

# Fundamental physics I **Dark Matter**

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F. Sapia, M. Visco, G. Trincherio, W. Fulgione, E. Baracchini, G. Bonnoli, M. Landoni, L. Nava,  
P. Soffitta, F. Tavecchio (and INAF associates: P. Caraveo; E. Costa; A. De Angelis; M. Roncadelli)



*Giornate RSN4 - Seconda Edizione*  
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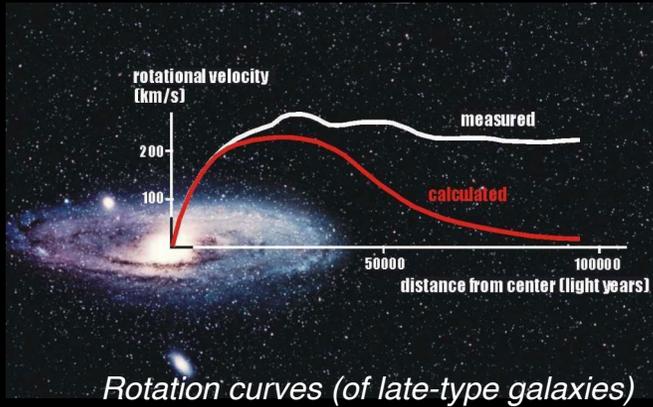
A vibrant, multi-colored star field with a central pink and red nebula-like glow. The background is a dense field of stars in various colors including yellow, orange, blue, and white. A prominent bright blue star is visible in the upper right, and another bright blue star is in the lower right. A large, bright yellow star is in the upper left. The central region is dominated by a large, glowing pink and red nebula-like structure. The overall scene is a rich, multi-colored star field.

**Observational evidence for the existence of dark matter**

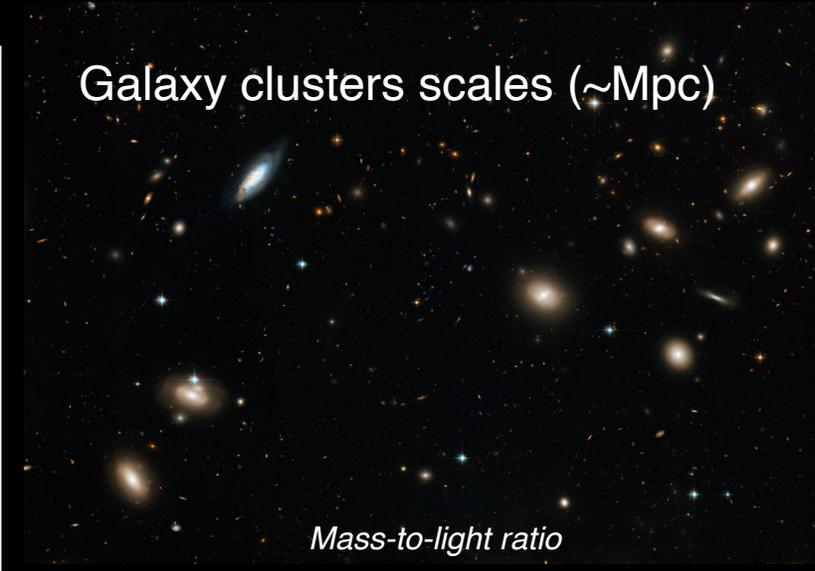
# Observational evidence of dark matter at all scales

\*also smaller scales, not listed here

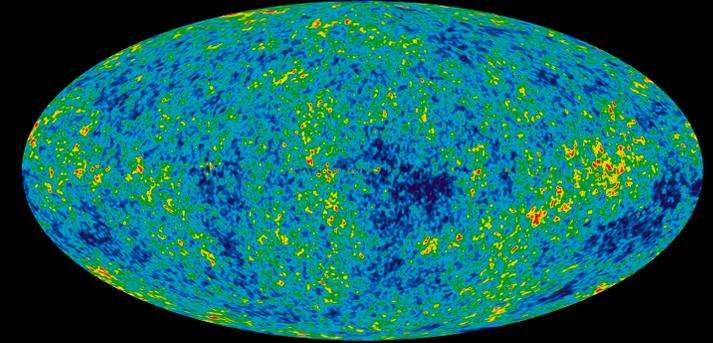
## Galaxy scales (10s-100s kpc)



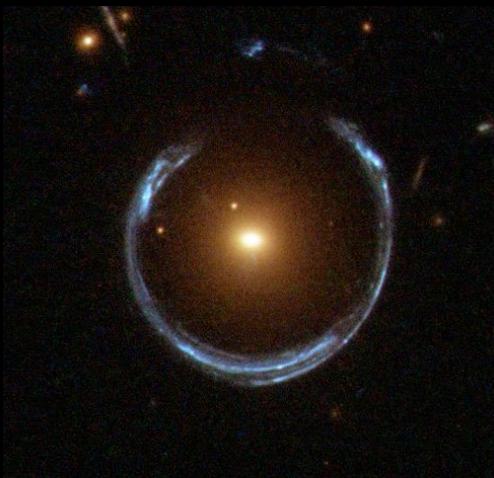
## Galaxy clusters scales (~Mpc)



## Cosmological scales (~Gpc)



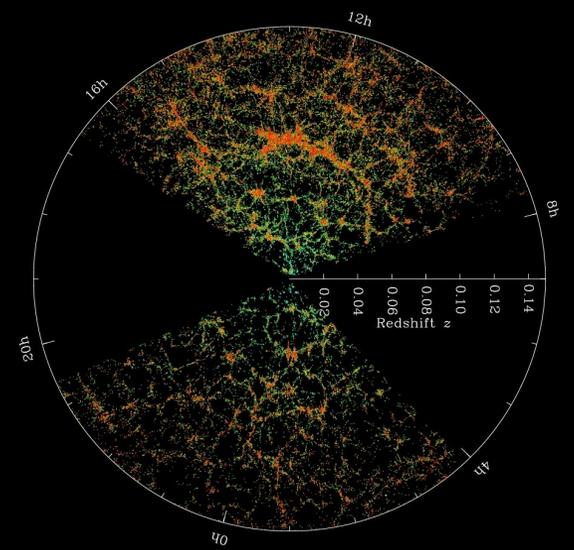
## Strong gravitational lensing



## Collisions (combined weak and strong gravitational lensing by clusters)



## Large scale structure



## The biggest questions in science

In recent centuries we have learned so much about the worlds around and within us that it may sometimes seem that no nook is left unexplored. The truth is, though, that every new discovery leads us to ever deeper questions. *Innovations In: The Biggest Questions in Science* is a special report on the state of inquiry into these questions—the latest research on the nature of spacetime, the identity of dark matter, the origins of life, the source of consciousness, and more.

### What Is Spacetime?

Physicists believe that at the tiniest scales, space emerges from quanta. What might these building blocks look like?

George Musser

### What Is Dark Matter?

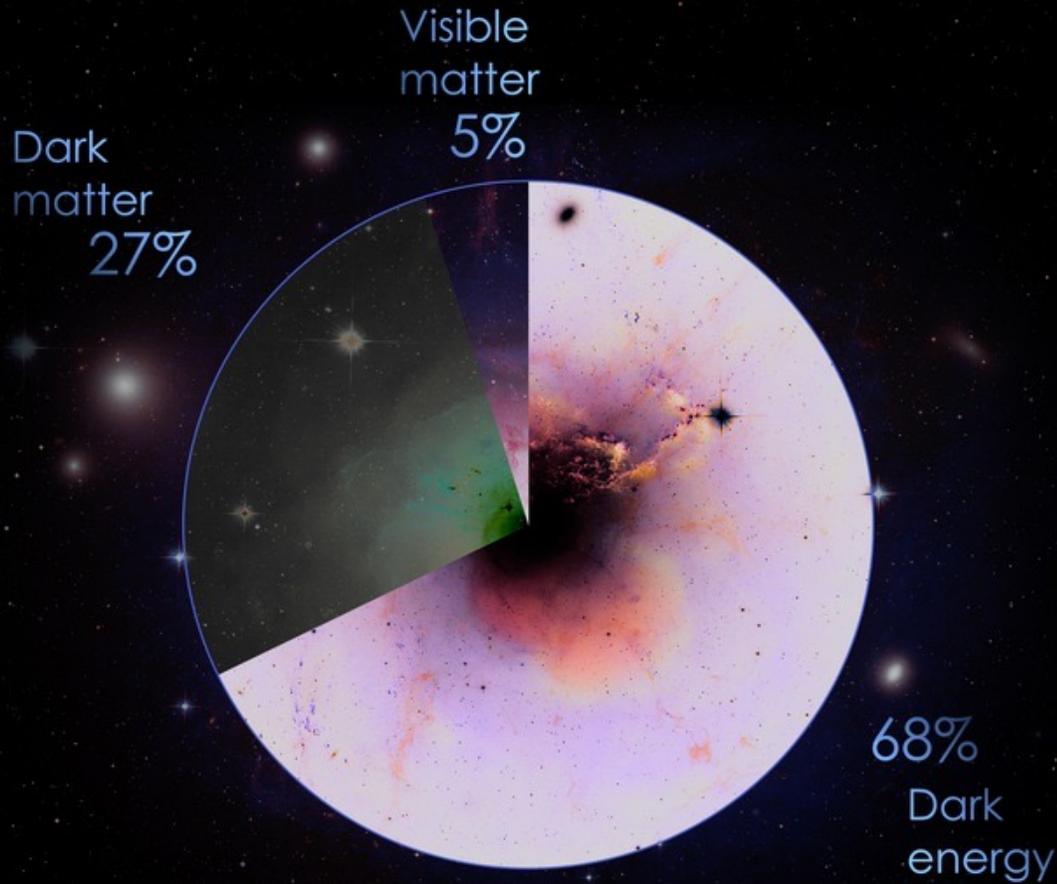
An elusive substance that permeates the universe exerts many detectable gravitational influences yet eludes direct detection.

