Mysterious eclipses of Boyajian's star: a possible explanation

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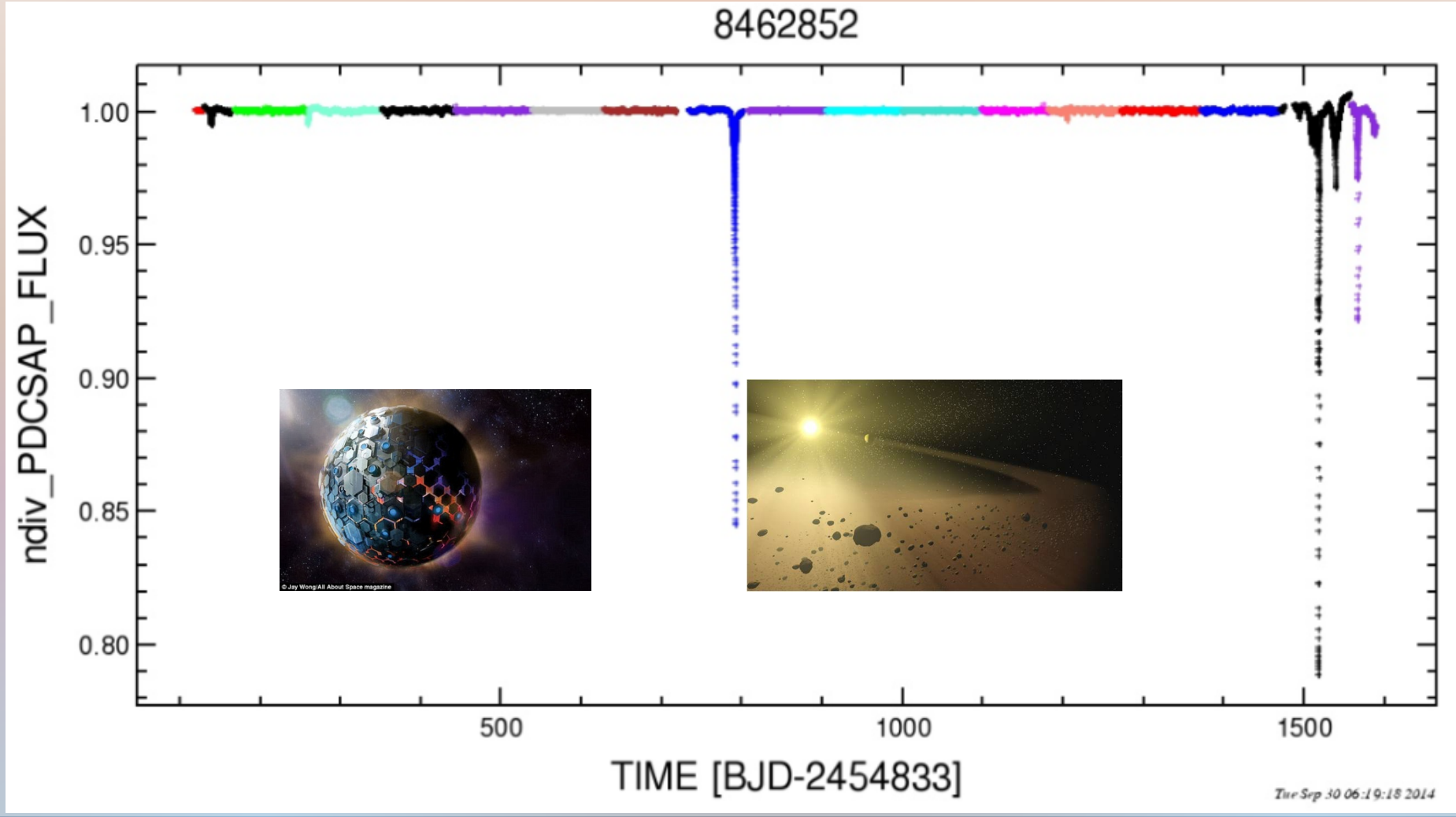
Content

