

SMACK Models of Collisional Pericenter Glow



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Collision-less Pericenter Glow

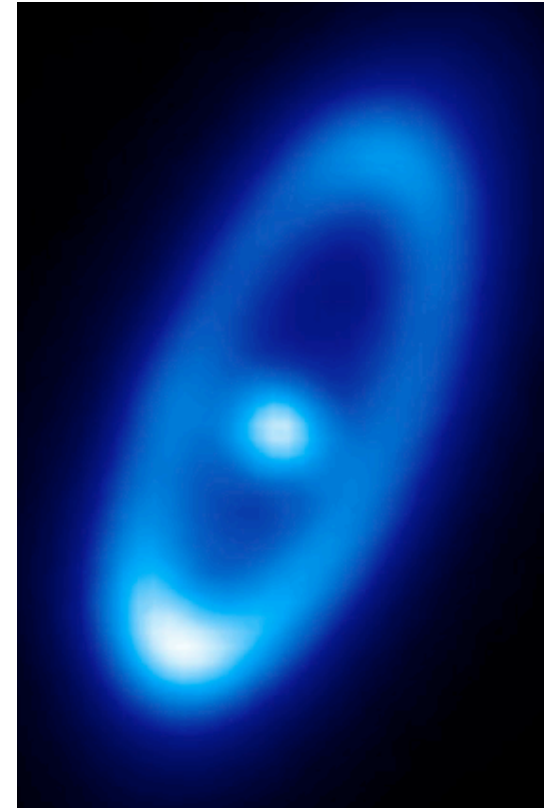
(Wyatt et al. 1999)

One side of the ring is closer to the star, so it's brighter.

No azimuthal density variations.

Easy to model: just offset the ring

Sufficient to explain shorter wavelength images ($\leq 70 \mu\text{m}$) of HR 4796, Fomalhaut.



Fomalhaut
Herschel 70 μm
Acke et al. 2012

Collisional Pericenter Glow

(Nesvold et al. in prep)

Includes density asymmetries caused by azimuthal variation in dust production rates.

The possibility was mentioned by

Marsh et al. (2005)

Schneider et al. (2009)

Moerchen et al. (2011)

but never properly modeled.

Suggested by longer wavelength images of Fomalhaut

CSO 350 microns (Marsh et al 2005)

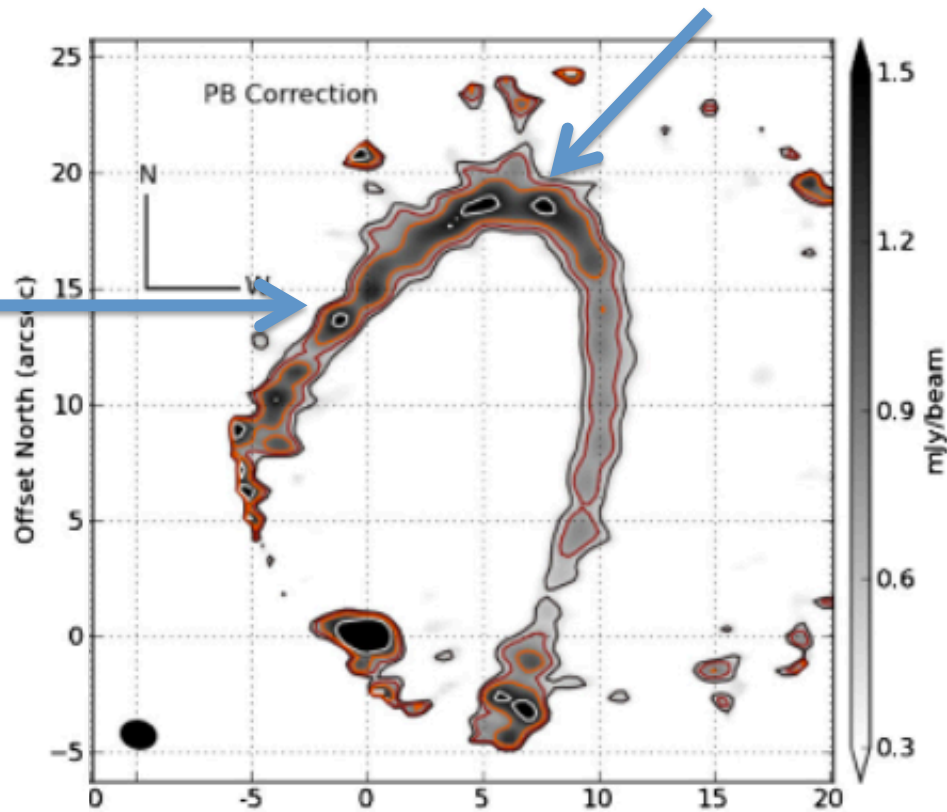
ALMA 850 microns (Boley et al. 2012)

