GIANT IMPACTS IN THE BETA PIC SYSTEM

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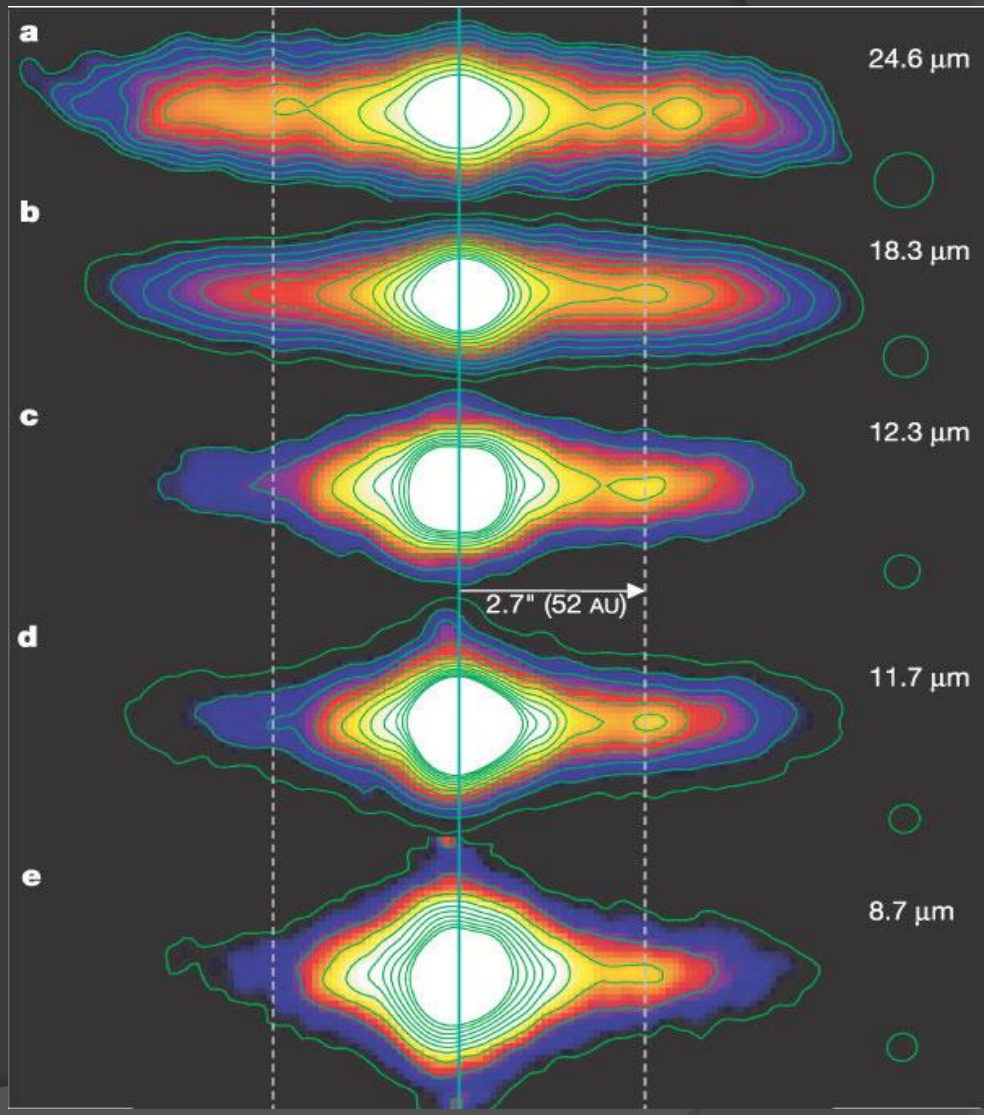
Image: NASA

Outline

- What features are we hoping to explain?
- Overview of giant impact debris
- Application to Beta Pictoris

