Image credit: NASA/JPL-Caltech/T. Pyle (SSC)

PLANETARY DEBRIS AROUND WHITE DWARFS IN ZTF

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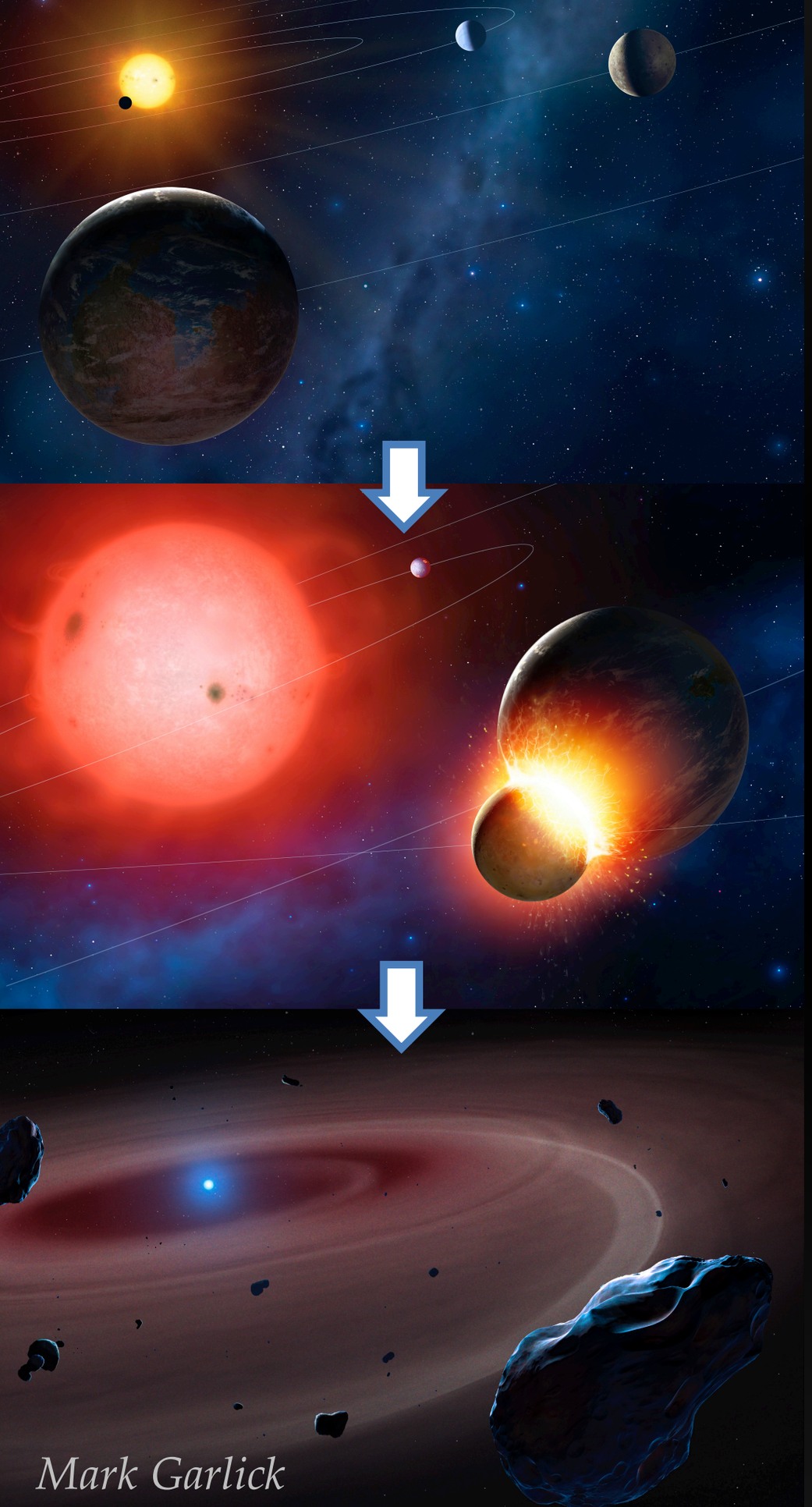
WOOTTON CAPP



