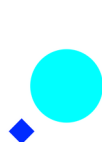


astrofisica multimessaggera e del dominio temporale

il supporto degli standard dell'IVOA

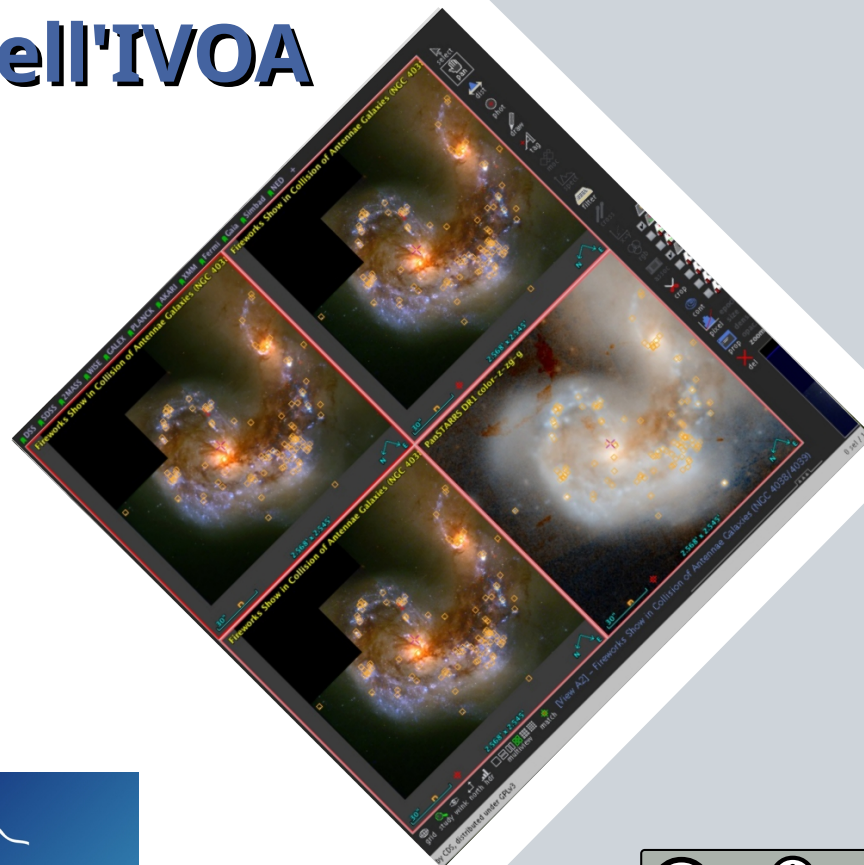
Marco Molinaro
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challenges and solutions

Any area of the sky not observed in a certain moment in time is missing data

- **Preservation**
 - “forever”
- **Sharing**
 - **Open/Public** accessibility
- **Interoperability**
 - Technical & **Semantic**

DATA



- **International Virtual Observatory Alliance**
- Formed in 2002
- Open standards organisation
- Interoperability as the core goal
- FAIR-enabler standards for astronomy

