

Time-domain astronomy & multi-messenger (TDAMM): past, present and future

A visionary (biased) view

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INAF - Osservatorio astronomico di Brera

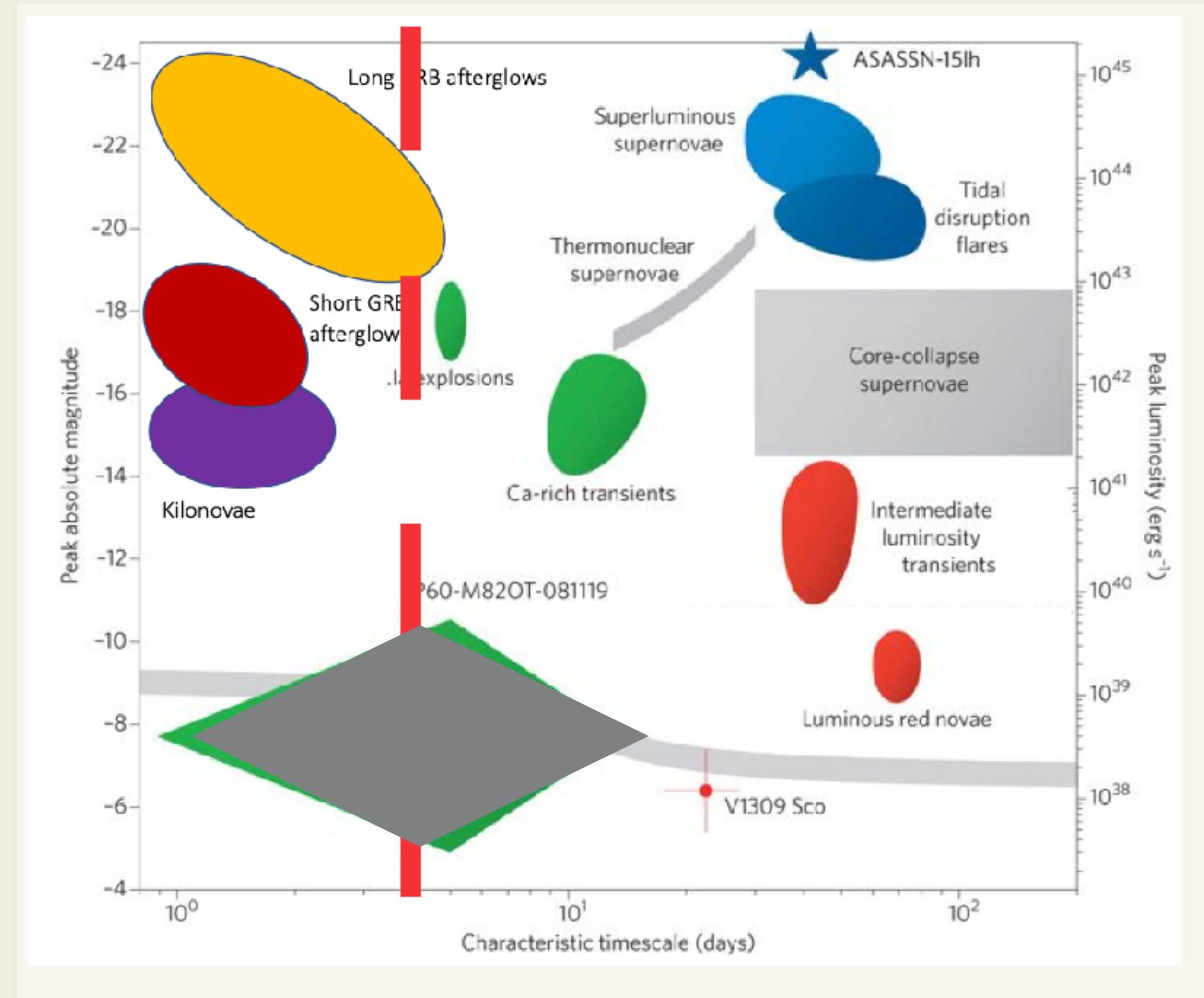
The wonder



Transient sky

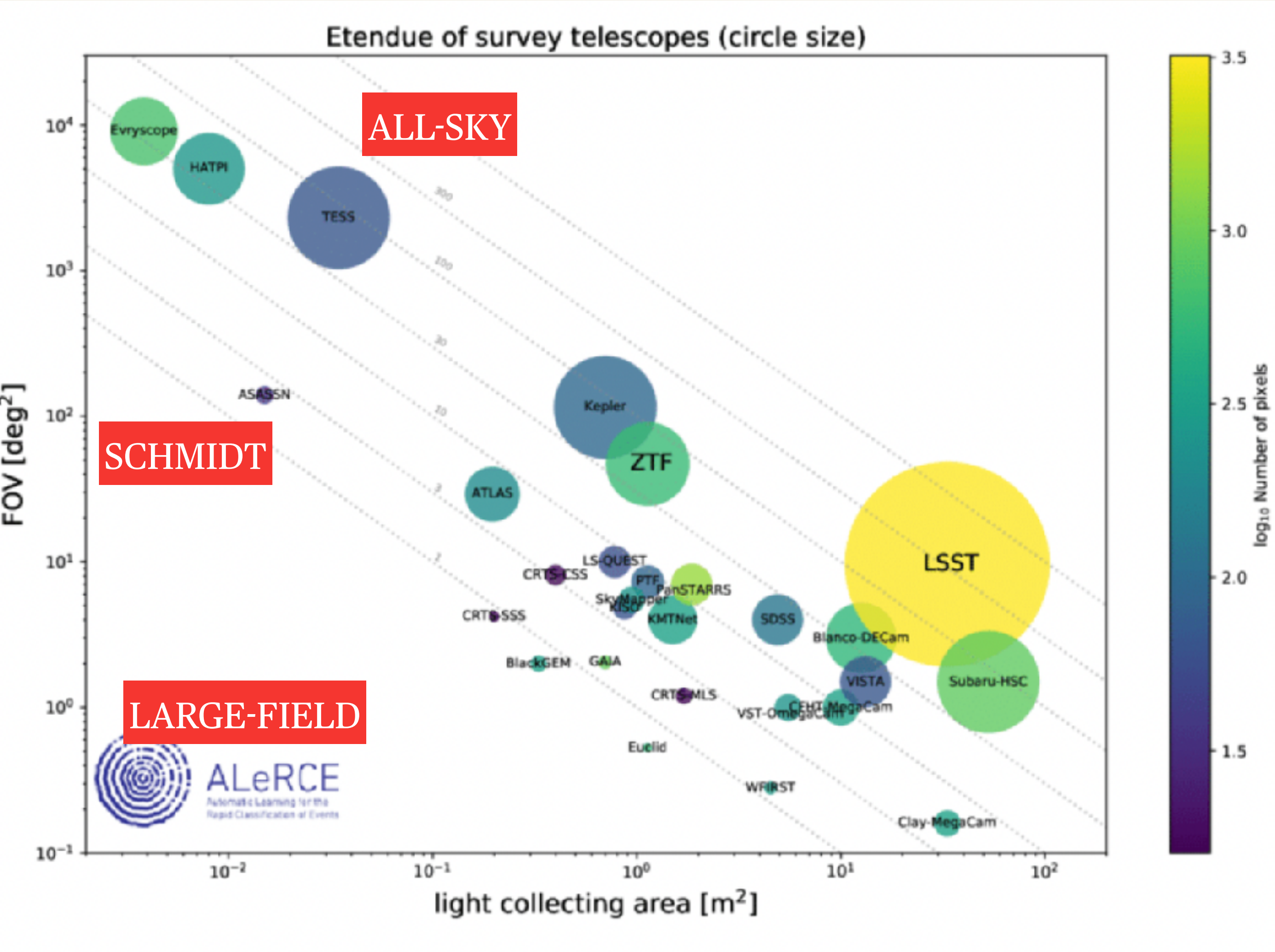
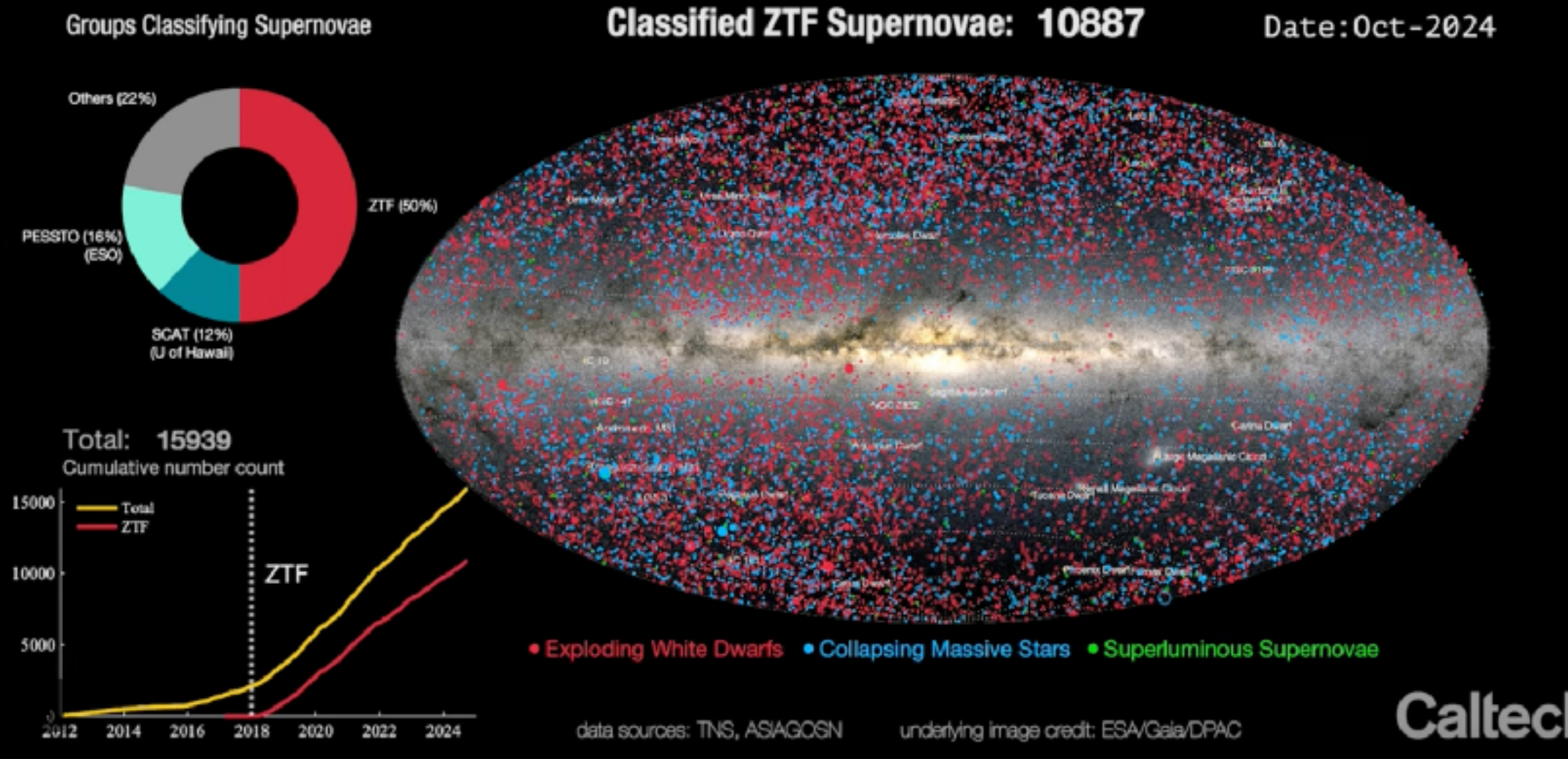
Gray pre-surveys!

- Variable stars
- Flaring stars
- Moving asteroids
- Variable AGNi
- (Satellites)
- (Defects-bogus)



Optical surveys

Zwicky Transient Facility Leads to Classification of 10,000 Supernovae



SERGIO CAMPANA - MAY 16, 2025

Rubin!