Lisa Randall

### What Is Consciousness?

Scientists are beginning to unravel a mystery that has long vexed philosophers.

Christof Koch



Despite the overwhelming evidence, the nature of dark matter is still one of the major unsolved problems in astrophysics

# What dark matter is

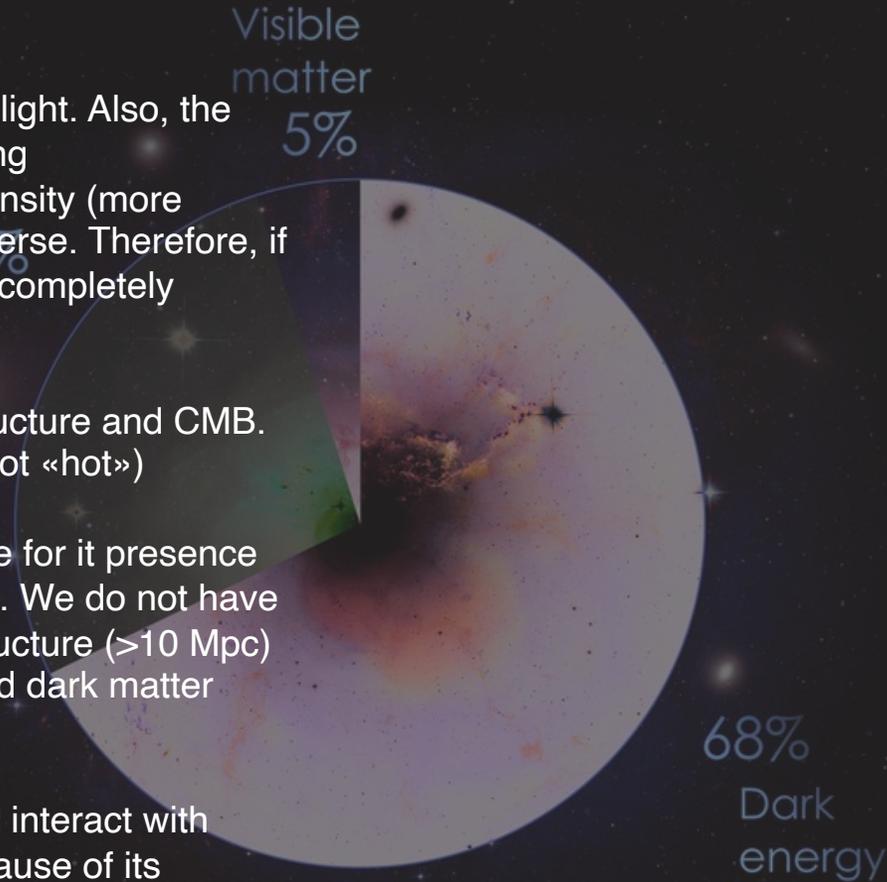
- **Dark (non-baryonic)**: it does not emit nor absorb light. Also, the abundance of light elements created during Big-Bang nucleosynthesis depends strongly on the baryon density (more precisely, on the baryon-to-photon ratio) of the Universe. Therefore, if dark matter were baryonic the Universe would look completely different.

- **Non-relativistic** - as suggested by large scale structure and CMB. This means that it must be «cold» (or «warm» but not «hot»)

- **Stable (or at least, long-lived)**: we have evidence for its presence from the Local Universe out to the largest distances. We do not have hints for a possible «decay» and the large-scale structure (>10 Mpc) across cosmic time are consistent with a stable, cold dark matter picture

- **Neutral (no charge, no color)**: otherwise it would interact with baryonic matter. We «observe» dark matter only because of its gravitational influence

- **Abundant**: it is the dominant component in galaxy formation and evolution and it makes the 27% of the Universe

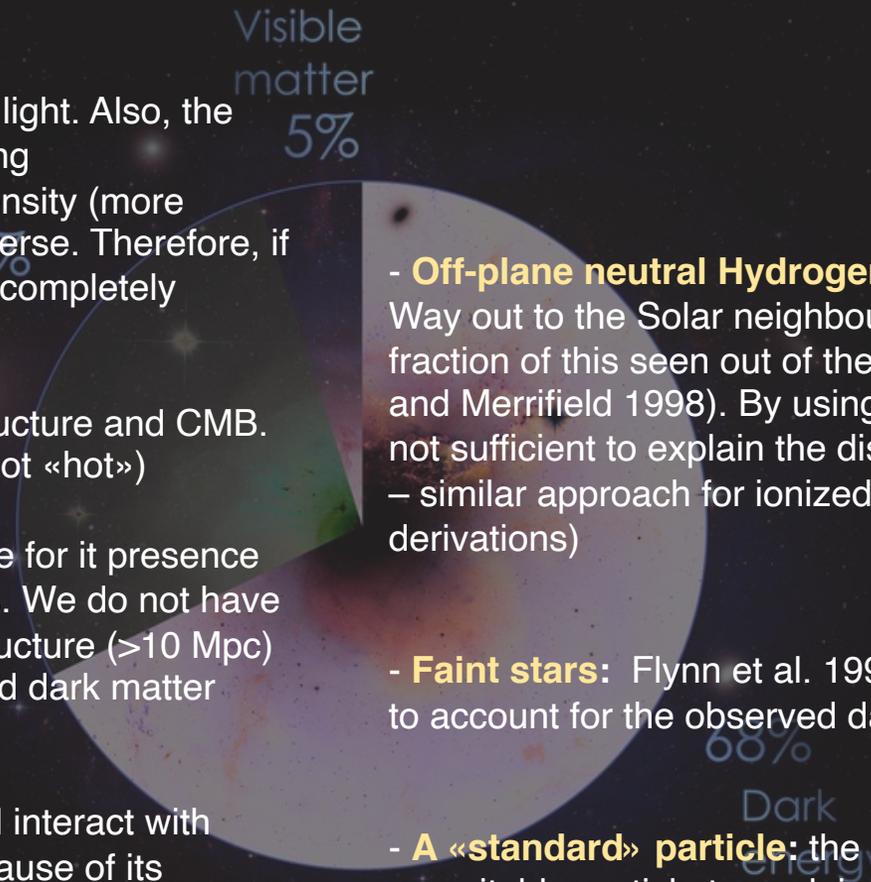


# What dark matter is

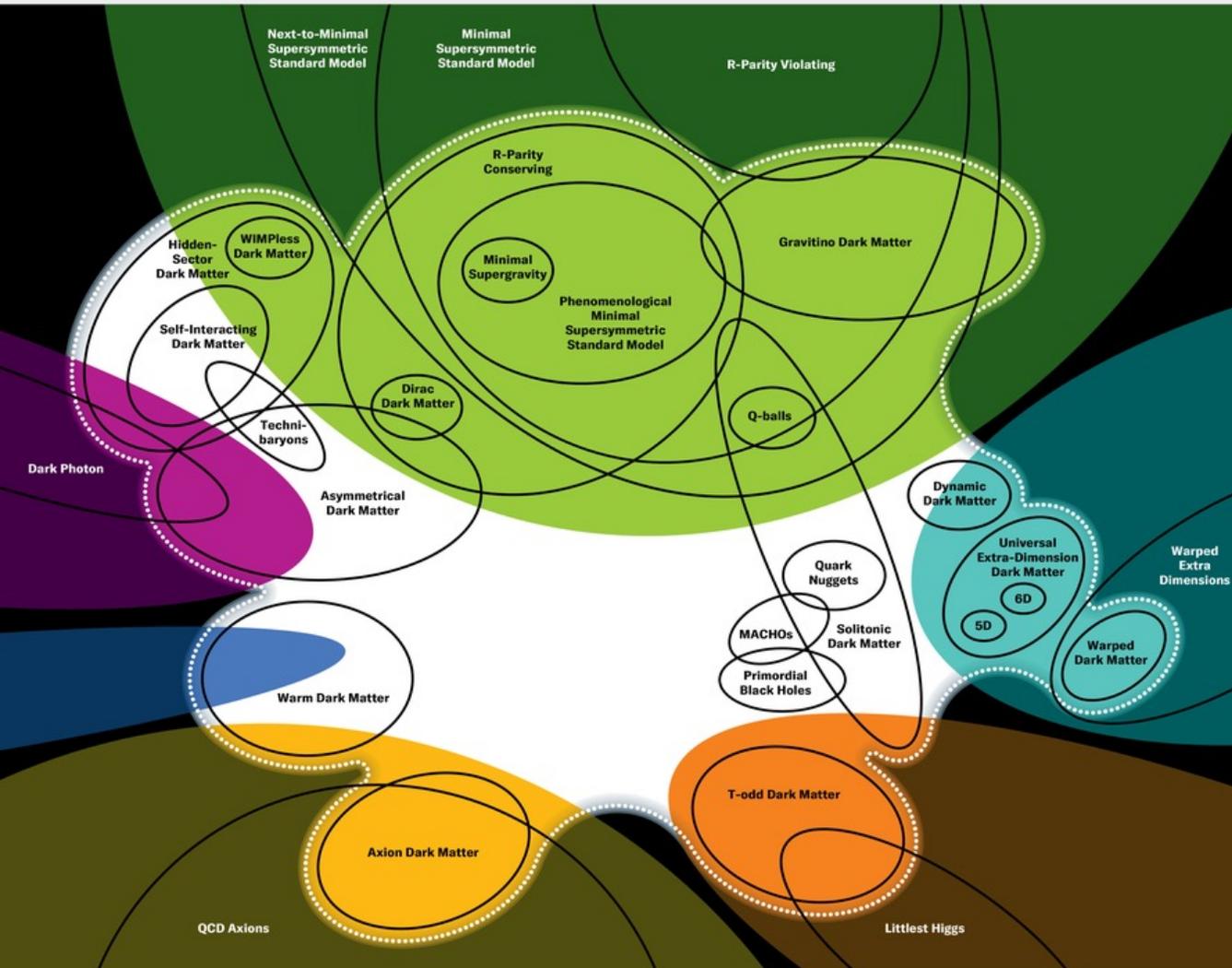
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# What dark matter is (likely) not