Brightness asymmetries

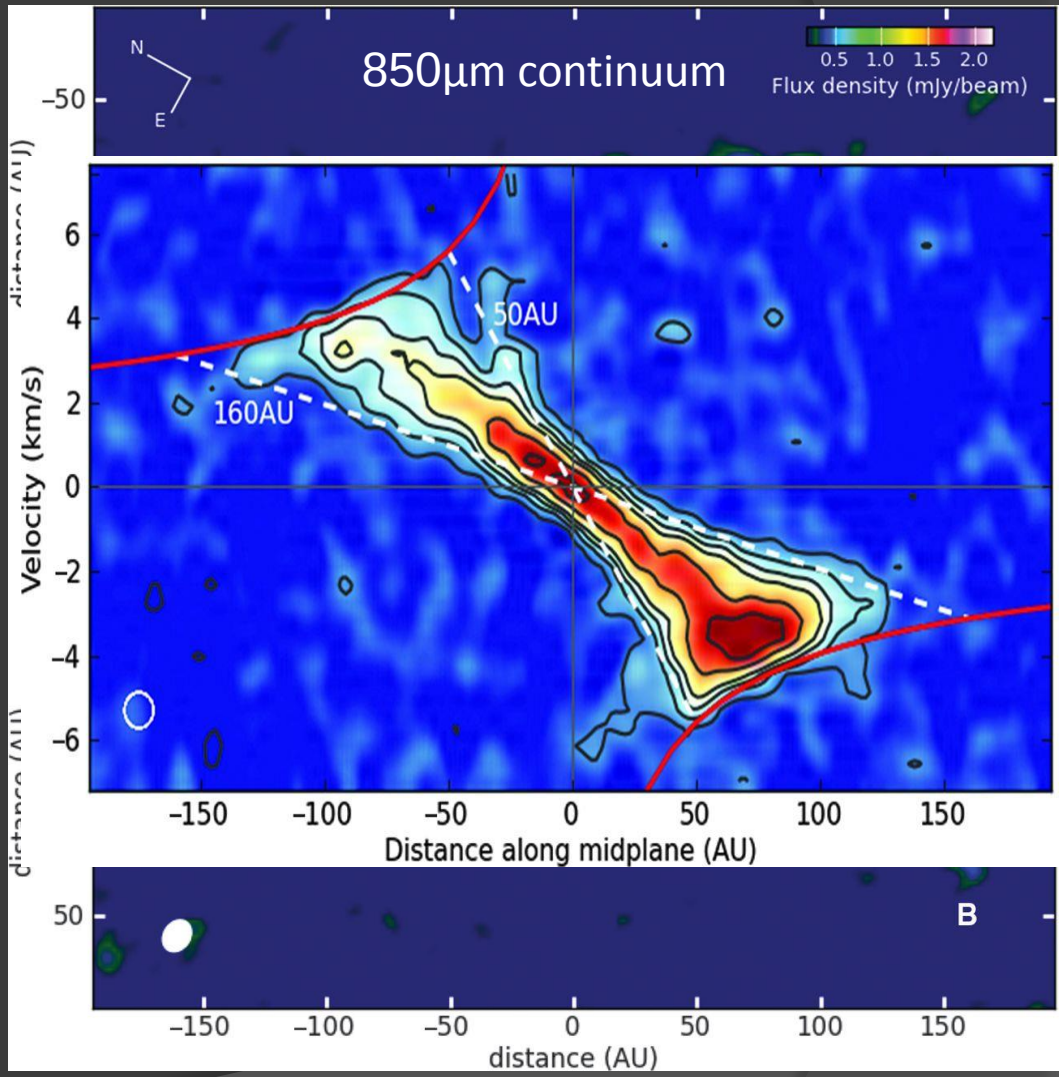
- Brightness asymmetry at 2.7” separation seen in 2005 with T-ReCS by Telesco et al.



