EvryFlare: Stellar activity for every bright solar-type and red dwarf star in the Southern sky

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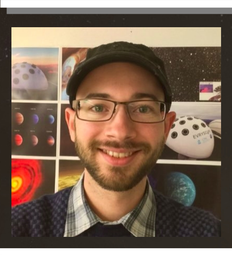
EVRYSCOPE

NSF
- CAREER / 1555175
- ATI / AST-1407589



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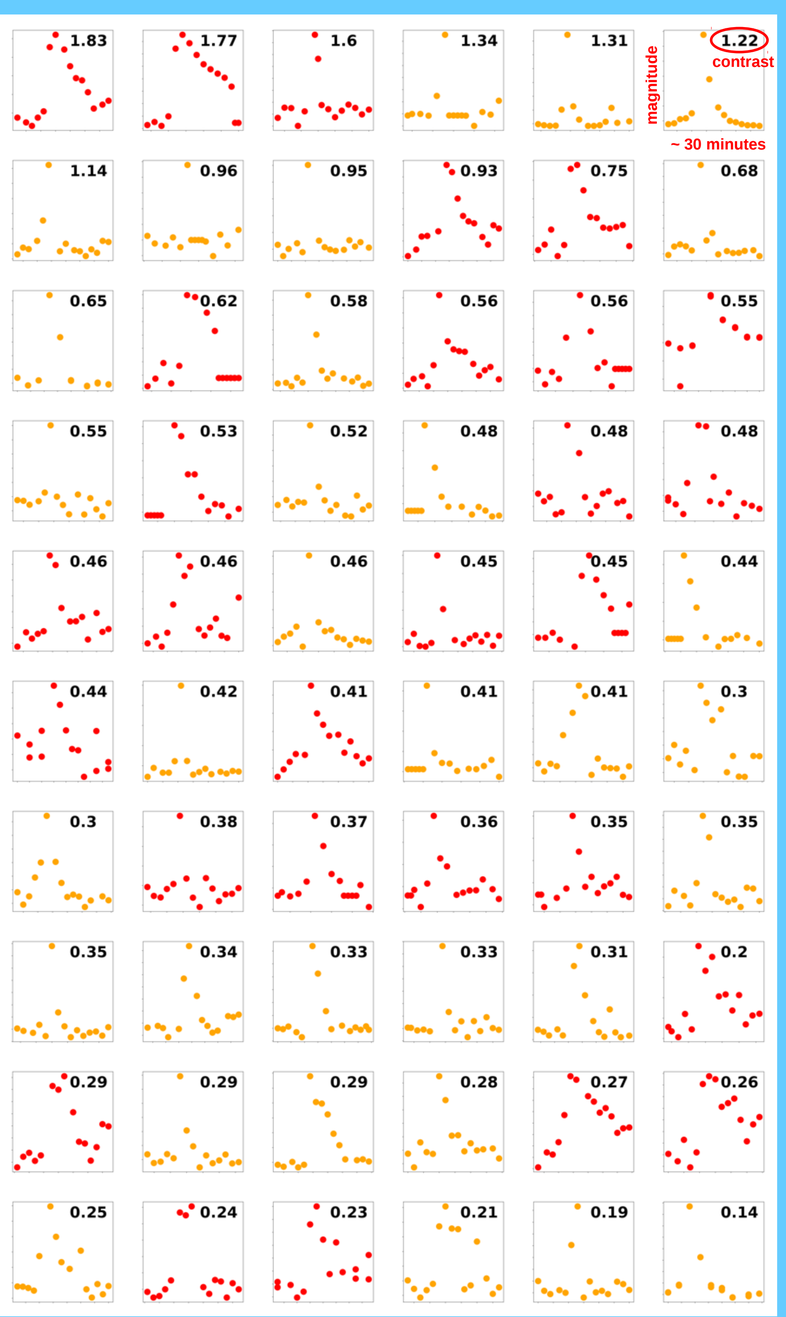
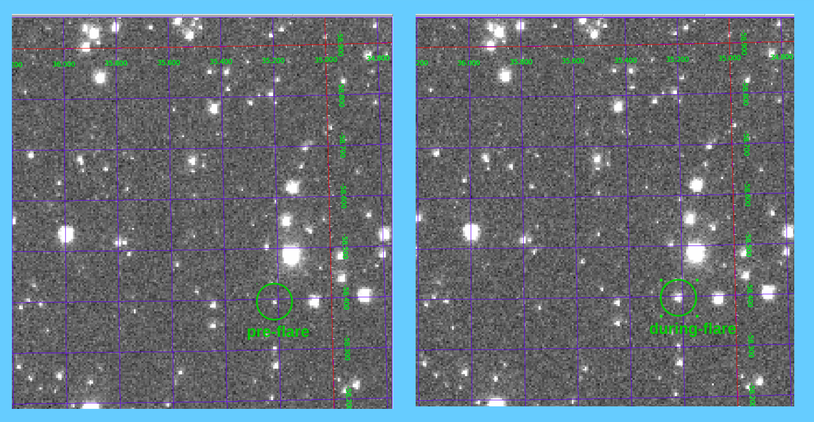
An Evryscope sample of flares for red dwarfs & solar-type stars

