

L'attività' di ricerca del RSN2 nel contesto internazionale. Il punto di vista del Consiglio Scientifico

Consiglio Scientifico - INAF

An Integrated Roadmap For European Astronomy

SCIENTIFIC PRIORITIES

The strategic Roadmap for the next decade of European Astronomy is based on the scientific aspirations of the community to answer fundamental questions about our Universe, the most pressing being:

- What is the nature of dark matter and dark energy?
- Are there deviations from the standard theories and models (general relativity, cosmological model, standard model of particle physics)?
- What are the properties of the first stars, galaxies and black holes in the Universe?
- How do galaxies form and evolve, and how does the Milky Way fit in this context?
- What are the progenitors of astronomical transients?
- What physical processes control stellar evolution at all stages, from formation to death, and how?
- What are the necessary conditions for life to emerge and thrive? Are we alone?
- How do planets and planetary systems form and evolve?

- What is the impact of the Sun on the heliosphere and on planetary environments?
- What are/were the characteristics and habitability of various sites in the solar system (Mars, Jupiter's icy moons, ...)
- What is the origin of cosmic rays of all energies?
- How can extreme astrophysical objects and processes probe new fundamental physics?

A general theme of the roadmap is the need for an **integrated approach to decision-making** if we are to achieve our scientific goals. This includes, for example, the necessity of planning for rapid response, small-scale facilities to complement large flagship observatories, to consider requirements for data processing, storage and dissemination at the stage of mission/facility planning, and to fund the computational and theoretical efforts that go hand-in-hand with breaking new observational grounds. While the strategic roadmap is shaped by science goals, its implementation must also respect the increasing desire of the European community to ensure Astronomy research is conducted in a sustainable and equitable manner that also fulfils our roles as educators and responsible citizens.

ASTRONOMY AND ASTROPARTICLE PHYSICS

Astronomy & Astroparticle Physics (A&AP) seek to understand the Universe and its components from its still mysterious beginnings to its growing complexity, with the formation and evolution of galaxies, stars and planetary systems, until the emergence of life. The main science questions addressed by the RIs can be summarized as follows:

- understand the origin of the universe, its main constituents;
- understand the extreme conditions the Universe hosts;
- understand the formation of galaxies and their evolution;
- understand the formation of stars and planets;
- search for planetary systems in our galaxy, study the Solar System and extrasolar planets, search for life and understand the conditions enabling life.

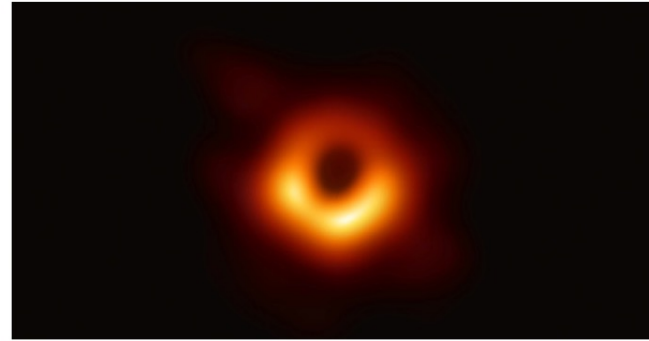
Pathways to Discovery in Astronomy and Astrophysics for the 2020s

Key Scientific Challenges for the Next Decade



Worlds and Suns in Context

Priority Area: Pathways to Habitable Worlds



New Messengers and New Physics

Priority Area: New Windows on the Dynamic Universe



Cosmic Ecosystems

Priority Area: Unveiling the Drivers of Galaxy Growth

Understanding the formation of stars and associated planetary systems. Searching for Earth-like planets to characterize, studying them in detail and searching for signatures of life

Using light in all its form, gravitational waves, and neutrinos to study cosmic explosions on all scales and the mergers of compact objects

Unveiling the drivers of the galaxy growth, focusing on processes affecting galactic scales

Final recommendations from the Voyage 2050 Senior Committee

Recommendations for Large Mission Scientific Themes

- Moons of the Giant Planets: (1) Habitability of ocean worlds; (2) search for biosignatures; (3) Connection of interior and near-surface environments
- From Temperate Exoplanets to the Milky Way: (1) Characterization of the Atmosphere of Temperate Exoplanets; (2) Galactic Ecosystem with Astrometry in the Near-Infrared
- New Physical Probes of the Early Universe: (1) New Opportunities for Exploring the Early Universe; (2) Precision Spectroscopy of the Fireball Universe; (3) Adding Colour and Depth to the Gravitational Wave Sky

