The Mass of the White Dwarf Companion in the Self-Lensing Binary KOI-3278: Einstein vs. Newton

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- github.com/dyahalomi/koi3278 -

Daniel A. Yahalomi (CfA), Yossi Shvartzvald (IPAC), Eric Agol (UW), Avi Shporer (MIT), David W. Latham (CfA), Ethan Kruse (NASA Goddard), John M. Brewer (Yale/Columbia), Lars A. Buchhave (DTU), Benjamin J. Fulton (Caltech/IPAC), Andrew W. Howard (Caltech), Howard Isaacson (UCB/USQ), Erik A. Petigura (Caltech), and Samuel N. Quinn (CfA)

Background:

- KOI-3278 is the first discovered self-lensing binary system; G star primary and white dwarf (WD) secondary.
- Kruse and Agol, 2014 presented Einsteinian model of the *Kepler* photometric observations: WD mass ~63% M_{sun} .

Methods:

- Updated the Kruse and Agol, 2014 Einsteinian model with spectroscopic estimates of primary parameters.
- Created independent Newtonian model of spectroscopy.
- Created Joint Einsteinian & Newtonian model.
- All models use MCMC modeling with emcee. Spectroscopic analysis with SPC, SpecMatch, and Brewer. Isochrone fitting with Padova PARSEC isochrones.

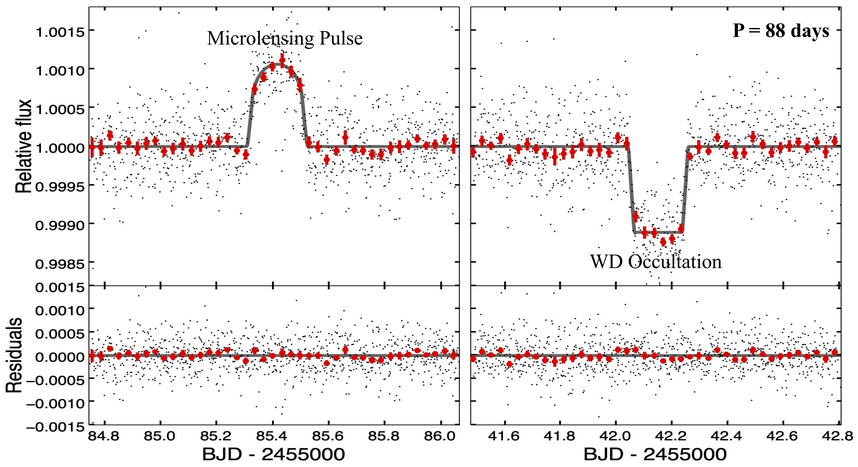

Figure 1. Einsteinian microlensing model fit to *Kepler* phase folded light curve. Period of 88 days.

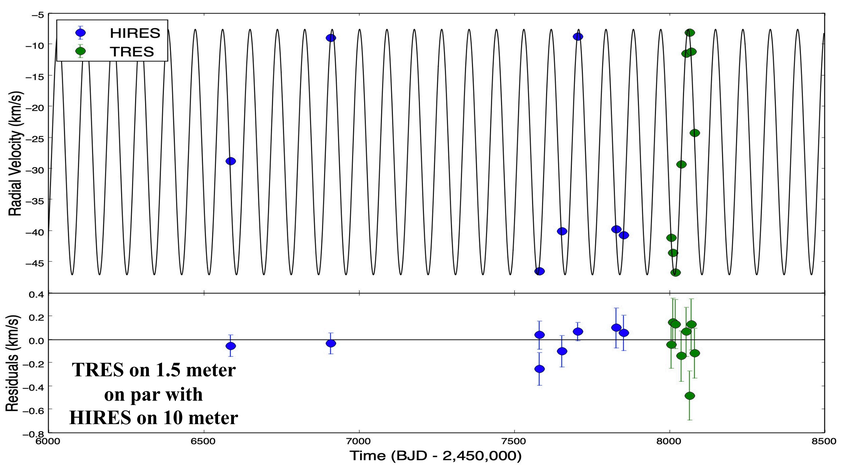

Figure 2. Newtonian dynamical model fit to radial velocity observations from TRES and HIRES.

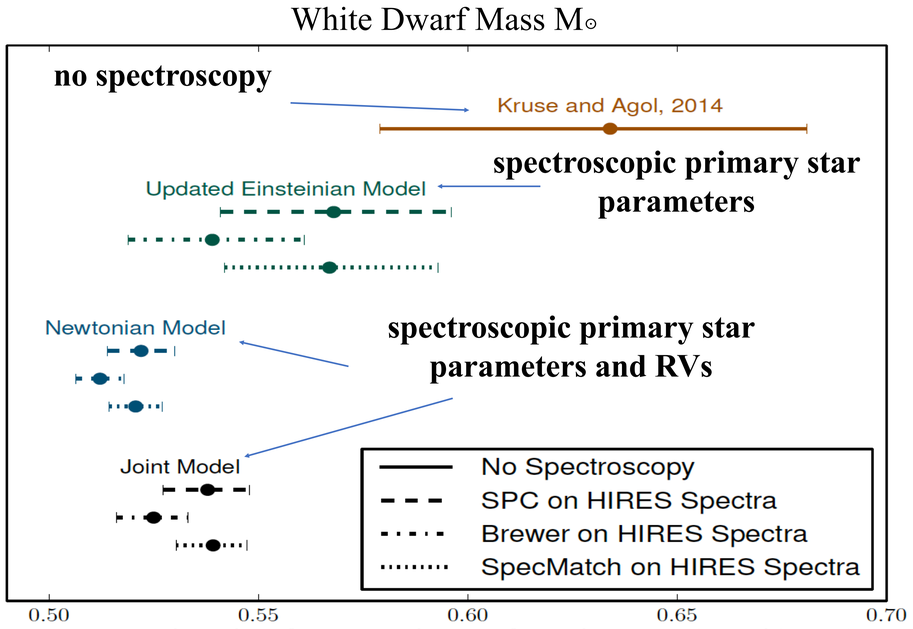

Figure 3. White dwarf mass predictions from the Kruse & Agol (2014) paper and the three models presented in this paper.