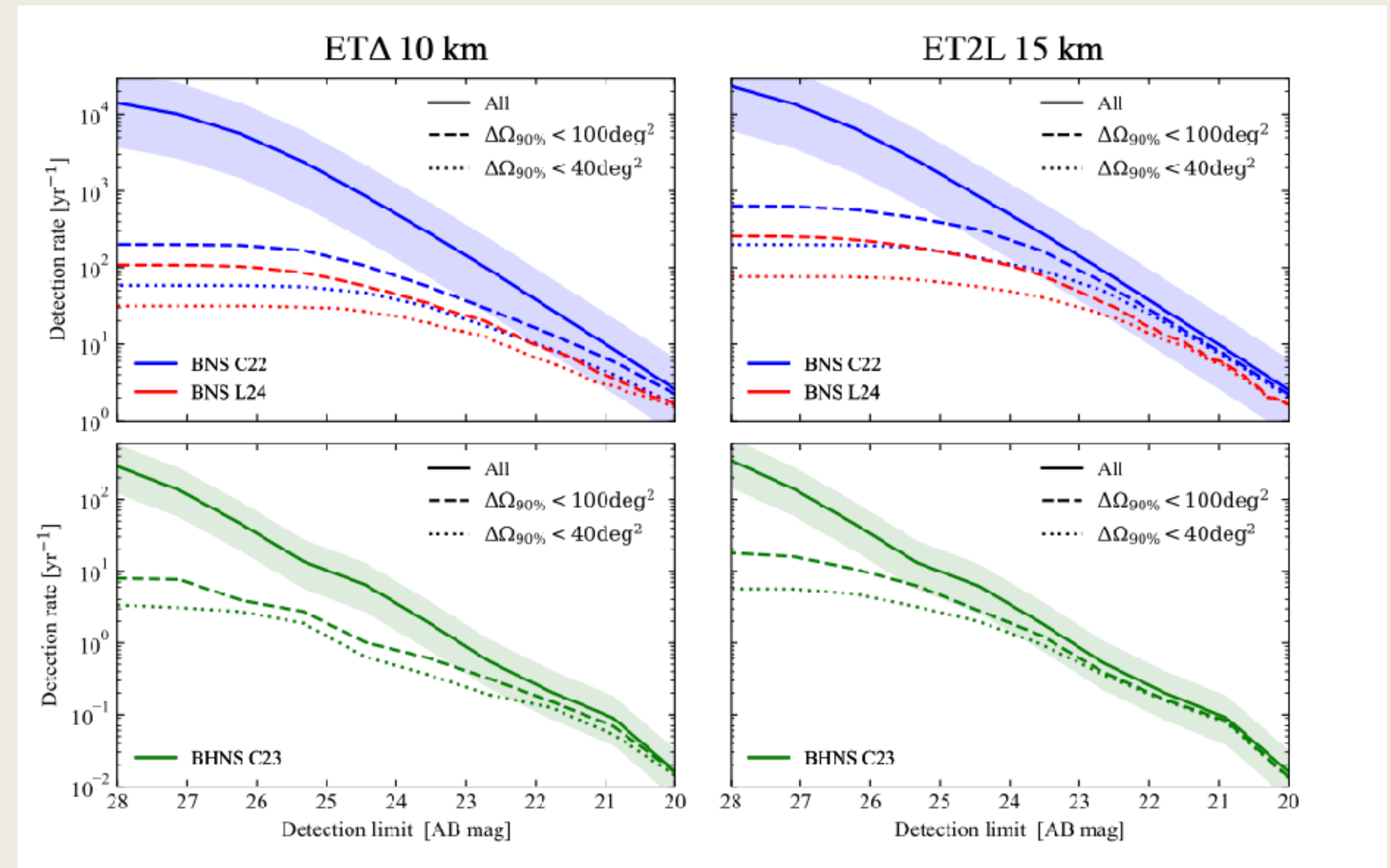
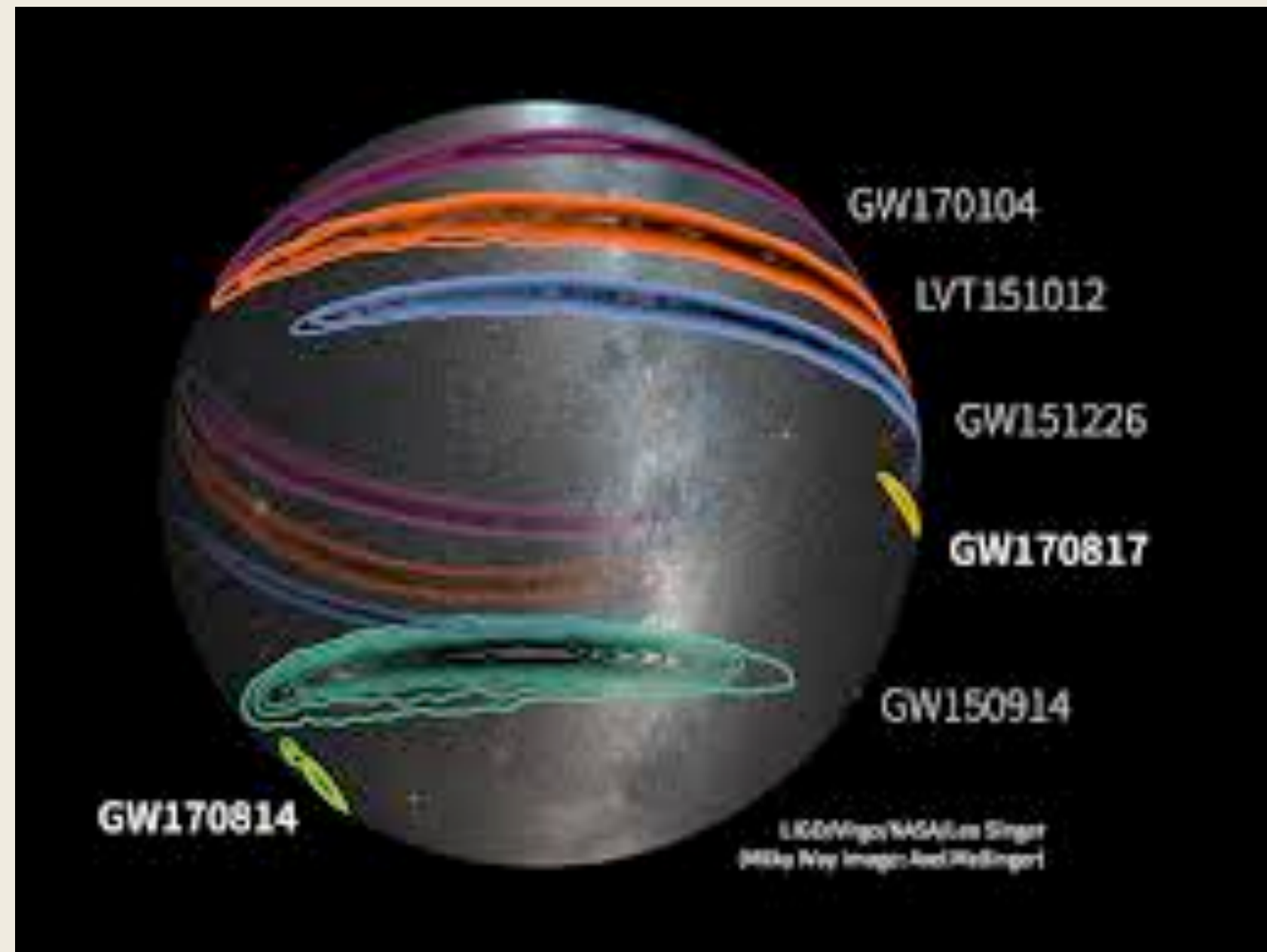


July 4th 2025: first light

September 18th 2025: Operations Readiness review

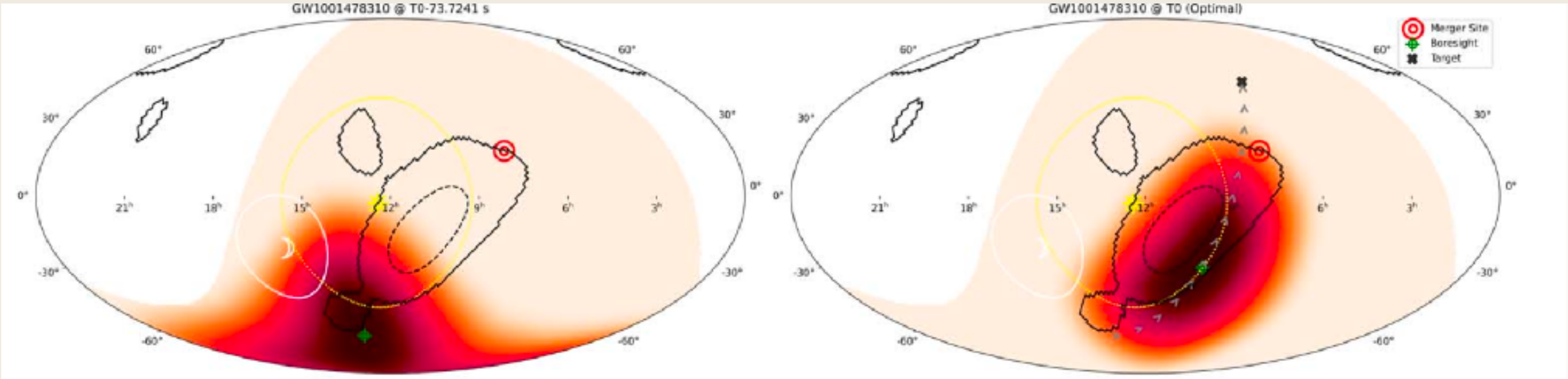
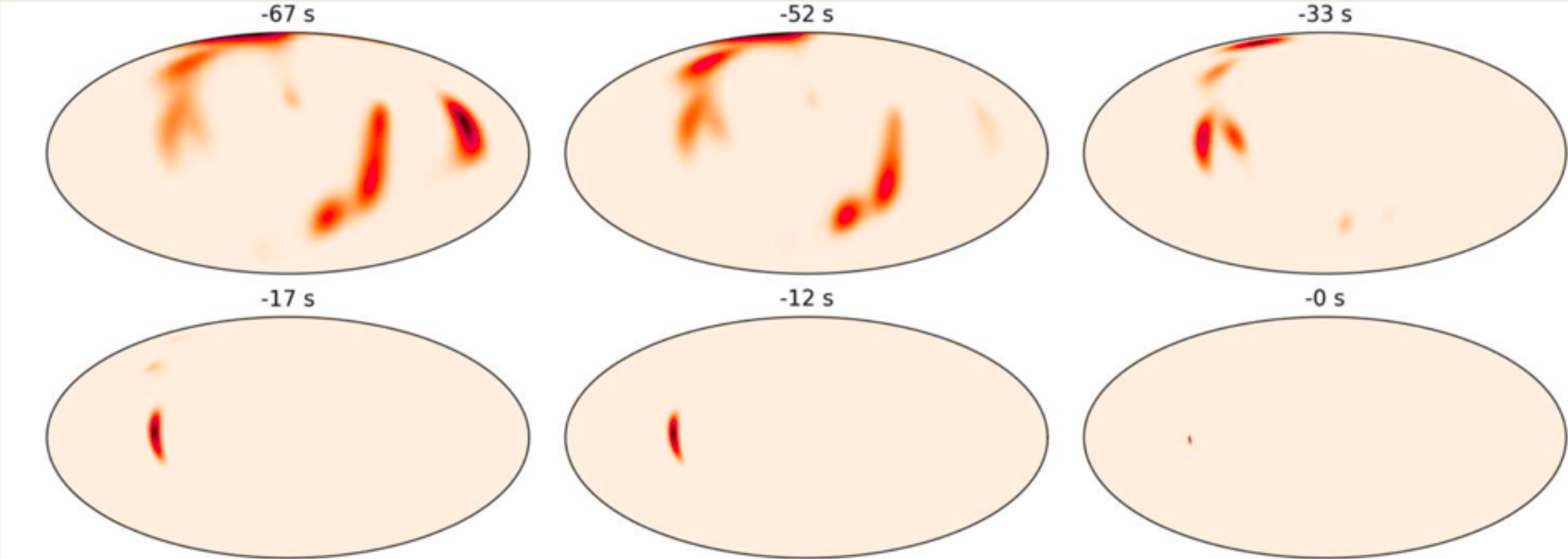
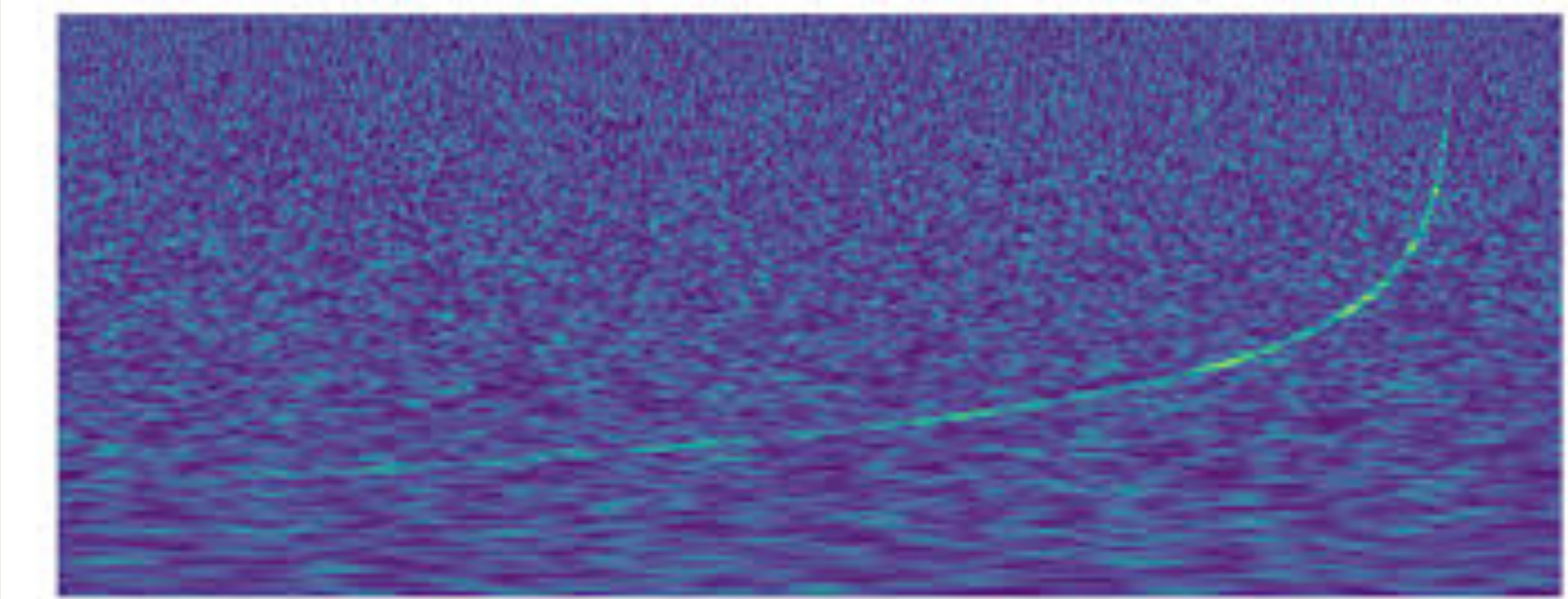