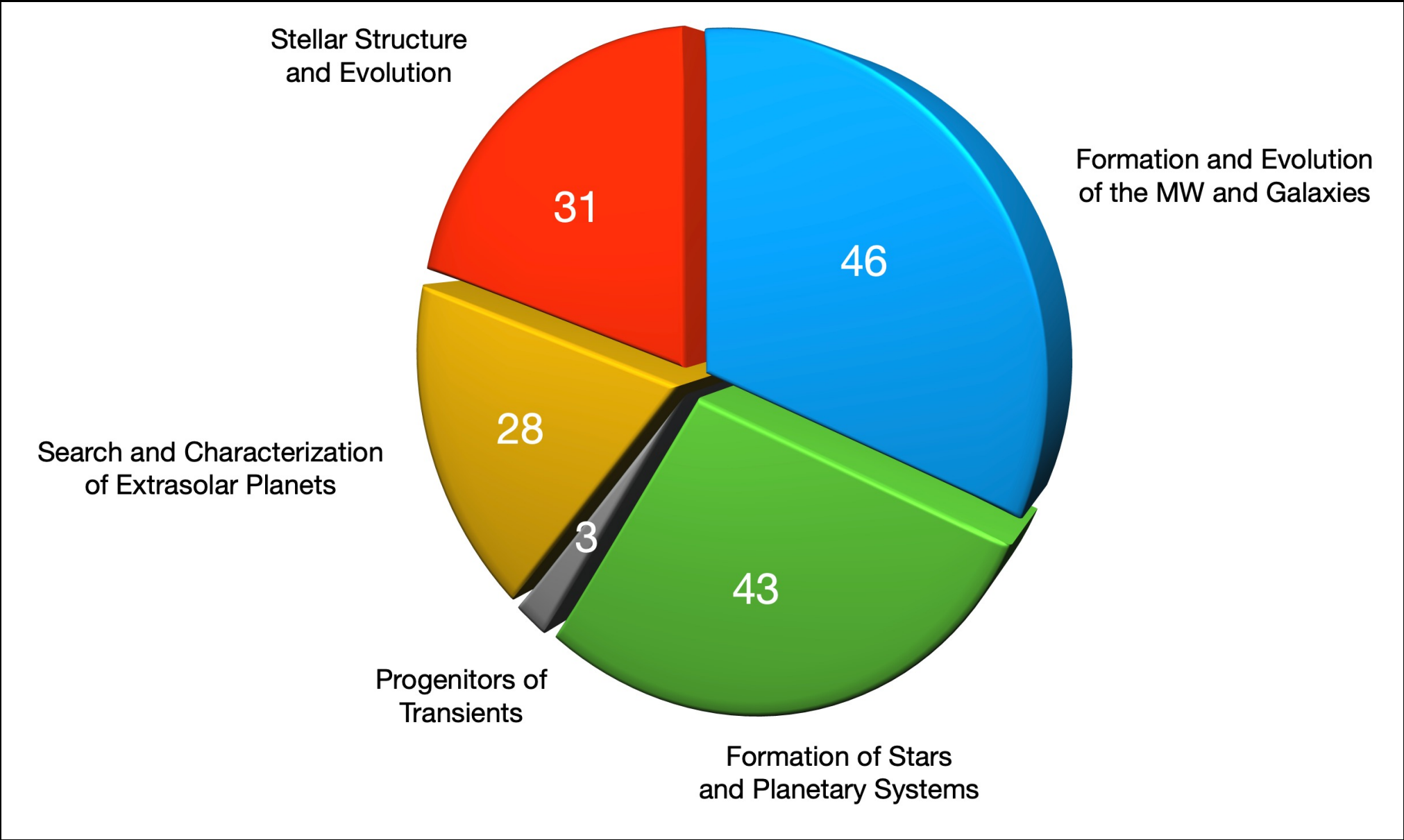
Potential Scientific Themes for Medium Missions (among the others):

- High Precision Astrometry
- High Precision Asteroseismology
- The Role of the Multiphase ISM in Star Formation and Galaxy Evolution

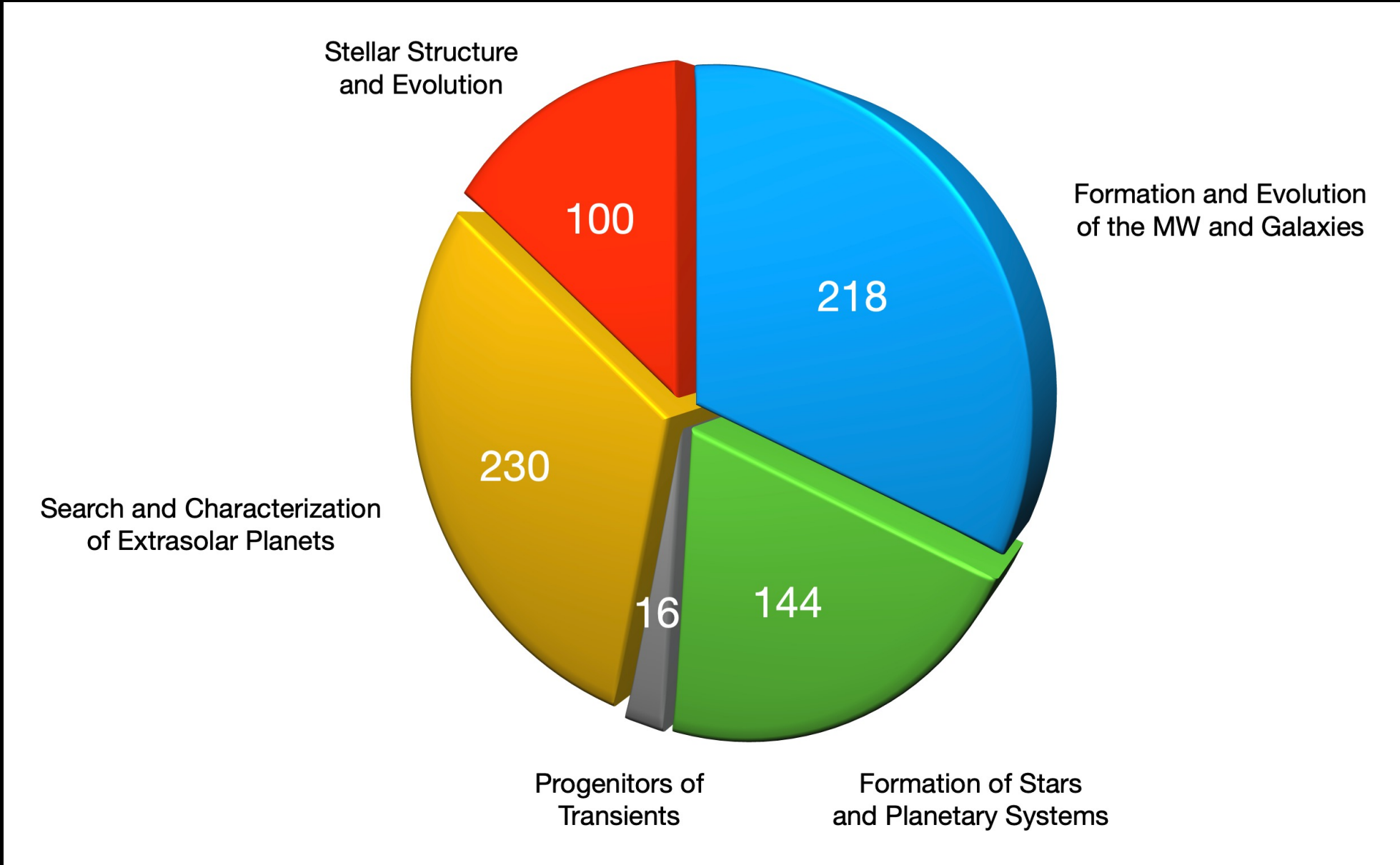
Mapping the projects on the fundamental scientific questions

