum solution of a rigid rotator scattering problem.

**Author:** ROSSI, Paolo (Dipartimento di Fisica Università di Pisa)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century



Contribution ID: 41

## An imperial total solar eclipse: 8th July 1842

Thursday, 7 September 2023 10:15 (20 minutes)

In the early morning of 8th July 1842, a total solar eclipse ran across Europe, passing through the major cities of the Habsburg Empire: Milan, Venice, Gratz, Wien, Bratislava, Budapest, Lemberg (Lviv). The eclipse received a great attention from the astronomers given the many observatories present along the path. At the Astronomical Observatory of Padua, the Director Santini was ready to observe it together with his assistant Pietropoli, Prof Conti and Capt. Von Biela, the discoverer of the famous comet 3D/Biela. We will relive the eclipse in the reports of Santini and in the rediscovered original drawings of the eclipsed Sun made by Biela. The scientific impact of the observations will be discussed.

**Author:** ZAGGIA, Simone (Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 42

## A dynamical interpretation of Hipparchus' diagrams

Wednesday, 6 September 2023 09:45 (20 minutes)

Eccentric-epicycle constructions are the basic machinery used by Ptolemy (II cent. CE) in the *Mathematical Syntaxis* to account for Sun, Moon, and planetary phenomena. In Ptolemy's astronomy, these kinds of diagrams represent the geocentric configurations of heavenly bodies in space, i.e. the variable *spatial relationship* between a moving body and the fixed Earth. However, there are reasons to believe that such diagrams, which Ptolemy recovers from Hipparchus' works (II cent. BC), could have been in origin *velocity diagrams*, i.e. geometrical constructions representing in an abstract *velocity space* the variable *kinematical relationship* between two points in relative motion. Strong indications in this sense come from the Greek assimilation of Babylonian astronomy, in which it was common practice to describe astronomical motions in terms of time-velocity couples, and from the highly refined art of *sphere-making*, as it is exemplified by the so-called Antikythera Mechanism (II cent. BC). Therefore, in my communication, I will propose a new interpretation of *Hipparchus' diagrams* which takes these elements into account and aims to be as close as possible to the general methodological framework of Hellenistic mathematics. My proposal highlights the possibility that around II century BC a theory of heavenly motions largely equivalent to *classical dynamics* had been developed, a conjecture first proposed by Lucio Russo in 1994.

**Author:** AMABILE, Alessandro (Università degli Studi di Napoli Federico II)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos

Contribution ID: 43

## **Maurizio Buscalioni: The first director of the Caracas Observatory**

*Wednesday, 6 September 2023 10:05 (20 minutes)*

The astronomer Maurizio Buscalioni (1856–1914) who comes from a family of renowned political and scientific career, served as the Caracas observatory's first director in 1890 and was also a meteorologist. He outfitted the observatory with cutting-edge equipment, concentrating on meteorological and astrometric instruments. The first comprehensive measurements of atmospheric pressure, temperature, humidity, and precipitation were made under his direction. He did astrometric measurements to ascertain the geographic latitude of the observatory and the official Venezuelan time. All of these initiatives were developed in collaboration with astronomers and observatories in America and Europe. Even so, unknown aspects related to his training and career in astronomy and mathematics, apparently intertwined with important changes in his life, constitute a challenge for historical research in science. In this work, we present new elements that may answer some important questions.

**Authors:** VERRILLI HERNANDEZ, David (Universidad Central de Venezuela); MARTÍN LANDROVE, Rafael (Universidad Central de Venezuela)

**Presenter:** VERRILLI HERNANDEZ, David (Universidad Central de Venezuela)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 44

## **Celestino Galiani and the strengthening of astronomy in Naples: a preliminary investigation of his correspondence**

*Wednesday, 6 September 2023 17:35 (20 minutes)*

On the evening of 17 December 1819, Carlo Brioschi made the first astronomical observation from the new observatory of Naples on the hill of Miradois. This building, founded on 4 November 1812, represented an architectural innovation for Naples, being the first neoclassical building and for Italian astronomy, being the first building built to be an observatory. But the events on the establishment of the Neapolitan Specola, passing through the initiatives of the astronomers Giuseppe Cassella and Felice Sabatelli, date back to the reforming effort of the Naples University by Celestino Galiani, Chaplain Major of the Kingdom of Naples during the Habsburg vice-reign, and the reign of Charles of Bourbon.

The correspondence he intertwined with Manfredi, Marinoni, Gravesande, the Austrian court and the Neapolitan intellectuals testify to the relevant impulse given by Galiani for the renewal of the University of Naples, which led to the establishment of the chair of Astronomy, and for the creation of an Academy of Sciences and the Astronomical Observatory.

The communication intends to present some letters received from Galiani that highlight the strong commitment to creating solid scientific institutions in Naples, such as the English and French ones or those established in Bologna.

**Author:** GARGANO, Mauro (INAF - Osservatorio Astronomico di Capodimonte)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 45

## **Between Copernicus, Kepler and Galileo. A memory of Owen Gingerich (1930-2023)**

*Tuesday, 5 September 2023 15:30 (20 minutes)*

Owen Gingerich, recently passed away, has been one of the most important historians of astronomy between the twentieth and the twenty-first centuries. Teacher of history of astronomy at the Harvard University (1967-2000) contributed with fundamental studies from the astronomy of ancient Greece to the birth of astrophysics.

His most important job has been the search and study of the copies of first (1543) and second (1566) editions of the “De revolutionibus” of Copernicus. A job that led him to personally visit hundreds of libraries and collections of rare books around the world.

I will try to describe his main contributions and teachings through his texts and personal memories mainly about his relationship with Italy, on the copies of the “De revolutionibus” described in his works and on the copies he was not able to include in an update of the “Census” never published but which deserve a new study.

**Author:** TRUFFA, Giancarlo (Member of SISFA)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus’ Changeover from the Old to the New Cosmos

Contribution ID: 46

## **Nicolaus Copernicus, a testimonial of the heliocentric system at the Astronomical Observatory of Padua**

*Wednesday, 6 September 2023 10:05 (20 minutes)*

Nicolaus Copernicus is unanimously acknowledged as the father of modern astronomy. Giuseppe Toaldo (1719-1797), the first director of the Astronomical Observatory of Padua, credited him as a testimonial of the new science, immortalizing him with a full-length, life-size portrait in the pictorial cycle that decorates the Paduan Observatory. This series of frescoes recounted the progress of astronomical knowledge from antiquity to the eighteenth century. It had to transmit educational and historical-scientific notions to a broad public, especially regarding the transition from the geocentric to the heliocentric view of the cosmos. The pictures were carried out by the Vicenza painter Giacomo Ciesa (1733-1822) between 1767 and 1777. The portraits largely refer to the chalcography made by Gerard Hoet (1648-1733) and Joseph Mulder (1658-1742) and inserted before the frontispiece of the *Astronomica Institutio* by the Dutch Joannis Luyts (1655-1721), published in 1692. This communication intends to illustrate both the Copernicus portrait and the large heliocentric fresco that dominates the east wall of the Meridian room, with its iconographic details.

