Modelling (mostly) non-fragmenting meteors

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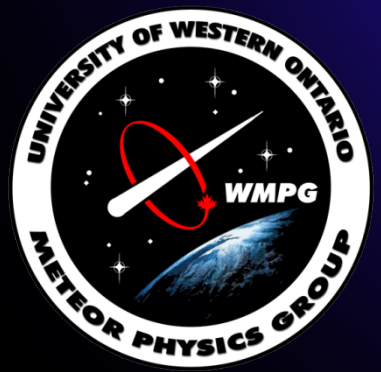
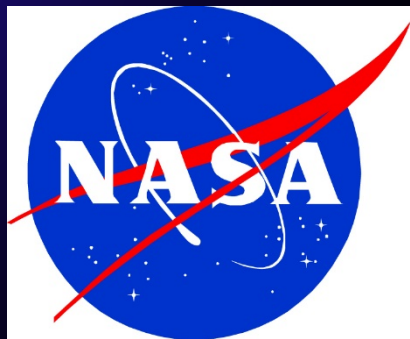
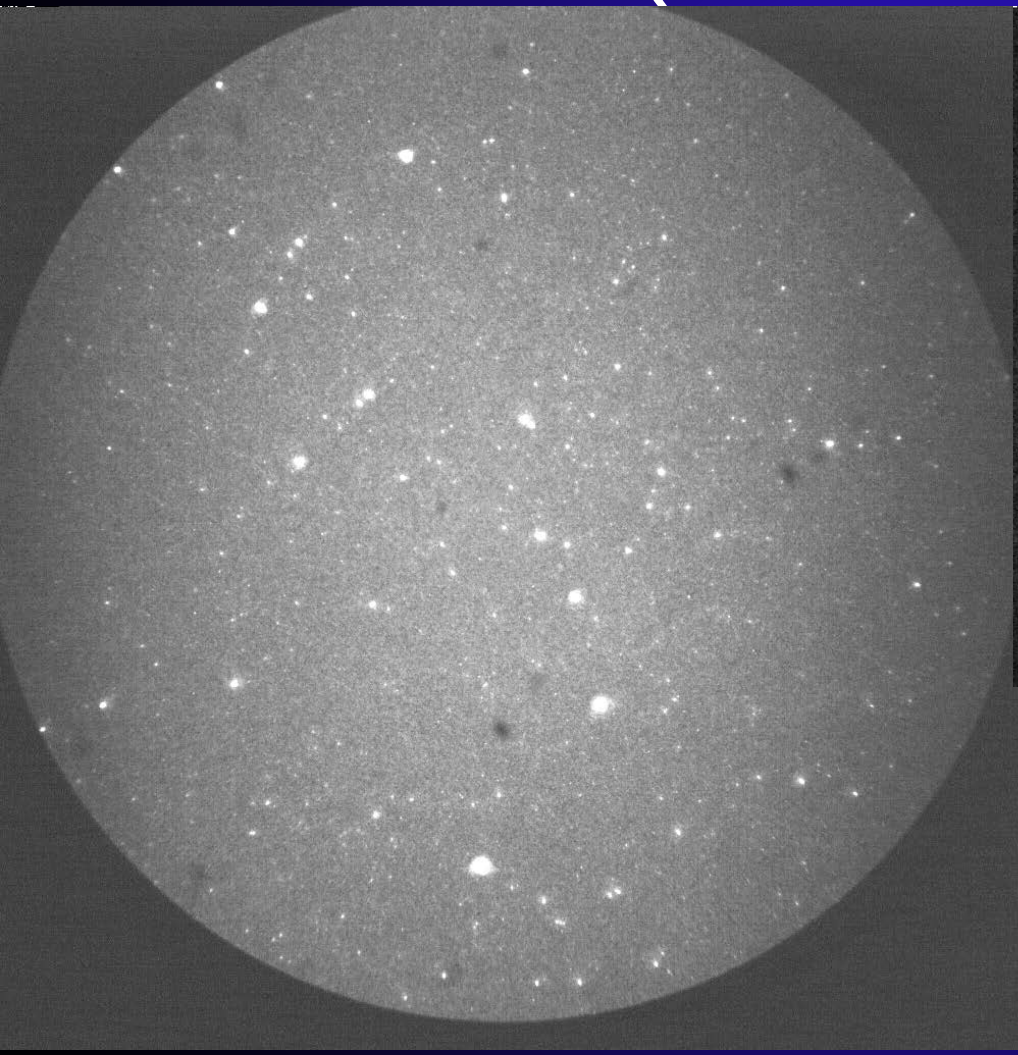




