# Infrared Variability of Transition Disks: Influence of a Planet?

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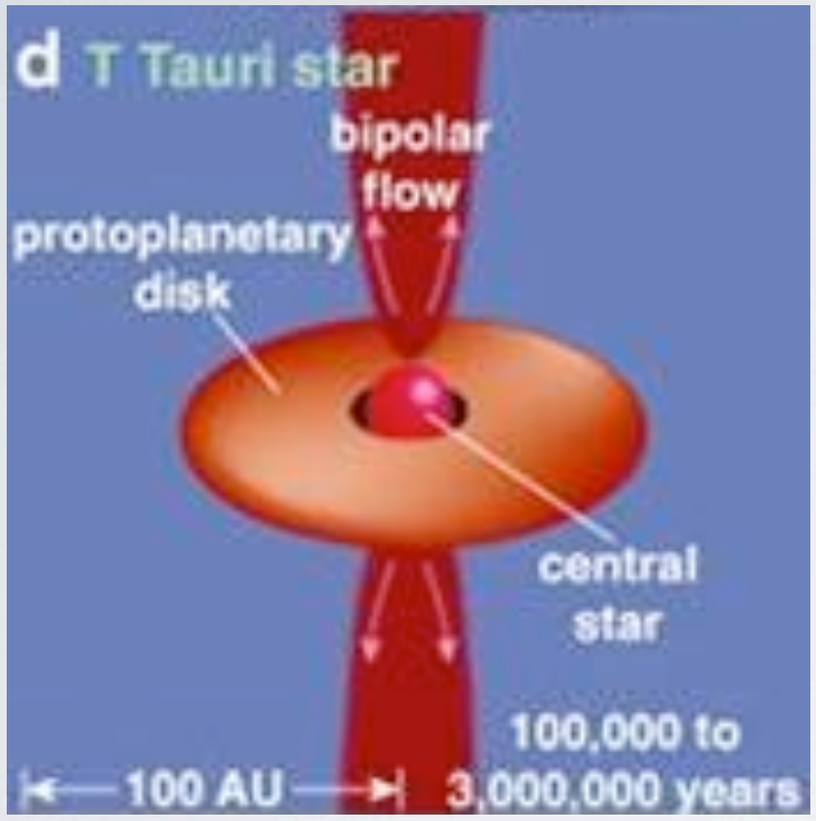
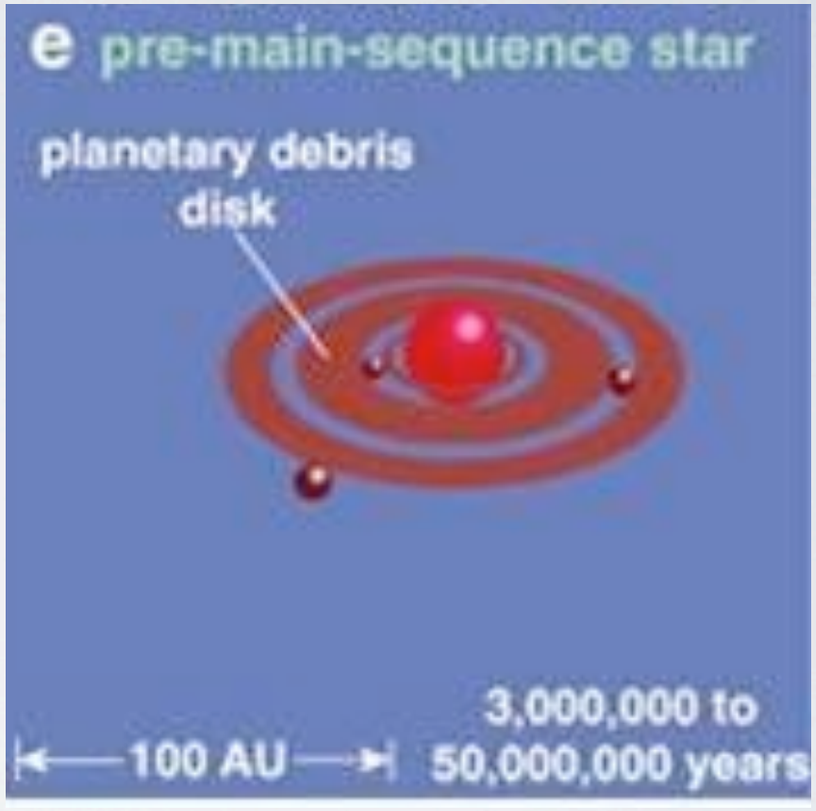
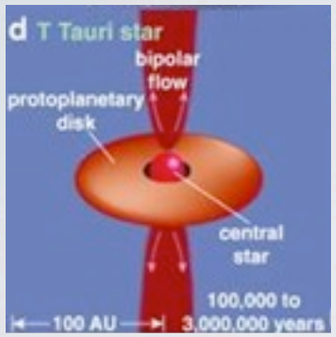
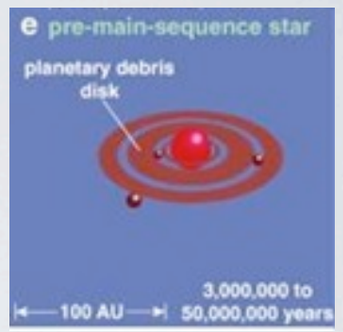
R. Gutermuth, Z. Balog, W. Herbst, S.T. Megeath, M. Kun


