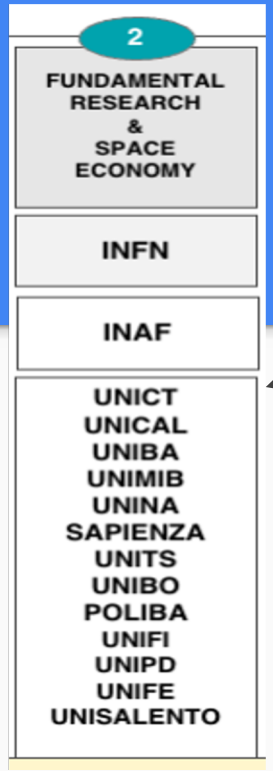
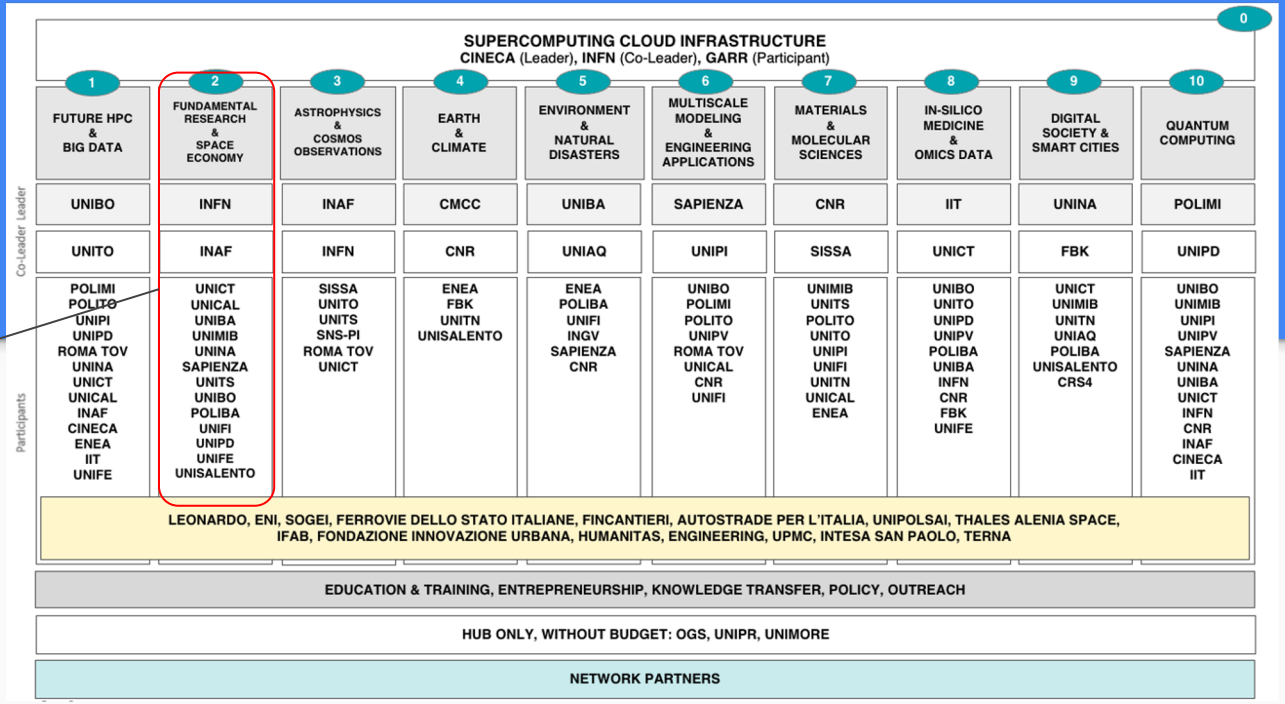
Spoke 2

Tommaso Boccali (INFN Pisa)





2 EPRs, 13 Universities, 3(4?) companies

Leonardo
Intesa Sanpaolo
IFAB
(ENI?)
+ ???