1. We are observing the future of planetary systems around 2-3 solar-mass ZAMS stars.

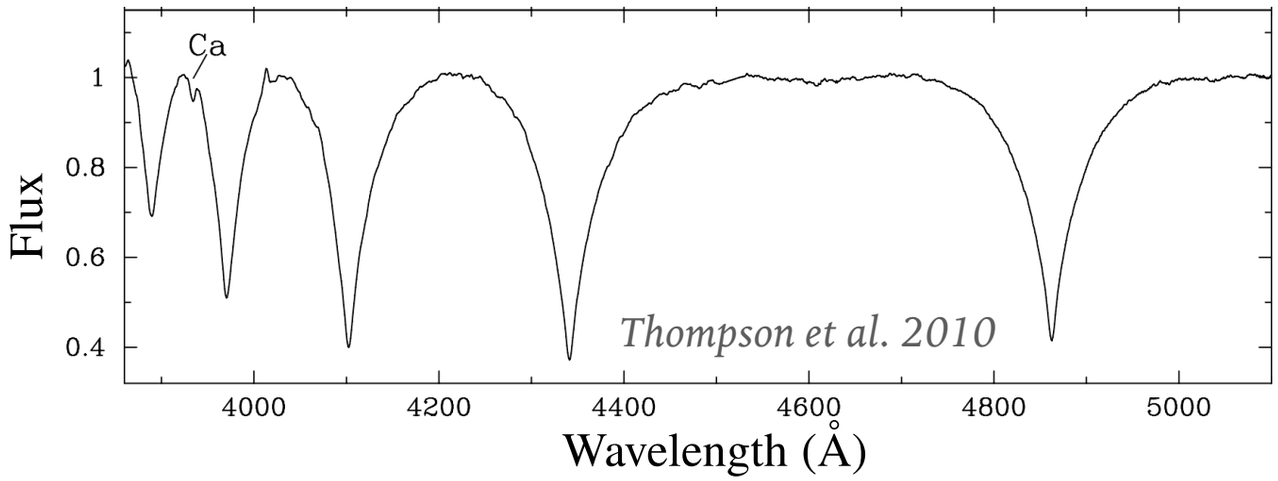
2. As the host evolves, the **orbits** of surviving planets **expand**. Objects destabilize, some **scatter** in.

3. Ancient solar systems have leftover debris. We can see it if it pollutes a pristine **white dwarf**.

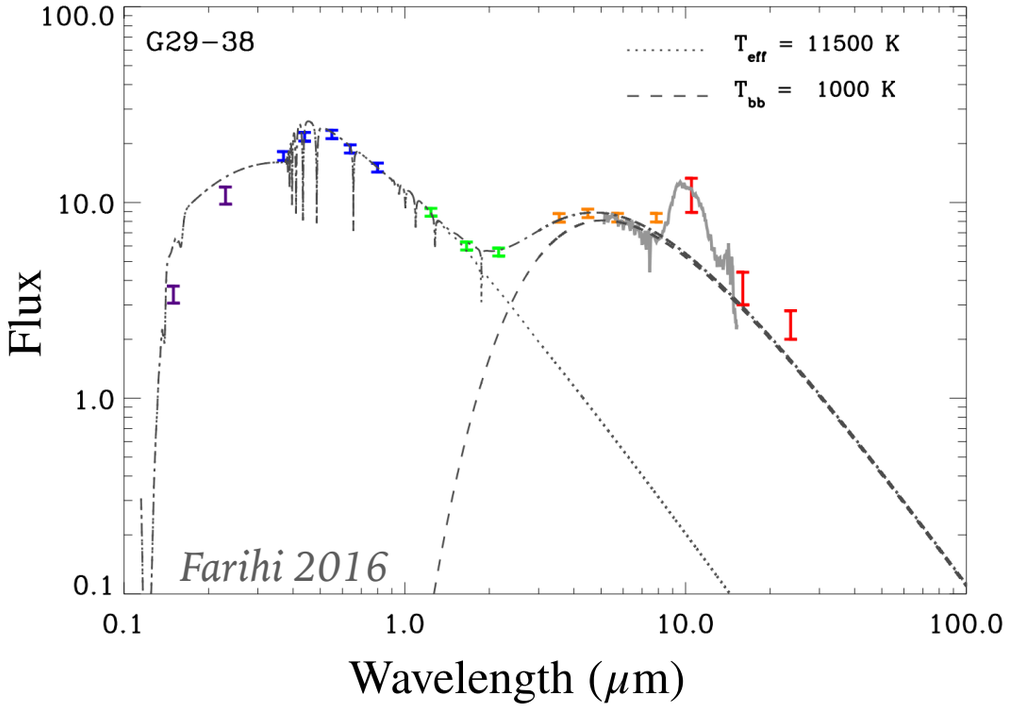
DETECTING PLANETARY DEBRIS AROUND WHITE DWARFS

