MINERVA-Australis: Two years of TESS follow-up

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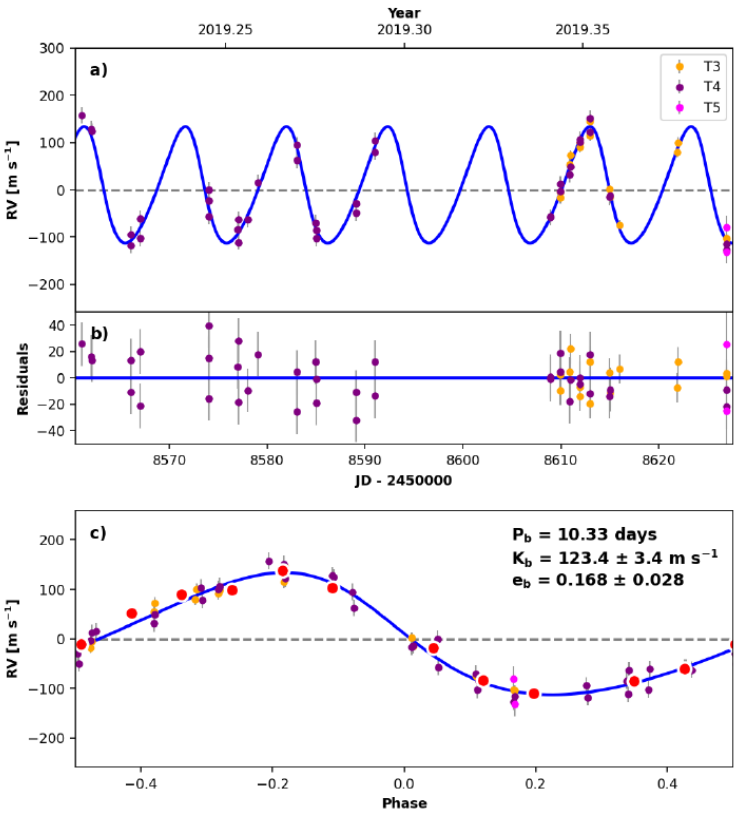
- MINERVA-Australis, based in Queensland Australia, is the world's only fully dedicated TESS follow-up observatory.
- 4 x 0.7m telescopes + R~80000 stabilised spectrograph.
- Precise RVs for "well-behaved" stars V<11.
- Time available via NOIRLab open proposal calls.
- Contributed to confirmations of 23 TESS planets.

