

From LSST Alerts to Follow-up: Observational Capabilities of the LNA Facilities

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From LSST Alerts to Physical Characterization

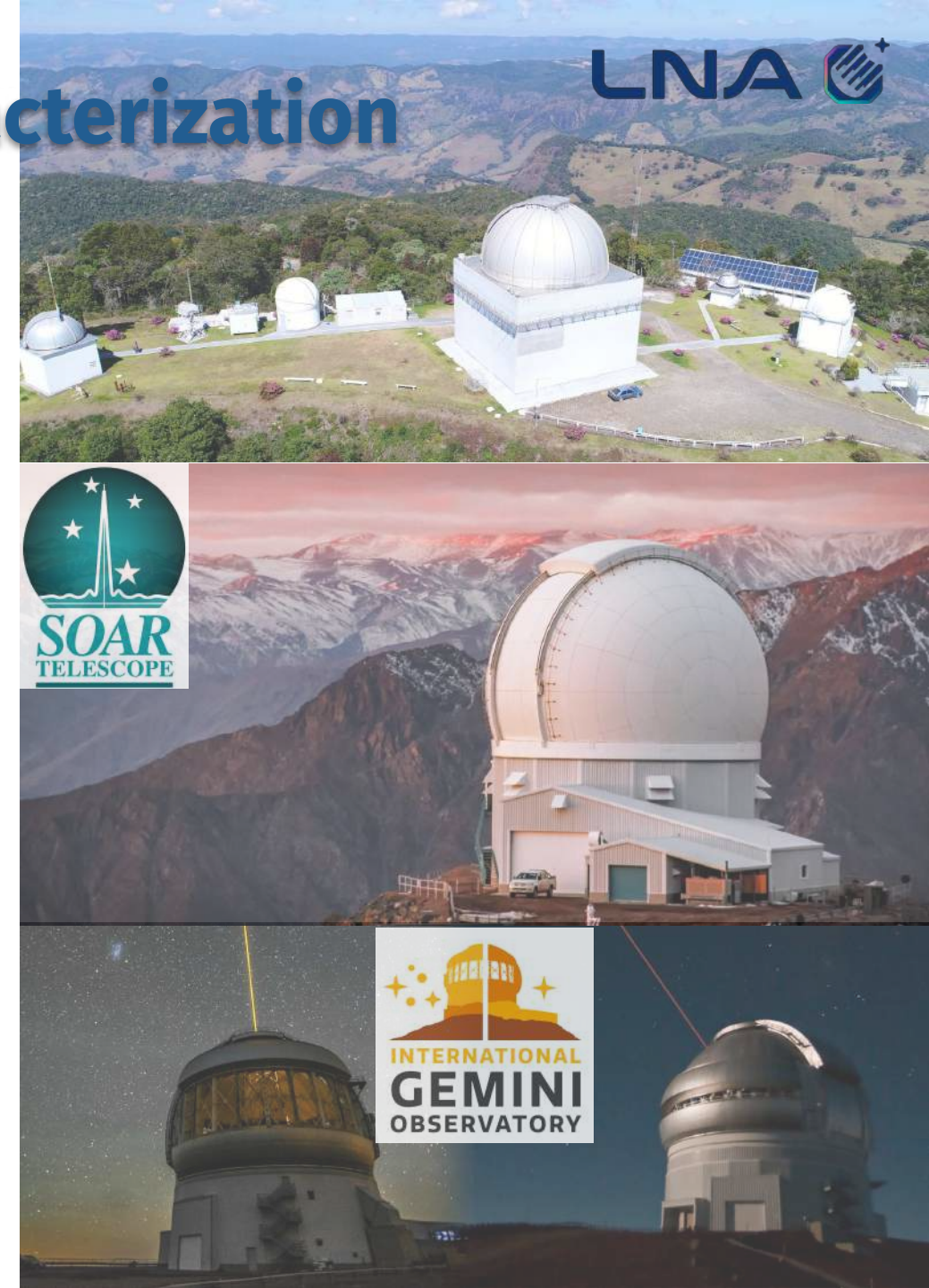
LSST will transform the discovery side of time-domain astronomy.

- Millions of alerts expected every night
- Rapid identification and prioritization of transients
- Multi-band photometric monitoring and long-term variability
- Spectroscopic classification and physical characterization

LNA facilities provide complementary follow-up capabilities

- **Pico dos Dias Observatory (OPD, <1.6-m) - Brazil**
- **SOAR telescope (4-m) - Cerro Pachón, Chile**
- **Gemini telescopes (8-m) - Chile & Hawaii**

More info: https://www.gov.br/lna/pt-br



OPD - Pico dos Dias Observatory (Brazil)

LNA
Laboratório Nacional de Astrofísica



Mantiqueira Forest - Minas Gerais
~1800 m above sea level
Main telescope: 1.6-m (remote/classical operations)
4 smaller telescopes (0.5-m class) - classical operations
4 robotic telescopes (2028+): 1.5-m, 1.0-m, 2x 0.8-m

OPD - Pico dos Dias Observatory (Brazil)

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OPD: current observational capabilities



- Photometric monitoring
- Multi-band lightcurves
- Polarimetry

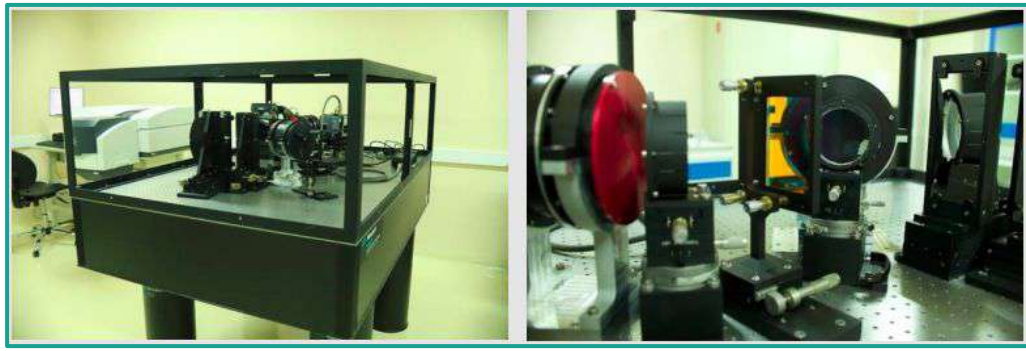
https://www.gov.br/lna/pt-br/composicao-1/coast/obs/opd

Perkin-Elmer 1.6-m telescope



- **SPARC4:** simultaneous four-band imaging and polarimetry
- **Coudé spectrograph**
- **ECHARPE:** fiber-fed high-resolution spectroscopy (R ≈ 50,000), commissioning planned for 2027

Boller & Chivens 60 cm and Zeiss 60 cm telescopes

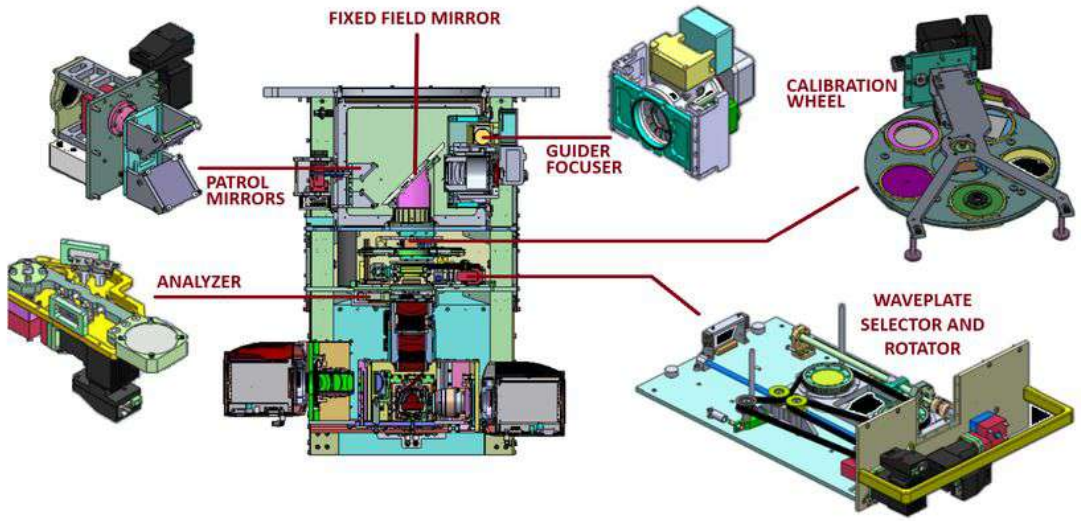


- Direct imaging, polarimetry and spectroscopy

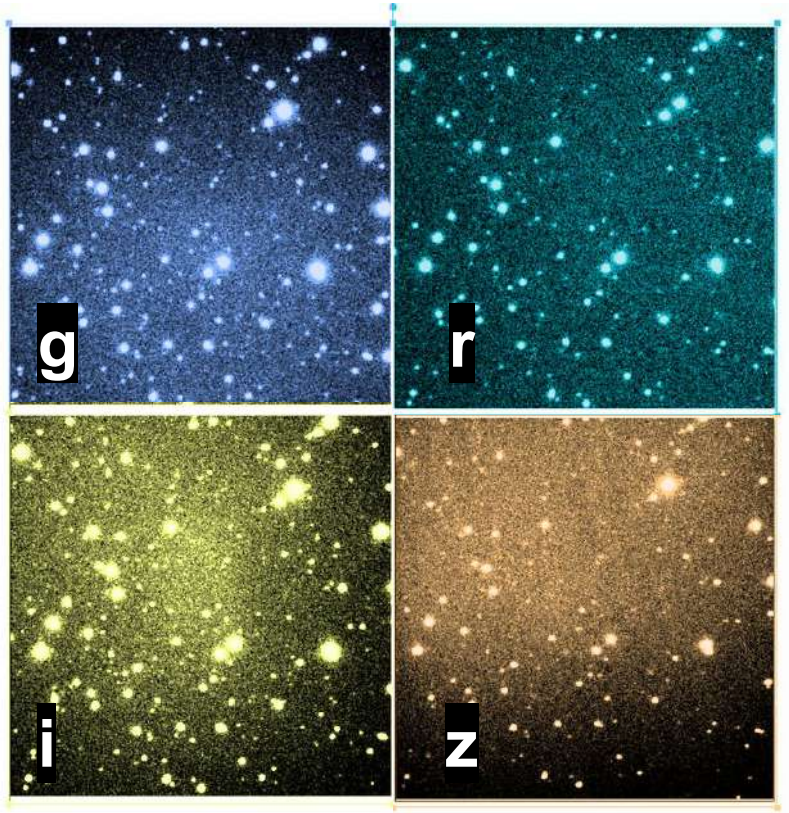
SPARC4: **S**imultaneous **P**olarimeter **A**nd **R**apid **C**amera in **4** bands

- Simultaneous imaging in 4 broad-band filters (griz)
- photometric and polarimetric modes
- FOV = 5.6'x5.6', temporal sampling < 1 sec
- More information: https://coast.lna.br/home/sparc4
- Pipeline for data processing: github.com/edermartioli/sparc4-pipeline





SPARC4 @ 1.6m OPD (Brazil)



Where OPD can contribute

A natural facility for repeated observations

- Multi-band photometric monitoring
- Long-term variability studies
- Polarimetry of selected transients
- Follow-up of brighter alerts and candidate counterparts
- Coordinated observations with larger telescopes

Example: SOUTH POL (2028) - a planned wide-field polarimetric survey using the new 1 m telescope.



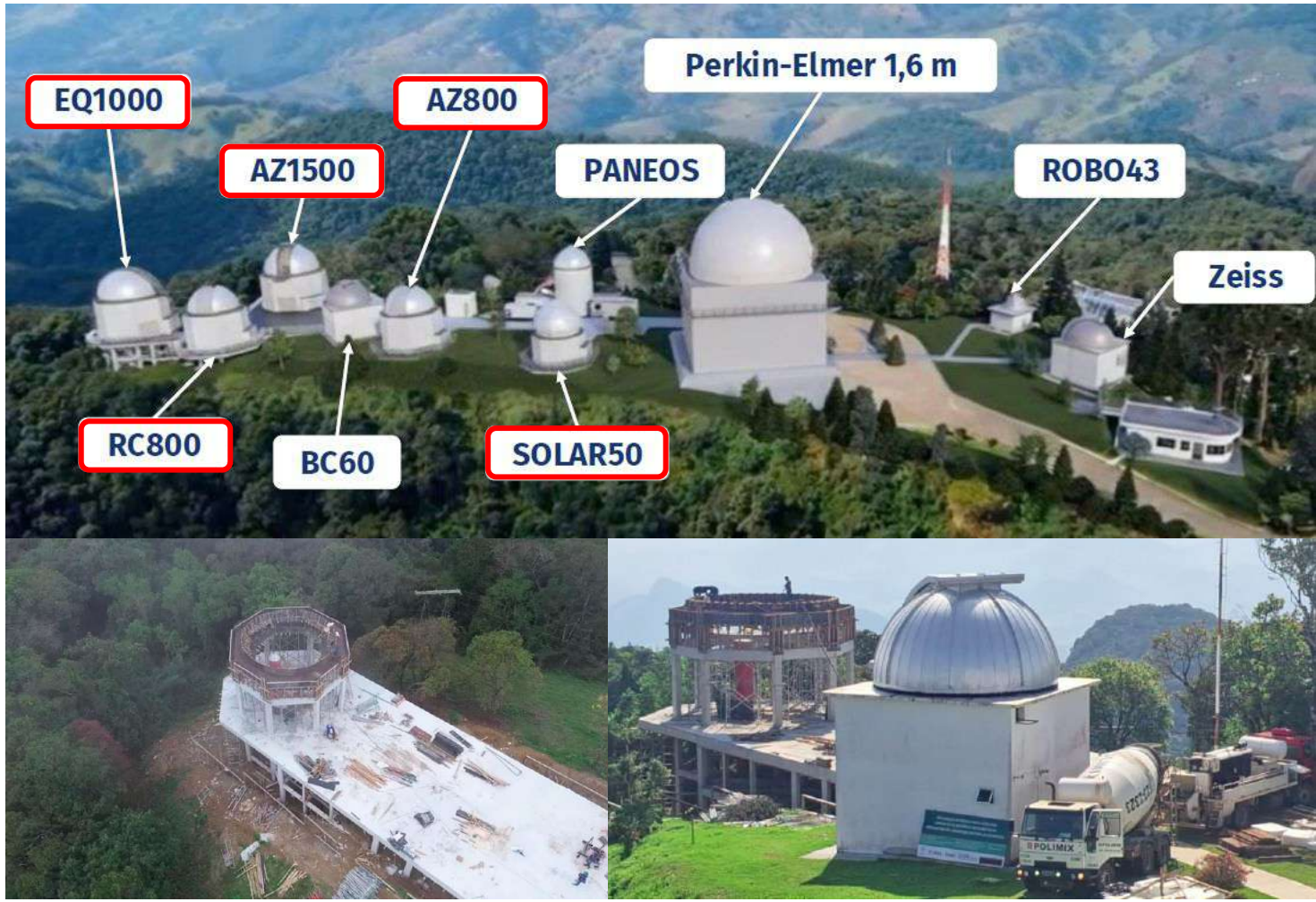
OPD: towards robotic operations

A **new telescope infrastructure**

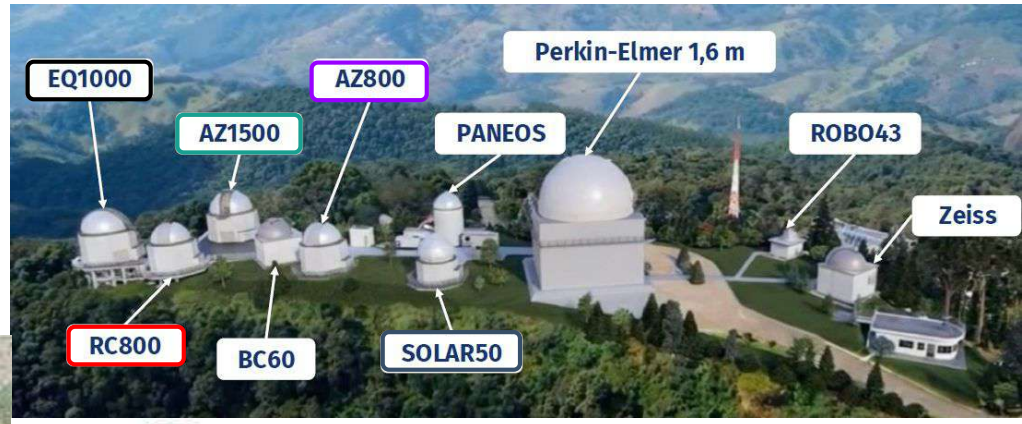
- Five new telescopes planned within the modernization project (2027-2030)
- Apertures from 0.5 m to 1.5 m
- New control room and data-processing infrastructure
- Updated telescope control and focusing systems

A path toward more automated and flexible observing

More systematic monitoring and more responsive follow-up of selected alerts.