DAZ = Metal Polluted H-atmosphere White Dwarf

≈30% of white dwarfs below 20,000 K exhibit metal pollution

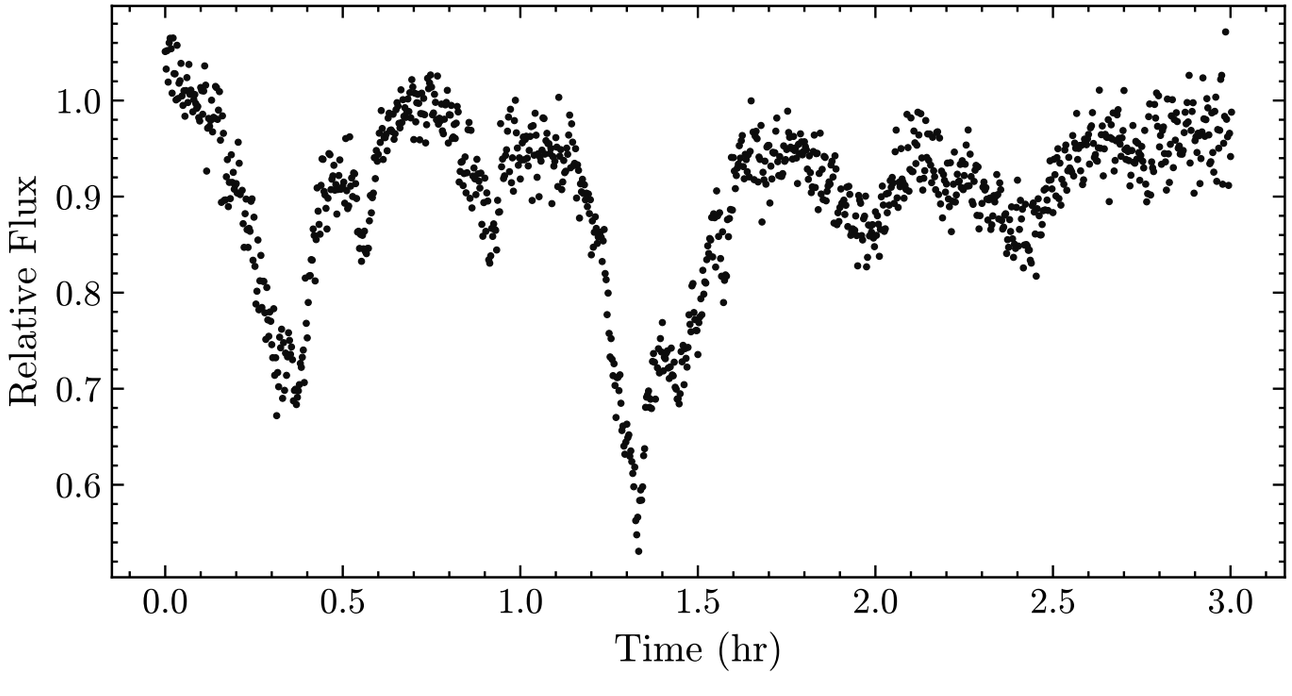


IR-excess due to warm circumstellar dust seen in 1-2% of white dwarfs



Transiting Planetary Debris offers the most direct evidence, only two objects known

WD 1145+017, 4.5–4.9 hour orbital periods



ZTF J0139+5245: TRANSITING DEBRIS IN A 107-DAY ORBIT

Orbital period **Two Orders of Magnitude** longer than WD 1145+017!