- **Off-plane neutral Hydrogen:** The total HI mass in the disc of the Milky Way out to the Solar neighbourhood is  $\sim 10^{10} M_{\odot}$ , with only a small fraction of this seen out of the plane (Marasco and Fraternali 2011; Binney and Merrifield 1998). By using this mass of HI outside the plane  $\rightarrow$  HI is not sufficient to explain the discrepancy. (Kalberla and Kerp 2009 Review) – similar approach for ionized and hot gas (see Read lectures for derivations)
- **Faint stars:** Flynn et al. 1996 found very few faint stars -- too few by far to account for the observed dark matter
- **A «standard» particle:** the standard model of particle physics contains no suitable particle to explain these observations (Bertone & Tait 2018) Note that it could be a family of particles (and not a single one)



# The landscape of candidates for dark matter



## Theories of Dark Matter

Some kind of invisible mass—dark matter—must be suffusing the universe, and scientists have lots of ideas for what it could be. This chaotic web of overlapping ellipses shows the various options for explaining dark matter and reveals just how complex those options are. Physicist Tim M. P. Tait, co-author of this article, first made a version of this Venn diagram in 2013. This updated chart shows that many plausible dark matter models are still viable and consistent with the data scientists have from astrophysical observations and laboratory experiments. The challenge is to figure out which, if any, of these ideas are realized in our universe.

Each colored bubble below represents a category of theories. The portions of the bubble inside the white dotted line are versions of the theory that could account for dark matter, whereas those in the areas outside the line could not.

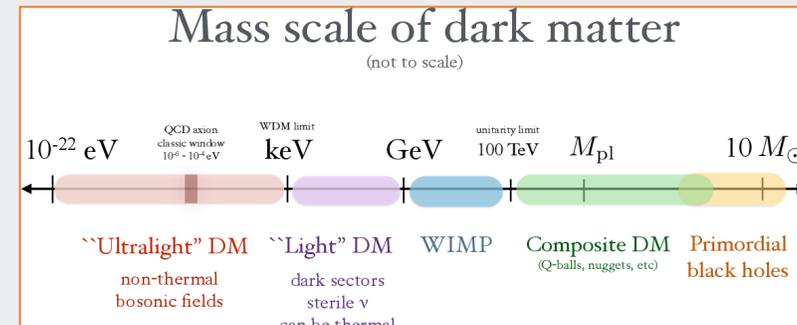
- LIGHT FORCE CARRIERS**  
These models suppose that there is a new force in the universe beyond the known four (gravitational, electromagnetic, strong and weak) that interacts with dark matter and is carried by a lightweight boson—a “dark photon” akin to electromagnetism’s photon. In some cases, the force carrier could itself be the dark matter.
- STERILE NEUTRINOS**  
There are three known flavors of neutrinos—light, ubiquitous particles made in stars and other phenomena. If a fourth, “sterile” neutrino exists that ignores normal matter even more than the regular neutrinos do, it could account for dark matter.
- AXIONLIKE PARTICLES**  
This category includes lightweight particles called axions that naturally arise as a possibility from the quantum chromodynamics (QCD) theory that describes the strong nuclear force. They could explain some of its puzzling features, as well as variations on the idea.
- SUPERSYMMETRY**  
The hypothetical theory of supersymmetry supposes that every known particle has a “superpartner” particle we haven’t yet discovered. If they exist, superpartners could be dark matter.
- EXTRA DIMENSIONS**  
If our universe contains spacetime dimensions beyond the known four, dark matter may be made up of ordinary or exotic matter or radiation that is hiding in them. The dynamical dark matter theory, for example, posits that dark matter encompasses an array of new forces and fields with different masses that inhabits the extra dimensions.
- LITTLE HIGGS**  
Perhaps there are more Higgs bosons beyond the one discovered at the Large Hadron Collider near Geneva in 2012, which could explain why the Higgs mass is so much smaller than the scale of gravity. If so, a cousin of the Higgs, and perhaps some additional particles weighing roughly 1 TeV (a tera-electron volt, about 1,000 times more mass than a proton), could account for dark matter.

### LEADING PARADIGM: AXION OF QUANTUM CHROMODYNAMICS

One of two favored theories among physicists, this model would explain dark matter as a collection of tiny particles called axions. Not all axions would be good dark matter candidates, and not all naturally arise from the quantum chromodynamics theory (QCD) that governs the strong nuclear force, which binds atomic nuclei. But those axions that both match the properties of dark matter and solve problems in QCD are the quarry of numerous experiments.

### LEADING PARADIGM: WIMPS (SPLIT ACROSS GROUPS)

The other leading contender for dark matter is a class of particles called weakly interacting massive particles (WIMPs), which would be significantly heavier than axions. These particles would interact with regular matter only through a weak force (such as the weak nuclear force responsible for radioactive decay) and gravity. Many supersymmetry theories predict WIMP dark matter, but not all of them do.



More than 20 orders of magnitude in mass!!

Venn diagram by Tim M. P. Tait and Jen Christiansen

# **Methods for finding and inferring dark matter properties:**

direct detection, indirect detection and cosmological probes

Methods for finding and inferring dark matter properties:

**direct detection**, indirect detection and cosmological probes

# XENON Dark Matter Project



**Goal:** direct detection of dark matter particles

Use of double-phase Xenon Time Projection Chamber (TPC).

Running underground since 2007 at INFN Laboratori Nazionali del Gran Sasso with detectors of increasing mass and sensitivity.

Currently operating detector is XENONnT (*see pictures*)  
→ TPC height 1.5 m, 4 ton fiducial mass.

## Selected results

→ Very stringent limits on the interaction of WIMPs, Solar Axions, Axionlike Particles (ALPs) and Dark Photons

E. Aprile et al., Phys. Rev. Lett. 135, 221003 (2025)      E. Aprile et al., Phys. Rev. Lett. 129, 161805 (2022)

→ First measurement of solar  $^8\text{B}$  neutrino flux via neutrino-nucleus coherent scattering

E. Aprile et al., Phys. Rev. Lett. 133, 191002 (2024)

→ Measurement of ultra-rare weak decays of  $^{124}\text{Xe}$  and  $^{136}\text{Xe}$

E. Aprile et al., Phys. Rev. C 106, 024328 (2022)

## Involved INAF researchers

**A. Molinario, G. Trincherò, W. Fulgione (OA Torino)**

## Methods for finding and inferring dark matter properties:

direct detection, **indirect detection** and cosmological probes

La polarimetria X spazialmente risolta può essere utilizzata per cercare imprinting polarimetrico prodotto da processi legati a candidati DM:

- 1) **conversione fotone  $\leftrightarrow$  Axion Like Particles (ALPs) in campi magnetici coerenti (che potrebbe generare polarizzazione lineare localmente elevata),**
- 2) **segnali coerenti associati a Self Interacting Dark Matter (SIDM) che possono indurre pattern di polarizzazione allineati con l'asse del merger: scambio di quantità di moto da SIDM self-scattering può introdurre anisotropie nella distribuzione di elettroni relativistici, potenzialmente facendo da seed per emissione Inverse Compton polarizzata anche lontano dagli shock**

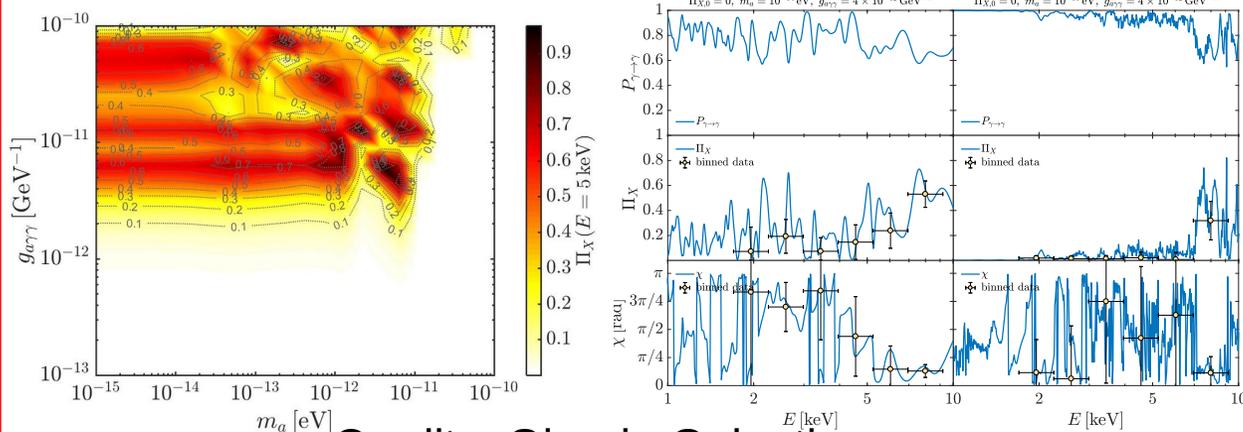
## 1) Perseus Cluster: Galanti et al. In progress

**Sinistra:** grado di polarizzazione di fotoni inizialmente non polarizzati a 5 keV in funzione della massa dell'ALP  $m_a$  e della costante di accoppiamento  $g_{a\gamma\gamma}$ .