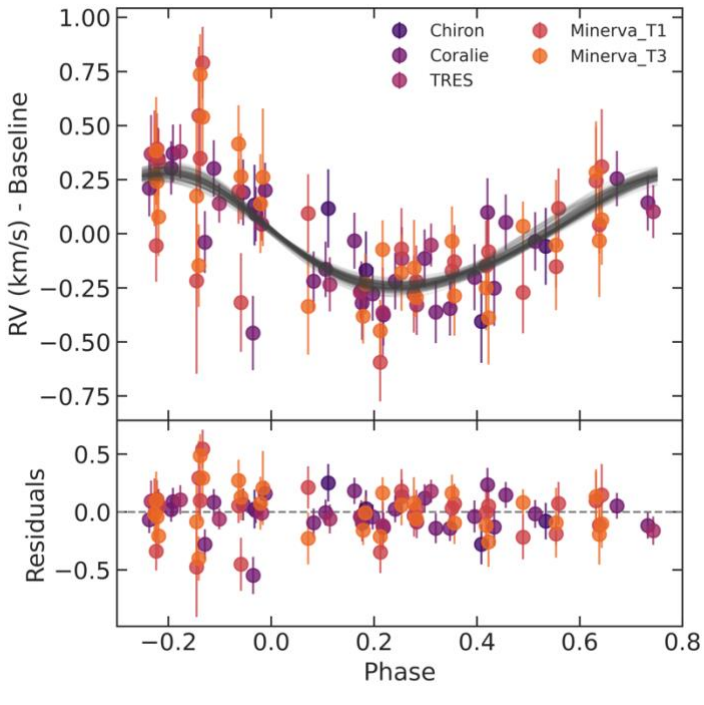
The poster child: TOI-481

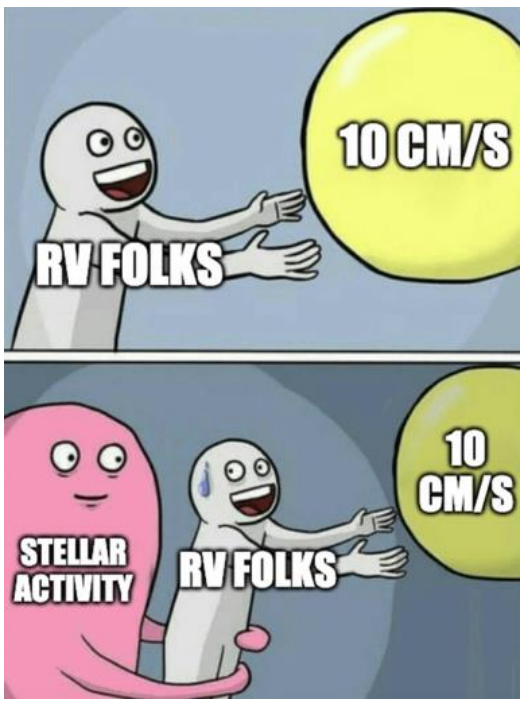
Shows how well we can do with a good target



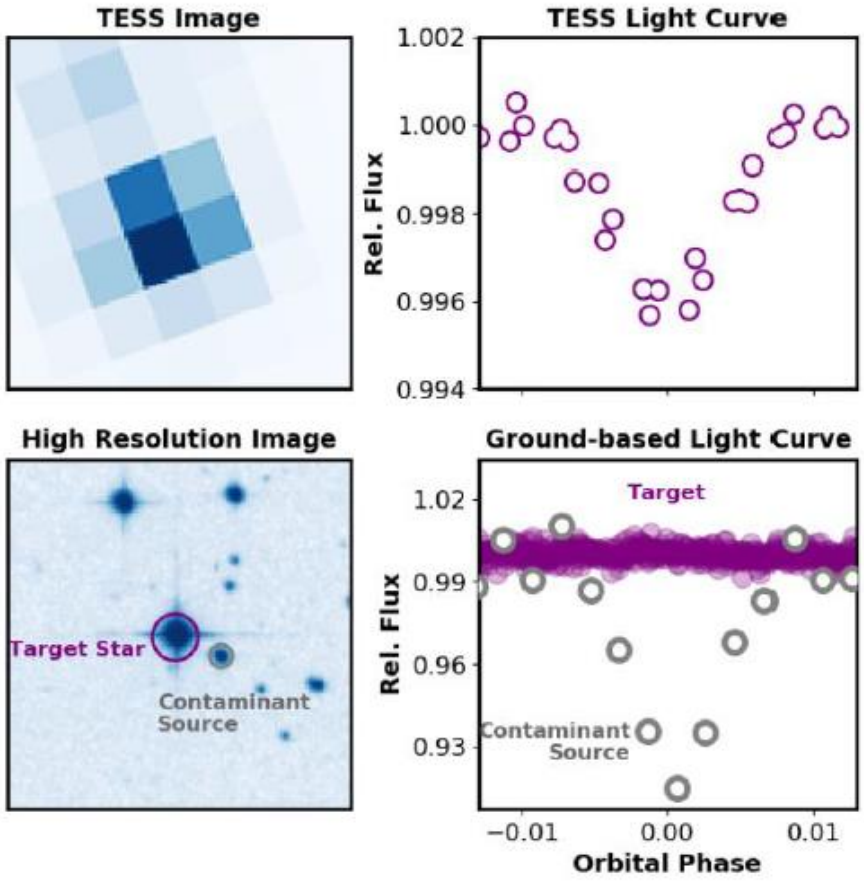
The dumpster fire: TOI-778

Rapid rotator 30 km/s, but we got a mass measurement (Jake Clark et al., 2021 in prep)