Key Properties

$T_{\rm eff} = 10{,}530\,K$

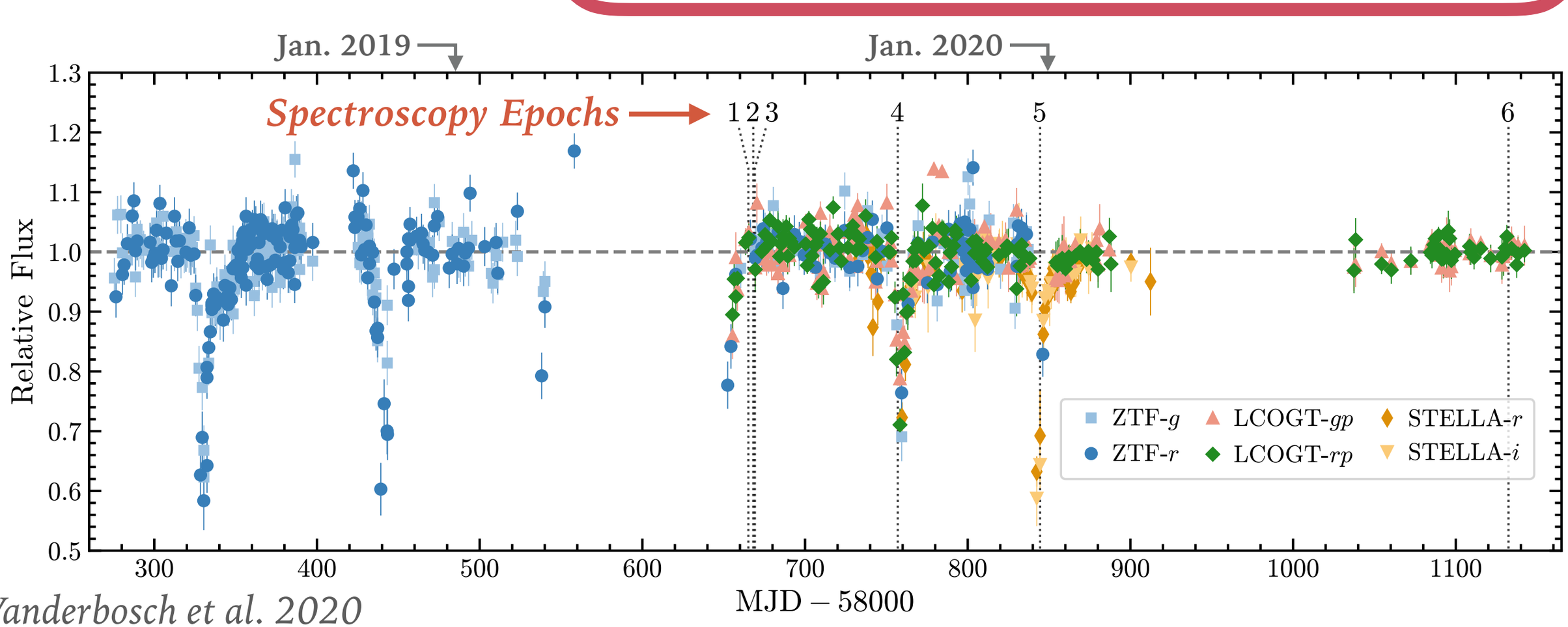
$M_* = 0.52\,M_\odot$

1 – 10 year Ca Diffusion Timescale

$P_{\rm orb} \approx 107$ days

Transit Durations $\approx 15 - 25$ days

Minimum Debris Mass comparable to solar system objects ($> 10^{16}$ g)

