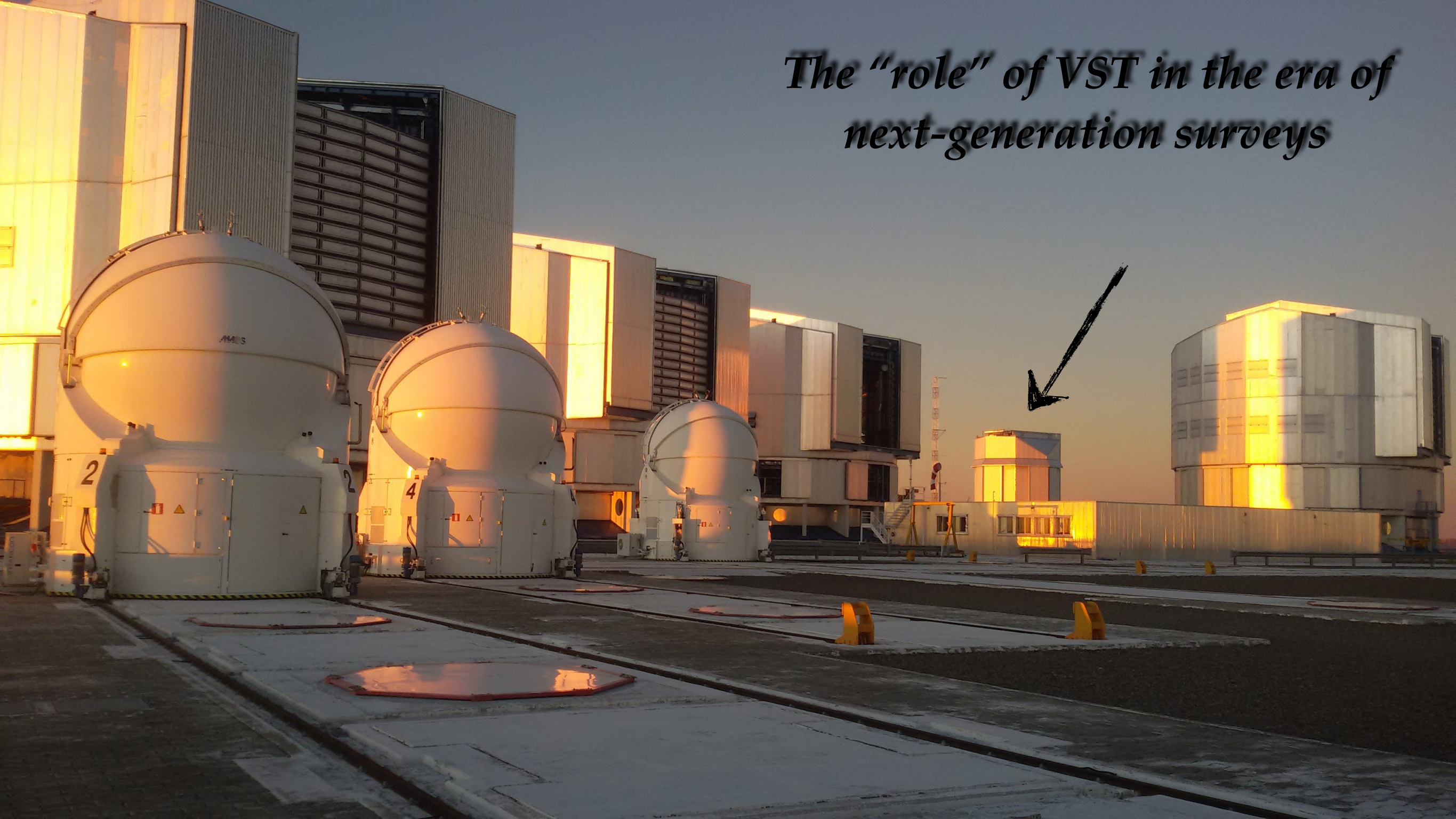
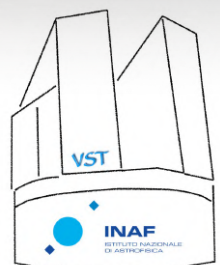


The “role” of VST in the era of next-generation surveys



Enrichetta Iodice



INAF Coordination Centre for VST
<https://vst.inaf.it>

*INAF - Astronomical Observatory of
Capodimonte, Italy*

The VLT Survey Telescope: overview



- ➔ 2.6m telescope designed for surveys in the optical bands, located at ESO Cerro-Paranal Observatory
- ➔ It is equipped with a single dedicated focal plane instrument: OmegaCAM
- ➔ OmegaCAM: 0.1 - 0.3 micron & FOV=1deg²
- ➔ INAF has designed and built the telescope
- ➔ OmegaCAM was designed and built by a consortium including institutes in the Netherlands, Germany and Italy (with major contributions from ESO)
- ➔ 2011 (1st light) - 2022, has been operated by ESO, while INAF obtained GTO
- ➔ from Oct 2022, VST returned to INAF



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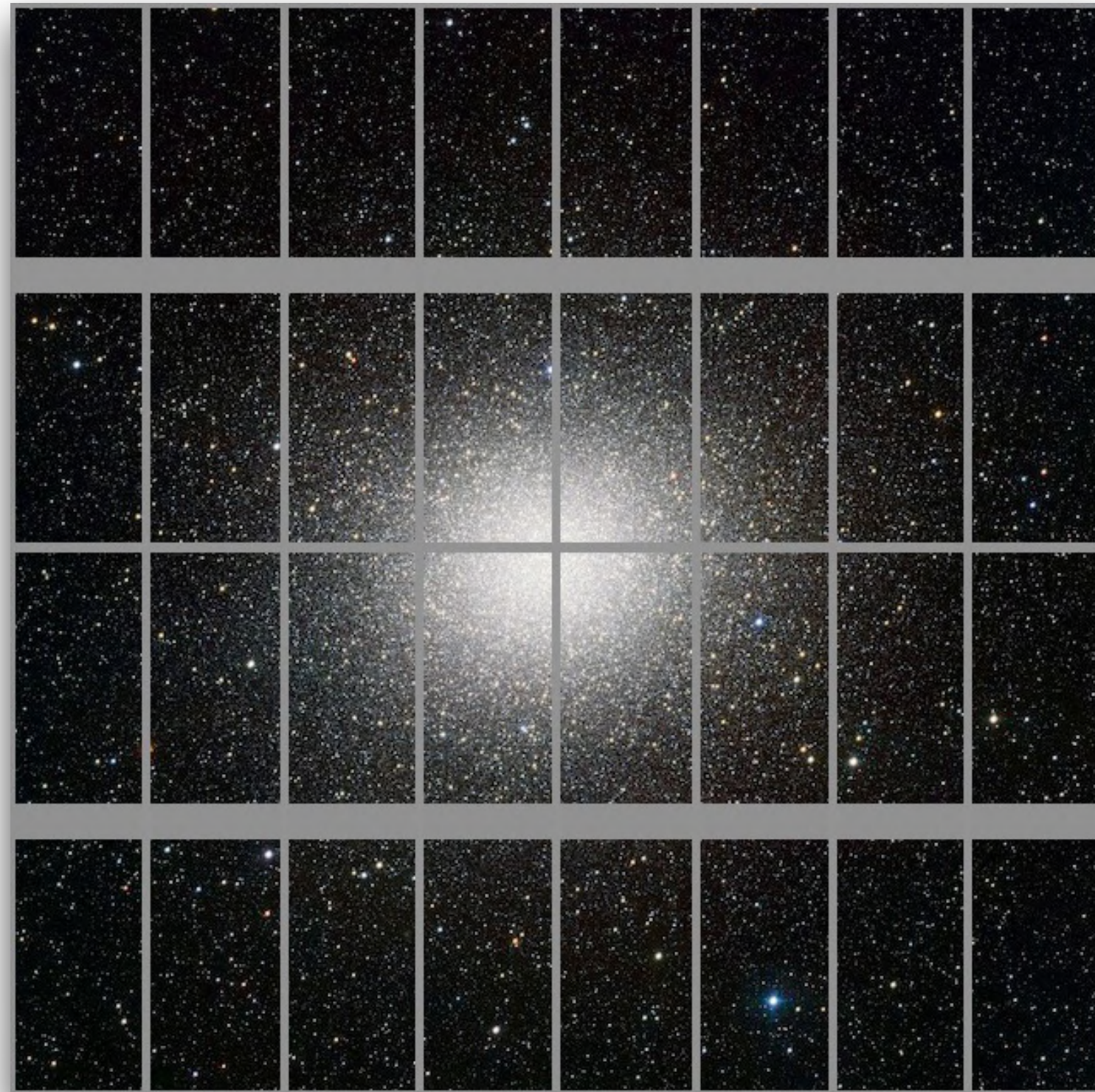
OmegaCam@VST

<https://www.eso.org/sci/facilities/paranal/instruments/omegacam/inst.html>

32-CCD

16k x 16k detector mosaic

0.21 arcsec/pixel



85''

25''

85''

1 deg²



INAF Coordination Centre for VST

<https://vst.inaf.it>

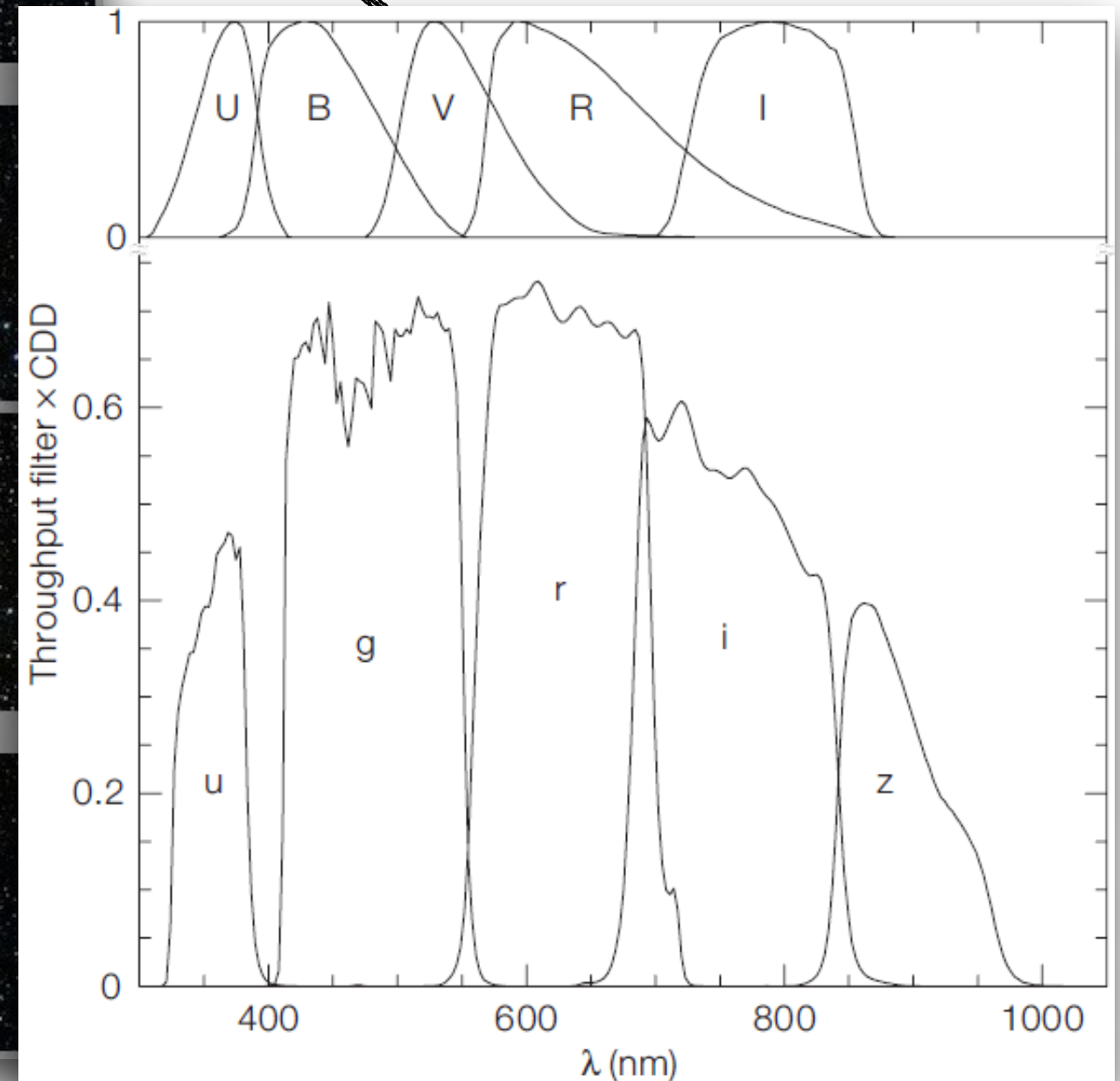
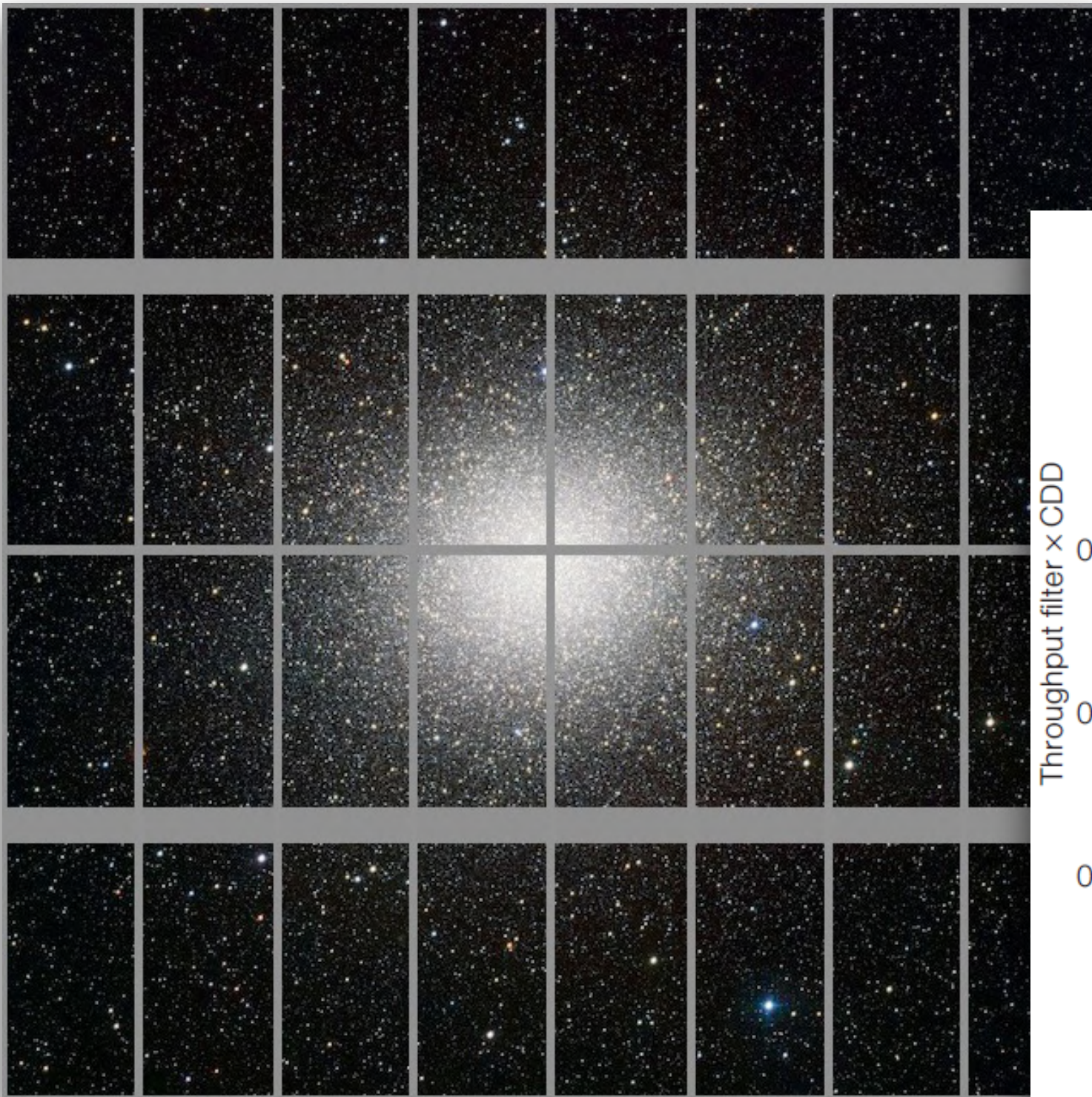
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The VLT Survey Telescope: science 2011 - 2022

