Searching for GEMS: Characterizing Giant Planet Candidates within 200pc

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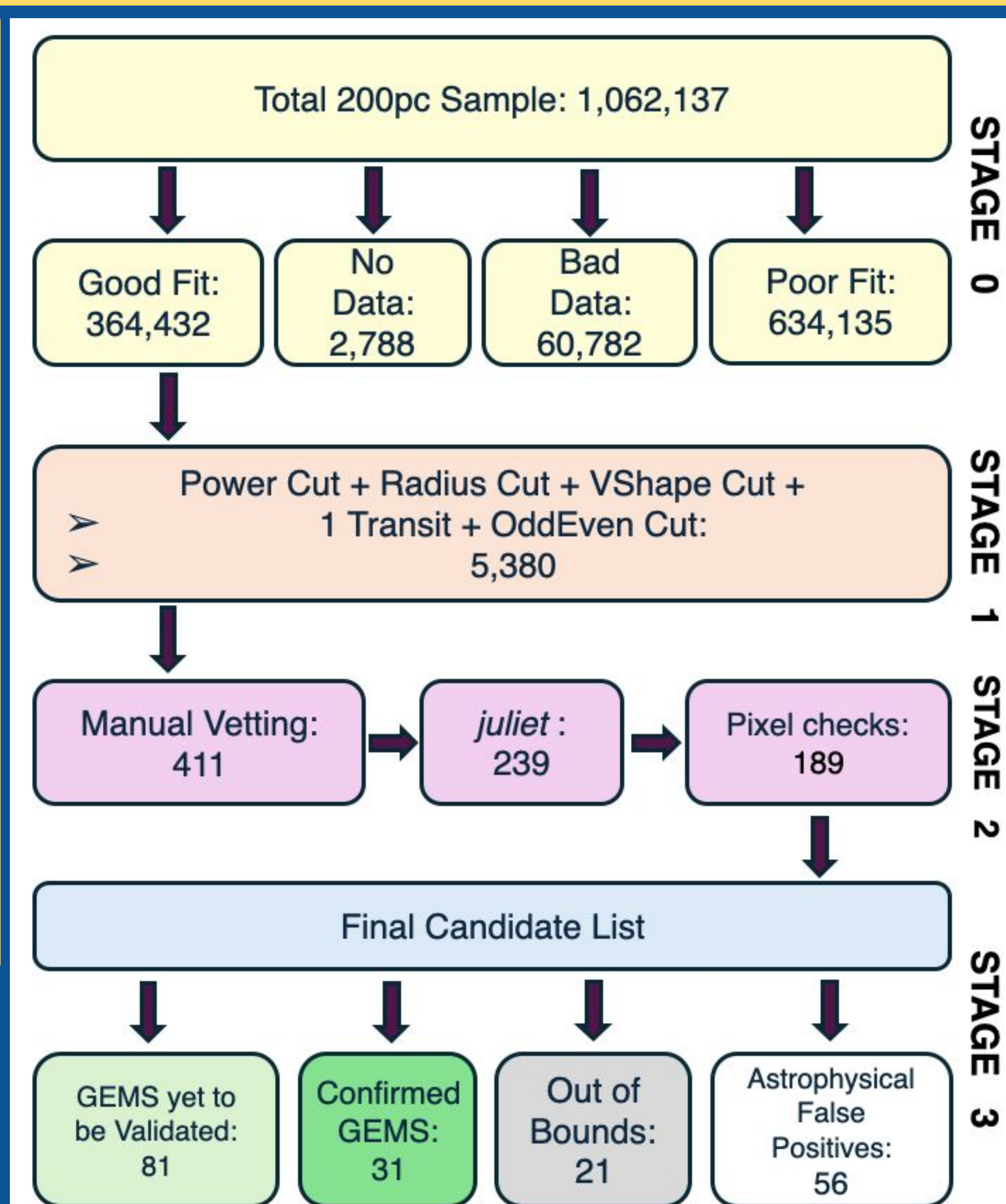
What Are GEMS? Why Do They Matter?

Giant Exoplanets around M-dwarf Stars

- Their existence challenges standard core-accretion planet formation models, which predict few giant planets around low-mass stars
- Measuring a larger sample of transiting GEMS with high-confidence mass measurements will let us compare their bulk densities to hot Jupiters around FGK stars
- Better occurrence rate constraints on GEMS help refine how planet formation efficiency depends on stellar mass