Telesco et al. 2005

Brightness asymmetries

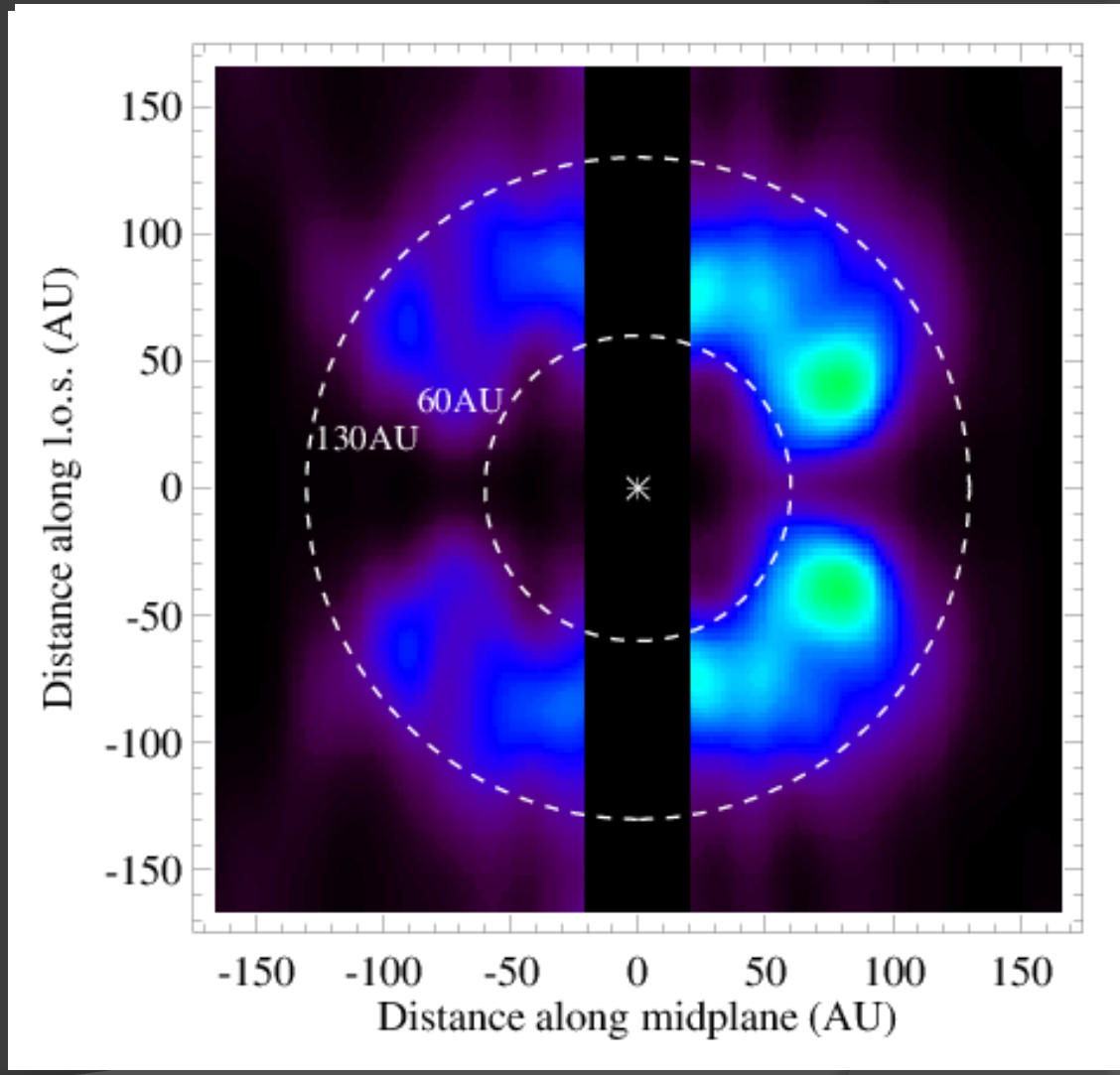
- ALMA observations show the same asymmetric geometry
- Asymmetry much stronger in CO line emission
- Velocity information indicates clump is at 85AU



Dent et al. 2014

Brightness asymmetries

- We can de-convolve the CO data to produce a ‘face-on’ image
- CO decays on less than orbital timescales