**Authors:** ZANINI, Valeria (Istituto Nazionale di Astrofisica (INAF)); ZARANTONELLO, Lucia (Liceo Statale “A. Veronese” (Montebelluna))

**Presenter:** ZANINI, Valeria

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus’ Changeover from the Old to the New Cosmos

Contribution ID: 47

## **Bruno Rossi and the art of jumping on the Sputnik bandwagon**

*Wednesday, 6 September 2023 17:35 (20 minutes)*

The launch of the first Russian satellite and the advent of the space age did not catch a stellar scientist like Bruno Rossi unprepared. Through a long experience in the study of cosmic rays, and especially during the 1950s, he had acquired a sense of outer space as a space populated by high-energy particles, radiation, and magnetic fields that now could be studied in their primary form, beyond the Earth's atmosphere. I will show the significant aspects which, during this articulated path, have contributed to the evolution of his multifaceted scientific personality, ensuring that, at the moment of the creation of NASA in early 1958, Rossi was already fully aware of what the potential deriving from the new cosmic dimension could be and, notably, of which should be the scientific goals to be achieved in the immediate future. In record time, he championed the well-known projects that gave rise to scientific space enterprises that led to the launch of the satellite that first detected cosmic gamma rays, to the construction of a probe that systematically explored the space plasma and provided the first concrete clues of the existence of the solar wind, and to the launch of the rocket that discovered the first extrasolar source of X-rays, Scorpius X-1, and inaugurated the great season of X-ray astronomy.

**Author:** BONOLIS, Luisa (Max Planck Institute for the History of Science)

**Session Classification:** Da Poleni a B. Rossi e oltre / from Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 48

## **An information analysis of the ‘Celestial Object’ concept in Copernican Revolution**

*Wednesday, 6 September 2023 10:45 (20 minutes)*

The concept of information was introduced in the middle of the last century by Shannon and since then an entire branch of research has been developing into what is called Mathematical Theory of Communication which deals with studying the amount of information exchanged in a communication channel.

In this presentation we want to use the concept of information to analyze the conceptual change that occurred with the Copernican Revolution, limiting ourselves to the concept of Celestial Object. The taxonomy associated with this concept underwent a drastic change in the transition from Aristotelian philosophy to modern science. The concepts of star and planet were revised and the concept of satellite and comet were introduced. The familiar objects of astronomy were redistributed into these categories in hitherto unaccepted ways. The concept of comet also introduced a category of celestial bodies that was not admissible in Aristotelian Cosmology: a celestial object that is not permanent.

In the history of science, a tool used to study conceptual changes is that of dynamic frames - introduced by Barsalou in Cognitive Science - which allows us to identify the salient attributes of concepts and the relationships between them. Through it, we will try to analyze the dynamic frame associated with the concept of Celestial Object from an information point of view - before and after the Copernican Revolution - and we will highlight how it gradually lost the existing constraints between the attributes that characterized it, while requiring more information.

**Author:** GASCO, Enrico (Zirak)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos

Contribution ID: 49

Type: **Invited**

## **When the time was ripe to publish Copernicus: a view of the European intellectual context of the first half of the 16th century**

*Wednesday, 6 September 2023 09:15 (30 minutes)*

The talk elucidates the context of transformation of astronomical knowledge in the years when Nicholas Copernicus' work saw the light of day, the *Revolutionibus orbium coelestium* of 1543. In particular, it is intended to show that the publication took place at the beginning of a period in which the processes of transformation, dissemination and accumulation of scientific knowledge had taken on a dynamic quite different from the previous period and marked by a greater speed of dissemination, an enlargement of the space of knowledge circulation and, above all, a marked tendency toward scientific innovation.

Thus, taking the perspective of the potential audience of Copernicus' text, it will be shown how the publication was the consequence of a changed intellectual environment and economy of knowledge due to Wittenberg's entry into the scene as a scientific center.

**Author:** VALLERIANI, Matteo (Max Planck Institute for the History of Science)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos

Contribution ID: 50

## **Physics for Medicine at the Milan Institute of Complementary Physics**

*Wednesday, 6 September 2023 12:05 (20 minutes)*

The interaction between Physics and Medicine was one of the founding issues that guided the establishment and development of the research laboratories of the Milan Institute of Complementary Physics (then Institute of Physics). In this communication, we shall take into consideration the main teaching and research activities that formed a bridge between Physics and Medicine in Milan in the second half of the 1920s, in particular as regards radiology and its connections with the erecting "Vittorio Emanuele III" Institute for the Study and Treatment of Cancer (today's National Cancer Institute).

**Author:** GARIBOLDI, Leonardo (Università degli Studi di Milano, Dipartimento di Fisica "Aldo Pontremoli")

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 51

Type: **Invited**

## Giuliano Romano's Exceptional Astronomical Research at Padua

*Wednesday, 6 September 2023 14:35 (30 minutes)*

In this presentation, I will review Giuliano Romano's research activities within the academic realm at the University of Padua.

Giuliano Romano graduated in Mathematics from the University of Padua in 1950 with a thesis entitled "Sui problemi statistici ed evolutivi delle stelle doppie (*On the statistical and evolutionary problems of binary stars*)". Immediately after, he began collaborating with the Padua Astronomical Observatory and the Asiago Astrophysical Observatory, which was equipped with a 1.22m telescope. He later conducted research campaigns using the new telescopes at Asiago, including the wide-field Schmidt telescope and the 1.82m telescope. At the University, he became a lecturer in Astrophysics at the Institute of Astronomy, then appointed as an Associate Professor of Cosmology, and became a Professor of the History of Astronomy.

His studies, conducted through astrophotographic observations, allowed him to discover hundreds of variable stars. The variable star he discovered in the spiral galaxy M33, known as GR290, is still studied and referred to as Romano's Star. In 1952, he discovered the binary star system EE Cephei, which has been the subject of numerous modern observational surveys worldwide. He was the first Italian to discover an extragalactic supernova in the galaxy M84 on 1957, and later replicated the discovery of another supernova on 1961, in the galaxy NGC4564. The new telescopes at Asiago allowed him to expand his studies on active galactic nuclei such as BL Lac objects, the variability of Quasi Stellar Objects (Quasars), discover new galaxies, and study the variability of extragalactic objects.

**Author:** UMBRIACO, Gabriele (Università di Bologna - Università di Padova – Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** In Memoria / Commemoration of Giuliano Romano (1923-2013)

Contribution ID: 52

## Italian physics in the international organization of science: the case of IUPAP

*Wednesday, 6 September 2023 12:25 (20 minutes)*

To commemorate its centenary, the International Union of Pure and Applied Physics (IUPAP) initiated a historical endeavor to comprehend the evolving roles of the institution in fostering international collaboration in physics from the 1920s until the present day. Drawing upon the findings of this historical project, this presentation offers a critical overview of Italy's involvement in the IUPAP. By examining pivotal events and notable individuals, the study demonstrates that Italy's participation in the IUPAP underwent major reconfigurations, heavily influenced by changing political circumstances both domestically and internationally. Following the reformation of the National Research Council (CNR) in 1927, the newly constituted CNR board of directors viewed the IUPAP as an obstacle rather than a facilitator of international physics cooperation. Conversely, in the immediate aftermath of World War II, Italian physicists in prominent positions within national science policy-making circles recognized the IUPAP as an opportunity to pursue two interrelated objectives: the internationalization of Italian physics and the restoration of Italy's central role in the emerging international physics community. This convergence of motives resulted in a privileged alliance between Italian physicists and the IUPAP, culminating in the election of Edoardo Amaldi as President during the IUPAP general assembly held in Rome in 1957. Following Amaldi's presidency, the Italian Physical Society remained committed to fostering an internationalist outlook. While increasingly focusing on the European context, Italian physicists remained actively engaged in the IUPAP, actively influencing some of its major objectives.

