THE VST - VLT SURVEY TELESCOPE

P. SCHIPANI

ON BEHALF OF THE TEAM

AUDIZIONI INFRASTRUTTURE

31.05.2021

INAF

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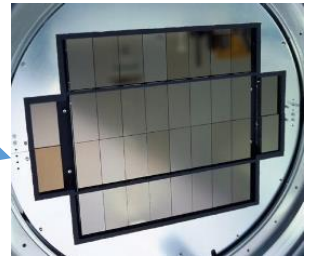
DI ASTROFISICA

AN INAF INFRASTRUCTURE IN THE BEST SITE AND MOST PRODUCTIVE OBSERVATORY

- ESO, Chile, Cerro Paranal (2635 m)
- 2.6-m Ø , visible band
- **1° x 1° wide-field imager (OmegaCAM)**
- **Active Optics (WFS,M1,M2)**
- **Designed and realized by INAF**
- Same tech performance of ESO UTs (tracking, AO)
- Same reliability of ESO UTs
- ESO Dataflow System
- No stop work since end 2011
- ESO-INAF Agreement till 03/2022



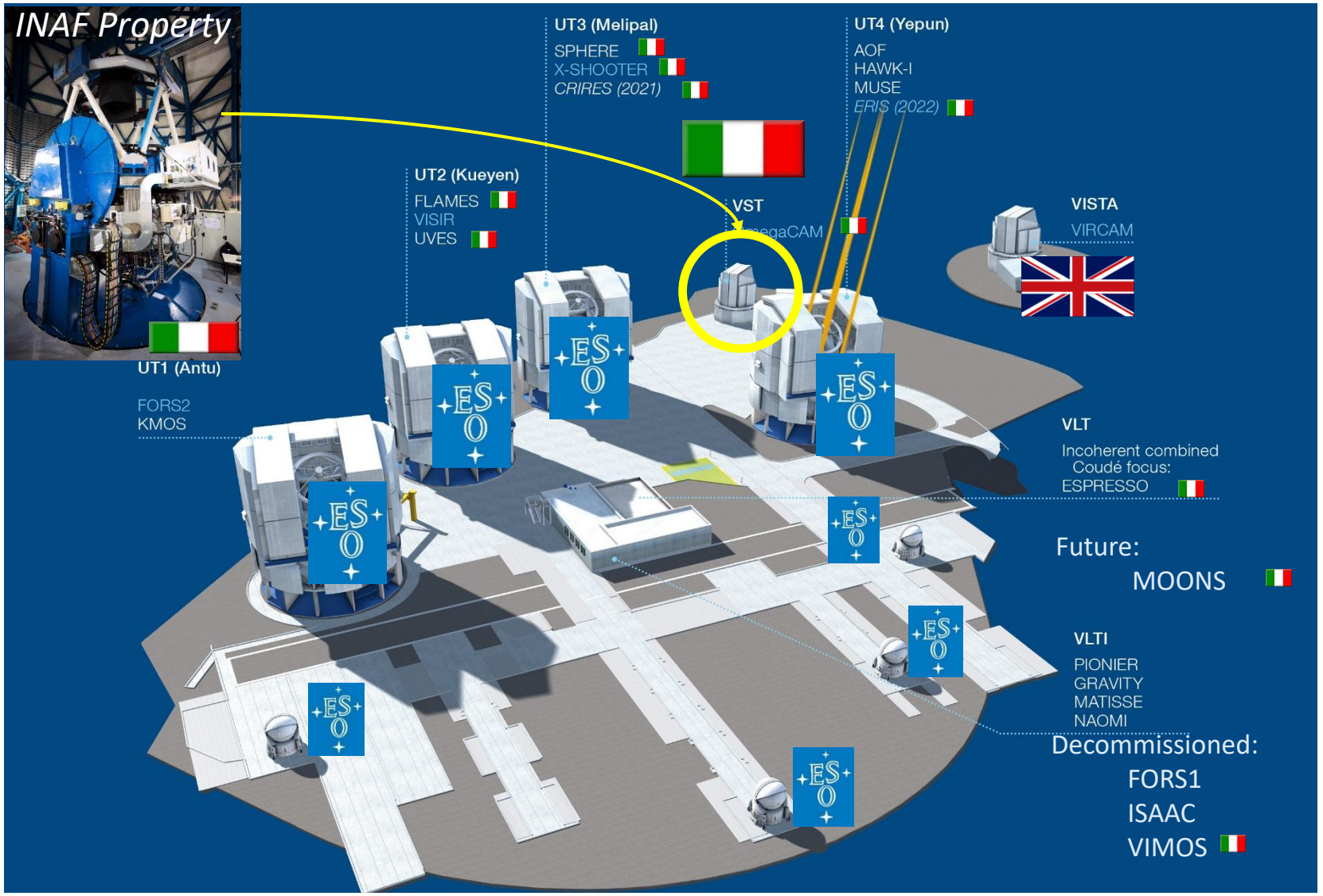
- **Phase 1 - Realization**
  - Cost: ~15 M€ (ext. + INAF) + Instr. + Dome
  - FTE (INAF only): ~200
- **Phase 2 - Operations under ESO control**
  - Cost: <200k€/yr (INAF)
  - FTE (INAF only): ~25

- *HW relatively cheap (INAF did most of the work)*
- *Huge INAF human investment for the realization and operations (Nx100 FTEs)*
- *Big INAF heritage for optical surveys (e.g. VRO)*