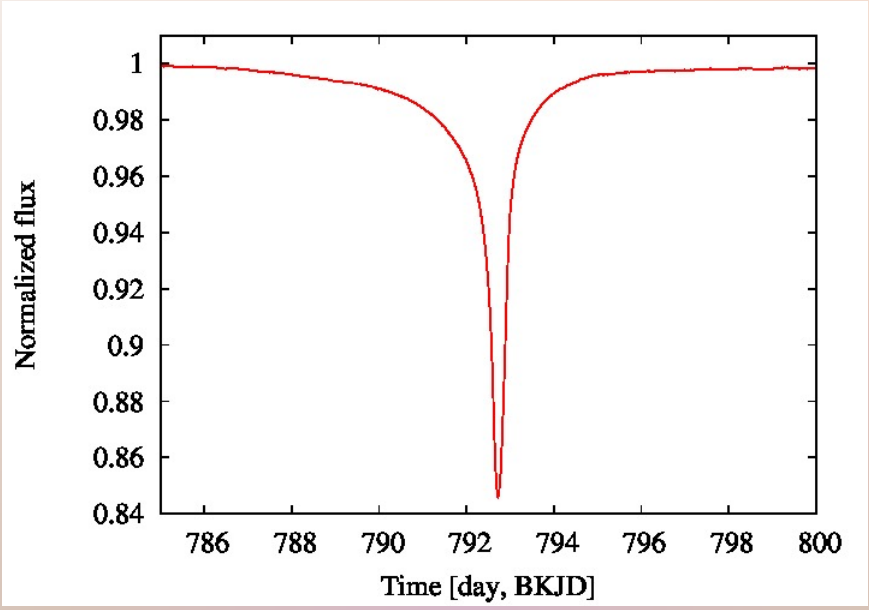
- Discovery
- Light curves and observational constraints
- Models and their problems
  - Comet scenario
  - Massive object scenario
  - Brown dwarf scenario
- Future

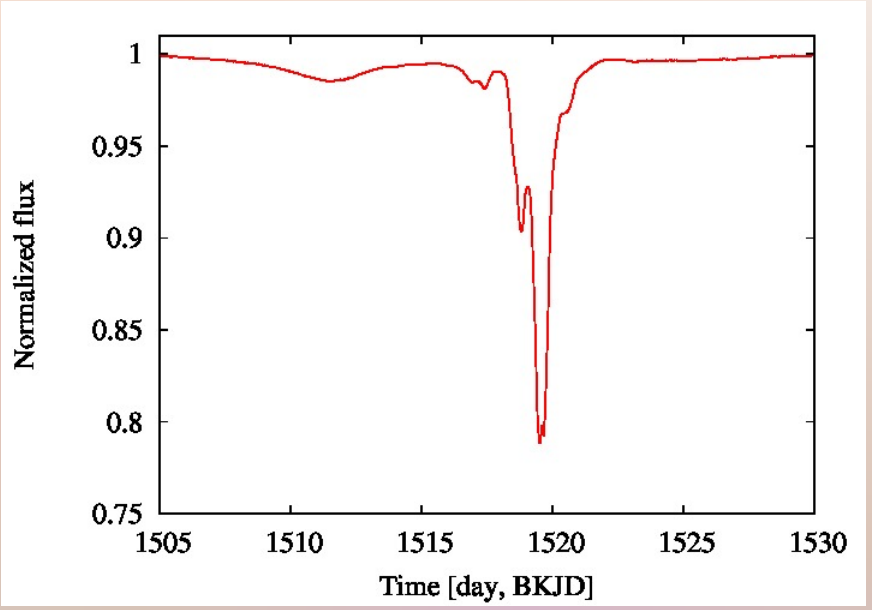
KIC 8462852

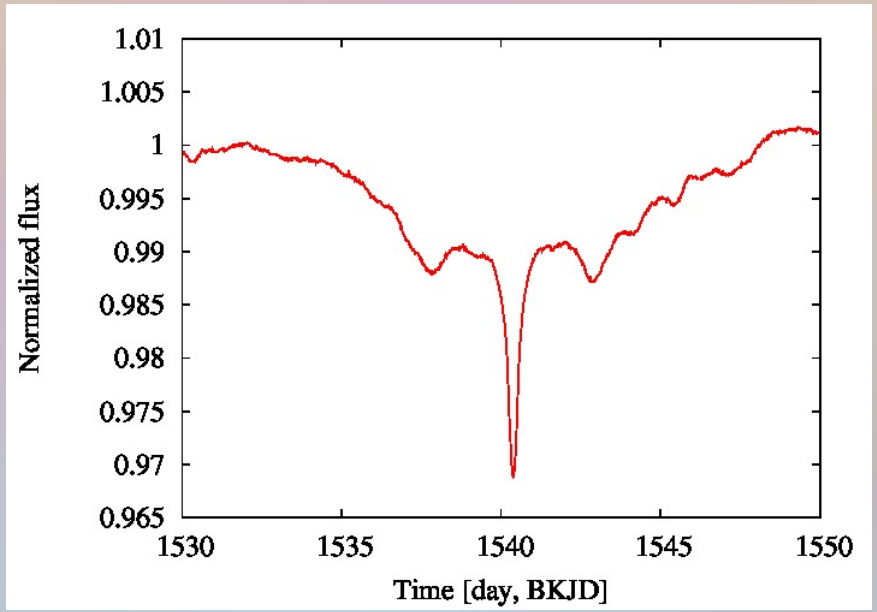
- Boyajian et al.(2016), Kepler data, normal 12 mag F3V(IV) star
- M=1.43Msol, R=1.58Rsol, Teff=6750K
- Irregular dips with peculiar shapes, up to 20% deep