GW error regions

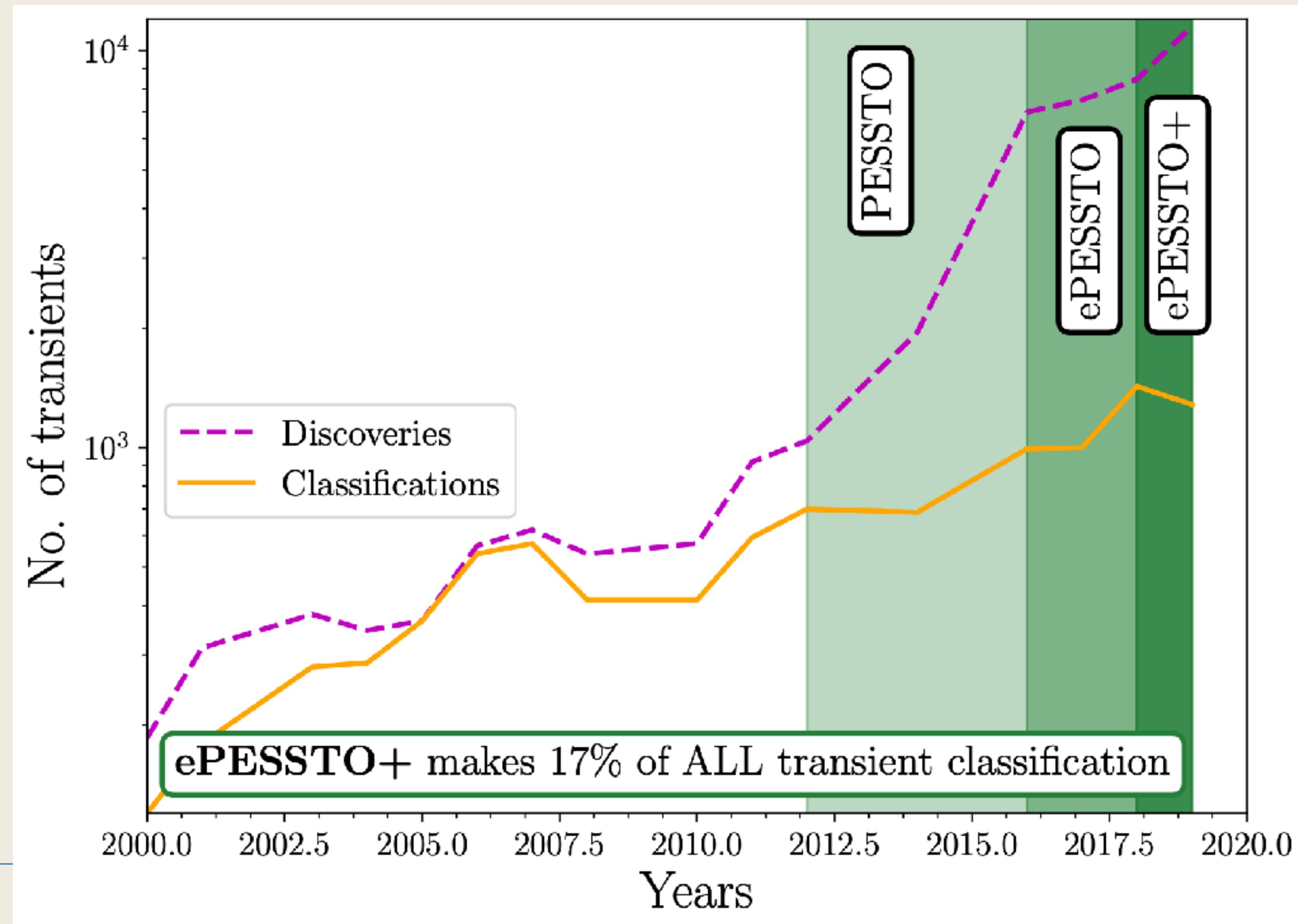




Swift (TDAMM machine)

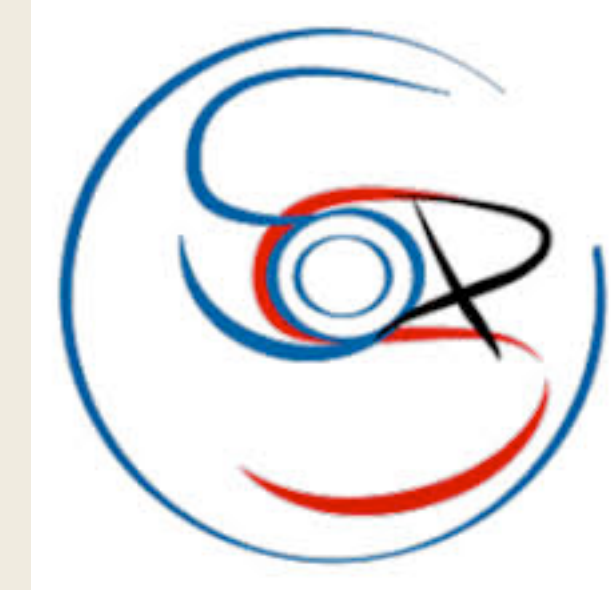


... but still: THE problem

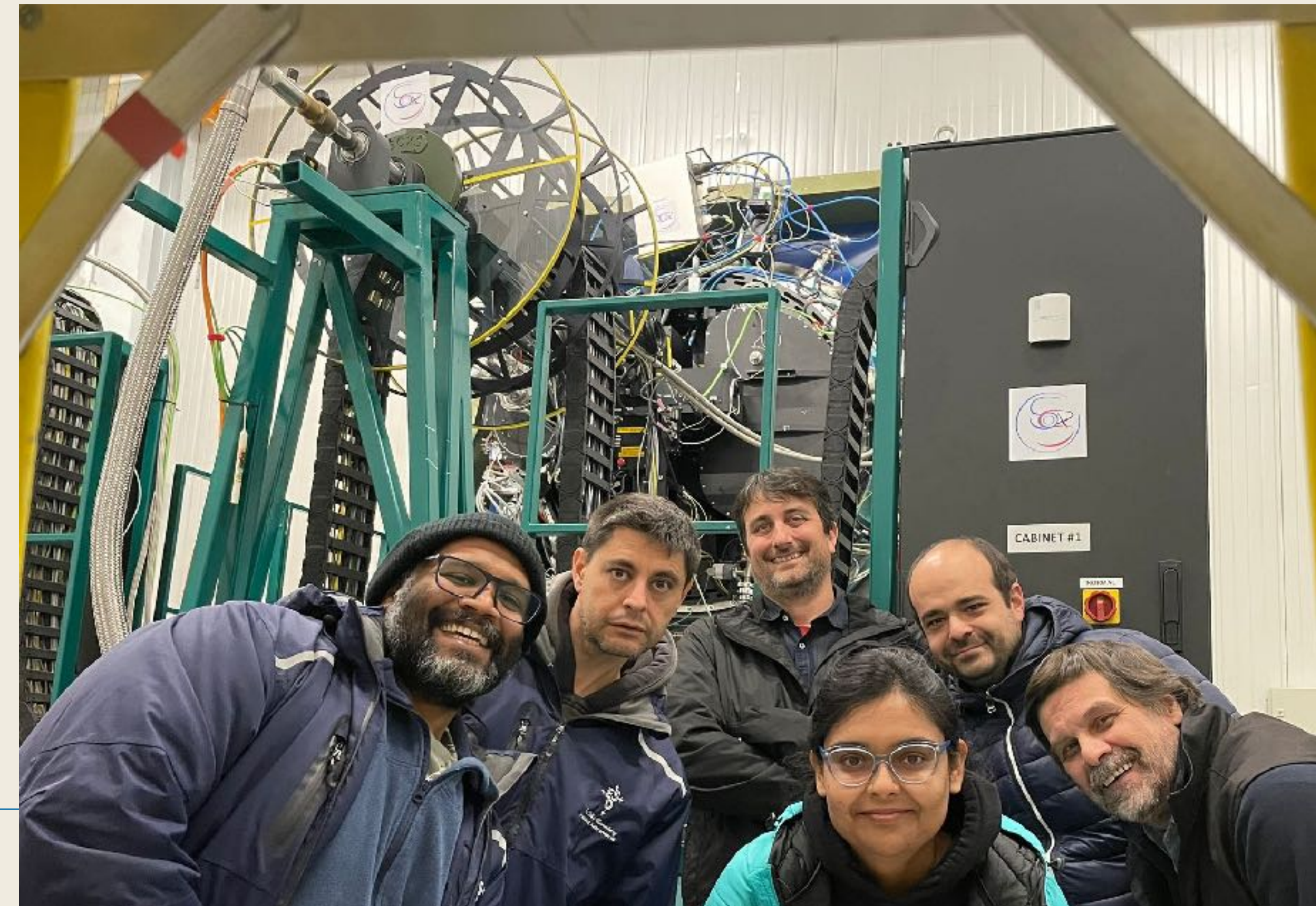
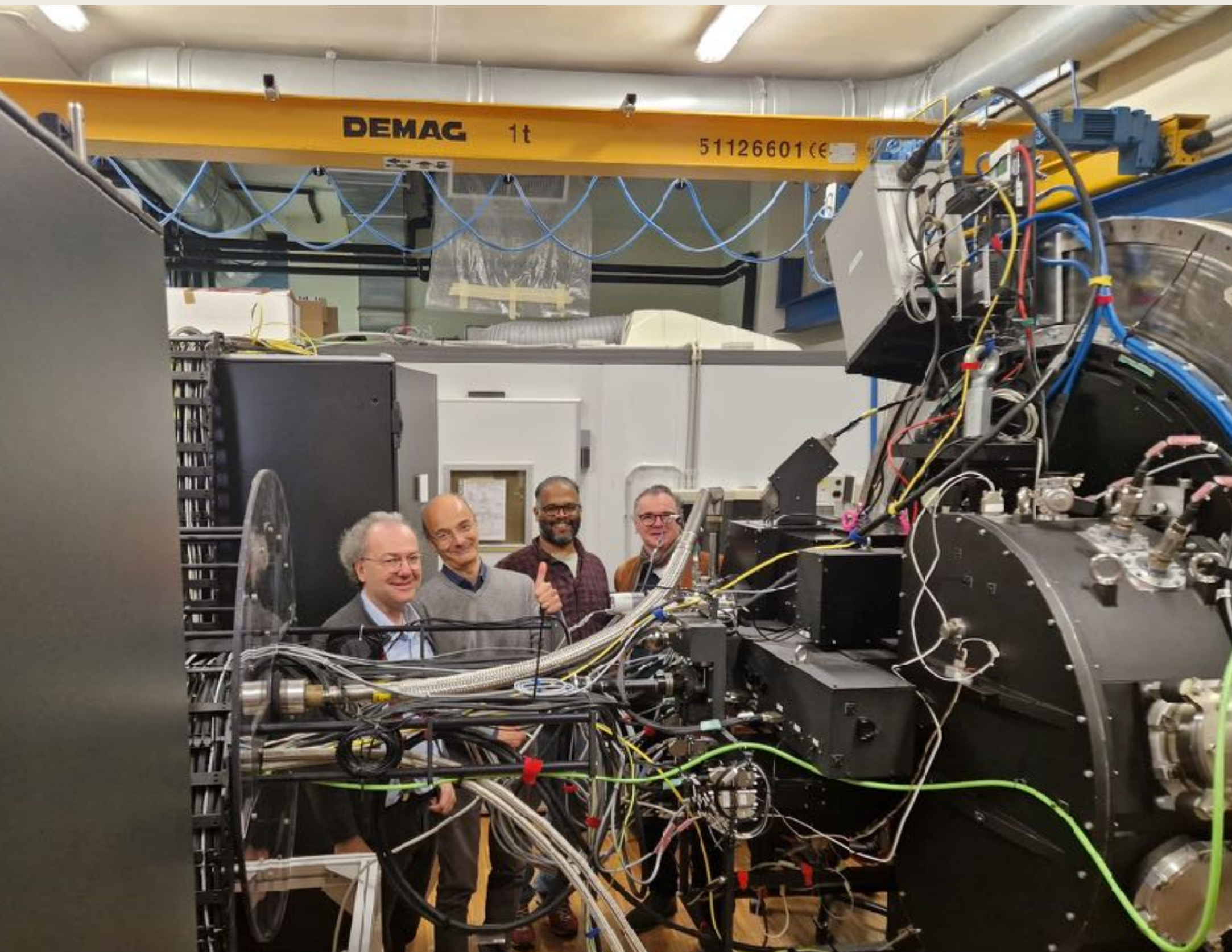