- Search and Characterization of Extrasolar Planets (SCEP)
- Formation of Stars and Planetary Systems (FSPS)
- Stellar Structure and Evolution (SSE)
- Formation and Evolution of the MW and Galaxies (FEMW)
- Progenitors of Transients (PT)

Scientific Topics Distribution: Schede



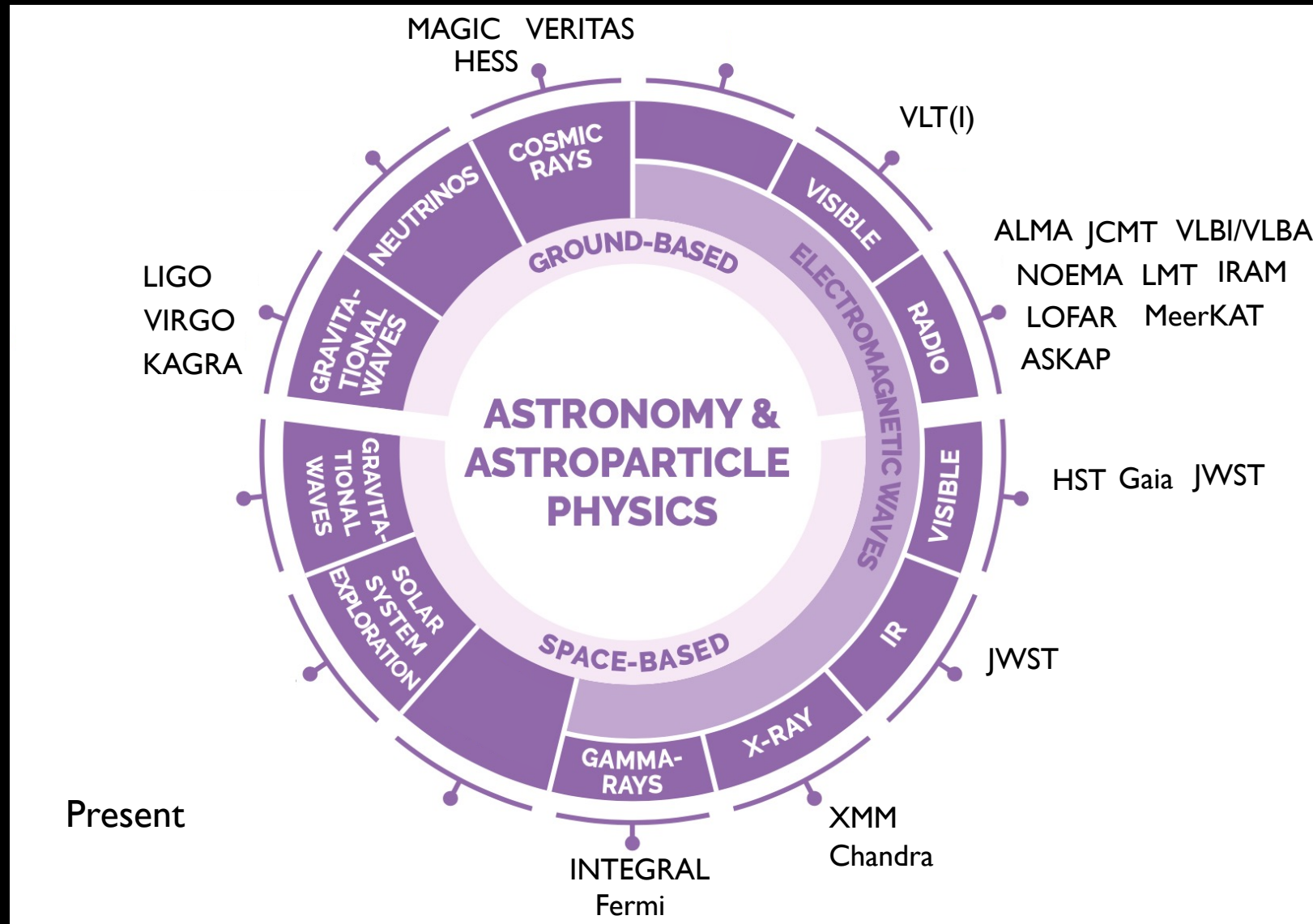
Scientific Topics Distribution: FTE



Conclusions. I

- All the **most relevant scientific topics** according to the current international roadmaps are **covered by RSN2 in an almost balanced way** (PT is poorly represented due to strong overlap with RSN4)