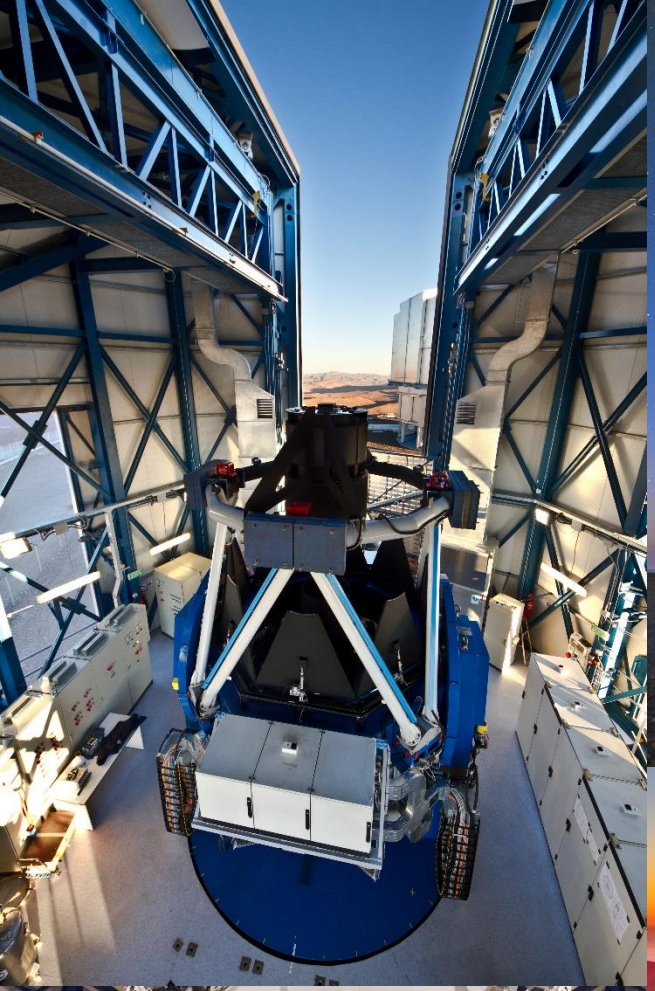
LEADERSHIP

ESO PARANAL

- Telescopes
  - ALL ESO projects but VST & VISTA
- Instruments
  - Consortia with many INAF participations



So far the only INAF-led telescope or instrument delivered to ESO

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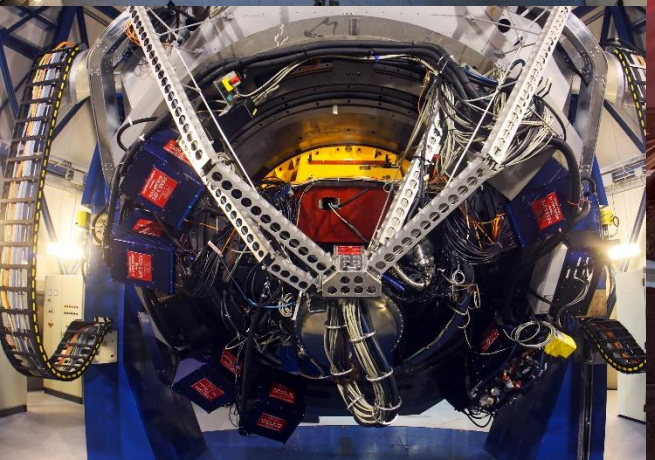


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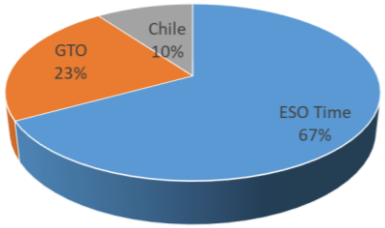
SCIENCE WITH THE VST

VST in the Era of the Large Sky Surveys
https://indico.ict.inaf.it/e/VST2018



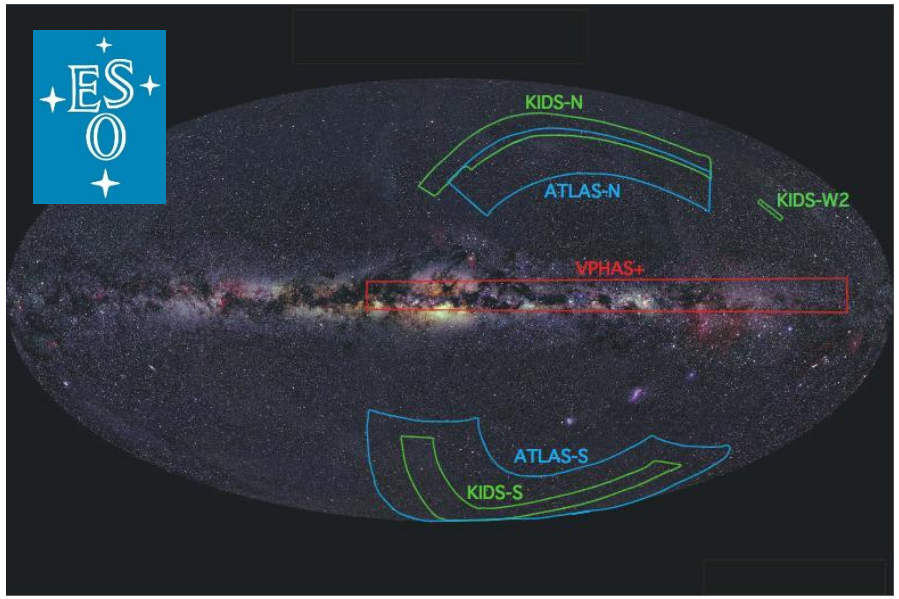
Summary from: VST Beyond 2021 report
http://www.inaf.it/it/sedi/sede-centrale-nuova/direzione-scientifica/report-vst-beyond-2021

ESO TIME

KiDS Kilo-Degree Survey. 2 areas of extragalactic sky 1350 square degrees ugri in parallel with the IR survey VIKING. Mapping the matter distribution in the Universe through weak gravitational lensing and photometric redshift measurements.