The observing time at the VST was shared between:

ESO public surveys
~60%

GTO VST & OmegaCAM
~23%

Chilean time
~10%



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- **KIDS** (de Jong et al. 2013)
- **ATLAS** (Shanks et al. 2015)
- **VPHAS+** (Drew et al. 2014)



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GAIA support
→ GBOT campaign

- Galactic astronomy
- STREGA (Marconi et al. 2014)
 - STEP (Ripepi et al. 2014)
 - YMCA (Gatto, Ripepi et al. 2022)

- Transients & Multi-messenger astronomy
- SUDARE (Cappellaro et al. 2015)
 - GRAWITA (Pian et al. 2017)

- Extragalactic astronomy
- VEGAS (Capaccioli et al. 2015; Iodice et al. 2021)
 - VST-GAME (PI A. Mercurio)
 - KABS (PI N. Napolitano)
 - OmegaWINGS (Gullieuszik et al. 2015)
 - Shaply Supercluster survey (Merluzzi et al. 2014)



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OmegaCen
VST first light 2011



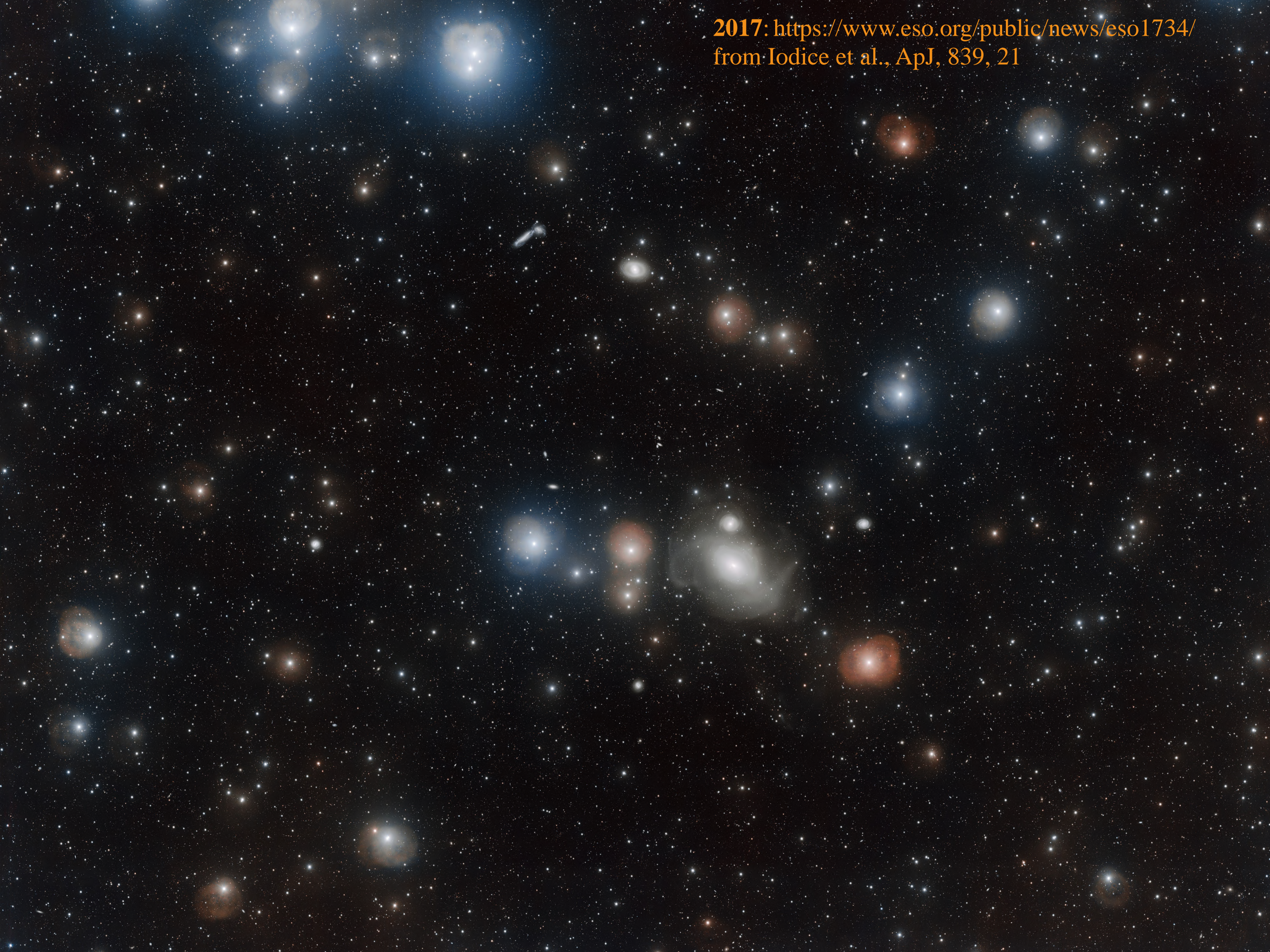
**NGC253 from science
verification (2014)**



2016: <https://www.eso.org/public/news/eso1612/>
from Iodice et al., ApJ, 820, 42



2017: <https://www.eso.org/public/news/eso1734/>
from Iodice et al., ApJ, 839, 21





2018: <https://www.eso.org/public/news/eso1827/>
from Spavone, Iodice et al., ApJ, 864, 149



2020: <https://www.eso.org/public/news/potw2122a>
from Iodice et al., A&A, 642, 48





2021: <https://www.eso.org/public/news/potw2145a>
from Iodice et al., A&A Letter, 652, L11





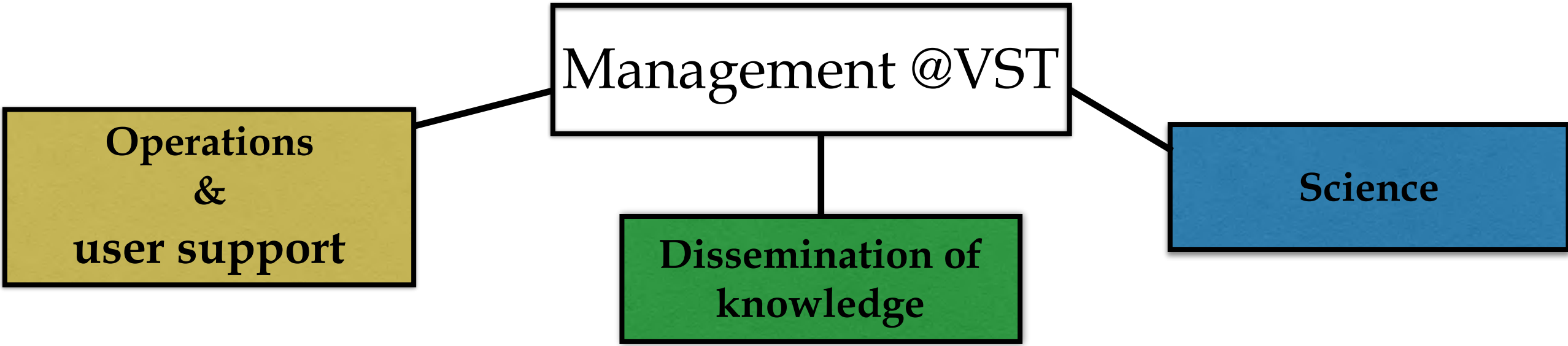
Ministero degli Affari Esteri
e della Cooperazione Internazionale