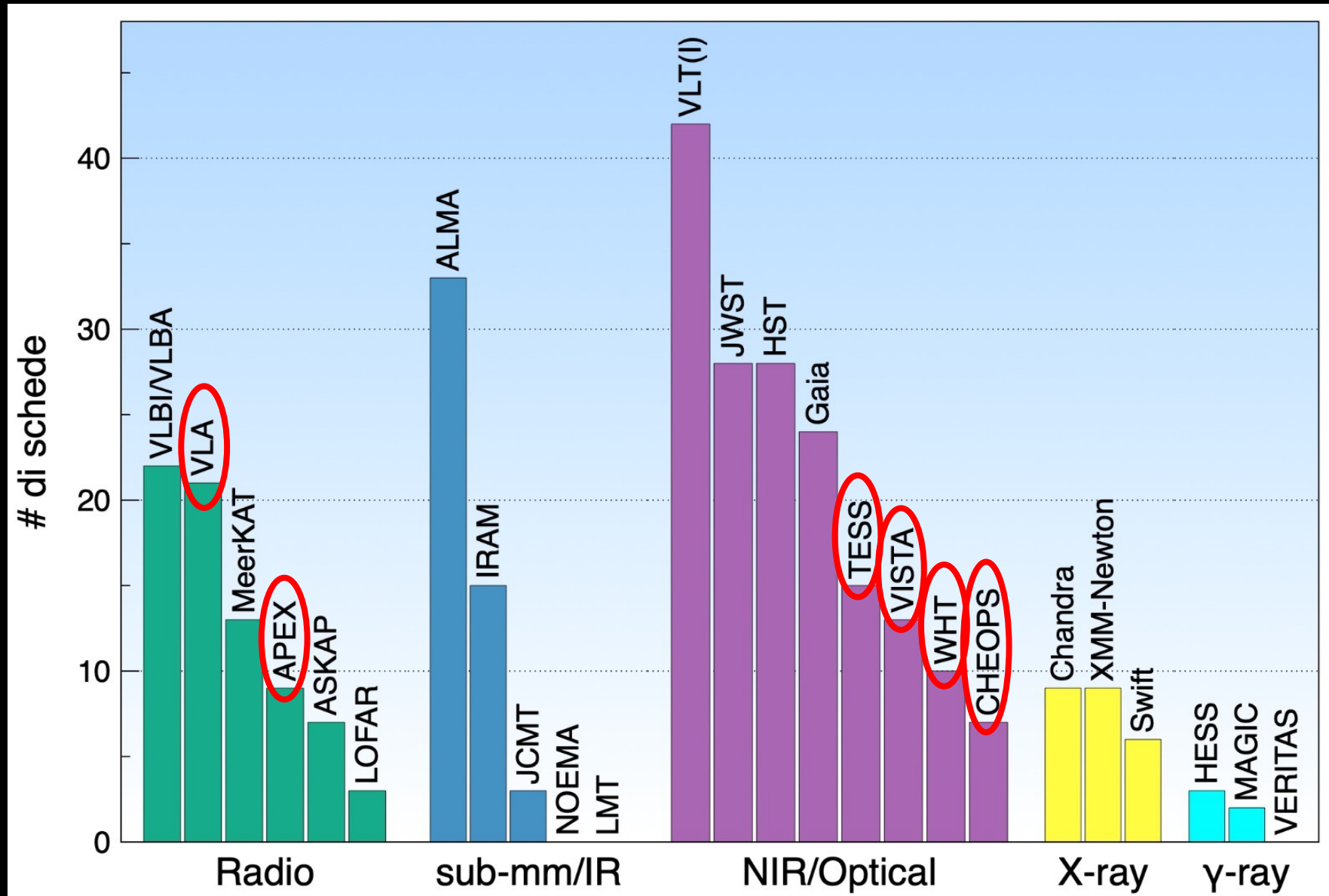
Overview of The Most Relevant International Observing Facilities According to the International Roadmaps of interest for RSN2



From:

- Astronet
- ESFRI
- Decadal Survey

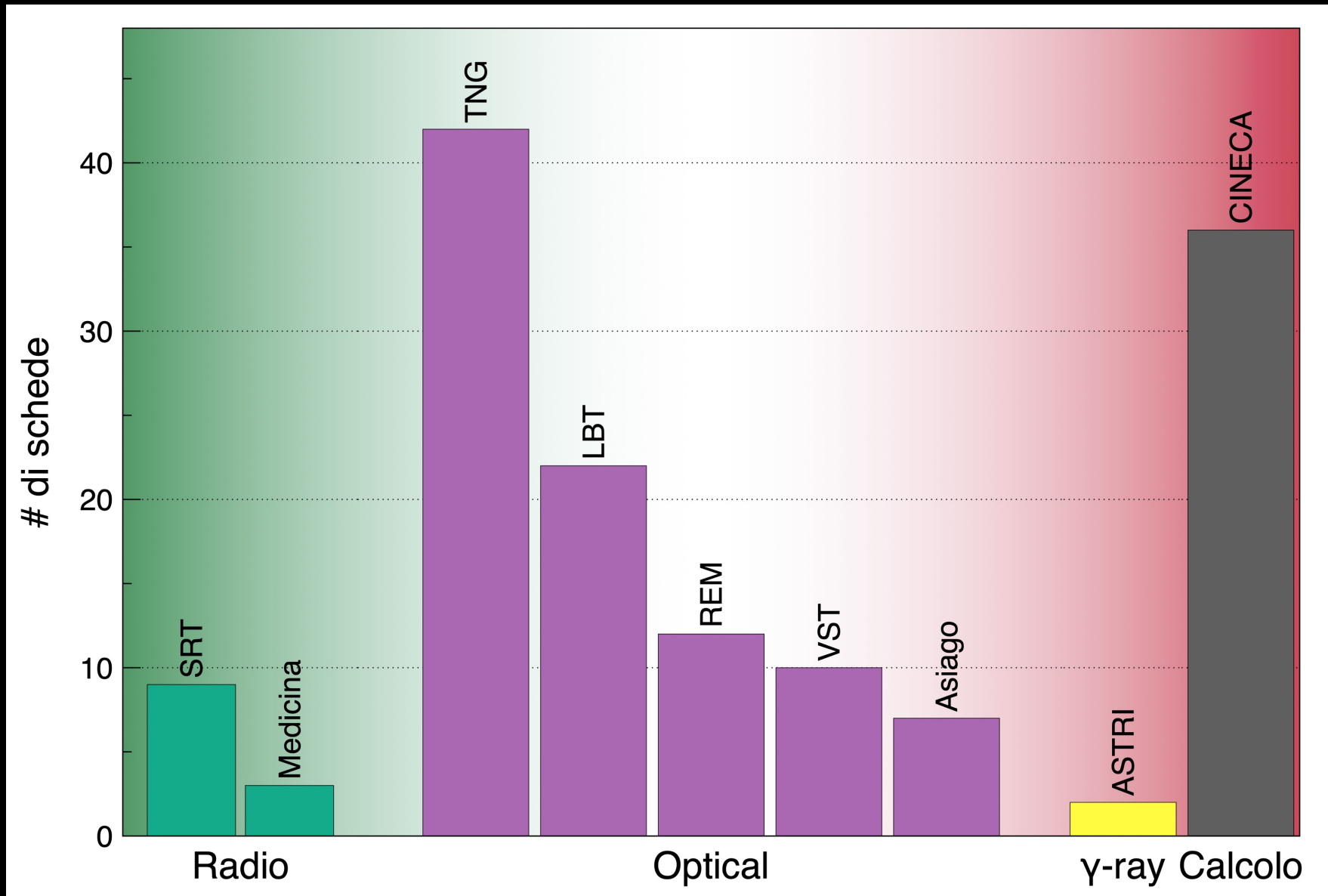
RSN2 Projects Involving Existing International Observing Facilities



