Measuring the mass of the brown dwarf in the debris disk of HD 206893

David Vizgan, Wesleyan University

First things first: Special thanks to

ALMA (Atacama Large Millimeter/Submillimeter Array)

Kevin Flaherty

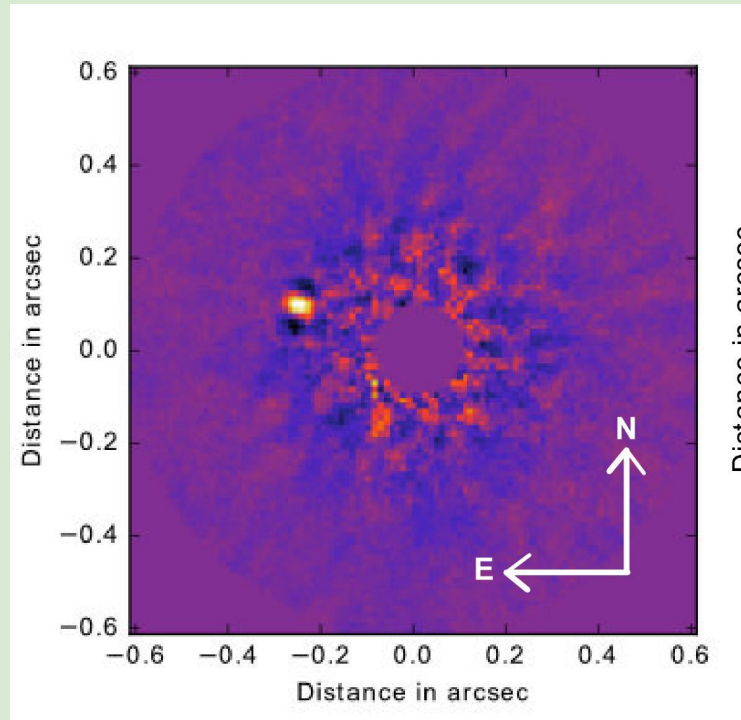**A. Meredith Hughes (my advisor)**