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SOXS



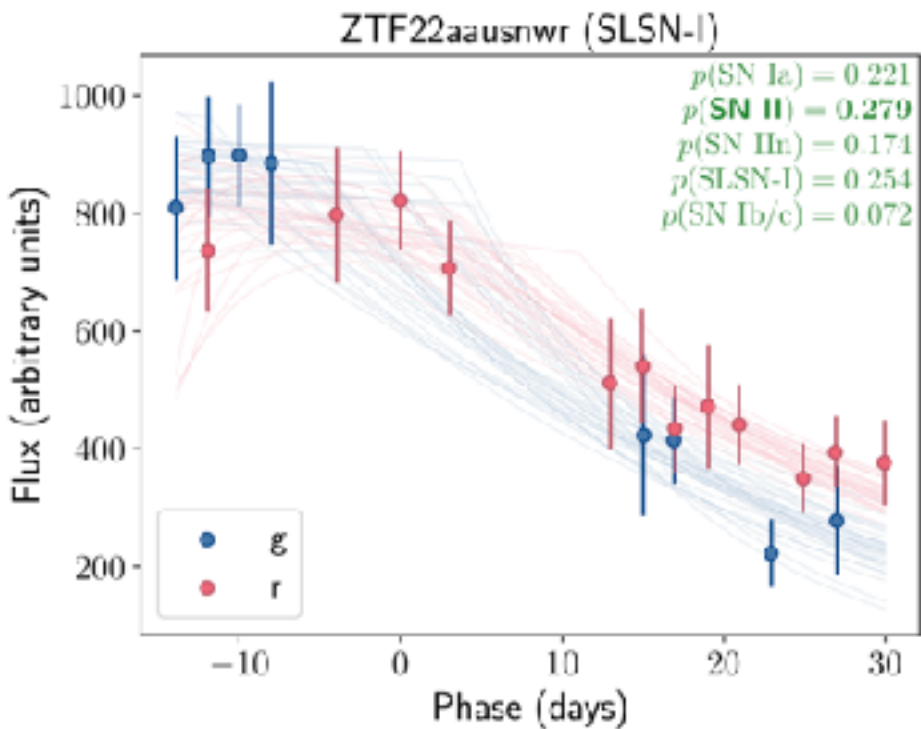
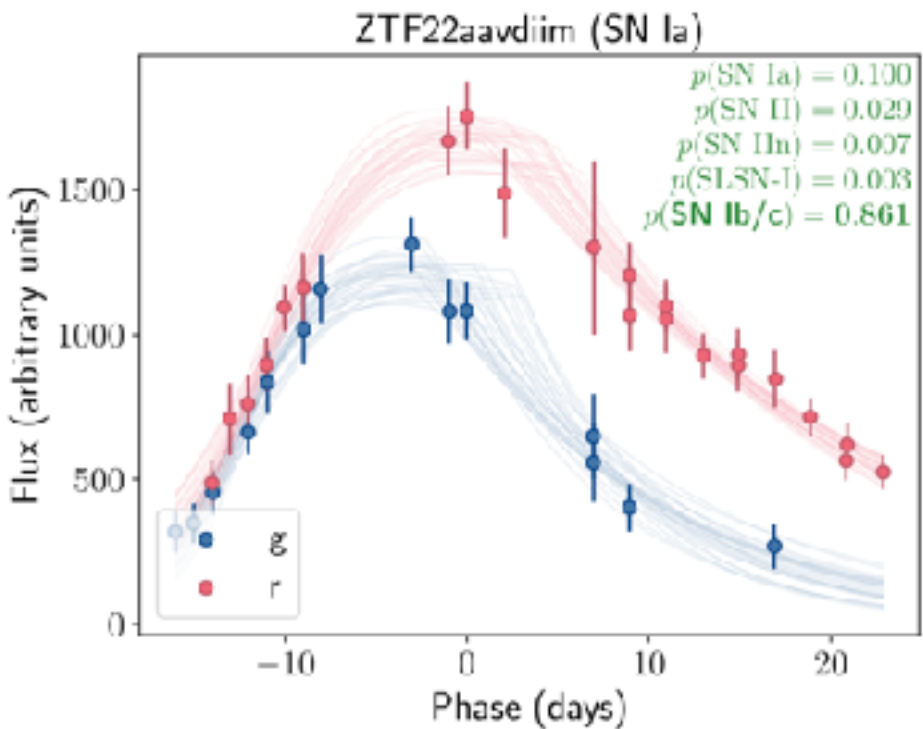
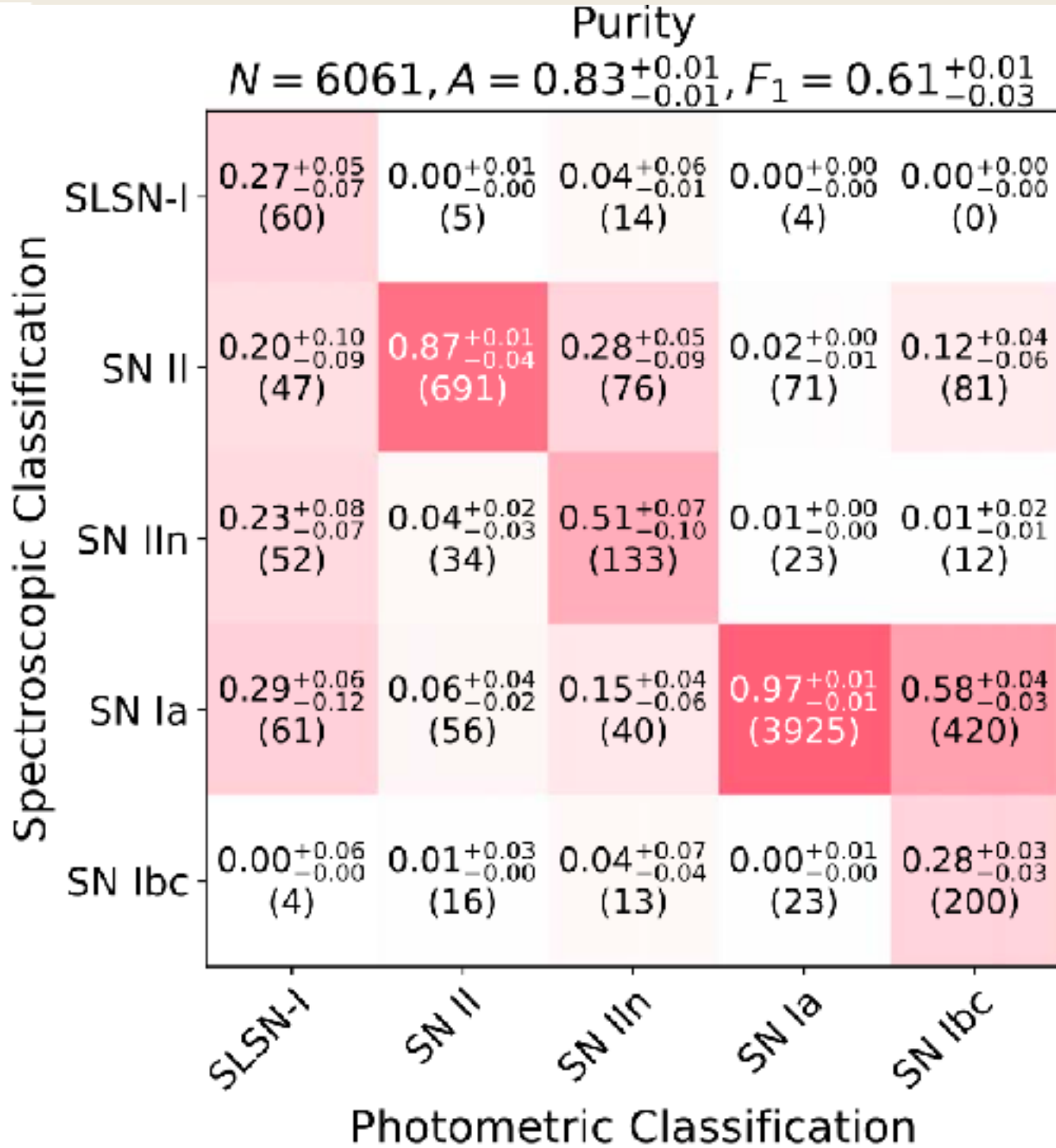