Meteor ablation modelling

- We often use the light curve and deceleration of a meteor to constrain ablation models.
- Fragmentation produces much better fits, but current models do not match the measured wake brightness.
- Focusing on meteors for which fragmentation is not important should help constrain meteoroid densities.

20101107_015015
(North Taurid)



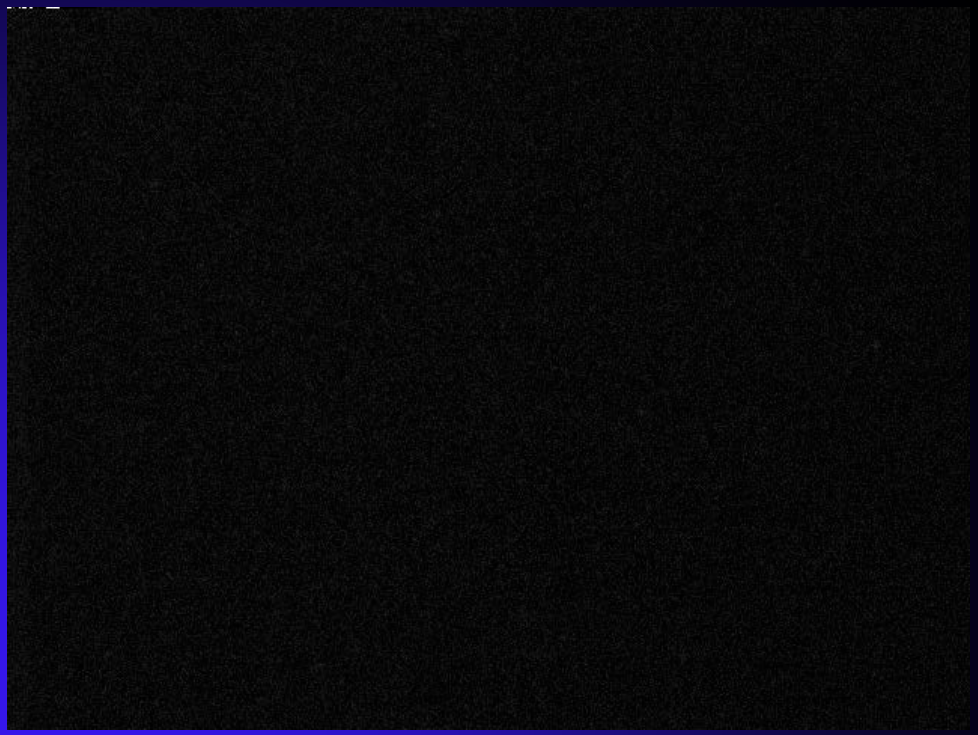