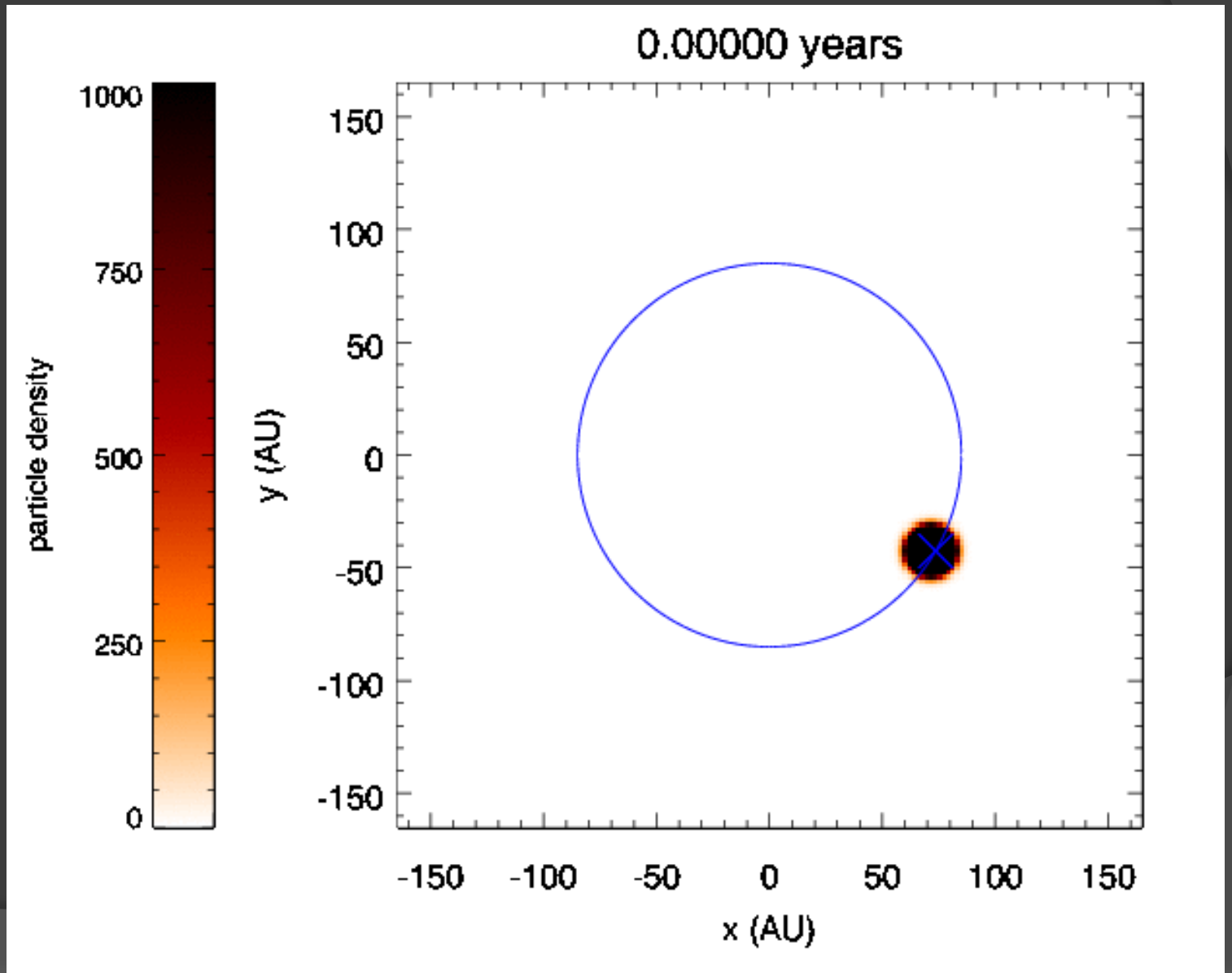


Dent et al. 2014

Giant impact debris

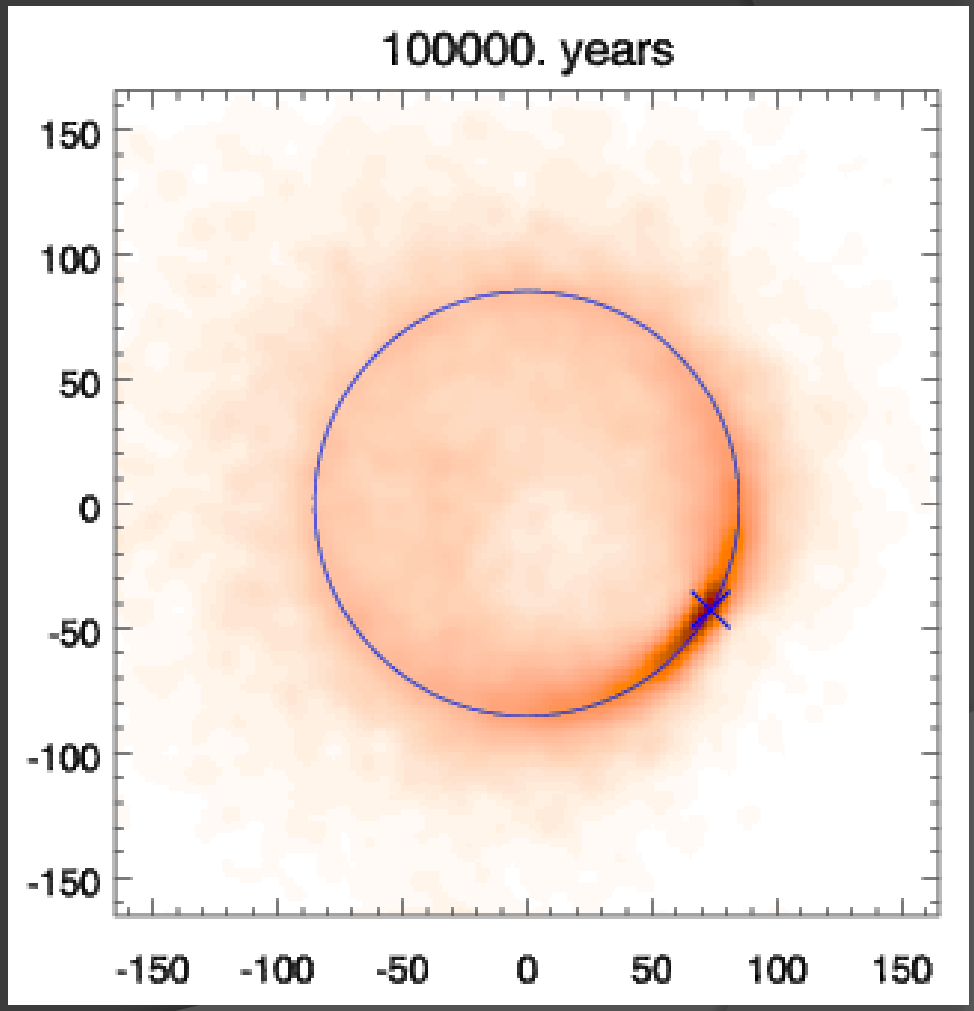
- Traditionally associated with terrestrial planet formation, but can occur anywhere in a system (c.f. Pluto-Charon)
- Substantial amounts of debris are released – averaging 3-5% for large planets
- Once released debris goes into heliocentric orbit