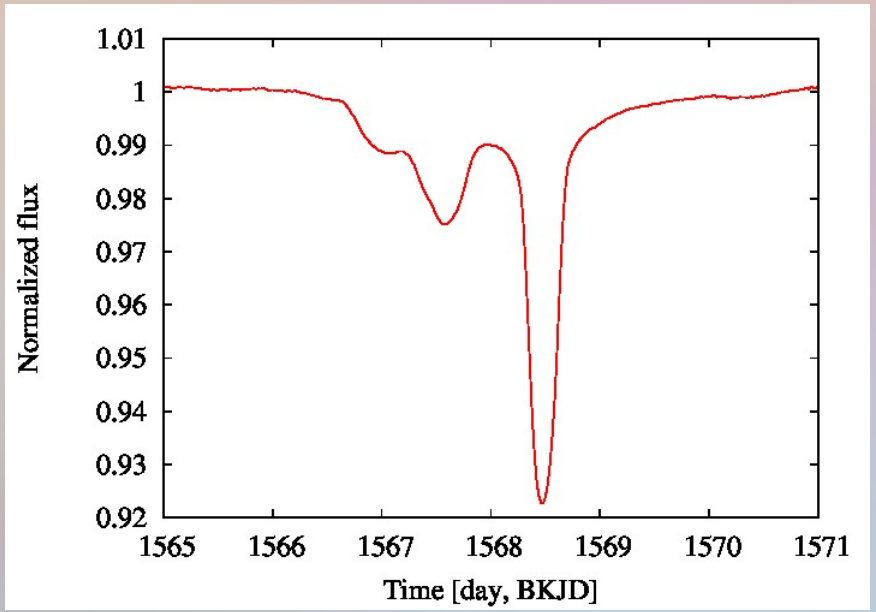


Shapes of four main events





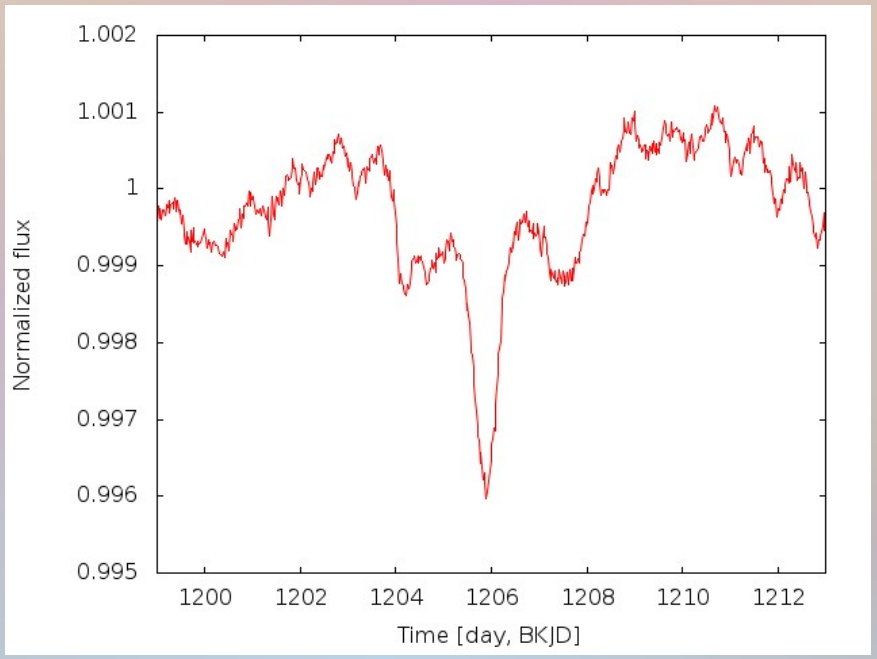




IR,sub-mm,mm,GAIA

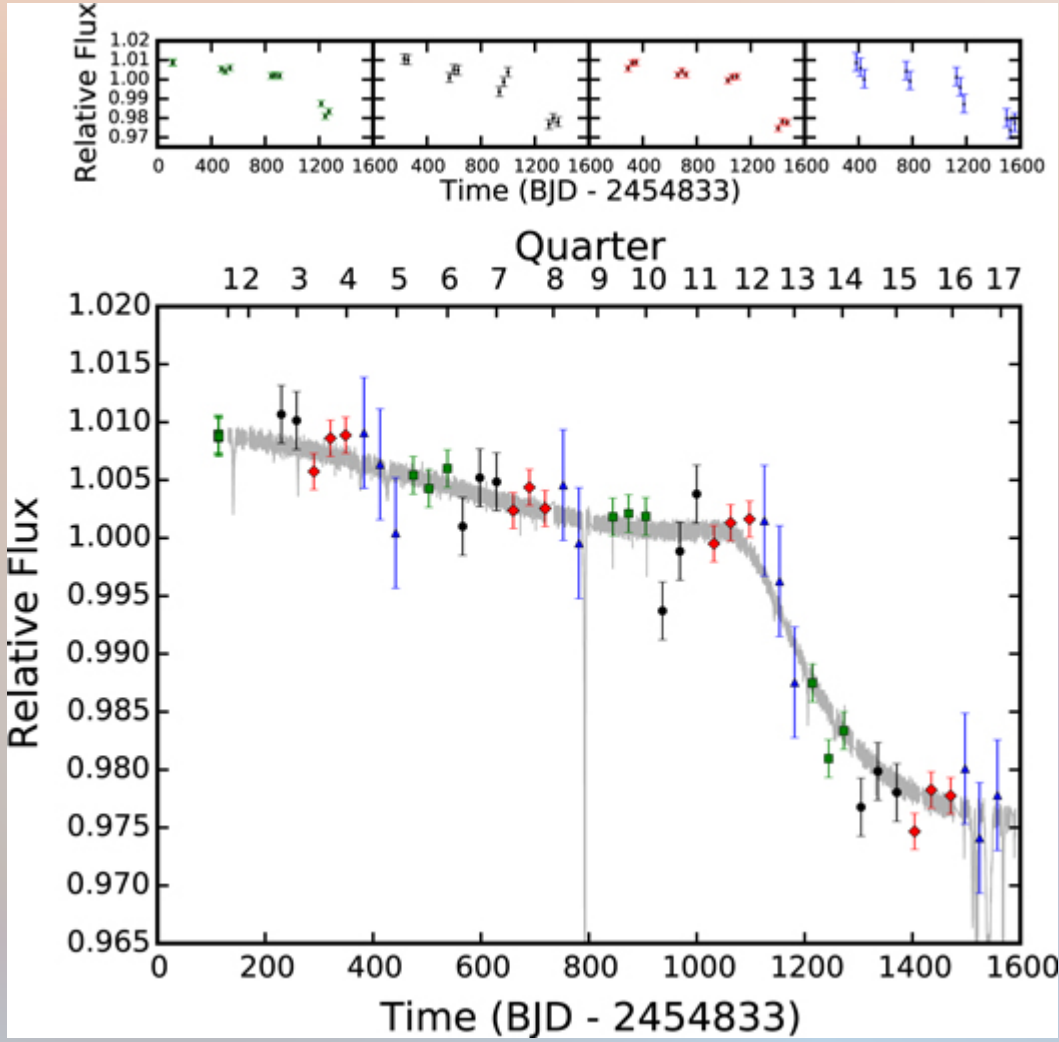
- Boyajian et al.2016, Marengo et al. 2016
- Lisse et al. 2015, Thompson et al. 2016
- Hippke & Angerhausen 2017 (GAIA, 390pc)
- Nondetection, not young object
- Dust <7.7 M_Earth within 200au
- Dust in occultation < 10^-3 M_Earth