**Primary author:** LALLI, Roberto (Politecnico di Torino)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20<sup>th</sup> Century

Contribution ID: 53

## **If 3D printing and CG graphics meet the historical heritage...**

*Friday, 8 September 2023 10:05 (20 minutes)*

3D printing and graphics play a crucial role in the conservation and dissemination of historical and museum assets in the astronomical field. Indeed, these technologies make it possible to make usable instruments and places of historical interest that would otherwise be inaccessible. Examples of the potential of these technologies are the three-dimensional reconstruction of the Paduan observatory and the animation of the meridian room.

The three-dimensional reconstruction of the observatory, based on the original projects, was made possible thanks to 3D printing, which faithfully reproduced the eighteenth-century architectural structure. The animation of the meridian hall showed that it is not only a building but also a complex astronomical instrument. These visual representations help viewers better understand the functionality and use of the building in the astronomical context. 3D printing and graphics also offer the opportunity to make the museum experience inclusive. For example, original instruments replicated with 3D printing can be explored and touched by blind visitors, offering them sensory engagement. Additionally, 3D printing and graphics are indispensable for visualizing past, present, and future astronomical concepts. In fact, these technologies make it possible to create three-dimensional models of celestial bodies, planetary systems, and complex astronomical phenomena, facilitating their understanding by the non-expert public and stimulating interest and curiosity in the astronomical field.

In conclusion, if properly directed, 3D printing and graphics can play a strategic role in the conservation and enhancement of historical and museum heritage.

**Author:** DIMA, Marco (Istituto Nazionale di Astrofisica (INAF))

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections

Contribution ID: 54

## **Analysis of a correspondence between Giovanni Poleni and Jacopo Belgrado**

*Wednesday, 6 September 2023 12:45 (20 minutes)*

In my master's thesis, I transcribed and studied the correspondence between Giovanni Poleni and a mostly unknown character: Father Jacopo Belgrado. Born in Udine in 1704, he joined the Jesuit company of Parma in 1723. In 1738, he was assigned to the chair of mathematics at the Studium Parmense, precursor of the University of Parma. In this role, he improved the didactics and became one of the first "lecture-demonstrators" in Italy, building his own instruments. After that, he became court mathematician for the duke Filippo di Borbone. He also carried on research in Physics and Mathematics, and in 1757 he founded the third Italian astronomical observatory in Parma. His career ended abruptly in 1768 when the minister du Tillot, guide of an anti-jesuitic movement, decided to expel Jesuits from Parma and seize their possessions. The information about Belgrado is, therefore, fragmented: most of his possessions were lost, sold or kept in private collections. In his life, Belgrado has proven to be a polyhedric, enterprising scientist. He was in touch with many Enlightenment exponents all over Europe, such as Jean Antoine Nollet, and contributed to scientific research and communication.

Belgrado and Poleni had a strong bond characterised by mutual esteem regarding each other's research, and their correspondence is characterised by many exchanges of opinions, advice and collaboration. Belgrade managed, thanks to Poleni's mediation, to publish two dissertations at the seminary printing house in Padua. Some of the instruments in the Poleni Museum in Padua were built and sent by Belgrade himself.

**Author:** DAMIANI, Francesca (Università degli Studi di Bologna)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries



Contribution ID: 55

## Signs of the principle of virtual work and of the “principle of conservation” in the *Mechanicorum Liber* by Guidobaldo del Monte

Wednesday, 6 September 2023 11:45 (20 minutes)

From a historical point of view, the principle of virtual work and the so-called “principle of conservation” follow different paths and have different origins. Some authors attributed the principle of virtual work to pseudo-Aristotle’s Mechanical Problems. The principle of virtual work was defined by Bernoulli: “for a system of forces that maintains a point, a surface, on a body in equilibrium, the sum of positive energies equals that of negative energies, considered with their absolute value”. Some signs of the “principle of conservation” can be found in Galileo Galilei’s *The Dialogue Concerning the Two Chief World Systems*: “Now fix it well in mind as a true and well-known principle that the resistance coming from the speed of motion compensates that which depends upon the weight of another moving body”. In Guidobaldo del Monte’s *Mechanicorum Liber* the concept of virtual work and the compensation of force, time, weight and space seem to be connected. In this talk, I will investigate this connection. Firstly, I present the well-known statements about the roots of the principle of virtual works and the “principle of conservation”. Secondly, I will examine the procedures used by Guidobaldo to study the behaviour of simple machines in equilibrium. Finally, I will analyse the relation between the equilibrium systems subjected to constraint reactions and the proportion of time, force, velocity and space in the *Mechanicorum Liber*.

**Author:** PIETRINI, Davide (University of Urbino)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 56

## The construction of domes for Italian astronomical observatories in the 20th century: the case of A. Bombelli realizations

Thursday, 7 September 2023 12:30 (20 minutes)

Many of the architectures of the first and second half of the 20th century are characterized by technological innovations that modify the architectural lexicon, the appearance and functioning of the buildings and require a new organization of the design activity and the construction process. The evolution of observation instruments and the need to find places uncontaminated by urban light pollution led, during the 20th century, to the construction of new astronomical observatories. The contribution presents, through the documentation of case studies and unpublished archive materials, some realizations of A. Bombelli, a company specialized in metal constructions founded in Milan in 1889 and active, in the historic Lambrate site, since the 1920s. Throughout the years the company specializes in the construction of the structures of domes and solar towers, with different movement and opening systems, in perfect design and construction synergy with the needs of astronomers. Inside Bombelli’s plant there was a specific building, called “Specole shed”, which was dedicated exclusively to the assembly and testing of the mechanical efficiency and movement functioning of these technological systems. Between 1919 and 1963, A. Bombelli built about 14 domes in Italy, many of which are still preserved and functioning in the main observatories (among these Brera, Merate, Capodimonte, Arcetri, Rome Monte Mario, Campo Imperatore, Monte Porzio Catone, Pino Torinese, Trieste, Castelgandolfo). The study intends to investigate some constructive-technological aspects relevant also for the protection and enhancement of this special architectural and cultural heritage of INAF.