Giant impact debris



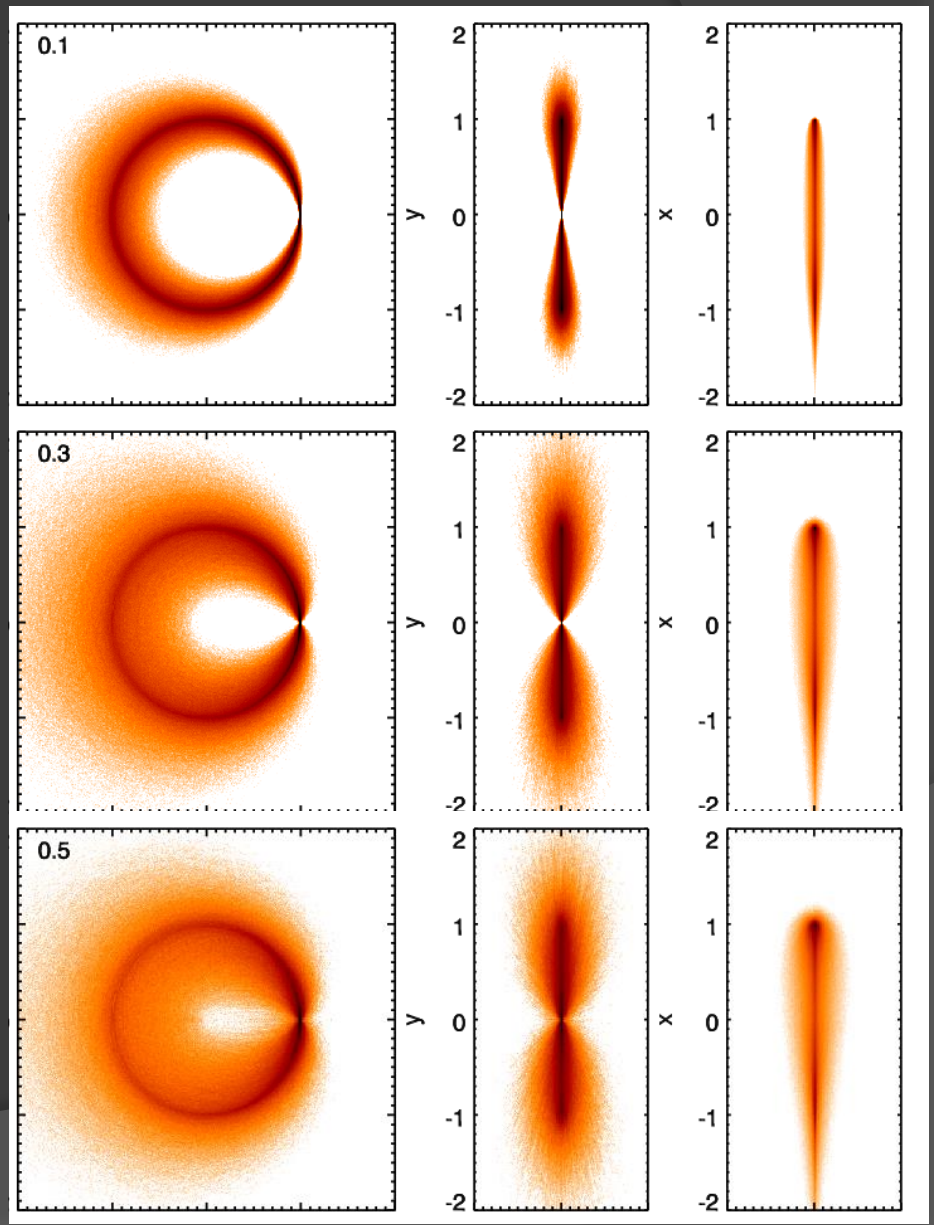
Giant impact debris

- Produces a smooth, asymmetric disk
- Bright point/pinch due to geometry of orbits – ‘collision point’
- Collision point lasts until precession disrupts orbital coherence, ~0.5-1Myr