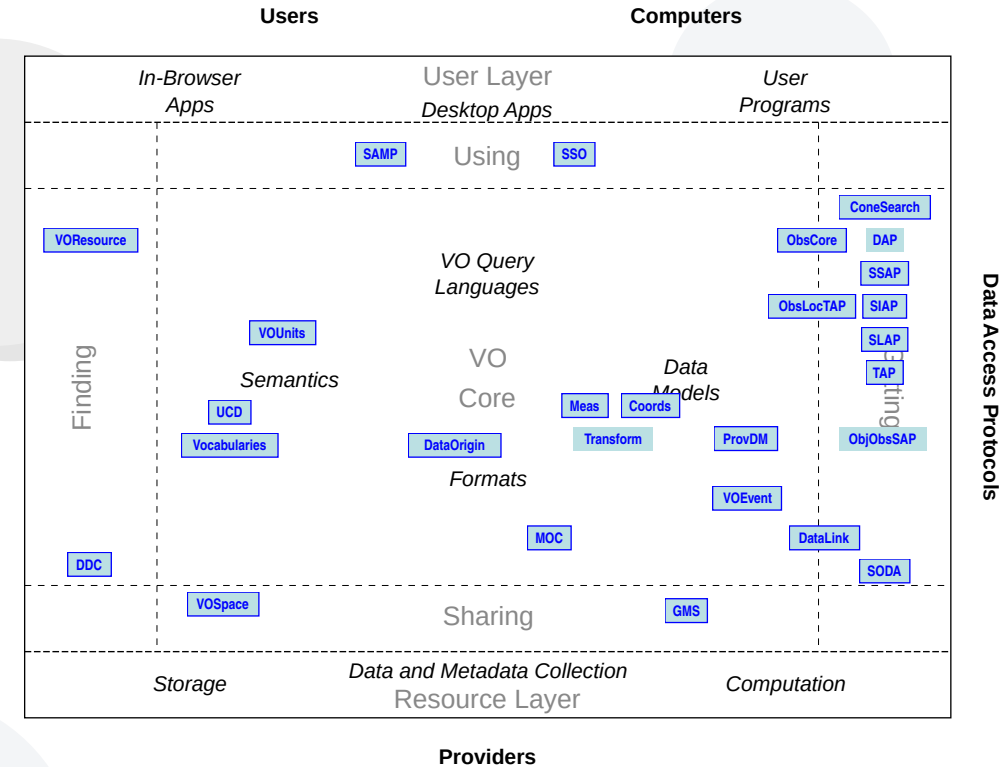
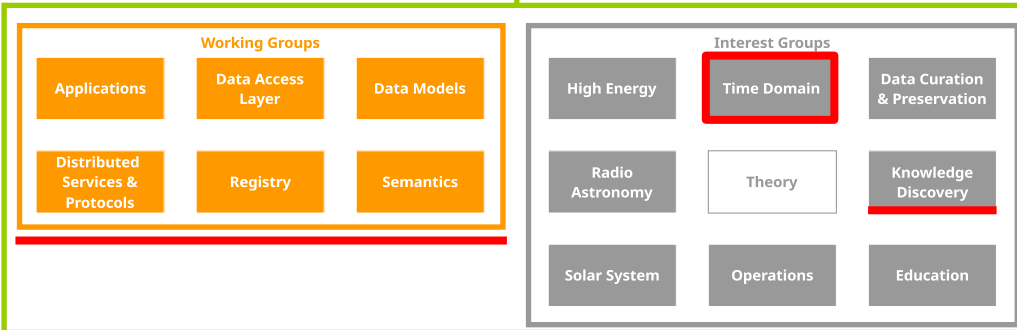
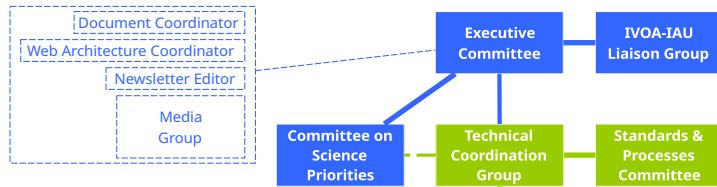
IVOA vision