**Authors:** SAVIO, Lorenzo, MARZI, Tanja, BOSIA, Daniela (Politecnico di Torino - Dipartimento di Architettura e Design); BOMBELLI, Virginia (Associazione A.Bombelli 1889)

**Presenters:** SAVIO, Lorenzo and MARZI, Tanja

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections



Contribution ID: 57

## Anthropic approaches and Copernican epilogues in John Archibald Wheeler

*Wednesday, 6 September 2023 17:55 (20 minutes)*

Smithsonian Institute, Washington DC, 22-25 April 1973. At the commemorative symposium for the 500th anniversary of the birth of Copernicus (1473-1543), John Archibald Wheeler (1911-2008), designated chairman of the event, shakes up the conference with a lecture which has, apparently, a strong “anthropic” flavor: *The Universe as Home for Man*. Is it just one of the ironies of history? A naïve mistake? Or even a provocation? The audience did not fail to notice the paradoxical situation - but was it really possible that such an eminent physicist was making such a childish error? This paper will provide an interpretative key to Wheeler’s highly original and baffling speculations, properly identifying the traits that - he thought - were bringing the legacy of Copernicus to a new level. To do that, it is first necessary to understand Wheeler’s speech within the crisis of his previous general relativity-based program, which led him to re-evaluate Bohr’s lesson and the participative role of the observer. This, in turn, got intertwined with the questions raised by his Princeton colleague Robert Dicke and by Brandon Carter (to whom the expression “anthropic principle” is usually credited) about the fine-tuning of natural constants. Wheeler would not stop there, however, and in the following years, he would make explicit his “Copernican” insights, decentering the anthropomorphic traits that were indeed present in his 1973 contribution and proposing a new picture of the universe. Only by looking at Wheeler’s intellectual trajectory in the years before and after that event it is possible to understand and disclose the power of his ideas, instead of mistaking them for some oddity.

**Authors:** FURLAN, Stefano (MPIWG, Berlin; Université de Genève); PULEIO, Daniele (Pontificia Università Lateranense)

**Presenter:** PULEIO, Daniele (Pontificia Università Lateranense)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 58

## Giovanni Poleni’s “pinwheel” calculator: a project destined to disappear

*Wednesday, 6 September 2023 16:35 (20 minutes)*

In 1709, the Marquis Giovanni Poleni (1683-1761) described his “pinwheel” calculator project in the essay “Miscellanea” of 1709. Poleni was an attentive reader of European scientific news of his time, despite the communication difficulties of the period. News of the inventions of calculating machines by Pascal and Leibniz did not escape him. He built the “pinwheel” to perform addition and subtraction like the Pascalina and multiplication and division like the Leibniz machine, on numbers of up to three digits. Instead of using the crank to operate his machine, Poleni introduced a solution similar to the mechanism of mechanical watches, based on a counterweight. Inexplicably, the Marquis destroyed his car after hearing of a similar but more efficient model built by the Austrian Anton Braun.

Poleni’s construction choices can be examined in relation to the experience of building other physics instruments and to the idea of putting science within the reach of the general public, including women, which permeated the period.

**Author:** CAMPANILE, Benedetta (Università degli Studi di Bari Aldo Moro)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 59

## **Temistocle Calzecchi Onesti Lab in Fermo and the Maggiori Sisters**

*Thursday, 7 September 2023 10:35 (20 minutes)*

In 1889, the physicist Temistocle Calzecchi Onesti (Lapedona 1853 – Monterubbiano 1922), the inventor of the coherer, organized a visit to the physics laboratory of the Royal Classical Lyceum Annibal Caro in Fermo for the Maggiori sisters. The physicist from Fermo, who discovered in 1883 the detecting properties of electromagnetic waves by a glass tube filled with metal filings, took care of the education of these two disadvantaged girls who were deaf and mute.

The visit to the laboratory was an exciting experience for the sisters, which they recorded in their diary in 1889. In my presentation, I will talk about the ancient physics laboratory of Professor Temistocle Calzecchi Onesti through the eyes of the Maggiori sisters. In the same laboratory, where Prof. Calzecchi was the director, the physicist Oreste Murani, the architect Giuseppe Sacconi, and the future Minister of Posts and Telegraphs, Enrico Stelluti Scala, also studied. In August 1904, Stelluti Scala, together with Guglielmo Marconi, conducted in Ancona the famous transmission experiments known as the “Monte dei Cappuccini” experiments, thanks to Temistocle Calzecchi Onesti’s coherer.

**Author:** MAURO, Oronzo (Independent Researcher)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 18th and 19th Centuries

Contribution ID: 60

## **Copernicus and Vespucci between East and West**

*Tuesday, 5 September 2023 15:50 (20 minutes)*

In this paper, it will be discussed the work of two important scholars, Nicolaus Copernicus and Amerigo Vespucci, and their possible relation.

Copernicus was born in Poland and studied in Italy, and Vespucci was born in Italy and worked in Spain and Portugal. Copernicus became a medical doctor and an astronomer and finally prepared the way toward a heliocentric world system. Vespucci became an explorer of big parts of the American East coast. America was named after Amerigo Vespucci. In the last years of his life, he started to organize the systematic Castilian explorations. In comparison to Columbus, he was not an admiral or a military expedition leader but a “private man” who had enough money to organize his activities.

This is somehow the general picture and the starting point of my presentation which will be a discussion of how far these two scholars and their work are related to each other and to other scholars of the time in Italy and other European countries. Copernicus represents the East of Europe in connection to Italy whereas Vespucci connects Italy to the Iberian peninsula and further to the shores of America.

Copernicus who came to Italy as a student of medicine became the astronomer who made the earth move and the sun stand still.

Vespucci as the son of a banker became the inventor of a “Novus Mundus” and the first who really could study the southern sky.

**Author:** GROPP, Harald (Universität Heidelberg)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus’ Changeover from the Old to the New Cosmos

Contribution ID: 61

Type: **Invited**

## **The origin of Galileo’s New Science in a challenging problem**

*Tuesday, 5 September 2023 10:30 (30 minutes)*

In *The Assayer* Galileo Galilei famously proclaimed that the book of nature is written in the language of mathematics. However, little support for this bold claim could be found in his own published works until that time. Indeed, it would take another fifteen years before the publication of the *Discorsi*, in which he convincingly demonstrated how a mathematical theory of motion could be established using “triangles, circles, and other geometric figures”. Based on a close reading of Galileo’s “Notes on Motion”, I will demonstrate that the foundation for this new theory of motion had been laid long before the *Assayer*, with its general remarks on scientific methodology, was published. The emergence of the new science was indeed driven not so much by a new methodology but rather by a very specific, mathematically challenging problem - the motion of a pendulum in relation to that of balls rolling down inclined planes.

**Author:** BÜTTNER, Jochen (Max Planck Institute for the History of Science (MPIWG), Berlin)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 62

Type: **Invited**

## **After the Abbé Nollet, the teaching of physics in “Lycées” in France**

*Thursday, 7 September 2023 09:15 (30 minutes)*

Abbé Nollet is known as the first professor of experimental physics in France in the 18th century. However, at that time, some technical school provided already an excellent technical education. But physics teaching in general education really took shape after the revolution and with the creation of the “lycées” by Napoleon. Curricula were then published, along with lists of equipment to be used in the “lycées”. This administrative organization still exists in France.

The “Ecole Normale de l’an III” was responsible, during four months, for training teachers for these new establishments. Professors were the greatest scientists of that time. The mineralogist René-Just Haüy was commissioned to write the first physics textbook.

During this period all the “grandes écoles” were created. At the same time, in 1808, the “baccalauréat” and the “agrégation” were introduced. However, it was not only at the middle of the 19th century that a scientific curriculum was created, separated from that of the humanities.

Also, during this period, the scientific “baccalaureat” becomes compulsory for medical studies. Nevertheless, it was not until 1880 that Camille Sée created the “lycées” for girls.

With the development of printing, many of the teachers published their lectures in textbooks for their students. Together with the official texts, these books and the collections of apparatus preserved in historical high schools provide us with information on the physics taught in the 19th century.