Influx

Mirror Wide

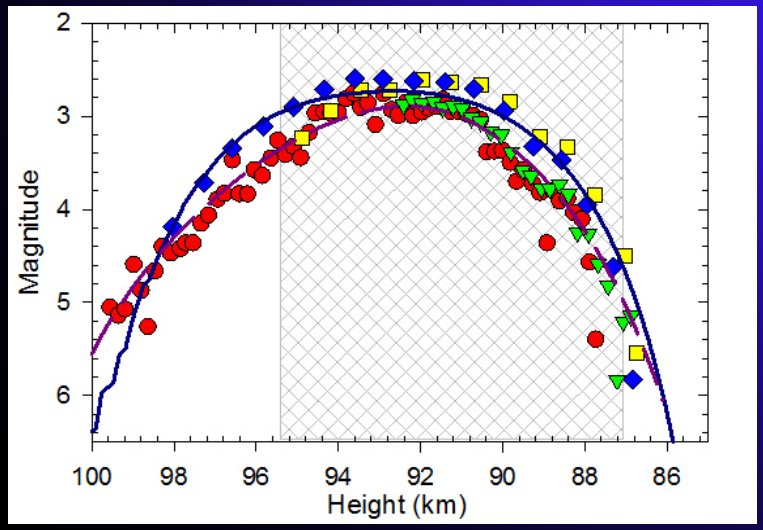
V = 27.4 km/s
M_{peak} = 2.6
T_J = 3.8 (NTA)

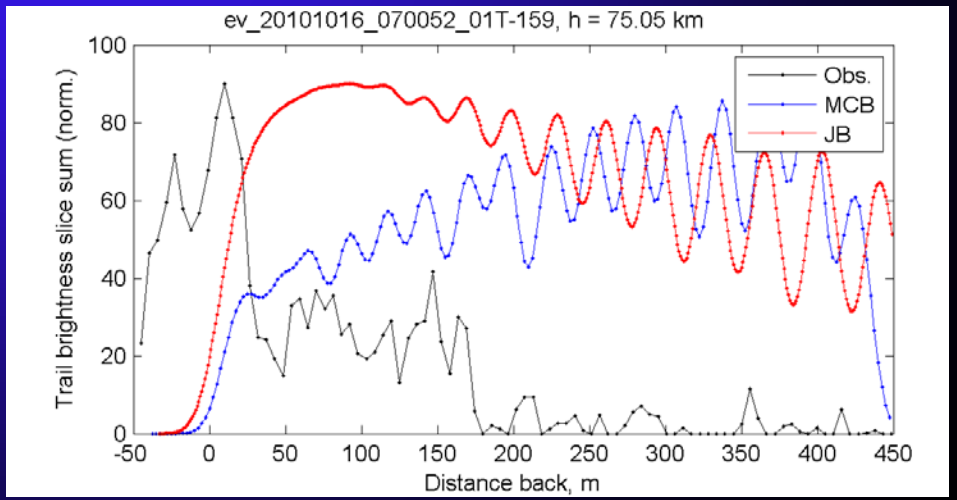
h_{beg} = 100.1 km
h_{end} = 86.9 km

- Meteor was modelled with a thermal disruption model (Campbell-Brown & Koschny, 2003) and a thermal erosion model (Borovička et al., 2007).
- Neither model predicted the lack of wake in observed in the narrow field camera.