White Dwarf Mass Results

- Updated Einsteinian WD Mass: $0.539^{+0.022}_{-0.020}\ M_{Sun}$.
- Newtonian WD Mass: $0.5122^{+0.0057}_{-0.0058}\ M_{Sun}$.
- Joint Model WD Mass: $0.5250^{+0.0082}_{-0.0089}\ M_{Sun}$.

What's next for Self-Lensing Binaries?

- Follow-up UV observations of the secondary eclipse would better constrain the white dwarf radius. This would provide a more precise test of white dwarf mass-radius relations.
- TESS single-sectors could observe first black hole and/or neutron star self-lensing binary.
- TESS multi-sector could observe more self-lensing white dwarf systems.

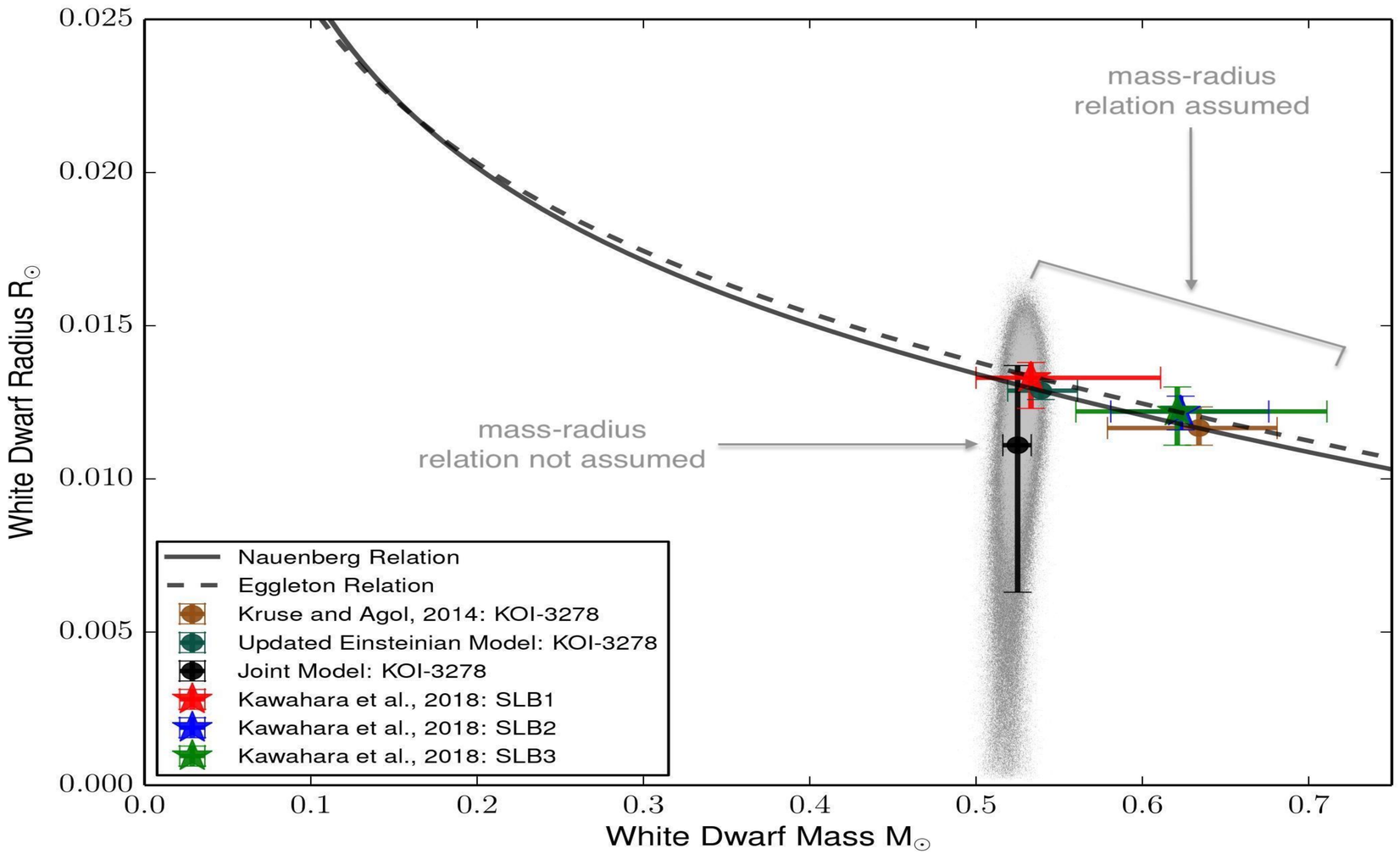

Figure 4. White dwarf mass and radius predictions from the Kruse & Agol (2014) paper, the three models presented in this paper, and the three self-lensing binaries presented in Kawahara et al., 2018. The joint model of KOI-3278 uses no mass-radius relation while all other mass-radius measurements stem from an assumed mass-radius relation.