**Author:** KHANTINE-LANGLOIS, Françoise (Université Lyon 1)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 63

Type: **Invited**

## Scientific instruments and the neglect of teaching in the history of physics

*Thursday, 7 September 2023 11:40 (30 minutes)*

While historians of science are mainly interested in the history of research, many if not most of the objects in physical cabinets and other historical scientific instrument collections emerged from a teaching context. I argue that we need to relocate education from the periphery of the history of science and technology to its centre. I claim that it is essential to study science education in its entirety and complexity if we want to understand the generation, reproduction, circulation and transformation of scientific and technological knowledge, practices, practitioners and objects inside and outside of scientific institutions and communities. Deborah Warner has suggested that the most common use of philosophical apparatus in the eighteenth century was in pedagogy. Since then, the relationship between research and teaching, and research and teaching instruments have changed considerably. For the last decades, the historical study of scientific instruments and collections has received a boost in Europe through the efforts of many of those involved to preserve the material heritage of universities, which had become endangered by institutional restructuring. Changes in research and teaching practices made these objects obsolete for current scientific activities and transformed them into historical objects. The material cultures and teaching practices related to these instruments, and their relation to research and other scientific practices, need to be studied.

**Author:** WITTJE, Roland (Indian Institute of Technology Madras)

**Session Classification:** Musei, Archivi e collezioni scientifiche / Museums, Archives, and scientific collections

Contribution ID: 64

## Gravitation: a project for secondary school students using history of Physics and museum instruments

*Friday, 8 September 2023 11:50 (20 minutes)*

Starting from the ideas developed in the Asiago TEachers' Network on Astrophysics (ATENA), a teaching-learning sequence has been organized to introduce the topic of gravitation to 16 years old students in a Liceo Scientifico. A major role was played by the instruments belonging to the collection of the School Physics Laboratory some of which are historical instruments. Examples are the Cavendish apparatus and the Foucault pendulum. The teaching-learning sequence can be divided into three parts. The first one started with an Object Based Learning activity and then developed in the study of different historical models for planetary motion from the Ptolemaic to the Keplerian system. The central part consisted in classroom lessons with explanatory exercises about forces, energy and the dynamics of planets and satellites in the solar system. Interactive simulations complemented the lessons and the work on instruments.

In the third part, students worked in groups with the aim of producing either a video or a presentation about the history of an instrument or of an experiment related to gravitation. The conclusion was the organization of a visit to the School Museum offered to several guests in which students described some of the instruments and their role in the construction of knowledge about the Universe.

**Author:** BAGNO, Paola (Liceo Scientifico I.Nievo e Dipartimento di Fisica e Astronomia (ATENA))

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 65

## First steps towards understanding neutrinos. A tribute to Enrico Fermi on the 90th anniversary of the $\beta$ decay model

Wednesday, 6 September 2023 16:55 (20 minutes)

We retrace the first steps towards understanding neutrinos, particles predicted by Pauli in 1930 to avoid a supposed violation of time-translation symmetry. Although there is a tendency to reduce the whole story to his intuition and the skill of Reines and Cowan, according to history great strides were made thanks to precious intellectual tools that combined ideas and mathematics. I refer to the contribution of Fermi, who proposed in 1933 a particular theory in which matter particles can appear and disappear, prototypical of those at the basis of today's particle physics. Fermi's theory, despite the limitations of the formalism available at the time, led physicists towards the observation of neutrinos, paved the way for further fruitful developments - for example, it anticipated the characteristic of crossing symmetry - and has an impressive scientific legacy. We reconstruct the chain of arguments in the most accessible terms for a modern reader, emphasising the role of theoretical physics and reflecting on some alternative assessments of Fermi's contribution.

**Author:** VISSANI, Francesco (INFN, Laboratori Nazionali del Gran Sasso)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century

Contribution ID: 66

Type: Invited

## Personalities and places of physics and astronomy in Padua from Galileo to the 20th century

Tuesday, 5 September 2023 16:30 (40 minutes)

Galileo, one of the founding fathers of the new science, spent eighteen fruitful years in Padua from 1592 to 1610. But modern physics and astronomy would fully enter the university system more than a century later: in Padua in particular with Giovanni Poleni and Giuseppe Toaldo. The talk traces the development of physics and astronomy in Padua, focusing on some of the significant places and personalities, without neglecting the events that, in the second half of the 20th century, would involve Padua in the birth of new public research institutions, in particular the National Institute of Nuclear Physics (INFN) and the National Institute of Astrophysics (INAF).

Galileo, uno dei padri della scienza nuova, trascorre a Padova dal 1592 al 1610 diciotto fecondi anni. Ma la fisica e l'astronomia moderne entreranno a pieno titolo in ambito universitario più di un secolo dopo: a Padova in specie con Giovanni Poleni e Giuseppe Toaldo. L'intervento ripercorre gli sviluppi della fisica e dell'astronomia padovane, soffermandosi su alcuni dei luoghi e dei personaggi significativi, senza tralasciare le vicende che, nella seconda metà del XX secolo, coinvolgeranno Padova nella nascita di nuovi enti di ricerca, in particolare l'Istituto Nazionale di Fisica Nucleare (INFN) e l'Istituto Nazionale di Astrofisica (INAF).

**Author:** PERUZZI, Giulio (DFA, Università di Padova)

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond

Contribution ID: 68

## Galileo «makeshift theologian»? A few remarks on Augustine and Galileo's biblical exegesis

Tuesday, 5 September 2023 12:05 (20 minutes)

First with an implicit reference, in his letter to Benedetto Castelli (December 21, 1613), and later with several explicit references, in his letter to Christina of Lorraine (spring-summer 1615), Galileo made his ultimate attempts to prevent the condemnation of Copernicus's *De revolutionibus*, arguing for its compatibility with the Scriptures, as well as for the freedom and autonomy of science. He did so by appealing to substantial passages from Augustine, which he carefully chose and even more carefully employed.

That Galileo, himself not a theologian, managed to understand the problem and rapidly advance a solution – one which is currently endorsed by the Church itself – is nothing short of amazing, and cannot but raise questions about the path he might have followed.

A careful perusal of Augustine's texts and the exchanges Galileo had with friends, disciples, and colleagues, suggests a different reading from the received one. Galileo was not driven, in a short time, «to instrumentally wear clothes that were not his, to become a makeshift theologian». Quite the contrary, his words were far from improvised, thrown together in haste, rhapsodically appealing to quotes that were made available to him by friends and acquaintances who knew the subject better than he did. Rather, they were the outcome of autonomous deliberations, which only later did he develop in dialogue with others. We may argue this, based on a famous expression of Galileo's, a loan from a Latin expression from Augustine's *De Genesi ad litteram*, to which I call attention in the present paper.

**Author:** GATTEI, Stefano (Dipartimento di Sociologia e Ricerca Sociale, Università di Trento)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 69

## What means that the book of nature is written in mathematical characters?

Tuesday, 5 September 2023 11:25 (20 minutes)

In his work *Il Saggiatore*, Galileo claimed that the book of nature is written in mathematical characters. What does this statement exactly mean? It is possible to offer different answers: 1) one could think that Galileo had a strong Platonic view. This means that a mathematical world separated from the phenomenal one exists and that the physical laws are an empirical transcription of the relations existing in this world; 2) a weak Platonic interpretation is also possible: mathematics does not exist in a separated world. It is the nomological structure of our universe. It is inherent to the universe itself; 3) an operational interpretation could be considered: mathematics is the best method we have to measure the objects and to formulate relations among them. It is an unavoidable means for any physical research, but we cannot assume a definitive position as to the relations between mathematics and structure of the world. Simply, mathematics is the best available instrument. In my talk, I will try to clarify the relation Galileo saw between mathematics and physics in the light of classical works as those by Koyré, Geymonat and Drake as well as relying upon more recent studies as Boccaletti's and mine.