ATCA 7 mm (Ricci et al. 2012)

Collisional Pericenter Glow

Projection effect can make the ring bright here at the ansa.

But not here at apocenter!



Fomalhaut
ALMA 850 μm
Boley et al. 2012

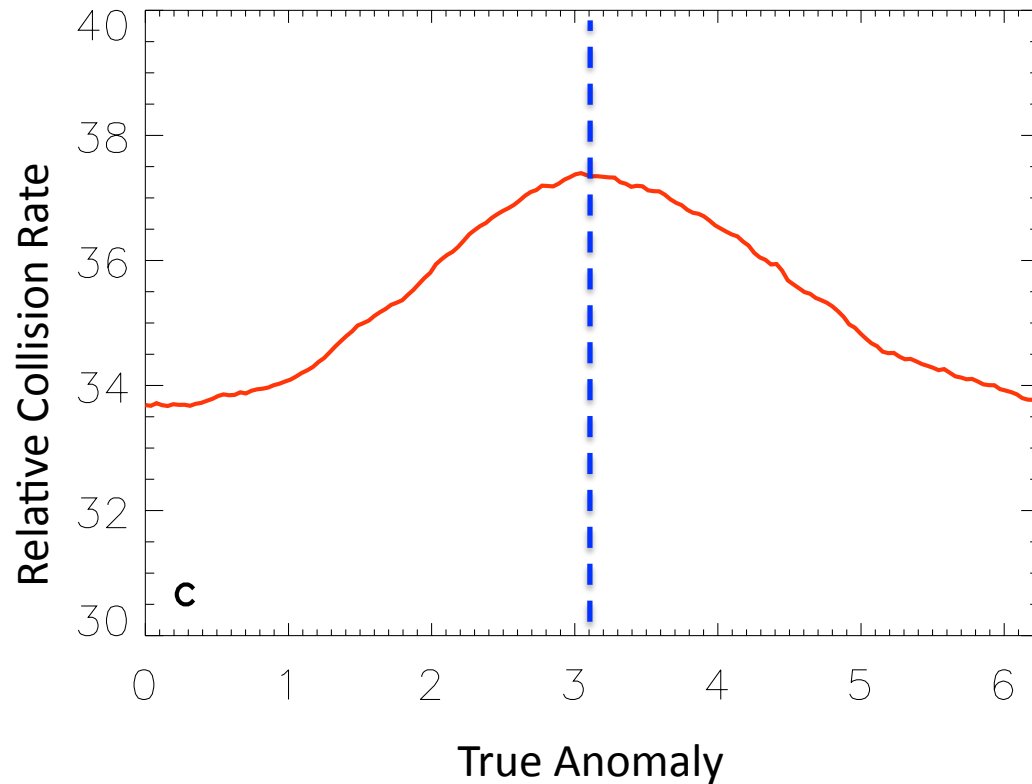
Semi-Analytic Model