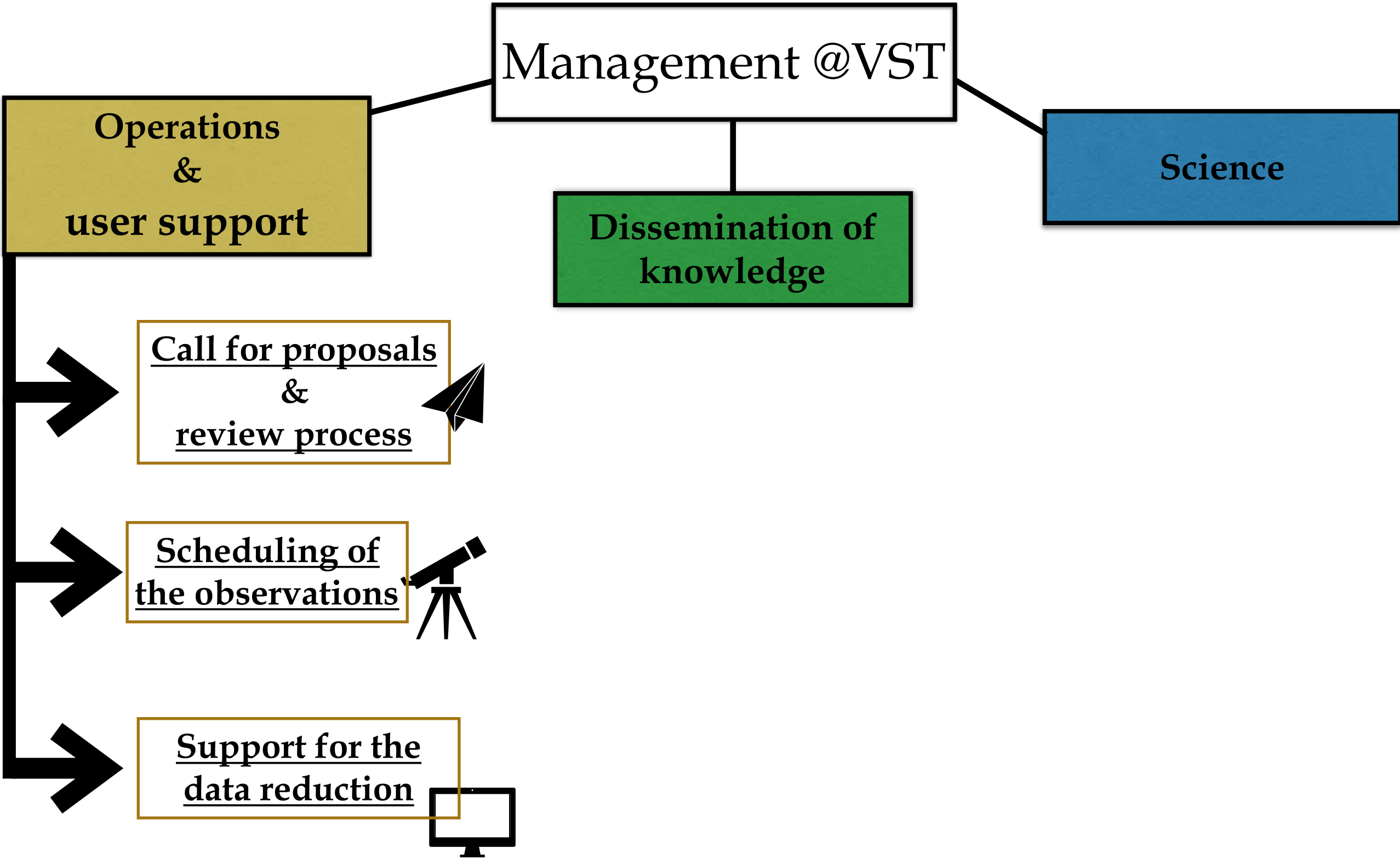
Diplomazia
Scientifica

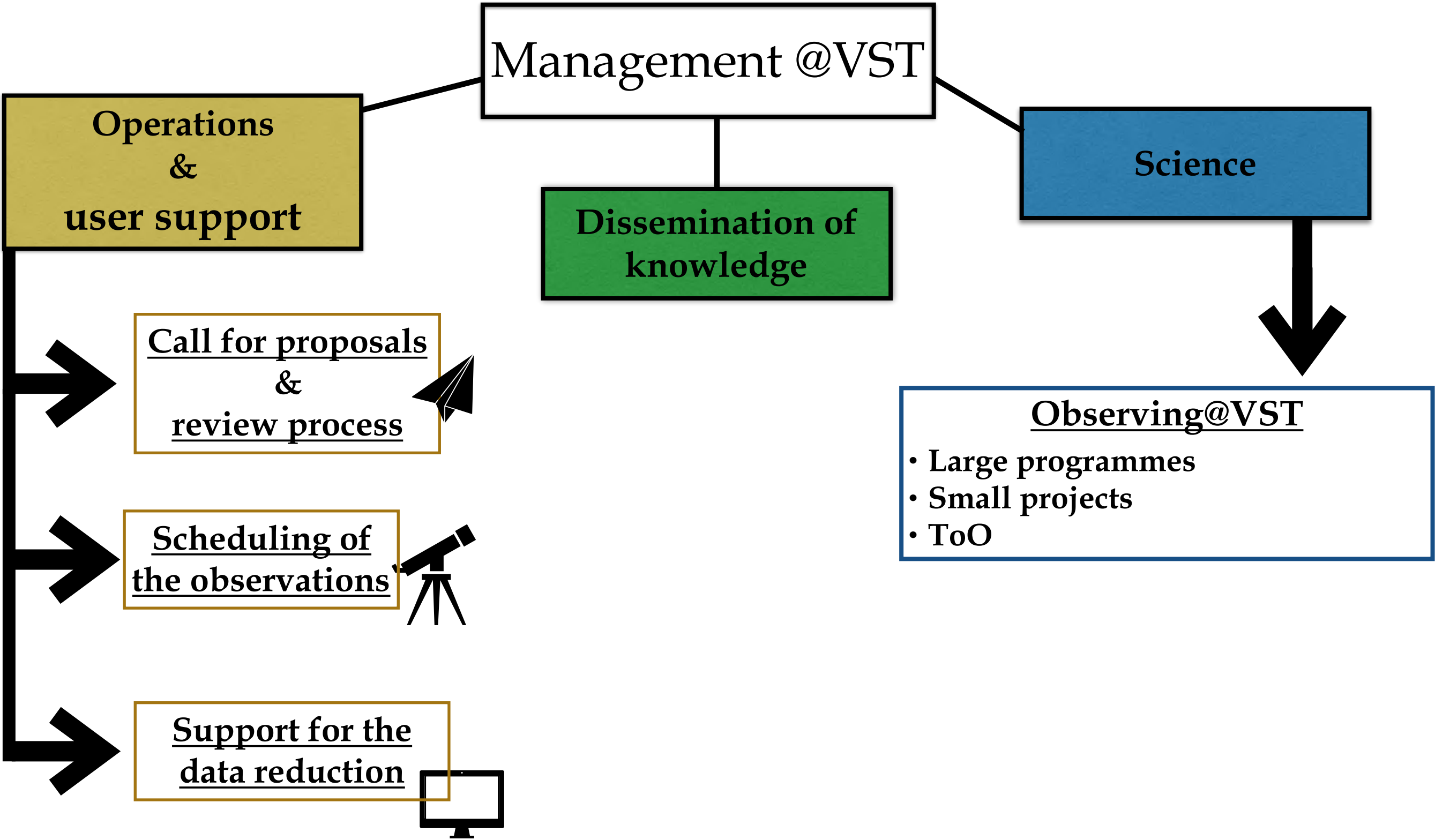
V edition of the Italian Research Day in the world - April 2022

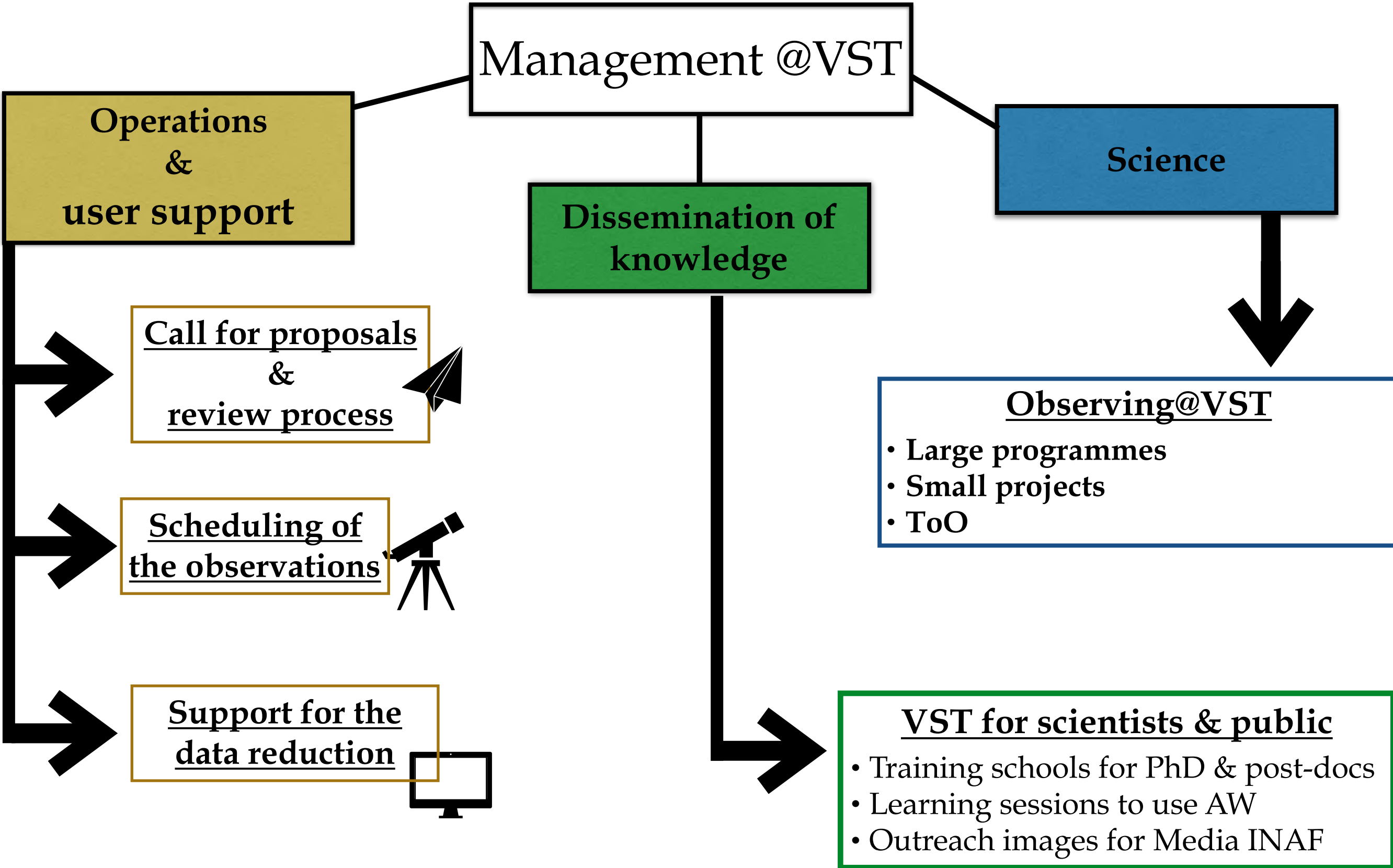
potw2145a

Crediti: ESO (CC BY 4.0) / E. Iodice et al. / INAF









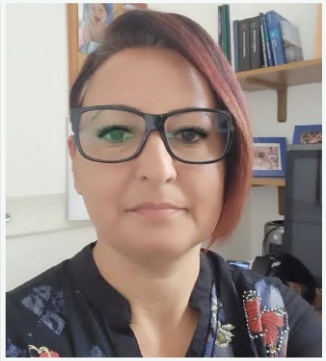
Team@VST

Operations
&
user support

Science

Dissemination of
knowledge

M. Spavone



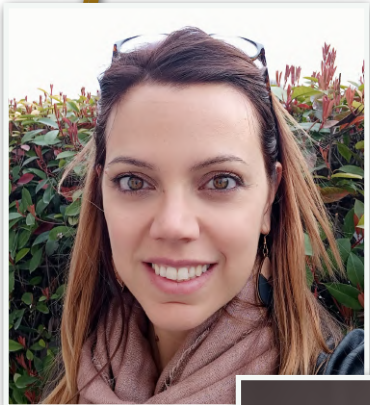
A. Loni



R. Calvi



V. Ripepi



E. Portaluri



G. D'Ago



V. Testa



Team@VST

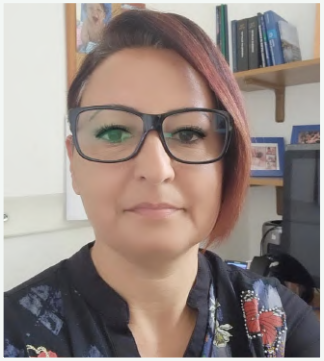
Operations
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Board of reviewers:
INAF
+
foreign research institutes

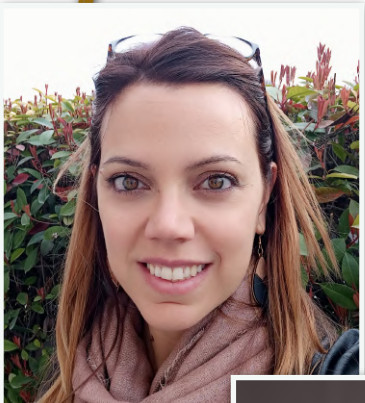
M. Spavone



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V. Testa



Team@VST

Operations & user support

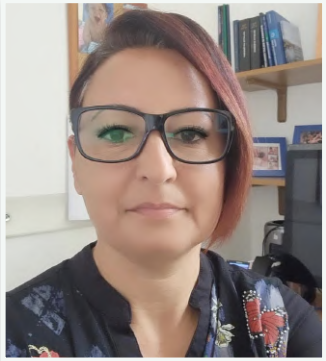
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C. Mignone
Media INAF

M. Spavone



A. Loni



R. Calvi



E. Portaluri



V. Ripepi



V. Testa



G. D'Ago



Observing@VST: call for proposals

Who can apply?

Proposal types & Observing modes

Time allocation



INAF Coordination Centre for VST

<https://vst.inaf.it>

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PI + > 50% co-Is from INAF, Italian Institutes
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- ▶ *Short observing programmes for young scientists (SP-young)*
- ▶ *ToO & Transient phenomena*

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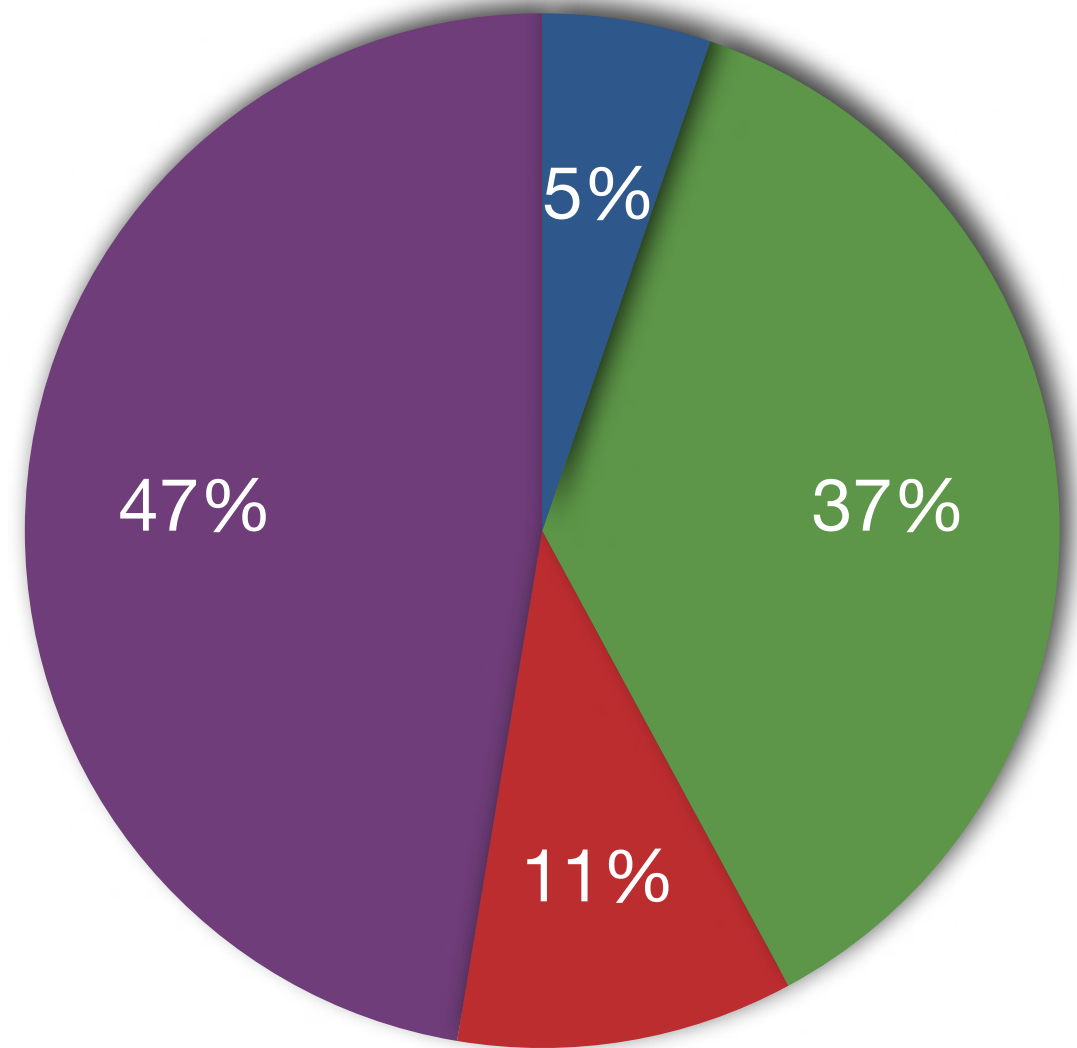
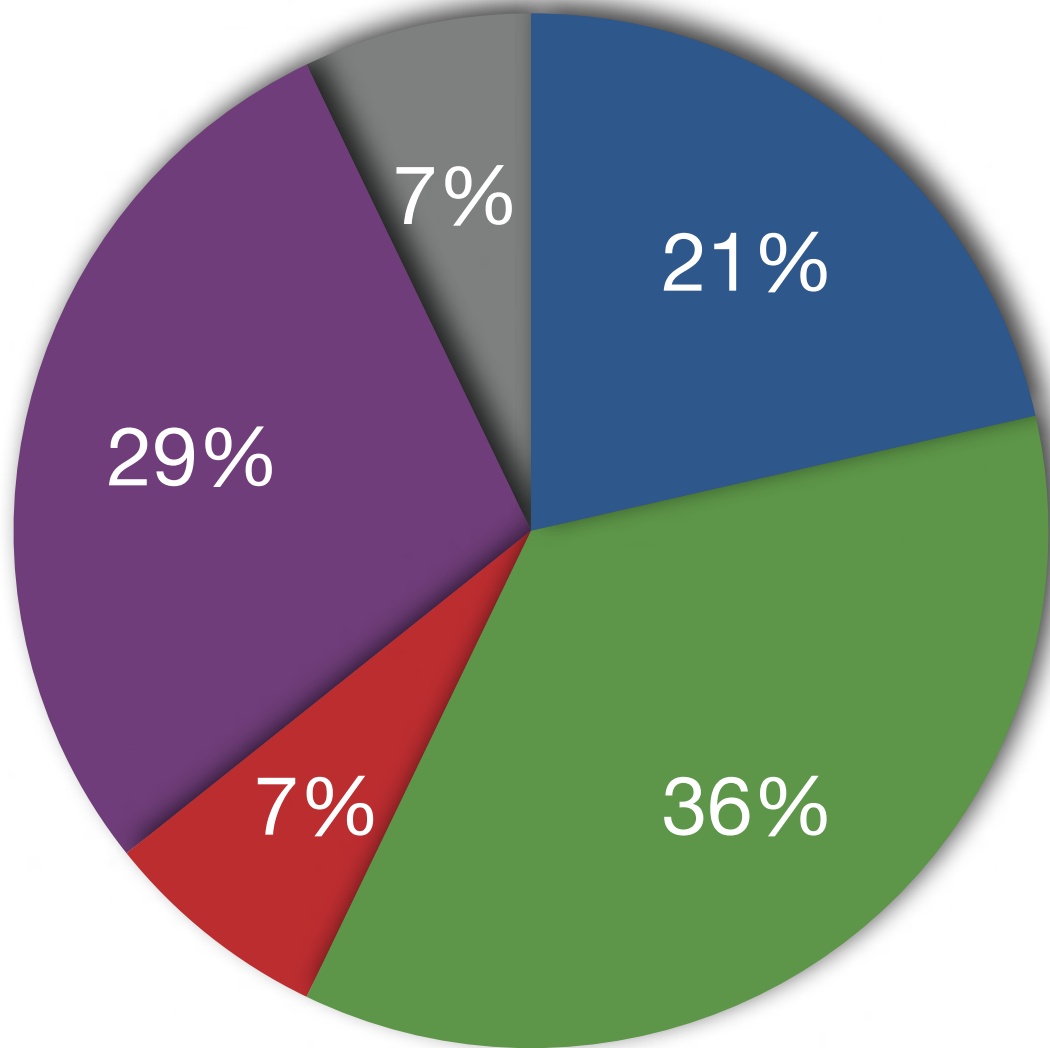
- ▶ *INAF*: ~ 80%
- ▶ *Chile*: ~ 10%
- ▶ *Pre-approved programmes*:
 - ➔ *GAIA GBOT* (PI: T. Prusti): ~3% (Optical Observations of GAIA@VST)
 - ➔ *GAIA FUP* (PI: L. Wyrzykowski): ~3% (Gaia Alerts Follow-Up Programme)
 - ➔ Searching for Optical counterparts of GW (PI: A. Grado)