Sovrapposti i limiti sullo spazio dei parametri determinati da Anastassopoulos et al. 2017, Sisk-Reynés et al. 2022, Dessert et al. 2022: la sola polarizzazione X monocromatica osservata nel cluster di Perseo fornirebbe vincoli competitivi sugli ALP.

**Destra:** previsioni della probabilità di interazione dei fotoni (in alto), del grado di polarizzazione (al centro) e dell'angolo di polarizzazione (in basso) in funzione dell'energia, calcolate per due specifiche assunzioni su  $m_a$  e  $g_{a\gamma\gamma}$ .

I punti neri più spessi rappresentano gli stessi dati raggruppati per approssimare la risoluzione energetica di IXPE, mostrando che i segnali sarebbero facilmente rilevabili da IXPE.

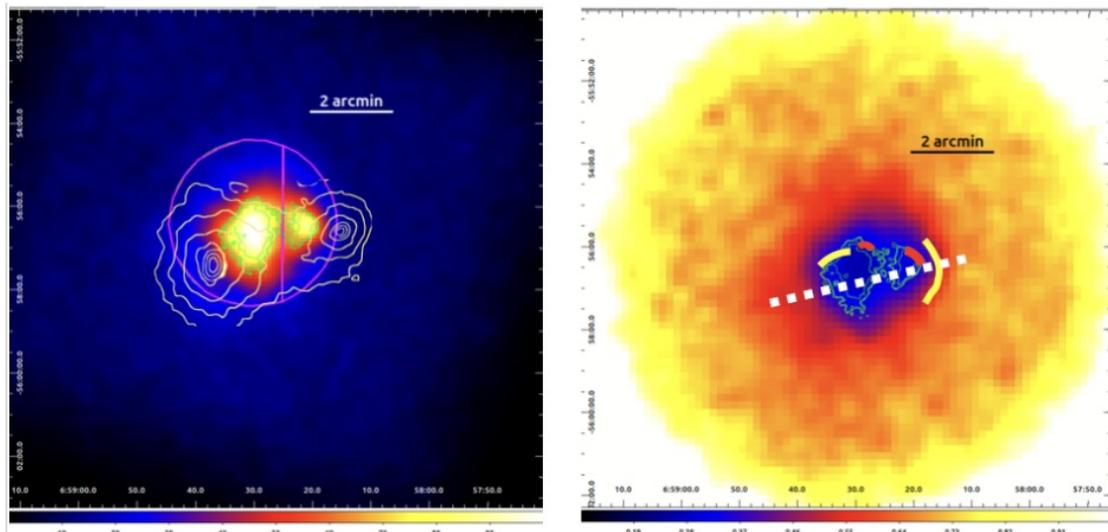


Credits: Giorgio Galanti

## 2) Bullet Cluster: Baracchini et al. proposed

**Sinistra:** Osservazione simulata del Bullet Cluster con IXPE. I contour rappresentano la distribuzione di DM.

**Destra:** Mappa simulata della Minimum Detectable Polarization con tratteggiato l'asse del merger ed evidenziati gli shock.



Credits: Riccardo Ferrazzoli, Elisabetta Baracchini

# Fundamental physics from astrophysical data (FUPA)

INAF staff: **G. Galanti (PI and TD, see slide at the end);**

**G. Bonnoli; R. Ferrazzoli, M. Landoni; L. Nava; P. Soffitta; F. Tavecchio**

INAF associates: P. Caraveo; E. Costa; A. De Angelis; M. Roncadelli

- **Involved Infrastructures:** Amazon; AMEGO; ASTRI Mini-Array; COSI; CTAO; Fermi-LAT; IAXO; IXPE; MAGIC
- **Research Grants:** Mini Grant, INAF, 20k euro (PI: G. Galanti), 2022
- **Objectives:**
  - Explaining astrophysical phenomena starting from first principles
  - Use astrophysical data to study fundamental physics, mainly in terms of
    - 1) axion-like particles (ALPs); 2) Lorentz Invariance Violation (LIV)
- **ALPs** → light neutral pseudo-scalar bosons, predicted by superstring theories, interacting with photons in the presence of external magnetic fields and producing astrophysical effects:
  - Increase of the Universe transparency (De Angelis+2011; Galanti+2018b)
  - **Solution of three VHE astrophysical problems:**
    - Observation of photons from FSRQs with  $E > 20$  GeV (Tavecchio+2012)
    - BL Lac VHE spectral anomaly (Galanti+2020b)
    - **Observation of GRB 221009A above 10 TeV** (Galanti+2023c,2025)
  - Blazar spectral alterations (Tavecchio+2015; Galanti+2019)
  - Capability of CTAO and ASTRI to observe ALP effects at VHE (Galanti, Landoni & Tavecchio, in preparation)
  - Variation of photon polarization (Galanti 2023; Galanti+2023a,b)
  - Measure of emitted photon polarization through photon-ALP interaction (Galanti 2022)
- **LIV** → predicted by quantum theories of gravity and producing astrophysical effects:
  - Variation of the behavior of standard physics processes (Tavecchio+2016)
  - Increase of the Universe transparency (Tavecchio+2016; Galanti+2020a)
  - Blazar spectral alterations (Tavecchio+2016; Galanti+2020a)
  - **Explanation of the detection by Carpet of GRB 221009A up to 300 TeV: First detection of quantum gravity effects?** (Galanti & Roncadelli 2025)
- **Proposals:** IXPE observational proposal about Perseus cluster approved (study about ALP effects is one of the primary topics)

**Publications starting from the formation of the team:** 1) Galanti & Roncadelli, PRD 98, 043018 (2018a); 2) Galanti & Roncadelli, JHEAp 20, 1 (2018b); 3) Galanti, Tavecchio, Roncadelli & Evoli, MNRAS 487, 123 (2019); 4) Galanti, Tavecchio & Landoni, MNRAS 491, 5268 (2020a); 5) Galanti, Roncadelli, De Angelis & Bignami, MNRAS 493, 1553 (2020b); 6) Galanti & Roncadelli, Universe 8(5), 253 (2022); 7) Cenedese, Franceschini & Galanti, MNRAS 516, 216 (2022); 8) Galanti, PRD 105, 083022 (2022); 9) Galanti, PRD 107, 043006 (2023); 10) Galanti, Roncadelli & Tavecchio, Costa, PRD 107, 103007 (2023a); 11) Galanti, Roncadelli & Tavecchio, PRD 108, 083017 (2023b); 12) Galanti, Nava, Roncadelli, Tavecchio & Bonnoli, PRL 131, 251001 (2023c); 13) Galanti, Universe 10(8), 312 (2024); 14) Galanti, Universe 11(10), 327 (2025); 15) Galanti, Roncadelli & Tavecchio, Physics and the Cosmos 1(1), 2 (2025)

**Submitted papers:** 1) Galanti & Roncadelli [arXiv:2504.01830] (2025); 2) Galanti, Landoni & Tavecchio, in preparation

**INFN-INAF press releases:** 1) Galanti et al., MNRAS 493, 1553 (2020b) (<https://www.media.inaf.it/2020/03/03/blazar-bignami/>); 2) Galanti et al., PRL 131, 251001 (2023c) (<https://www.media.inaf.it/2023/12/18/fotoni-alp-grb-221009a/>); <https://www.nature.com/articles/d43978-023-00191-9>)

# Dark matter searches in $\gamma$ -rays with Cherenkov telescopes

- Indirect searches of WIMP-like DM in  $\gamma$ -rays are underway since  $\sim 30$  yrs with the major Cherenkov telescopes (e.g., MAGIC; Acciari+ 2020, PDU 28, 100529, see Fig. 1) and  $\gamma$ -ray satellites. Such searches look for  $\gamma$ -ray signals emitted by WIMP self-interactions (annihilation or decay) into SM products taking place into the largest cosmic reservoirs (dwarf spheroidal galaxies — dSphs, Galactic center, galaxy clusters).
- The VHE@OAR group, along with collaborators from other institutions and universities, has recently studied the prospects for such searches with next-generation Cherenkov arrays such as ASTRI and CTAO.
- In particular, the ASTRI Mini-Array will be capable of probing annihilation x-sections down to  $\sim 10^{-25} \text{ cm}^3 \text{ s}^{-1}$  and decay lifetimes up to  $\sim 10^{28} \text{ s}$  @ DM masses  $> 10 \text{ TeV}$  in 300-h observations of dSphs for WIMPs interacting into the  $\gamma\gamma$  channel —  $> 1$  order of magnitude better than similar searches with current instruments (Saturni+ 2022, JHEAp 35, 91; see Fig. 2).
- For DM searches into more general SM interaction channels ( $b\bar{b}$ ,  $\tau^+\tau^-$ ,  $\mu^+\mu^-$ ,  $W^+W^-$ ), CTAO will be capable of reaching x-sections of  $\sim 10^{-24} \text{ cm}^3 \text{ s}^{-1}$  and lifetimes of  $> 10^{27} \text{ s}$  @ DM masses  $> 1 \text{ TeV}$  in 600-h observations of dSphs —  $> 1$  order of magnitude better than comparable searches with current instruments — after a thorough re-evaluation of the expected DM content in such targets with a uniform approach. (Abe+ 2025, MNRAS 544, 2946; see Fig. 3).