Another event

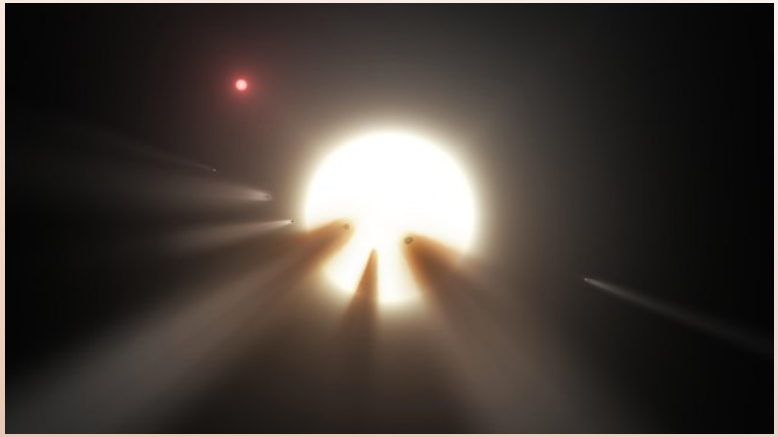


Long term trend

Montet & Simon (2016)



Swarm of Comets



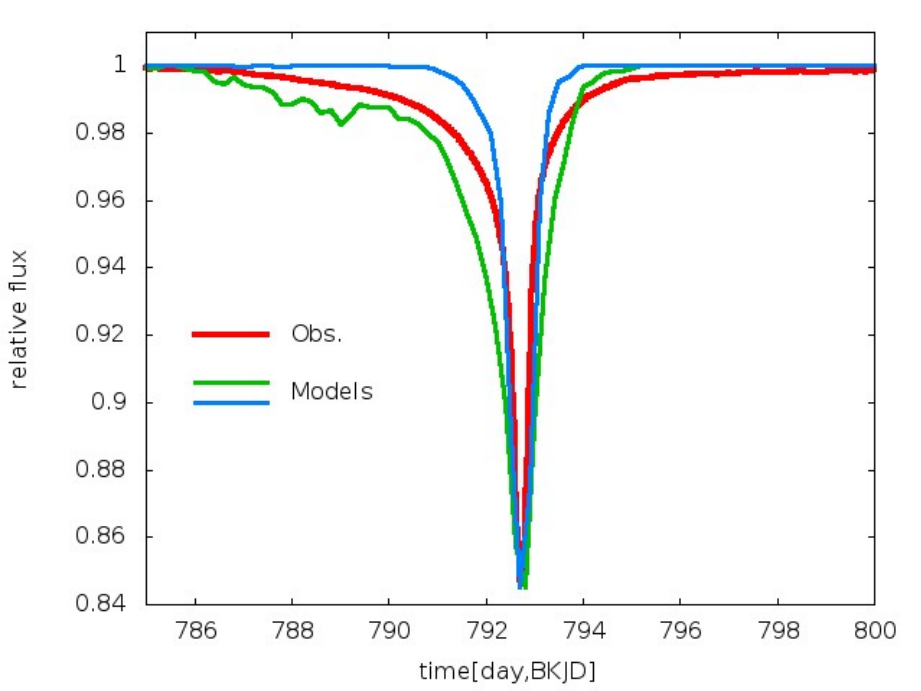
- Bodman & Quillen (2016)
  - a swarm of 70-700 comets
  - highly eccentric orbits
- Pros:
  - Fits most of the features very well
  - Satisfies the IR limits
  - Such comets are known to exist and have high probability of transit
- Cons:
  - cannot reproduce smooth 800d feature
  - produce shallower eggress with tails (obs. have the opposite trend)
  - many free parameters can fit anything, hence the model may not necesarily be correct even if the fit is perfect
  - Symmetric 'ring like' feature at BKJD 1540 would be an accidental constellation of comets
  - Another symmetric feature at BKJD 1210 would be another accidental constellation of comets