ATLAS survey ugriz covering ≈4700 deg^2 extended with u-band

VPHAS+ VST Photometric Hα Survey of the Southern Galactic Plane and Bulge southern Milky Way in ugri and Hα (segmented narrow-band filter)



ESO Public Surveys

GAIA GBOT

Ground Based Optical Tracking (GBOT) campaign, to improve the astrometric precision of GAIA. As a by-product this program discovered lots of new asteroids.

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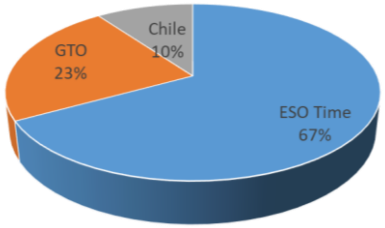

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GTO TIME

Extragalactic astronomy

- **VEGAS** (VST survey of Early-type GAlaxies in the Southern hemisphere, Capaccioli et al. 2015, A&A, 581, 10). Deep photometry, addressing the study of stellar halos and faint structures. The same VEGAS team worked also on the Fornax Deep Survey (**FDS**, Iodice et al 2016, ApJ, 820, 42)
- **WINGS/OmegaWINGS** (Wide-field Imaging Nearby Galaxy clusters Survey with OmegaCAM, Gullieuszik et al. 2015, A&A, 581, 41) surveys studied nearby galaxy clusters originating follow-ups with the AAOmega spectrograph, Alma, Meerkat, VLA, HST
- **ACCESS** - **Shapley Supercluster** (Merluzzi et al. 2014, MNRAS, 446, 803)

Galactic astronomy

- **STREGA** (STRucture and Evolution of the GAlaxy, Marconi et al. 2014, MNRAS, 444, 3809) aimed at investigating the formation and evolution of the galactic halo; **STEP** (the SMC in Time: Evolution of a Prototype interacting late-type dwarf galaxy, Ripepi et al. 2014, MNRAS, 442, 1897) and **YMCA** (Yes, Magellanic Clouds Again), looking into the Magellanic system stellar populations, were executed or are still running.

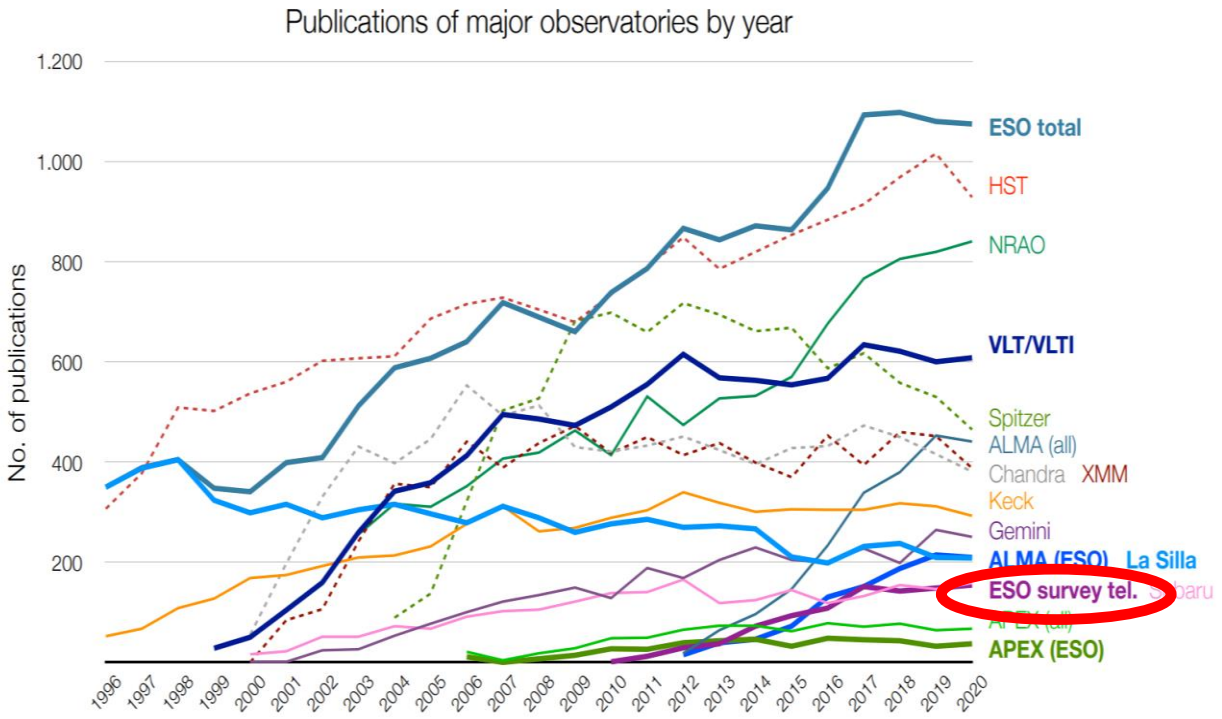
Transients and multi-messenger astronomy