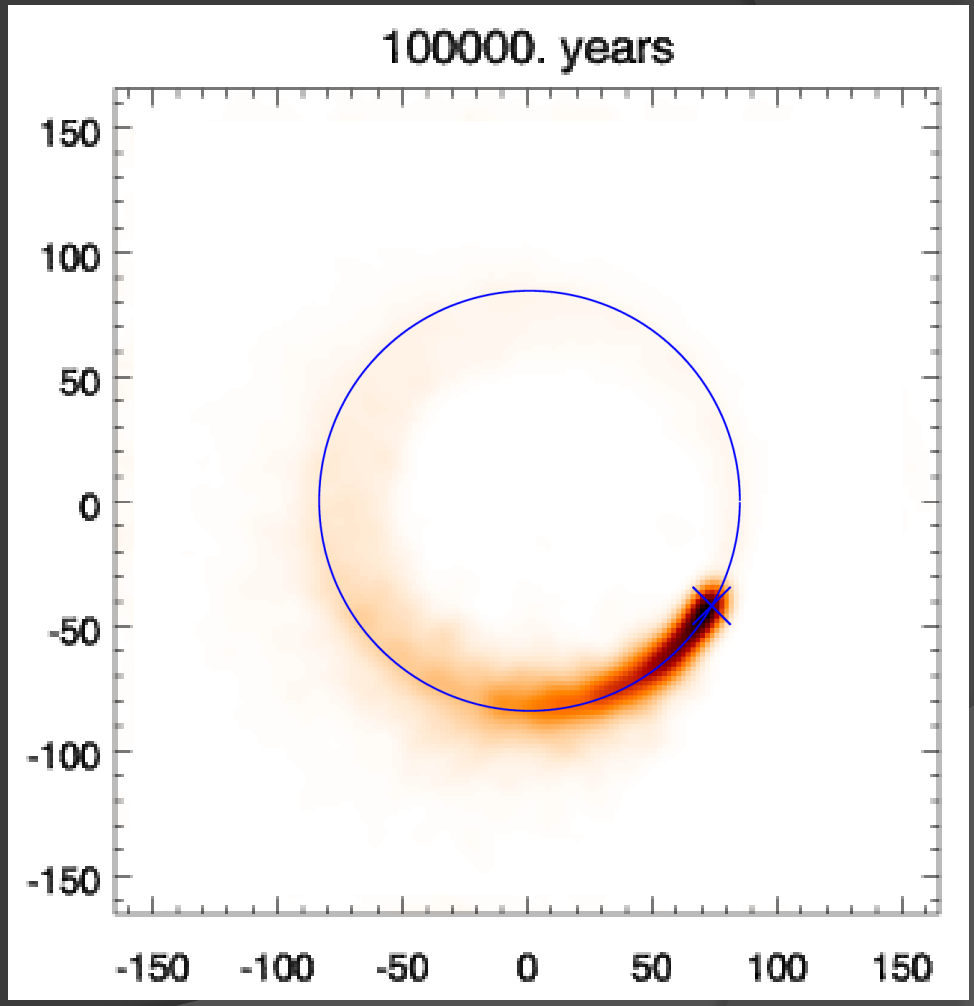
Giant impact debris

- Width of disk away from collision point depends on velocity dispersion
- Velocity dispersion set by escape velocity of progenitor
- Allows us to estimate mass of progenitor