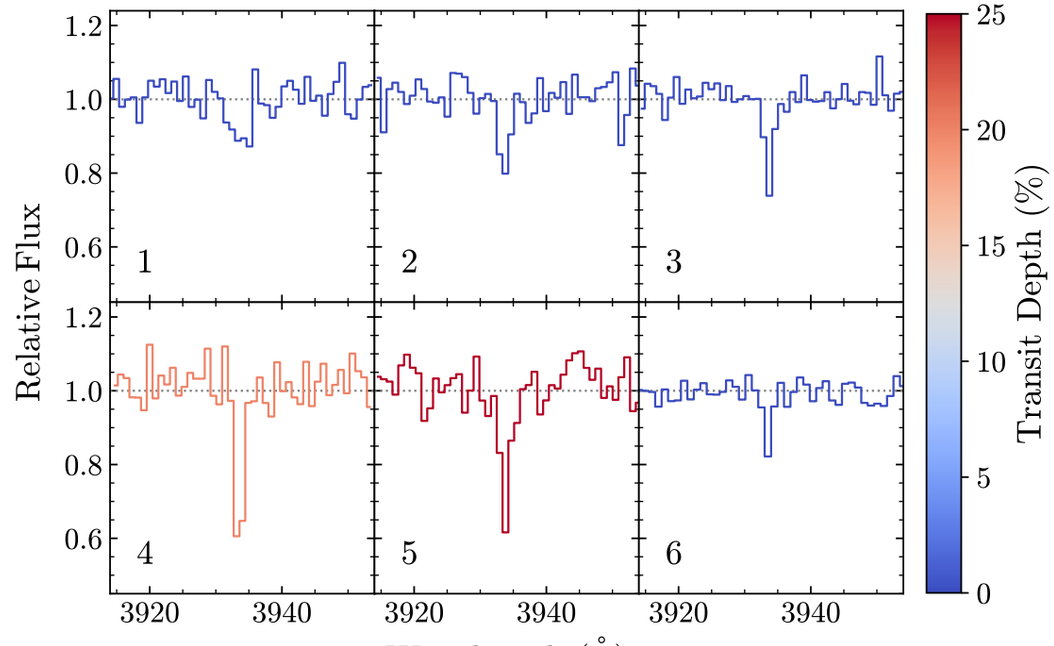


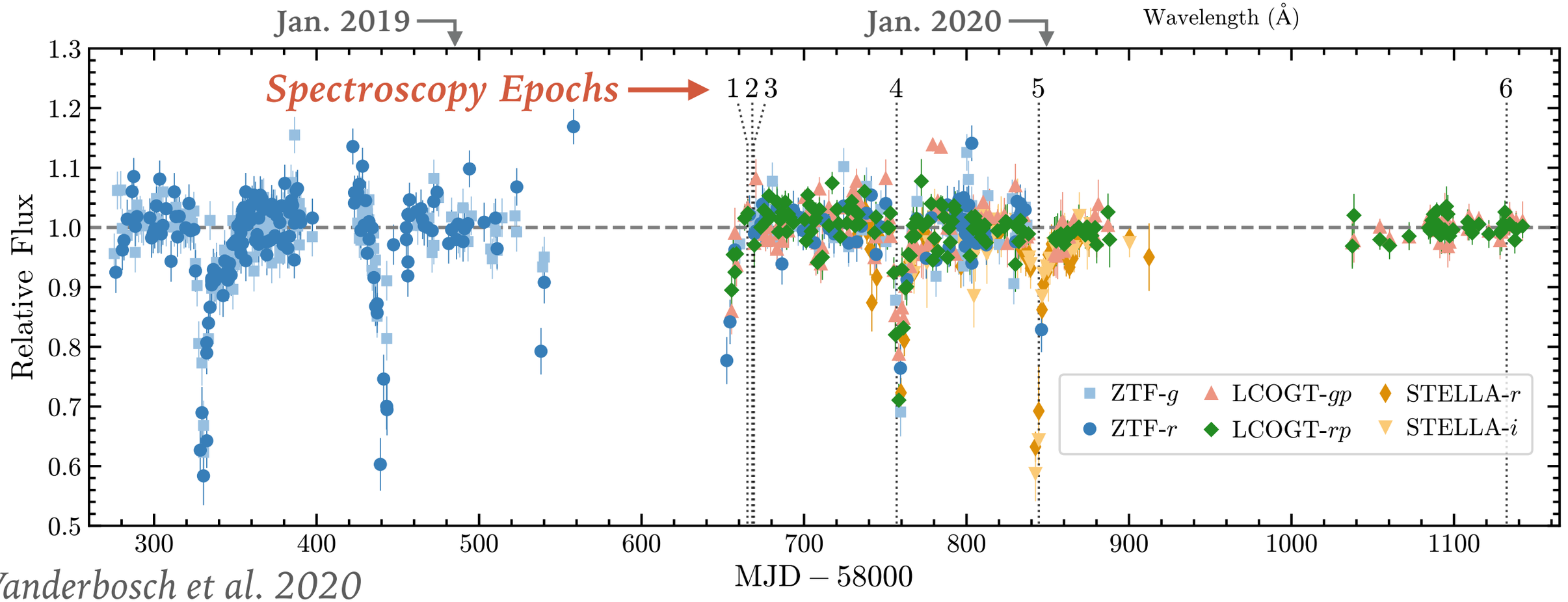
Vanderbosch et al. 2020

ZTF J0139+5245: DEPTH-DEPENDENT CALCIUM ABSORPTION

- 1-10 year diffusion timescale suggests recent accretion events are an unlikely source.