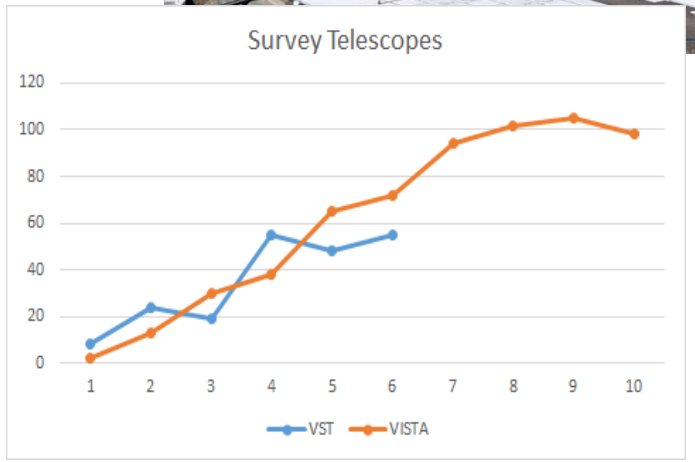
- The evolution of the supernova rate with cosmic time was studied by the **SUDARE** (SUpernova Diversity And Rate Evolution; Cappellaro et al. 2015, A&A, 584, A62) program, including Italian and Chilean time and the **VOICE** (VST Optical Imaging of the CDFS and ES1) program.
- **GRAWITA** (GRAvitational Wave Inaf TeAm) search for electromagnetic counterparts of gravitational wave events in reaction to LIGO/Virgo alerts. In particular the kilonova AT2017gfo, optical counterpart of the neutron star merger GW 170817, was observed by the GRAWITA team with the VST (Pian et al., 2017, Nature, 551, 67).