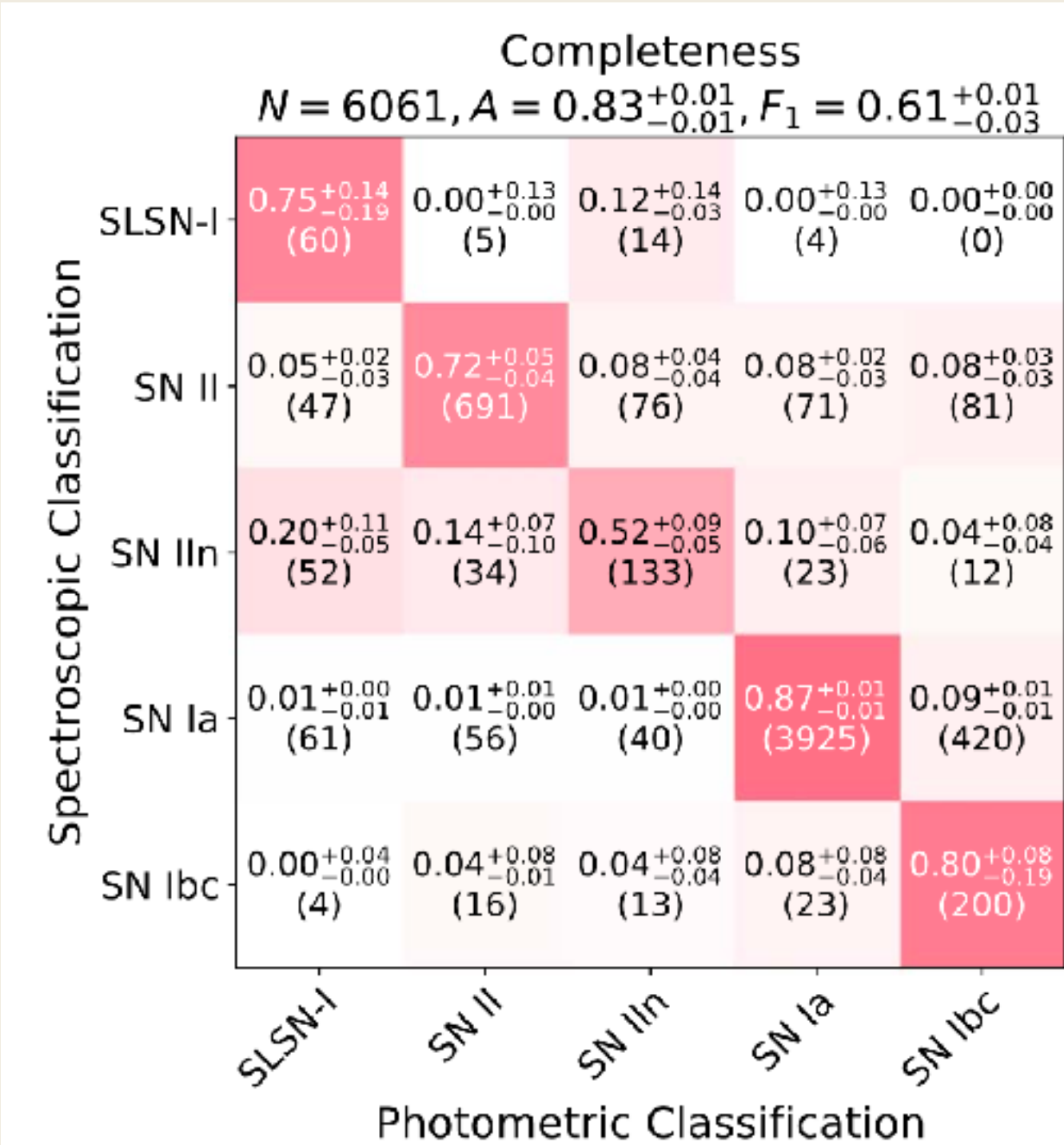
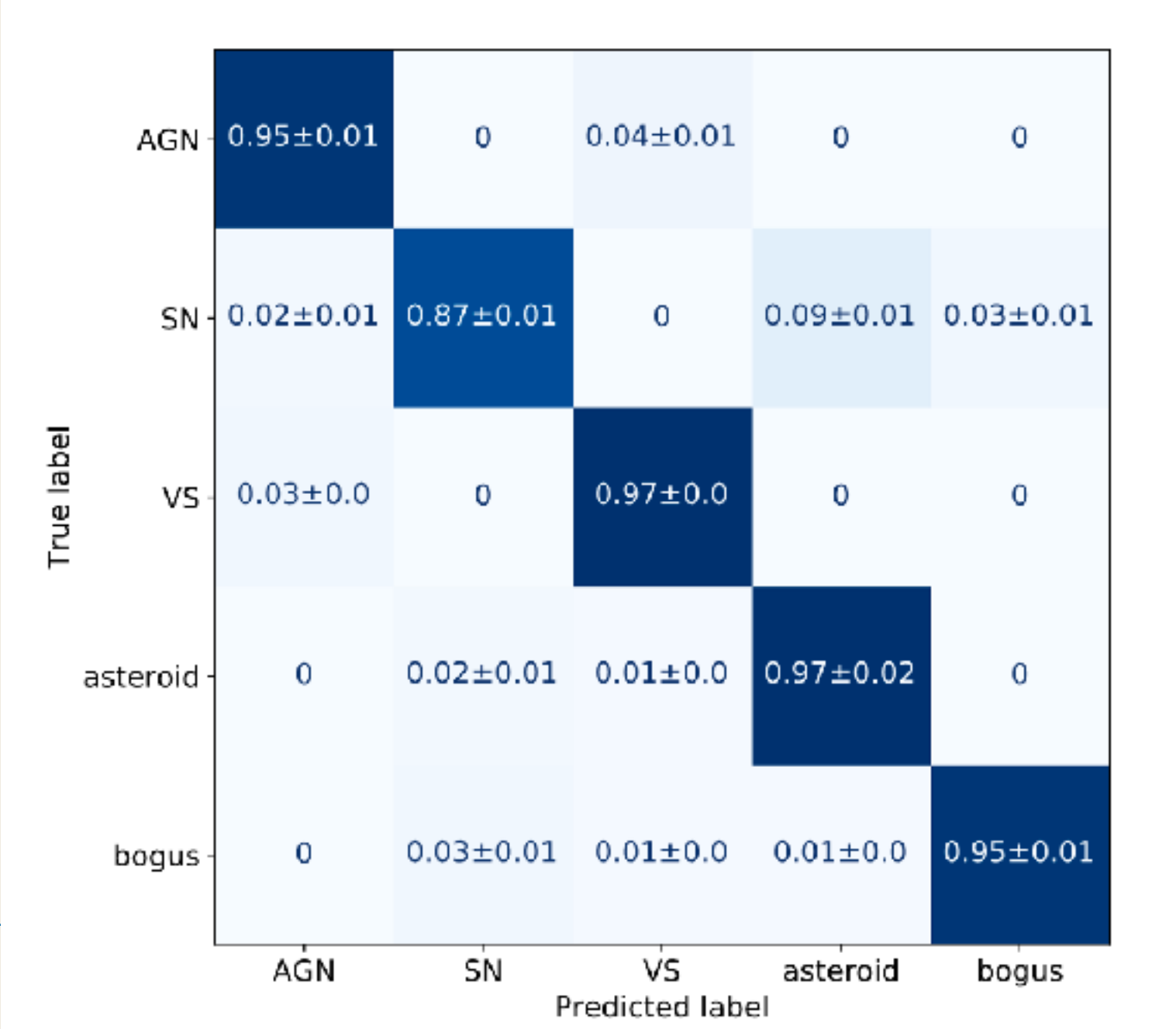
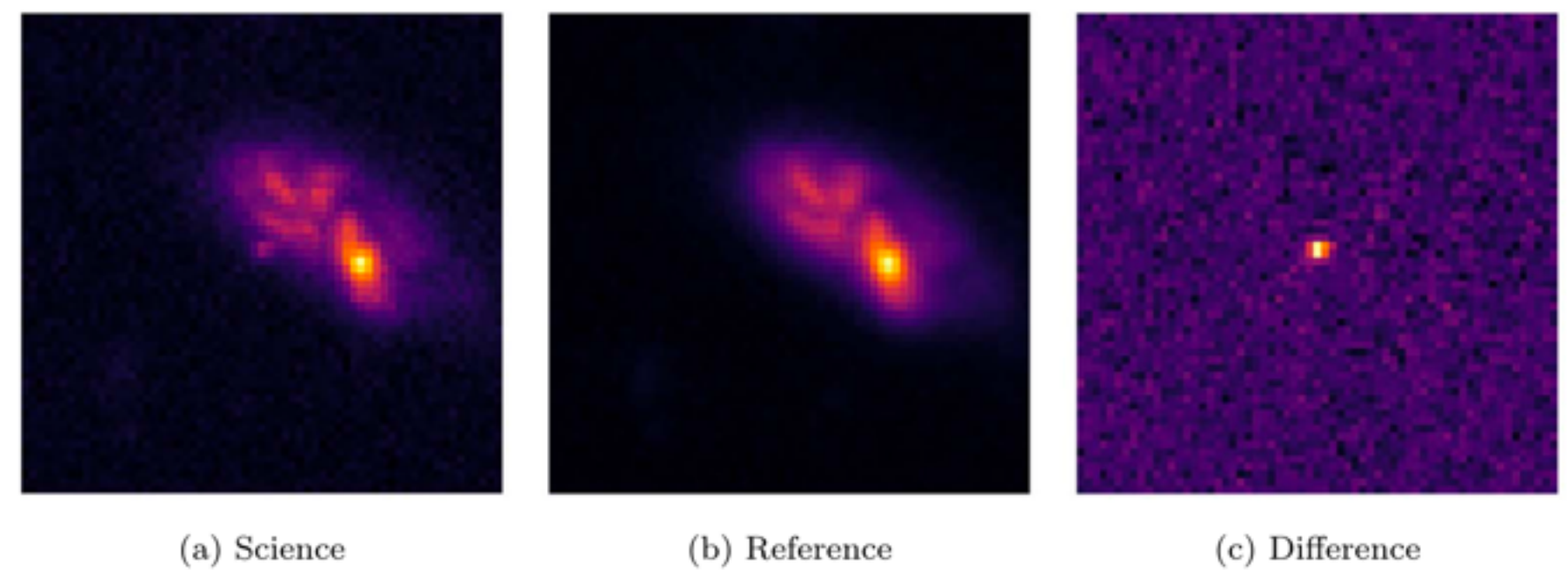
180 NIGHT/YR
SPECTROSCOPY (R~4000) OPTICAL-NIR