d T Tauri star
bipolar flow
protoplanetary disk
central star
100,000 to 3,000,000 years
100 AU

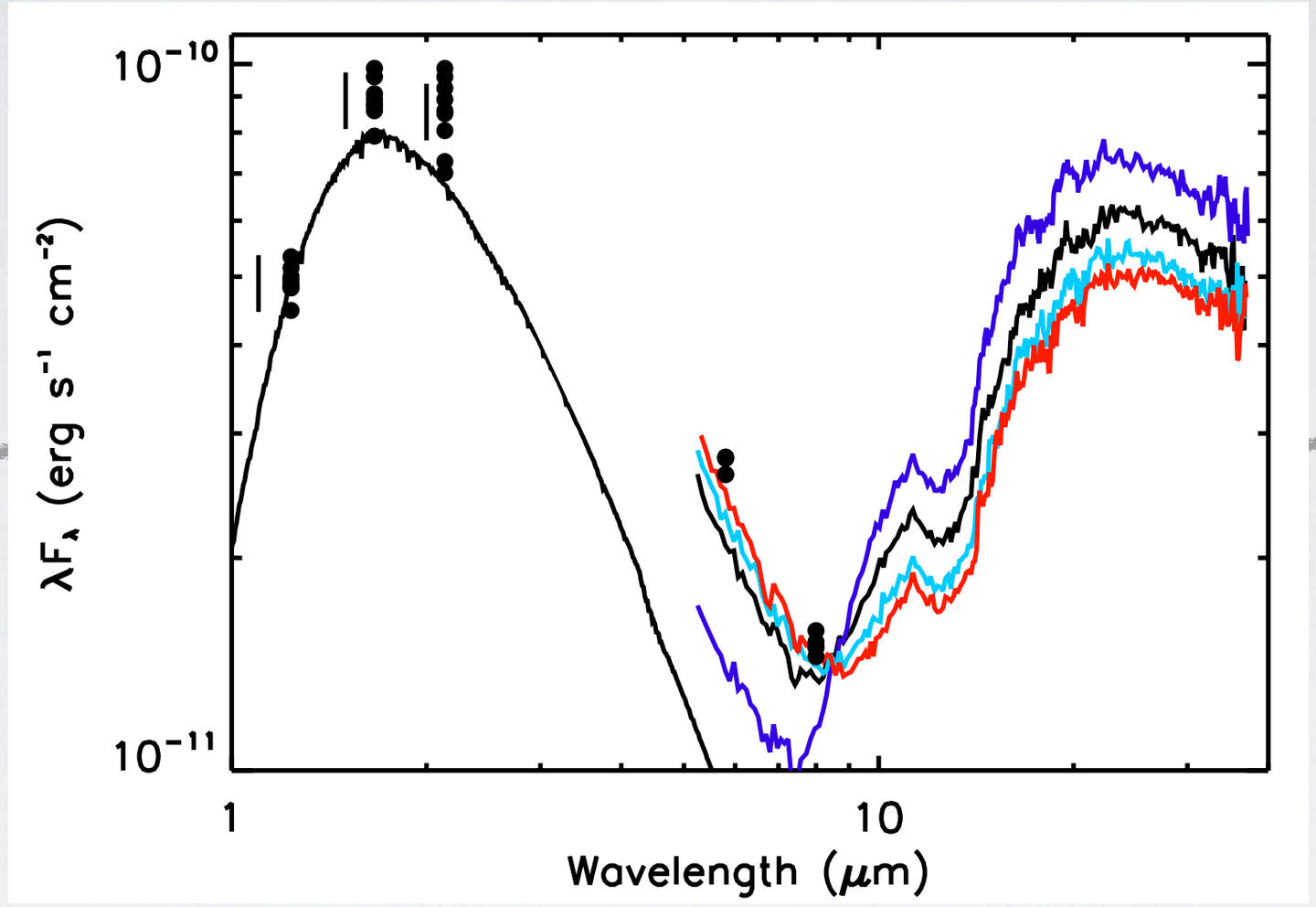

e pre-main-sequence star
planetary debris disk
3,000,000 to 50,000,000 years
100 AU