**Author:** BUSSOTTI, Paolo (University of Udine)

**Session Classification:** Il Saggiatore e la nascita della scienza moderna / The Assayer and the Birth of Modern Science

Contribution ID: 70

## **Physics and mathematics using and designing machines and mechanisms**

*Wednesday, 6 September 2023 18:15 (20 minutes)*

Identification and characterization of the interacting systems in the analysis of physical phenomena is a teaching strategy that facilitates:

- the examination of the significant variables in the evolution of a phenomenon;
- the distinction between state and interaction variables;
- the recognition of cause and effect relationships.

We present educational activities that we have been experimenting with for years at school and university based on the use and design of machines and mechanisms. The activities are framed in a didactic strategy that aims to recognize mathematical and physical principles. Analysis of geometric and motion transformations (i.e. linear vs circular) and transduction processes constitute an opportunity for students to master key concepts of mathematics and physics and to develop, at the same time, articulated technological skills. In mathematics, mechanical drawing machines are useful tools for the study of remarkable curves such as conic sections. In physics, the analysis of the internal working of machines and measurement devices is a great opportunity to clarify the relationship between theoretical entities and measurement processes. In the modeling process, familiarity with machines (old and contemporary) and transducers has a great cognitive value: the mechanical metaphor lies at the heart of every cause-and-effect reasoning and is of the highest importance in physics.

**Authors:** ARTIANO, Giancarlo (Università degli Studi L. Vanvitelli); BALZANO, Emilio (Università degli Studi di Napoli Federico II)

**Presenter:** ARTIANO, Giancarlo

**Session Classification:** Da Poleni a B. Rossi e oltre / From Poleni to B. Rossi, and Beyond: 20th Century



Contribution ID: 71

Type: **Invited**

## Celio Calcagnini's Philosophical Defense of the Motion of the Earth (ca. 1518)

*Tuesday, 5 September 2023 14:30 (30 minutes)*

Around 1518, the Ferrara humanist Celio Calcagnini (1479-1541) wrote an original defense of Earth's motion, *Quod caelum stet, terra moveatur vel de perenni motu terrae* (The Heavens Stand, the Earth Moves, or the Perennial Motion of the Earth). It was a short but complex philosophical treatise, written in a sophisticated style, on a topic of undoubted interest to the history of cosmology. It is one of the earliest documents attesting to the Renaissance circulation of geokinetic conceptions, in the very years when the revolutionary ideas of Copernicus started to circulate and the *De revolutionibus orbium coelestium* was taking shape. Yet, Calcagnini's text has not received adequate consideration in the history of science, apart from a few exceptions. This communication is devoted to this lesser known intellectual figure. It stems from a collaboration with Alberto Bardi aimed to offer the first modern translation of *Quod caelum stet*. I will discuss the cultural context from which Calcagnini's defense of terrestrial motion emerged. It especially relied on natural and epistemological considerations within the framework of an eclectic humanistic philosophy, influenced by skepticism and Platonism. Calcagnini discussed at length the limits of our cognitive faculties and argued for the need that reason moves beyond immediate sensible appearance. He then argued for the plausibility of the Earth's motion against common sense, on the basis of a series of natural arguments. I see this treatise as an important witness of the formation of cosmology, although Calcagnini remained vague concerning the celestial motions he actually attributed to the Earth. I will also discuss possible connections with Copernicus and his work.

**Author:** OMODEO, Pietro Daniel (Università Ca' Foscari, Venezia)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos

Contribution ID: 72

Type: **Invited**

## Copernicus' contribution to the Copernican Revolution

*Tuesday, 5 September 2023 15:00 (30 minutes)*

Copernicus' contribution played, of course, a central role in the birth of modern heliocentric astronomy. However, it is enhanced in our shared culture, even beyond its enormous value, due to three factors. First, the oblivion of the influence - explicitly admitted by Copernicus - of ancient ideas about the Earth's motions. Second, the underestimation of other modern contributions, such as the minor one by Celio Calcagnini and the later major one by Giordano Bruno. Finally, the undervaluing of the archaic elements present in Copernicus' astronomical construction.

Il contributo di Copernico alla nascita della moderna astronomia eliocentrica è stato ovviamente fondamentale. Nella cultura condivisa è però spesso amplificato anche al di là del suo enorme valore, grazie a tre fenomeni: l'oblio dell'influenza (ammessa esplicitamente da Copernico) delle antiche idee sui moti della Terra, la sottovalutazione di altri contributi moderni, come quello minore di Celio Calcagnini e quello successivo di grande rilievo di Giordano Bruno e infine la scarsa considerazione degli elementi arcaici presenti nella costruzione astronomica di Copernico.

**Author:** RUSSO, Lucio (Università di Roma Tor Vergata)

**Session Classification:** Copernico e il nuovo Cosmo / Copernicus' Changeover from the Old to the New Cosmos



Contribution ID: 74

Type: **Invited**

## **The Role of History of Science in Enhancing Physics and Chemistry Education**

*Thursday, 7 September 2023 14:00 (30 minutes)*

The teaching of Physics and Chemistry at the university level has traditionally presented a static and definitive view of science that was established in the early 20th century. However, contemporary research in science education has fostered a new perspective on the significance of the history of science as a source of metascientific knowledge for the improvement of educational practices. By reviewing the historical evolution of concepts taught, we gain insight into the dynamic nature of scientific knowledge construction and its implications for student learning. Simultaneously, it provides an opportunity to understand some of the learning difficulties that students face due to a certain parallelism between historical construction and personal construction of scientific knowledge. This work aims to examine the role of the history of science through two of our research investigations, conducted via documentary analysis, and the didactic implications of their findings. One case focused on organic chemistry, exploring the historical development of the benzene structure and the concept of resonance. The other involves a historiographical study on the establishment of the laws of thermodynamics and the impact of classical textbooks developed by scientists such as Planck and Fermi, which marked the beginning of thermodynamics instruction and still persist as study materials in classrooms. Through these investigations, we aim to emphasize the importance of integrating historical perspectives into Physics and Chemistry education at the university level. By leveraging historical contexts, educators can enhance students' understanding of scientific concepts and address the challenges they face in their learning process.

**Authors:** IDOYAGA, Ignacio (Universidad de Buenos Aires); LORENZO, María-Gabriela (Universidad de Buenos Aires)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 77

## **C. Bonfanti's book collection**

*Friday, 8 September 2023 12:30 (20 minutes)*

In this paper we bring light on some aspects of the Corrado Bonfanti's book collection held at "I.T.S. Alessandro Volta" in Trieste. The attention will focus on four books, two about quantum mechanics, one about relativity and one about television all dating from the first three decades of the twentieth century.