+ more recent programs

THE VST - VLT SURVEY TELESCOPE

- Wonderful seeing
- Good weather
- Outstanding telescopes & maintenance

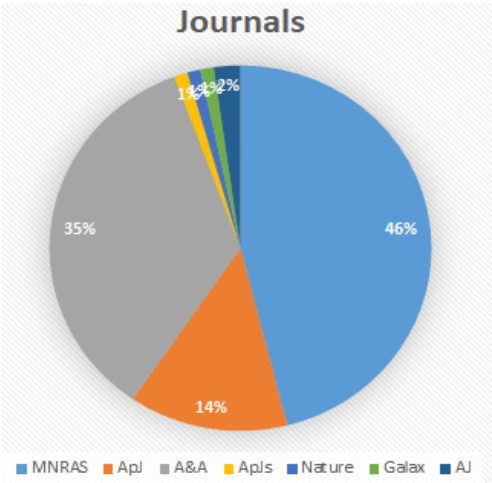


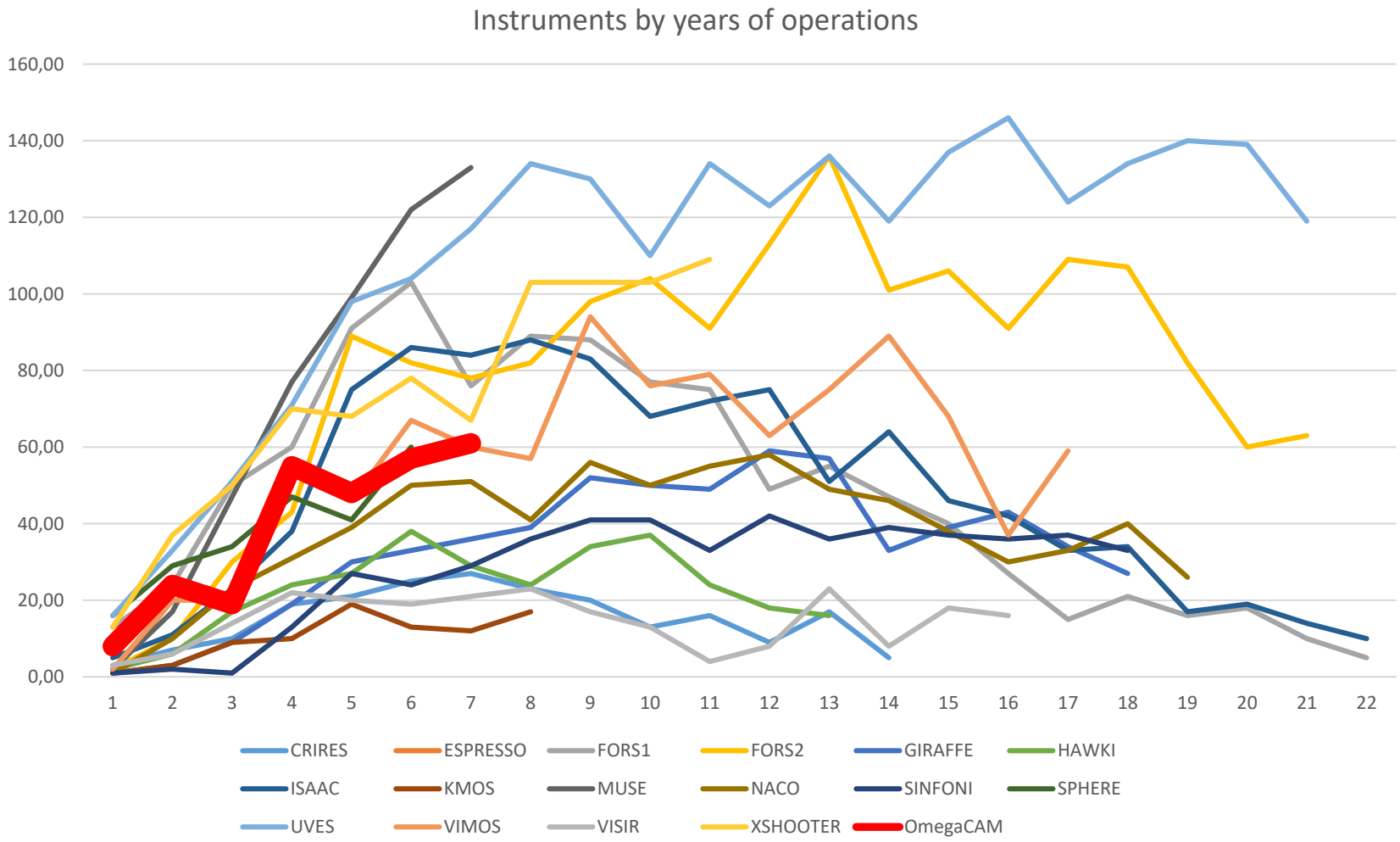


(Active) part of the most productive observatory of the world

SCIENTIFIC PAPERS ON REFEREED JOURNALS

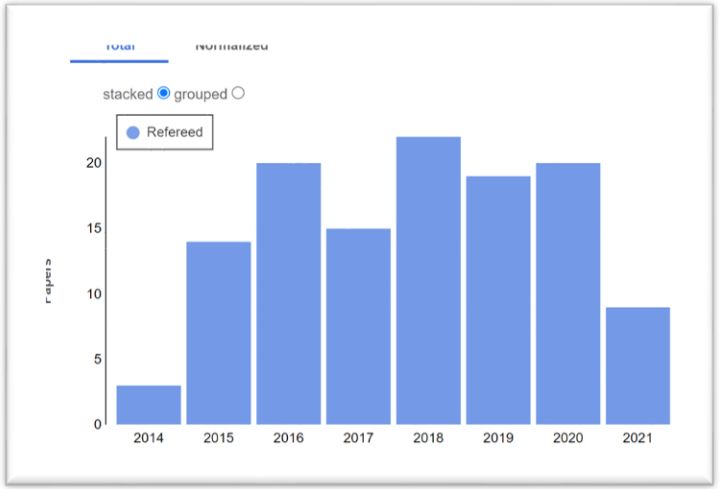
- **VST** papers vs **VLT** instruments
- Increasing number of papers on refereed journals (**>60** papers in **2020**)
- Papers: **~300**
- Citations > **18000**
- H-index **48**

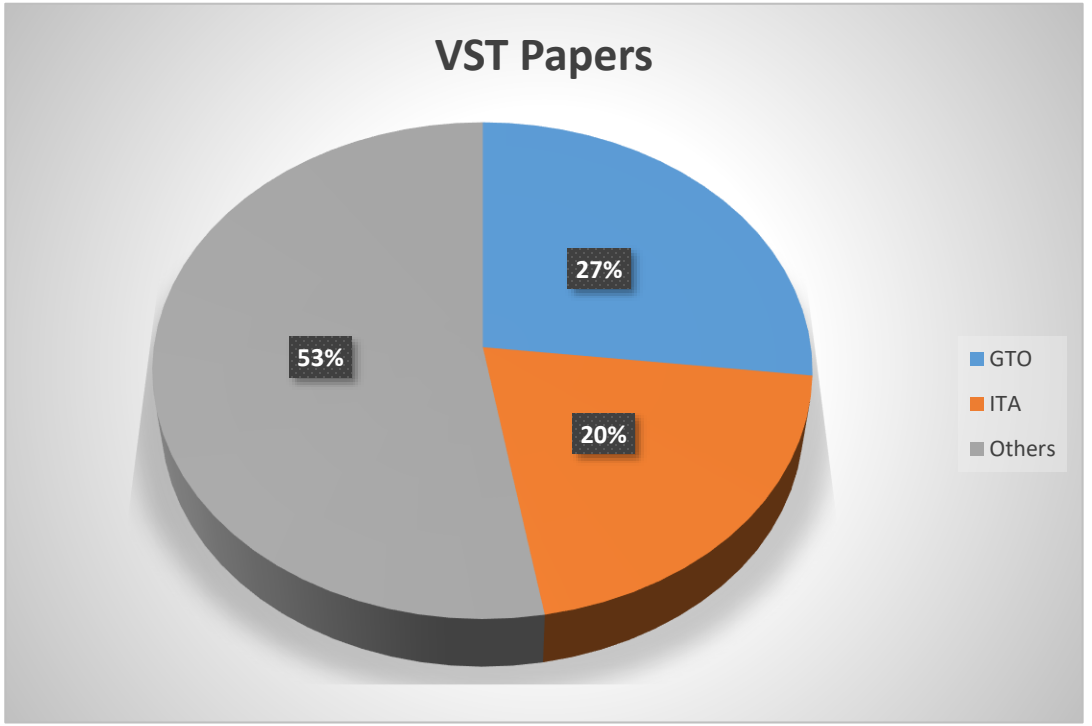




IMPACT ON ITALIAN COMMUNITY

- ❑ % of GTO papers in line with % of observing time (slightly greater)
- ❑ Good % of papers with Italian affiliation authors in non-GTO papers
- ❑ Good IT presence in KiDS
- ❑ Overall, Italian involvement in **> 40%** of VST papers
- ❑ All semesters: 5-10 INAF PI programs on GTO





Big impact, small cost

TECHNOLOGICAL PAPERS

- ❑ Total: 86 (mostly SPIE)
- ❑ Refereed: 9

Tech. Documents (ESO reviews)

- ❑ Countless (∞)