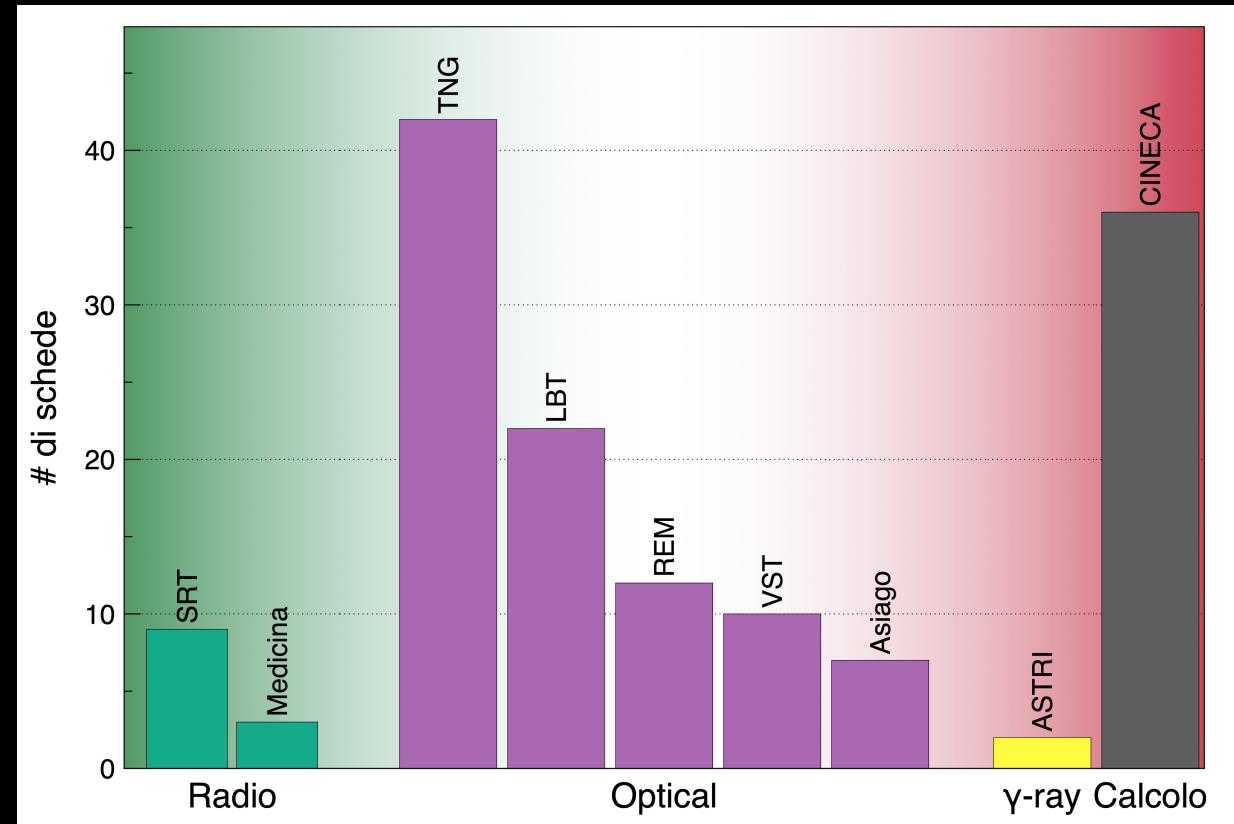
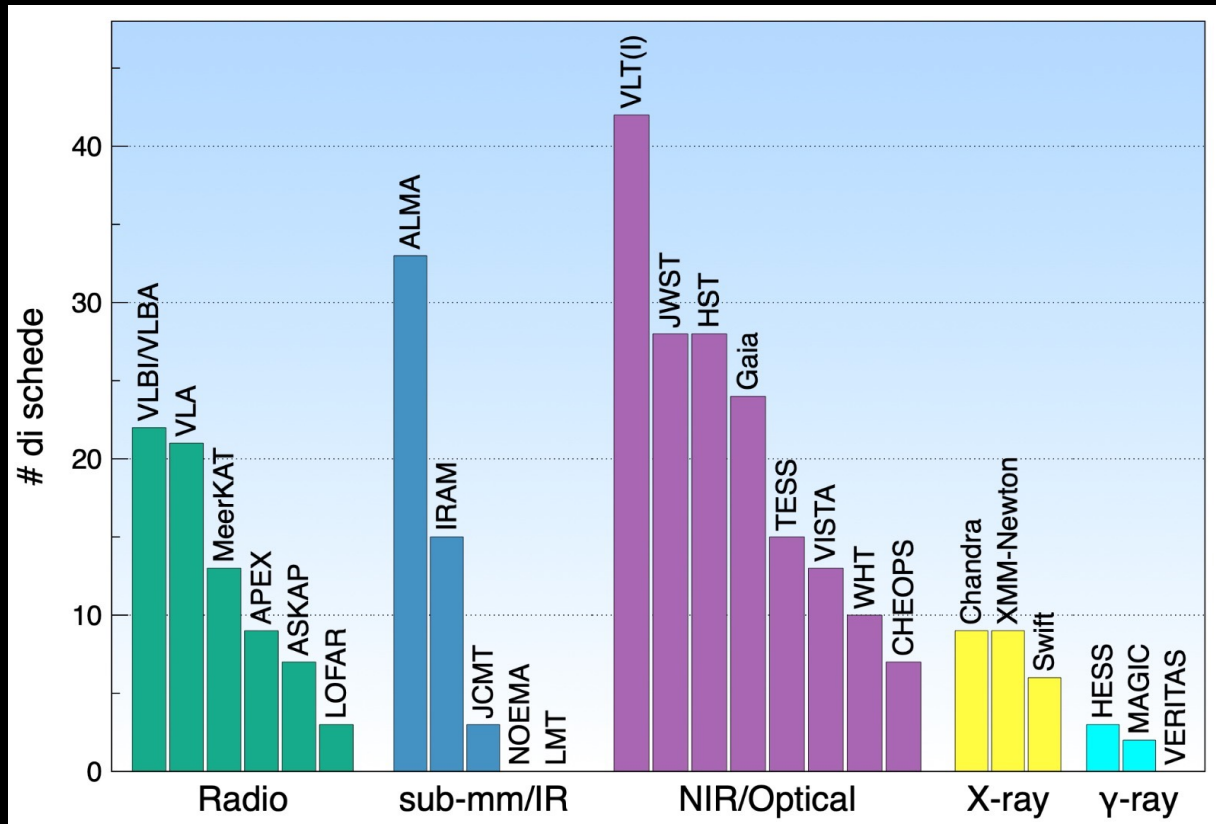
Conclusions. II