OPD: towards robotic operations



RC800 ASA (80cm)
Eq. mount
Status: delivered, pending installation



AZ800 ASA (80cm)
AZ mount
Status: delivered, pending installation



Solar Telescope (INPE)
RC500 ASA (50cm)
status: delivered, pending installation





ASA EQ1000 (1m)
Eq. mount
Status: delivered, pending installation



ASA AZ1500 (1,5m)
AZ mount
Status: pending funding

OPD: 2027A Call for Proposals

OPD 2027A - Chamada para envio de propostas

Publicado em 04/02/2021 13h25 | Atualizado em 30/10/2026 12h18 Compartilhe:

OPD 2027A - Chamada para envio de propostas

Período 2027A - 01/03/2027 - 31/08/2027

Data limite para submissão de propostas: 06 de novembro de 2026 às 17h* de Brasília. - NOVA DATA.

https://www.gov.br/lna/pt-br/composicao-1/coast/obs/opd/chamadas/OPD2027A



SOAR: flexible 4.1 m follow-up

Optical / **NIR**

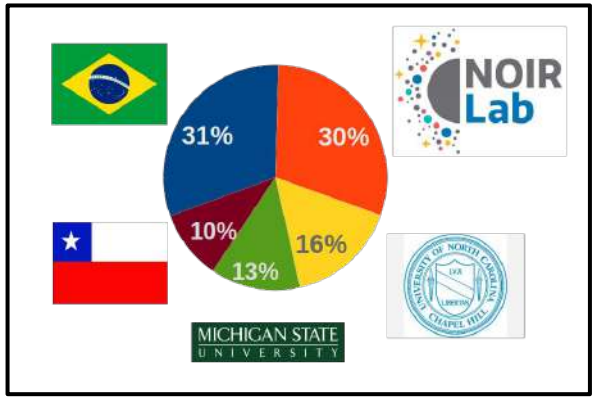
- **Goodman**:
  optical imaging and spectroscopy
- **STELES**:
  high-res optical spectroscopy (R~50,000)
- **SAMPlus / SAMOS**:
  adaptive optics and MOS-spectroscopy
- **SIFS**: fiber-fed IFU spectroscopy
- **TripleSpec**: near-IR spectroscopy
- **ISPI**: near-IR imaging

Instruments always available:
- allows multiple science program configurations
- flexibility for LSST follow-up

Classification, radial velocities, optical / NIR photometric/spectroscopic characterization

Cerro Pachón, Chile

~100 nights/year for Brazil



https://noirlab.edu/science/programs/ctio/telescopes/soar-telescope/instruments



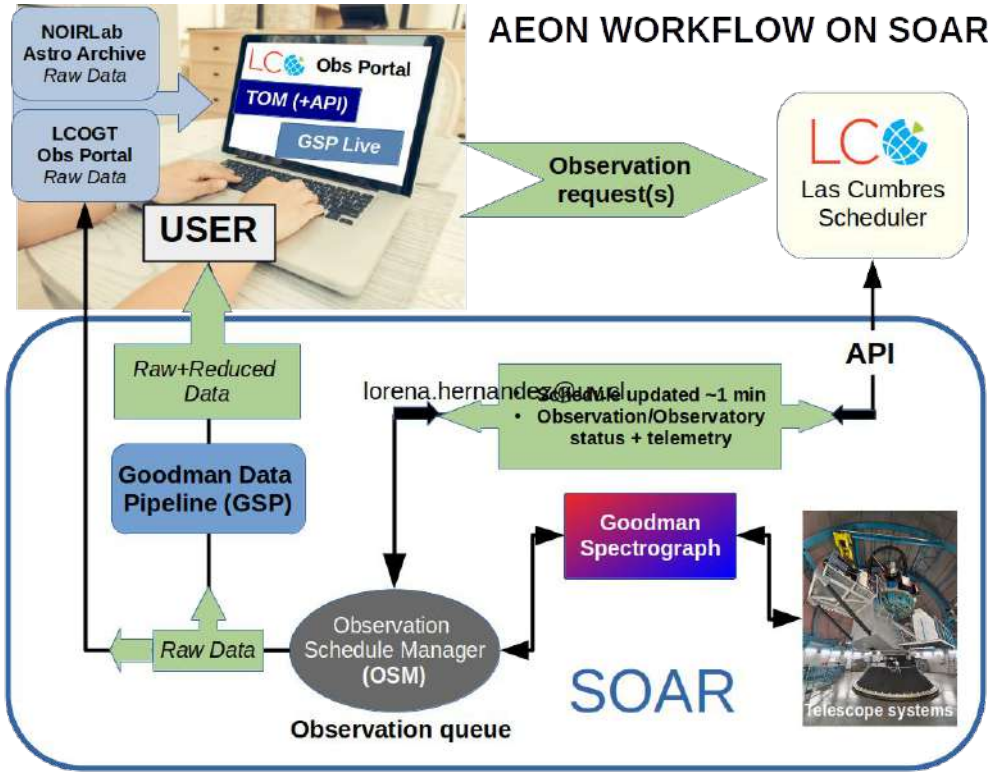


Queue-mode observations at SOAR

Astronomical Event Observatory Network

Cesar's talk at 11:30am

- SOAR controls the schedule; Human operators on-site
- Programmatic submission of observations provided by LCO portal
- Operating in AEON mode since Aug 2019
  (Elias+2018, SPIE: Observatory Operations, 107040B)
- Broad instrument configuration setups
  https://noirlab.edu/science/observing-noirlab/observing-ctio/observing-soar/aeon/features-2021a
  - Current: **Goodman** (optical spec/imager), **TripleSpec** (IR spec)
  - Future: **SAMPlus** (optical imager), **STELES** (hi-res. optical spec), **ISPI** (IR imager)



https://noirlab.edu/science/observing-noirlab/observing-ctio/observing-soar/aeon

Gemini: reaching the faintest targets

Two 8 m telescopes Brazil: ~5.7% partnership share ~60h per semester
Deep optical/NIR photometry/spectra, Faint transients

- **GMOS** - optical imaging and spectroscopy, including multi-object
- **GHOST** - high-resolution optical spectroscopy
- **FLAMINGOS-2** - near-IR imaging and spectroscopy
- **IGRINS-2** and **GNIRS** - near-IR spectroscopy

S. Panda's talk at 11:45am



	Gemini North	Gemini South
Optical	GMOS-N GNIRS	GMOS-S SCORPIO* GHOST
Near-IR	IGRINS-2 GPI-2	FLAMINGOS-2 SCORPIO* GSAOI
AO	ALTAIR NGS & LGS	GeMS (MCAO) LGS (5)

https://www.gemini.edu/instrumentation/current-instruments

Summary

Physical characterization of the transient sky: LSST will discover the transient sky. Our observatories will help us understand it.

- **LSST/Rubin:** Transient and variable-source **alerts**
- **OPD:** follow-up bright sources, **multi-band photometry, polarimetry**, future robotic operations (2028+)
- **SOAR: multi-instrumentation available**, optical / NIR photometry/spectroscopy, classification, high-resolution
- **Gemini**: **Deep photometry/spectroscopy**, fainter targets









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Obrigado!

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Machine Learning Identification of Classical Be Stars in the Era of Large Time-Domain Surveys

Clara A. Navarro[1], Alex C. Carciofi[1], Gabriel W. C. Rocha[2], Ilfa A. Gabitova[1], Vittória L. Schiavolim[1], Arghya Chakraborty[1]

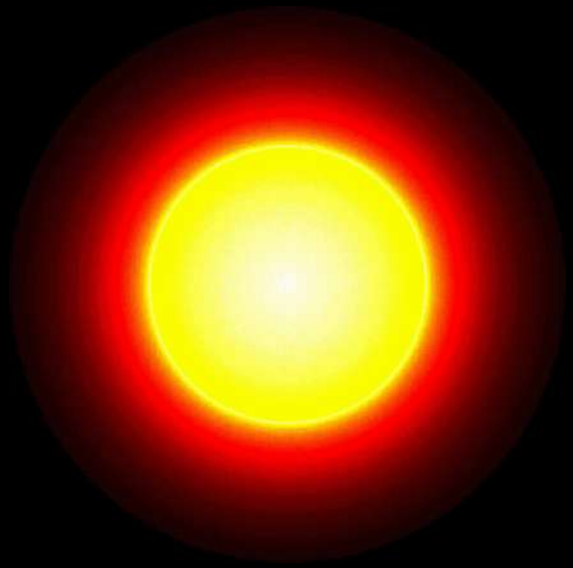
[1]Universidade de São Paulo (USP), Brazil
[2]Universidade Federal do Rio Grande do Norte (UFRN), Brazil

04/11/2026

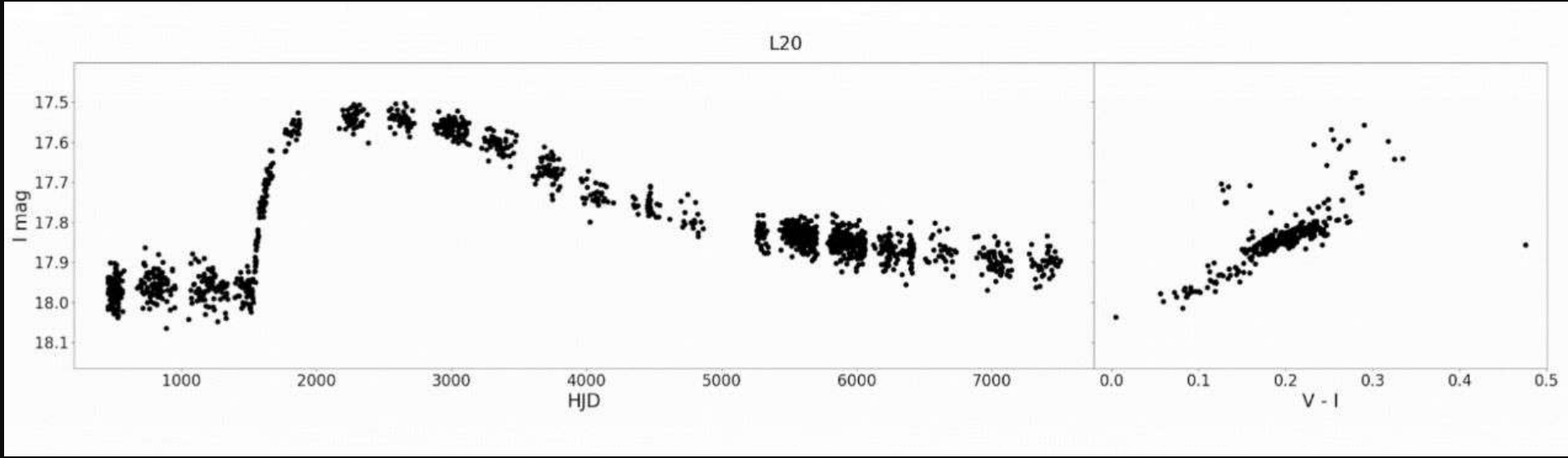
Classical Be stars

What are they?

- **Rapidly rotating B-type** non-supergiants;
- **Episodic mass ejection** produces a gaseous Keplerian **disk**;
- **Hα emission** is the spectroscopic hallmark;
- Disk growth and dissipation produce long-term photometric variability.



Classical Be stars



Example of a CBe light curve, showing long-term variability associated with disk evolution.

Why the Be fraction?

Be/(B+Be) as a constraint of spin-up channels



Binary interaction



Single-star evolution



Born-fast rotation

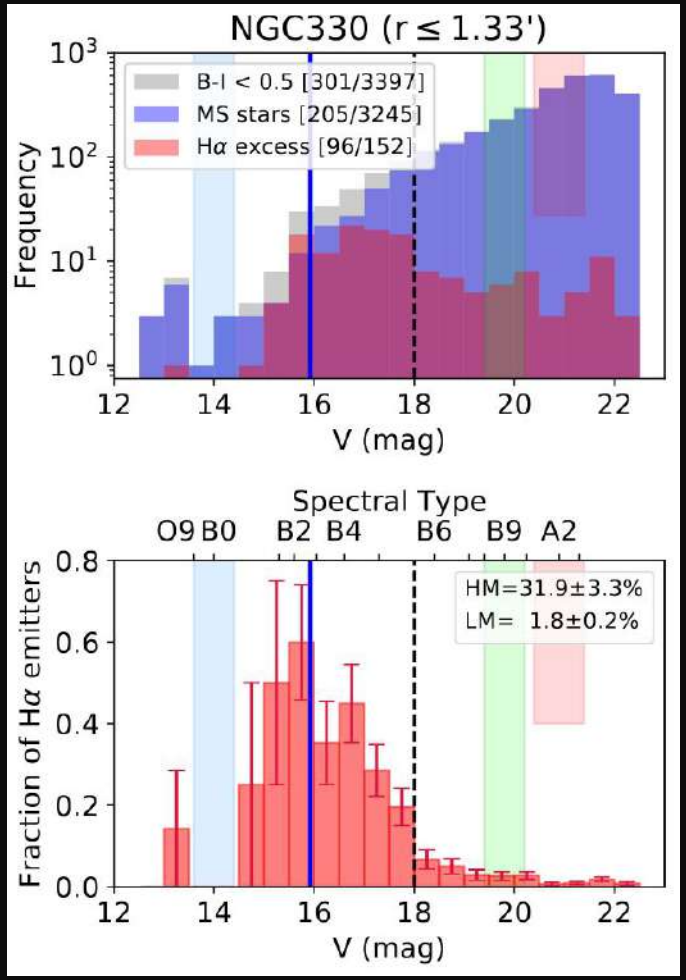
Existing Be fractions are biased

Photometric incompleteness bias

Variability bias

Weak disk bias

NGC 330: magnitude distributions (top) and observed Hα-emitter fraction (bottom). Figure from Navarete *et al.* (2024).

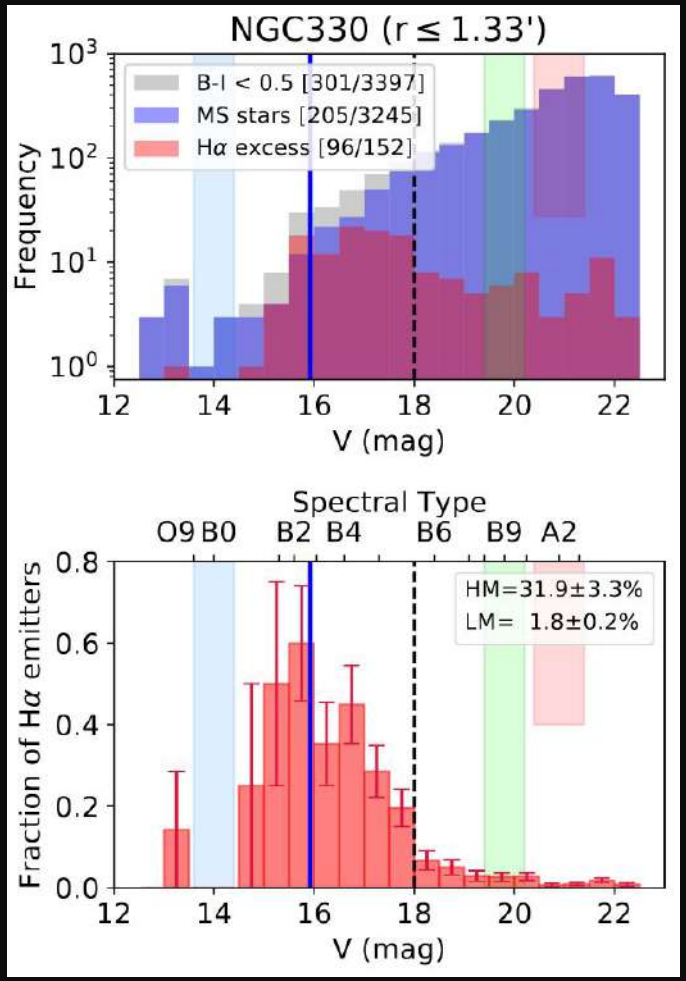


Existing Be fractions are biased

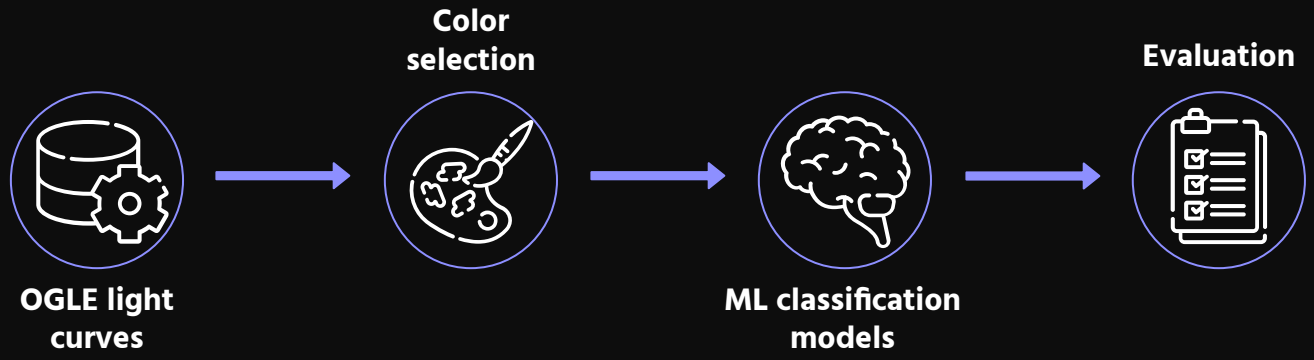
Variability bias

Multi-epoch photometry helps **mitigate the variability bias** by observing the stars during different disk phases!