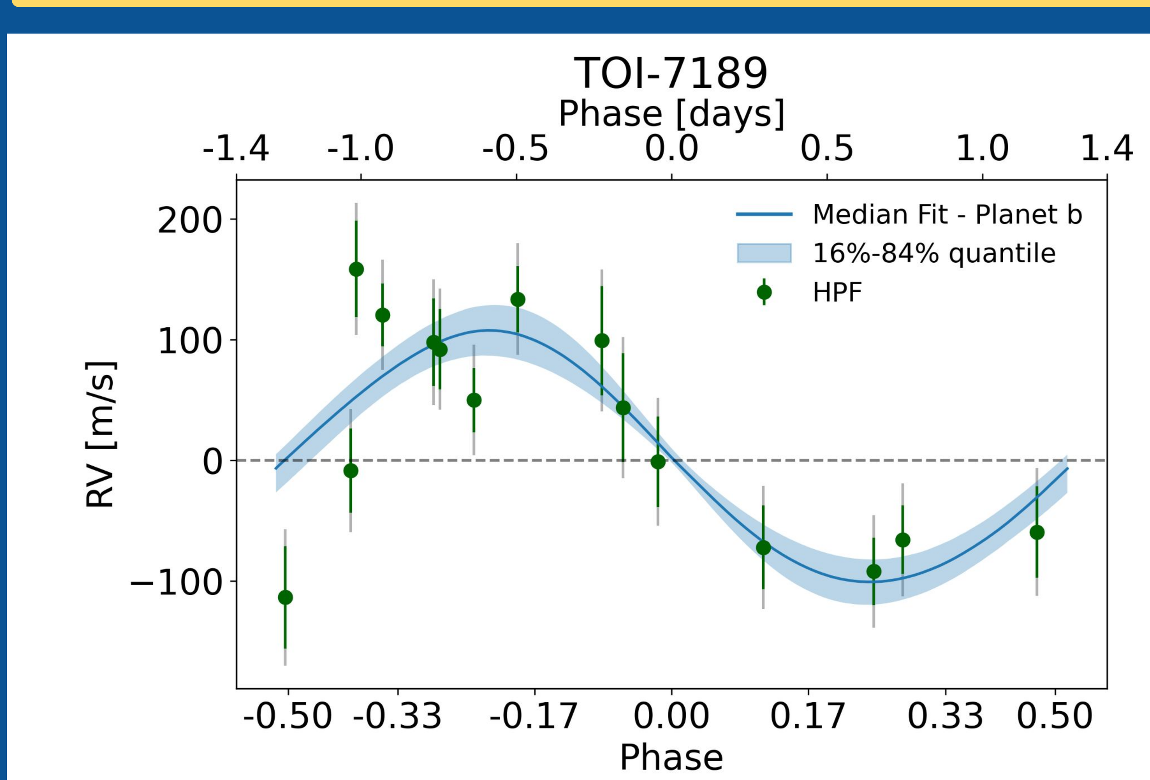
Challenges

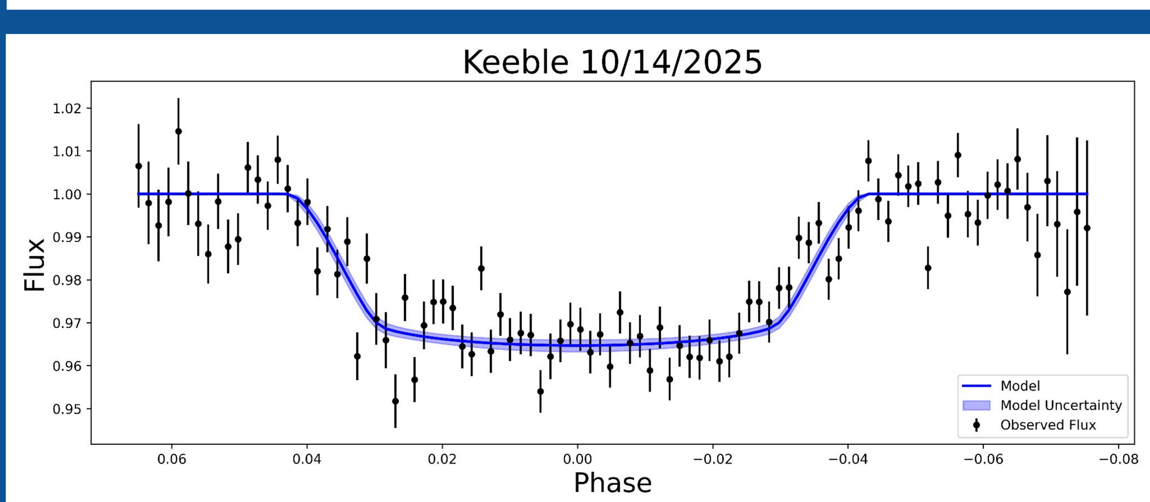
- Low signal-to-noise transits
- Low RV precision for faint, active M dwarfs
- High stellar activity/starspots
- Sparse occurrence — giants are rare around M dwarfs
- Crowded-field blending in TESS images
- False positives from binaries