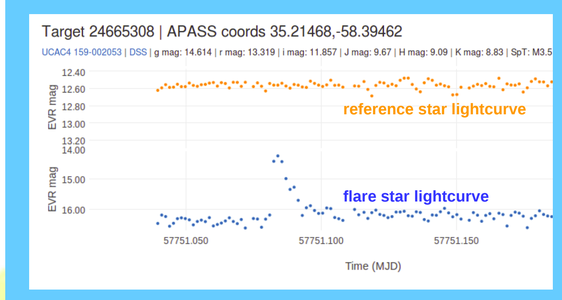
- **Late red dwarf** stars frequently host **habitable-zone rocky planets** (Dressing & Charbonneau 2015). They also **frequently flare**, with unknown effects on planetary habitability (Davenport 2016 & references therein). We are **surveying nearby, bright M-dwarfs for stellar activity** in the **optical** to better understand M-dwarf planet-host stars.
- **Solar-type** (G-dwarf) stars may emit super-flares, but their occurrence is an active area of research (Maehara et al. 2017; Shibayama et al. 2013). By **surveying the brightest G-dwarf stars**, we may help constrain both **flare statistics** of nearby G-types as well as provide **flare rates for nearby solar analogues hosting planets**.
- Below, a sample of flare candidates **detected with the Evryscope** on solar type (colored **yellow**) and late red dwarf (colored **red**) stars are displayed as **contrast-in-magnitude** versus about **30 minutes of time**.

References: [1] C. Dressing, D. Charbonneau (2015). *ApJ*. 807. [2] J. Davenport (2016). *ApJ*. 829. 1, 12 pp.
[3] H. Maehara et al. (2017). Accepted by *PASJ*. (arXiv:1702.07141). [4] T. Shibayama et al. (2013). *ApJS*. 209. 5, 13pp.