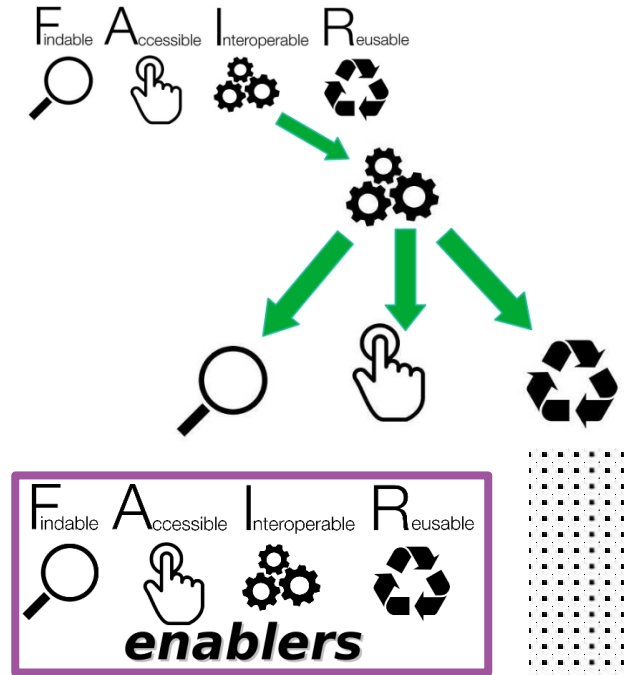
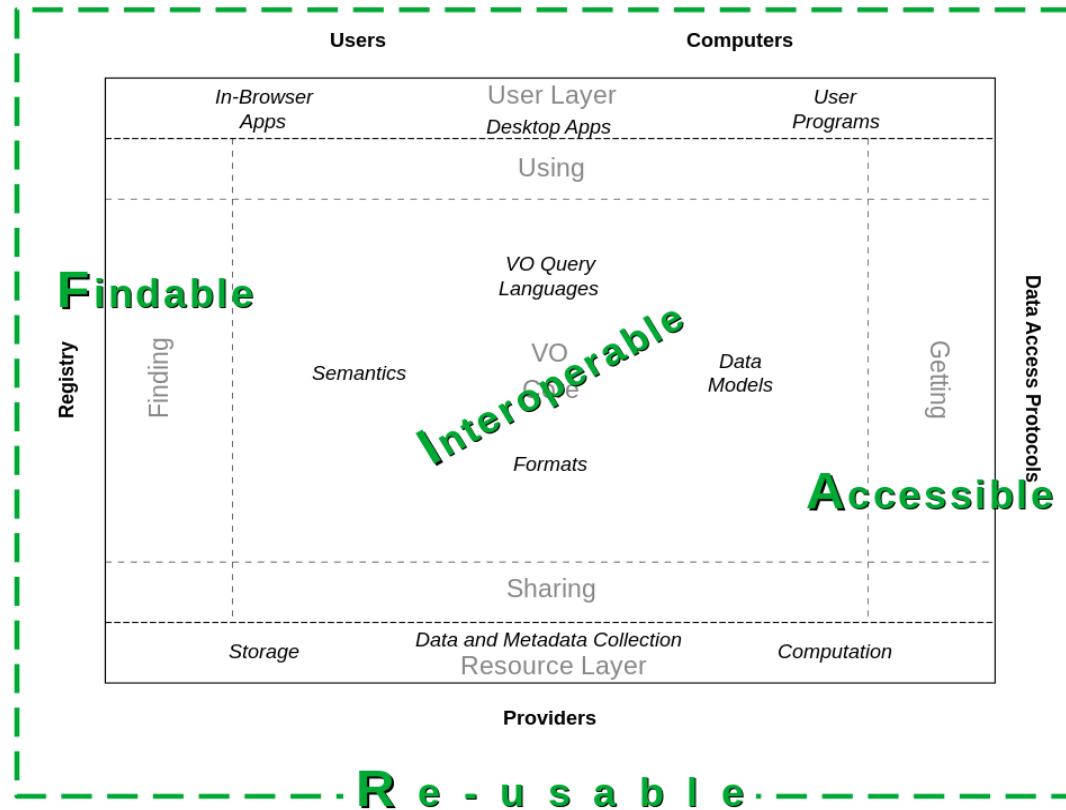
The **Virtual Observatory (VO)** is the vision that astronomical datasets and other resources should work as a seamless whole. [...] The **International Virtual Observatory Alliance (IVOA)** is an organisation that debates and agrees the technical standards that are needed to make the VO possible.

- ✓ Semestral “Interoperability” Meetings
- ✓ Recommendations (standards) are **agreed on consensus**