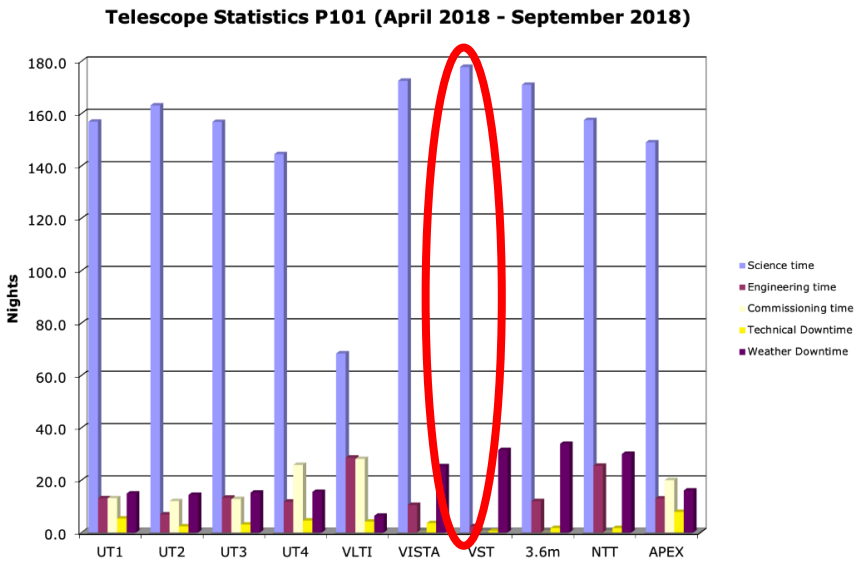
RELIABILITY

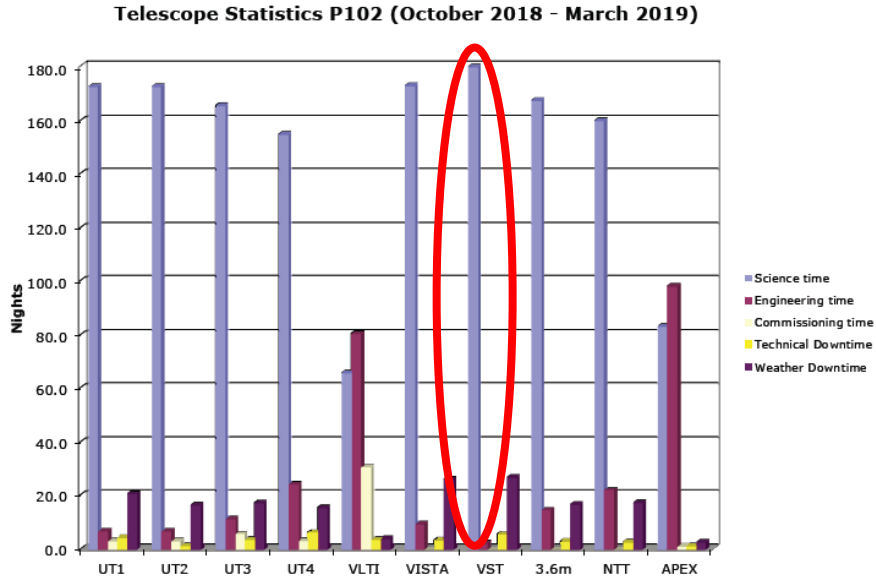
- ❑ Technical Downtime due to telescope + instrument (only 1: you can't switch to another) + dome: negligible
- ❑ Weather downtime
- ❑ Technical nights