Science with VST@2022-2027

P1: Oct 1, 2023 - 31 Mar 2024

P2: Apr 1 - 30 Sep 2024



- Cosmology
- Galaxies & cluster of galaxies
- Interstellar medium, Nebulae
- Planetary systems
- Stars
- The Galaxy

**Over-subscription of
~1.1 dark time**



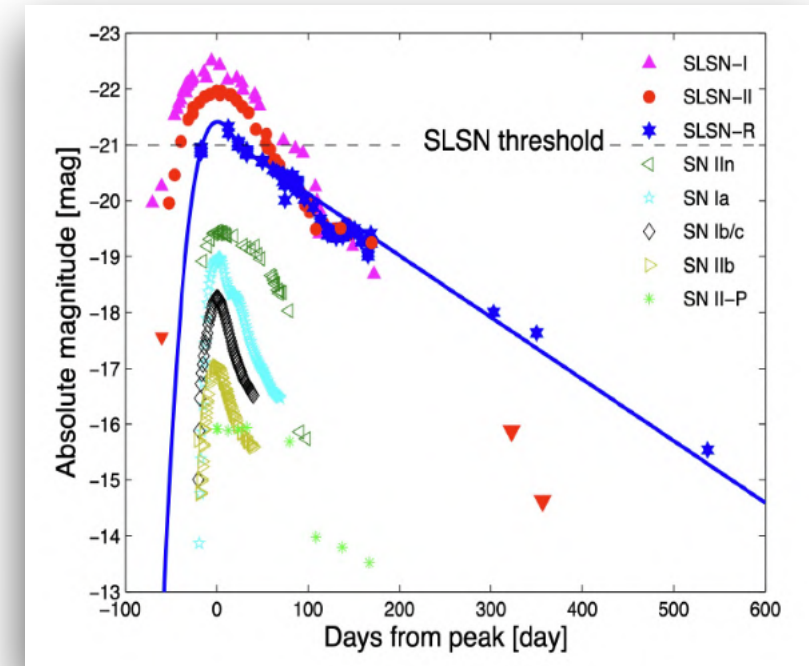
Science with VST@2022-2027

Cosmology:

Search for SN explosions from Pop III "analogs" in the Local Universe
(PI M. Della Valle)

➔ **search for "Pop III SN-like" events in the relatively nearby Universe ($z < 1$)**

superluminous SN, characterized by long-lasting maxima, produced in the explosions of pair instability SN occurring in progenitor stars with masses $> 100 M_{\odot}$



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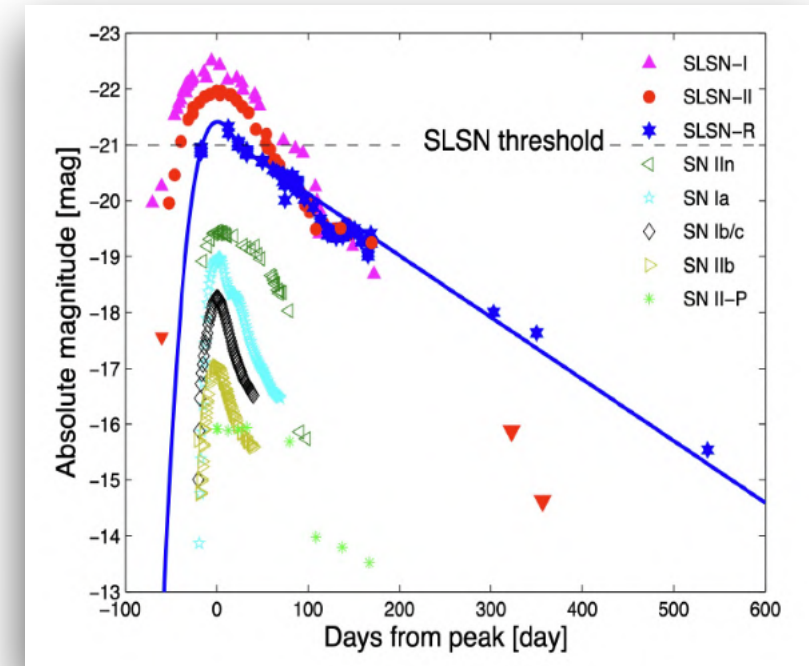
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Searching for Optical counterparts of gravitational wave events and neutrinos during the LIGO/Virgo/KAGRA O4 run

(PI A. Grado)

➔ **The primary goal of this proposal is to search for optical counterparts of promising multi-messenger events**

use the VST in ToO mode to promptly survey the GW alert area and identify optical emissions associated with compact binary objects coalescence (CBC), such as binary neutron stars (BNS) and neutron star-black hole (NS-BH) systems



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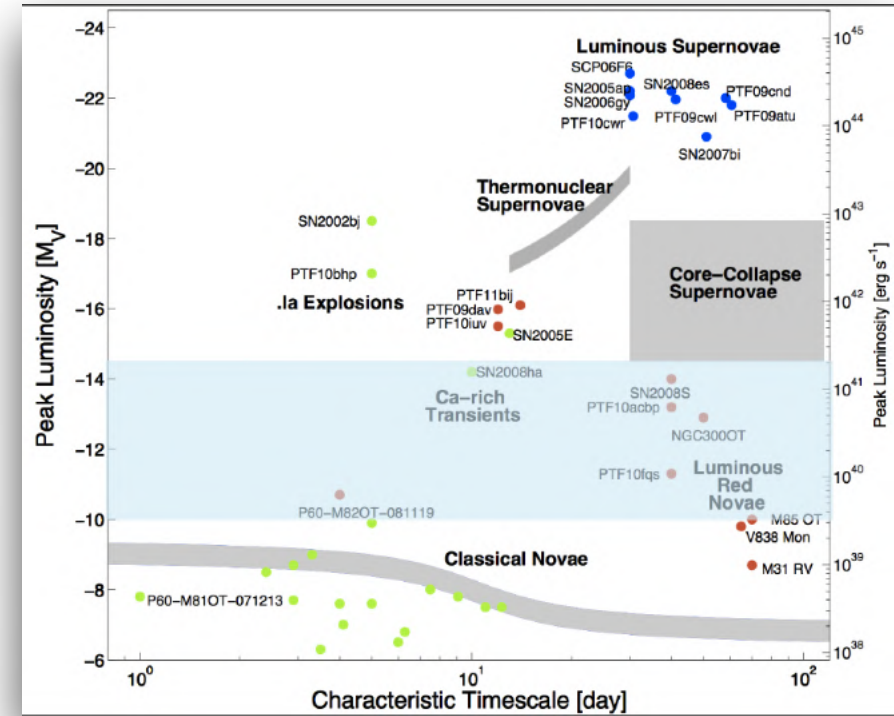
Science with VST@2022-2027

Stars

Stellar Explosions and their Evolution In Nearby Galaxies (SEEING) with the VST

(PI L. Izzo)

➔ search for classical novae in nearby galaxies to determine their explosion rate, a fundamental ingredient for the role of novae in chemical evolution studies



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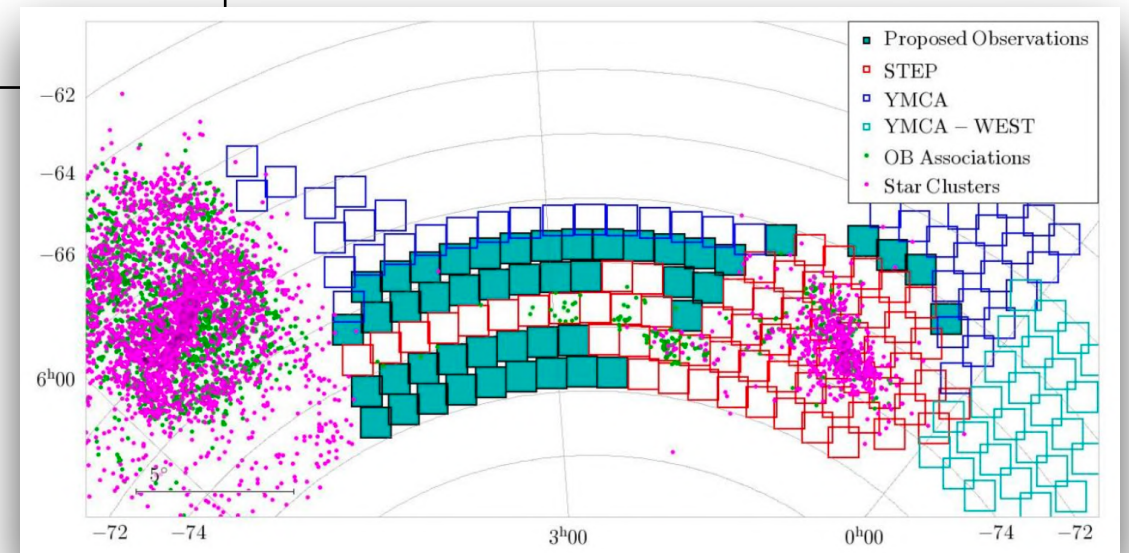
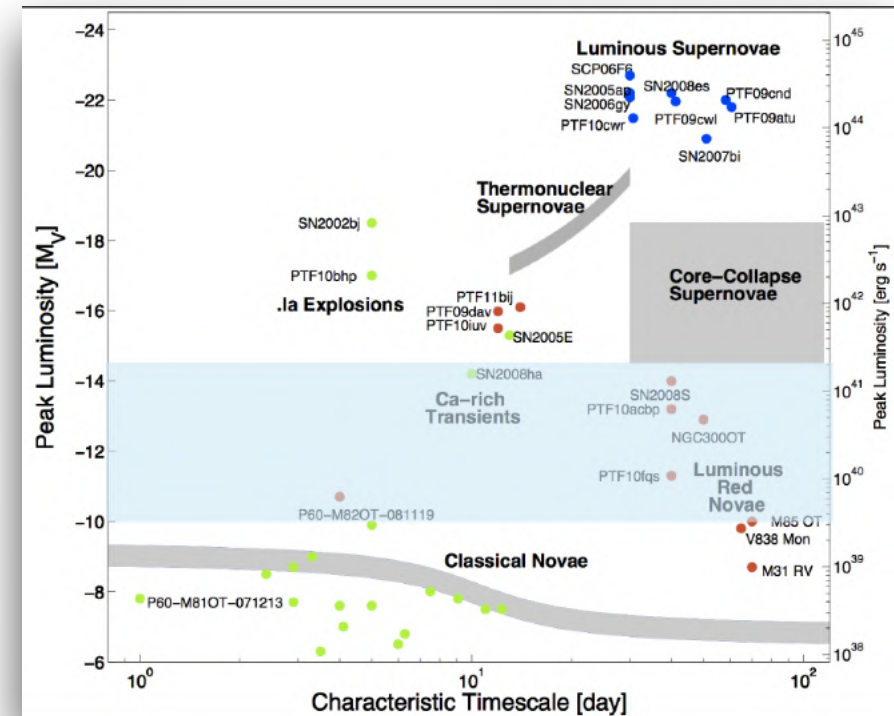
(PI L. Izzo)

- ➔ search for classical novae in nearby galaxies to determine their explosion rate, a fundamental ingredient for the role of novae in chemical evolution studies

Filling the gaps between the STEP and YMCA surveys

(PI V. Ripepi)

- ➔ obtain continuous and homogeneous photometry over an area of about ~ 225 sq. deg., to study in detail the variation of star formation history and the extended structure of the SMC and Bridge



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<https://vst.inaf.it>

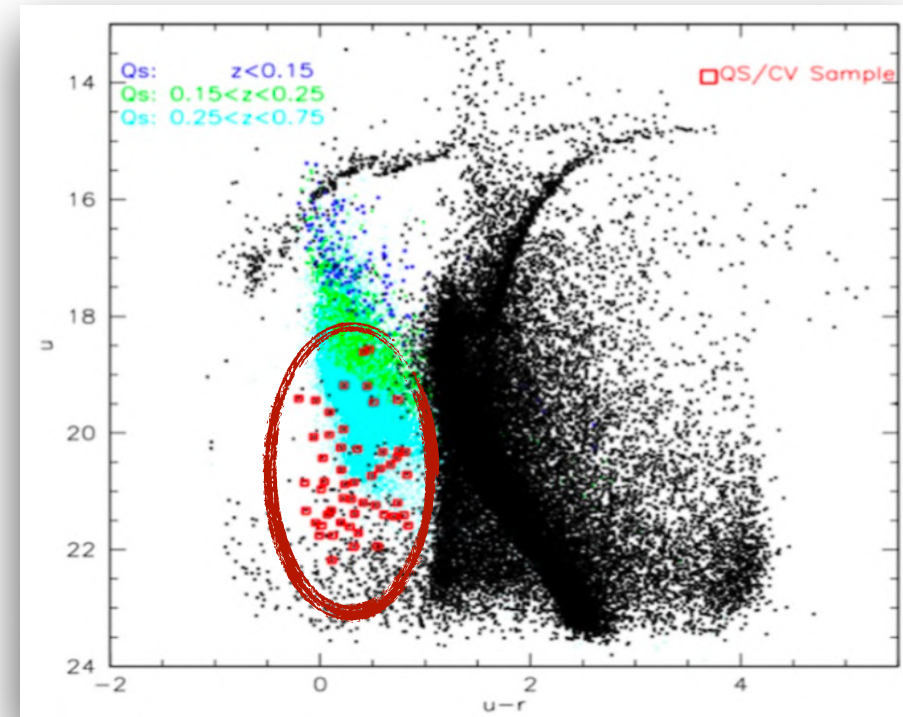
Science with VST@2022-2027

Stars

*An OmegaCAM Monitoring Survey to Solve the Cataclysmic Variables
Puzzle in Globular Clusters*