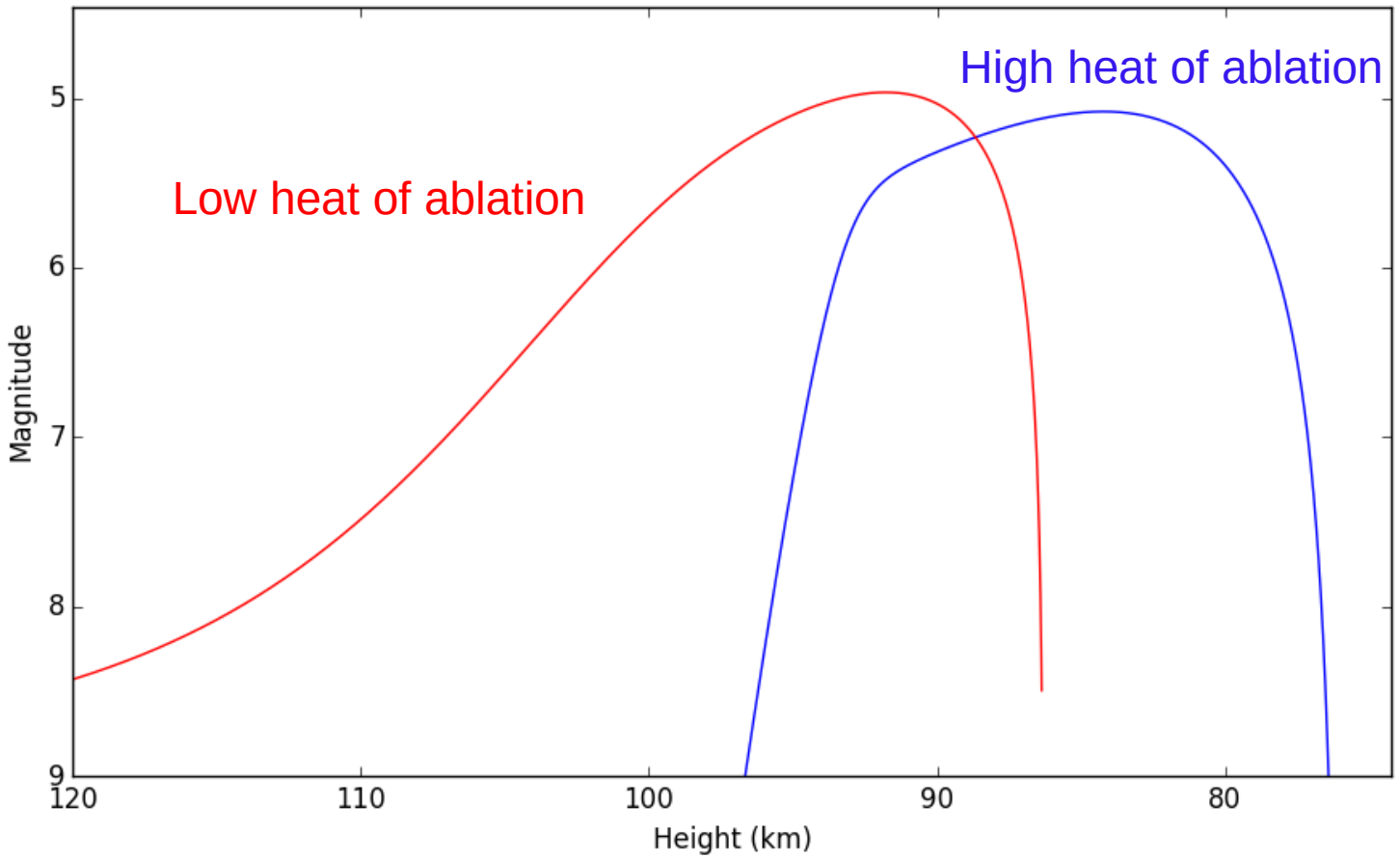


Meteor 20101107_015015
North Taurid





Single body, classical light curves