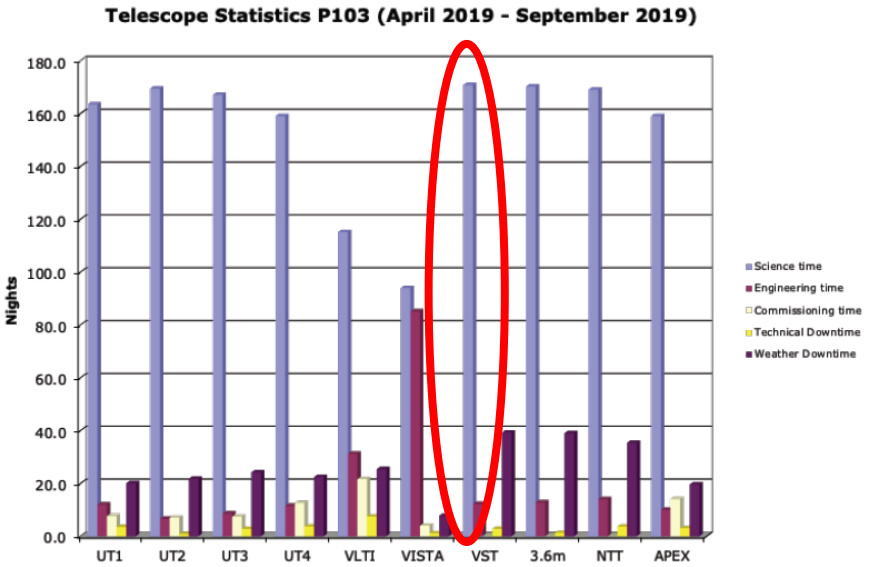
SCIENCE TIME

Consistently the highest of all ESO telescopes in last years

Source: ESO







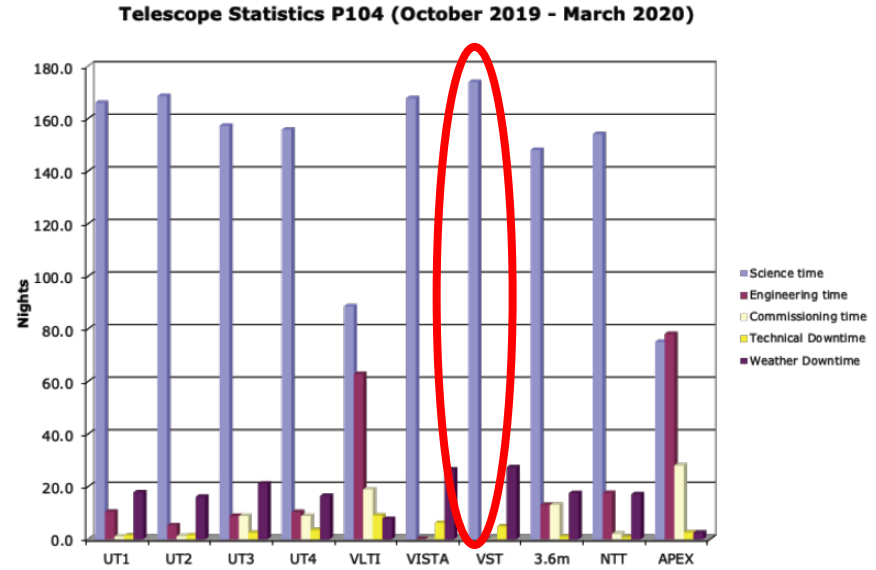
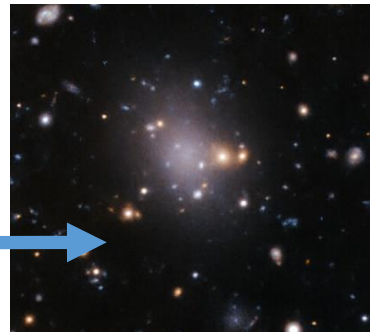
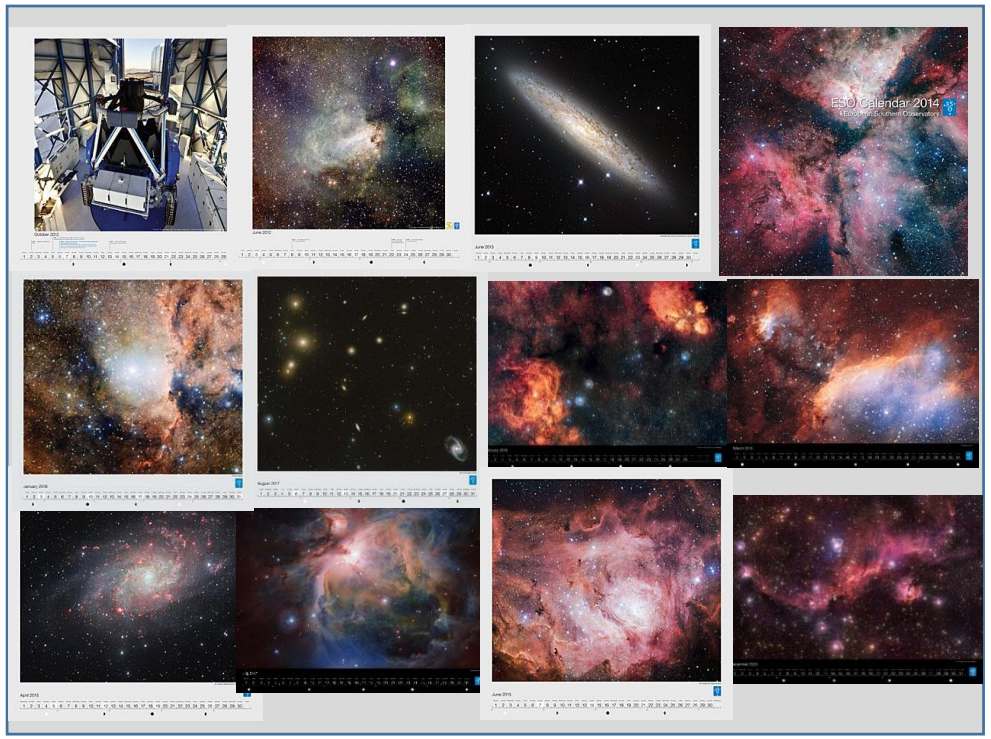


IMAGE QUALITY

*ESO Picture of the Week… of **this** week*
https://www.eso.org/public/italy/images/potw2122a/





- **Seeing limited** over a wide-field of view
- Best site for optical astronomy

2 Tom Shanks

Survey	Type	Epoch	Bands	Lim. Mag.	deg^2	N/S	Seeing (arcsec)
DENIS	NIR	1997-03	iJK	$K \approx 12$	20000	South	3
SDSS	Visible	2000-05	*ugriz*	$r \approx 22.7$	14500	North	1.2
CFHT RCS2	Visible	2002-09	*grz*	$r \approx 24.8$	830	N+S	0.9
CFHTLS Wide	Visible	2003-12	*ugriz*	$r \approx 25$	157	North	0.9
2MASS	NIR	1997-01	*JHK*	$K \approx 14.3$	All sky	N+S	1.5
UKIDSS	NIR	2005-12	*YJHK*	$K \approx 18.4$	7500	North	0.9
WISE	Mid-IR	2010-12	$3.4-22\mu m$	$W1 \approx 17$	All Sky	N+S	6
Pan-Starrs 3π	Visible	2010-14	*grizy*	$r \approx 22.8$	30000	N+S	1.1
SkyMapper	Visible	2009-	*uvgriz*	$r \approx 22.0$	20000	South	2.5
VST ATLAS	Visible	2011-	*ugriz*	$r \approx 22.7$	4700	South	0.9
VST KiDS	Visible	2011-	*ugri*	$r \approx 24.6$	1500	South	0.7
VISTA VHS	NIR	2010-	*YJK*	$K \approx 18.4$	18000	South	0.7
VIKING	NIR	2010-	*zYJHK*	$K \approx 19.5$	1500	South	0.9
DES	Visible	2013-	*grizy*	$r \approx 25.0$	5000	South	0.9
DECaLS	Visible	2015-	*grz*	$r \approx 23.6$	9000	North	1.2
HSC Wide	Visible	2015-	*grizy*	$r \approx 26.0$	1400	South	0.7

Table 1 Recent Optical and NIR extragalactic imaging sky surveys with an area of $> 100\text{deg}^2$. Magnitude limits are quoted in r_{AB} and K_{Vega}.

