



WST

**the Wide-field
Spectroscopic
Telescope**

Surveying the Universe in the 2040's and beyond

Italian Workshop
in memory of Bianca Garilli

**Novelty and value of WST
in the context of time-domain astronomy**

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Why time-domain astronomy?

- **Bottleneck problem !!** Only a a tenth of the optical transients are spectrally classified (Kulkarni 2020)
- Bottleneck problem will get worse by a factor of 20 (or more) once LSST comes on line
- **Astro2020 program** – Sustain and Balance the science: **implement time-domain & multi-messenger programs**
- Time domain observations are a central element of the top ground and space-based projects supported by Astro2010; Rubin (LSST in 2010) & Roman (WFIRST in 2010)
- Solutions: multiband photometric studies or spectroscopic characterization
- **Rubin LSST** (photometric scan of transient sky) + **4MOST and WEAVE** (follow-up spectroscopy)
- WST is being conceived with a **time-domain mindset**, to enable maximum operational flexibility and rapid data processing (to integrate efficiently with other alert systems and facilities)

100 Mpc

100 kpc

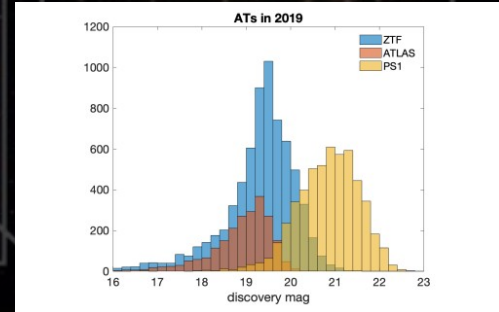


Figure 1. Histogram of the magnitudes upon detection of ATs reported in 2019 for ZTF, ATLAS and PS1. ATLAS and PS1 self report (§A.1). Several groups receive ZTF alerts and submit their own reports: Bright Transient Survey (§A.4), AMPEL (§A.3) and ALeRCE (§A.2).

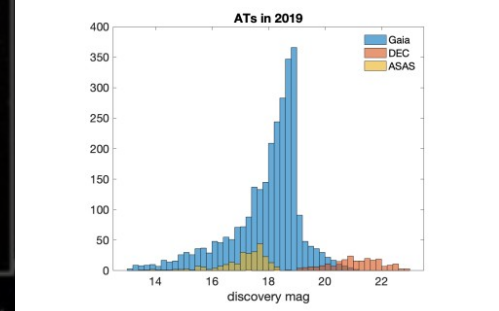
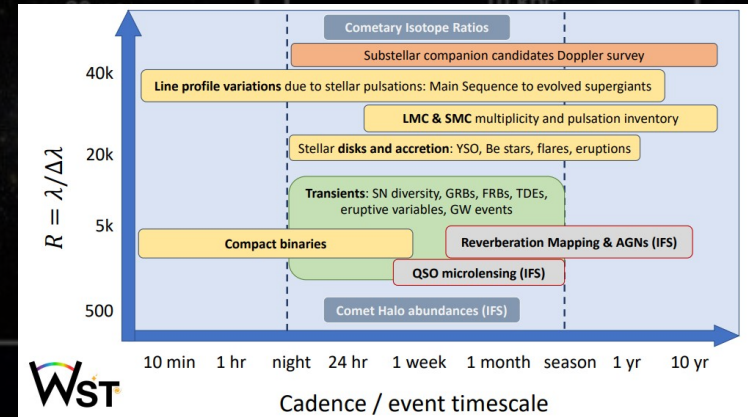


Figure 2. The same as in Figure 1 (but with a reduced y-axis scale) for *Gaia* (§A.5), DECam (in the course of pursuing GW events) and ASAS-SN.

What makes WST unique?

- It's a response to one of the most in demand spectroscopic facilities around the globe, a 8- to 10-meter class telescope to conduct follow-up spectroscopy: 75% of ESO's pool & Australian astronomical community (Vis+NIR), United States (Decadal 2020, support Roman and Gaia), Canada (Long Range Plan 2010)
- 12 meter telescope with IFS & MOS capabilities, provides unprecedented opportunities for studying time-resolved phenomena
- 4MOST, WEAVE, and SDSS-V limited in terms of scheduling, number of targets, and the depth that can be observed, which becomes a problem for alerts issued by Rubin LSST due to limited overlap in magnitude – WST is the best solution proposed so far!
- **Only a dedicated wide-field spectroscopy facility on a 10-meter class telescope can meet the challenge of characterizing the huge data releases** e.g. 20 billion galaxies and 17 billion stars down to $R \sim 27.5$ from the Rubin LSST; 10 billion galaxies from Euclid; 1.5 billion stars down to the Gaia magnitude $G \sim 21$ from Gaia
- WST will also implement ToO operations at both the telescope and MOS fibre levels
- WST will **both** issue alerts and provide spectroscopic observations of other facilities
- Requires fast data reduction and processing to be useful in the context of issuing alerts
- **BUT** – Operates on different time scales to study both high and low stellar densities, such as globular clusters, nearby galaxies, and in the search for EM counterparts to GW events
- Different resolving powers tailored to various science cases and source classifications
- **Concieved in a timely manner**; Multi-messenger astronomy will be mainstream in the WST era (SKA, and GW observatories such as LIGO/VIRGO/KAGRA + ET & LISA)