Second things second: what is a brown dwarf?
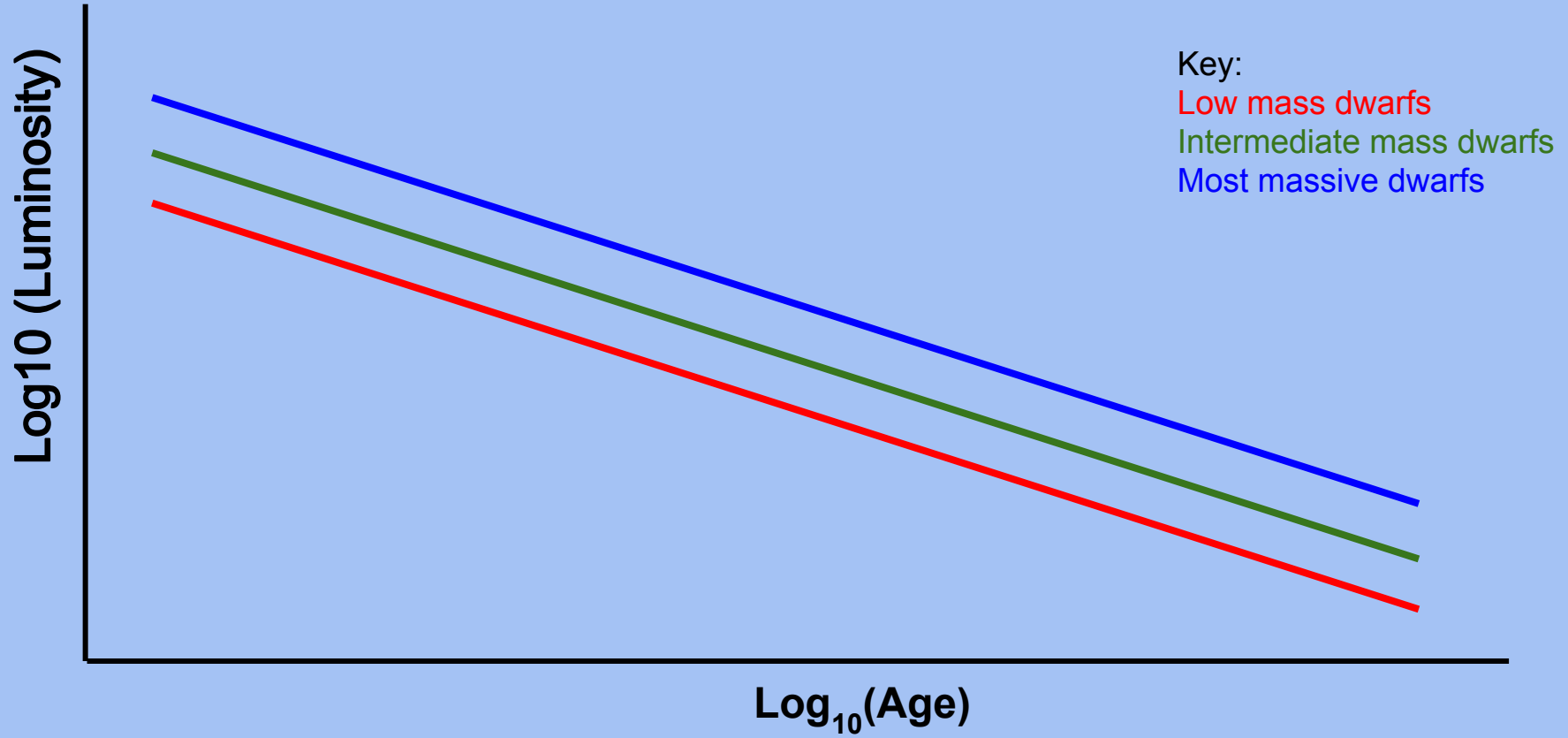
These are dwarves, but not brown dwarfs.
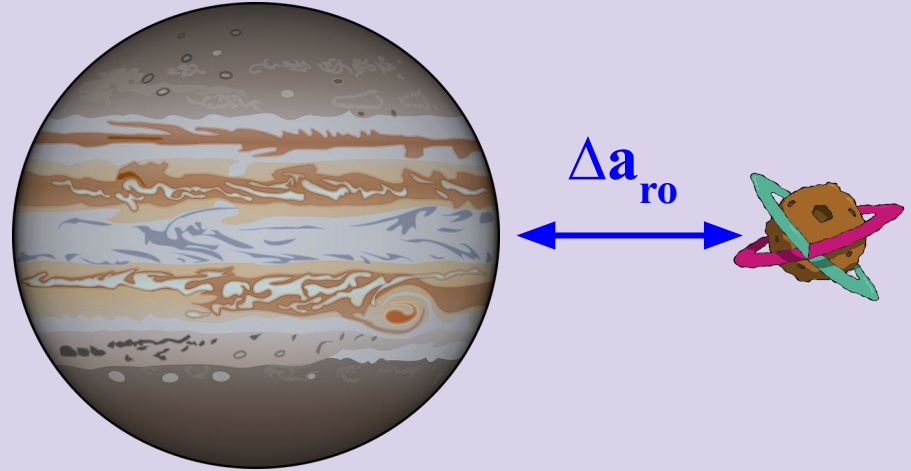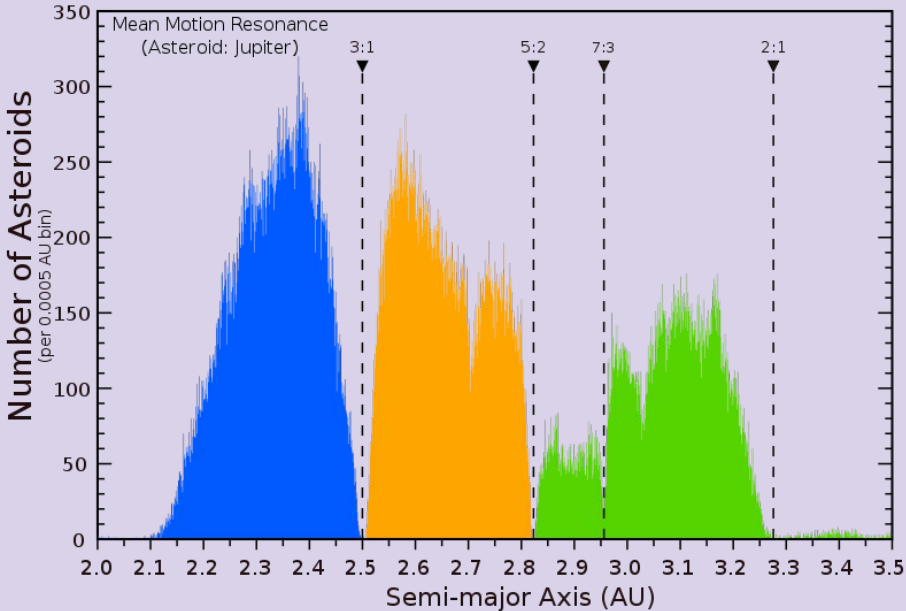
AHA! There we go.