organisation & architecture

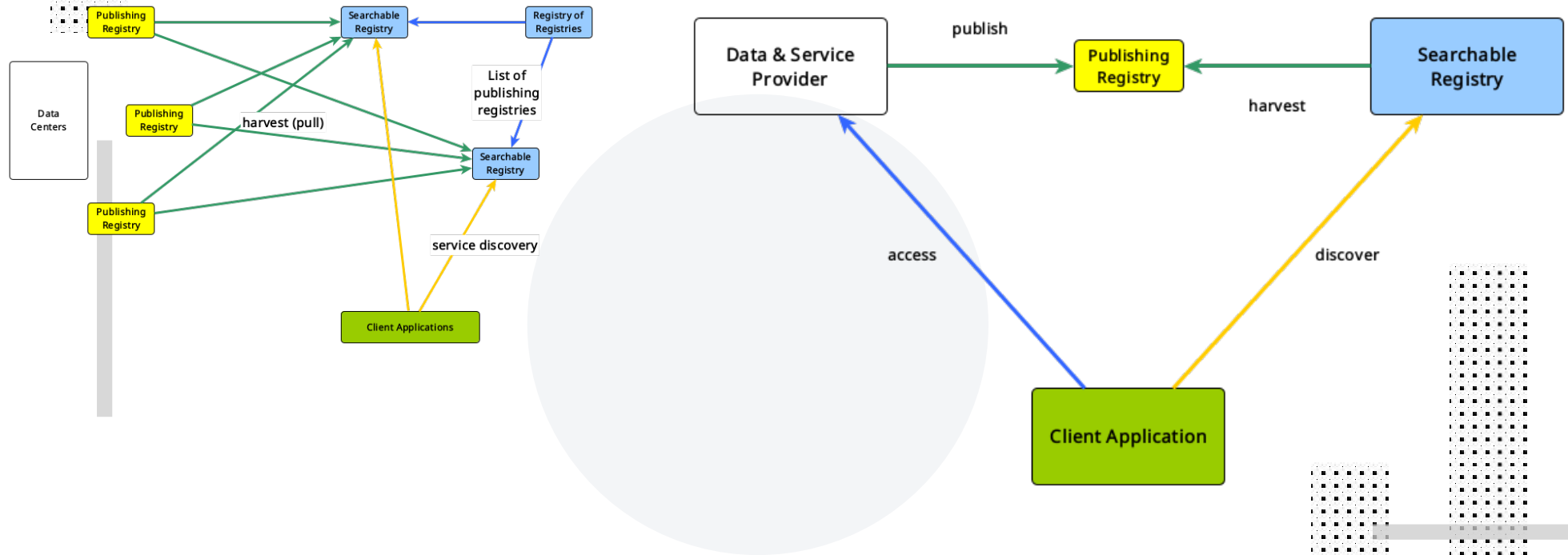


IVOA – FAIR mapping



The IVOA Registry

Findability of Resources



What to do?