The two books on quantum mechanics (written by Antonio Carrelli and Enrico Persico in 1932 and 1936, respectively) show the great advances made in understanding the structure of the atomic nucleus following the discovery of the neutron by James Chadwick in 1932. The book about general relativity is a second Italian edition (from 1922) of a translation of the 1920 text "Das Weltbild der Relativitätstheorie. Allgemeinverständliche Einführung in die Einsteinsche Lehre von Raum und Zeit". The book provides a fairly complete introduction to the subject and remains accessible to a wide audience, is one of the first informative works on relativity. The last book is "Televisione, le basi fisiche del radiovedere" by Gaetano Castelfranchi, published by Hoepli in Milan in 1931. This book offers an introduction to the history and the development of the scientific discoveries that made possible the creation of the first apparatus for the transmission of moving images by means of electromagnetic waves.

The main interest in the study of these books lies in the fact that they provide a deep insight into the history of physics and its teaching since they were written at a time when the fields they cover were not yet fully developed.

**Author:** KLUN, Giuliano (Università degli studi di Udine)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

Contribution ID: 78

Type: **Invited**

## **Real-world phenomena as useful tools in physics teaching**

*Wednesday, 8 September 2023 11:30 (30 minutes)*

Some real-world phenomena may capture students' attention and trigger their curiosity. The rolling of a can on a conveyor belt in the supermarket; the observation of the optimal angle in a weight-throwing competition; the running of a sprinter; the trajectory of a ball or a water droplet in the air; a coloured line appearance on a CD or a DVD under white light; the kinematics of fireworks; the spectacular dance sun glints on the shallow waters by the seashore: all these phenomena can be proposed to students in the “engagement” phase of a lesson which uses the Inquiry-Based Learning approach.

In this talk, we propose all these examples along with a brief justification of the observed phenomena, based on the elementary principles of classical physics.

Alcuni fenomeni del mondo reale possono catturare l'attenzione degli studenti e suscitare la loro curiosità. Il rotolamento di un barattolo su di un nastro trasportatore al supermercato, l'osservazione dell'angolo ottimo in una gara di lancio del peso, la corsa di un velocista, la traiettoria di un pallone o di una gocciolina d'acqua in aria, la comparsa di una riga colorata su di un CD o un DVD illuminato con luce bianca, la cinematica dei fuochi d'artificio, la spettacolare danza di riverberi luminosi sull'acqua del mare in prossimità della riva sono tutti fenomeni che possono essere proposti agli studenti nella fase di “engagement” di una lezione in cui viene utilizzato l'approccio dell'apprendimento basato sull'indagine. In questo intervento proponiamo tutti questi esempi insieme a una breve giustificazione, basata sui principi elementari della fisica classica, dei fenomeni osservati.

**Authors:** DE LUCA, Roberto (Dipartimento di Fisica “E. R. Caianiello” - Università degli Studi di Salerno)

**Session Classification:** Dialogo storia, didattica e divulgazione / Dialogue between History, Teaching and Dissemination

## **Tavola rotonda: Come può essere utile la storia alla didattica della fisica e dell'astronomia?**

Thursday, 7 September 2023 14:30 (2 hours)

**Coordinano:** MICHELINI, Marisa (URDF Dept of Math-Info\_Phys in University of Udine); ESPOSITO, Salvatore (Dipartimento di Fisica “Ettore Pancini”, Università di Napoli & I.N.F.N. - Sezione di Napoli)

**Intervengono:** BOCCATO, Caterina (INAF-Istituto Nazionale di Astrofisica); GIANNETTO, Enrico (Università di Bergamo); LA RANA, Adele (University of Macerata and INFN Section Rome 1); LEONE, Matteo (University of Turin); MICHELINI, Marisa (URDF Dept of Math-Info\_Phys in University of Udine); Prof. PANTANO, Ornella (DFA-Università di Padova); STRAULINO, Samuele (Università di Firenze)

### **Abstracts:**

*C. Boccato*

#### **Lo studio dell'Universo di ieri e di oggi per una didattica più efficace**

L'apprendimento dell'Astronomia, e dell'Astrofisica, è sicuramente reso più efficace nel momento in cui riusciamo a contestualizzare, per gli studenti, le diverse scoperte scientifiche. Dal forte legame che Galileo Galilei aveva con la “tecnologia” del '600, ossia con le botteghe degli ingegnosi artigiani della Padova di allora, che gli permise di appropriarsi di un cannocchiale, e poi di perfezionarlo, per scoprire un universo fino ad allora inedito, ai primi spettrografi dell'800 che, abbinati ai telescopi, hanno sancito il passaggio dall'Astronomia di posizione allo studio della fisica dei corpi celesti ossia all'Astrofisica.

Il connubio didattica e storia della scienza, in INAF, si è concretizzato in diverse attività che rispecchiano quanto appena detto: presso le aule e gli spazi museali della Specola di Padova si sono proposte delle attività di riproduzione di strumentazione astronomica del passato da un lato e dall'altro le visite ai nostri laboratori di tecnologia di frontiera dove si testano le ottiche di satelliti dell'Agenzia Spaziale Europea. Seguendo lo stesso approccio, negli spazi di diversi altri musei, condivisi con gli istituti attuali dell'INAF, sparsi in tutta Italia, abbiamo proposto anche ricostruzioni teatrali della storia astronomica del '900 e l'abbiamo poi messa a confronto con i risultati ottenuti negli ultimi 20, 30 anni. Questi approcci si sono dimostrati efficaci perché, in primis, danno la “dimensione umana” di una scienza così, apparentemente, slegata dalla vita quotidiana. Ma mostrano anche la realtà e cioè che la scienza non segue un percorso lineare, è costellata di errori tanto quanto di intuizioni corrette, di momenti di stallo tanto quanto di periodi di grandi scoperte.

*S. Esposito*

#### **La storia che insegna: progetti didattici (e divulgativi) su percorsi storici definiti**

L'obiettivo di far imparare la fisica praticando la scienza può essere raggiunto delineando dei percorsi ben definiti (su argomenti specifici), che seguano da vicino la realtà storica. L'intento non è quello di riprodurre a posteriori i processi mediante i quali i fisici costruiscono e applicano una data conoscenza, ma piuttosto quello di produrre processi reali mediante i quali gli scienziati del passato hanno costruito e applicato quella conoscenza. Alcuni progetti sviluppati negli ultimi anni,

in contesti didattici differenti, mostrano quanto questa prospettiva sia particolarmente fruttuosa, soprattutto quando si considerano percorsi storici di origine prettamente sperimentale.

*E. Giannetto*

#### **La fisica è la sua storia**

La storia è necessaria alla didattica della fisica e dell'astronomia, perché l'astronomia e la fisica non sono discipline immutabili che dispensano verità immutabili, ma sono attività umane storiche, che si dipanano nel tempo. Invero, implicitamente l'attuale insegnamento della fisica rispecchia tale caratterizzazione, in quanto vengono proposte la meccanica newtoniana, la termodinamica, l'elettromagnetismo, la relatività e la fisica dei quanti. Molti mis-concetti sorgono però perché non viene spiegata anche la fisica aristotelica (basata sull'esperienza, come la fisica ingenua degli studenti e delle studentesse) che precede la fisica moderna (basata sugli esperimenti). Non solo: difficoltà e mis-concetti nascono anche in chi apprende proprio perché tali sotto-discipline moderne non sono presentate in prospettiva storica esplicita e non si riesce a comprendere perché mai la meccanica newtoniana debba poi essere sostituita dalla relatività e dai quanti.