Source: Milli et al. (2017)

How are brown dwarf masses currently calculated?

Key:
Low mass dwarfs
Intermediate mass dwarfs
Most massive dwarfs

Chaotic Zone Measurements
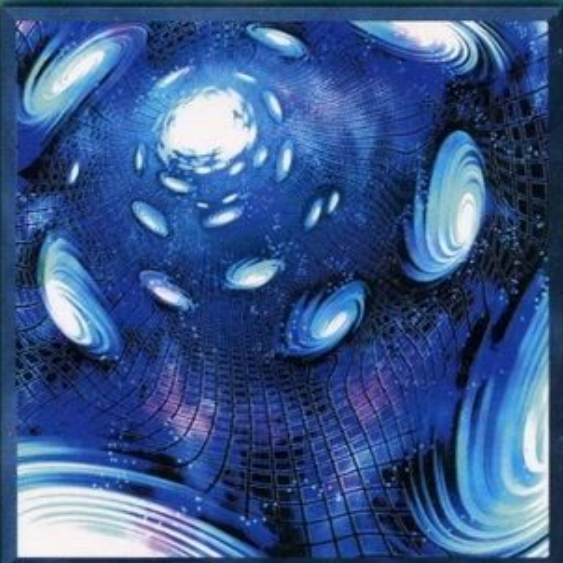
$$\Delta a_{ro} = a_p c \mu^{2/7}$$

Asteroid Main-Belt Distribution
### Kirkwood Gaps

Chaos Zone

SPELL

[SPELL CARD]

1st Edition

SDDC-EN024

Each time a monster(s) is banished, place 1 Chaos Counter on this card for each of those monsters. Once per turn: You can remove 4 or more Chaos Counters from your side of the field to target 1 banished monster with a Level equal to the number of Chaos Counters removed; Special Summon that target. When this card on the field is sent to the Graveyard by your opponent's card effect: You can add 1 LIGHT or DARK monster from your Deck to your hand, whose Level is less than or equal to the number of Chaos Counters that were on this card.
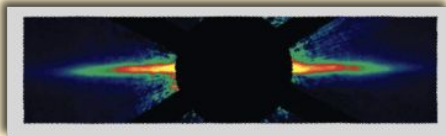
94243005

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First resolved image of the disk!
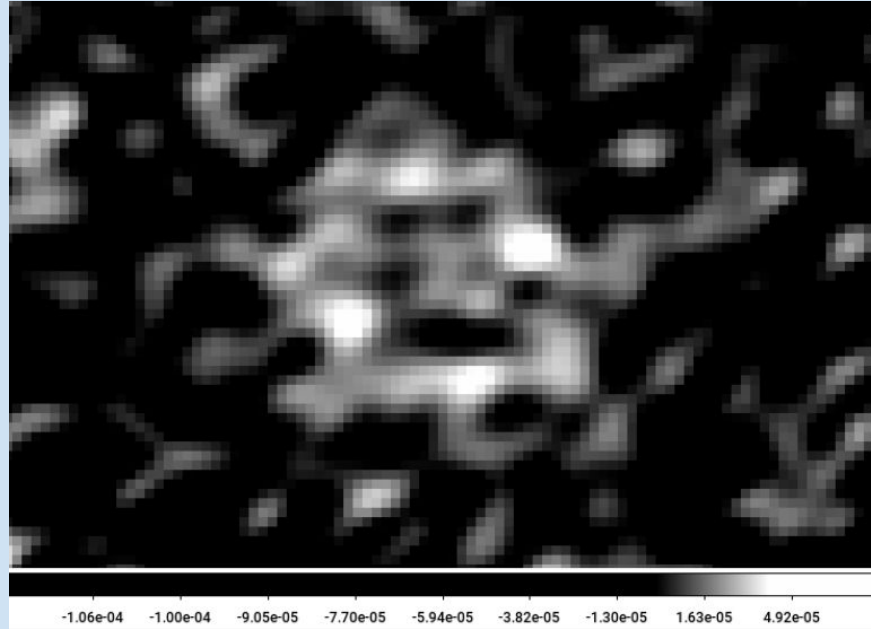
Source: ALMA (July 2017)