(PI S. Zaggia)

➔ address the apparent lack of Cataclysmic Variables (CVs) and
Dwarf Novae (DNe) in Globular Clusters



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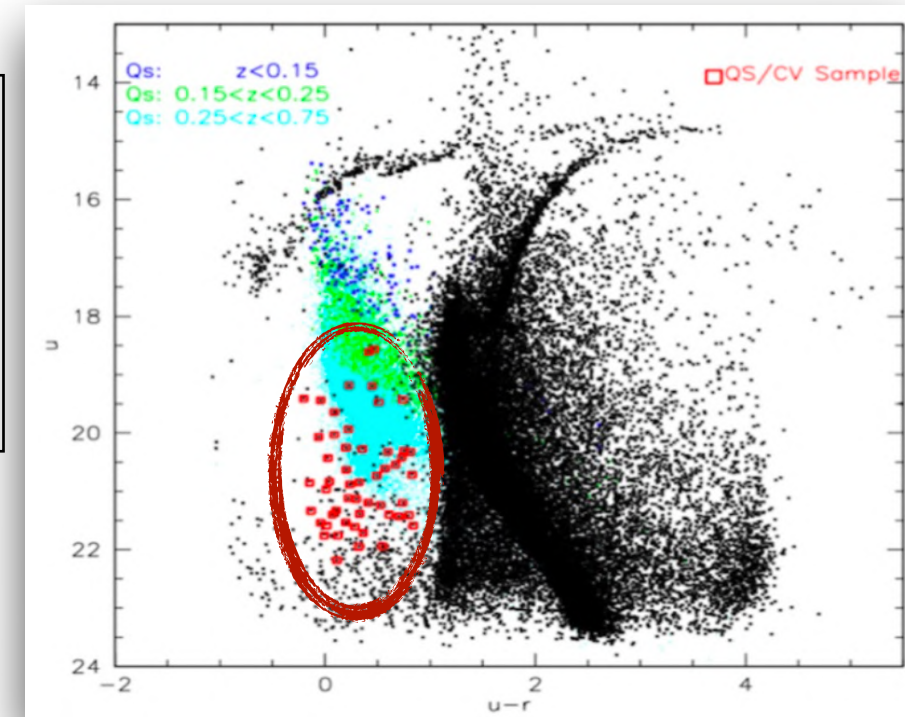
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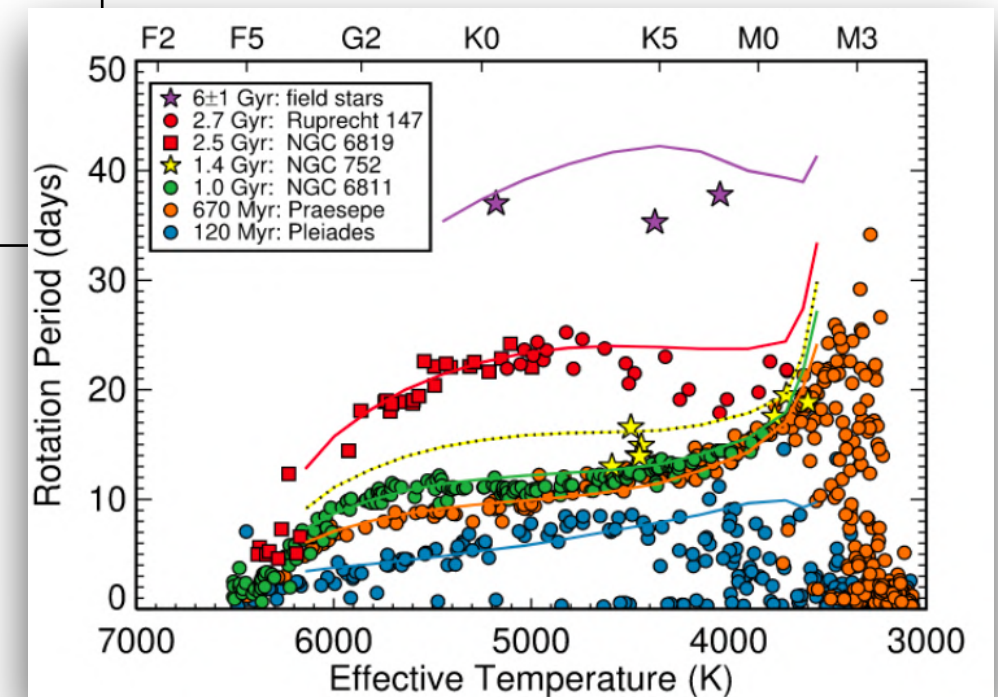
➔ address the apparent lack of Cataclysmic Variables (CVs) and Dwarf Novae (DNe) in Globular Clusters



*Origins of ultracool low mass objects and brown dwarfs from rotation
rates*

(PI R. Smart)

➔ study the evolution of the angular momentum of UCDs and substellar objects as a function of mass and age in a selected number of cornerstone clusters



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Science with VST@2022-2027

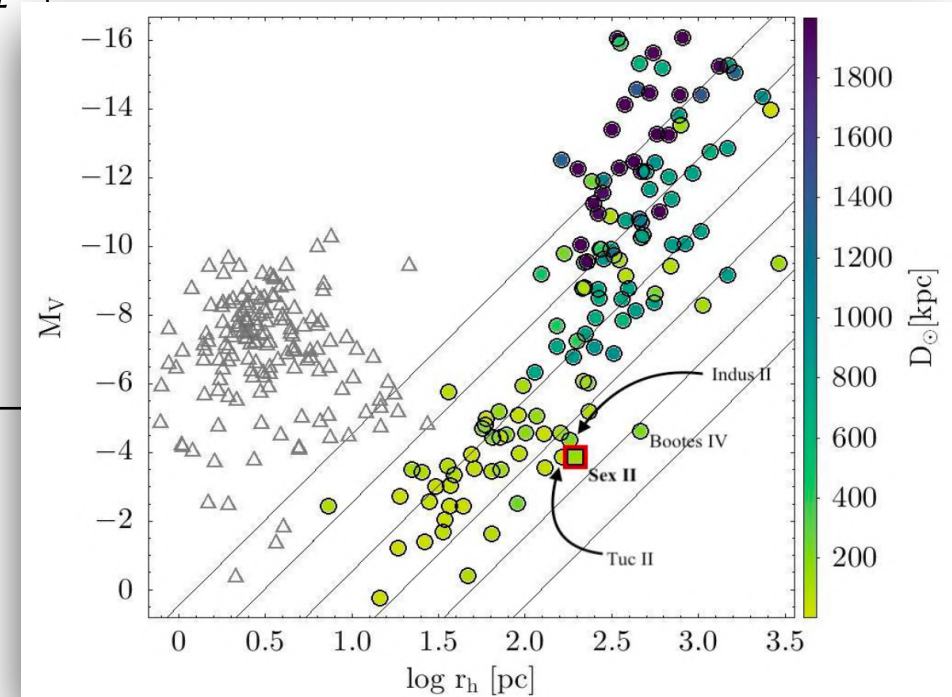
Stars

Search for RR Lyrae stars in the newly discovered Ultra-Faint Dwarf galaxy Sextans II

(PI M. Gatto)

- ➔ carry out a photometric follow-up of Sextans II to characterize its RRL stellar population, searching for variable stars out to about 10 half-light radii from its center

SP-Young



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Science with VST@2022-2027

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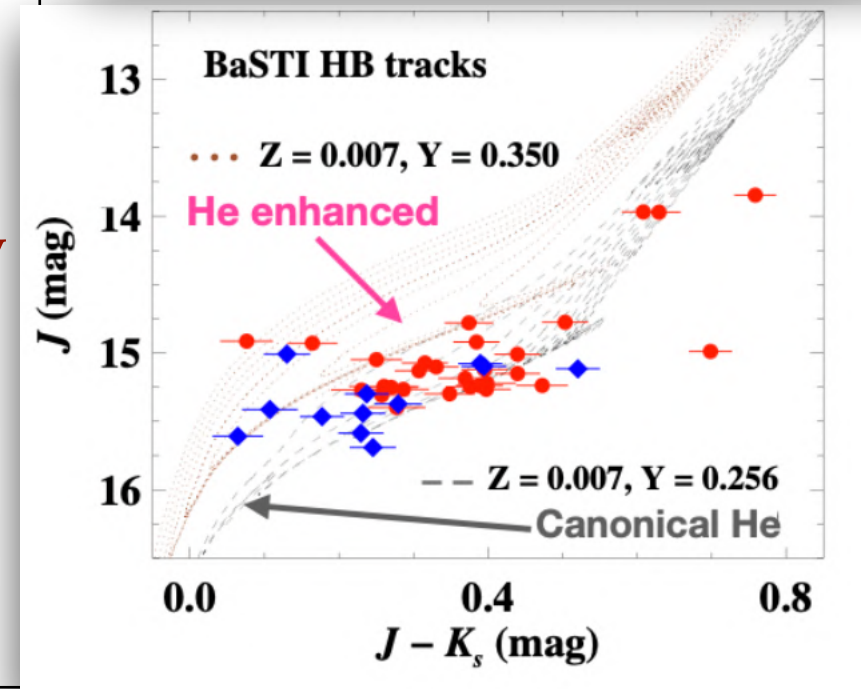
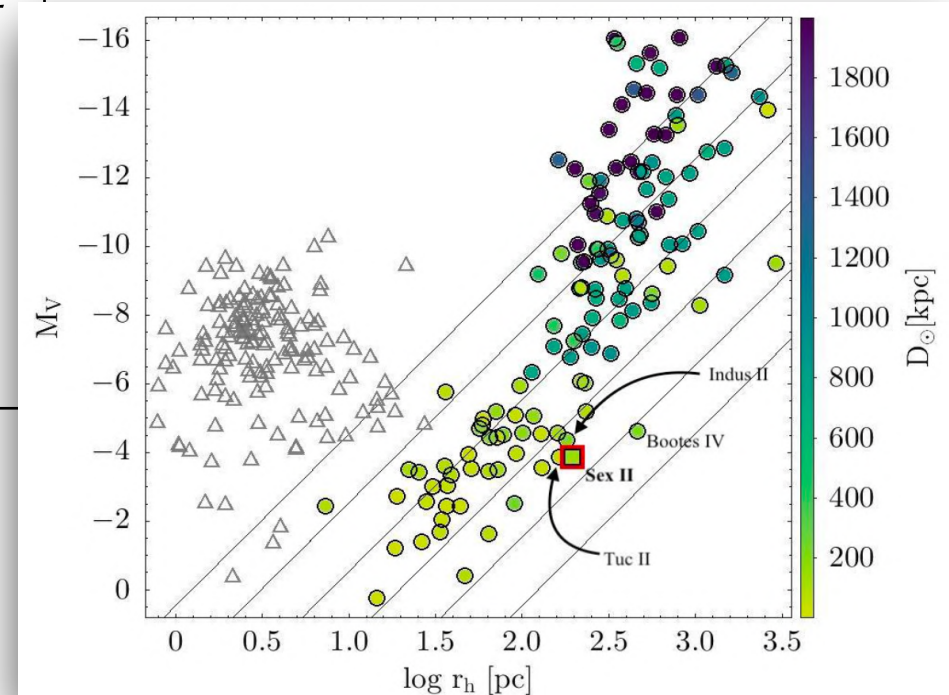
- ➔ carry out a photometric follow-up of Sextans II to characterize its RRL stellar population, searching for variable stars out to about 10 half-light radii from its center

Probing peculiarity and possible helium enhancement in RR Lyrae stars in NGC 6441 and NGC 6388

(PI A. Bhardwaj)

- ➔ homogeneous optical (ugriz) monitoring of NGC 6441 and NGC 6388 RR Lyrae stars to complement their NIR photometry and probe likely helium enhancement by comparing their multi-wavelength pulsation properties and PLR with the predictions of stellar pulsation models for the normal and enhanced helium content

SP-Young



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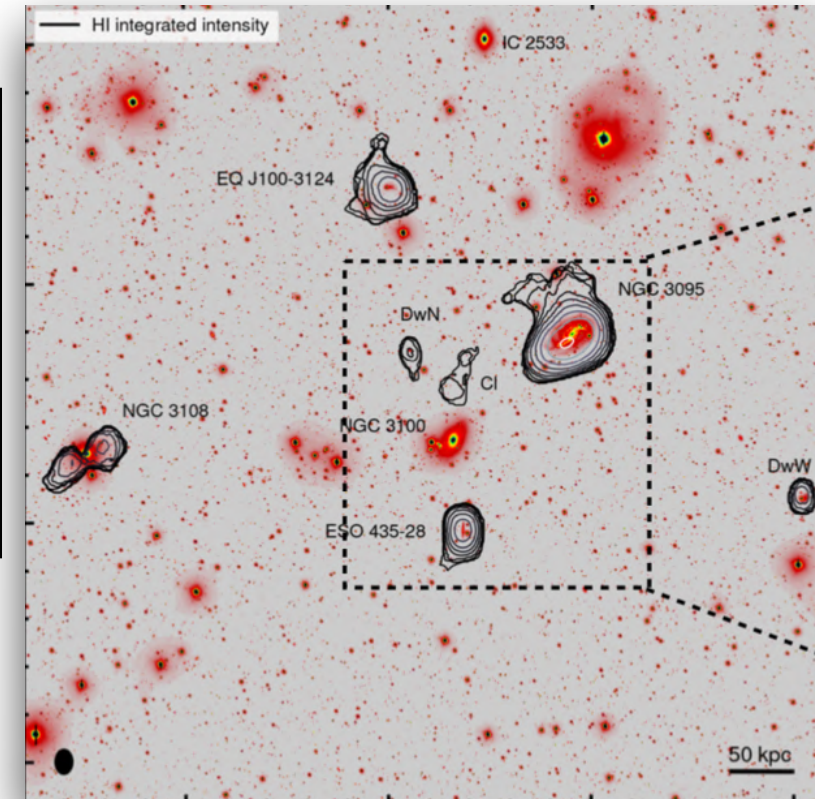
Science with VST@2022-2027