Spoke Leader Institution (INFN) designated Sandra Malvezzi and Tommaso Boccali as leaders
Spoke Co-leader Institution (INAF) designated Antonio Stamerra as co-leader

Cosa facciamo?

Spoke 2 - Fundamental Research & Space Economy

Science, and in particular science at the frontier of knowledge, is becoming more and more a computing intensive discipline. Current and next-generation experiments show processing and data needs comparable with the top global players and need a stack of solutions which are not typical of the curriculum of scientists. The trend has indeed started more than 15 years ago, with the development of solutions needed to satisfy the science of Collider Physics; since then, similar needs have been documented in other scientific domains, with Astroparticle physics showing by the end of the 2020s similar if not larger resource deployments. The activities in Spoke 2 "Fundamental Research and Space Economy" focus on boosting the science capabilities of current and future science initiatives, using the opportunities that PNRR in general and the National Centre for Big Data, HPC and Quantum Computing (CN) in particular offer in the next three years.

"share solutions between partners"

"use the CN infrastructure as enabling technology"

"no basic science, but computing FOR basic science"

GOALS AND OBJECTIVES

The activities in the "Fundamental Research & Space Economy" Spoke will be cast within the context of state-of-the-art research in basic science, and, in particular, of the domains of theoretical and experimental physics with accelerators and with space- and ground-based detectors for astroparticle physics and gravitational wave investigations. Within different time scales, all of these areas have or will have to face problems regarding the scaling and efficiency of computing infrastructures. These areas demand a scaling of the computing infrastructures and an improvement in efficiency. The Spoke intends to address these needs designing, developing and testing solutions apt to the current and next-generation experiments, and fitting the contingent situation in Italy arising from the opportunities provided by the PNRR in general and the National Centre (CN) "Big Data, HPC and Quantum Computing".

In addition, the Spoke activities aim at demonstrating that the same set of solutions are of value in domains outside the bounds of basic science and of the specific research use cases. We plan to address at least two specific situations:

- the handling of data and processing in the context of the Space Economy Italian Strategy, including the handling and processing of data from the Mirror Copernicus program, by fostering the conditions to enable radically innovative services;
- the seeding of similar solutions in the productive context, with industry-research shared testbeds and proofs of concept; this will cover the productive domains in which data and processing resources need to be geographically dispersed, need a secure and granular solution for the data access, and experience computational problems with an unsustainable predicted future scaling (due to cost, efficiency, or performance).

The crucial aspects of its mission concern the creation and/or optimization of algorithms and, in general, computing solutions capable of maximizing the potential physics output from experimental data and theoretical and phenomenological simulations, by using the tools made available by the Centre: e.g., heterogeneous and high-performance computing (via standard programming and AI-based solutions) and the ability to process large quantities of data beyond the capabilities of traditional methods.

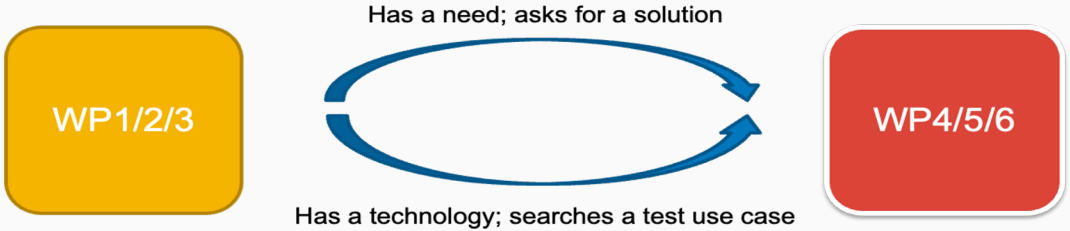
"design and test novel computing oriented solutions"

"go outside the academic environment; not to teach them, but to share experience in both ways"

Some high level ideas..