Debris vs. protoplanetary disks

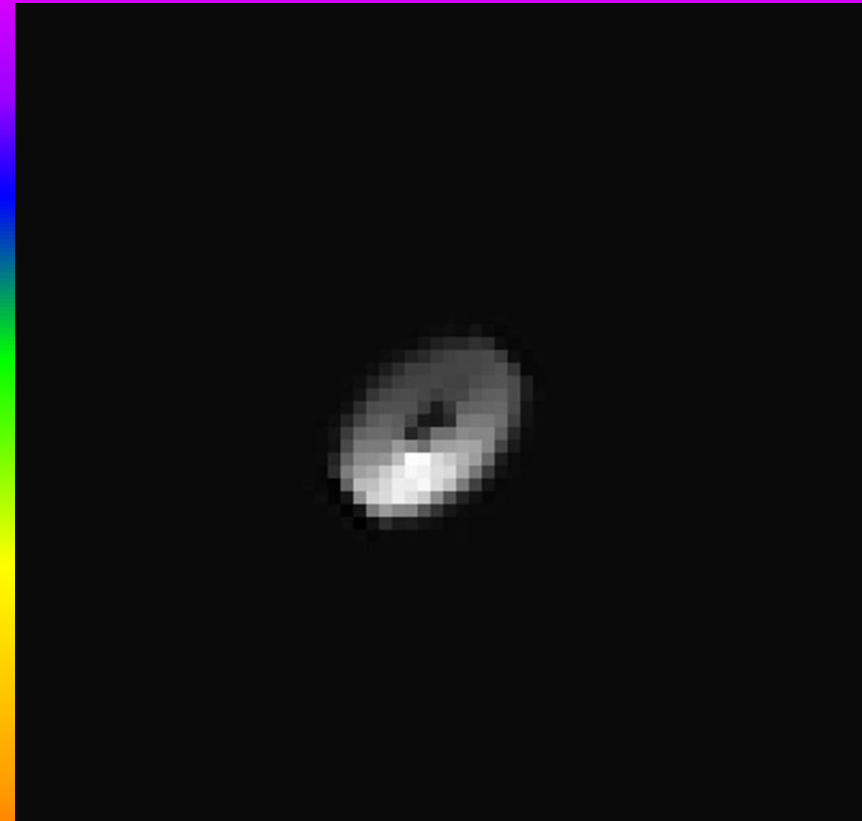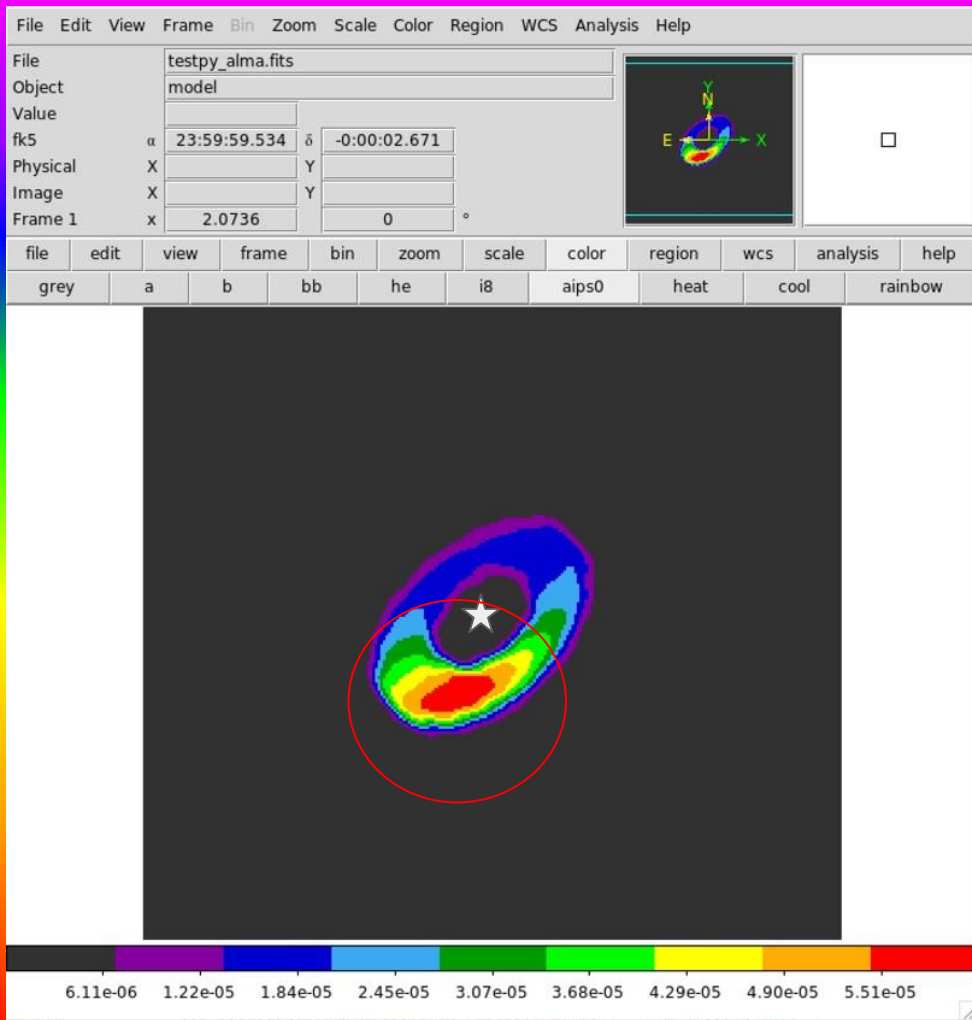| Debris disks	Protoplanetary disks
● Vertically isothermal	● Hottest on the surface
● Optically thin	● Optically thick
● Gas-poor	● Gas-rich
● Vertical density structure modelled like a Gaussian in height above and below the disk	● Vertical density structure is dependent on hydrostatic equilibrium