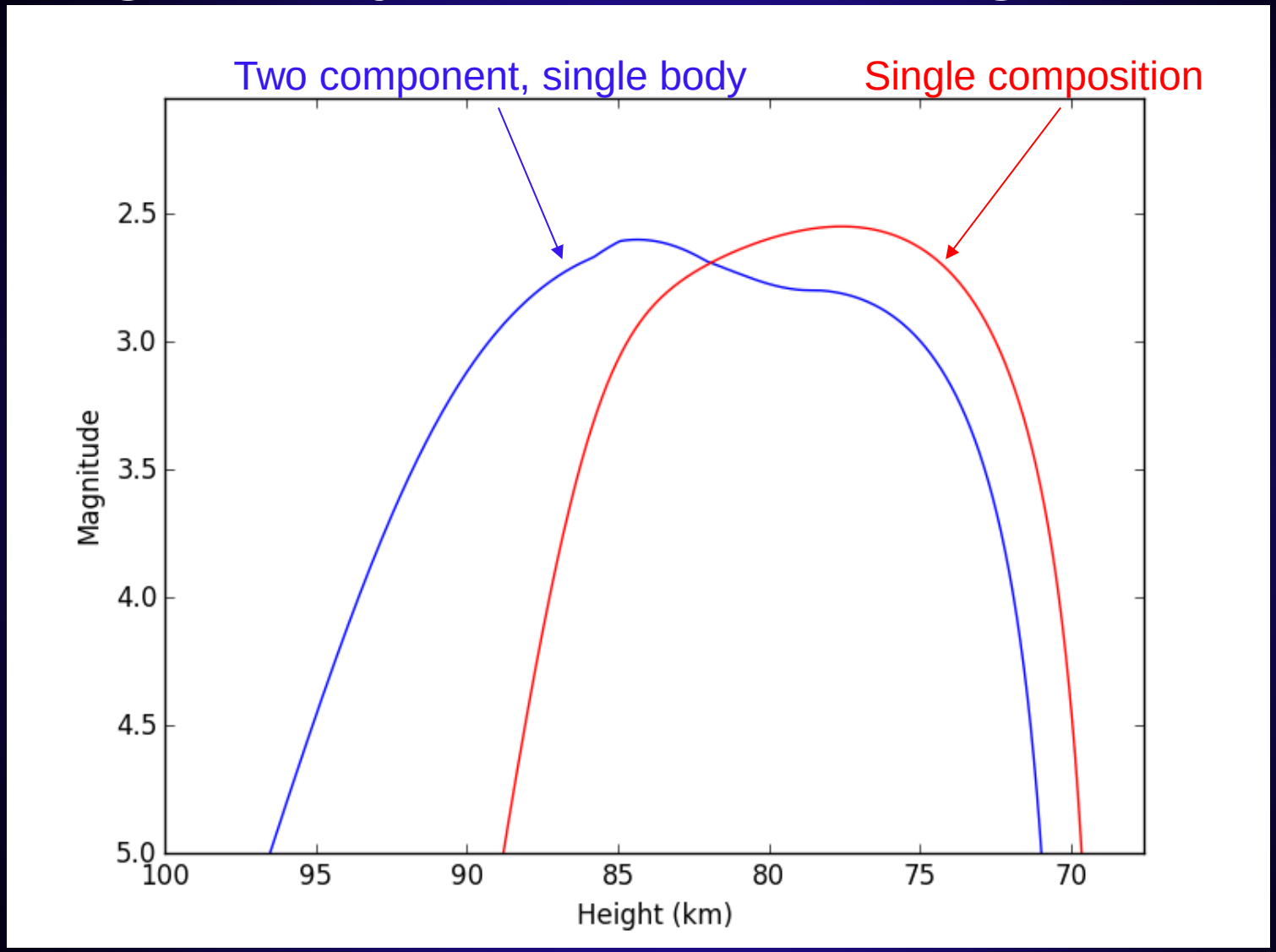


Classical, single body light curves are late peaked.