Spoke2 - structure

- 6 Work Packages were defined; 3+3:
  - the former 3 are "(scientific) use case driven"
    - "in order to perform this activity, I would need this kind of solution / technology / resources"
  - The latter 3 are "technology driven"
    - Our affiliates are / want to be expert in this technology, we offer what the spoke 2 community knows
- This means we expect each use case to belong to at least 2 WPs
- (in reality the boundaries are not going to be so sharp; this is more a direction of work)



1 Design and development of science-driven tools and innovative algorithms for Theoretical Physics

2 Design and development of science-driven tools and innovative algorithms for Experimental High Energy Physics

3 Design and development of science-driven tools and innovative algorithms for Experimental Astroparticle Physics and Gravitational Waves

4 Boosting the computational performance of Theoretical and Experimental Physics algorithms

5 Architectural Support for Theoretical and Experimental Physics Data Management on the Distributed CN infrastructure

6 Cross–domain Initiatives (+ Space Economy)

Kick off meeting: 13-14 Ottobre

	Leader 1	Leader 2
WP1	Leonardo Giusti (UNIMIB)	Leonardo Cosmai (INFN BA)
WP2	Piergliulio Lenzi (UNIFI)	Vincenzo Vagnoni(INFN BO)
WP3	Paolo Natoli (UNIFE)	Marco Landoni (INAF Brera)
WP4	Alexis Pompili (UNIBA)	Simone Gennai (NFN MIB)
WP5	Elvira Rossi (UNINA)	Daniele Spiga (INFN PG)
WP6	Alessia Tricomi (UNICT)	Francesco Visconti (INAF Roma)

Parallel WP1

ZOOM: https://cern.zoom.us/j/68480249888?pwd=U1pEbkJsY1B2a0htYWlVSVRNTWFwQT09

Conveners: Leonardo Cosmai (Istituto Nazionale di Fisica Nucleare) , Leonardo Giusti (Istituto Nazionale di Fisica Nucleare)

15:00 **Condensed matter and low dimensional systems**
Speaker: Domenico Giuliano (Istituto Nazionale di Fisica Nucleare)
topic_6-1.doc

15:20 **Lattice field theory**
Speaker: Leonardo Cosmai (Istituto Nazionale di Fisica Nucleare)
WP1_Lattice.pdf
WP1_Lattice.pdf

15:40 **Collider physics phenomenology**
Speaker: Pierpaolo Mastrolia (Istituto Nazionale di Fisica Nucleare)
CN1-spoke2-WP1-b...

16:00 **Gravitational waves, cosmology and astroparticle physics**
Speaker: Bruno Giacomazzo (Milano-Bicocca)
Spoke2-WP1-b3-Ott...

16:20 **Physics of complex systems**
Speaker: Antonio Suma
Complex_Suma.pdf

16:40 **High energy nuclear physics**
Speaker: Francesco Becattini (Istituto Nazionale di Fisica Nucleare)
HENP.pdf

17:00 **Discussion (All)**
Speakers: Leonardo Cosmai (Istituto Nazionale di Fisica Nucleare) , Leonardo Giusti (Istituto Nazionale di Fisica N

Parallel WP2

ZOOM https://cern.zoom.us/j/65426958849?pwd=NGtWUXdKcmlXNTVXeHh4Mkg1NjloZz09

Conveners: Piergiulio Lenzi (Istituto Nazionale di Fisica Nucleare) , Vincenzo Maria Vagnoni (Istituto Nazionale di Fisica Nucleare)

15:00 **Impostazione del lavoro**
Speakers: Piergiulio Lenzi (Istituto Nazionale di Fisica Nucleare) , Vincenzo Maria Vagnoni (Istituto Nazionale di Fisica N
WP2opening -1.pdf

15:15 **Data reduction workflows and statistical interpretation**
Speakers: Daniele Spiga (Istituto Nazionale di Fisica Nucleare) , Diego Ciangottini (INFN Perugia)
Spoke2_ Data reduc...