Dust production rate scales with relative velocity v_{rel}

v_{rel} is constant with respect to longitude unless $\Delta e \ll 1$

Dust production rate scales with optical depth τ

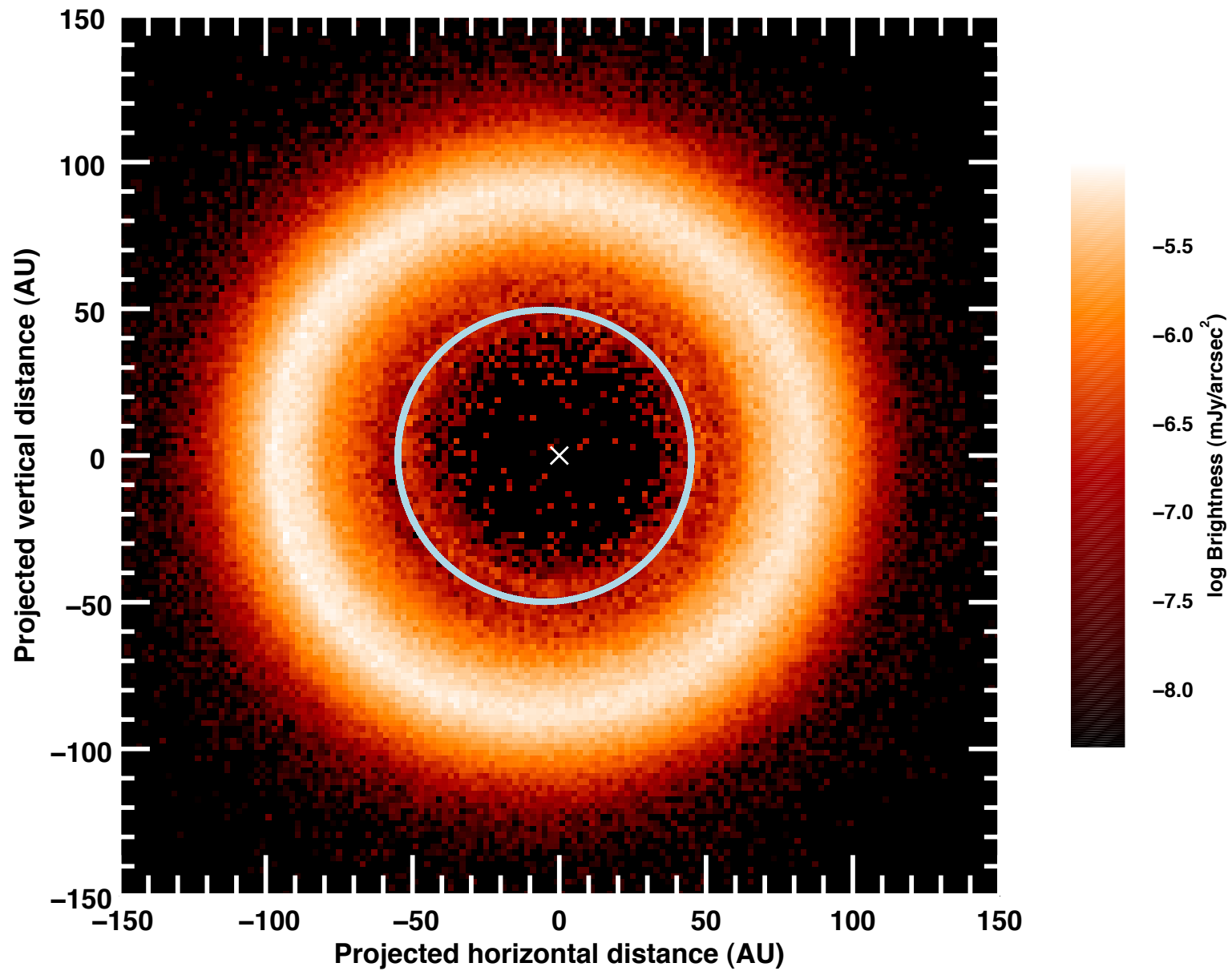
τ is inversely proportional to Δr and v_{ang}