Multi-component single body model

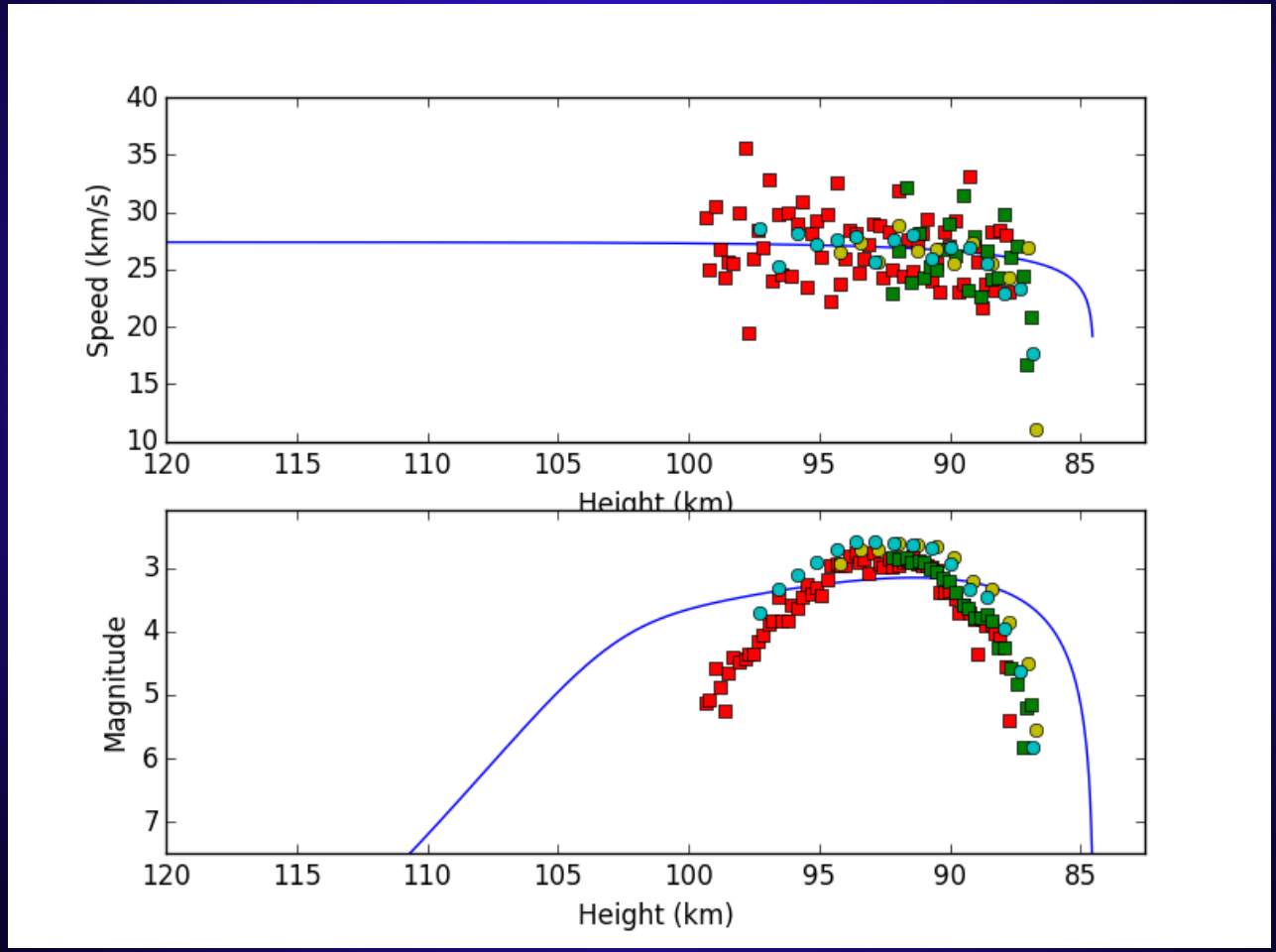
- Meteoroids are assumed to consist of several distinct minerals, each with their own physical and thermal properties.
- The meteoroid is assumed to be isothermal (small meteoroids only).
- All components interact with the airstream.
- The porosity changes as more volatile components ablate.

Single body, non-classical light curves



Light curves may be early, late or symmetric.
All are wider than single composition.