*A. La Rana*

### **Fisica, storia e cultura scientifica**

Igal Galili promuove da diversi anni un approccio al sapere scientifico inteso come forma di cultura. In quest'ottica, l'insegnamento della fisica richiede una "conoscenza culturale del contenuto" (*cultural content knowledge*), che si affianca alla "conoscenza pedagogica del contenuto" (*pedagogical content knowledge*), quest'ultima ben consolidata all'interno dei modelli didattici correnti.

La storia della fisica assume un ruolo centrale in questo approccio, perché consente di guardare allo sviluppo del pensiero scientifico in modo argomentativo, calandolo nel contesto storico e nella più ampia prospettiva delle esperienze e attività di indagine del pensiero umano.

La conoscenza culturale del contenuto permette di cogliere la natura dialogica della scienza e del metodo scientifico, e contrasta il pregiudizio comune che concepisce la scienza come corpus assertivo, come ricettario di formule e leggi da assimilare e memorizzare. "Perché questa conoscenza e non un'altra?" "C'era forse un altro possibile modo di descrivere lo stesso fenomeno? Perché non ha avuto successo nell'attuale quadro delle nostre conoscenze?": domande di questo tipo sono troppo spesso accantonate nei corsi di fisica per dare spazio a un approccio pragmatico, che snatura il processo di costruzione del sapere scientifico.

Assumendo questo punto di vista, una buona didattica della fisica - che abbia l'obiettivo di stimolare una comprensione più profonda della natura dell'indagine scientifica e una visione culturale ampia e contestualizzata del pensiero scientifico - dovrebbe mostrare come alcuni concetti siano gradualmente emersi nel corso del tempo, e come il loro significato e ruolo si siano evoluti nella conoscenza dei fenomeni fisici, sullo sfondo progressivo di un mutevole quadro teorico di interpretazione della realtà.

Questo particolare approccio didattico alla fisica e alla storia della fisica sarà qui illustrato attraverso un esempio concreto.

*M. Leone*

### **Quante storie... ovvero: come fare buon uso della storia nella didattica della fisica?**

Quante storie. Quelle raccontate nelle storie dei manuali di fisica della scuola secondaria o dell'università: medaglioni di scienziati e poco altro, esperimenti mai fatti o fatti e mai raccontati, teorie avulse da un contesto.

Quante storie. Quelle che vorrebbero imparare, scoprire, applicare, i docenti di fisica della scuola secondaria consapevoli del valore culturale e motivazionale della storia della loro disciplina.

Quante storie. Quelle che la storia della fisica ci riserva, quasi a presagire, anticipare, la fisica "spontanea" degli studenti.

Per ognuna di queste storie si porteranno esempi fondati su ricerche storiche e/o empiriche attinenti al rapporto tra storia e didattica della fisica.

*M. Michelini*

### **La storia in percorsi concettuali per l'apprendimento**

Lo scopo principale della didattica è produrre quell'apprendimento che corrisponde ad un'appropriazione dei contenuti e dei metodi disciplinari, che il soggetto sa utilizzare in diversi contesti. La letteratura di ricerca ci ha insegnato che ciò viene favorito se il soggetto che apprende ha un ruolo attivo in cui si mette in gioco con lo stile proprio di apprendimento in esperienze significative. La fisica richiede interpretazione a diversi livelli e spesso con prospettive diverse di contesti fenomenologici. La comprensione di potenzialità e limiti di ciascuno richiede un'elaborazione concettuale, spesso ricostruendo pezzi di realtà in esperimenti di laboratorio. Ecco che la più importante conquista nell'apprendimento della fisica è quella dell'appropriazione concettuale, che implica quella epistemica. Essa costruisce diverse competenze, che accanto a creatività e fantasia, crescono mettendo in campo strategie basate su ipotesi, esperimenti e confronto dei risultati con le ipotesi, identificazione di concetti e argomentazioni che li correlano e vi danno senso. Sono passi spesso compiuti nel percorso storico di chiarificazione concettuale in fisica. In percorsi concettuali coerenti basati su attività sperimentali abbiamo evidenza che hanno un ruolo fertile esperienze di costruzione concettuale vissute nella storia della fisica. Ecco che sfruttare idee ed argomentazioni di scienziati del passato per costruire esperienze in cui gli studenti vivono (non sentono raccontare) come nascono relazioni, modelli e interpretazioni offre loro gli elementi artigianali del costruire conoscenza in fisica. Nella nostra esperienza abbiamo costruito percorsi che hanno favorito il cambiamento concettuale in meccanica, nella fluidodinamica, in termodinamica, elettromagnetismo ed ottica mettendo nelle mani degli studenti situazioni carismatiche di Newton, Fourier, Ampere e Balmer. L'autenticità delle problematiche e dati storici hanno attivato ragionamenti ed argomentazioni capaci di costruire appropriazione concettuale di interpretazioni attuali. La storia vissuta fa acquisire consapevolezza dei nodi concettuali, offre padronanza di modalità di lavoro e, mentre costruisce conoscenze, offre competenze di identità fisica.

*O. Pantano*

### **Il ruolo dei musei scientifici nell'insegnamento della fisica e dell'astronomia**

Il gruppo di ricerca in didattica della Fisica e Astronomia dell'Università di Padova da diversi anni collabora con il Museo di Storia della fisica 'G. Poleni' e il Museo 'La Specola' dell'INAF nello sviluppo di percorsi didattici

che integrano attività laboratoriali e visite tematiche presso i Musei. In particolare, saranno presentate alcune esperienze fatte con insegnanti in formazione e in servizio di scuola primaria e scuola secondaria. Gli obiettivi dei progetti sviluppati sono vari: far sperimentare agli insegnanti dei percorsi da riproporre a scuola, adattandoli ai diversi bisogni formativi dei propri studenti; stimolare una riflessione su come i musei scientifici possono essere usati per motivare gli studenti e favorire l'apprendimento di alcuni temi disciplinari; riconoscere la relazione tra strumenti ed evoluzione della conoscenza scientifica; fornire esempi di insegnamento integrato di fisica e astronomia.

*S. Straulino*

### **Ricostruzione di esperimenti storici in classe**

La storia della scienza ha fra i suoi meriti quello di far comprendere agli studenti che il percorso della conoscenza scientifica non è stato quasi mai progressivo e lineare, ma in molti casi tortuoso; per ragioni di semplicità di narrazione e di coerenza interna, i libri di testo seguono il corso principale del “torrente della conoscenza”, ignorando spesso i piccoli affluenti laterali.

In alcuni casi gli esperimenti storici vengono descritti sui libri di testo in una versione semplificata e “normalizzata”, ma è interessante e utile capire qual era l'approccio originale e le motivazioni che giustificavano le scelte operative dello scienziato. Inoltre, realizzando l'esperimento, gli studenti hanno la possibilità di riflettere sulla sua fattibilità, in termini di ripetibilità e di precisione della misura.

La connessione fra storia e didattica ha connotato parte della mia esperienza di ricerca nella ricostruzione di esperimenti storici a scopo didattico; durante la presentazione descriverò alcuni esperimenti galileiani come esempi significativi di questo approccio storico/sperimentale.