15:35 **ML based fast simulation**
Speaker: Lucio Anderlini (Istituto Nazionale di Fisica Nucleare)
FastSim@Spoke2.2....

15:55 **ML based event classification techniques**
Speakers: Elvira Rossi (Istituto Nazionale di Fisica Nucleare) , Evelin Meoni (Istituto Nazionale di Fisica Nucleare)
ML_Classification_T...

16:25 **ML based event reconstruction techniques**
Speakers: Maurizio Martinelli (Università degli Studi di Milano Bicocca e INFN) , Nicola De Filippis (BA)
CNHPC_WP2_2022...

16:55 **Cross domain initiatives (with appeal for industry)**
Speakers: Simone Gennai (MIB) , Simone Gennai (Istituto Nazionale di Fisica Nucleare)
2022_10_13_XAI_D...

Parallel WP3

ZOOM https://cern.zoom.us/j/66525894565?pwd=VlJPU2hpTVJNQ0dvQU9ZTWE5Ujlvdz09

Conveners: Marco Landoni (INAF - Istituto Nazionale di Astrofisica) , Paolo Natoli (Istituto Nazionale di Fisica Nucleare)

15:00 **Context and goals of the session**
Speakers: Marco Landoni (INAF - Istituto Nazionale di Astrofisica) , Paolo Natoli (Istituto Nazionale di Fisica Nucleare)
WP3_Landoni_Natol...

15:05 **INAF activities in WP3 and use cases**
Speaker: Antonio Stamerra (INFN-Roma and INAF-OAR)
Report_WP3_Kickof...

15:25 **HPC case studies for the CMB**
Speaker: Luca Pagano (Istituto Nazionale di Fisica Nucleare)
2022_10_13_CNHP...

15:40 **Turbulence everywhere: Atmosphere, Heliosphere, Cosmos**
Speaker: Leonardo Primavera (UniCal)
Presentazione_attivi...

16:00 **Machine learning techniques for multimessenger and multiwavelength astrophysics**
Speakers: Elisabetta Bissaldi (Istituto Nazionale di Fisica Nucleare) , Silvia Raino' (Istituto Nazionale di Fisica Nucleare)
Bissaldi_Spoke2_H...

16:15 **Landscape and computational challenges for the LISA global fit**
Speaker: Riccardo Buscicchio (UniMiB)
Kick-offWP3Spoke2...

16:30 **Computing and analysis for gravitational wave searches with LIGO/Virgo/KAGRA data**
Speaker: Cristiano Palomba (Istituto Nazionale di Fisica Nucleare)
INFN_GW_Roma_Pr...

16:40 **Transient GW signals without templates**
Speaker: Edoardo Milotti (Istituto Nazionale di Fisica Nucleare)
GWTransients.pdf

16:50 **ML based PID (astroparticles) and GW signal detection**
Speaker: Massimo Lenti (Istituto Nazionale di Fisica Nucleare)
MLbasedAstroGW_...

17:10 **HPC studies applied to astroparticle/astrophysics and gw theory**
Speaker: Achille Nucita (Istituto Nazionale di Fisica Nucleare)
hpc-wp3.pptx

17:25 **New physics from n-point correlations of large-scale structure, gravitational waves and the c**
microwave background
Speaker: Alvise Raccanelli (CERN)
PNRR WP3 UniPD.pdf

17:40 **CYGNO a large TPC for dark matter and neutrino study**
Speaker: Giovanni Mazzitelli (Istituto Nazionale di Fisica Nucleare)
imeges4DM.pdf

Parallel WP4

ZOOM https://us06web.zoom.us/j/88325395679?pwd=QTRDQXZ0bnlrZCtBbWN0eUJDeDNJQT09

Conveners: Alexis Pompili (Istituto Nazionale di Fisica Nucleare) , Simone Gennai (MIB) , Simone Gennai (Istituto Nazionale di Fisica Nucleare)

17:30 **News**

2022_10_13_spoke...