Single body ablation with data

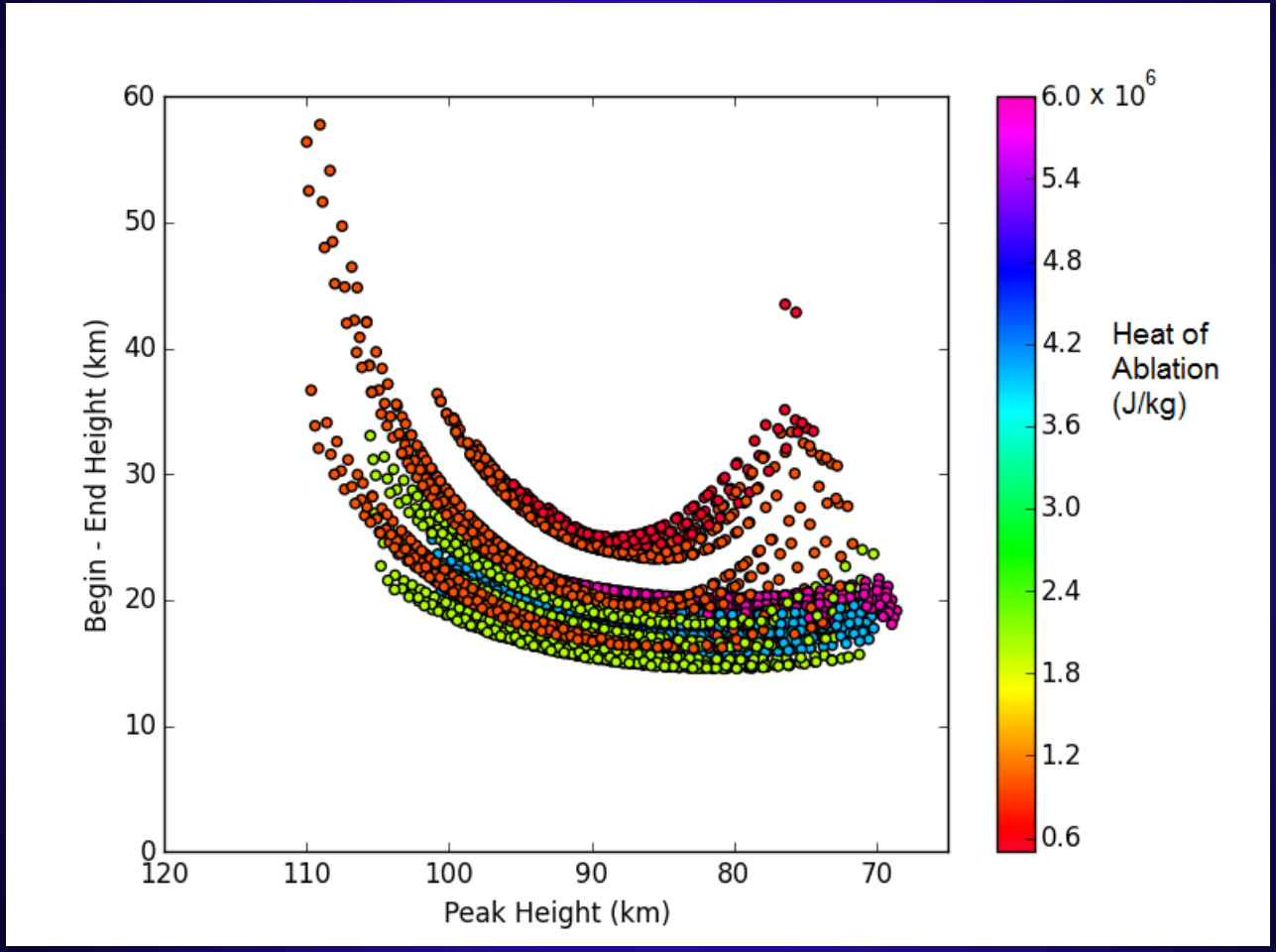


Meteor 20101107_015015
North Taurid

Light curve width

- The mass, heat of ablation, boiling point, density, molar mass, and shape factor all affect the width.
- The North Taurid being modelled has a width (two magnitudes down from the peak) of ~10 km in height.
- The above parameters were varied independently through their physical range to try to reduce the modelled meteor’s width.

Light curve width



Even with single component, light curve is always too wide.

Resolving the issue

- Possibilities:
  - There is some fragmentation present: limited by the faintness of the wake, but present.
  - Fragmentation is not important, but some other physics not captured by the model dominates.

Next steps

- Survey more non-fragmenting meteoroids, relating the width of the light curve to the amount of (faint) wake present.
- Obtain fits for meteors with wide light curves.
- Allow a small amount of fragmentation for meteoroids, consistent with wake.