- All the most relevant scientific topics according to the current international roadmaps are covered by RSN2 in an almost balanced way (PT is poorly represented due to strong overlap with RSN4)
- **RSN2 is interested in the most relevant international observing facilities at work that will be continuously supported in the future**

RSN2 Projects Involving Existing “National” Observing Facilities



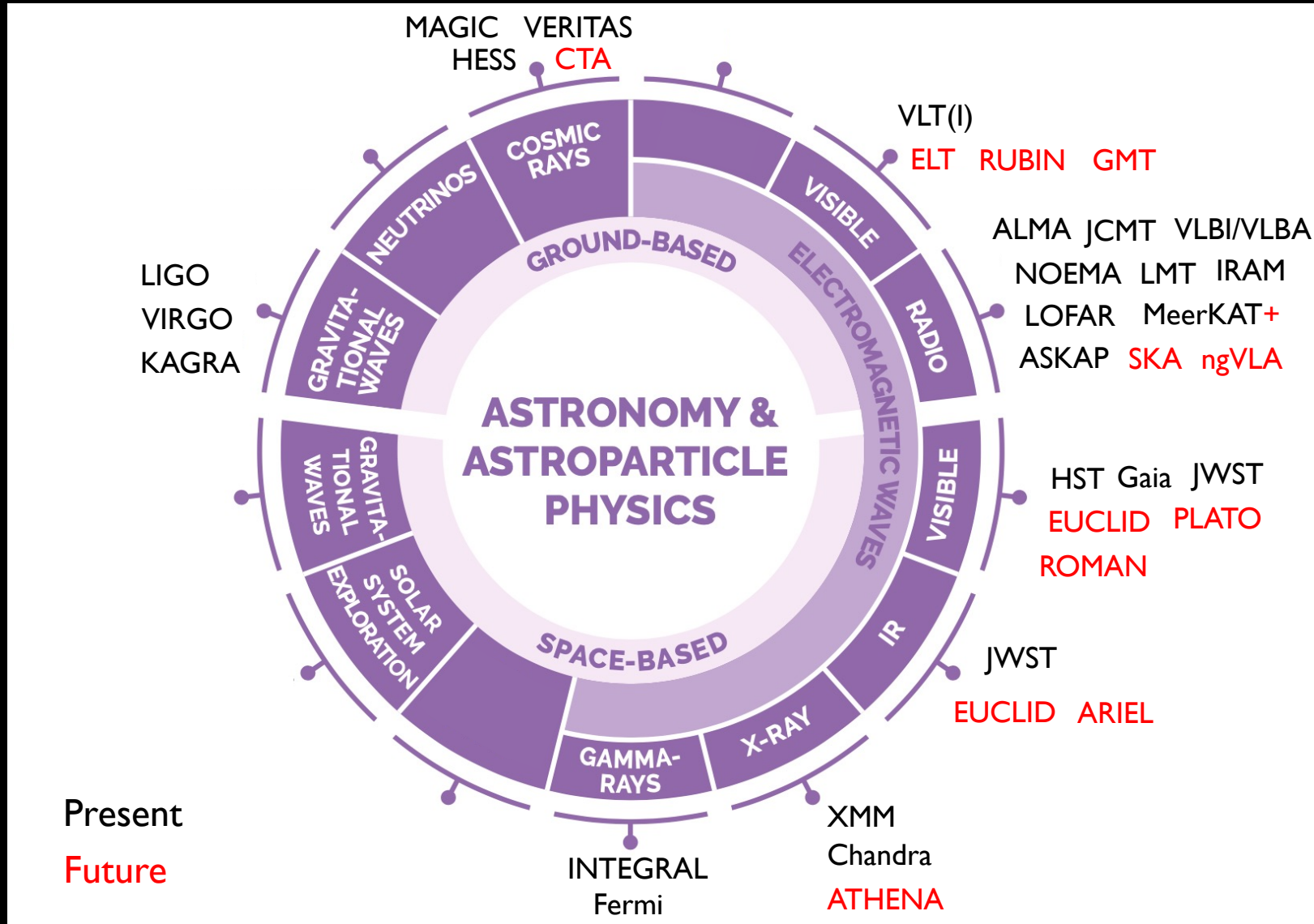
RSN2 Projects Involving Existing International and “National” Observing Facilities