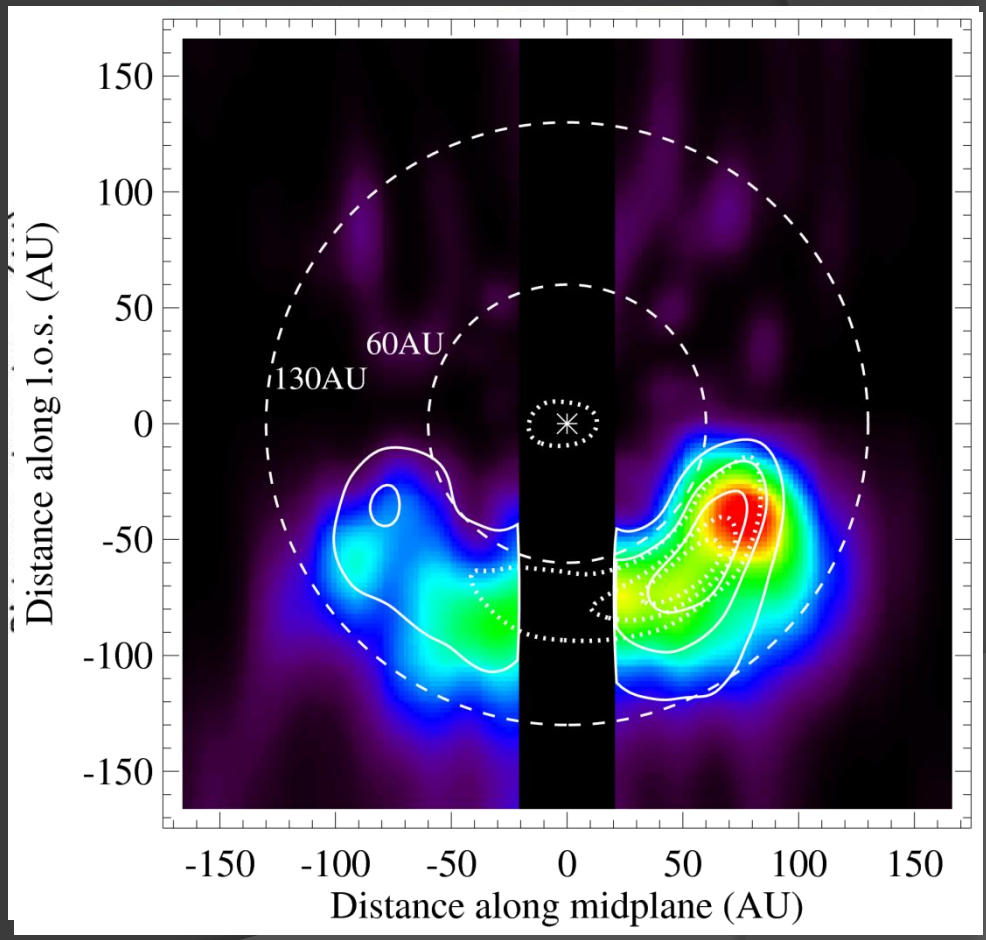
Giant impact debris

- Collision point dominates collisional evolution
- CO released in collisions
- CO production dominated by collision point
- CO then decays around orbit