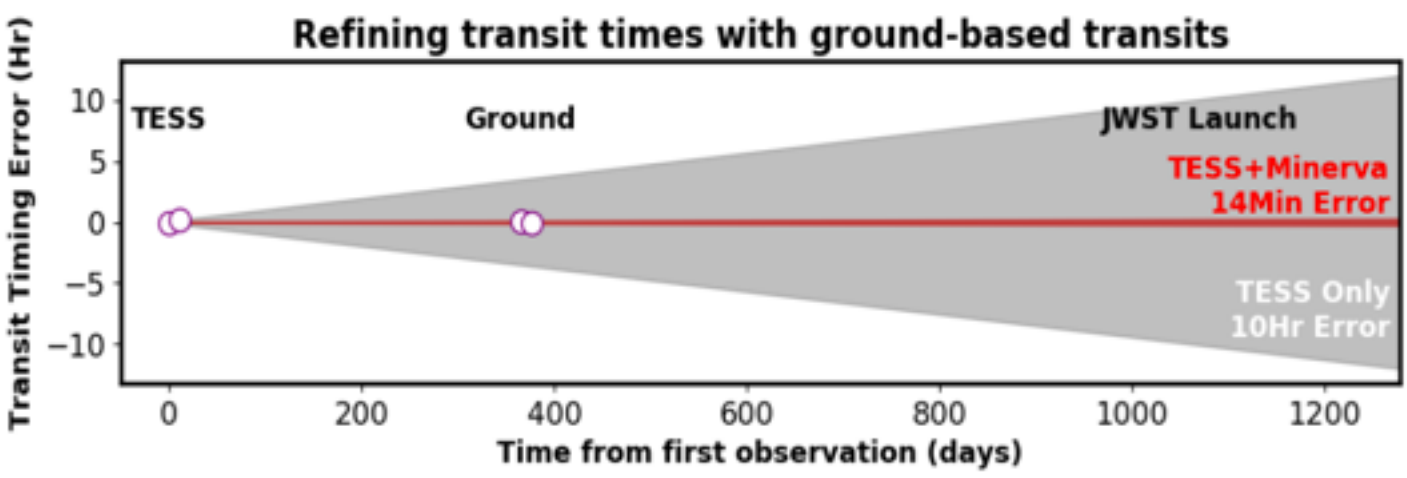


TESS is finding loads of small planet candidates.
Problem: But they are difficult and expensive to confirm.



Solution: We can use MINERVA to validate them with high-precision photometry!
Add <u>photometric</u> capability to the MINERVA-Australis array to recover planets that otherwise would be lost.

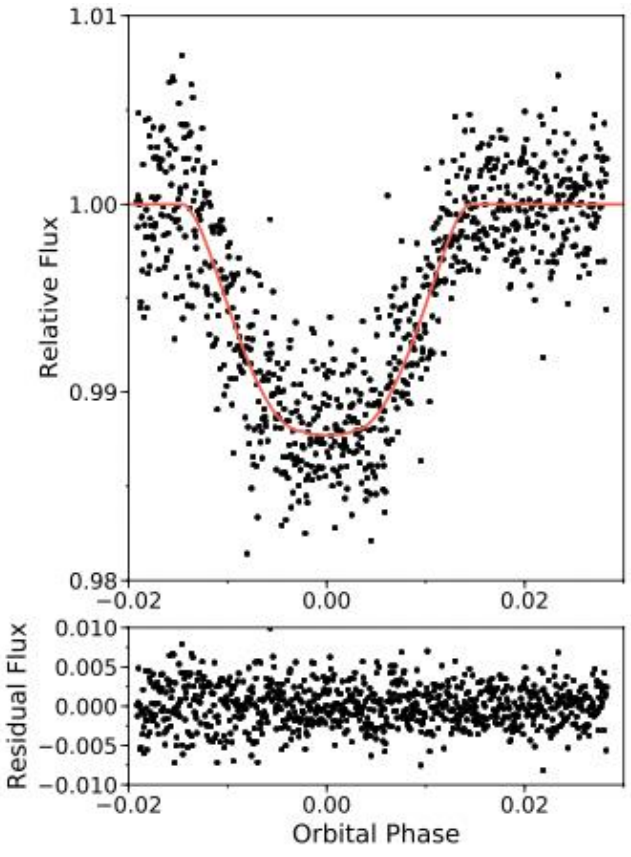
Transit timing uncertainties grow and planets can be “lost.”
One missed transit on JWST can cost up to $2M USD in lost telescope time.
We will rescue planets with MINERVA-Australis transit observations.