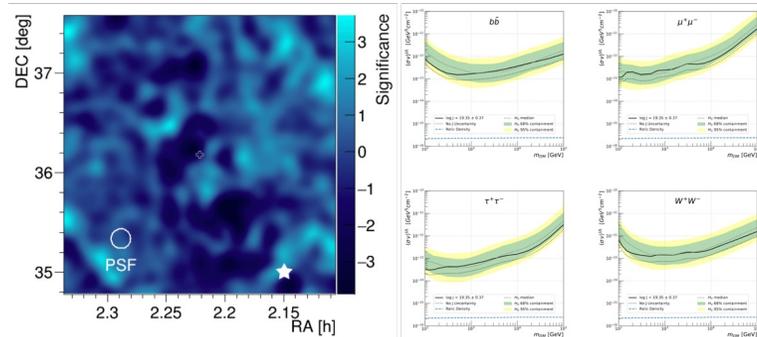


Fig. 1 — Left: significance skymap of the Trill dSph observed for 60 h with the MAGIC telescopes. Right: ULs on the WIMP annihilation x-section for four representative SM channels.

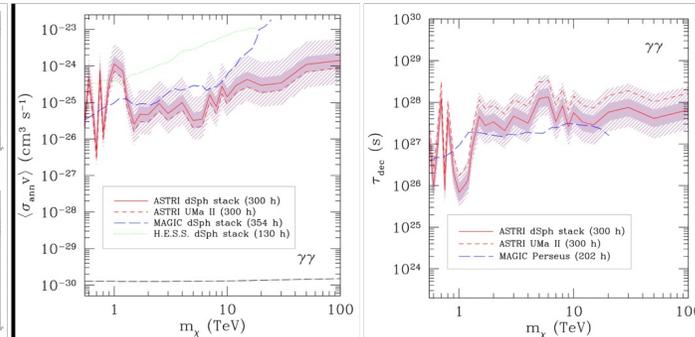


Fig. 2 — Left: comparison between 300-h ASTRI Mini-Array ULs on the x-section for WIMPs annihilating in the  $\gamma\gamma$  channel and those obtained by current facilities. Right: comparison between 300-h LLs on the particle lifetime for WIMPs decaying in the  $\gamma\gamma$  channel and those obtained by current facilities.

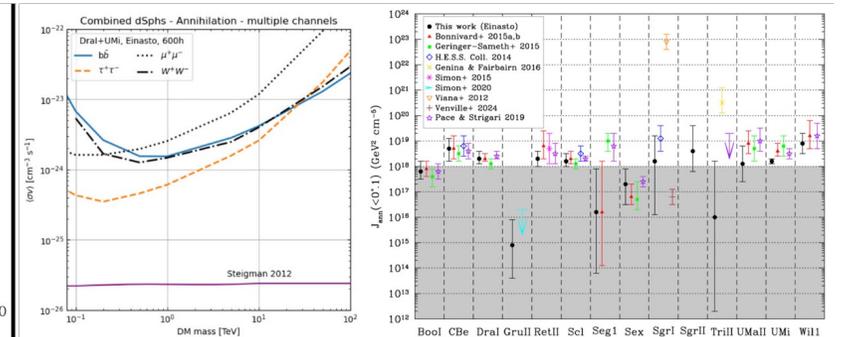


Fig. 3 — Left: constraints on the WIMP annihilation x-section for various choices of the SM interaction channel with 600-h of CTAO observations of optimal dSphs. Right: comparison of the astrophysical factors computed within  $0.1^\circ$  of integration adopting a uniform approach with the equivalent values derived in the literature with different methodologies for the most DM-dominated dSphs.

# Domain wall dark matter, Global Navigation Satellite Systems and Atomic Clocks

Gruppo di Gravitazione Sperimentale

David Lucchesi, Marco Cinelli, Alessandro Di Marco, Emiliano Fiorenza,  
Carlo Lefevre, Pasqualino Loffredo, Marco Lucente, Carmelo Magnafico,  
Roberto Peron, Francesco Santoli, Feliciano Sapia, Massimo Visco

**IAPS** ISTITUTO DI ASTROFISICA  
E PLANETOLOGIA SPAZIALI

ASI – CGS



*Francesco Vespe*

**Giornate dei Raggruppamenti Scientifici Nazionali 4 (RSN4) INAF - Dark Matter  
Italia, Napoli, Osservatorio Astronomico di Capodimonte  
28 - 30 Jan 2026**

# G4S

The evolution of the very early Universe, especially above the Standard Model symmetry-breaking scale, is still not fully understood. In particular, additional first or second order phase transitions may have occurred, leading to the formation of domain walls associated with light or ultralight scalar or pseudoscalar fields  $\phi$ .

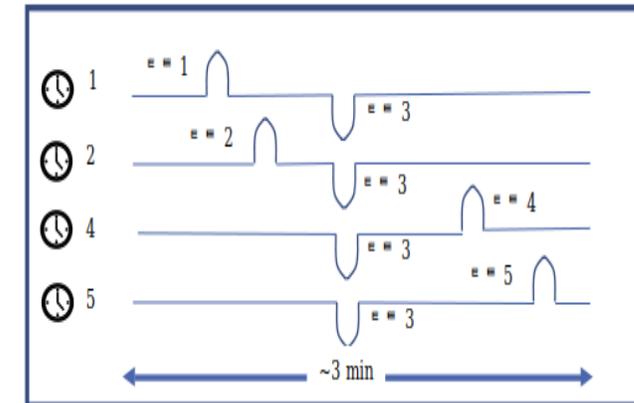
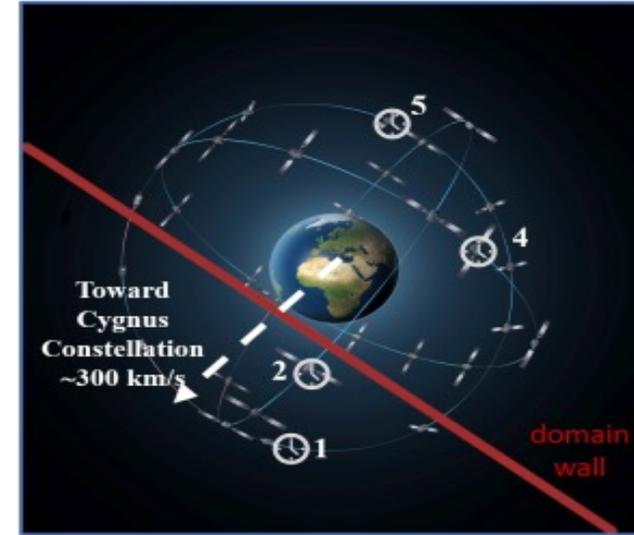
Domain walls are extended regions of space where the scalar field interpolates between different vacuum values (e.g. from  $-v$  to  $+v$ ). They are locally flat, exhibit curvature only on cosmological scales, and have a thickness set by the inverse mass of the field.

A population of domain walls could contribute to the local or galactic dark matter distribution and may be probed using a distributed network of correlated detectors, such as a Global Navigation Satellite System (GNSS).

A GNSS consists of satellites orbiting Earth and a network of ground stations. Satellites carry atomic clocks synchronized to reference clocks on the ground. The time difference between a satellite and a ground clock is referred to as the *bias*.

If the scalar field comprising domain walls couples (e.g. quadratically) to Standard Model fields, a domain wall traversing the geospace will inevitably intersect individual GNSS satellites. When a satellite clock is crossed, its nominal frequency is transiently perturbed, leading to a bias variation and a spike in the bias derivative. As the domain wall intercept the ground clock, all the satellite clocks experience a spike with opposite sign (see Figure).

The analysis of GNSS atomic clock time-series data (bias or bias derivative) thus provides a powerful tool to search for domain walls and to constrain their coupling strength to Standard Model fields.



The INAF-IAPS Experimental Gravitation group is currently involved in the **Galileo For Science (G4S) project** (funded by ASI) and one of the main goal is to constrain domain wall dark matter exploiting the very precise **hydrogen atomic clock** onboard the European Galileo GNSS constellation.

# Methods for finding and inferring dark matter properties:

direct detection, indirect detection and **cosmological probes**

## Strong complementarity between RSN4, RSN1 and RSN2

(Lol for Science Network focusing on cosmological probes RSN4+RSN1+RSN2)

### RSN1 examples

Cluster abundance, stacked weak lensing, cluster shapes → Giocoli et al. (**Euclid**); Radovich et al. (**KiDS**)  
Strong + weak lensing for density profiles and concentration-mass relation → Meneghetti, Rosati, Grillo et al.  
Constraints on dark matter self-interaction using X-ray emission in galaxy clusters → Etori et al.  
Dark matter and alternative theories of gravity (e.g., MOND) → Lelli et al. (HI+H $\alpha$  rotation curves)

### RSN2 examples

Proper motions in dwarfs spheroidal to investigate dark matter → Massari et al. (GAIA, HST) Massari+2018 Nature Astronomy  
Test on dark-matter driven hierarchical model → Massari et al. on arXiv today, under review in Nature Astronomy,  
but also bulge fossil fragments (BFFs) → Dalessandro, Ferraro et al.