NGC 330: magnitude distributions (top) and observed Hα-emitter fraction (bottom). Figure from Navarete *et al.* (2024).



Our sample and framework



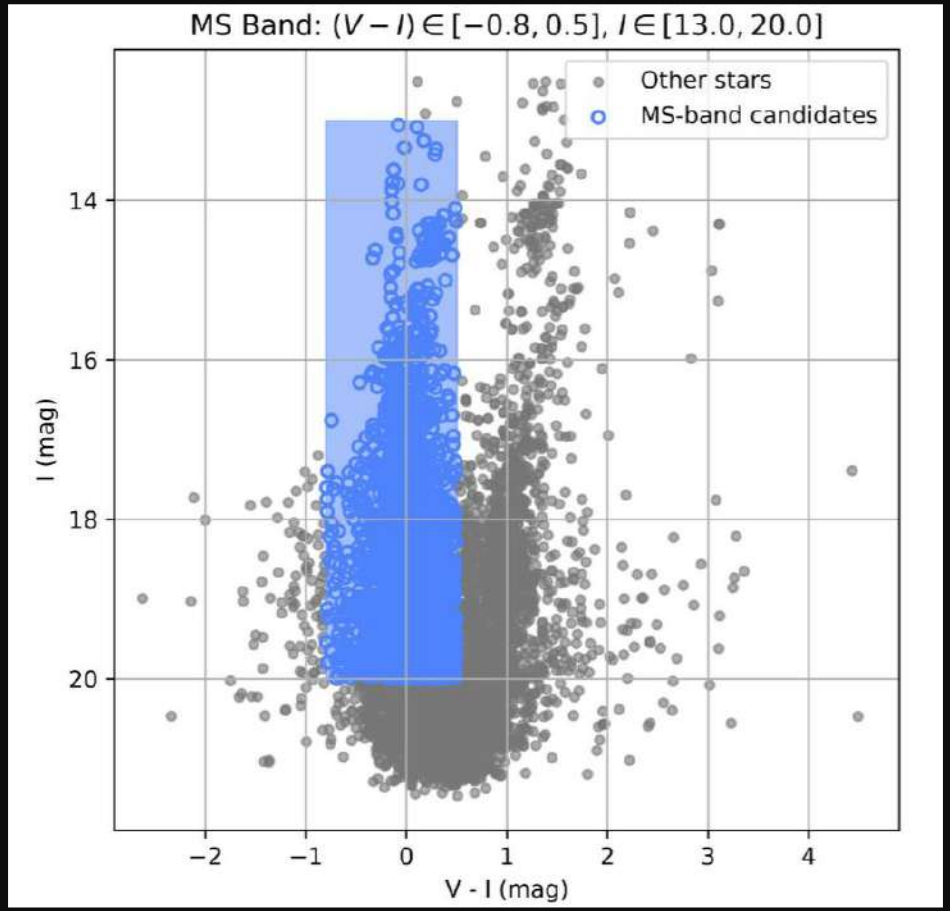
Full sample

~14,000 **manually classified**, **23-yr OGLE I+V band** light curves, including:

- ~3,000 stars from Figueiredo *et al.* (2025);
- ~11,000 stars from NGC 330 and NGC 1850;
- **~18%** are classified as **CBe candidates**.

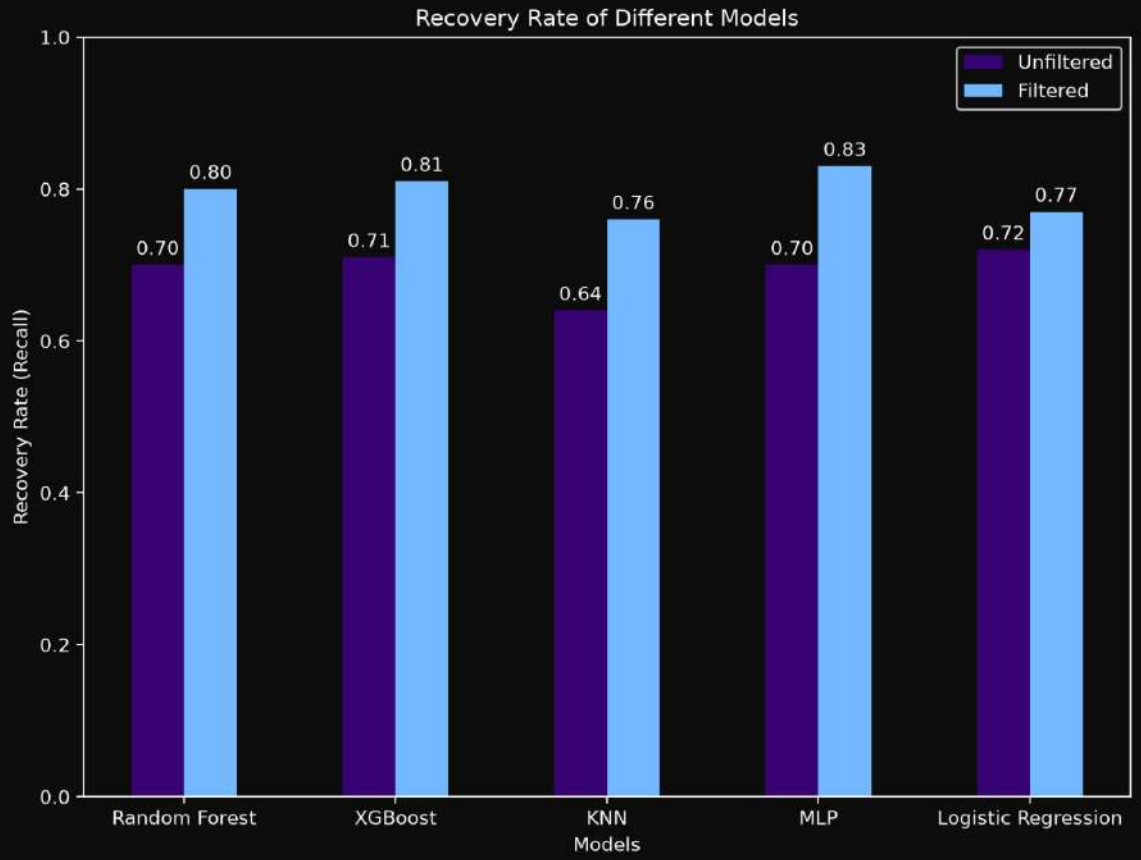
CMD selection

We use **synthetic photometry** from the BeAtlas grid (Rubio et al. 2023) to define the **expected CMD region for MS-band stars** and exclude candidates outside this region.



CMD cut used to select main-sequence-band candidates.

CMD selection: results

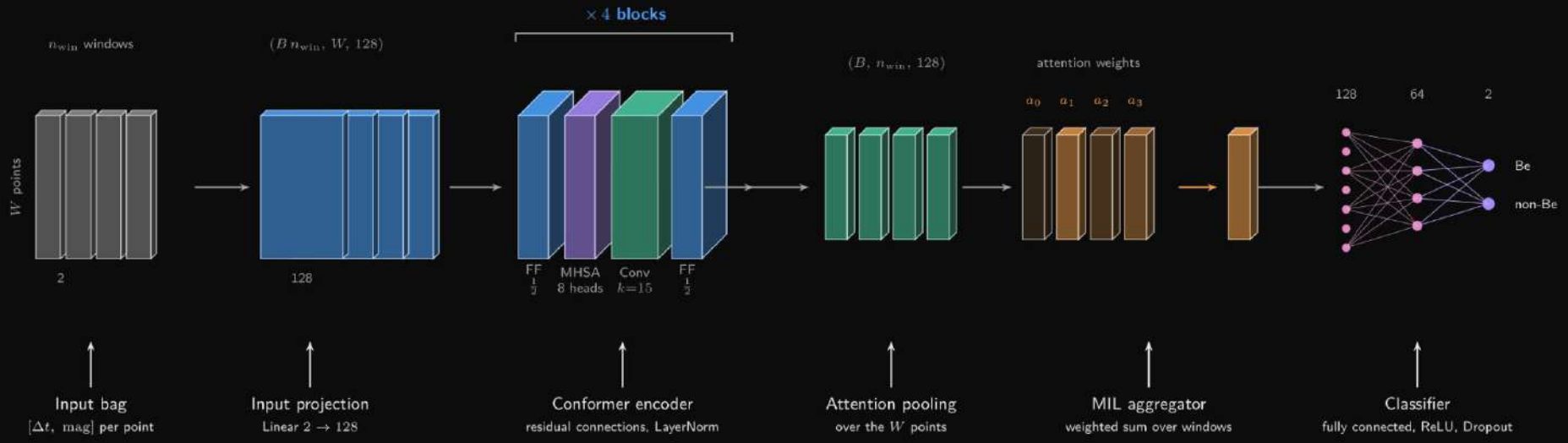


CMD selection improves the recovery of CBe star candidates by about 0.1 for all tested models.

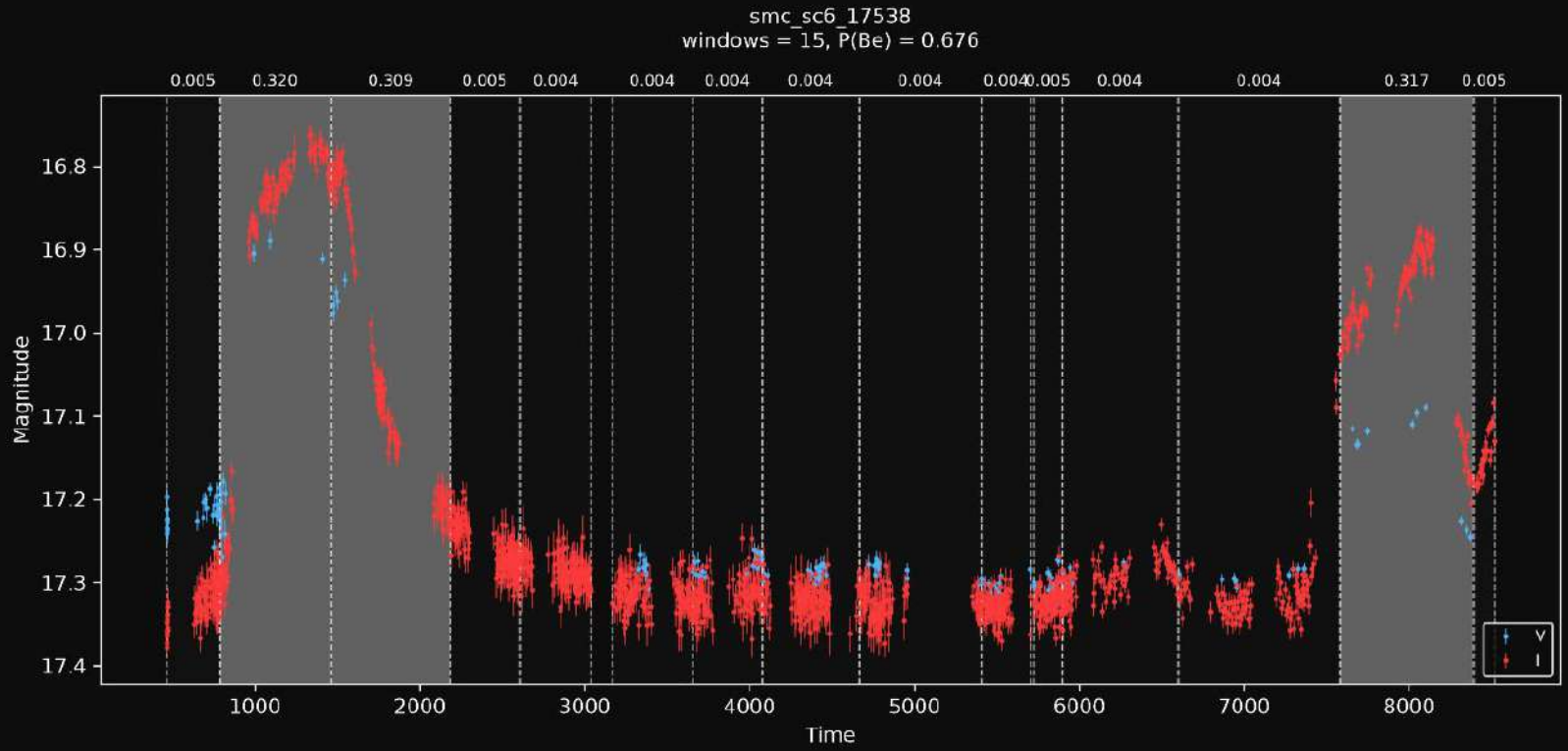
We also tested the effects of class-imbalance handling, complexity of the models, different data representations and feature importance.

Conformer+MIL model

Main idea: not all parts of a light curve are **equally informative**. The light curves are divided into **smaller**, consecutive, non-overlapping **windows** and the model learns a **different weight for each** temporal window.