//

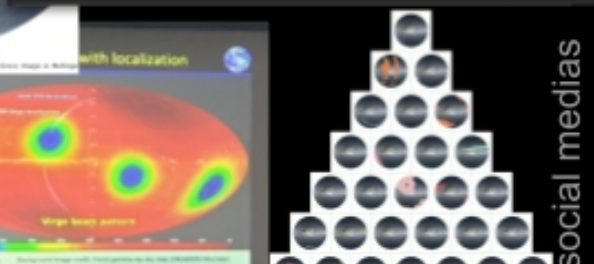
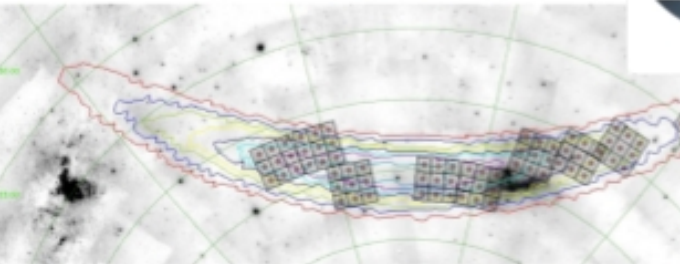
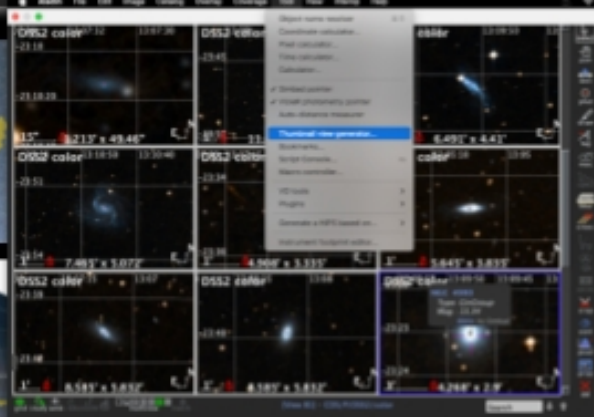
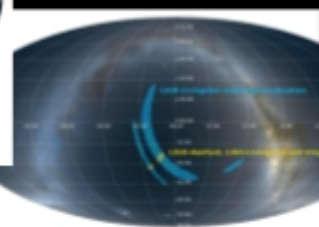
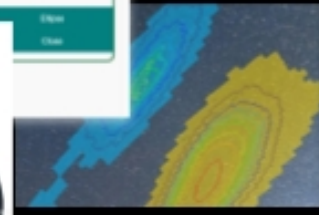
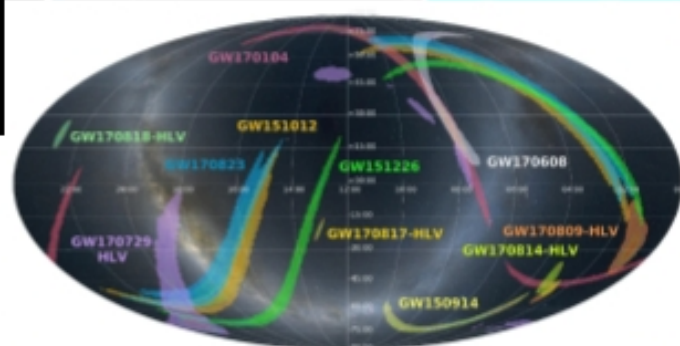
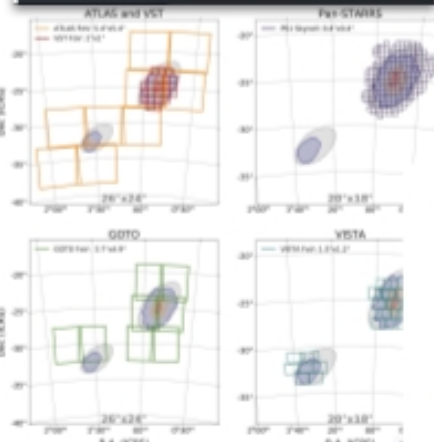
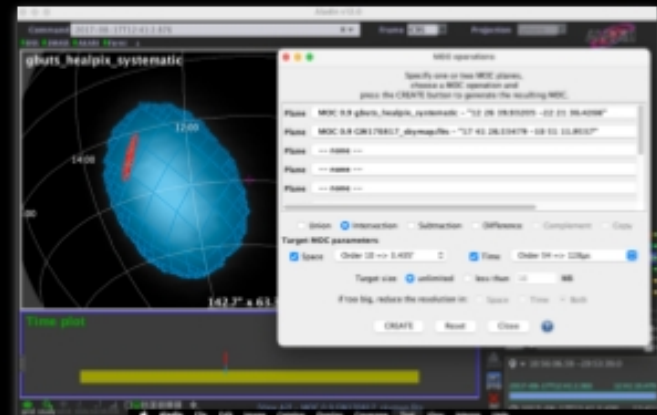
As a data providers,
manager, describe your
resources, add them to
the Registry, and let the
applications connect. **//**

VO-Enabled Spatio-Temporal Analysis of GW Localizations

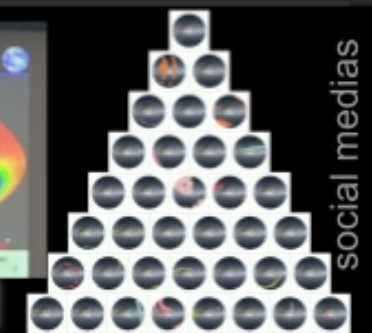
Thanks to VO standards, GW sky localization regions have evolved from static areas into active, queryable regions.

- **Interfacing with VO big-data services, such as VizierR.**
 - **Interactive visualization, accessible on any device.**
 - **Logical operations supporting reference-image retrieval, skymap update comparison, and transient localization, and other advanced analyses.**
 - **All operations are performed in both the spatial and temporal domains. This enables EM followup strategies and multi-messenger studies through joint analysis of localization maps from different messengers, including GWs, GRBs, and neutrinos.**
- ❑ The development has supported observational campaigns by **GRAWITA** and several other teams, evolved into the standard approach described in the official **IGWN User Guide**, and is now being adopted in the era of big transient data enabled by the **Vera C. Rubin Observatory**.
 - ❑ These activities were carried out through several European projects, including: **ASTERICS**, **ESCAPE**, **AHEAD** and **ACME** with dedicated tutorials delivered at VO Schools and LVK Open Data workshops, and indexed on the EOSC platform.
 - ❑ Within the Virgo Collaboration, new web apps have been developed for cosmology and low-latency applications, including **GWsky** and **GLADEnet** - integrated into the **ASI SSCDC** tools.
 - ❑ This has also enabled significant **technology transfer** into interactive **outreach products**, including images published on APOD and press-release images produced by the LVK Collaboration, ENGRAVE, and GRAWITA.