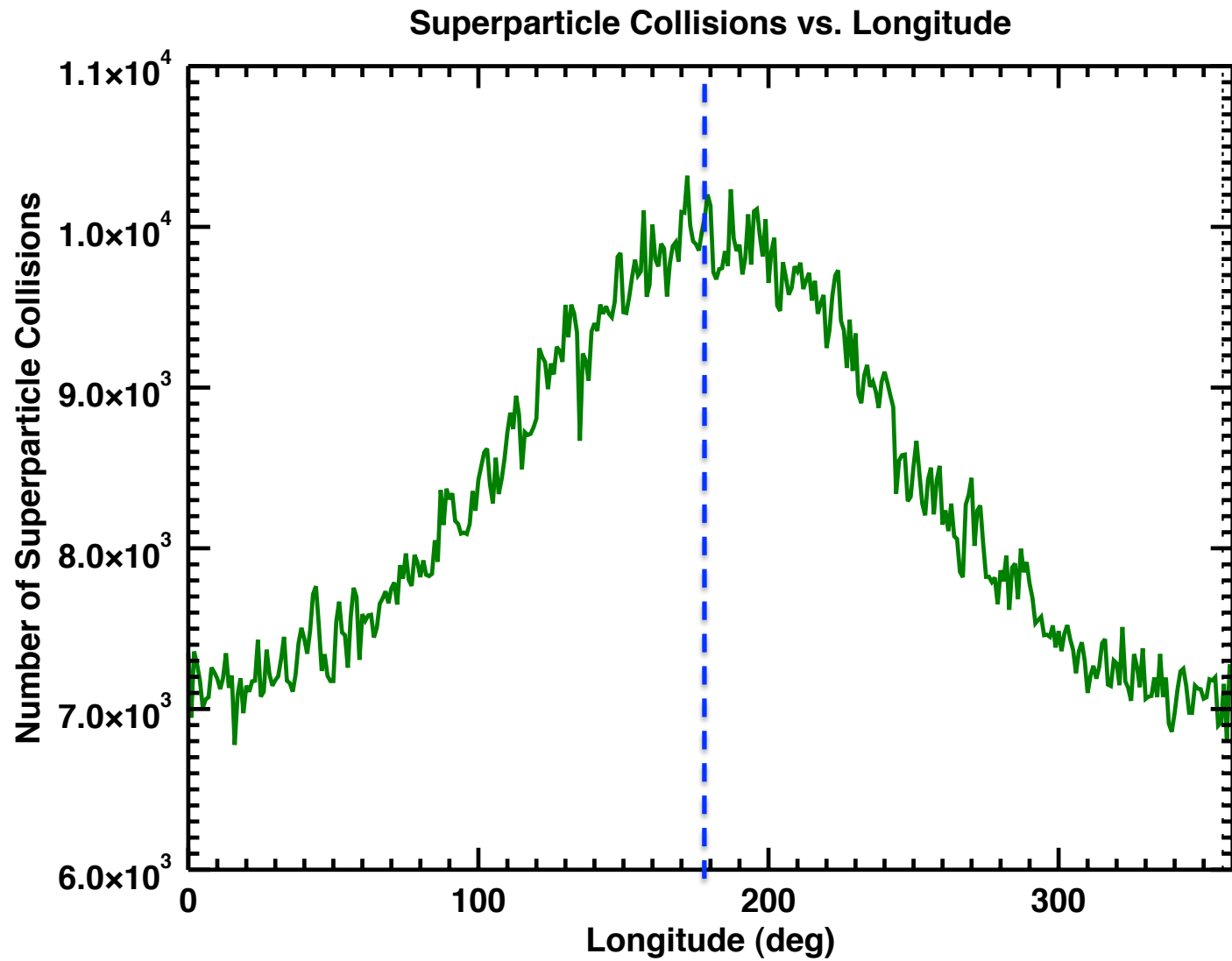
Δr is larger at **apocenter**, but
 v_{ang} is larger at **pericenter**