Some sample disks modelled this year using custom data. It looks good!

Dust density graphed as a function of distance above the midplane (100 AU)
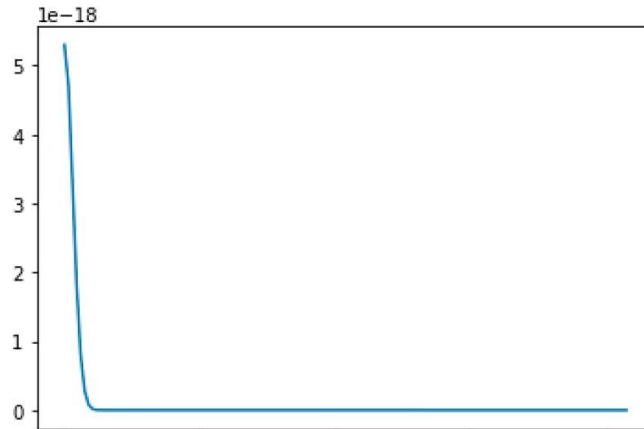
Independently graphed in Python
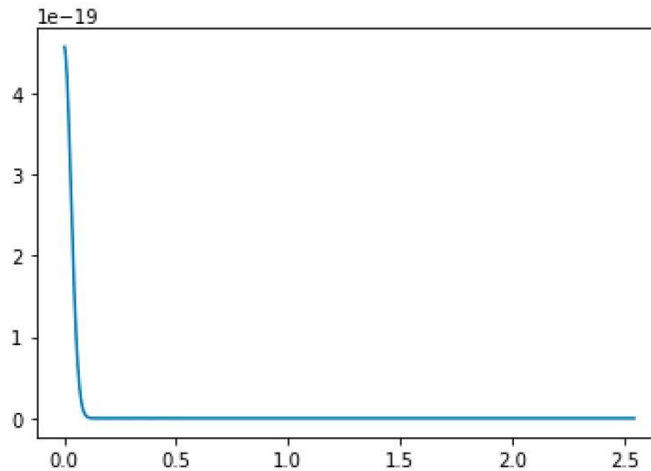
Graph generated by modelling code

Thank you so much!