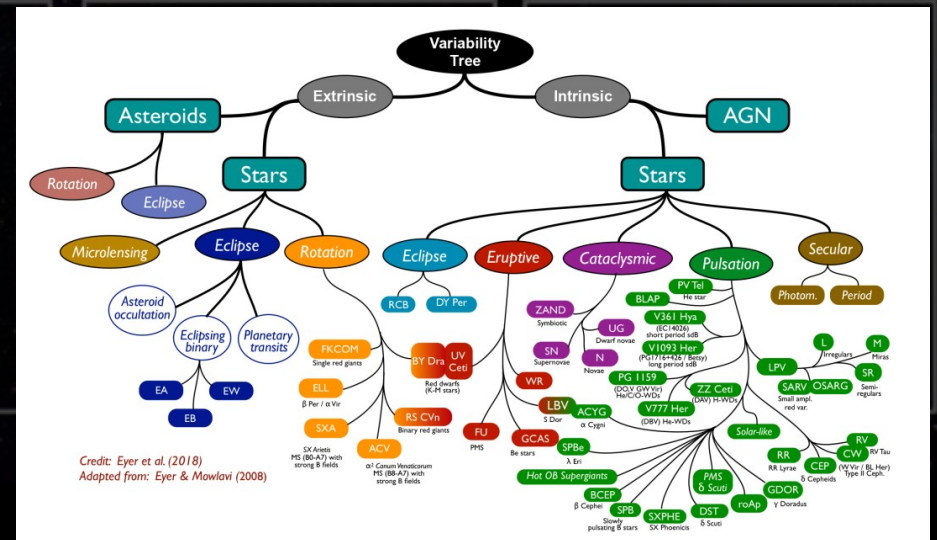


How can you contribute?

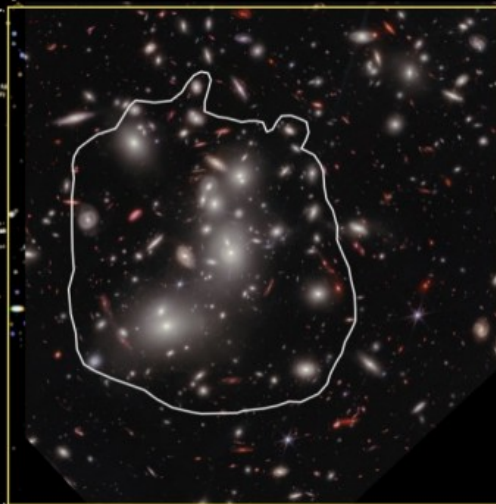
- The time domain WG considers **all types of objects** for which timing is crucial to collecting, processing, or interpreting the data. This naturally creates overlap with all other science WGs, including Cosmology, Extragalactic, Galactic, and the study of resolved populations
- For operational considerations of repeat observations, cadence, monitoring, observing modes, data processing, alerts, etc. synergies among overlaps/synergies among science cases can adequately inform the Top Level Requirements for WST
- Creating synergies and establishing sub-working groups are of utmost importance
- Science cases in our WG (currently): EM counterparts of GWs, Transients, Stellar variability, Solar system, Serendipity and Alerts
- Join us!

2 Time Domain

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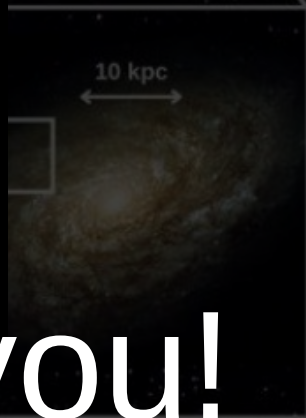
WST-MOS (~ 5 R_{vir})



WST-IFU (~ 0.25 R_{vir})



100 kpc



10 kpc

Thank you!