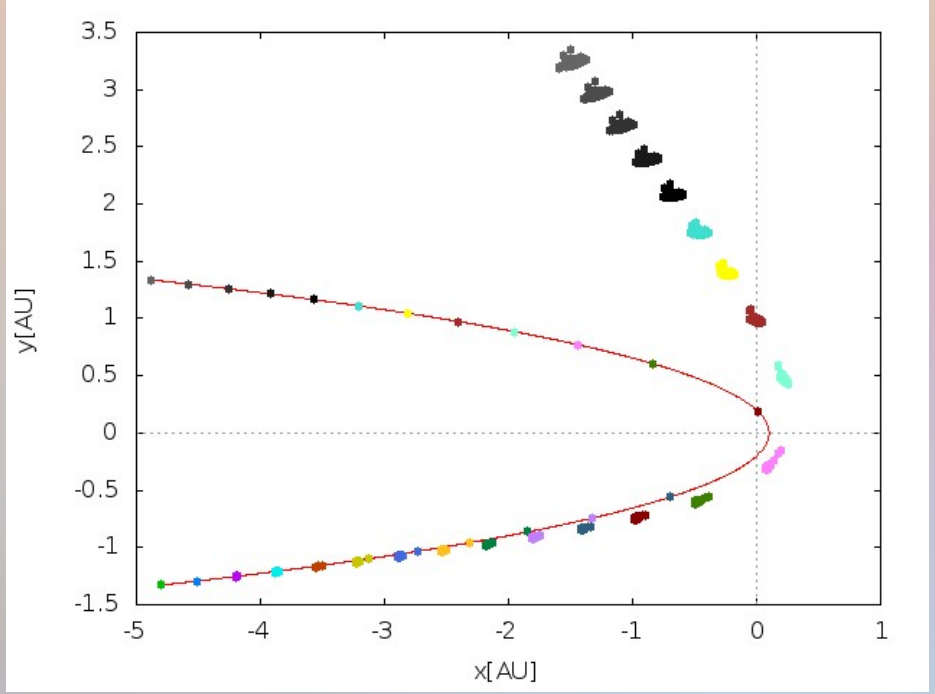
Massive bodies wrapped in the dust

- Neslusan & Budaj (2017)
- star & 4+ massive bodies with dust clouds
- Assumptions: initial dust cloud model, gravity (star+body), P-R drag
- Example solution found: 4 objects on almost identical orbits:

  i=90 deg, p=0.1 AU, a=50 AU and identical particles with beta=0.63

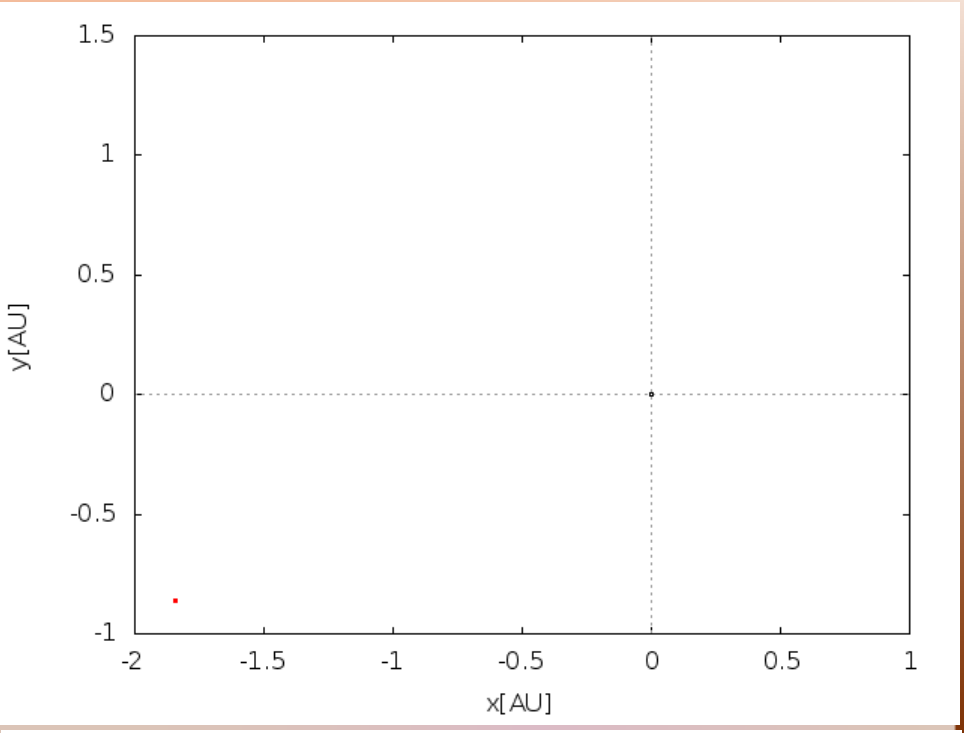
Spherical cloud (blue: M=10^-10 Mstar, green: 10^-8 Mstar