Articles, Press releases, Cosmology and EM followUP

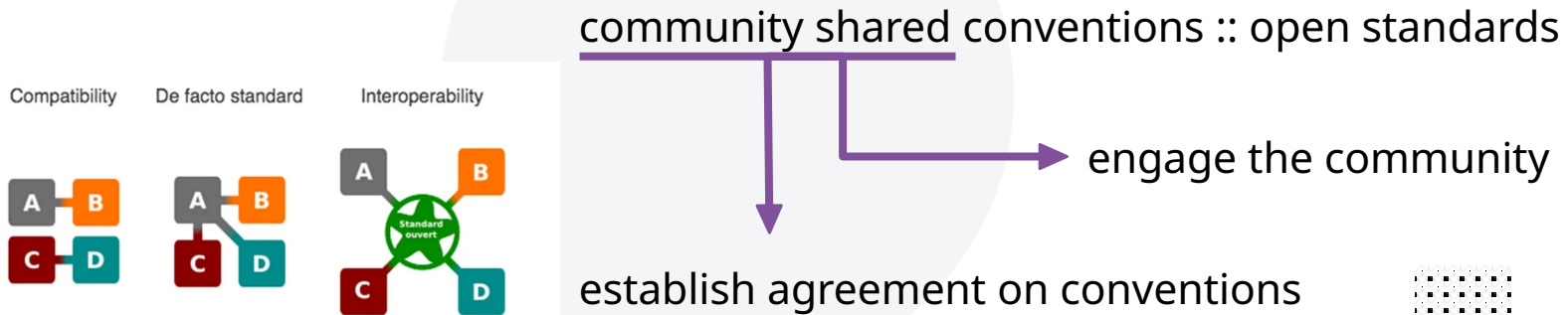
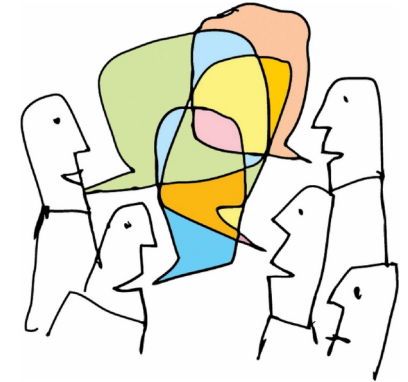


Based on Greco et al., 2022 A&C- <https://doi.org/10.1016/j.ascom.2022.100547>



Driven by “open community”

- Open Science <> opposite of bad science
- Digital resources -> leverage FAIR principles
- Principle $\neq$ Rule/Convention/Norm
- Research domain -> Intrinsic characteristics
- Characteristics -> turn principles into conventions
- Conventions -> Standards
- Research domain :: Community



come partecipare



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- 2nd Scientific Training
 - Sept. 29th – Oct. 1st
 - Strasbourg
 - <https://indico.in2p3.fr/event/38575>
- 2nd Technology Forum
 - week 19-23 Oct. 2026
 - Paris

Semestral “Interoperability” Meetings

- Northern Spring Interop
 - 8-12 June 2026
 - Strasbourg
 - <https://indico.ict.inaf.it/event/3454/>
- Southern Spring Interop
 - 6-8 November 2026
 - Perth
 - after ADASS XXXVI (1-5 November)

Scuola VO

- 24-26 Novembre
- Area CNR Bologna
- *...in definizione*

punto di contatto: marco.molinaro@inaf.it



Molinaro – LXVII SAIIt – L'Aquila 08.05.2026





LXVII Congresso Annuale della Società Astronomica Italiana (SAIt)

L'AQUILA | 4-8 MAGGIO 2026



EUROVO

*If you want to go fast, go alone.
If you want to go far, go together.*



OSCARS

Astro-CC

Grazie dell'attenzione!

Marco Molinaro

[INAF - OATs]



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