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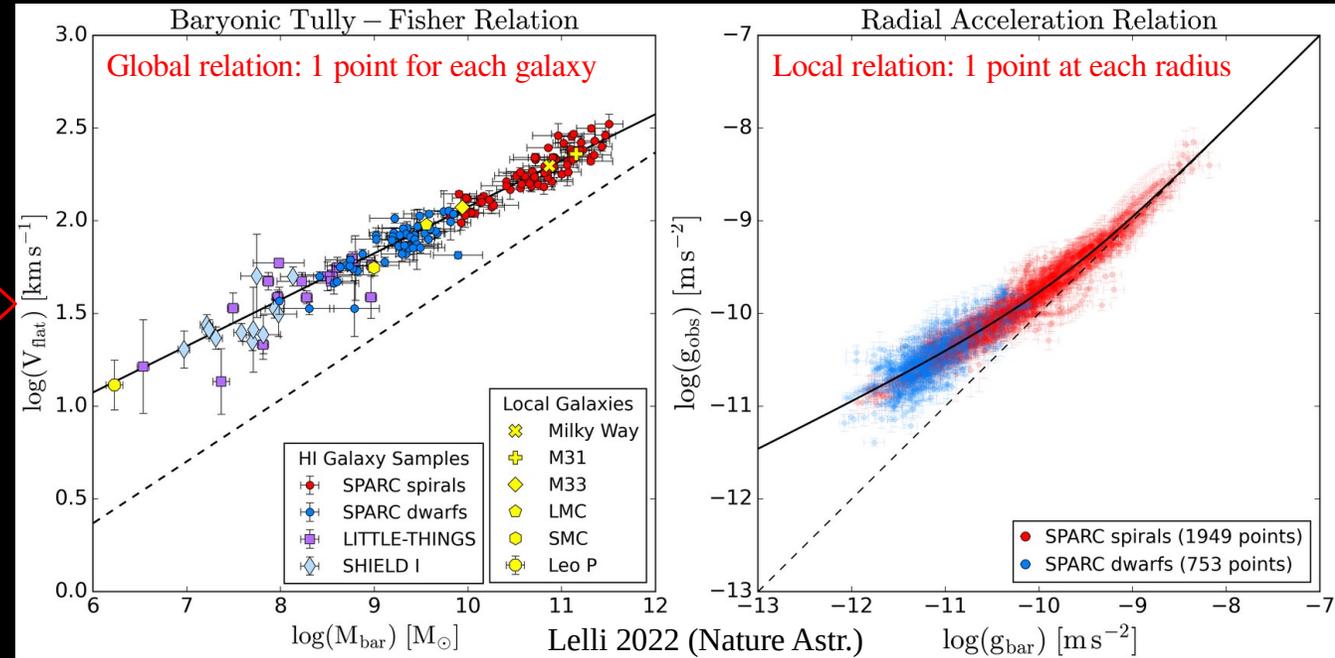
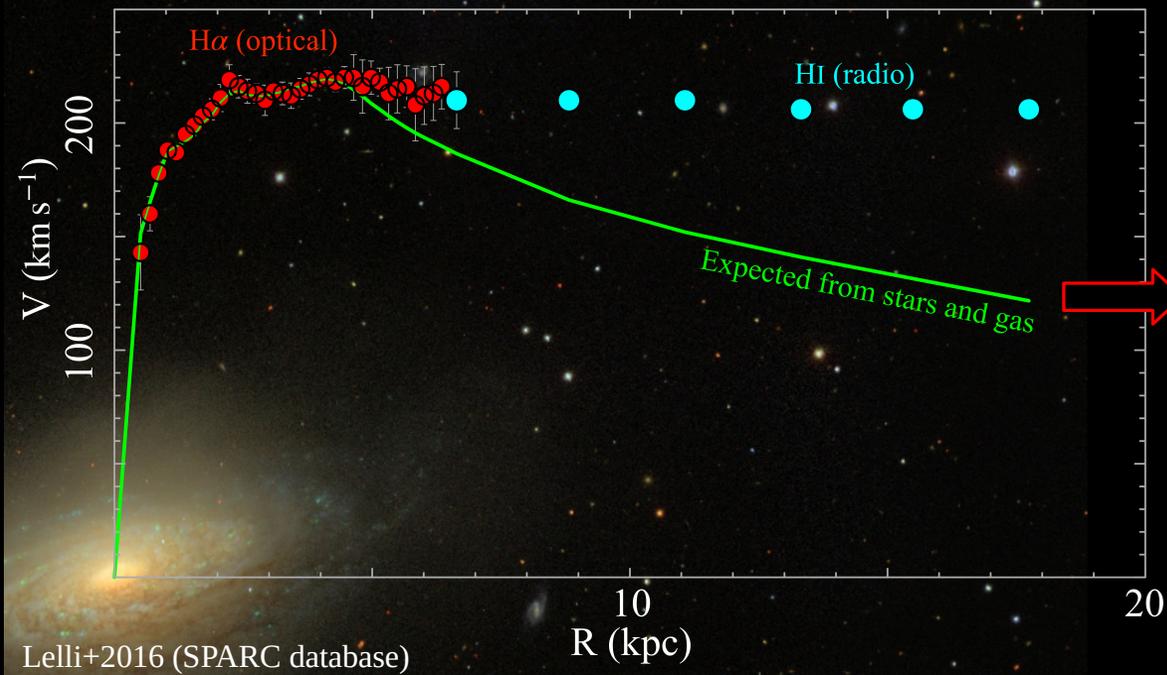
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but also bulge fossil fragments (BFFs) → Dalessandro, Ferraro et al.

INAF hosts **two grants supported by the MUR Fondo Italiano per la Scienza (FIS) focusing on dark matter**  
one affiliated to RSN4 (Starting scheme) and one affiliated to RSN1 (Consolidator scheme)