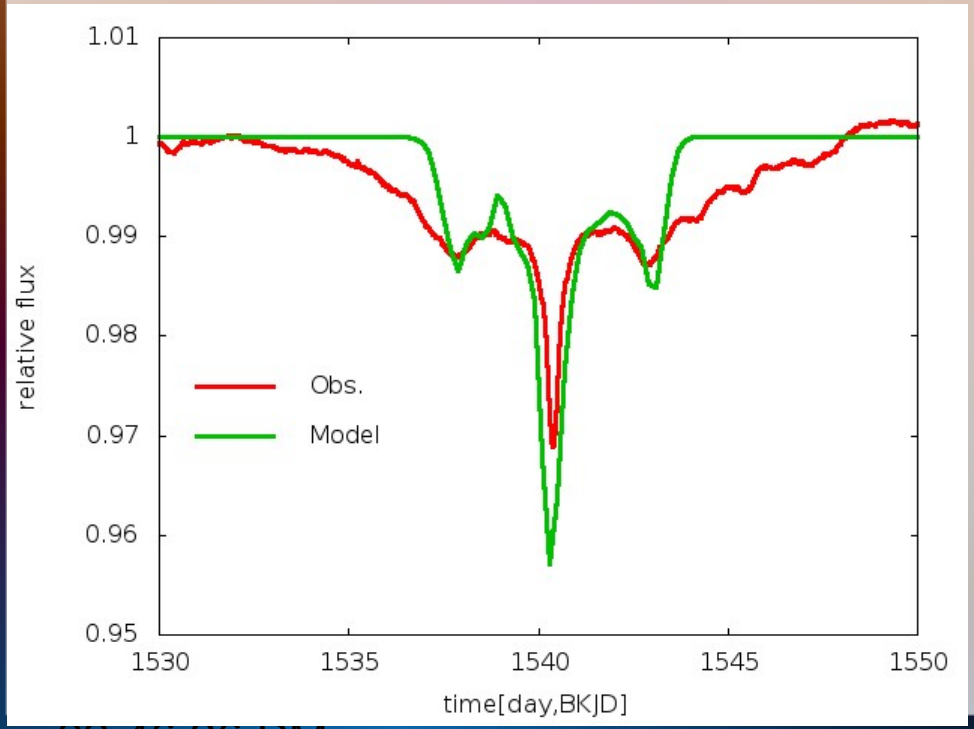


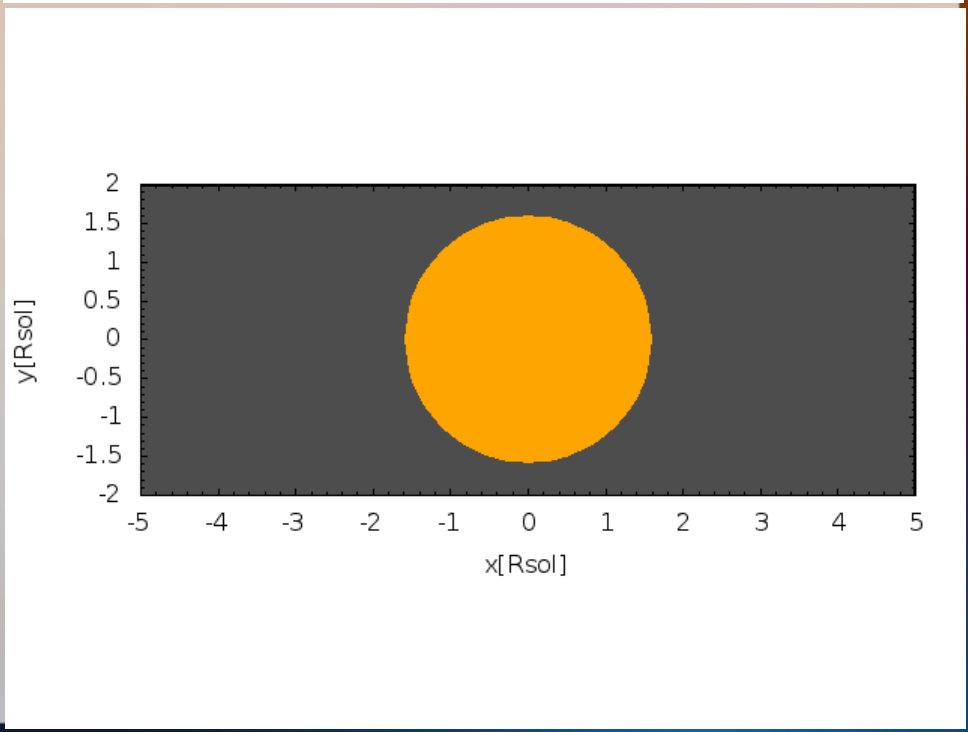


Massive bodies wrapped in the dust

An initial ring-like cloud,
Inclination=45deg, R=5000-10000km,
M=10^-8 Mstar







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Massive bodies wrapped in the dust