Conclusions. III

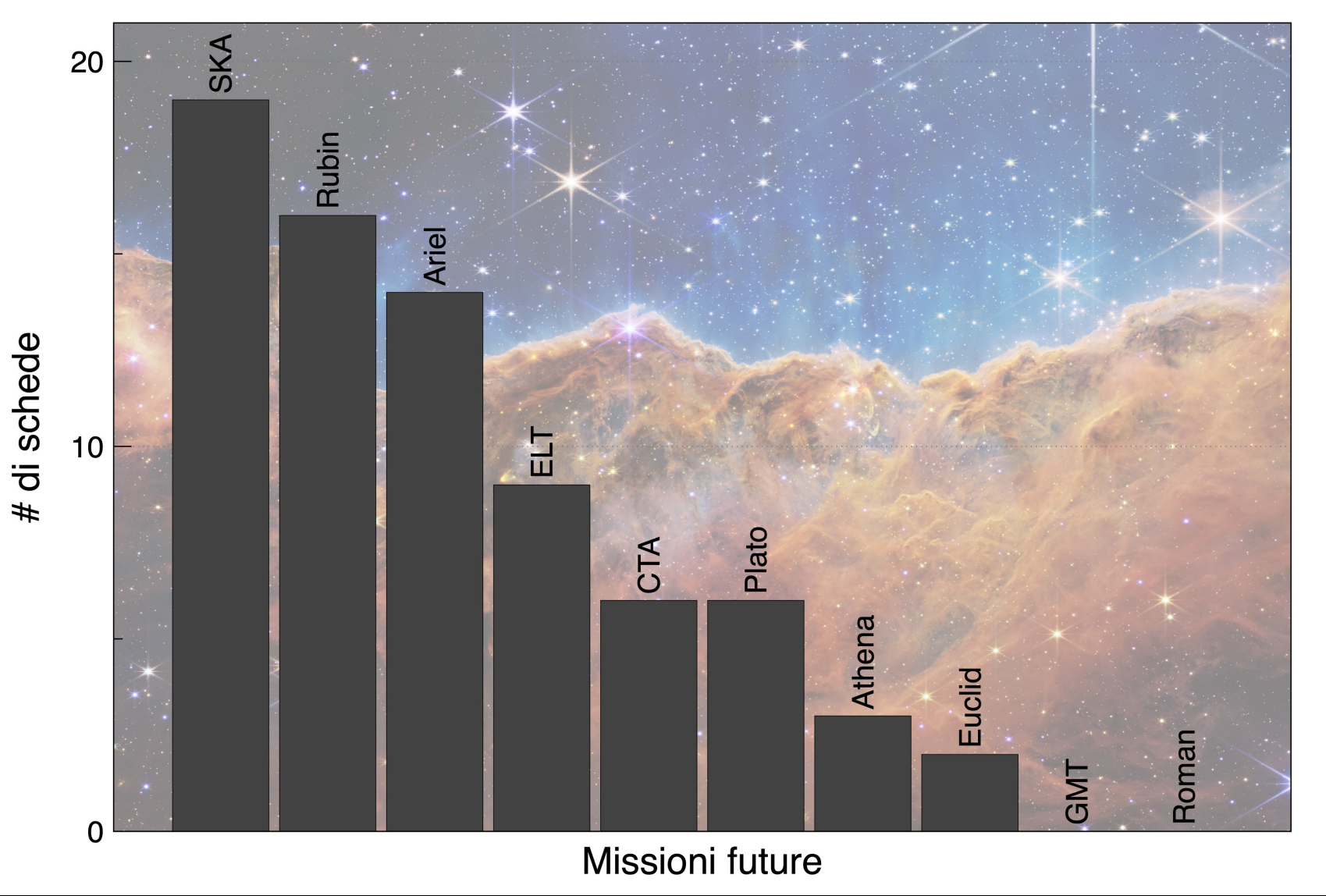
- All the most relevant scientific topics according to the current international roadmaps are covered by RSN2 in an almost balanced way (PT is poorly represented due to strong overlap with RSN4)
- RSN2 is interested in the most relevant international observing facilities at work that will be continuously supported in the future
- National observing facilities represent equally efficient complementary tools
- Presence of a non negligible theoretical community interested in numerical simulations ready to exploit the future national and international facilities

Overview of The Most Relevant International Observing Facilities According to the International Roadmaps of interest for RSN2



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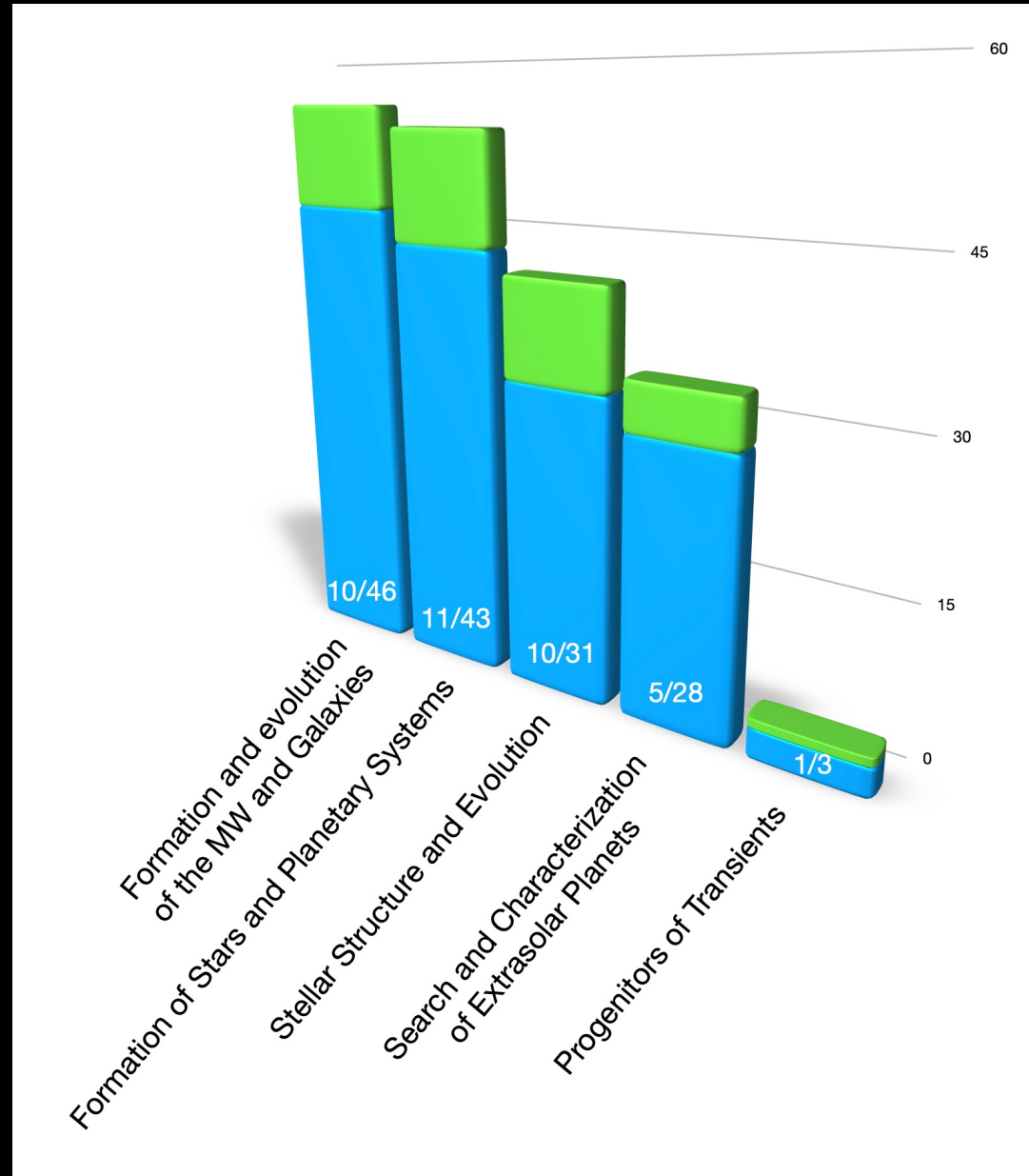
RSN2 Projects Involving Future International Observing Facilities