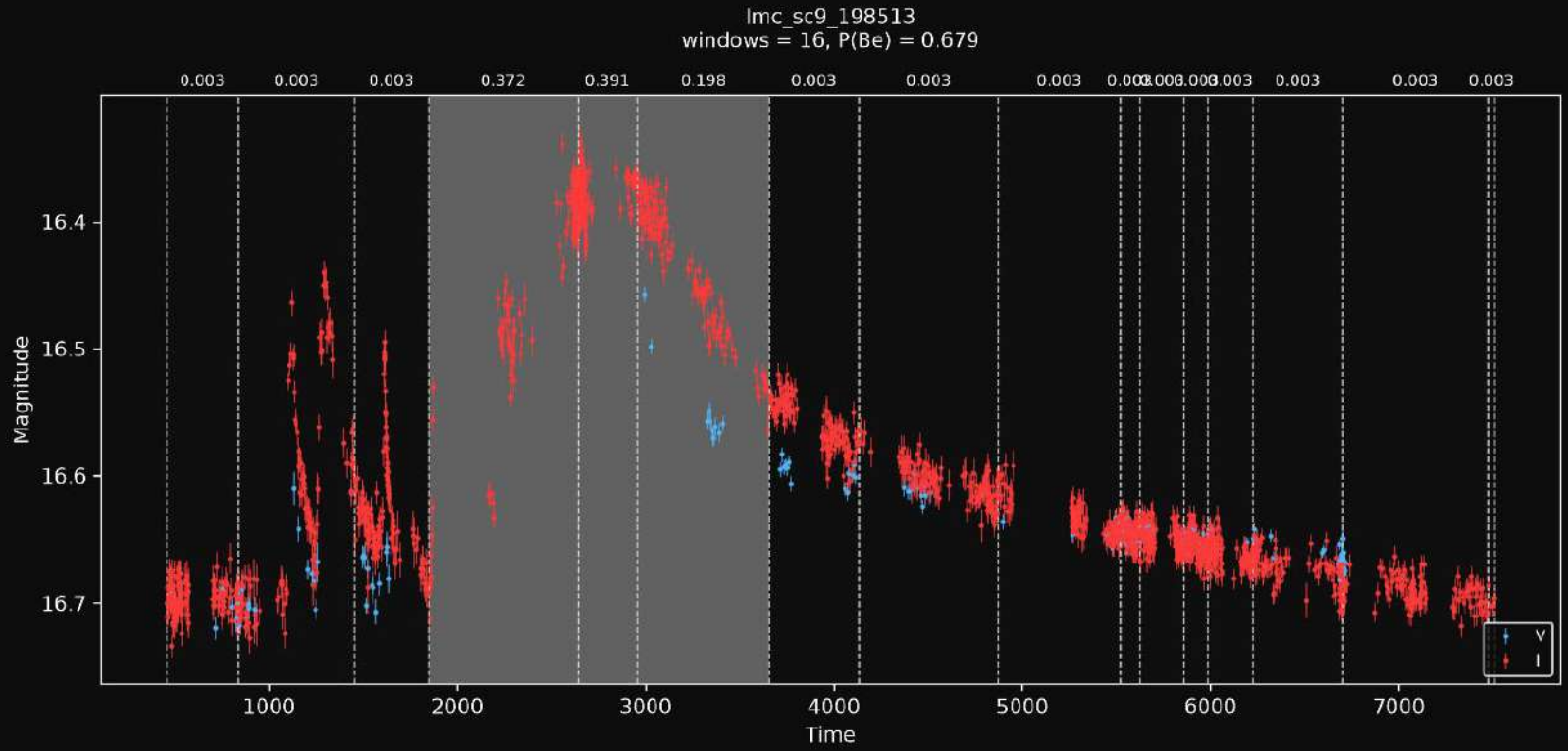


Conformer+MIL model



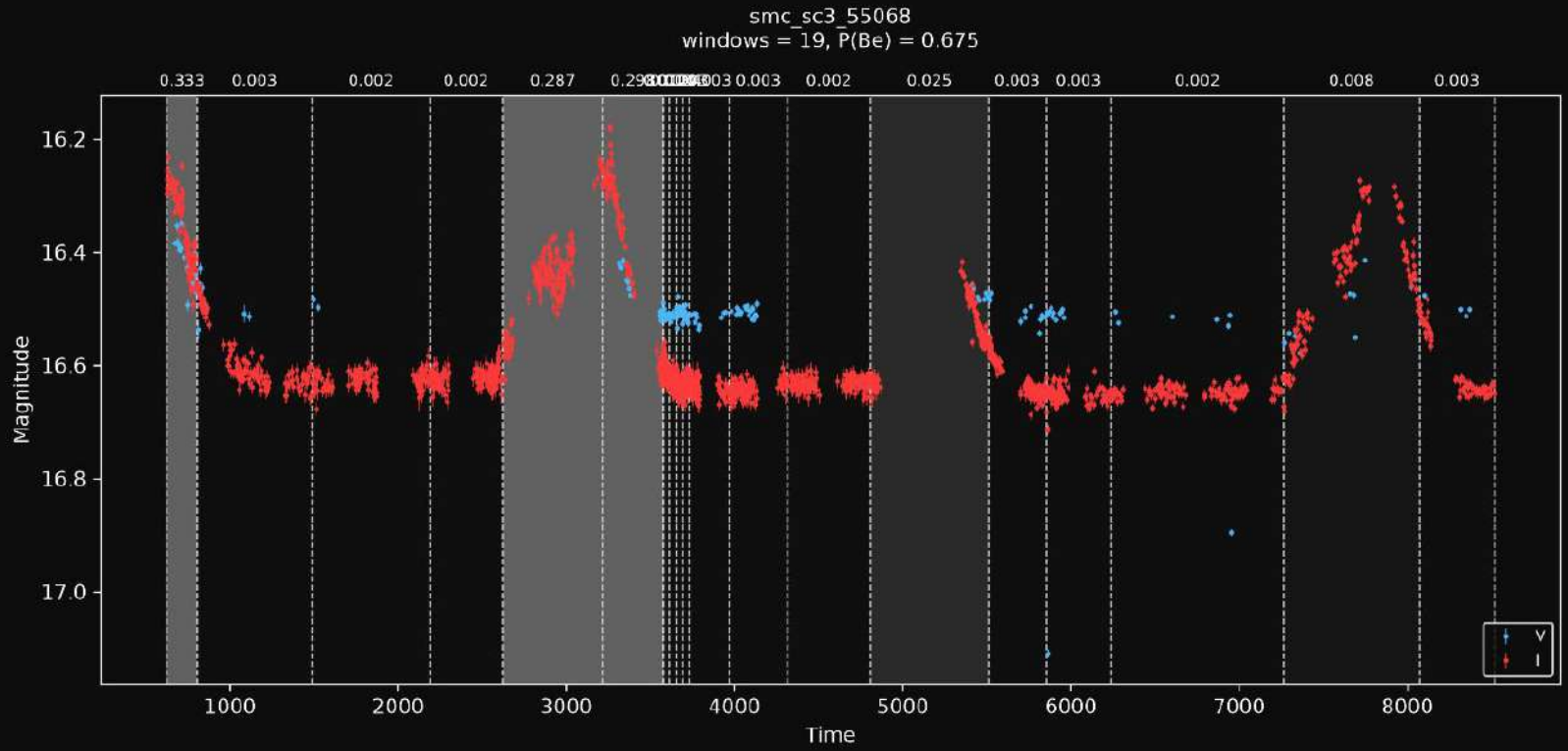
Example CBe light curve with window weights assigned by the Conformer+MIL model.

Conformer+MIL model



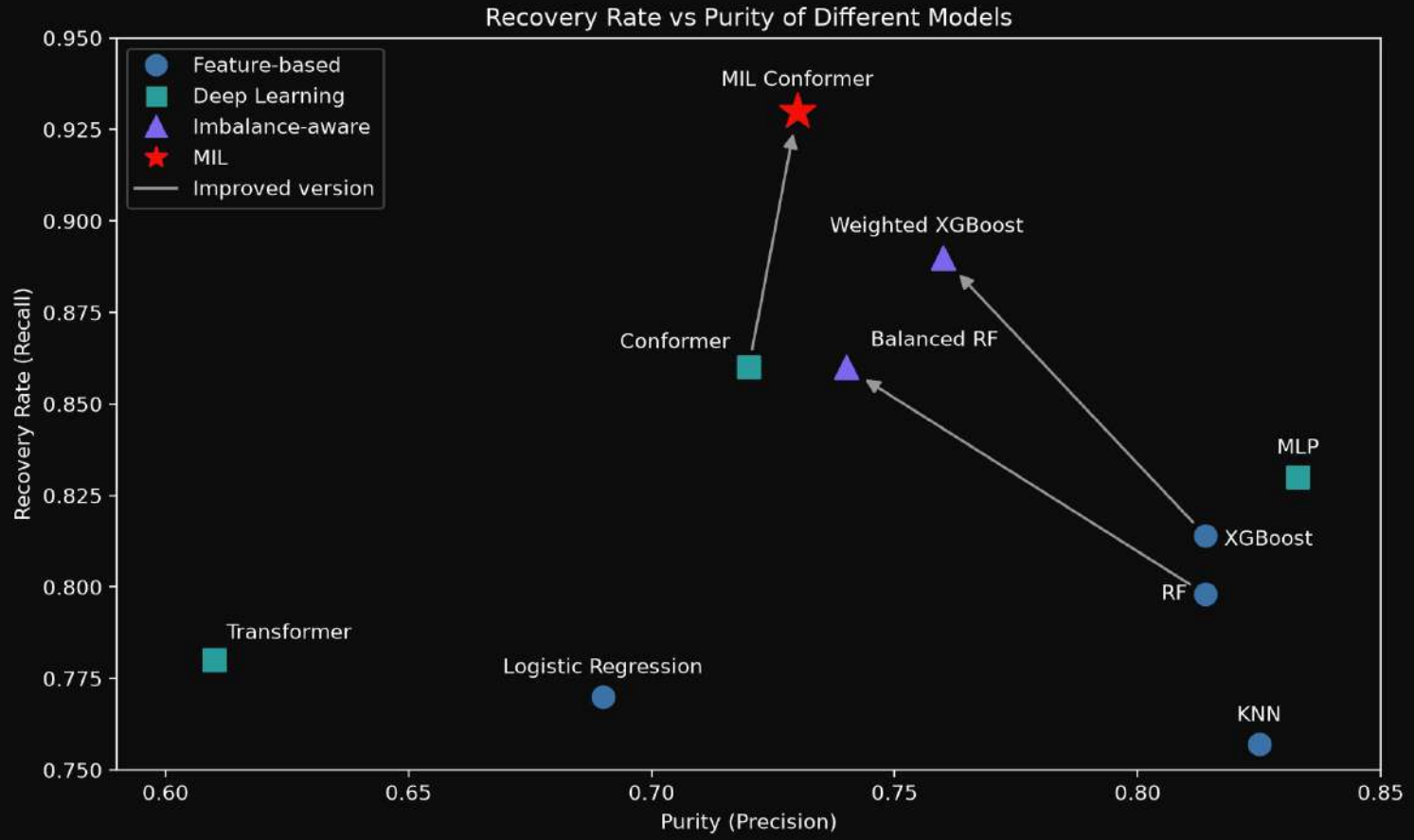
Example CBe light curve with window weights assigned by the Conformer+MIL model.

Conformer+MIL model



Example CBe light curve with window weights assigned by the Conformer+MIL model.

Results on OGLE



Three main questions for Rubin



Temporal baseline

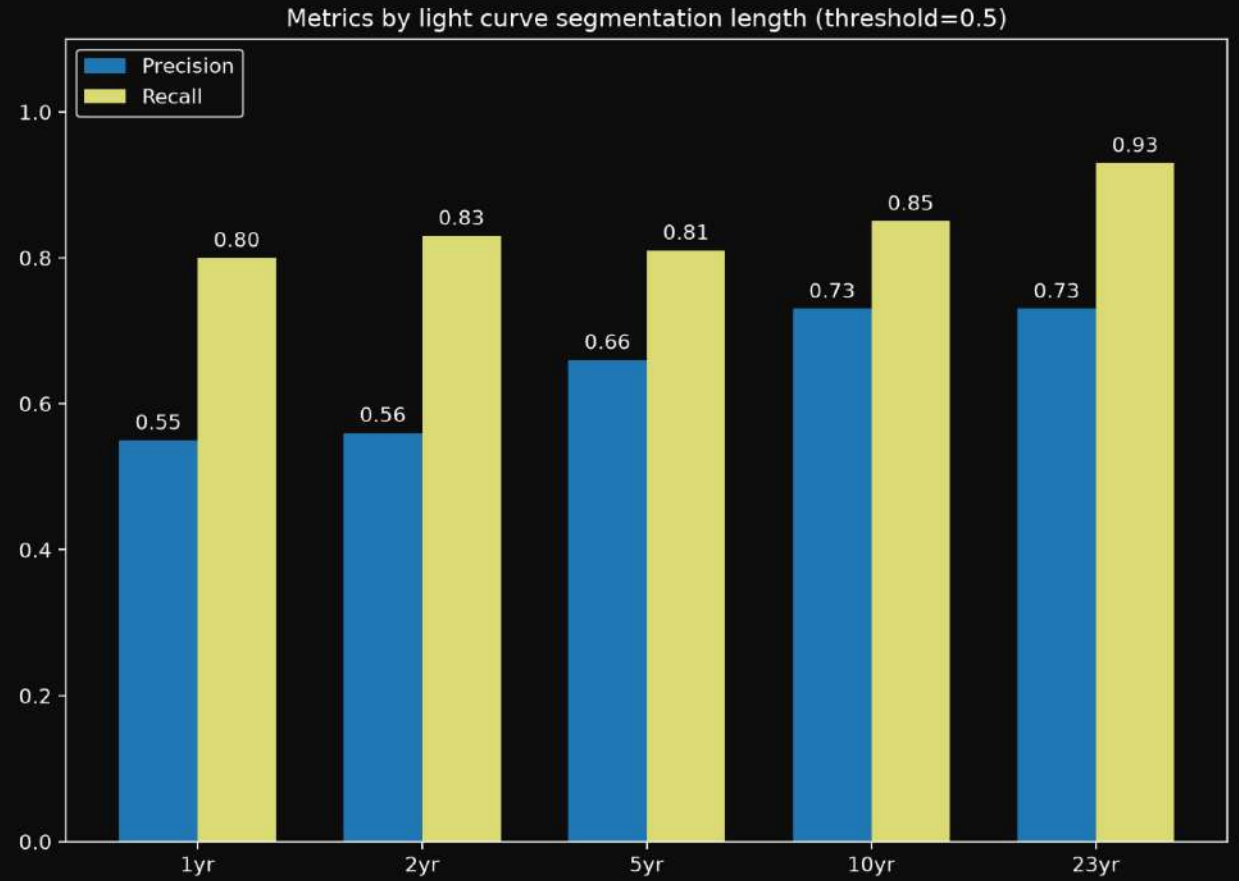


Filters

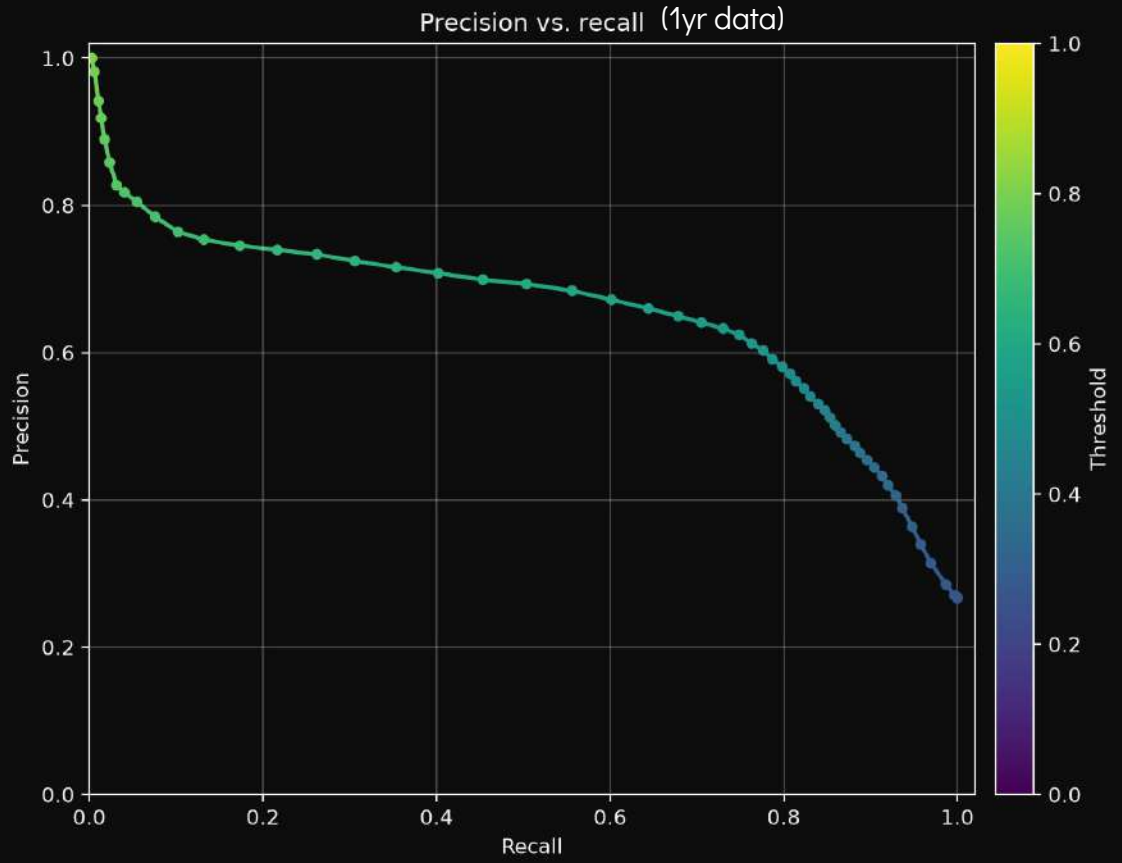


Scalability

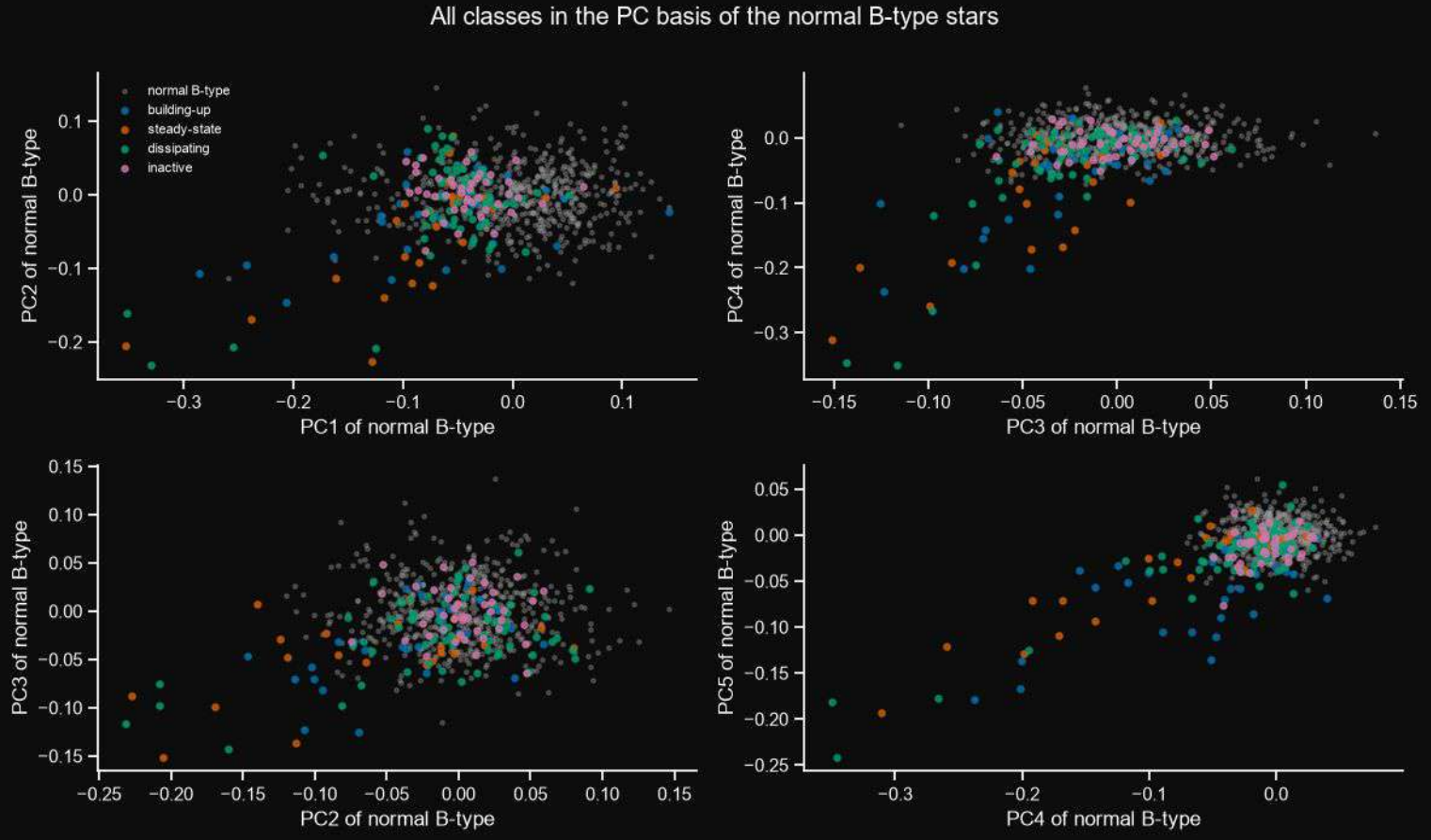
How much data is necessary?