# Transition Disks



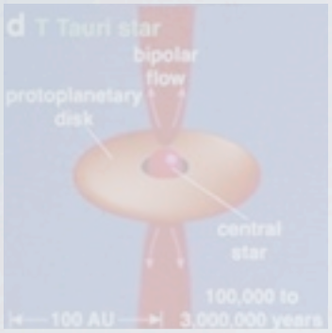



recently something unexpected has been seen...




Flaherty et al. 2011

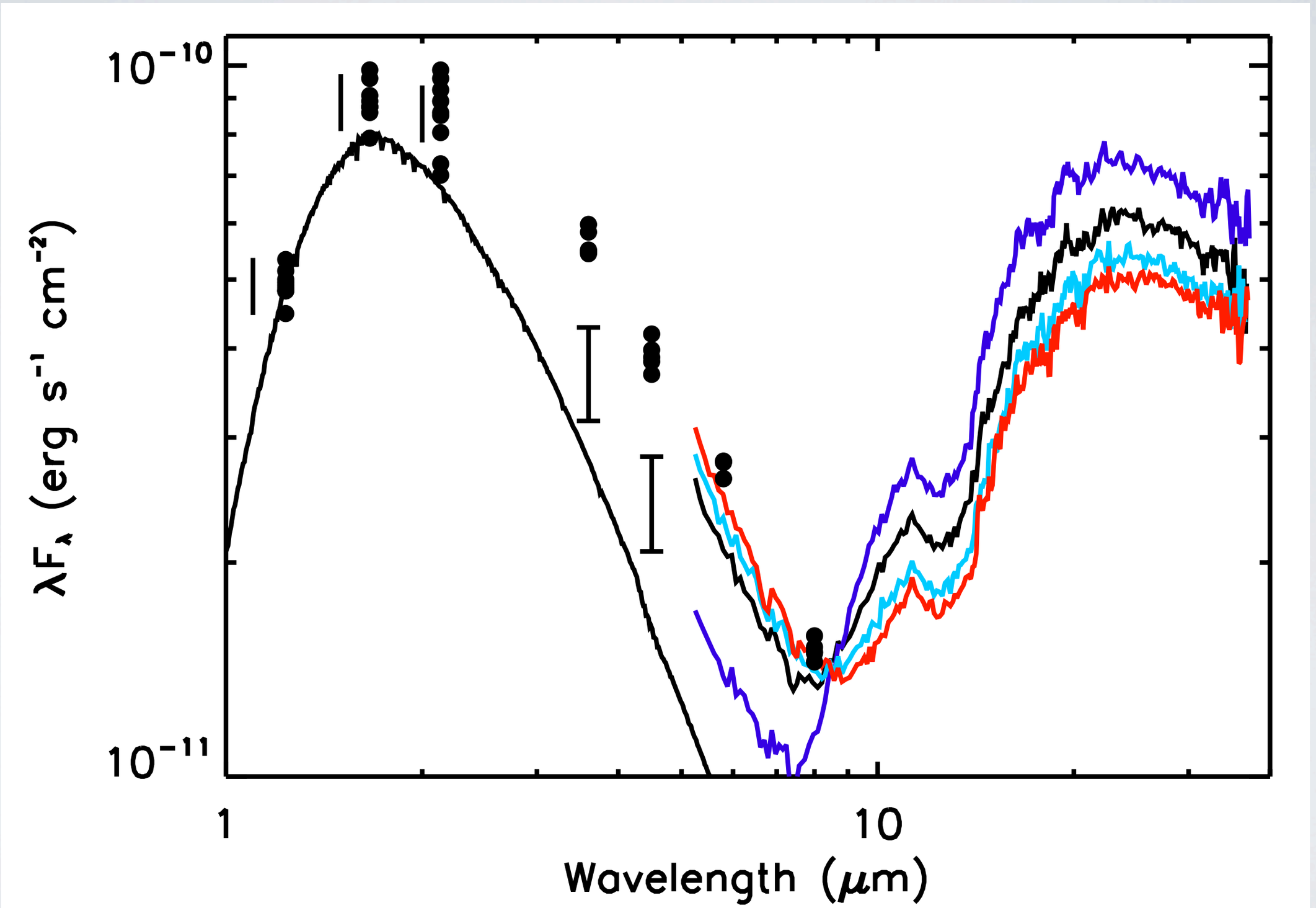
# What can multi-epoch observations of the dust teach us?