Galaxies & Cluster of galaxies

A MAGNHIFFIC view of the role of AGN feeding and feedback in galaxy evolution

(PI I. Prandoni/F. Maccagni)

- ➔ **The HI observations of the MAGNHIFFIC sample require a thorough comparison with deep optical images to identify the nature of the HI gas detected in the field**



INAF Coordination Centre for VST

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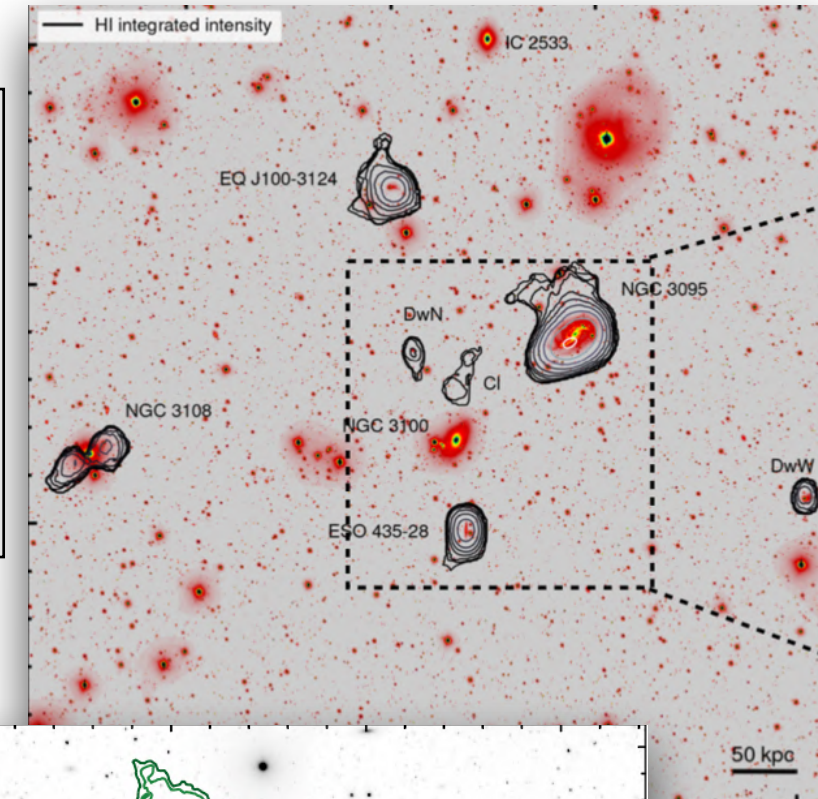
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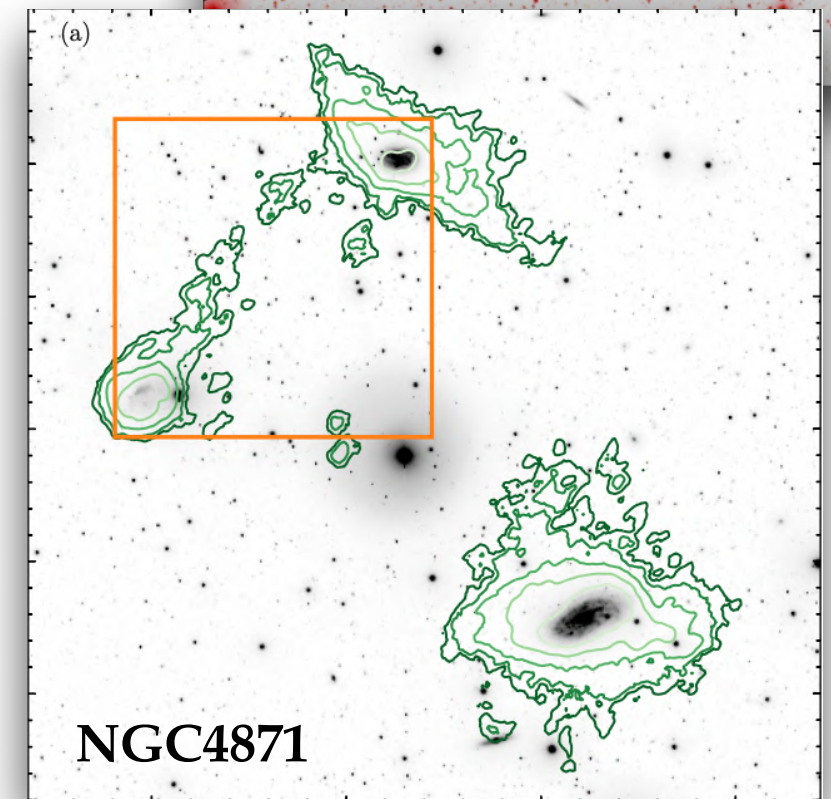
- ➔ **The HI observations of the MAGNHIFFIC sample require a thorough comparison with deep optical images to identify the nature of the HI gas detected in the field**



Understanding the origin of cold gas around nearby star-forming galaxies

(PI A. Marasco)

- ➔ **Continue the VST observing campaign in order to extend the study of HI and stellar features around galaxies to the entire MHONGOOSE sample**



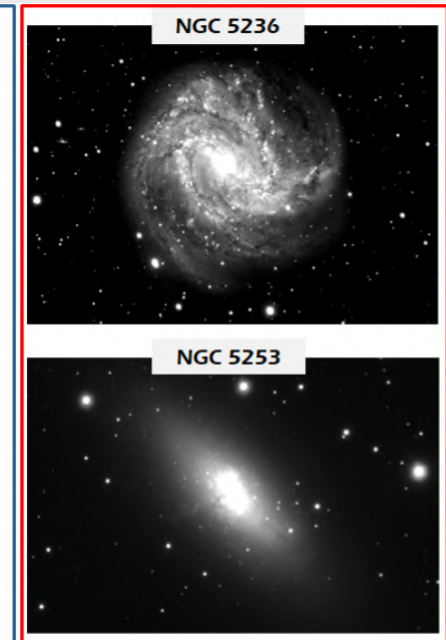
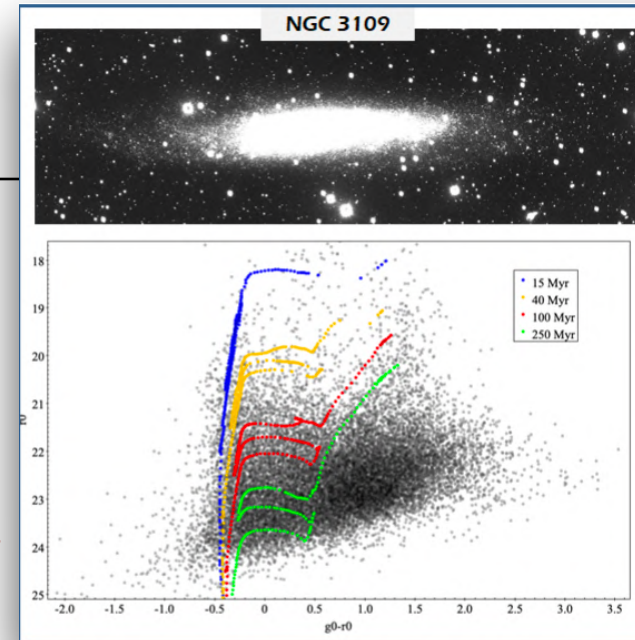
Science with VST@2022-2027

Galaxies & Cluster of galaxies

VST-SMASH: The VST Survey of Mass Assembly and Structural Hierarchy

(PI C. Tortora)

➔ **Detection and statistics of tidal features, LSB galaxies and star clusters in the outskirts of galaxies, up to 50-250 kpc**



INAF Coordination Centre for VST

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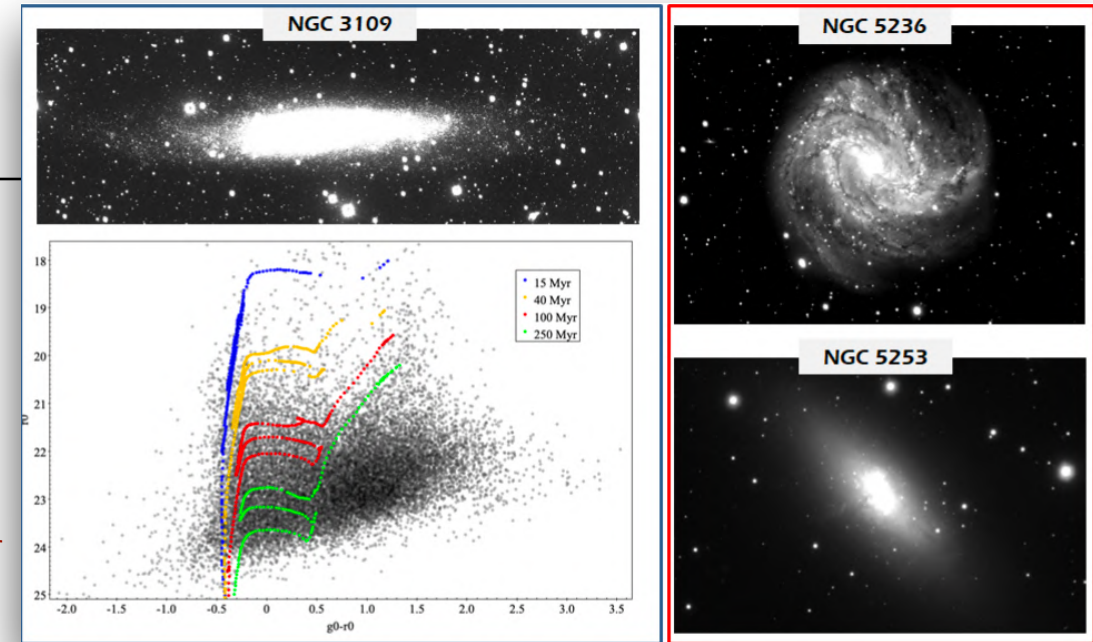
Science with VST@2022-2027

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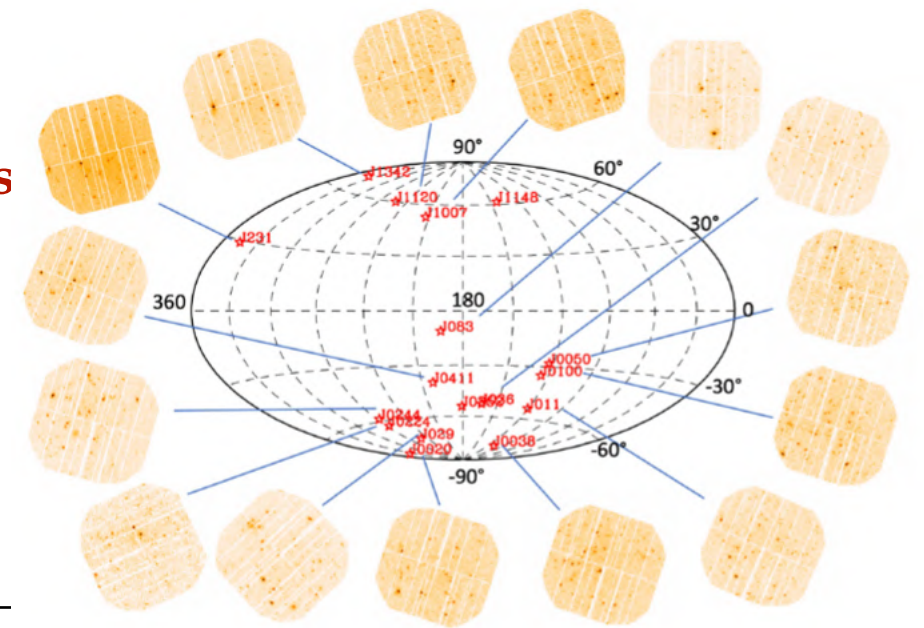
- ➔ Detection and statistics of tidal features, LSB galaxies and star clusters in the outskirts of galaxies, up to 50-250 kpc



HYPER-MAX: The HYPERION Medium Area X-ray Serendipitous Survey

(PI D. De Cicco)

- ➔ Survey based on the 18 non-contiguous fields of the ~700 hours HYPERION XMM-Newton Multi-Year Heritage programme to obtain the optical identification of the X-ray sources, performing a first classification and derivation of physical AGN/host properties and computing photometric redshift estimates



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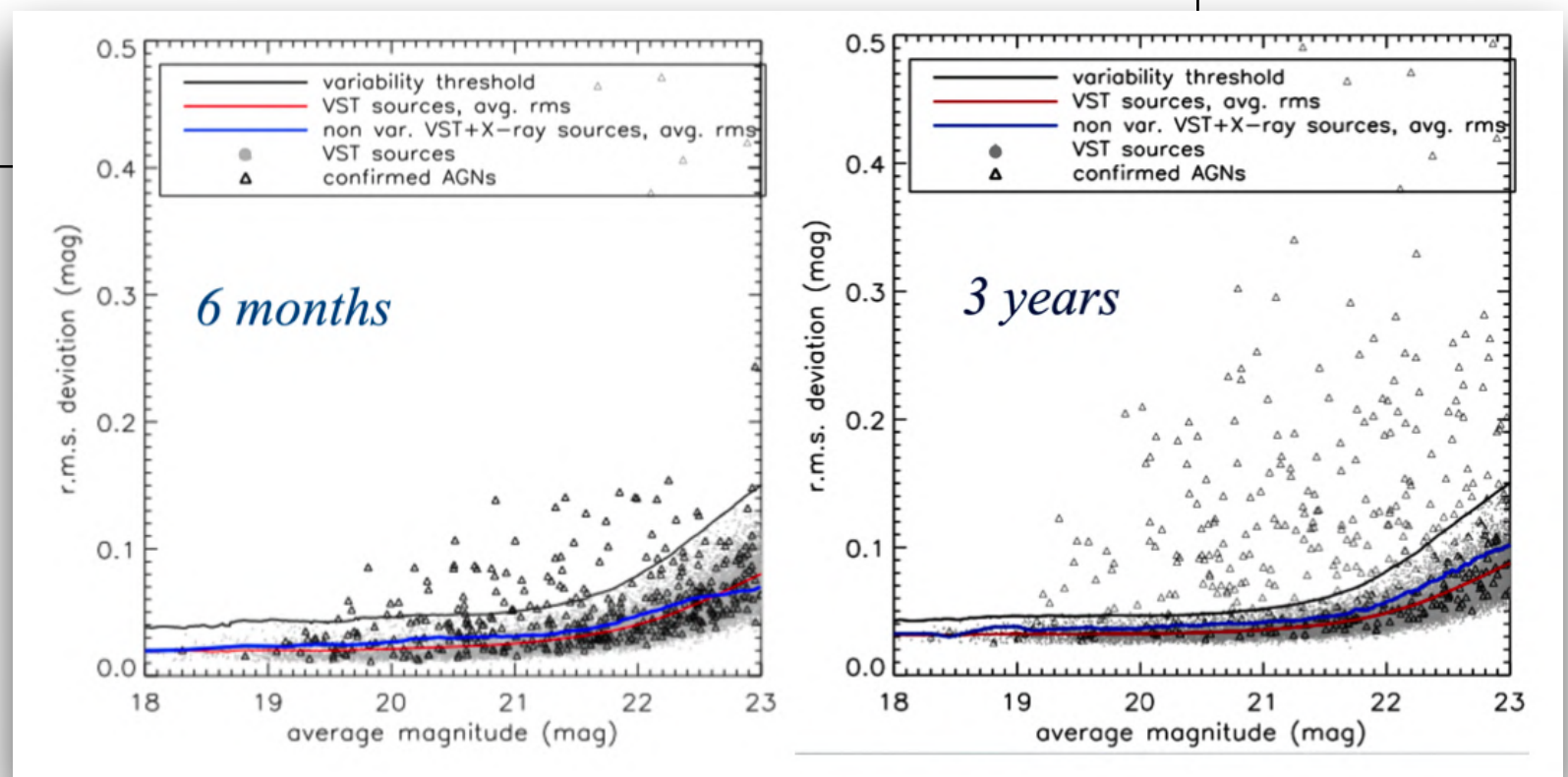
Science with VST@2022-2027