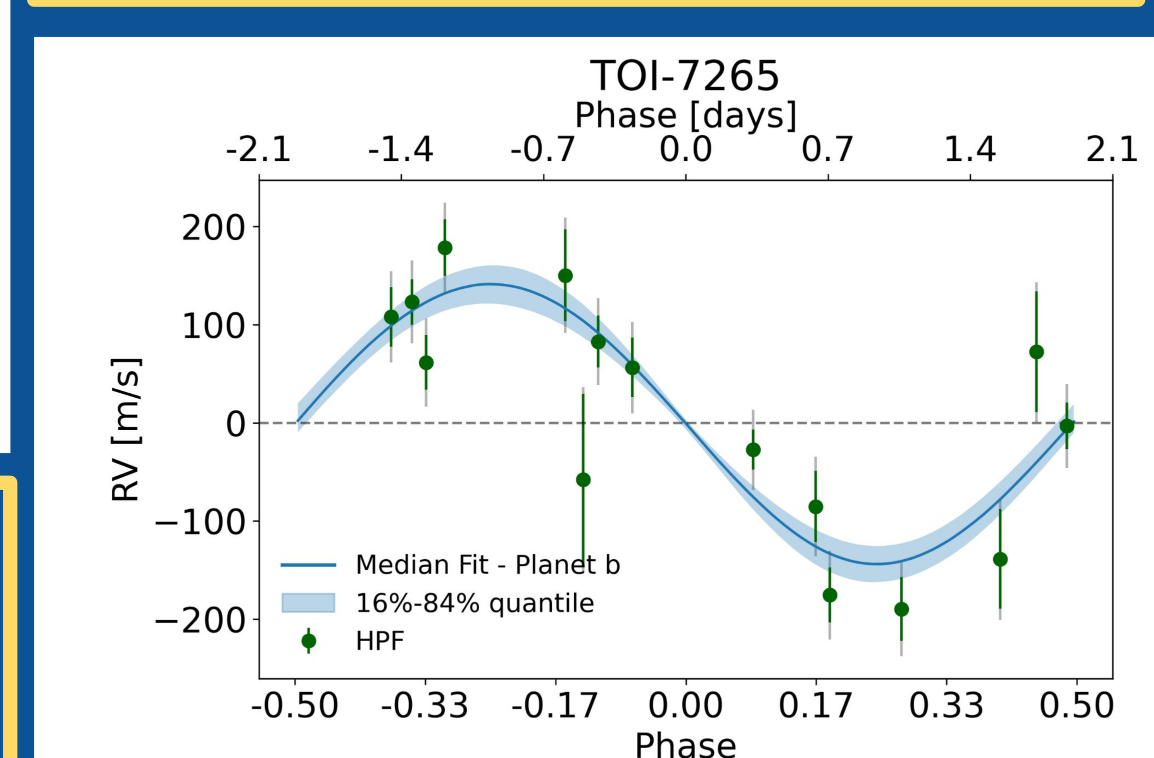


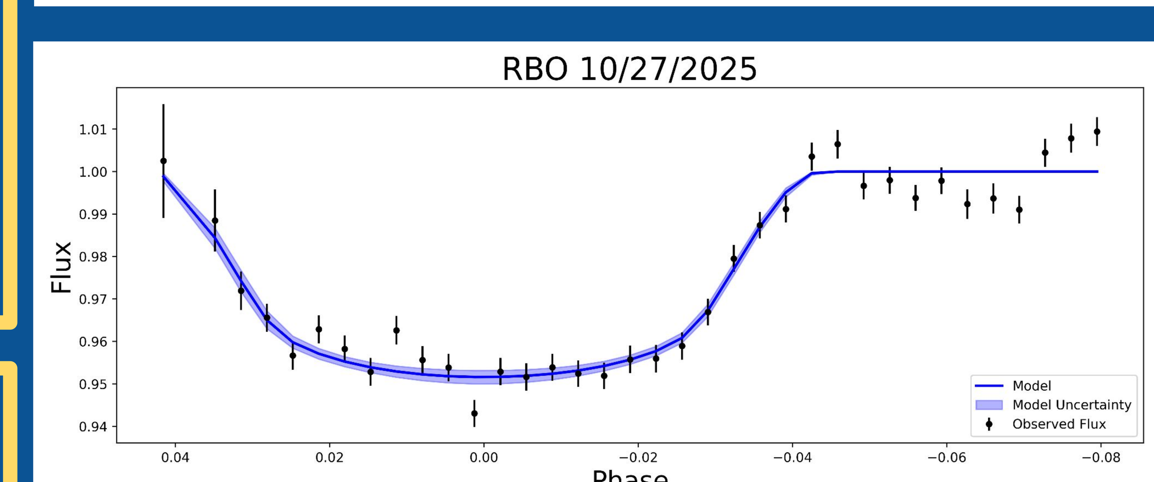
Data Collection

- High-contrast imaging (Speckle NESSI) → rule out nearby contaminants
- Ground-based transits (RBO, TMO, Keeble, TMMT) → reject background eclipsing binaries
- Spectroscopy (WINERED) → identify/avoid spectroscopic binaries
- Intensive RV follow-up (HPF, NEID, KPF, PFS) → confirm planets & measure masses









Latest Results

Validated two top GEMS targets: Joint TESS + ground-based photometry + HPF RVs confirm both as warm, low-density giant planets orbiting early-M dwarfs, showcasing the power of the GEMS vetting and follow-up pipeline.

Conclusion

GEMS are intrinsically rare, making them powerful tests of giant-planet formation around low-mass stars. Expanding the sample will sharpen occurrence rates and clarify how giant planets form, migrate, and survive around M dwarfs.

References

1. Kanodia et al. 2024, 2. Glusman et al. 2025, 3. Kanodia et al. 2025

Acknowledgment

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