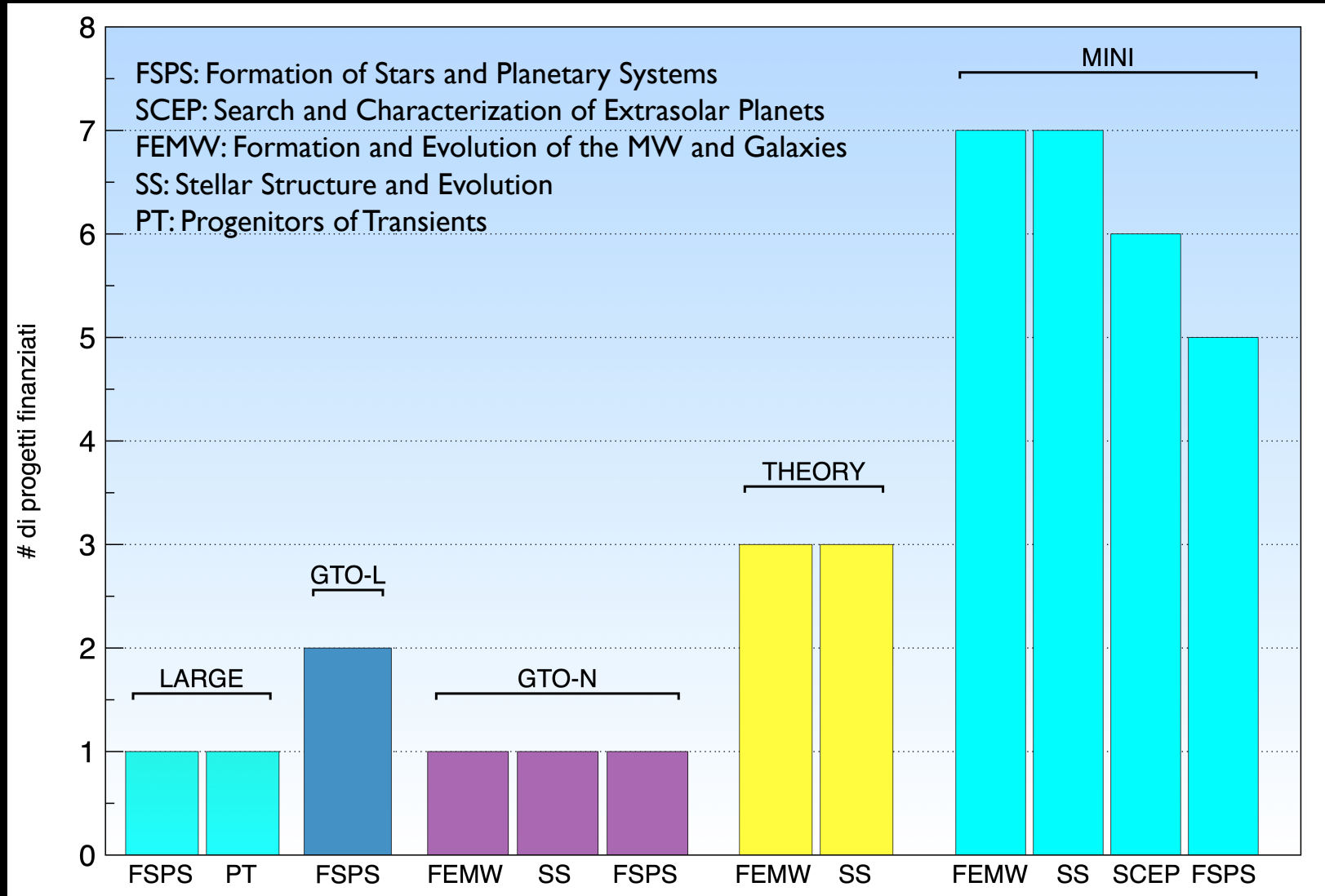
Conclusions. IV

- All the most relevant scientific topics according to the current international roadmaps are covered by RSN2 in an almost balanced way (PT is poorly represented due to strong overlap with RSN4)
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- National observing facilities represent equally efficient complementary tools
- Presence of a non negligible theoretical community interested in numerical simulations ready to exploit the future national and international facilities
- Among the three international ESFRI Landmark Projects in which INAF is mostly involved, **SKA is considered significantly, ELT less than expected, CTA only marginally**
- **Little interest for Euclid**

Scientific Topics Distribution: Funding



Scientific Topics Distribution: Funding



Summary and Conclusions

- All the most relevant scientific topics according to the current international roadmaps are covered by RSN2 in an almost balanced way (PT is poorly represented due to strong overlap with RSN4)
- RSN2 is interested in the most relevant international observing facilities at work that will be continuously supported in the future
- National observing facilities represent equally efficient complementary tools
- Presence of a non negligible theoretical community interested in numerical simulations ready to exploit the future national and international facilities
- Among the three international ESFRI Landmark Projects in which INAF is mostly involved, SKA is considered significantly, ELT less than expected, CTA only marginally
- Little interest for Euclid
- FPSP supported by almost all the financial channels (no theory), FEMW and SS mainly by Theory and Mini, SCPS only by Mini
- Poorly effective in obtaining financing on a competitive basis (2 Large Grants out of 16)

Possible Arguments of Discussion

- Increase interdisciplinary research (more interaction with other RSNs)
- Stimulate interest in all those facilities in which INAF is mostly involved (ELT, CTA)
- Organize National Meetings to Increase Collaborations and to Compact the various RSN2 (sub)Communities
- Reinforce the link with the Universities in order to guarantee the coverage of the topics relevant for RSN2