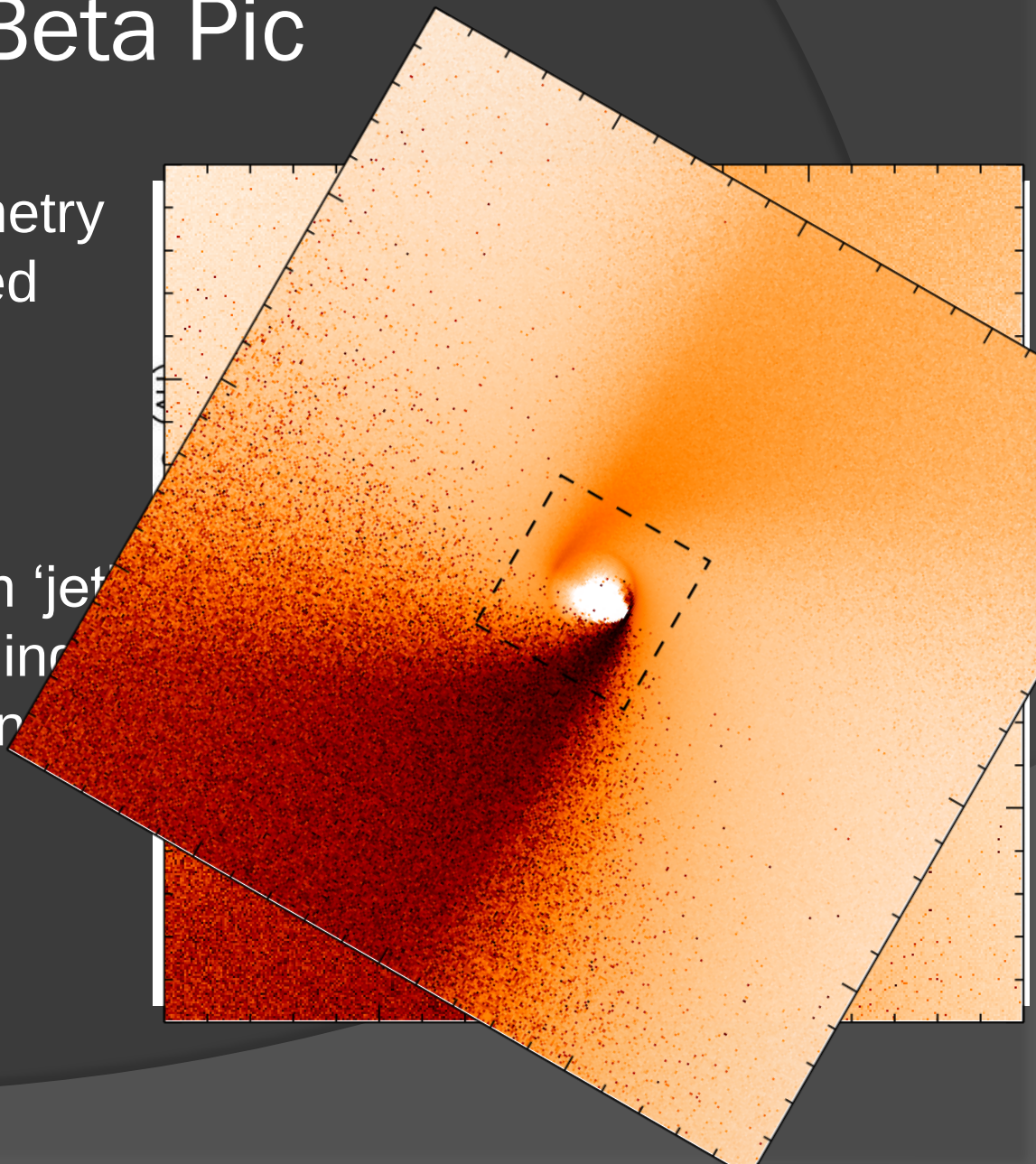
Application to Beta Pic

- Giant impacts naturally produce structures similar to that observed in CO.
- Beta Pic structure quite radially broad – need a progenitor of a few Mars mass



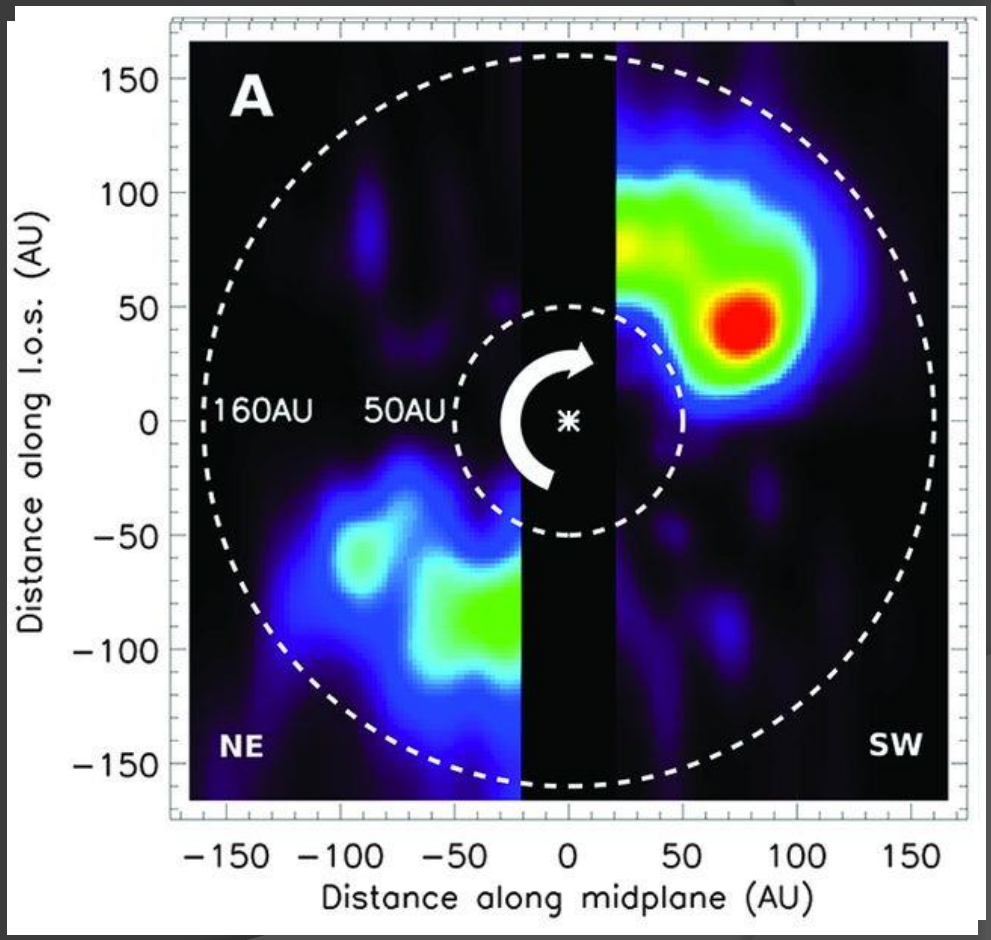
Application to Beta Pic

- Also fits with asymmetry observed in scattered light – NE more extended than SW
- Blow-out grains form ‘jet’ like structure extending from collision point in orbital direction



Application to Beta Pic

- Grains trapped in resonance could also work (talk by Mark Wyatt)
- If confirmed, tentative observation of clump motion by Li et al 2012 would favour resonance model



Conclusions

- A giant impact involving a body of a few Mars mass at ~85 AU is a possible model for the brightness asymmetry in Beta Pictoris

- Picture not yet complete though and other models are possible – e.g. resonance trapping