Machine learning classifications

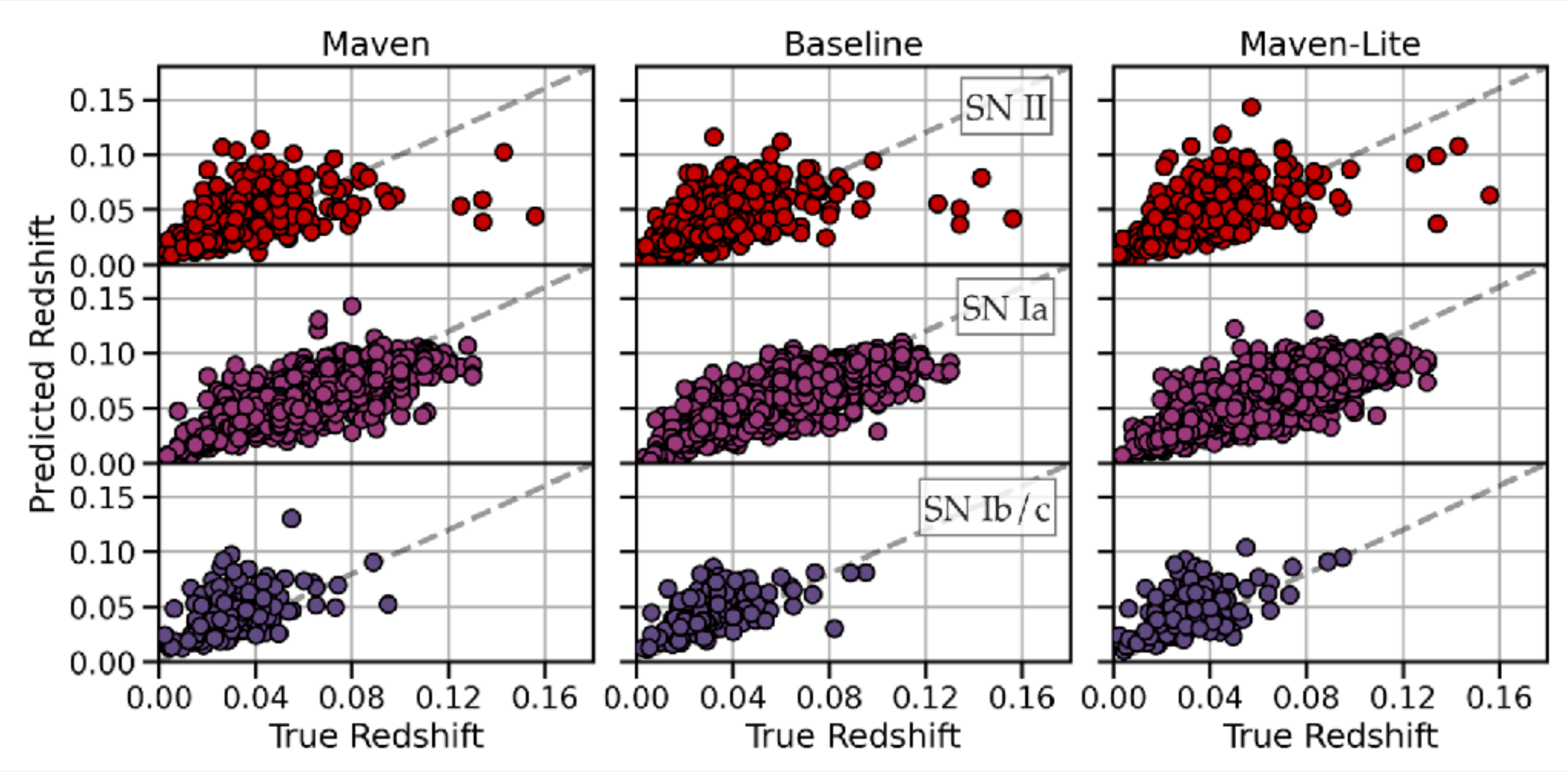
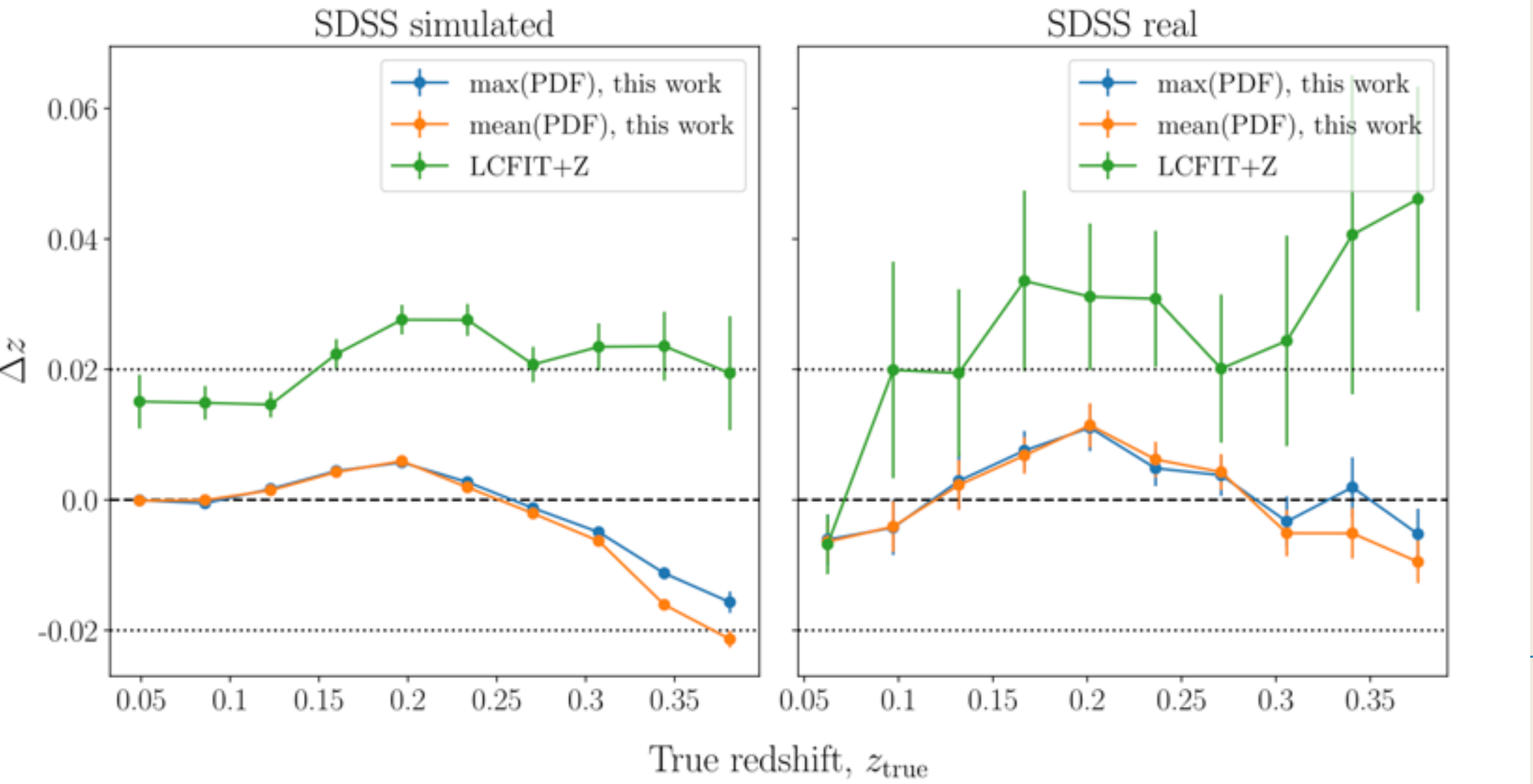
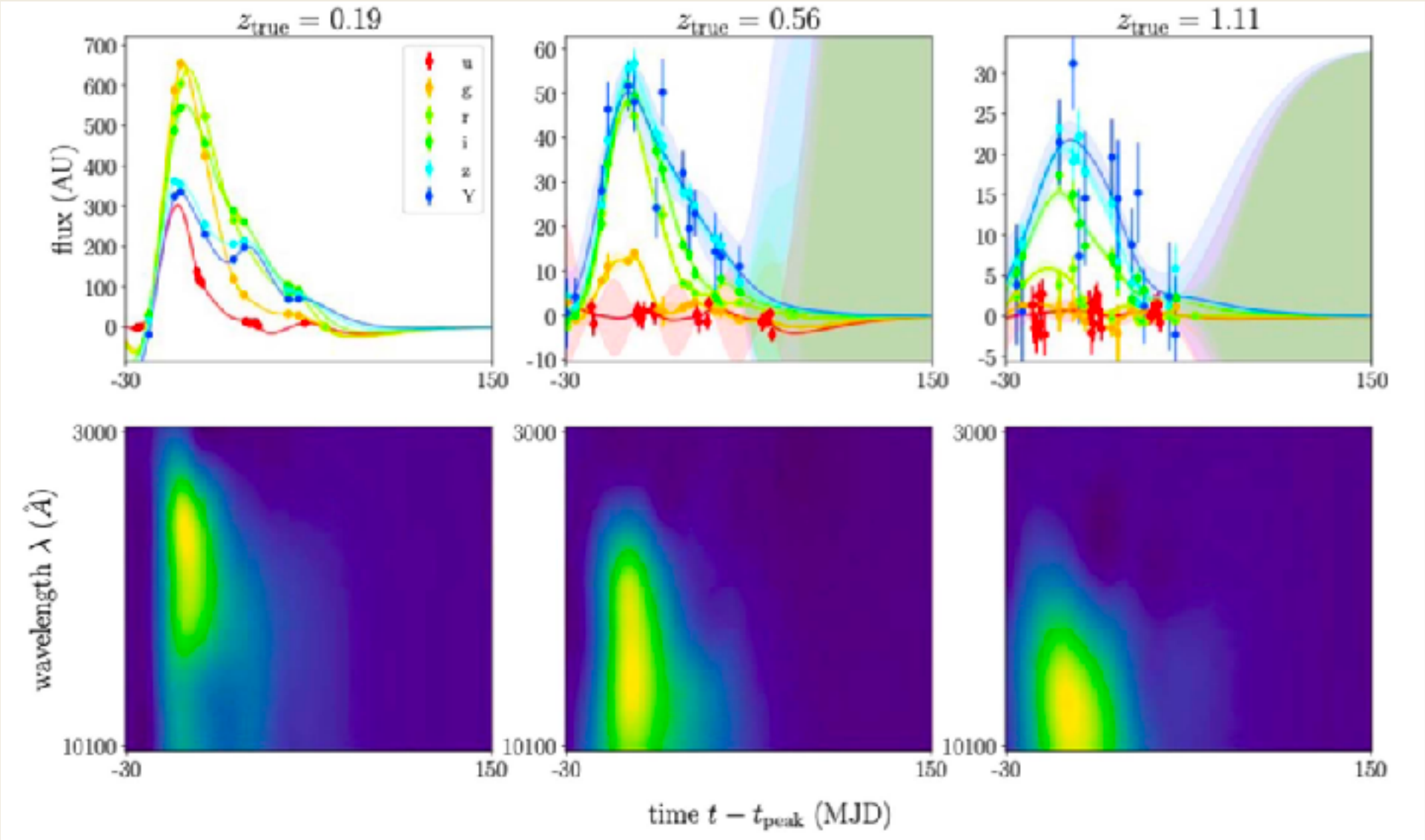
STAMP