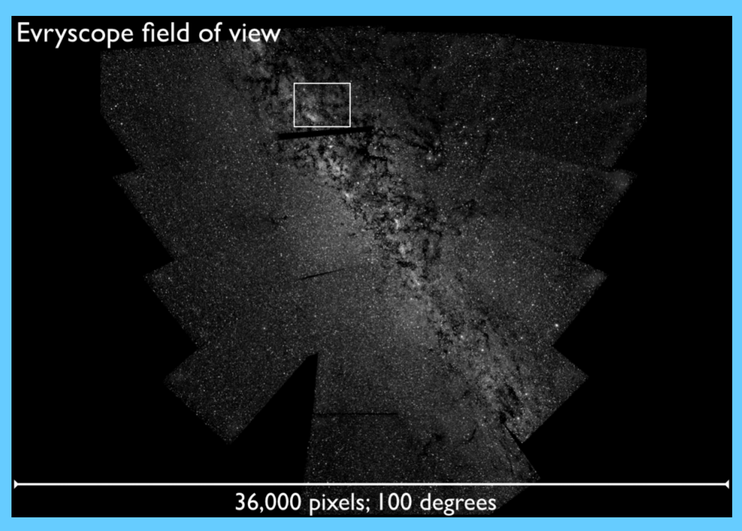


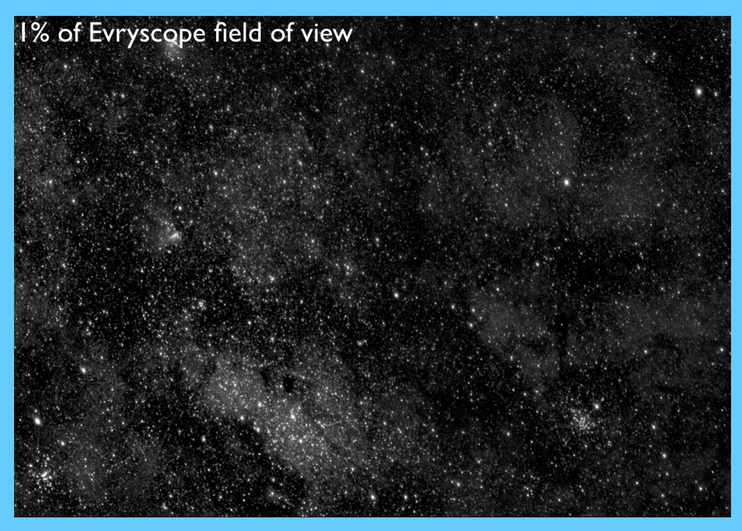
- The gigapixel-scale **Evryscope**, an array of 24 optical telescopes, simultaneously observes the entire visible sky with an 8,000 square degree field every 2 minutes.
- Designed for time-domain astronomy and transient science, the Evryscope explores **exoplanet transits**, **stellar activity** and **variability**, and **pre-imaging** & **real-time detection** of **microlensing** & **supernova** events.
- Its **g' = 16.5** limiting magnitude is increased by hour-coadds to **g' = 18**, with a database of **3.4 million lightcurves**.
- Funded by NSF/ATI and NSF/CAREER, and operating at CTIO since May 2015, the Evryscope-South will soon be joined by the **Evryscope-North** to give truly-all-sky coverage.





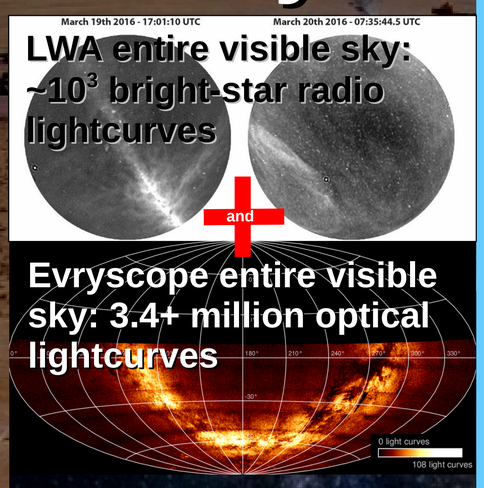
- Above: an **M3.2 star** captured by the Evryscope in **pre-flare** (left) and **flaring** (right) stages.
- Left: **same M-dwarf flare**, displayed along with a **reference star** in our interactive lightcurve tool.





Evryscope & Owens Valley LWA Collaboration

Complementing Evryscope in the radio, the entire-sky Owens Valley Long Wavelength Array (LWA; PI: Gregg Hallinan) is an array of 288 dual polarization antennas covering 1.7 km in diameter. Recently constructed at Caltech's Owens Valley Radio Observatory (OVRO), the LWA and its 9-second integration time will enable exciting Evryscope + LWA science, including:



- **Possibility of detecting an exoplanetary magnetic field**
- **Optical/radio prompt emission for *Swift*-triggered flares**
- **Possibility of detecting an extrasolar CME**
- **Stellar activity statistics for nearby stars, especially exoplanet hosts**
- **Super-flares on solar analogues**

How will we do this?

- Simultaneous lightcurves across the (overlapping) visible sky in the optical and radio
- Evryscope-North will increase sky overlap with LWA from ~45% to 100%.
- If a radio flare, CME or exoplanet auroral emission is detected by LWA, Evryscope will search for possible optical counterparts at higher spatial resolution.
- If successful, statistics for flare & CME energy distributions and frequencies in the optical and radio may give increased insight into stellar behavior of nearby planet-hosts.
- Prompt flare emission follow-up to *Swift* triggers may be performed using future Evryscope and LWA pipelines.

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Evryscope-North at Mount Laguna Observatory

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- Evryscope-North & Evryscope-South will provide **all-sky rapid monitoring** of essentially **every object brighter than 16th magnitude** .
- Overlapping Evryscopes allow **truly-simultaneous multi-site multi-color** observations over **thousands of square degrees**.
- Expected deployment of Evryscope-North **at MLO this year.**
- In collaboration with supernova & transients researcher **Robert Quimby**.
- Funded by SDSU, UNC-Chapel Hill and the Research Corporation Scialog program.