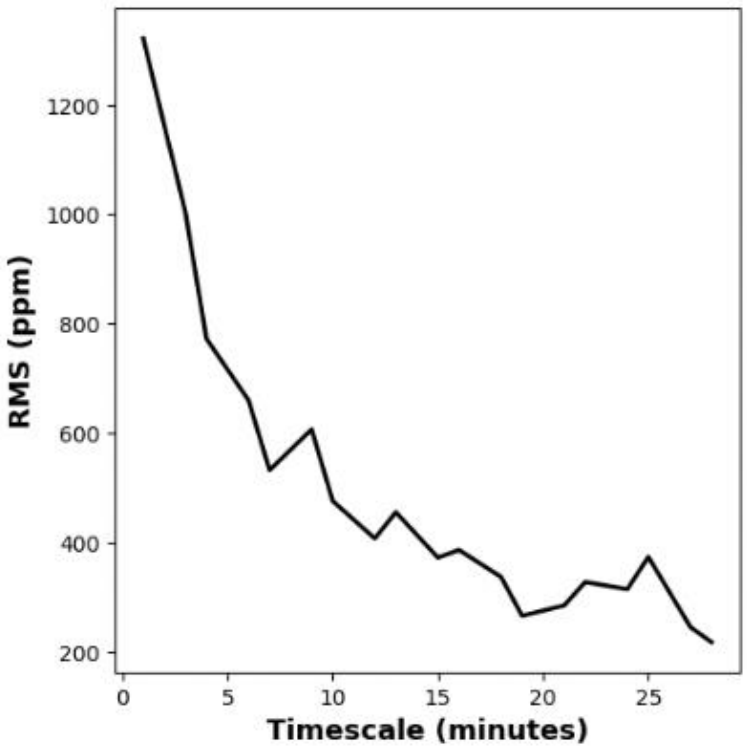


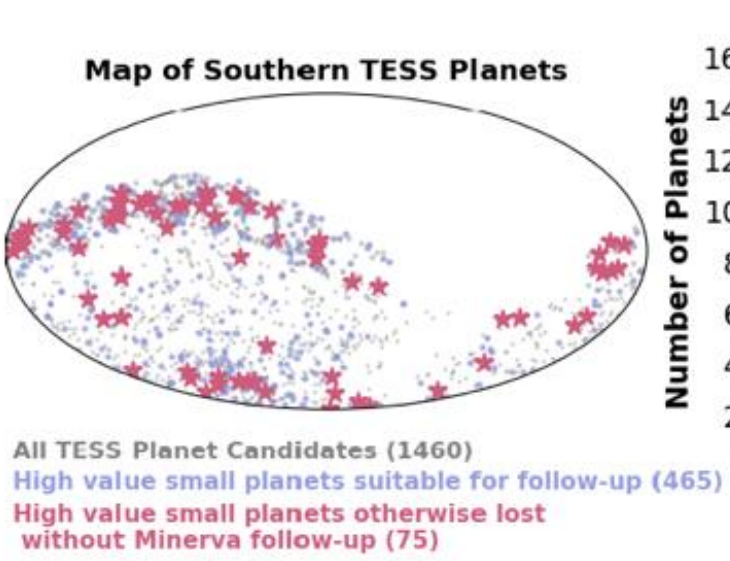
- Grant proposal in to buy 3 new QHY600 CMOS cameras.
- Each telescope samples an independent seeing cell.
- So the photometric precision scales as root-N.