How much data is necessary?



Which filters work best?



Which filters work best?



Scalability

120-216 stars/s

End-to-end time for different batch sizes (from 1 to 128)

120-1200 hours (5-50 days)

to classify 10^8-10^9 stars using our current hardware infrastructure
(NVIDIA A30 GPU, 16 CPUs, AMP off, 1.5M parameters)

Summary and next steps

Summary

- **Multi-epoch photometry captures disk variability** that single-epoch observations can miss;
- **Color pre-selection improves** CBe candidate **recovery** across the tested models;
- We are **testing how observing time and filter choice affect performance** with Rubin.

Next steps

- **Refine** the observing-baseline and filter choices for **candidate selection**;
- **Test our models using fake light curves with LSST filters and cadence!!!!**

Thank you!!! :) **Contact: clara.navarro@usp.br**

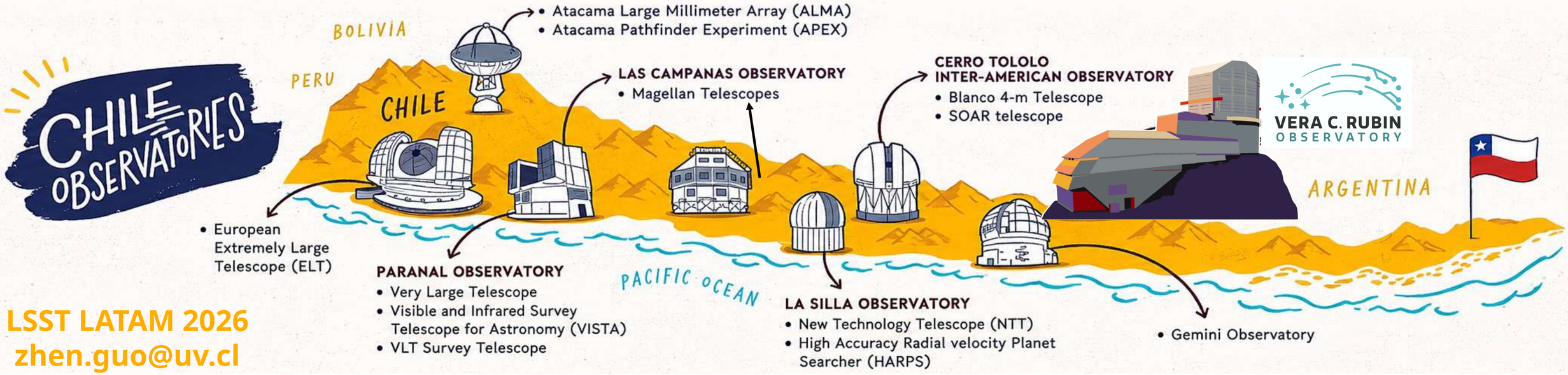
Caught-on-fire: Eruptive Young stars in the Rubin era

Zhen Guo (郭震)

IFA, Universidad de Valparaíso, Chile

Chinese Academy of Sciences, Southern America Center for Astronomy (CASSACA)

(In collaboration with J. Osses, **V. Fermiano**, C. Lizana, D. Torres, A. Aliaga, C. Morris, M. Montesinos, J. Borissova, R. Kurtev, **C. Briceño, F. Navarete**, D. Minniti, M. Gomez, Min Fang, V. Elbakyan, K. Singh, V. Ivanov, J. Ninan, P. Lucas, S. Nayakshin, C. Contreras Peña, He Zhao, R. Saito and the VVVXSS survey team

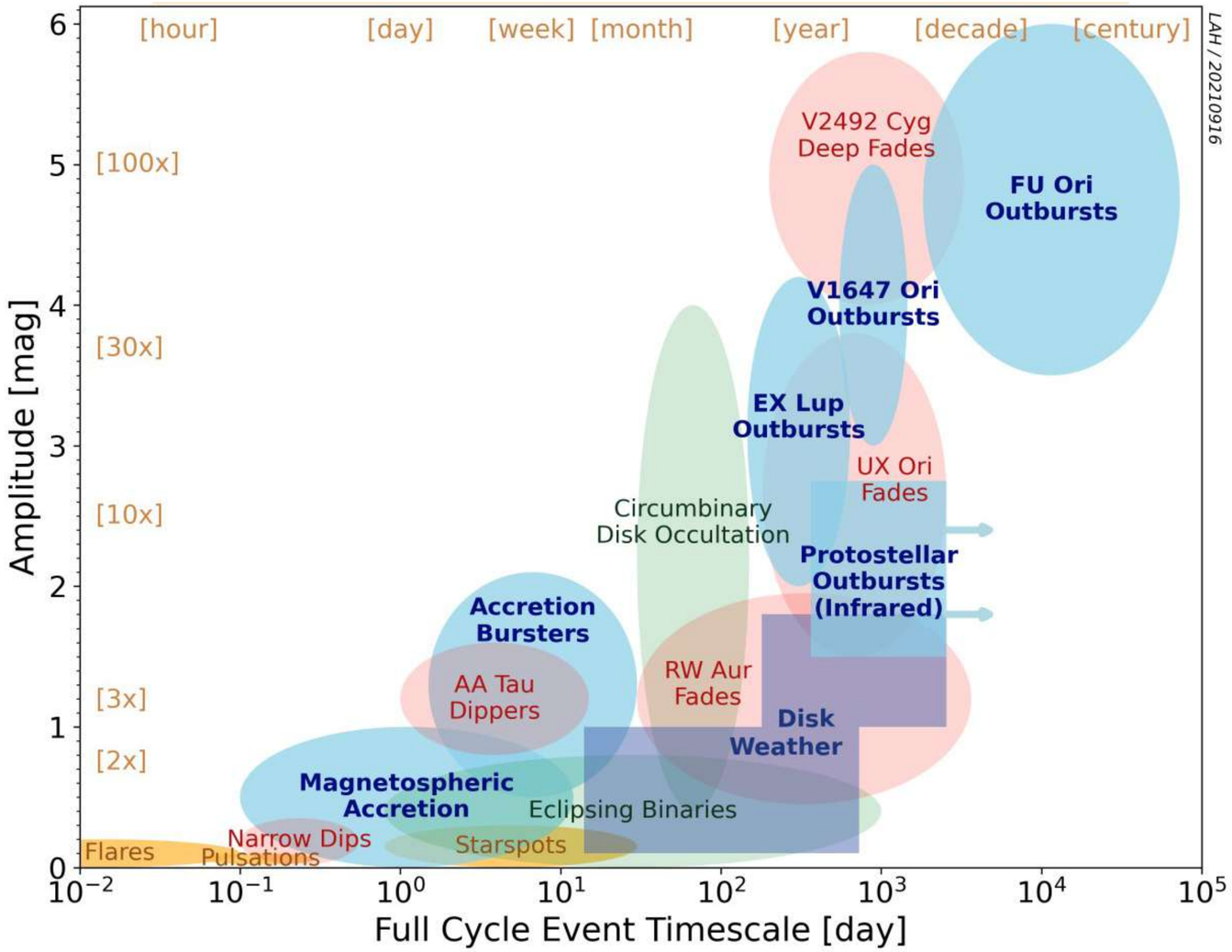


LSST LATAM 2026

zhen.guo@uv.cl

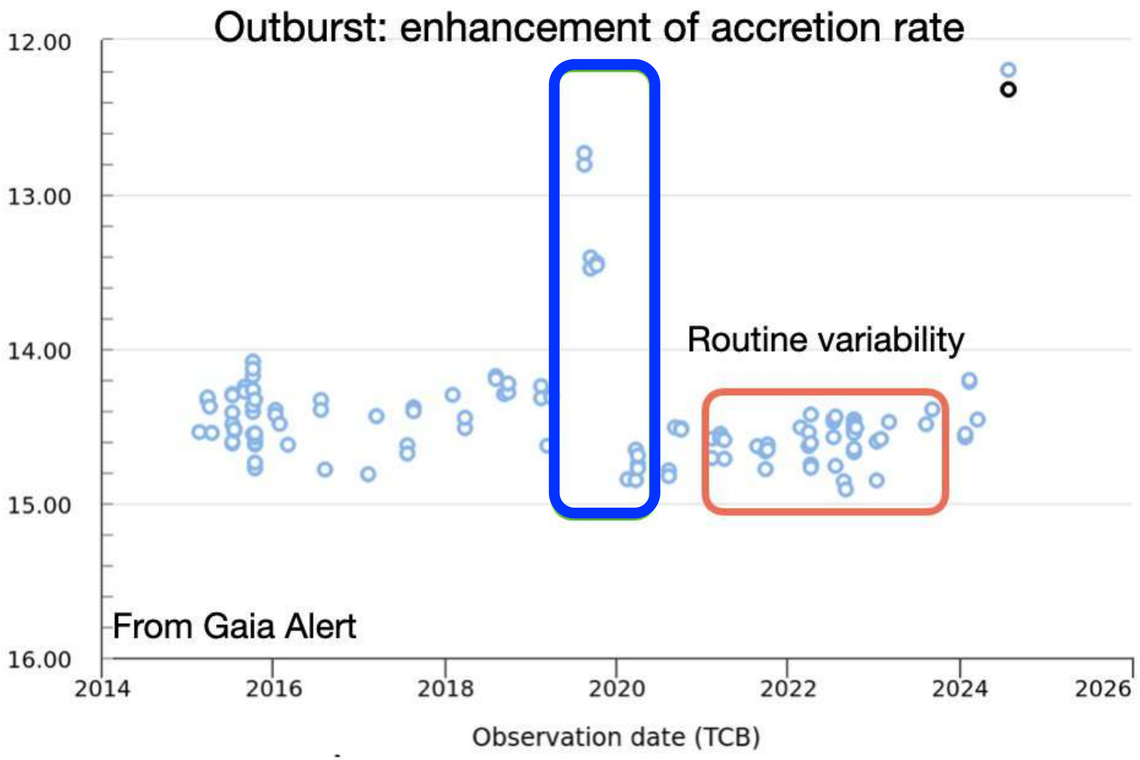
Young stars are variable stars

Accretion Extinction Binary



Credit: L. Hillenbrand

- Stellar mass assembly
- Impact on planet-formation
- Different phases of eruptive
- Star-planet-disk interaction events



Caught on fire: the Chilean observation on Eruptive YSOs

Target selection:

1. Photometric data: Gaia Science Alert, ALeRCE broker, NEOWISE light curve, ATLAS

2. Watch-list system: previously known Class I/II YSOs (SPICY, Lagoon, Monoceros, Carina, etc)



Paper published: Guo+2025, 2026a, 2026b, Singh+2026a

Caught on fire: the Chilean observation

LCOGT 1.0 m: regular photometric monitoring including u-band

SOAR 4.1 m: optical to near-IR spectrum (0.4-2.4 μm)

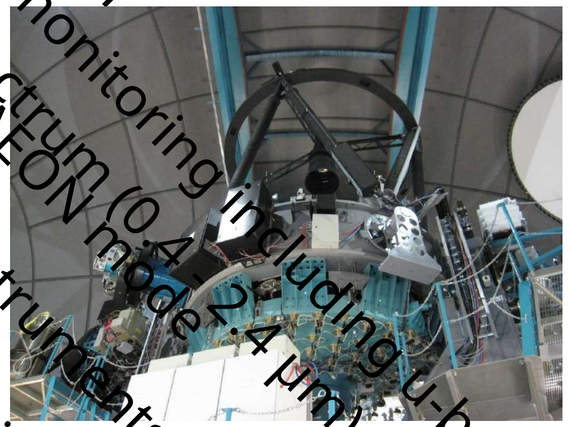
-> Flexible scheduling using AEON mode

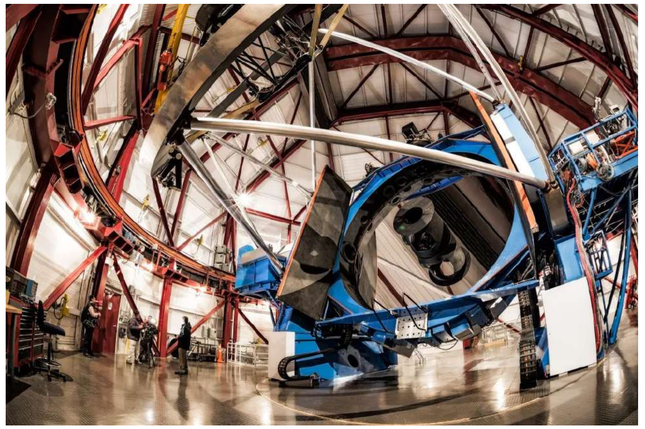
-> Multi-epoch spectra on two instruments