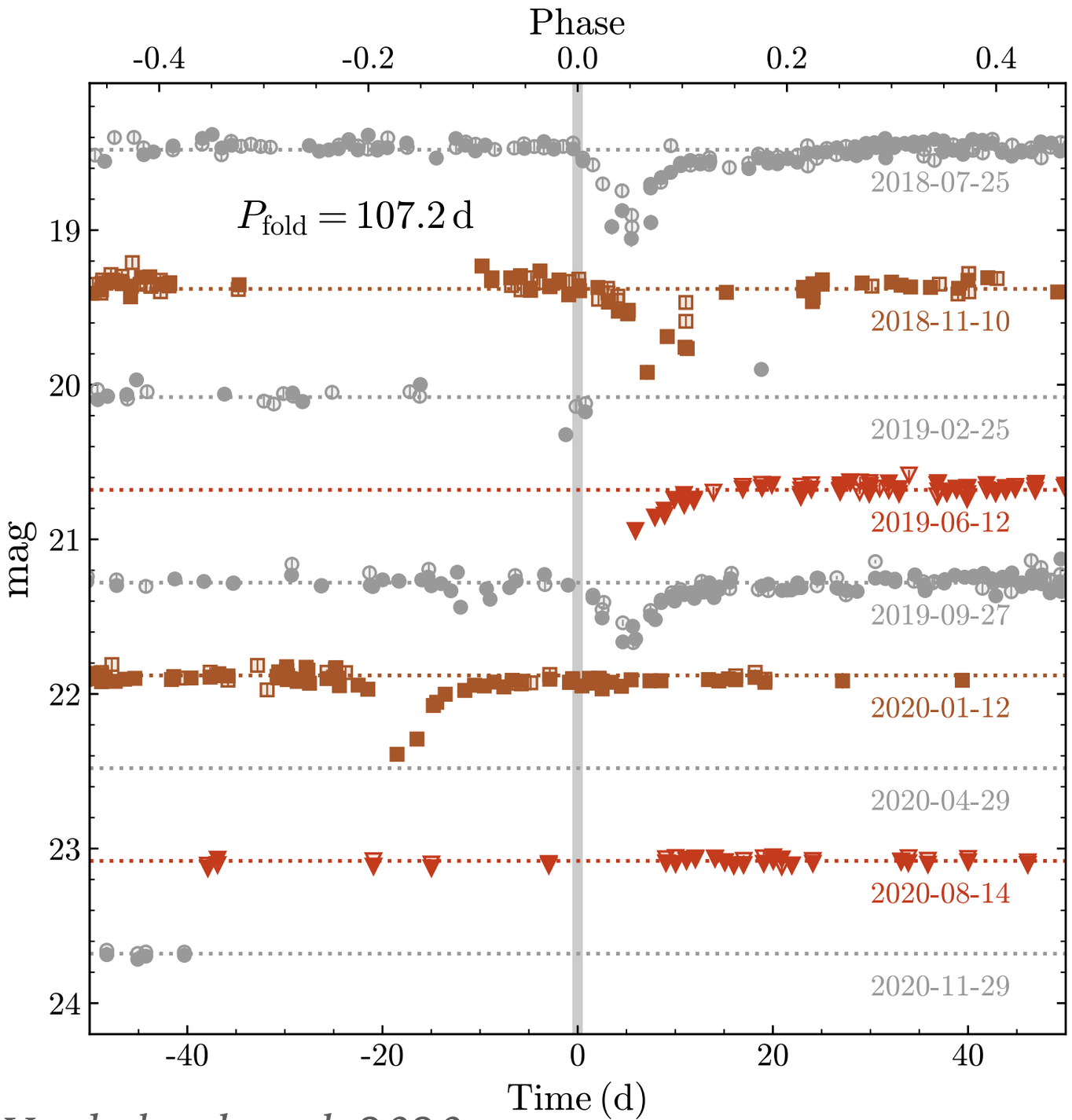
- **Absorption from circumstellar debris** is likely responsible.
- **Active disruption or collision events are** required to maintain supply of metallic gas.