The affect of v_{ang} is larger, so
 τ is higher at **apocenter**

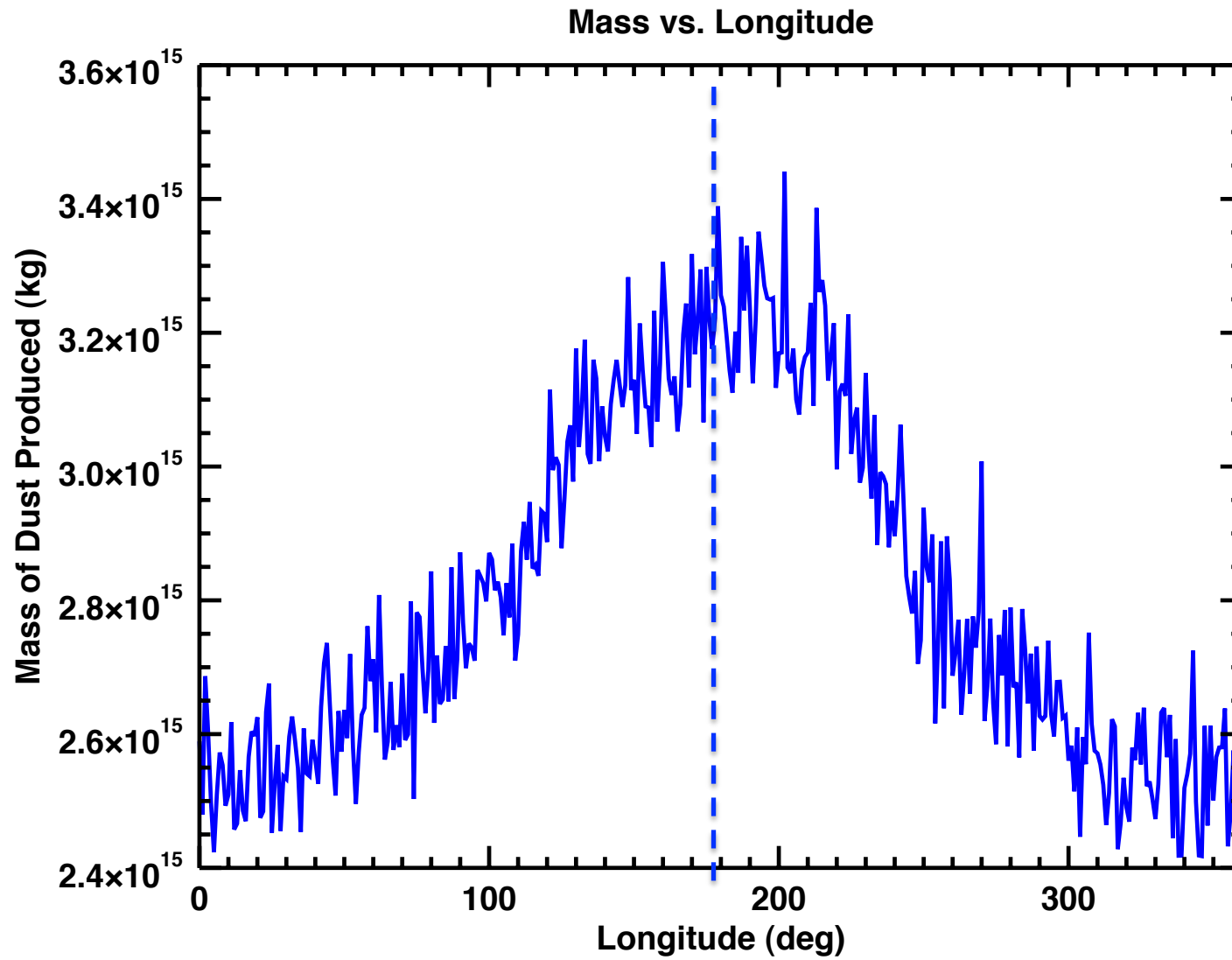
SMACK Model of a Debris Disk with an Eccentric Planet



Numeric Investigation with SMACK



Numeric Investigation with SMACK



Collisional Pericenter Glow

- Higher dust production at apocenter up to 43%
- SMACK simulations supported by semi-analytic models
- Required by long-wavelength (ALMA) observations (e.g., Fomalhaut)
- Improves constraints on planet eccentricity