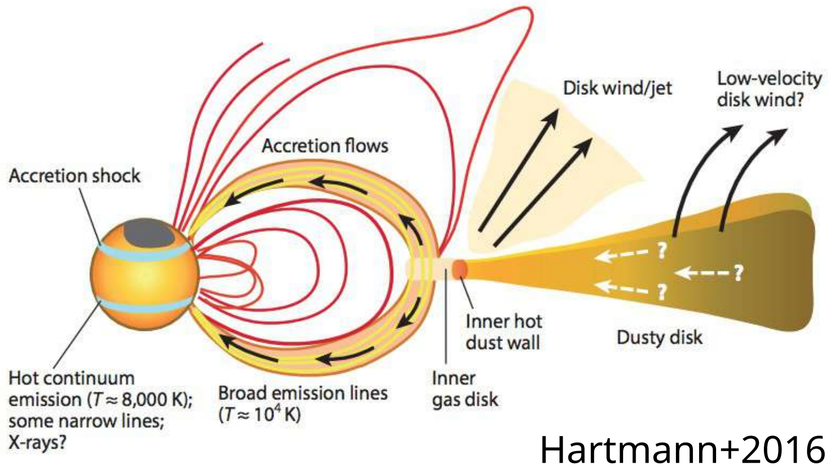
Magellan 6.5 m: mid/high-resolution s

-> Painter target observation, lor









Hartmann+2016



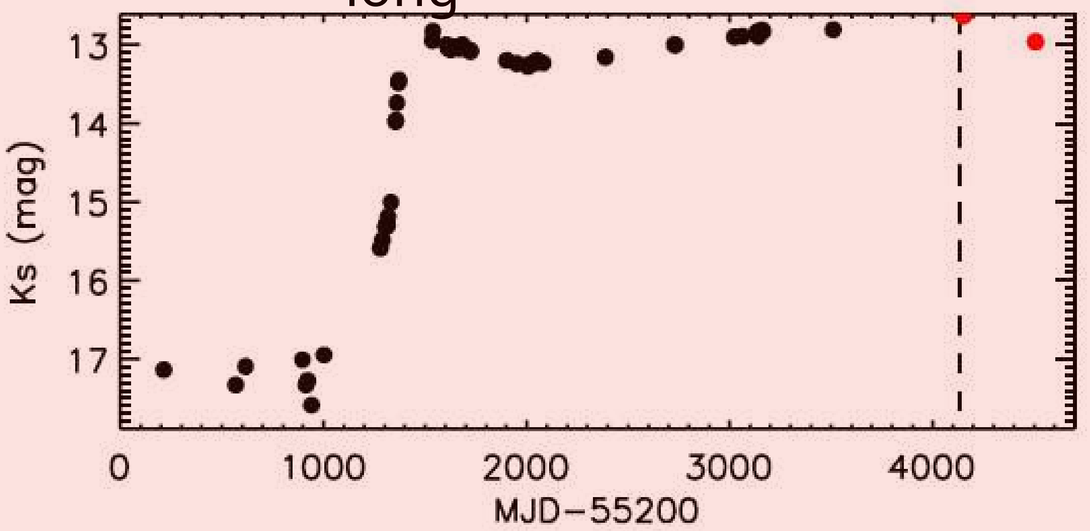
Prof. Cesar Briceño's talk

AEON
Astronomical Event Observatory Network

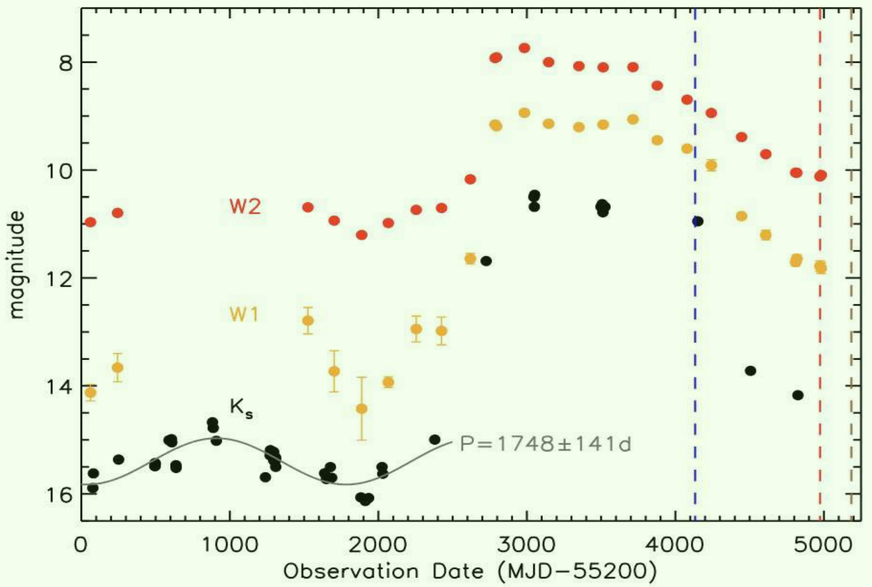
Different types of outbursts on YSO

Guo et al., 2022, 2024a, 2025, 2026a

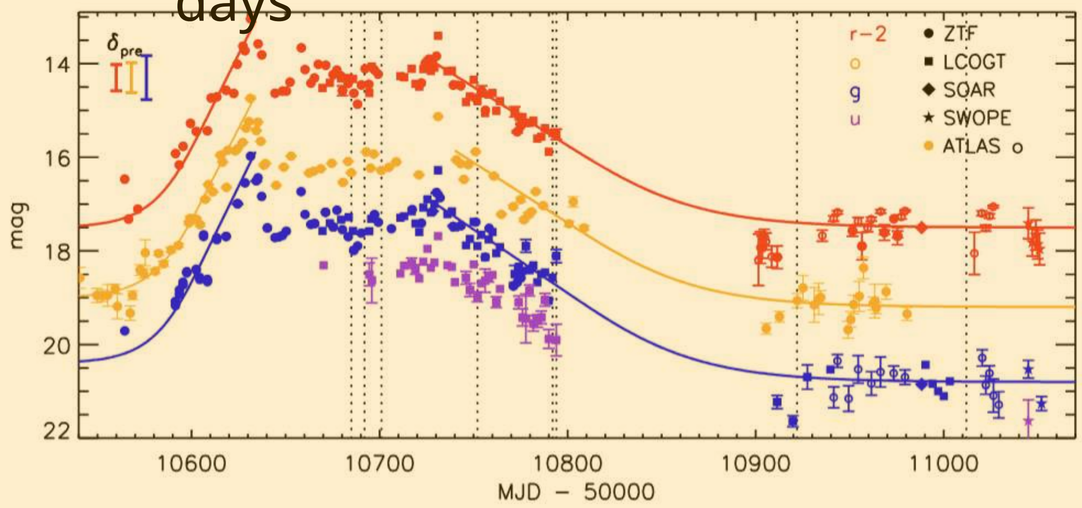
FUors: decade-long



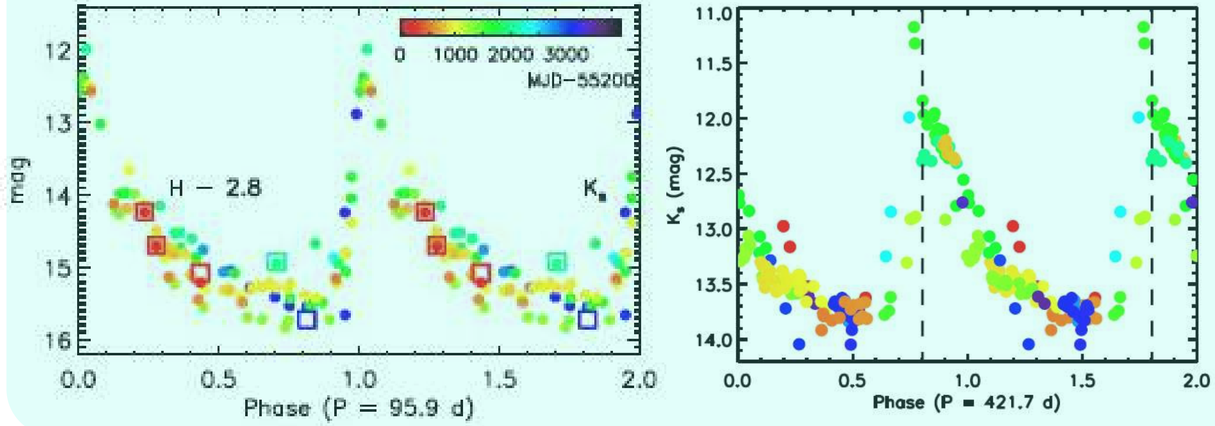
Intermediate: a few years



EXors: random and hundreds days

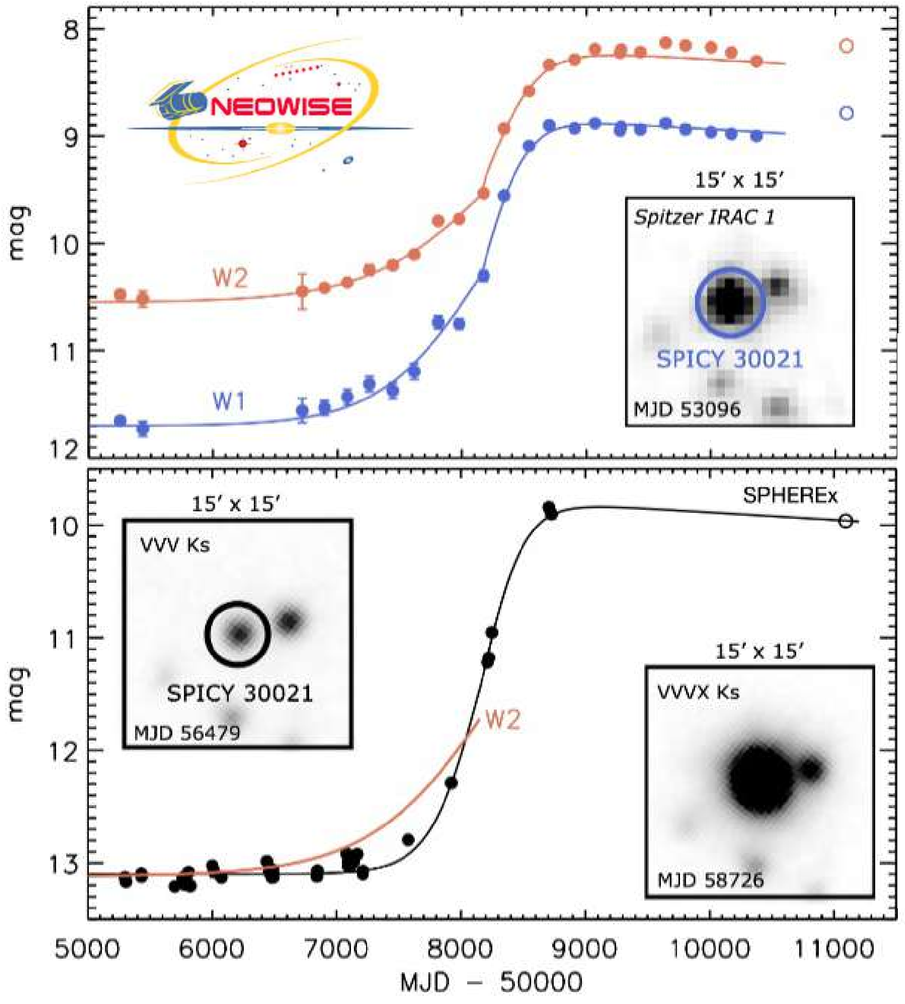


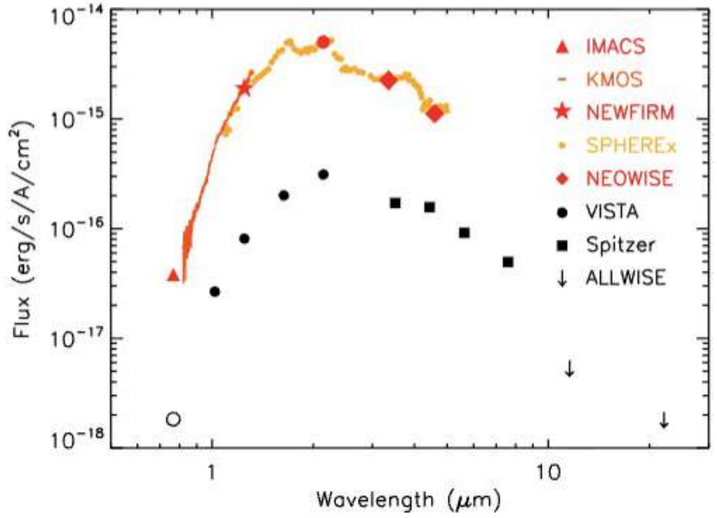
Repeated



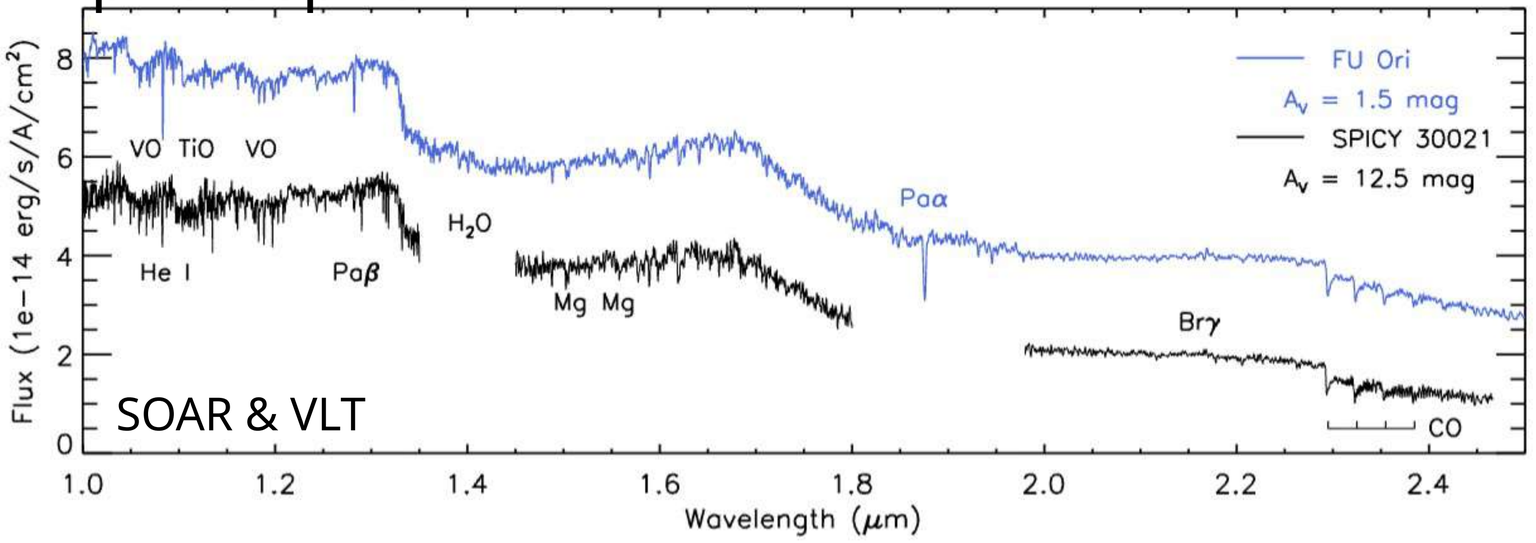
SPICY30021: an infrared eruptive young star

- Discovered from NEOWISE photometry with ΔW2 = 2.3 mag
- There is a 900 days “pre-brightening” in the MIR W2-band