Galaxies & Cluster of galaxies

Toward next-generation time-domain surveys: census and properties of AGN in the LSST Deep Drilling Fields

(PI M. Paolillo)

➔ **Monitoring program of the central 4 sq.deg. for 4 DDFs that will be observed by the future LSST to obtain extended (up to > 10 years) precursor light curves (as well as deep images) that will be crucial to detect and characterize variable and transient sources (AGN, TDE, blazars)**



Science with VST@2022-2027

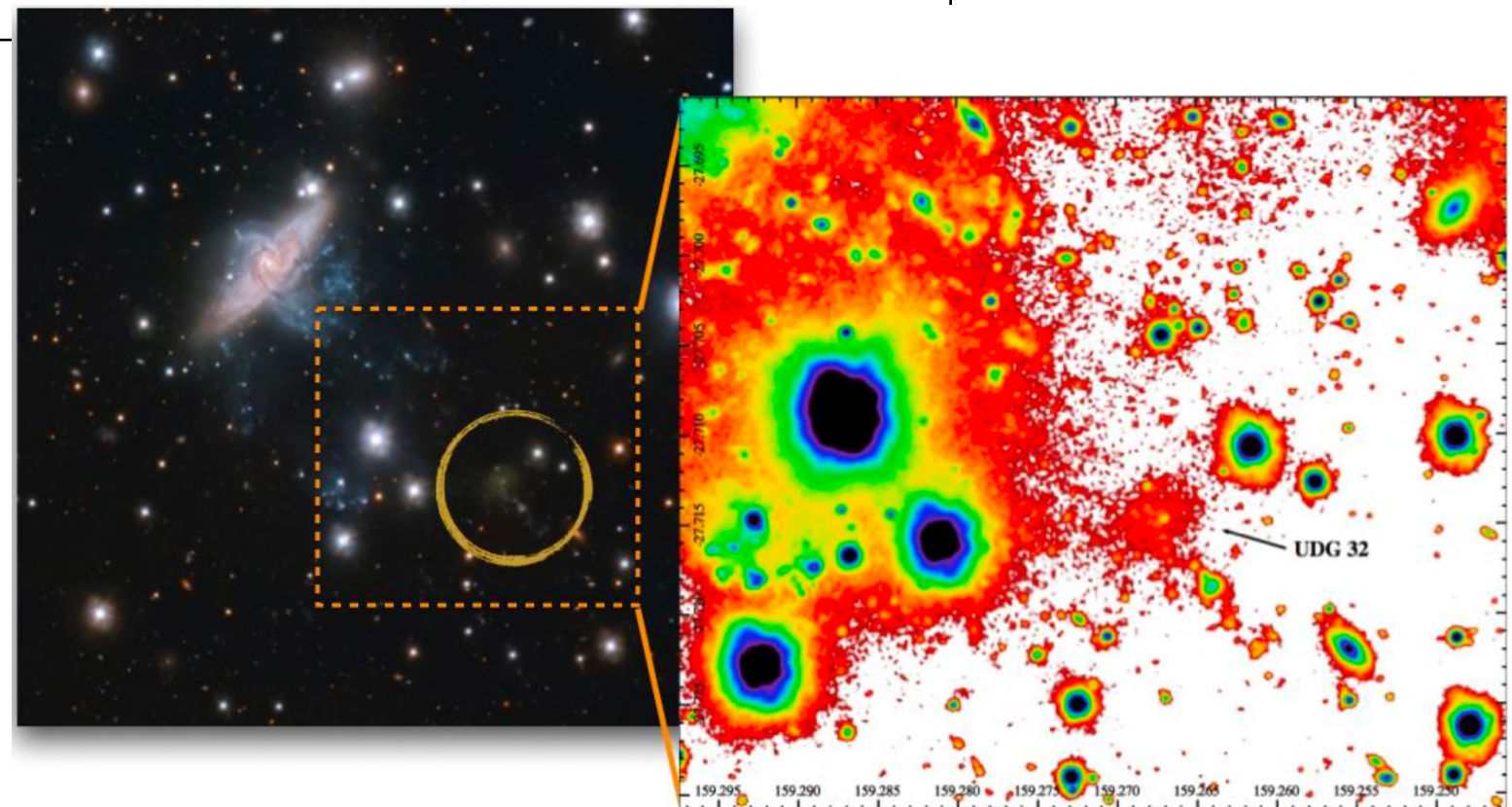
Galaxies & Cluster of galaxies

Searching for UDGs In the Tails of Stripped gas of GASP Jellyfish galaxies (SUITS)

(PI N. Bellucco)

➔ Map the LSB features in 7 cluster of galaxies to find UDGs

SP-Young



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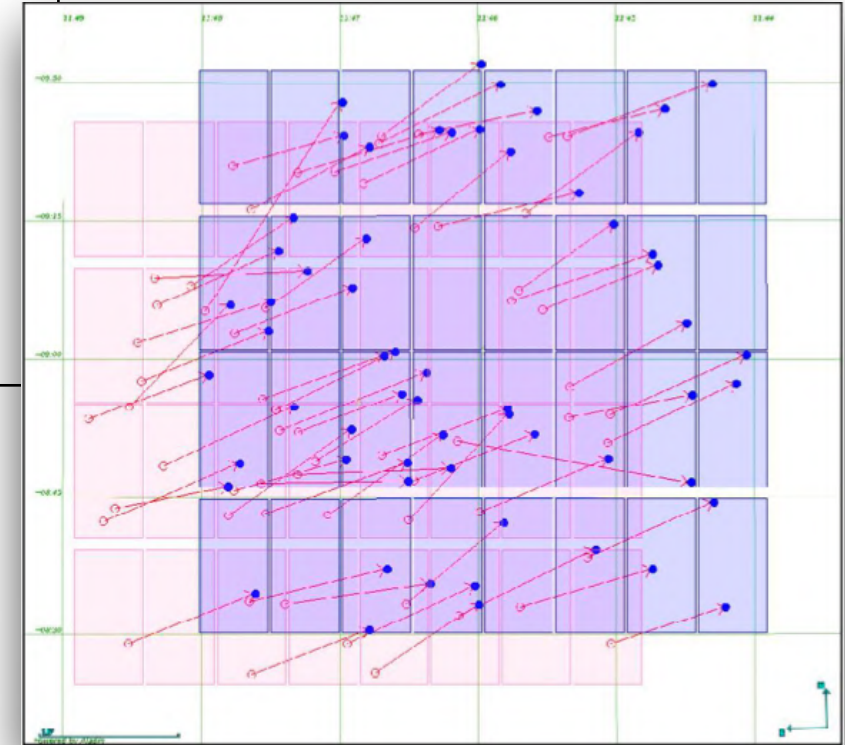
Science with VST@2022-2027

Planetary Systems

Near-opposition observations of asteroids to extend, complement and improve Gaia and WISE results

(PI A. Dell'Oro)

- ➔ **Multi-band follow-up observations of asteroids detected by GBOT within 48 hours of first detection, to obtain the absolute magnitudes of already known objects**



INAF Coordination Centre for VST

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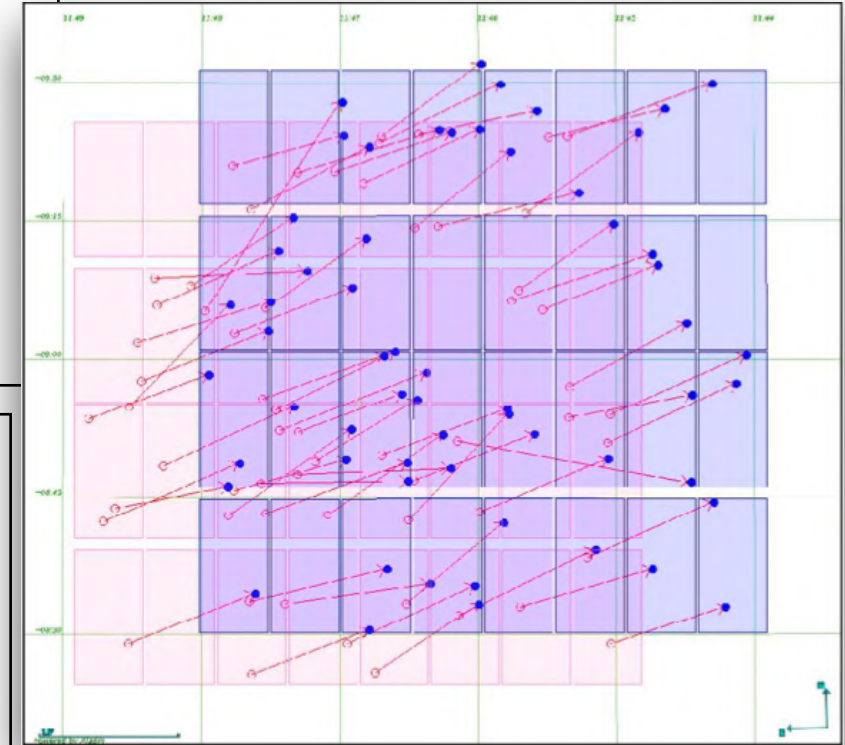
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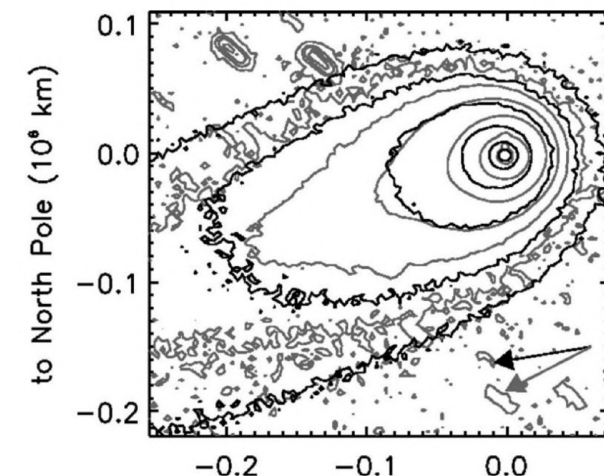
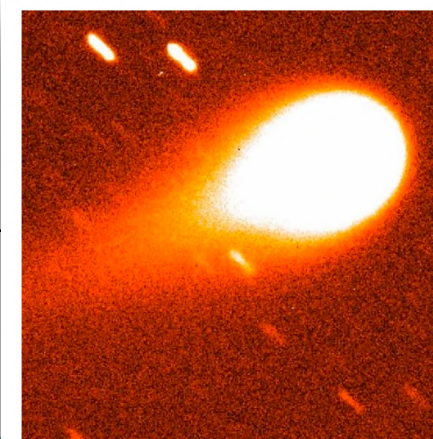
- ➔ **Multi-band follow-up observations of asteroids detected by GBOT within 48 hours of first detection, to obtain the absolute magnitudes of already known objects**



Comets as tools to constrain the structure and dynamics of protoplanetary disks

(PI E. Mazzotta Epifani)

- ➔ **Obtain high-SNR multiband images of Dynamically New Comets observable by the telescope during the next semester and investigate their nature homogeneously, by applying a probabilistic tail model to infer the fundamental properties of each object from the observations, and then investigate their implications on protoplanetary disks evolution**



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<https://vst.inaf.it>

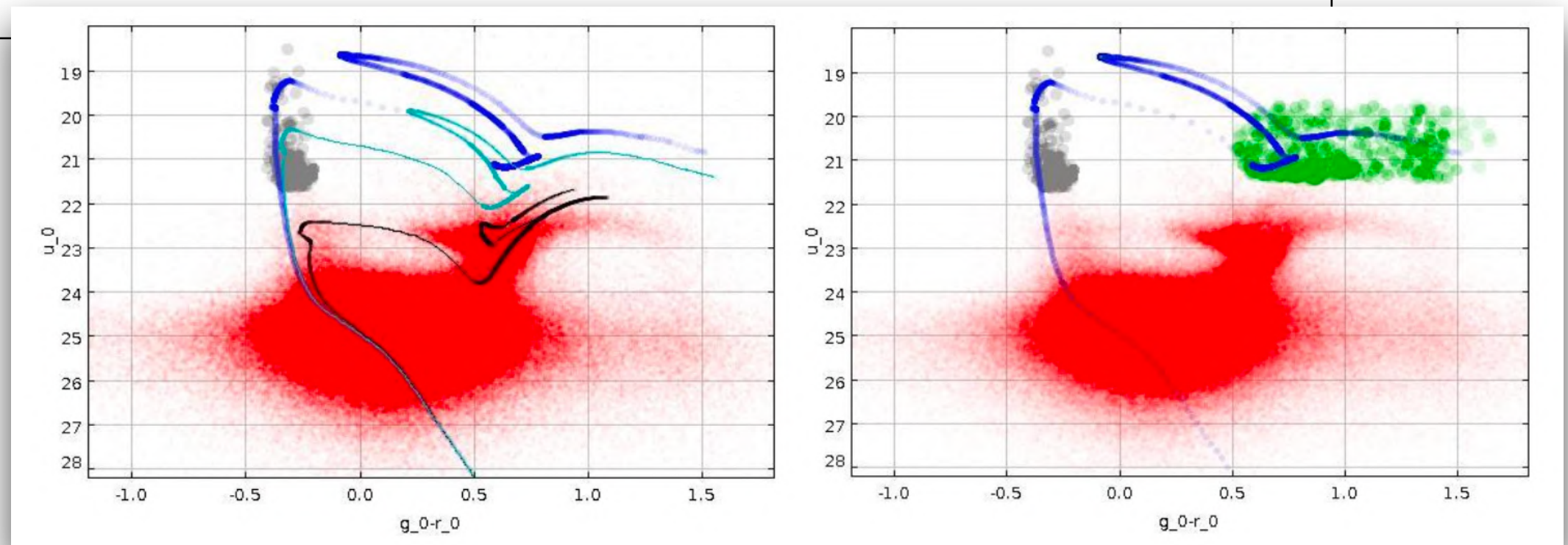
Science with VST@2022-2027

The Galaxy

An extended KiDS view of the Fornax dwarf spheroidal galaxy

(PI M. Dall'Ora)