FITTING

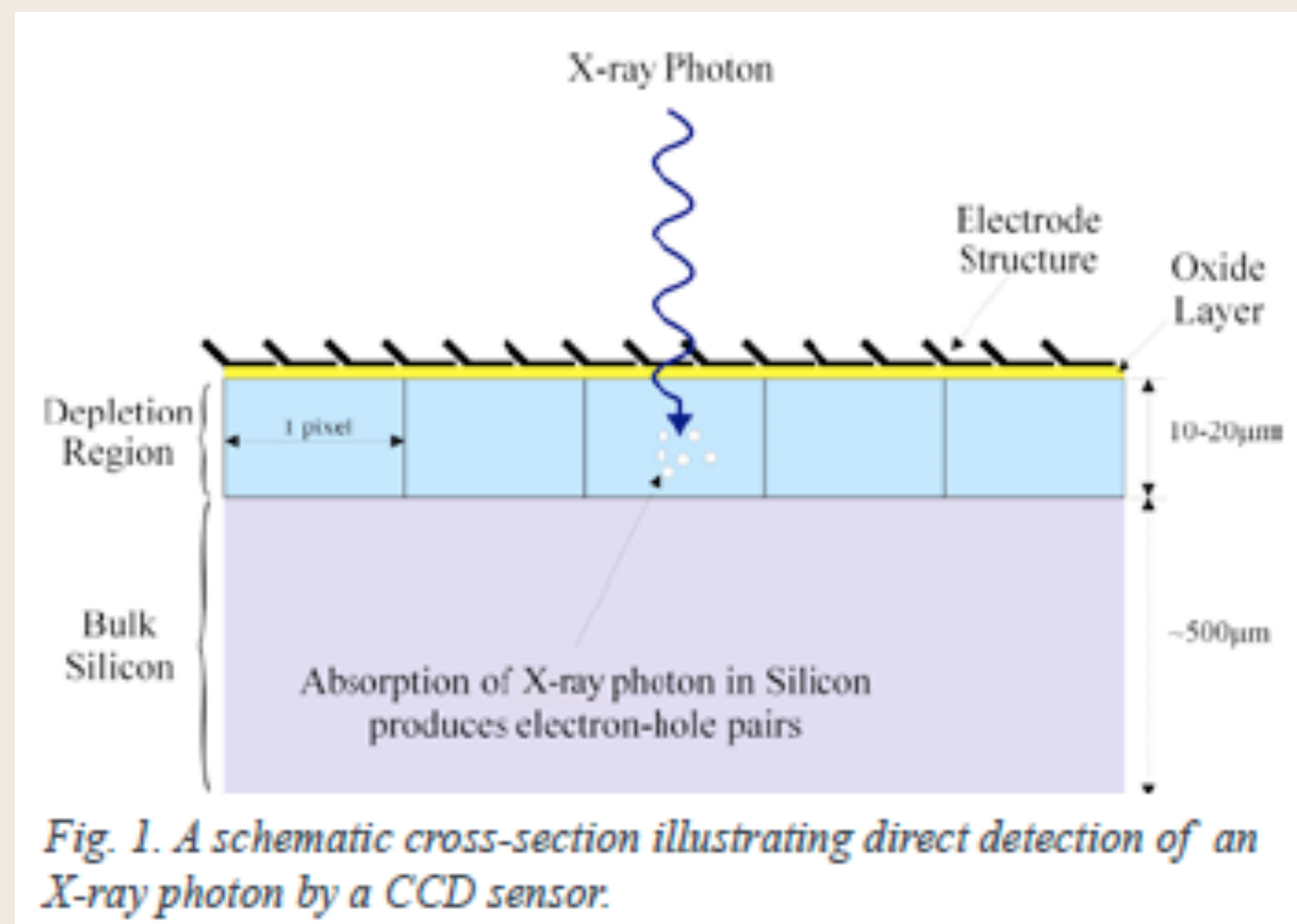


TYPE IA

Still need for redshifts



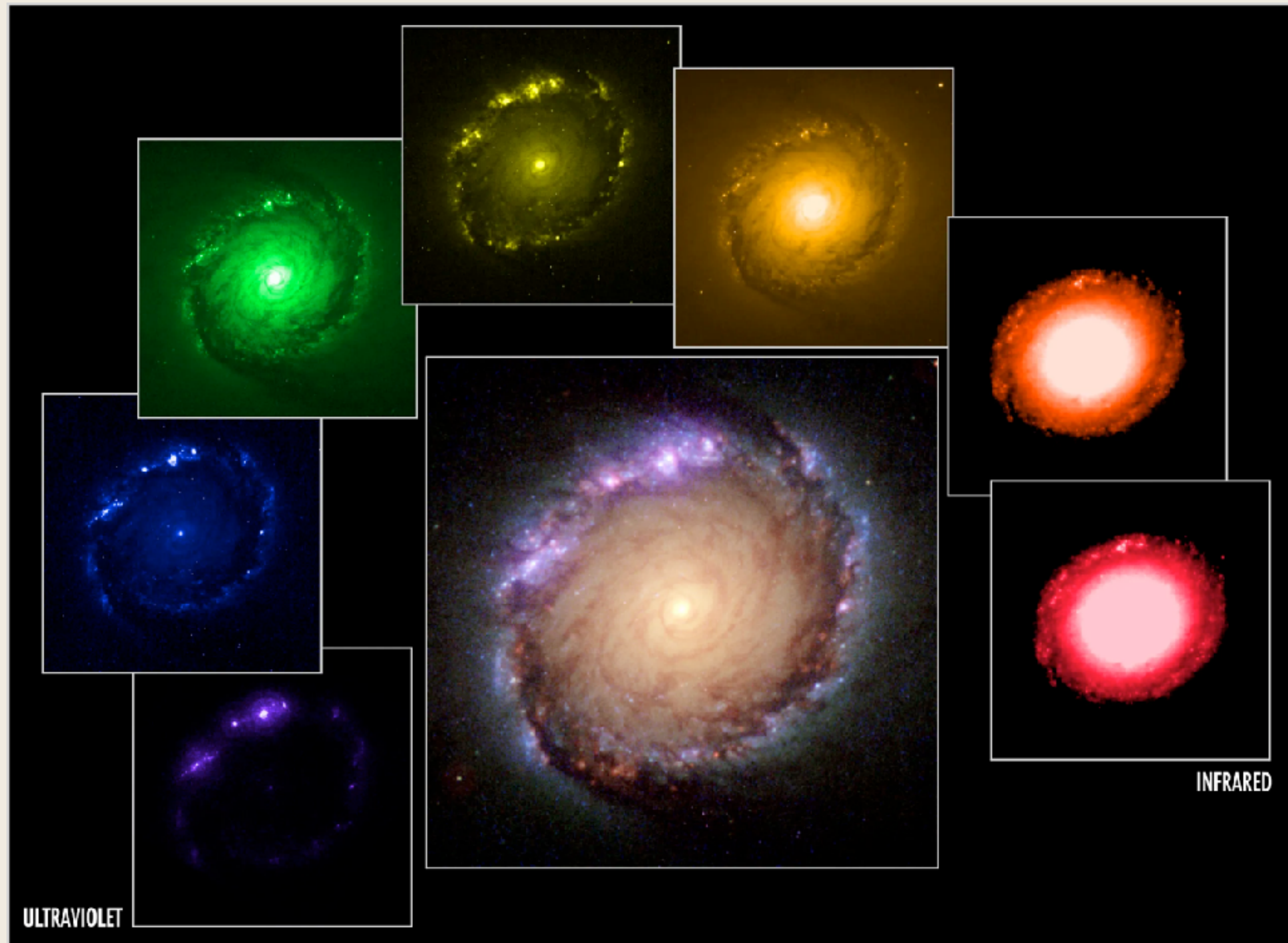
Available information



X-RAYS:

- POSITION
- TIME
- ENERGY
- (POLARISATION)

Optical images



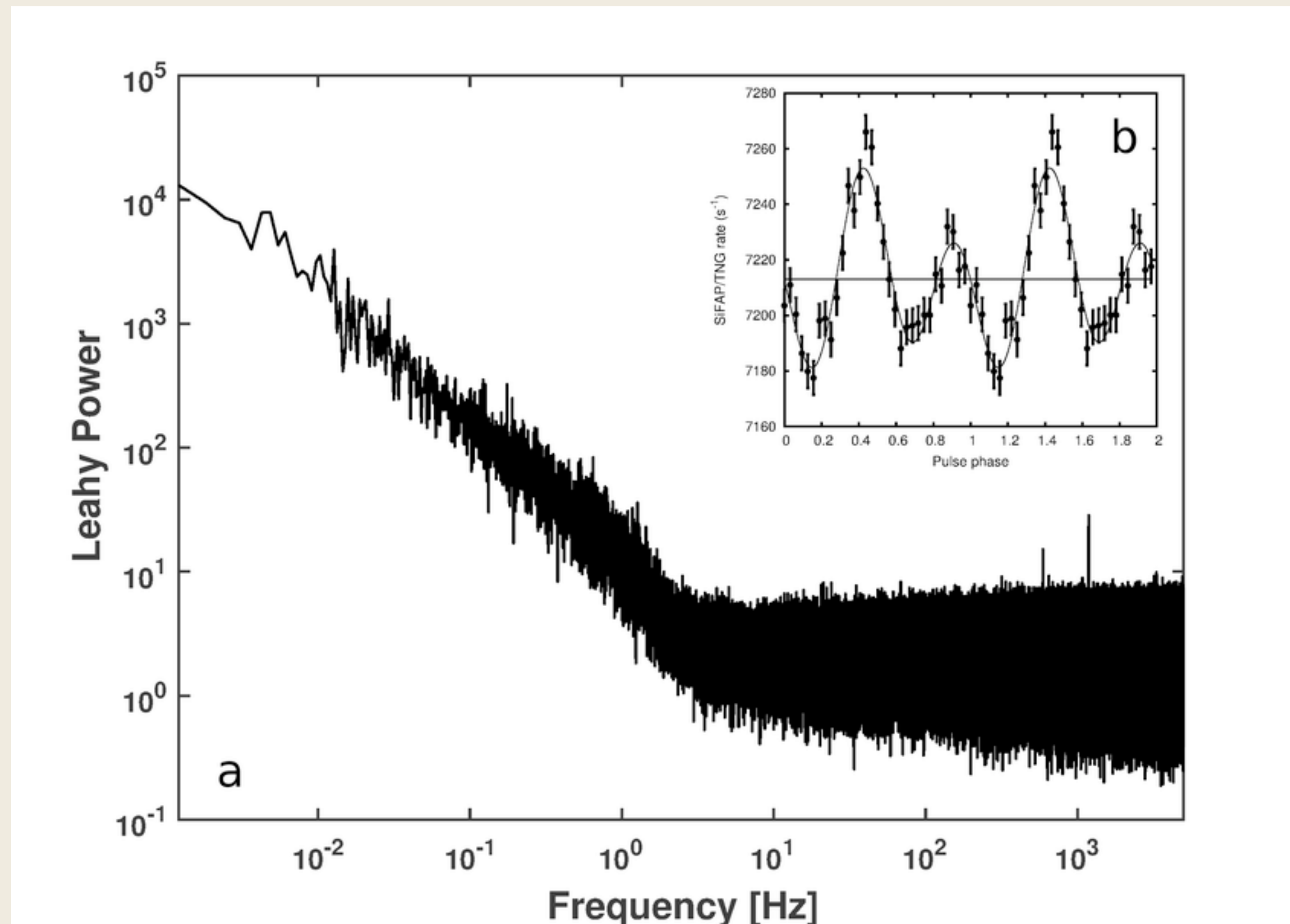
Position

Energy (very loose)

Timing (on the exposure timescale)

(e.g. REM, GROND)

Optical timing



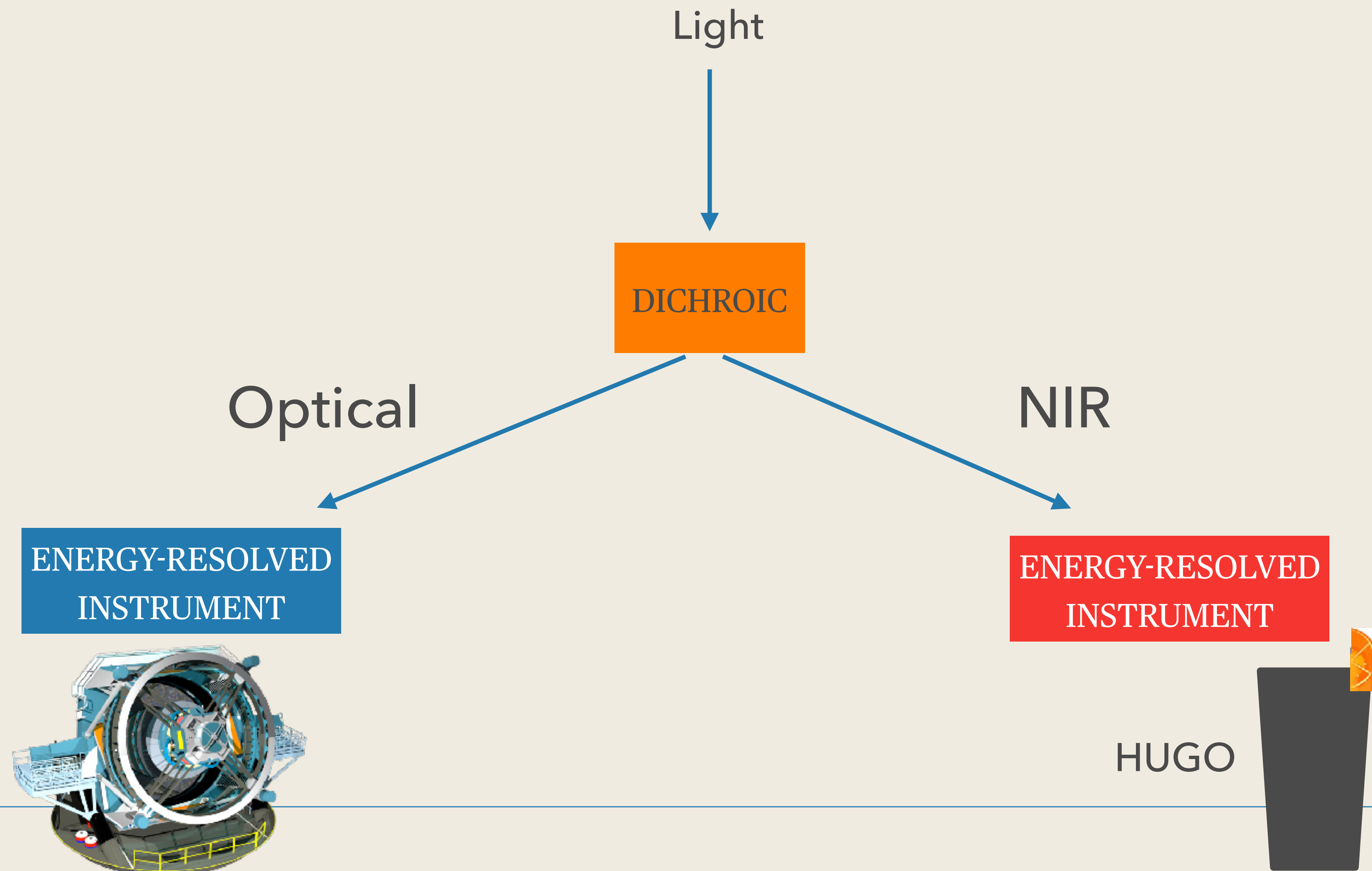
Timing

Position (very loose)

