ASASSN-18bt/SN 2018oh: A Type Ia Supernova with a Two-Component Rising Light Curve Seen in K2 Observations

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Papers: Shappee, Holoien et al. 2019;
Dimitriadis et al. 2019a,b; Li et al. 2019;
Tucker et al. 2019
• Survey began in 2013
• Current: 5 units (20 telescopes), \( \sim 6500 \) images per night, \( \sim 40,000 \) sq. degrees per night
• Limiting mag of \( g \sim 18.5 \)
• Fully automated data reduction pipeline
• Discoveries announced publicly
• Light curves available at https://asas-sn.osu.edu//
Type Ia “Progenitor Problem”

**Single Degenerate (SD):** WD accretes from MS or RG companion to reach Chandrasekhar Mass

**Double Degenerate (DD):** WD-WD merger after angular momentum loss through gravitational waves

Image credit: STFC/Dave Hardy

Image credit: GSFC/Dana Berry
ASASSN-18bt/SN 2018oh

- Discovered by ASAS-SN on 2018-02-04
- First K2 detection $\sim$ 8 days prior
- $B_{\text{max}} = 14.31$, $d = 47.7$ Mpc

Shaphee et al. (2019)
ASASSN-18bt: Early Flux Excess

Shappee et al. (2019)
ASASSN-18bt: Early Flux Excess

SN 2018oh
- K2 Raw Data
- K2 Binned Data (12h)

Dimitriadis et al. (2019a)
ASASSN-18bt: Early Flux Excess

Shappee et al. (2019)
ASASSN-18bt: Early Flux Excess

Shappee et al. (2019)
Flux Excess: SD Companion Interaction

- Shock-interaction between SN ejecta and non-degenerate companion generates excess flux (Kasen 2010)
- Best fit to $\sim 10 R_{\text{Sun}}$

Dimitriadis et al. (2019a)
Flux Excess: Off-Center Nickel Distribution

- If nickel is mixed into the outer layers of the ejecta it can generate excess flux (Piro & Morozova 2016, Contreras 2018)
- Requires non-smooth distribution, highly concentrated at surface

Contreras et al. (2018)  Shappee et al. (2019)
Flux Excess: Other Possibilities

• Sub-Chandrasekhar "double-detonation": He shell detonates and ignites explosion of CO core (e.g., Woosley & Weaver 1994, Noebauer et al. 2017)
• Interaction with nearby CSM (e.g., Prio & Morozova 2016)

Dimitriadis et al. (2019a)  Shappee et al. (2019)
Summary

- ASASSN-18bt was the brightest and nearest SN observed by Kepler
- Early flux excess in light curve can be attributed to a variety of different physical processes, including interaction between the SN ejecta and a non-degenerate companion or a non-smooth, surface-concentrated distribution of nickel
- Nebular phase observations should help constrain these models.
Thank You

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