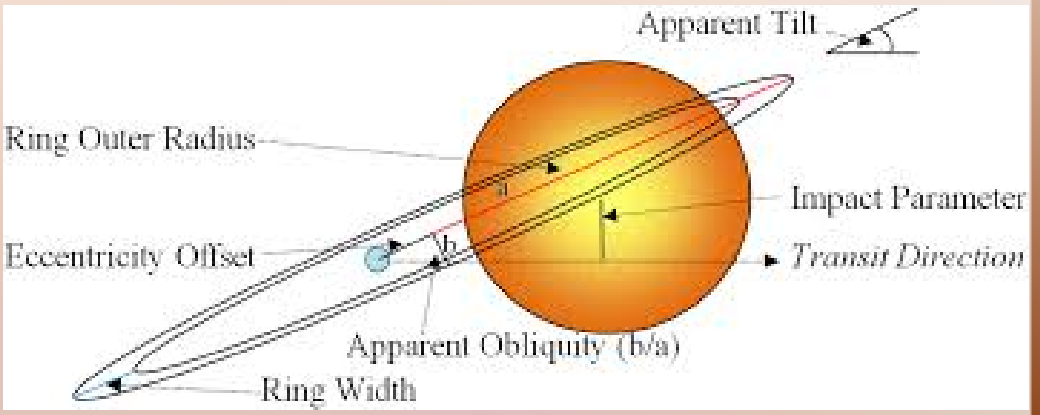
Pros:
-problems of the comet scenario are gone
-low number of free parameters

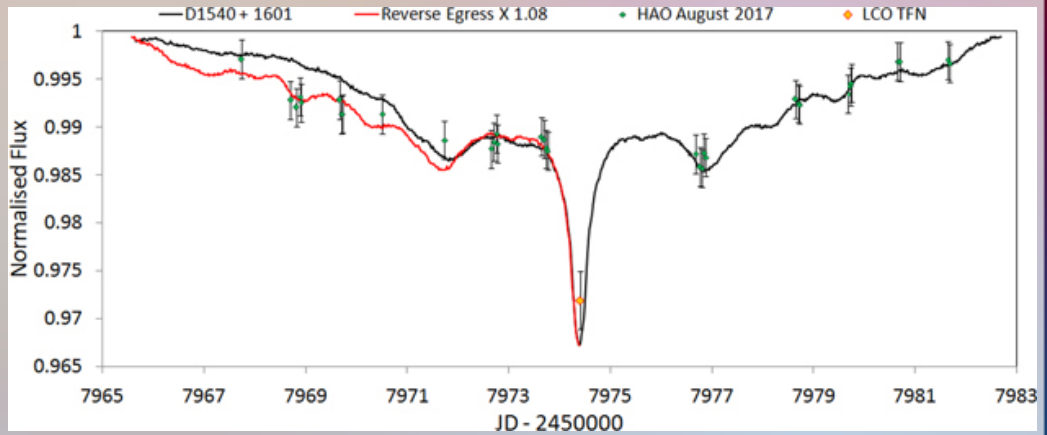
Cons:
-fits are not perfect (but surprisingly good given only a few free param)
-how to get a massive body on such eccentric orbit
-how to form a dust cloud around it

Granvik et al. 2016:
Super-catastrophic disruption of asteroids at small perihelion distances.

Brown dwarf & 9 rings

- May 2017, the star is waking up, new dips
- Bourne, Gary & Plakhov (2018)
  - a brown dwarf with 9 rings
  - 4.4yr, 3au, mild eccentric orbit
- Pros:
  - Explains BKJD 1540 and 9.8.2017 eclipses
  - some repeating long term variability
  - Prediction of new eclipse 27.12.2021
- Cons:
  - Does not explain other features
  - Mass, period & ring sizes are close to observational and theoretical limits





Boyajian's star is still active ... to be continued ...

Thank you!

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