17:35 **Porting to GPU, experience from Experimental-HEP**

Speaker: Dr Tony Di Pilato

Tony_Spoke2Perfor...

17:55 **Porting to GPU, experience from Theory-HEP** ¶

Speakers: Francesco Sanfilippo (Istituto Nazionale di Fisica Nucleare) , Francesco Sanfilippo (INFN - Sezione Roma III)

2022-10-13.pdf

18:15 **FPGAs array per fast track reconstruction at trigger level**

Speaker: Giovanni Punzi (Istituto Nazionale di Fisica Nucleare)

Punzi-ICSC-Spoke2...

18:35 **ML_INFN: cosa possiamo imparare ?**

Speaker: Lucio Anderlini (Istituto Nazionale di Fisica Nucleare)

ML_INFN initiative - ...

Parallel WP5

ZOOM https://cern.zoom.us/j/68264031386?pwd=WFJsMlZEWDNBVThEMjlDWUxua1hBZz09

Conveners: Daniele Spiga (Istituto Nazionale di Fisica Nucleare) , Elvira Rossi (Istituto Nazionale di Fisica Nucleare)

17:30 **WP5: Introduction and status**

Speakers: Daniele Spiga (Istituto Nazionale di Fisica Nucleare) , Elvira Rossi (Istituto Nazionale di Fisica Nucleare)

WP2.5_intro.pdf

18:00 **WP1: Use cases/Requirements and summary of WP1 parallel**

Speaker: Mattia Bruno

bruno_WP5forWP1....

18:15 **WP2: Use cases/Requirements and summary of WP2 parallel**

Speaker: Piergiulio Lenzi (Istituto Nazionale di Fisica Nucleare)

WP2forWP5-1.pdf

18:30 **WP3: Use cases/Requirements and summary of WP3 parallel**

Speakers: Marco Landolfi, Paolo Natoli

Parallel WP6

ZOOM https://infn-it.zoom.us/j/83188250196?pwd=MG1wdmpha0t2VUVVL0xmcXV1OUlMdz09

Conveners: Alessia Rita Tricomi (Istituto Nazionale di Fisica Nucleare) , francesco visconti (INAF)

17:30 **WP6: introduction and first ideas**

Speakers: Alessia Rita Tricomi (Istituto Nazionale di Fisica Nucleare) , Francesco Visconti

WP6_13102022.pdf

17:50 **Use cases from ARPAE**

Speaker: Michele Stortini (ARPA Emilia Romagna)

18:05 **Use cases from ISPRA**

Speaker: Stefano Mariani (ISPRA)

18:20 **Image reconstruction algorithm**

Speaker: Emiliano Tramontana (Università di Catania)

18:35 **General discussion**

Speaker: All

In particolare …

- I tools e le soluzioni che pensiamo di realizzare nei WP 4-5-6 sono generiche (devono essere valide anche per space economy e industrie) → non c'e' ragione di credere che non siano utili/utilizzabili anche in Spoke 3
  - In effetti, la soluzione piu' sensata sarebbe essere d'accordo su soluzioni ADESSO e svilupparle insieme
- I concetti sono sempre quelli
  - Adattamento a datalake e data management
  - Calcolo eterogeneo
  - Soluzioni di analisi avanzate (jupyter, dask, ….)

Come essere sicuri di non divergere …

- Spoke 2 e 3 hanno deciso di mettere un membro dell'altro Spoke nel loro Steering
  - **Spoke 2** → **Spoke** 3 : Daniele Spiga
  - **Spoke 3** → **Spoke 2**: Ugo Becciani
- Potremmo pensare a alcuni testbed comuni su cui testare use cases diversi
  - Anche visto che in parte "condividiamo" le industrie
- Altro??