- VST Regularly delivers images down to **0.45”**
- **FWHM** uniform over the field, small ellipticity

VST BEYOND 2021

http://www.inaf.it/it/sedi/sede-centrale-nuova/direzione-scientifica/report-vst-beyond-2021

In November 2019 the Optical/NIR Division of the INAF Scientific Directorate appointed the "VST beyond 2021" working group to study the possible science cases and management options for the VST future.

(P. D'Avanzo (*chair*) , M. T. Botticella, M. Gullieuszik, A. Papitto, P. Schipani)

- ❑ **Call for ideas**
- ❑ **Workshop** (June 2020): https://indico.ict.inaf.it/e/VST2021

Extremely high interest of the Italian community (+ international collaborators)

Call for ideas:

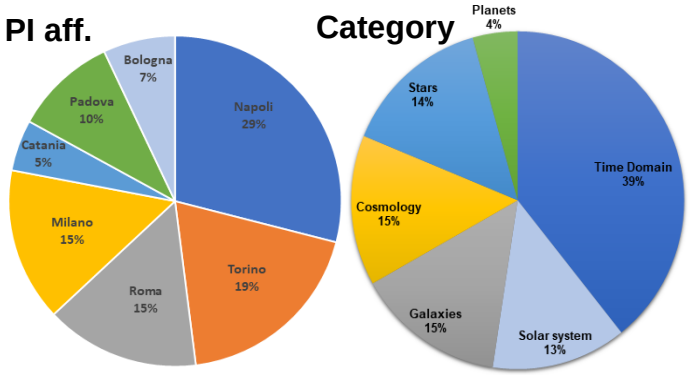
25 proposals

340 researchers + large collab.

2x Oversubscription for 5 yrs

Workshop:

170 researchers



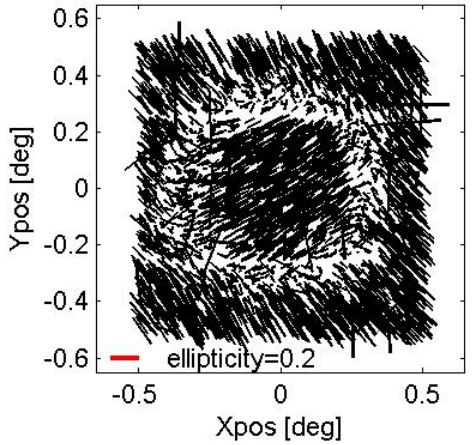
"The quantity, high quality and diversity of the projects presented in response to the Call for Ideas remarks the great interest of the community towards the VST. A significant fraction of these projects foresees synergies with the main future key astronomical facilities, demonstrating that the telescope is perceived as a vital and competitive scientific asset also for the next decade. Besides, the proposed plans for next generation instruments make it possible to project and extend the telescope activities over a long-term horizon."

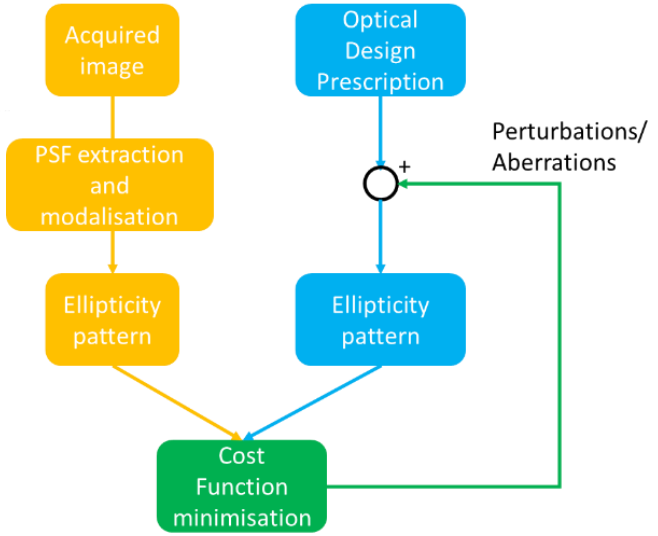
- Short, medium, long term proposals
- Many synergies with large facilities (VRO, CTA, SKA, EUCLID, JWST, 4MOST, WEAVE, SOXS, …)
- Change or upgrade of instrumentation

VRO IN-KIND CONTRIBUTION

- INAF proposed (end 2020) 3 contributions based on the VST:
  - Support to commissioning (parallel observations)
  - Complementary scientific programs (x3)
  - Open time - nights for US community
- VRO applied a weight factor for the evaluation of proposed telescopes: 0 < w < 1
  - Weight factor for VST: **1.16**
- All VST based contributions accepted (standby)

+ heritage for a 4th contribution
WFSless Active Optics
Concept proved on the VST
Proposed for VRO
Scheda IQ4VRO (G. Fiorentino)





FUTURE > 2022

- A new ESO-INAF agreement is needed (work in progress for a 5 yr Agr.)
- Up to 90% of time available for INAF. Hosted telescope
- VST operations under INAF control
- Service Mode => (Smart) Queue Mode
- ESO providing services in Chile (TIO, Maintenance)

- Operations handled by INAF: 7/7, 365/365
- Scheduler
- Connection with INAF PLEIADI

CRITICAL ISSUES

Make the VST a permanent INAF international infrastructures with a stable budget

Time

1. t0: Discuss and sign a new agreement with ESO asap
2. t0+1: Organize the INAF VST Center for handling proposals, observations, operations before the start of the new phase

Money

- ESO fee

Resources for INAF VST Center

- Personnel for VST-DOC for operations (7/7, 365/365), data reduction
- Hardware (possibly through INAF ICT)

And the usual question for all 'technological' duties

- Are duties rewarded in our system?

  ('siamo attraenti?' 'carriera?' 'tecnologi?' 'CTER?' 'cambiare sistema di valutazione?' ecc. ecc.)

VST +10

CELEBRATIONS