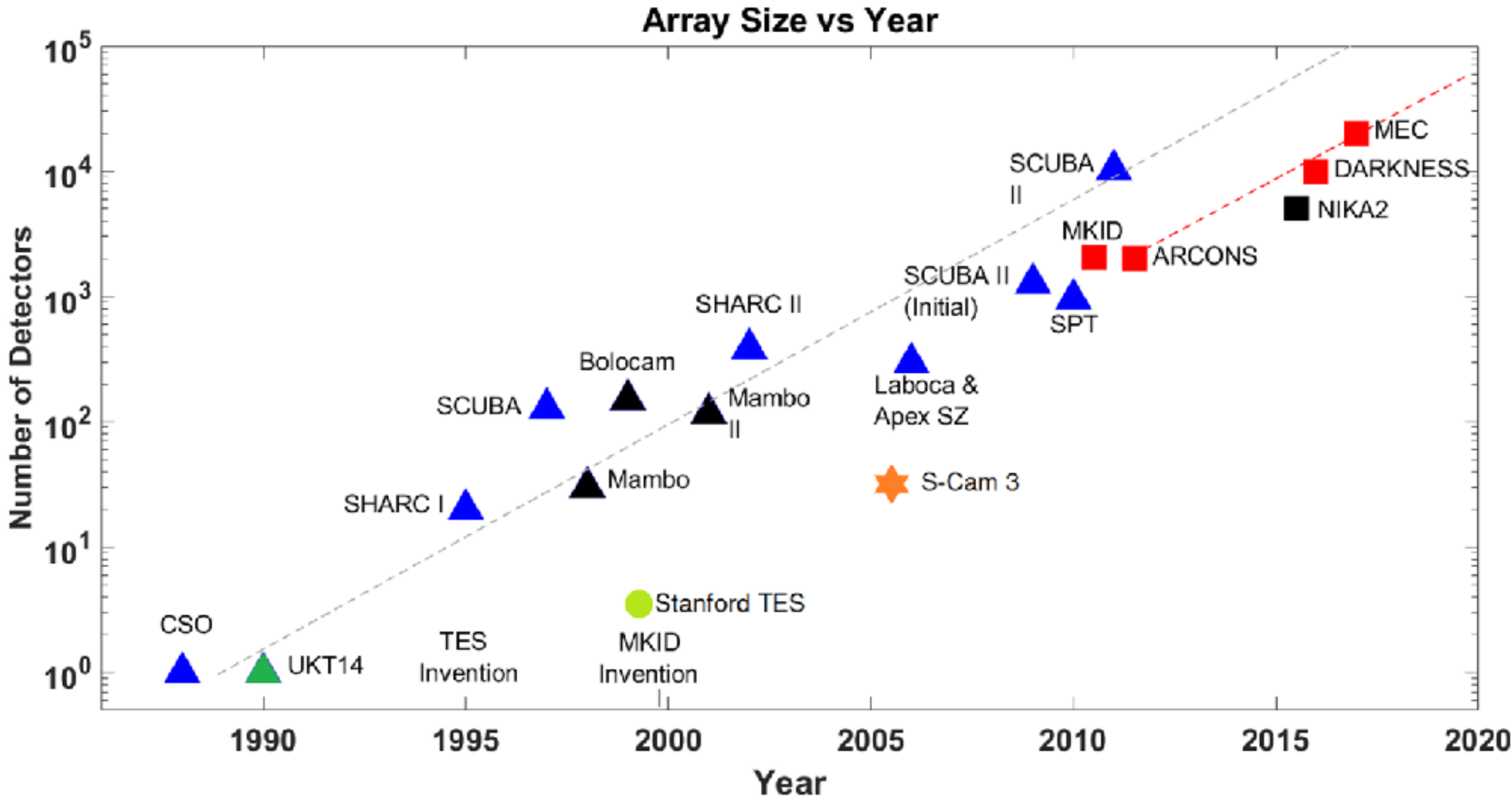
Spectral (if with filter)

SIFAP2 @ TNG
AQUEYE+ IQUEYE @ ASIAGO

What's next: do **NOT** loose information



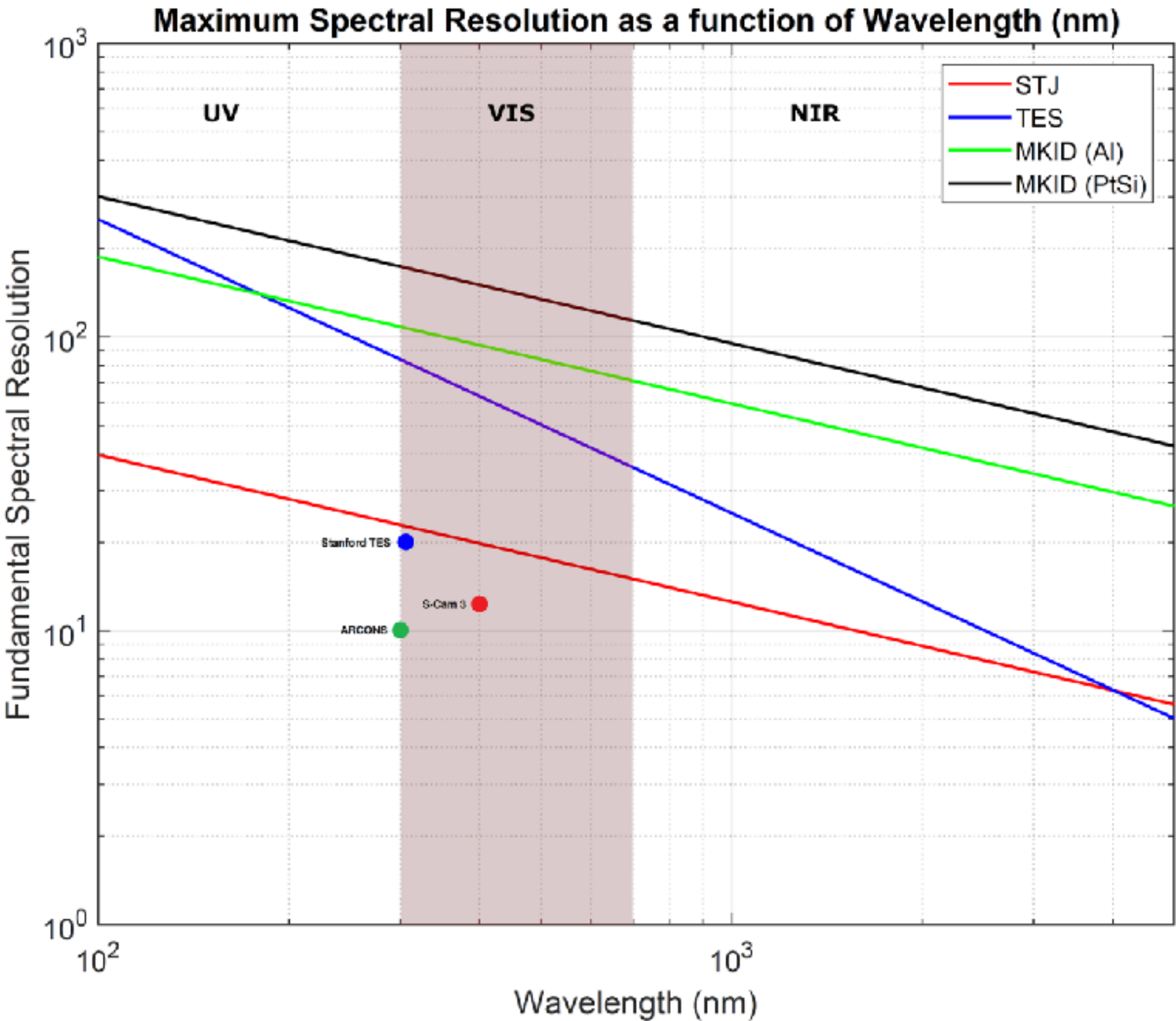
Status of detectors



3×10^7 by 2040

6k x 6k

MKID@TDT



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Energy-sensitive detectors for astronomy: Past, present and future[☆]

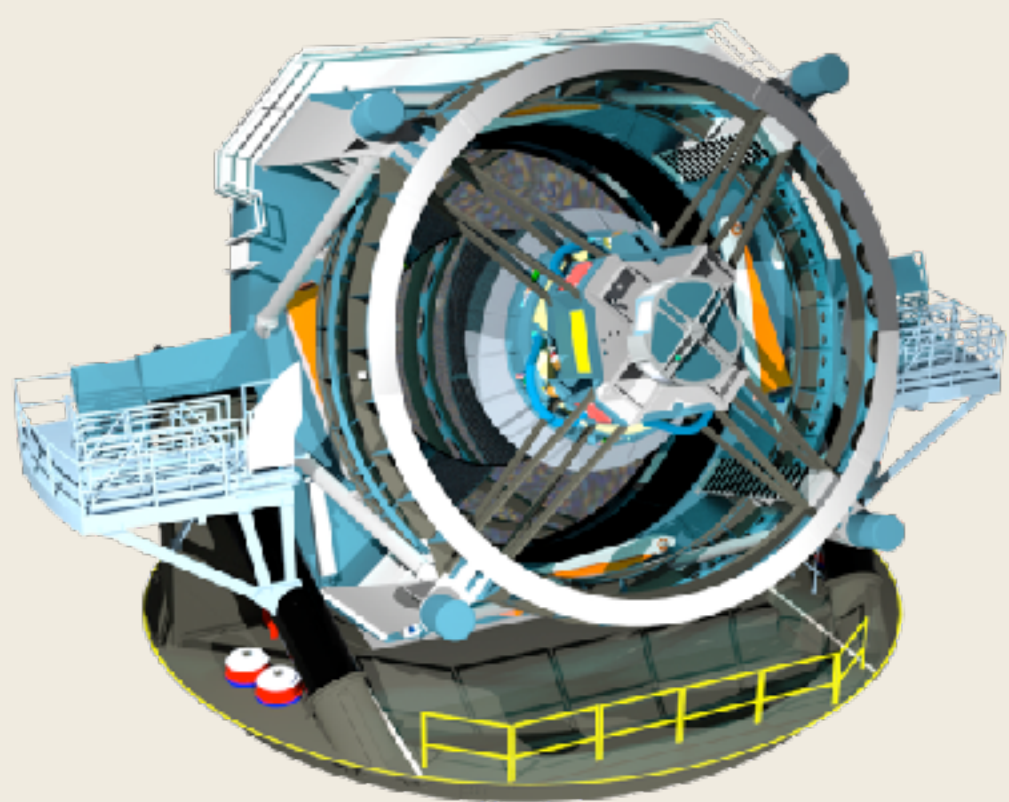
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^a Centre for Astronomy, School of Physics, NUI Galway, Ireland

^b Centre for Advanced Instrumentation, Department of Physics, Durham University, United Kingdom

What would we need

"Improving" ESO capabilities in TDA



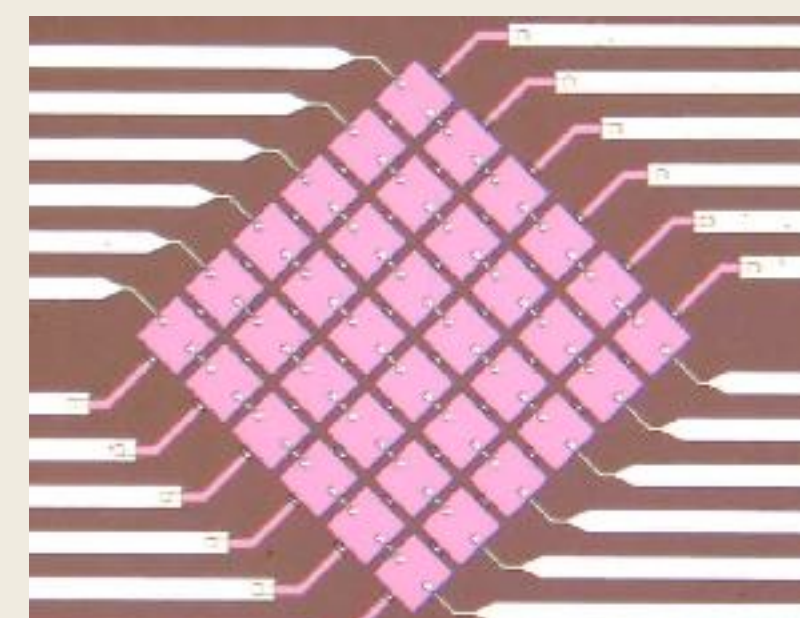
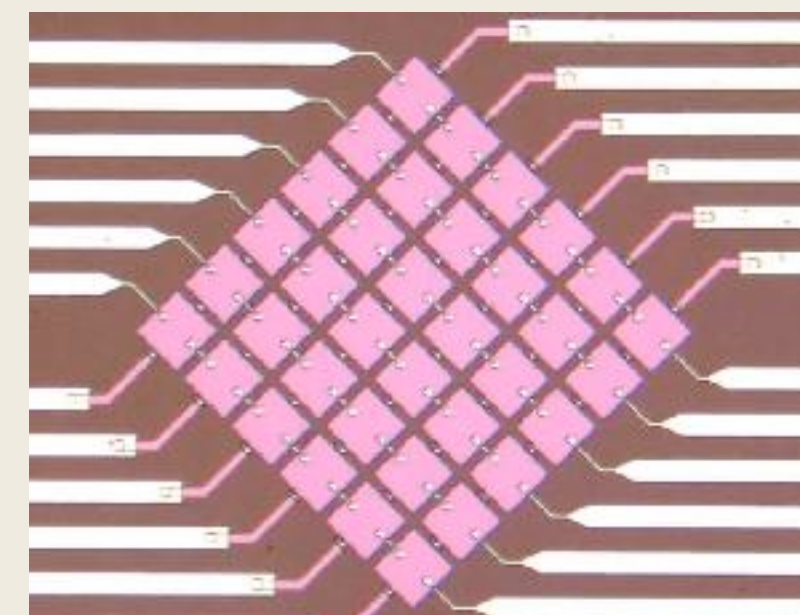
>10 m

>10 deg²

Robotic



Dichroic



Optical

R~300-1000



NIR

R~300-1000

Thanks

- use dichroic
- use energy-sensitive detectors
- use machine learning techniques