- ➔ **Collect accurate and deep multi-band (ugri) photometry of the Fornax dwarf spheroidal (dSph) to study the size and the spatial distribution of its stellar populations & confirm the presence of the young stellar populations and study its properties**



Science with VST@2022-2027

*After 10 years of operations,
VST is still producing amazing scientific results*



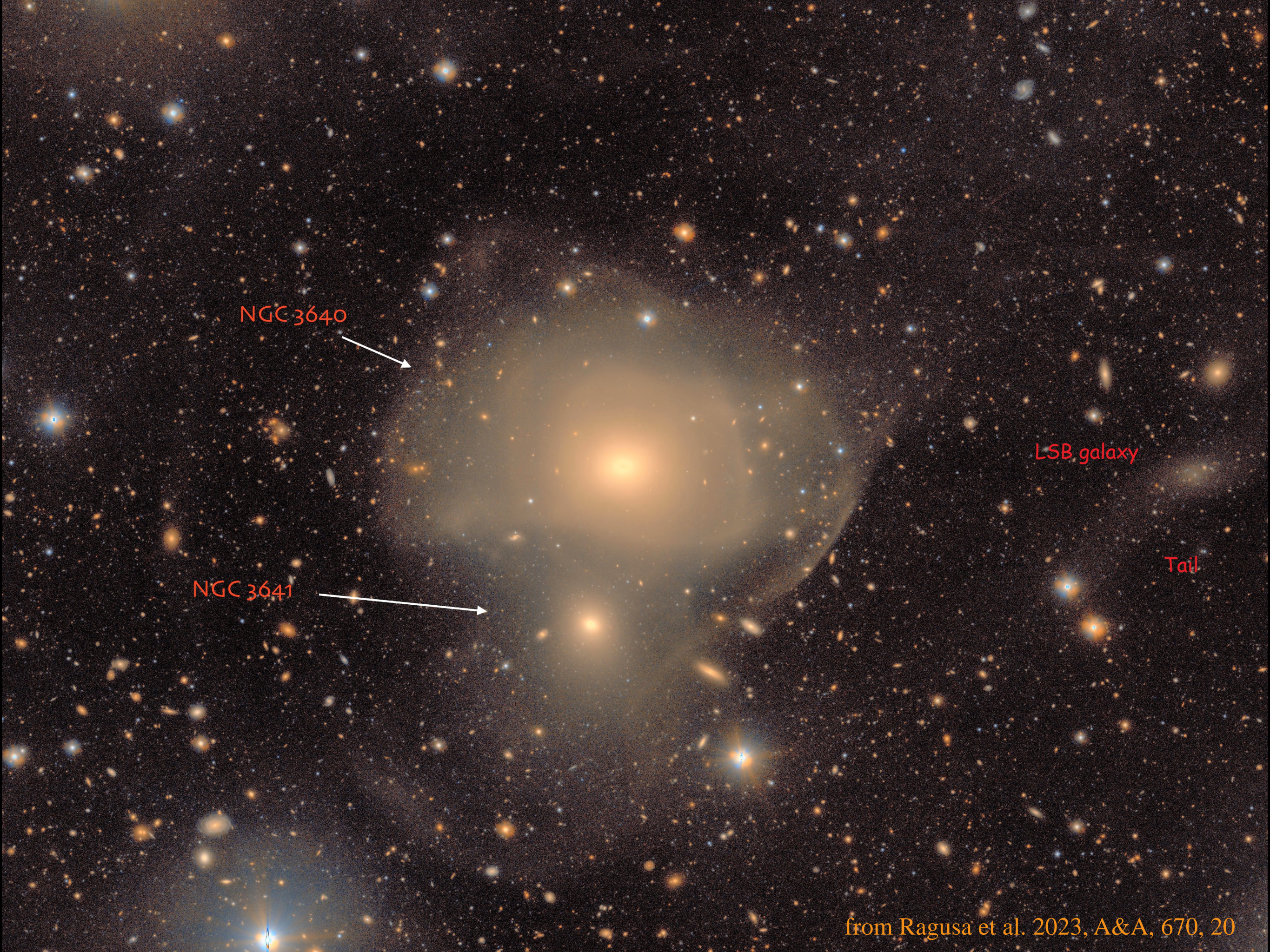
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HCG90

(credits M. Spavone & R. Calvi)





NGC 3640



NGC 3641



LSB galaxy

Tail

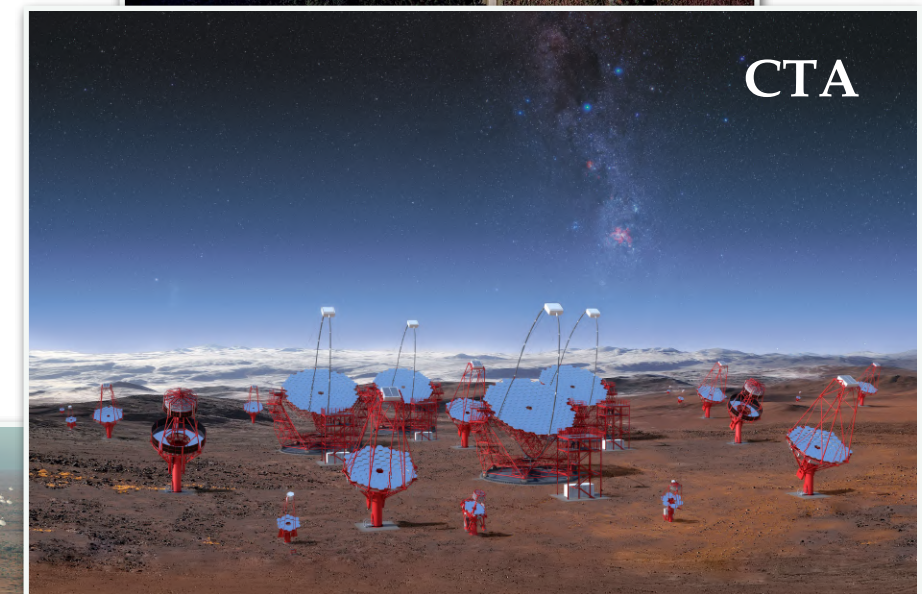
NGC 5236



Future perspectives

The role of VST in the era of next-generation surveys

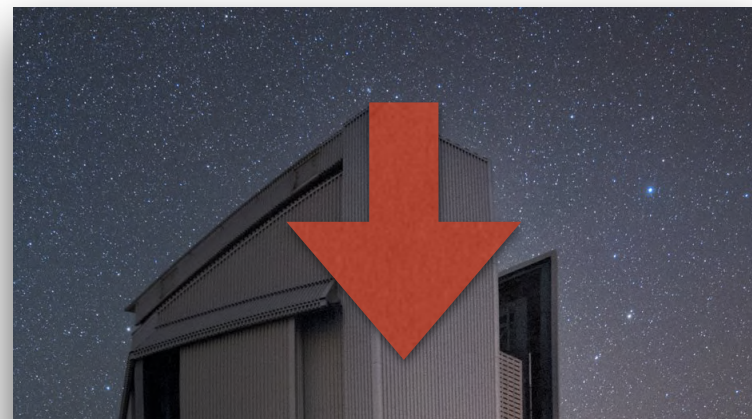
the Italian community has gained world-recognized expertise, to be transferred in the new surveys



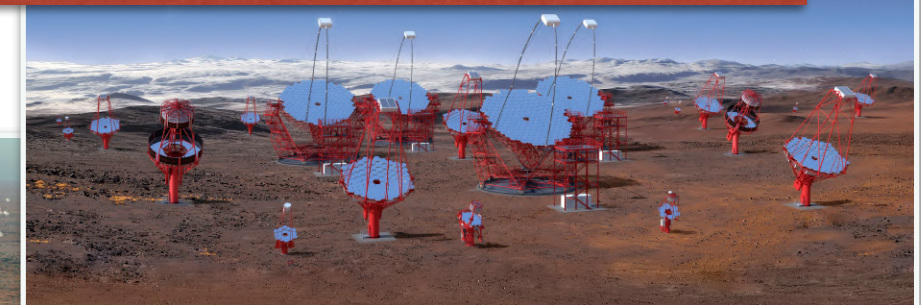
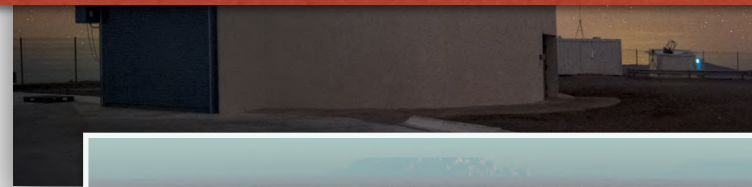
Future perspectives

The role of VST in the era of next-generation surveys

the Italian community has gained world-recognized expertise, to be transferred in the new surveys



dedicate the majority of the VST observing time to large observational campaigns, based on the INAF main-streams science and projects



Future perspectives

The role of VST in the era of next-generation surveys



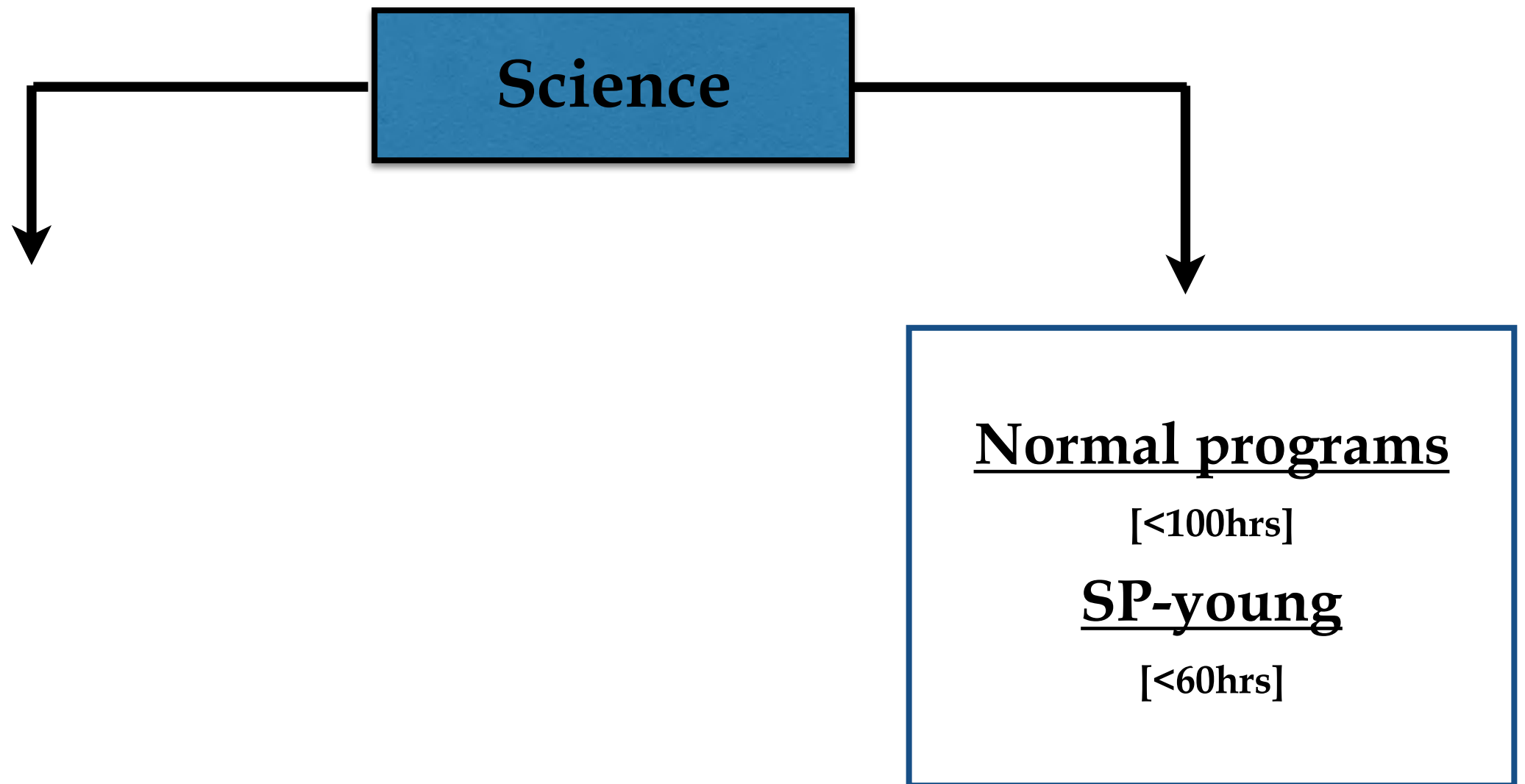
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Science with VST@2022-2027



Science with VST@2022-2027

Science

Large multi-cycle programs

[>100hrs]

- ▶ VST might support the upcoming imaging surveys (Euclid & LSST): calibrate, validate & test algorithms
- ▶ in-kind contributions@Rubin-LSST
- ▶ VST might have prominent role in the science with CTA & MAGIC
- ▶ new VST surveys to provide the optical counterpart of the radio data from SKA precursors

Normal programs

[<100hrs]

SP-young

[<60hrs]



VST Science Workshop

<https://vst.inaf.it/vst-workshop-2024>

16-17-18 April, 2024

Auditorium Nazionale INAF

Astronomical Observatory of Capodimonte, Naples, Italy

Goals

- ➔ provide an overview of the ongoing projects at the VST, approved during the the first two calls from the INAF allocation time, i.e. in 2022 and 2023
- ➔ trigger the discussion on the imminent call (~Apr 2024), which will open the VST observing time to large, multi-cycle programs



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