# Galaxy dynamics across cosmic time to unveil dark matter

## GALDYN – FIS2 Consolidator Grant (1.5 M€) – PI: Federico Lelli



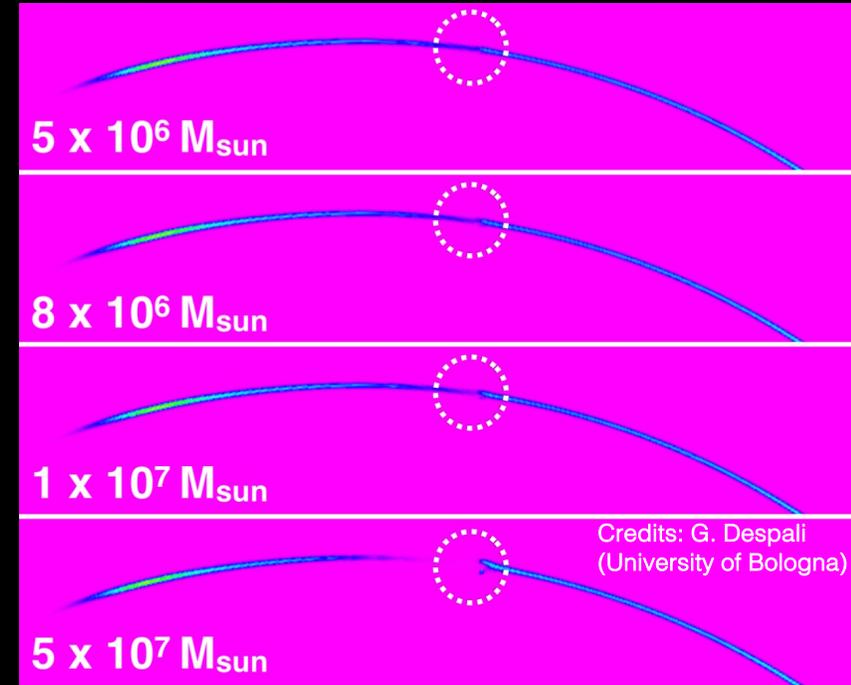
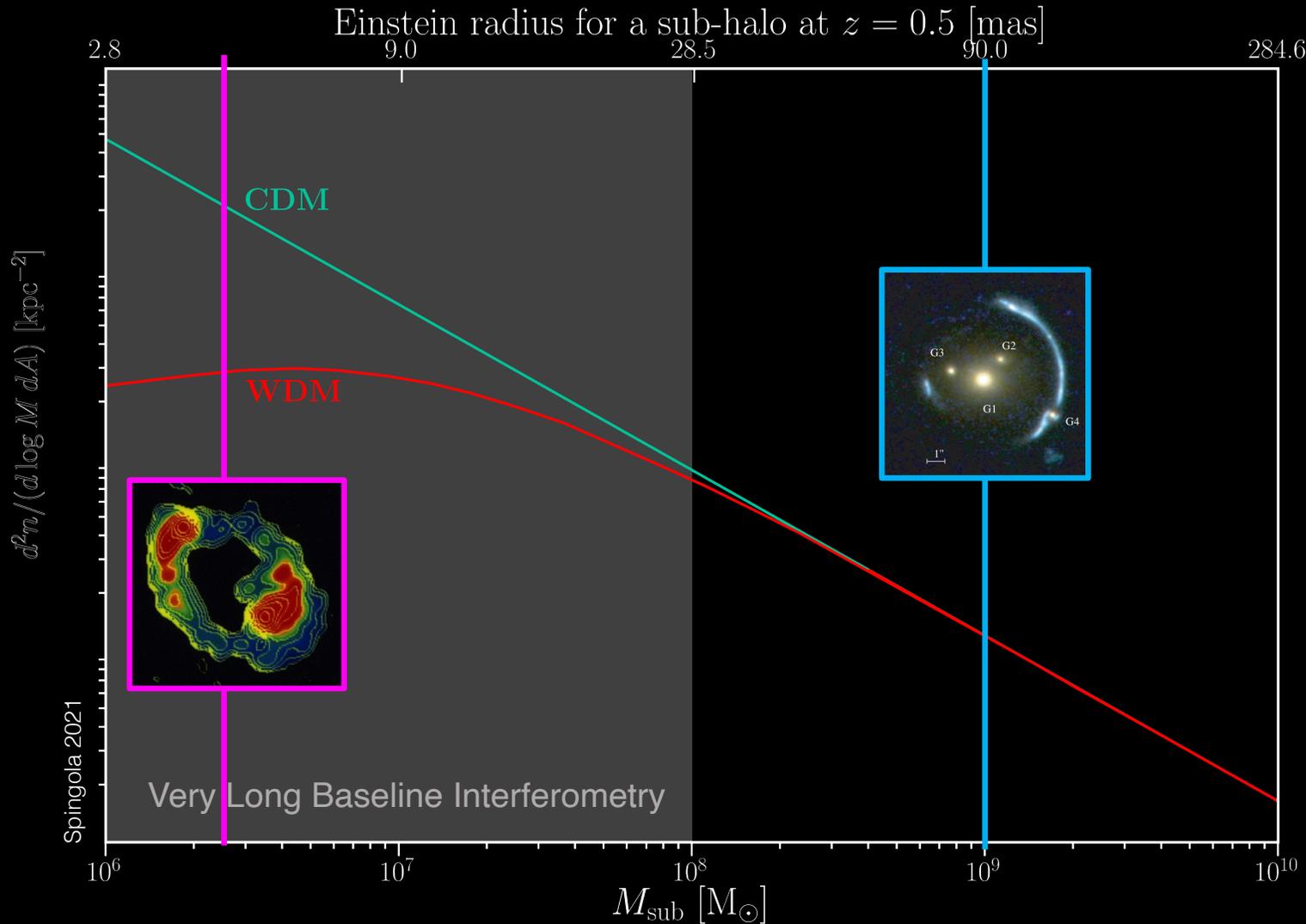
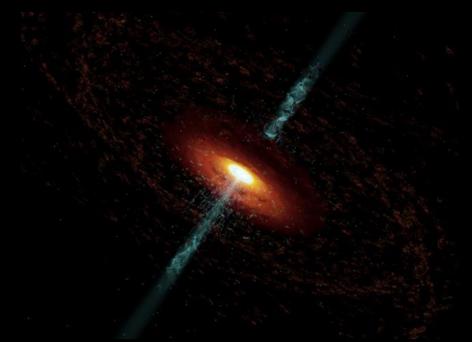
**Tight empirical laws linking baryons & dynamics in galaxies. What's their physical origin?**

- (1) End product of galaxy evolution in  $\Lambda$ CDM? Attractor solution of different processes?
- (2) Laws of Nature akin to Kepler's laws for planets? Modified gravity instead of DM?

# Strong gravitational lensing

## Dark sub-halos

The background source consists of active galactic nuclei (AGN) jets



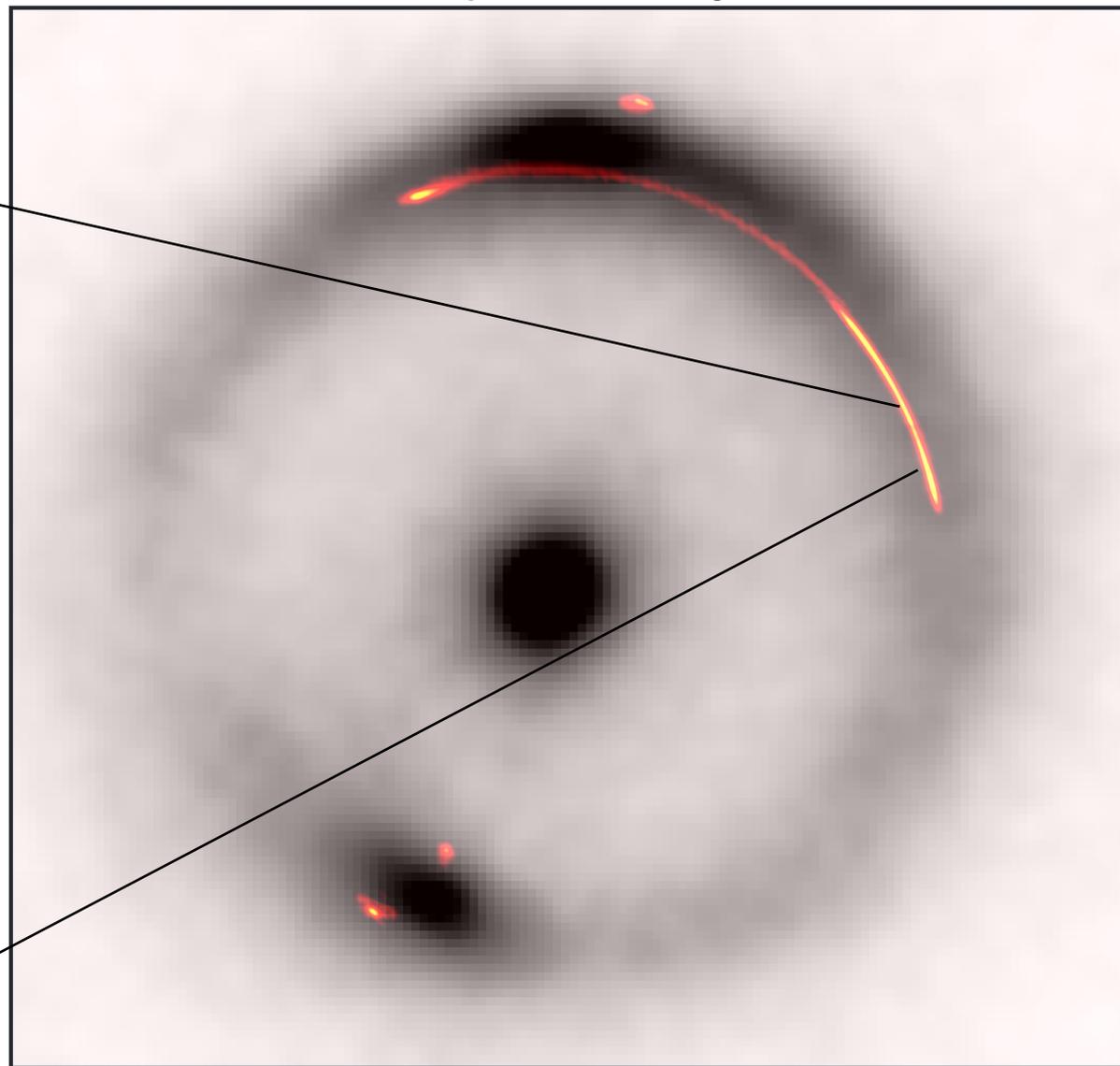
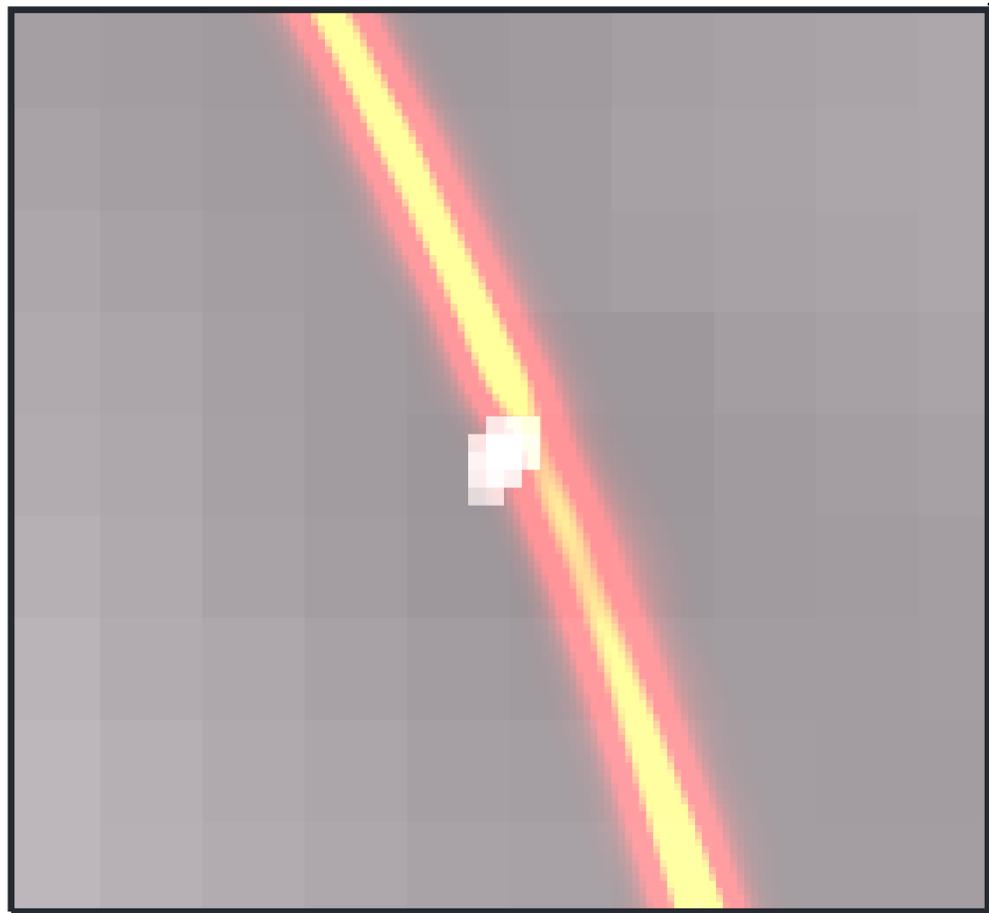
Sub-halos of  $10^6-7 M_{\text{sun}}$  can be directly detected only with mas angular resolution