Vanderbosch et al. 2020

ZTF J0139+5245: A DYNAMIC SYSTEM

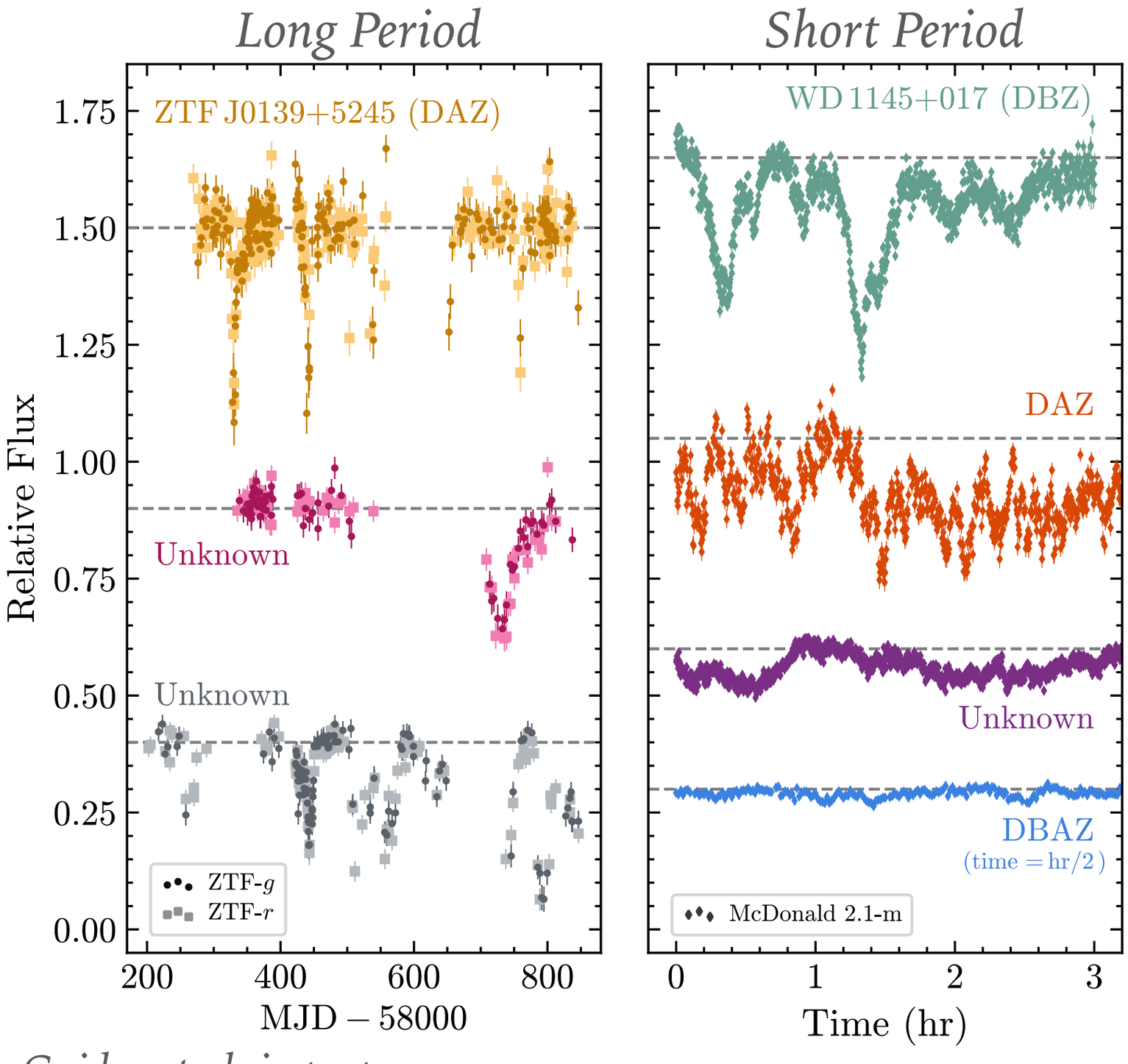


Vanderbosch et al. 2020

Transit Recurrence Times Observed to Vary up to 20-days

- Is the planetary debris evolving onto a closer orbit?
- Is the system actively generating new debris?
- **Ongoing photometric monitoring is required** to determine whether the transit recurrence time has shrunk permanently, or if variations of this magnitude are commonplace.
- Finding more transiting debris systems is necessary

KNOWN AND CANDIDATE PLANETARY DEBRIS SYSTEMS



Guidry et al. in prep

Transiting Debris Candidates Identified using **ZTF + *Gaia* Variability Metrics**

- **Excess ZTF Light Curve Scatter, excess *Gaia* flux uncertainty, and ZTF Alerts**
- **No J-band IR-excess**
- **Spectroscopic Metal pollution**
- **Flux dips on short or long timescales**
- **Gemini FT proposal accepted to get spectral IDs for two objects**

DAZ = Metal polluted H-atmosphere White Dwarf