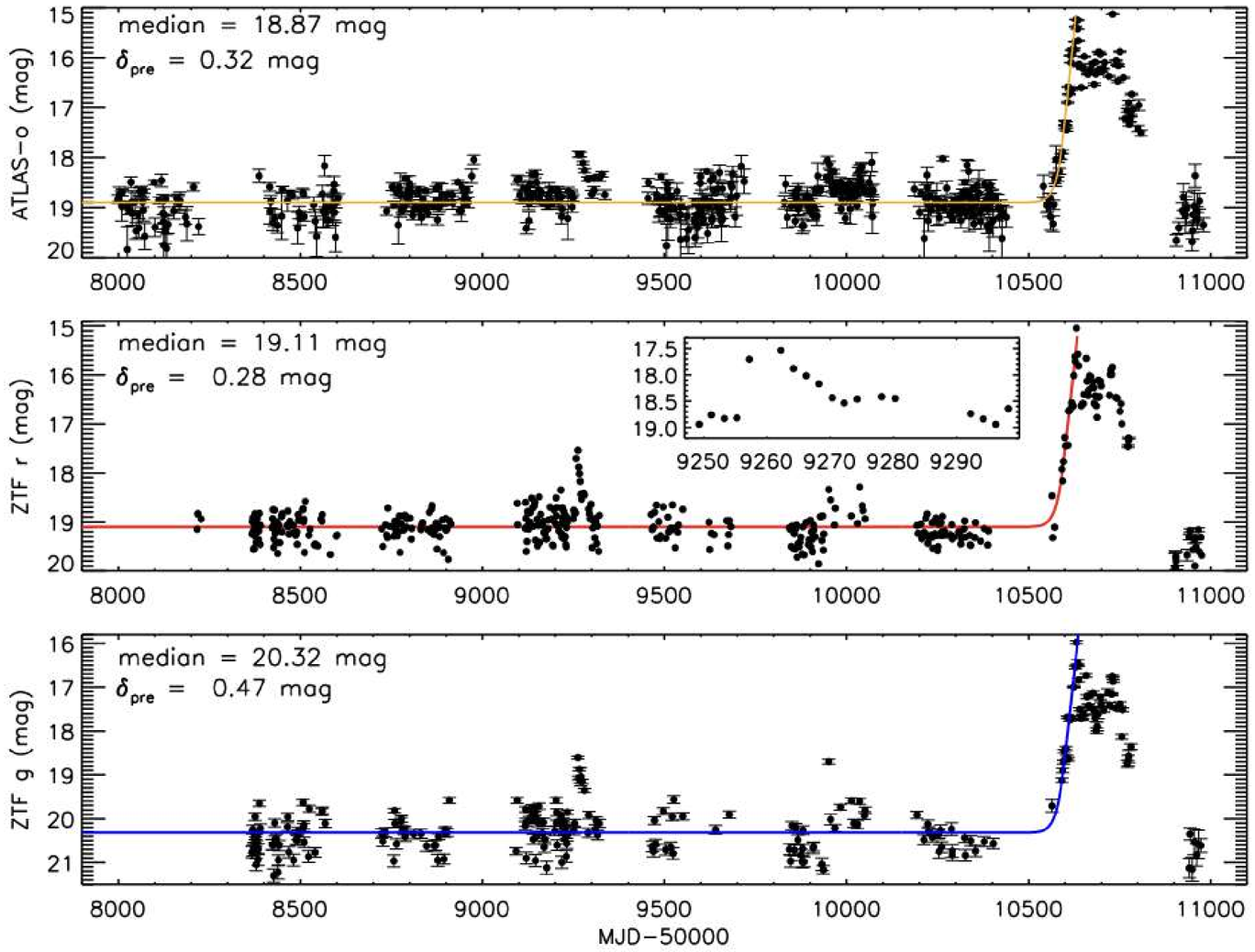


Accretion disk outshines the photosphere

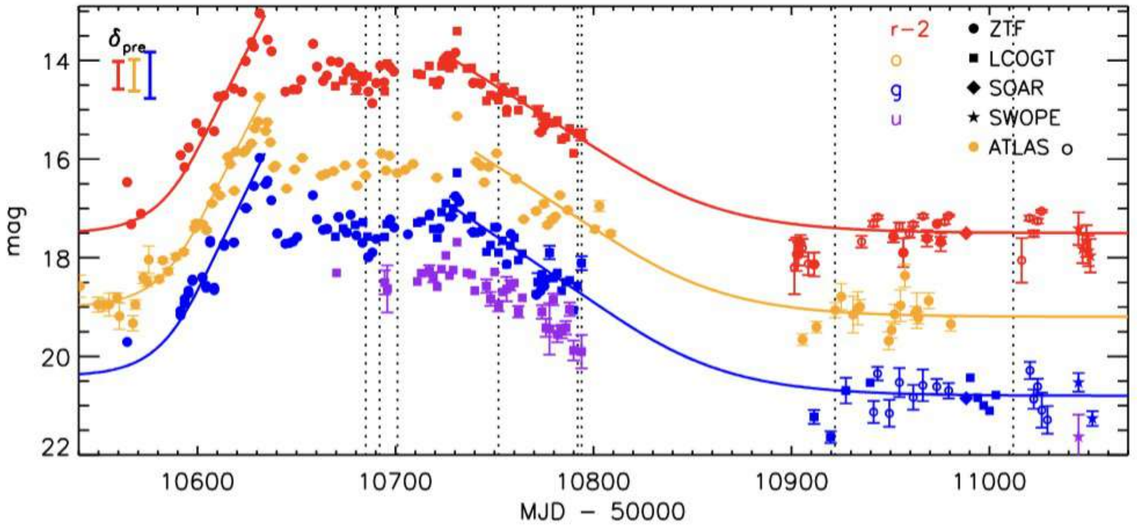


Guo et al., 2026b, A&A

V557 Mon: an **EXor** outburst on a T Tauri star, discovered from ZTF (ALeRCE)



1 year



-> 40 times brighter in 2 months

"daily" cadence with ZTF+LCOGT

Guo, Osses et al., 2026a

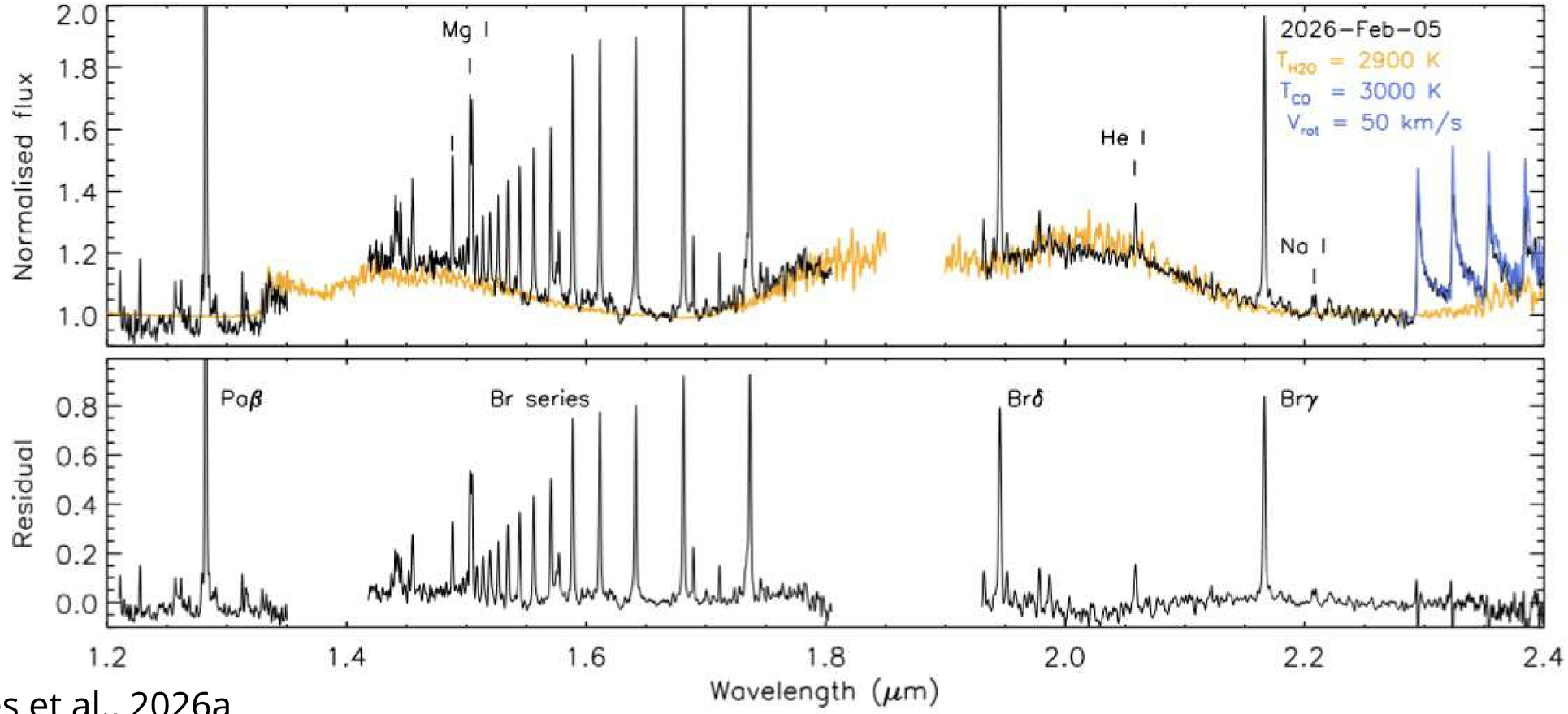
V557 Mon: an **EXor** outburst on a T Tauri star:

Pre-outburst: M1 type, quiescent Lacc = 0.13 $L_\odot$

A T Tauri star looks like an protostar in NIR

CO and water emission during the outburst

Peak Lacc = 4.6 $L_\odot$, average Lacc = 2.8 $L_\odot$





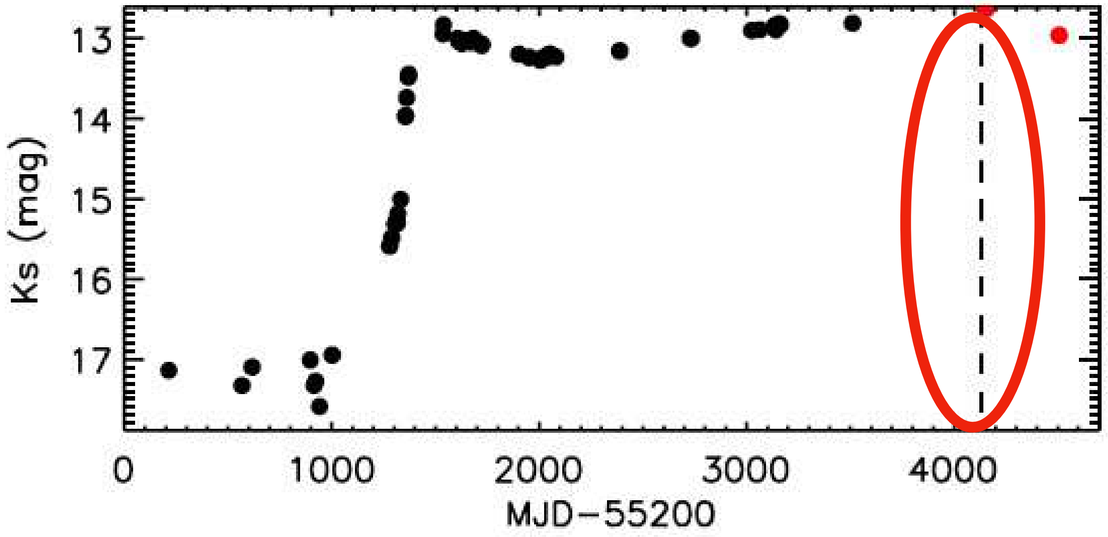


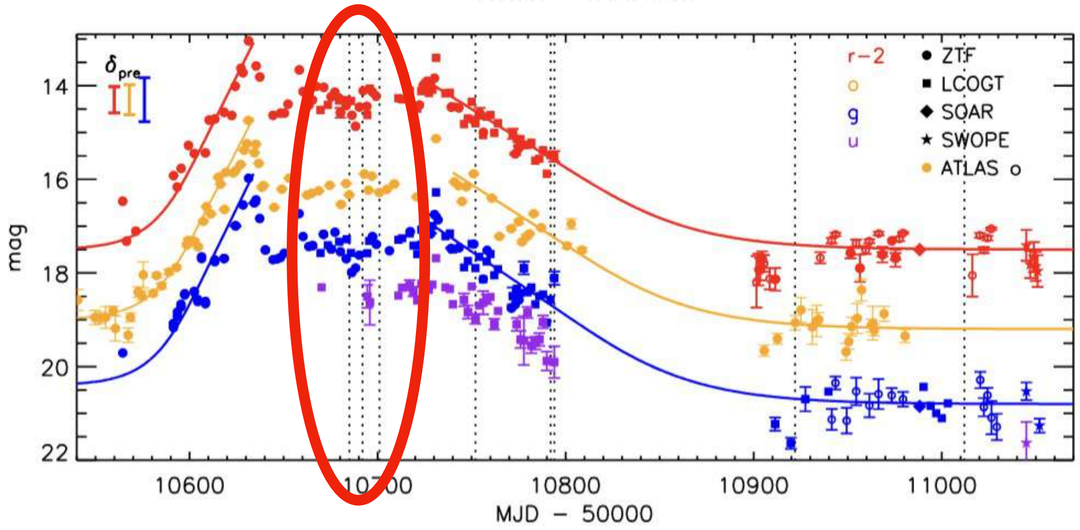
Javier Osses

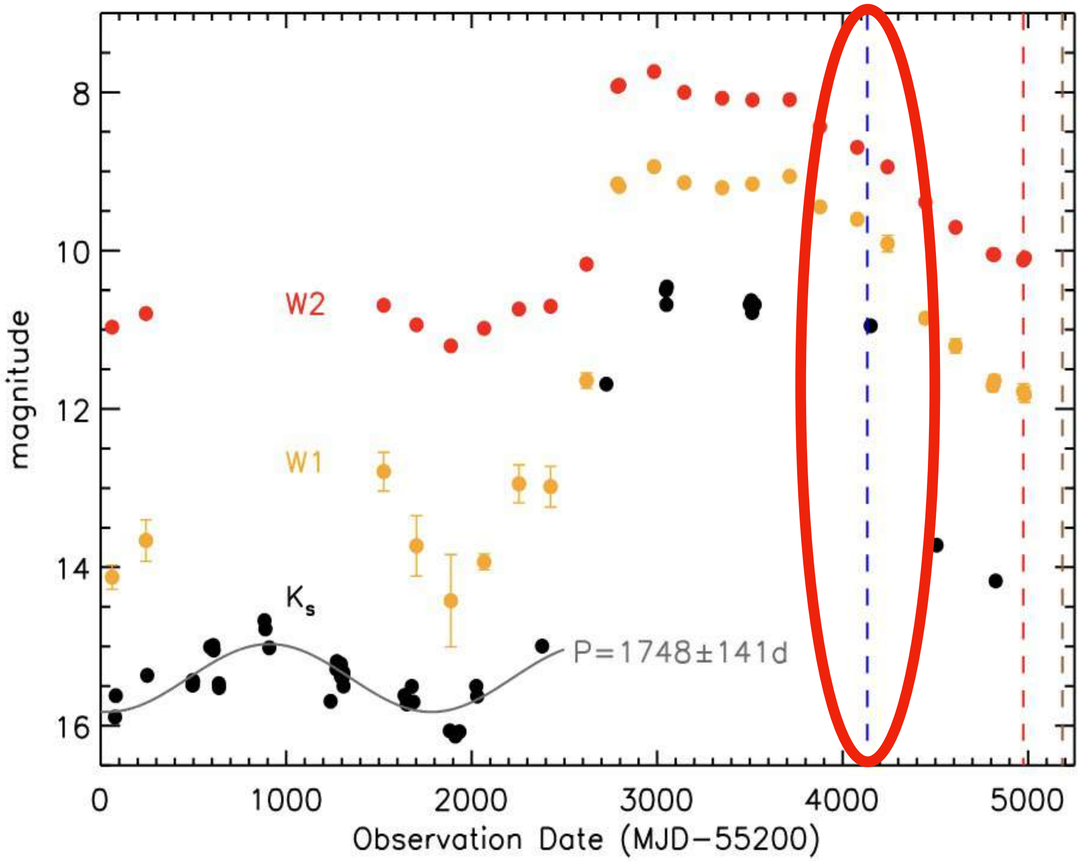
Guo, Osses et al., 2026a

Spectroscopic confirmation / follow-up observations

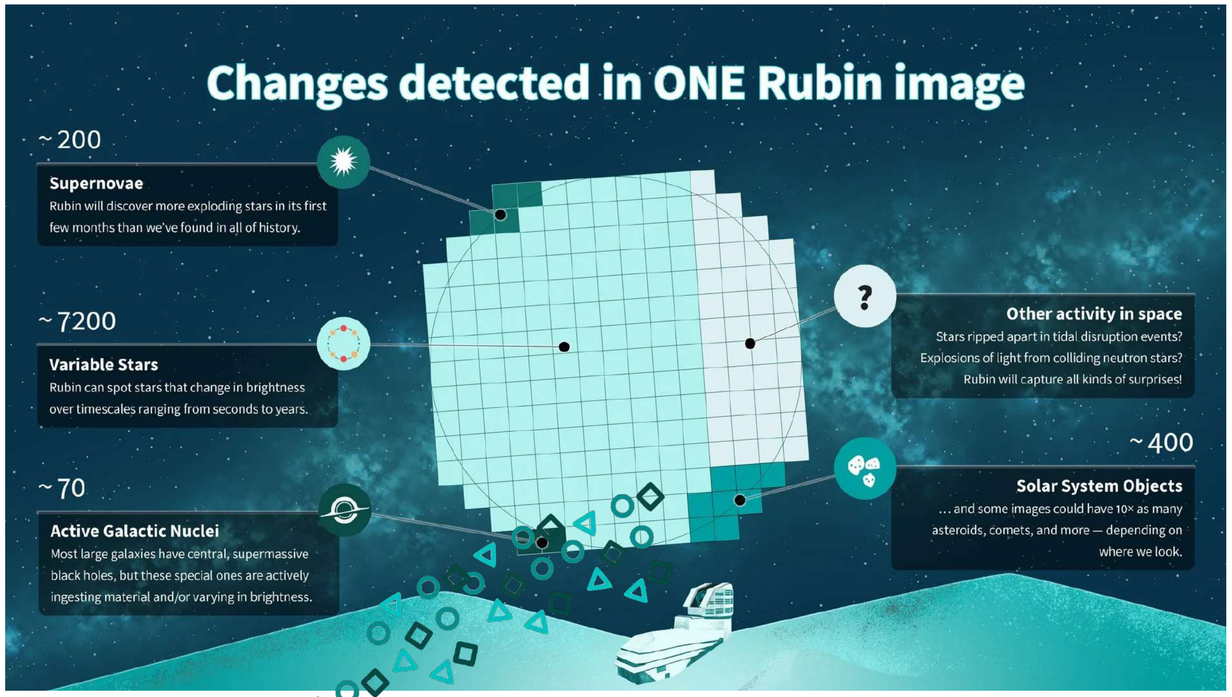
- Rising timescale: 1 - 3 months

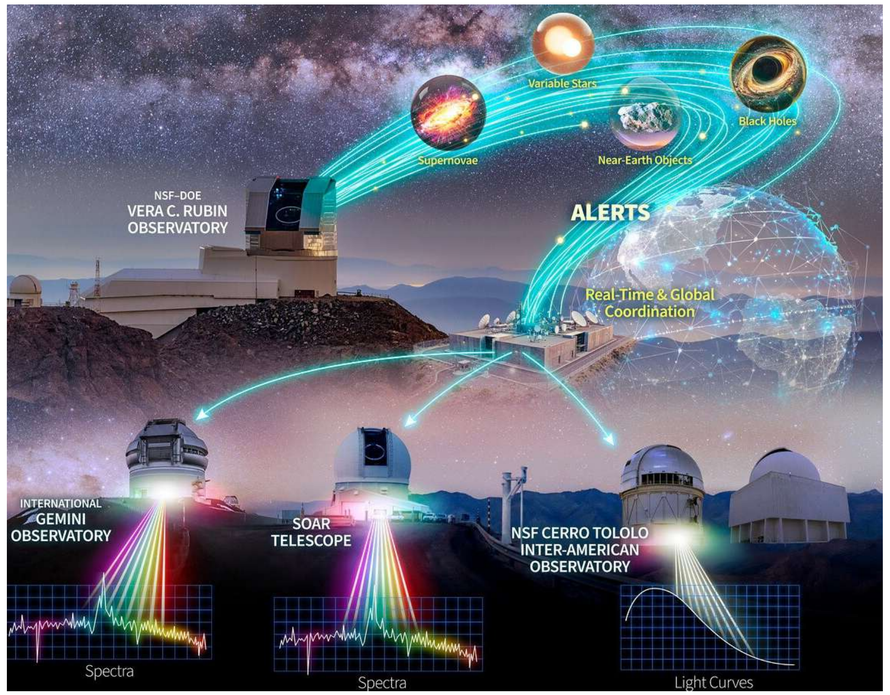




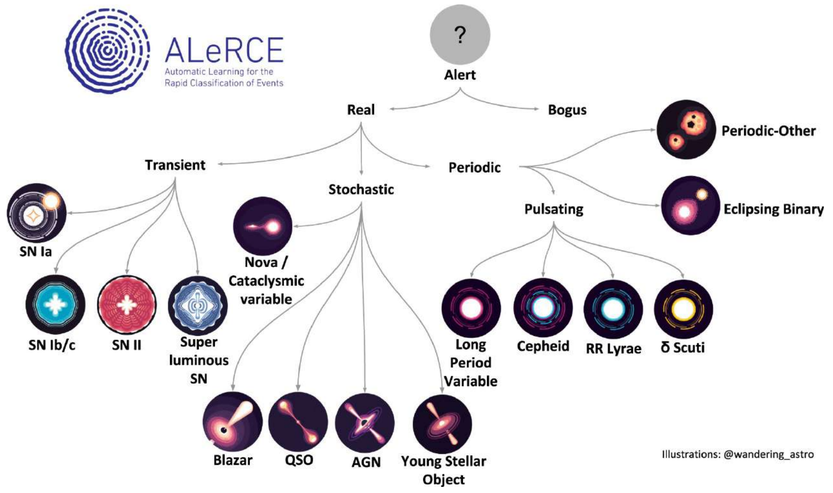


Caught on fire: Eruptive young stars in the Rubin era











Illustrations: @wandering_astro





Known issues in this field:

1. Most eruptive YSOs are optically faint

   -> Rubin can reach 22 mag in z & y band

2. Some dippers look like eruptive YSOs on the light curve

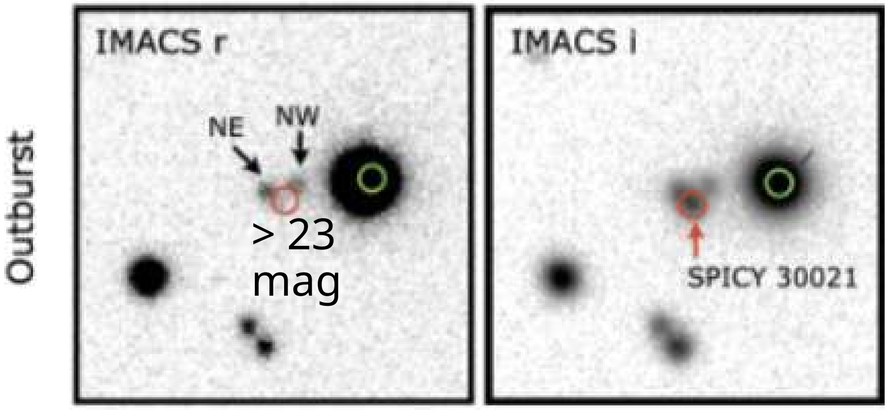
   -> Need multi-wavelength long-lasting time series

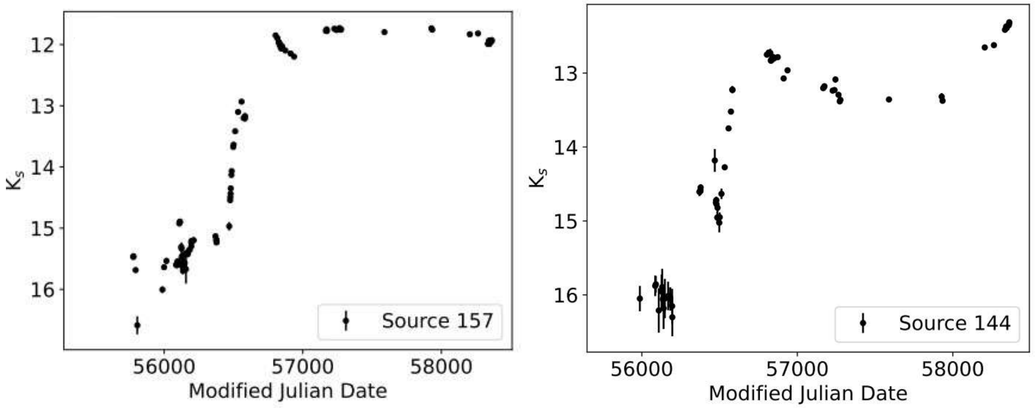
3. The confidence of YSO on brokers is low

   -> Using Watchlist on known YSO samples

4. Our observational resource is limited

   -> AEON, ToO or non-ToO observation?

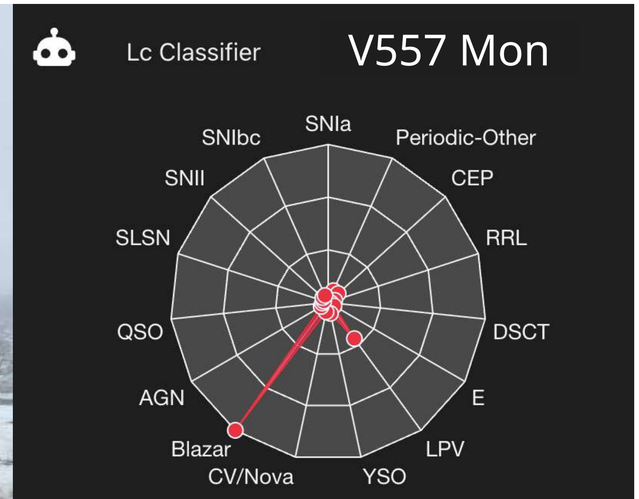










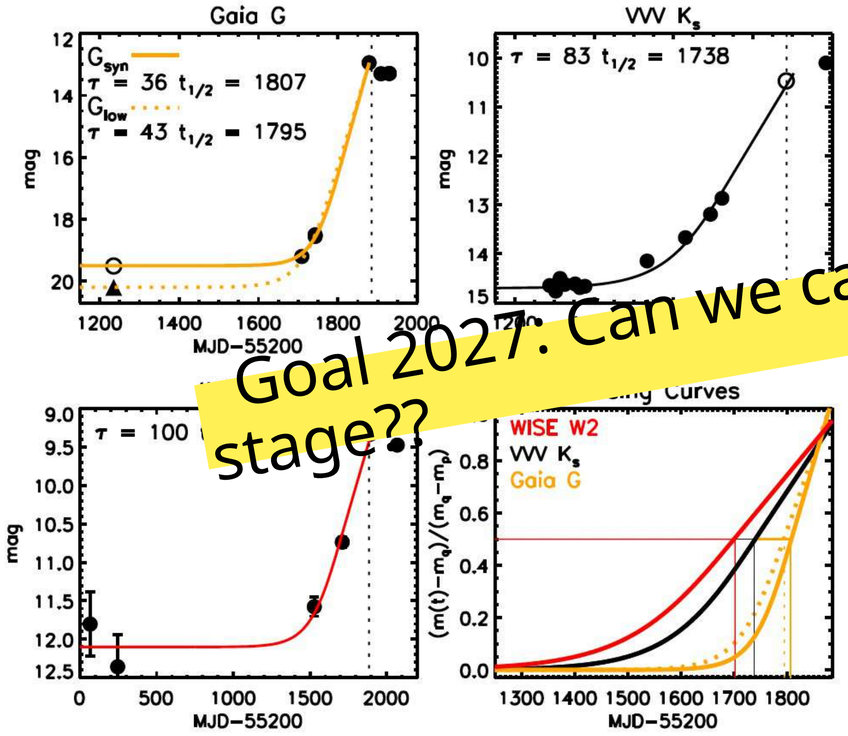


Watch-list and IR monitoring: a way to catch FUors on fire

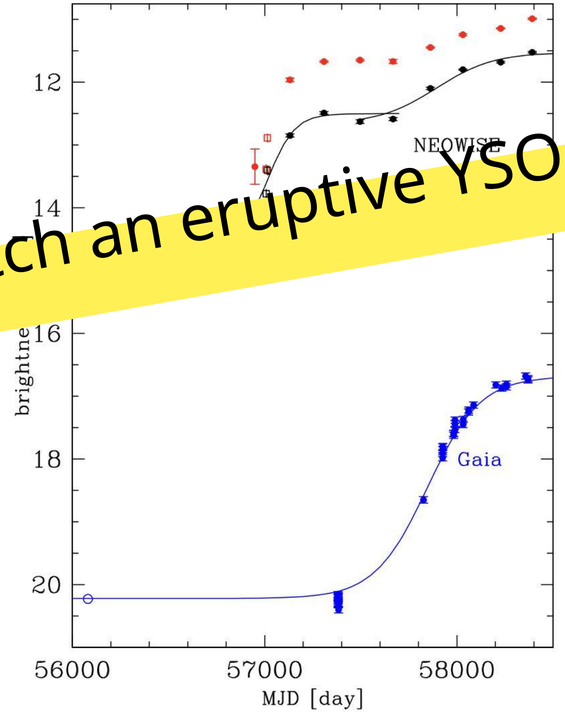
- In optical, the rising timescale of FUors: ~100 d
- The MIR precursor of FUors -> Pre-select eruptive candidates

2009-2024 2025-2027

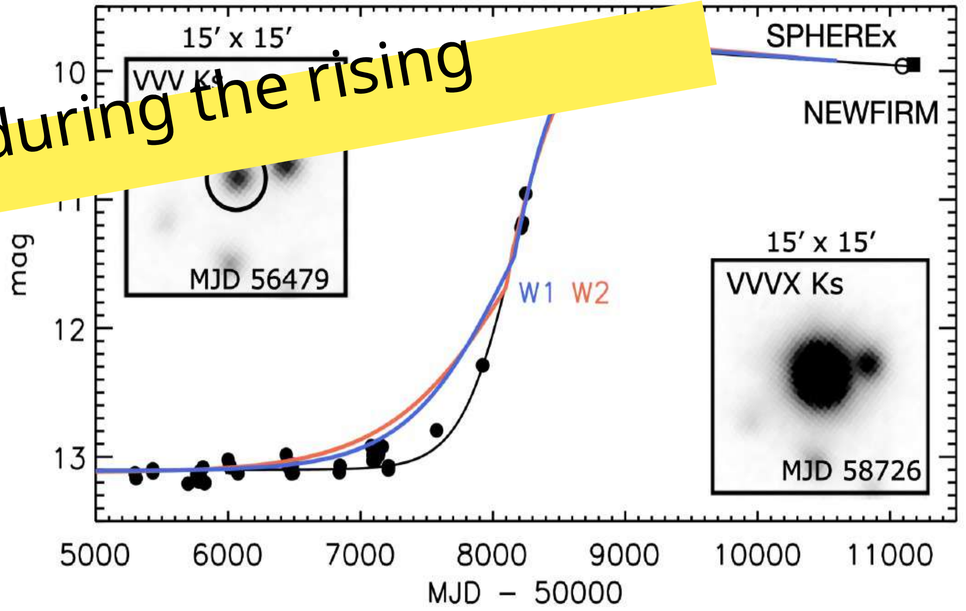
L222_78: 200 d



Gaia17bpi: 600 d



SPICY 30021: >500 d



Goal 2027: Can we catch an eruptive YSO during the rising stage??

Hillenbrand et al., 2018; Guo et al., 2024b, 2026b

Take home messages:

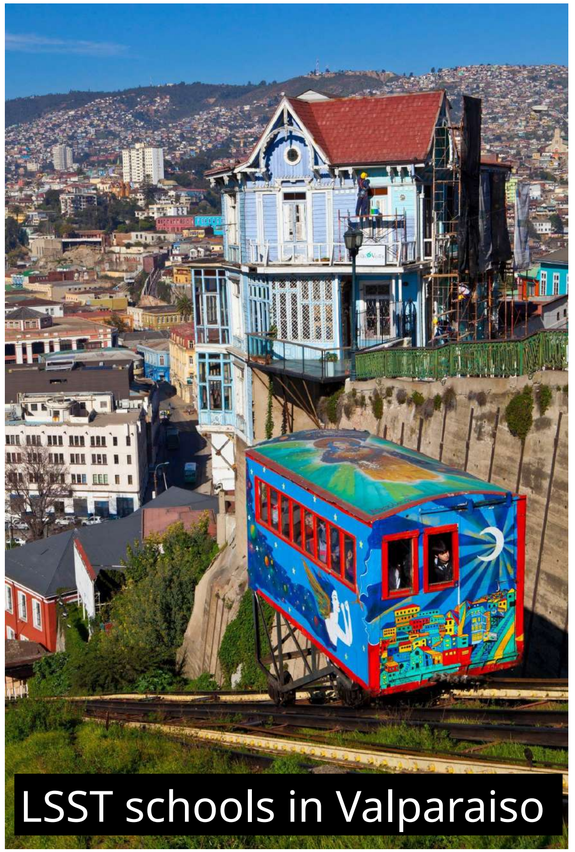
Episodic accretion is crucial for stellar mass growth

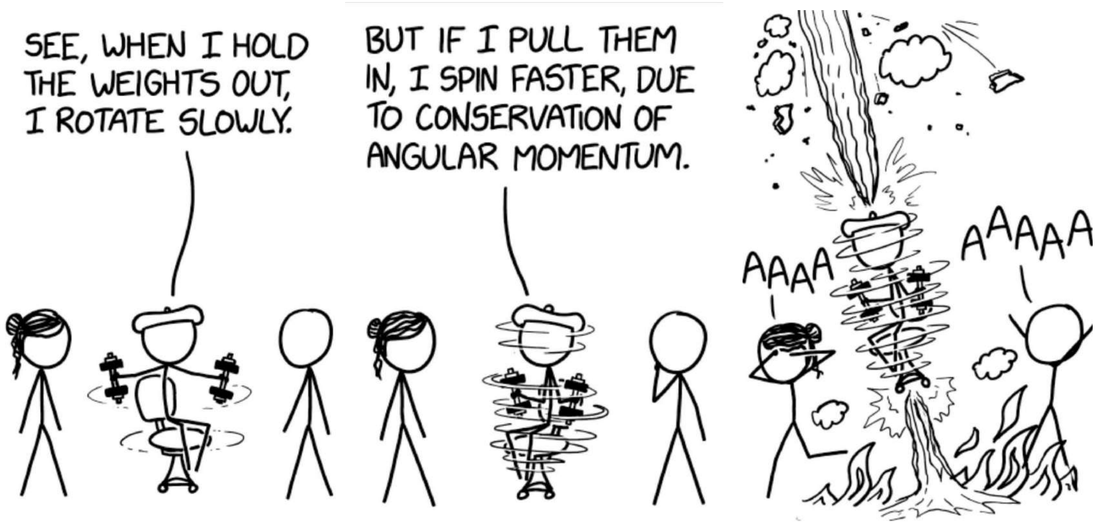
Caught on fire observation from Chile:

SPICY30021: embedded bona-fide FUor

V557 Mon: a short outburst with hot water emission bands

Rubin and future surveys: watchlist and downstream programs


LSST schools in Valparaiso




YSO group at UV