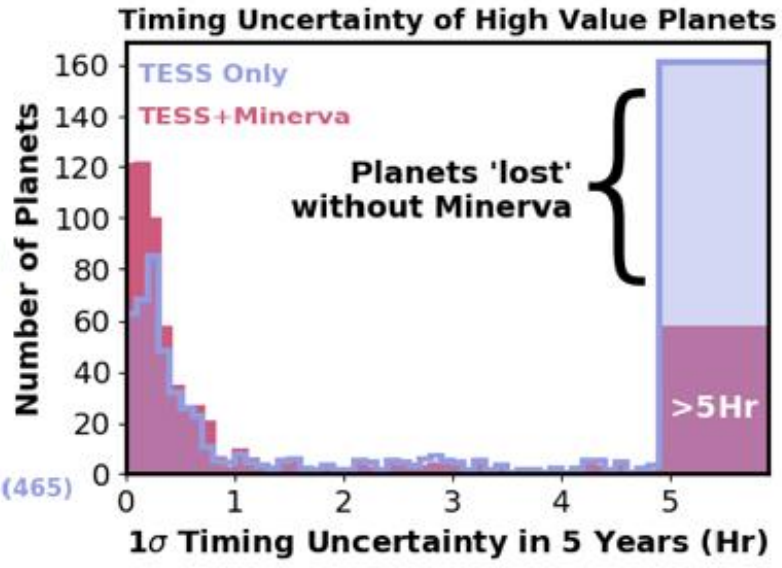
Proof of concept

- WASP-16b transit, single MINERVA telescope.
- Bins as white noise to <400 ppm in 15 min.
- So all 4 telescopes together could get 200ppm.
- This is enough to validate rocky planet candidates ~2 Earth radii.





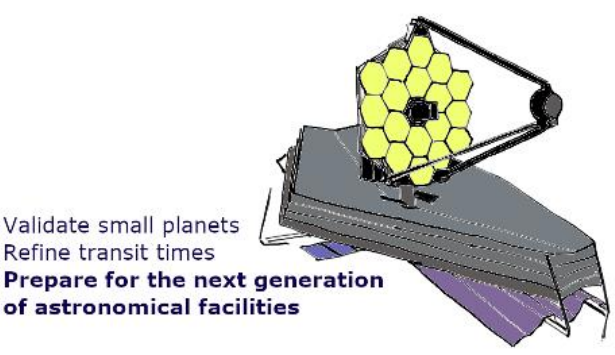


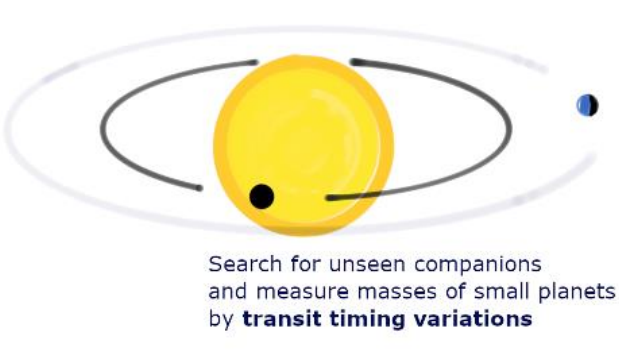


We can rescue ~75 high-value TESS planets with ground-based photometry!
(smaller than 4 Earth radii and T<11)

But wait, there's more!

- This high-precision photometric capability on a <u>dedicated observatory</u> allows us to measure Transit Timing Variations.
- We can measure TTV masses for systems where RV mass measurement is impossible.





High precision transits of TESS planets with the Minerva-Australis Array