They should be completely dark

# Strong gravitational lensing

## Dark sub-halos

INAF Medicina «Grueff» telescope included in the global VLBI observations



Best fit = virial mass of  $5 \times 10^6 M_{\text{sun}}$  at  $z = 0.9$   
(Radius  $< 10$  pc and density profile of point mass plus a uniform face-on disc –  
a challenge for both CDM and WDM, more common in SIDM)

McKean, Spingola et al. 2025  
Powell et al. 2025 (Nature Astronomy, incl. CS)  
Vegetti et al. 2026 (Nature Astronomy, incl. CS and DM)

**We lack of a statistically significant sample of low-mass lensing objects:  
we can take advantage of another property of strong gravitational lensing  
to **search for low-mass lenses in the time domain****

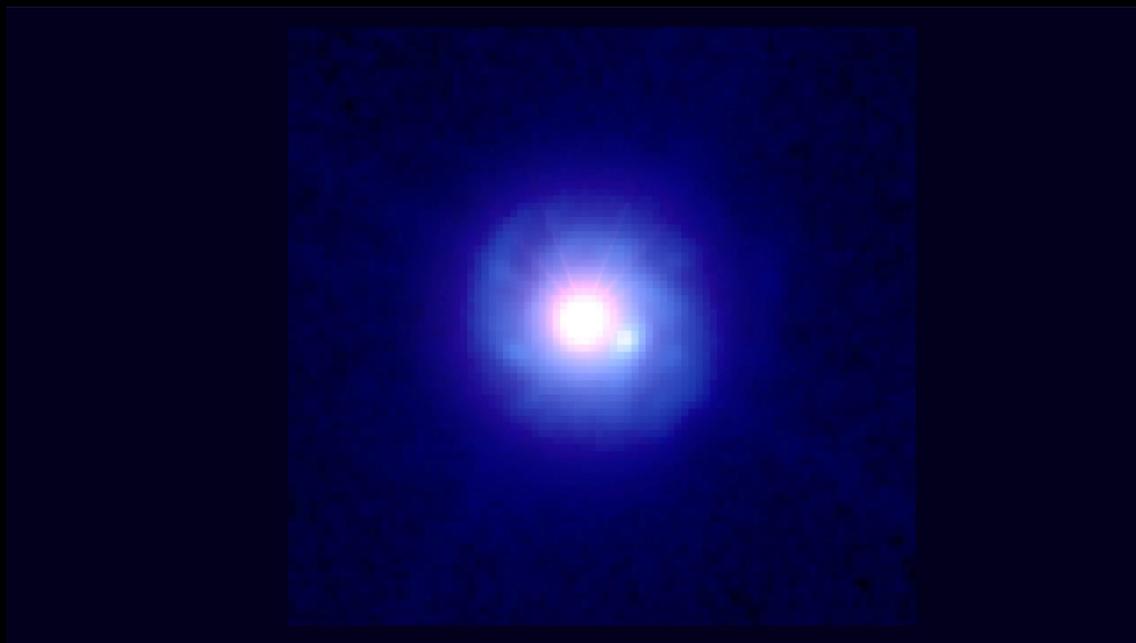
# FIS-2 «DARKER» (PI: Spingola)

## ACCURATE CONSTRAINTS ON DARK MATTER AND DARK ENERGY IN THE ERA OF PRECISION COSMOLOGY

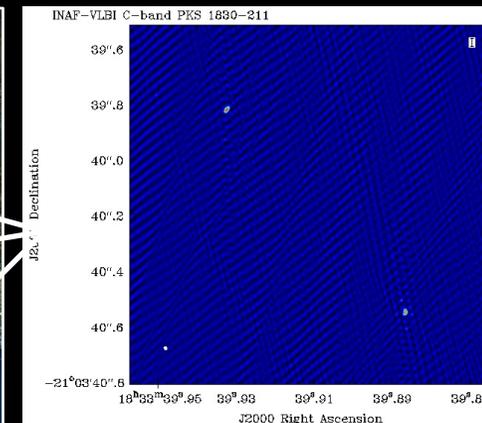
$$\Delta t \propto H_0^{-1}$$

$$\Delta t \propto \text{Mass}$$

Credits: NASA



Follow-up of  $\gamma$ -ray-discovered systems in the North with  
**VLBI Italian Array (VITA)**  
(1.4 to 116 GHz coverage thanks to new 3-band receivers with **PON-SRT**  
PI:Govoni, see also Baldini 2023 and Bolli 2024 INAF reports)



Spingola, Giroletti et al.  
in prep.

# Fundamental physics | **Dark Matter**

*Direct detection, indirect detection and cosmological probes:*

**RSN4** (and, in general, **INAF**) has the expertise in all of these methods, hence, **it is in a unique position** for being at **the forefront of dark matter research**.

Strong synergy and complementarity with RSN1 (see Meneghetti's talk at RSN1 days) and RSN2

However, the topic *T-SN 5 Precision Cosmology and the Early Universe* for the «Science Networks» **does not mention «dark matter»**

*this could limit the interaction among us and among RSNs to create a well connected research network on this fundamental topic*

Current and future **strategic instruments**:

ASTRI Mini-Array, CTAO, XENON, G4S, IXPE, but also VLBI (including VLBI Italian Network!), LSST

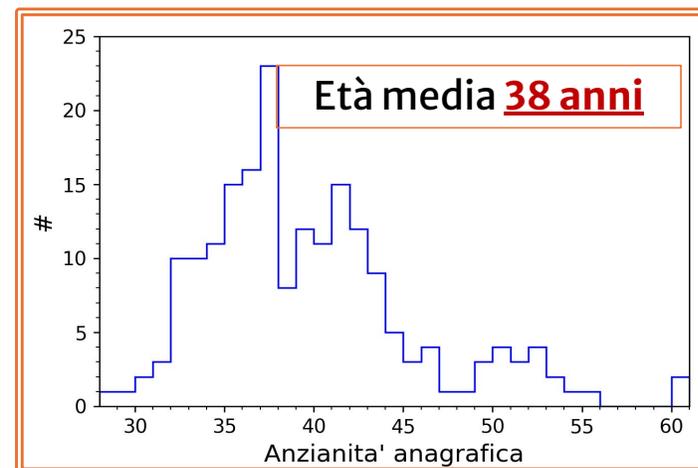
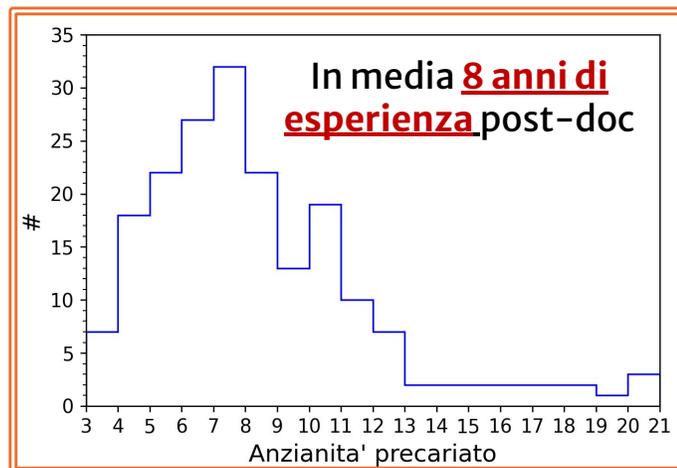
*Grazie a R. Ferrazzoli, A. Molinaro, F. G. Saturni, G. Galanti,  
A. Di Marco, D. Lucchesi e F. Lelli per il materiale!*



*Giornate RSN4 - Seconda Edizione  
28-30 gennaio 2026 | Auditorium INAF Napoli*

# La situazione del personale precario in INAF è **INSOSTENIBILE!**

**1.200 TI** Vs **650** precari: più di 1 precario ogni 2 persone di ruolo



Plot di un campione rappresentativo dei precari INAF al 31/12/2024

**Entro l'anno, l'attuale situazione determinerà l'esodo di > 100 lavoratori altamente qualificati**

È **URGENTE** che INAF **RIVENDICHI** con fermezza, presso il MUR, finanziamenti svincolati dal turnover ed etichettati per le **STABILIZZAZIONI MADIA**: unica soluzione per questa emergenza



Per sostenerci, inquadra il QRcode e firma