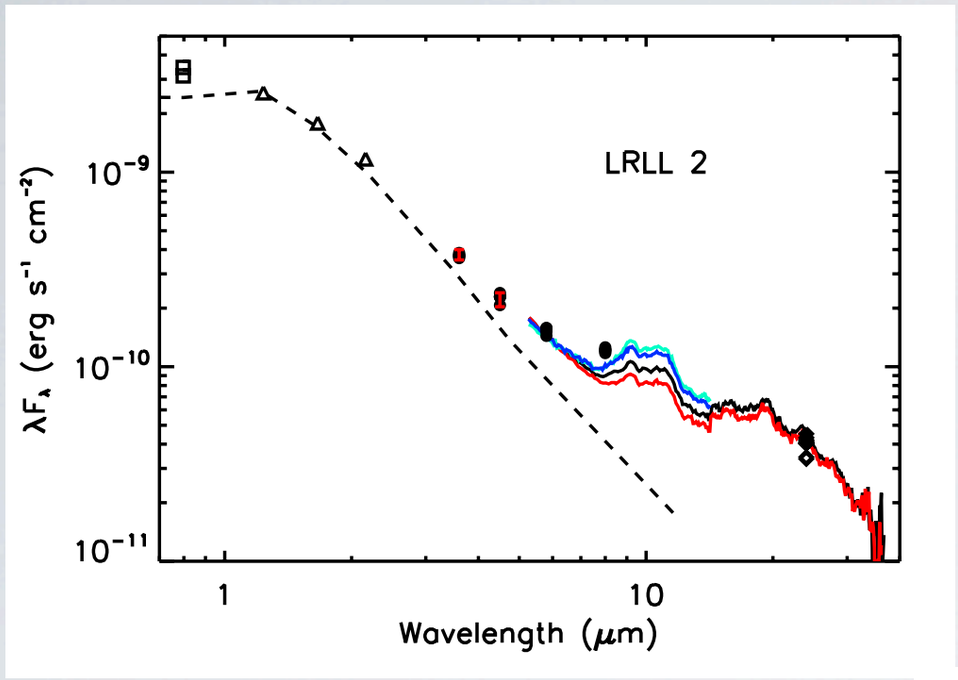

What is happening?

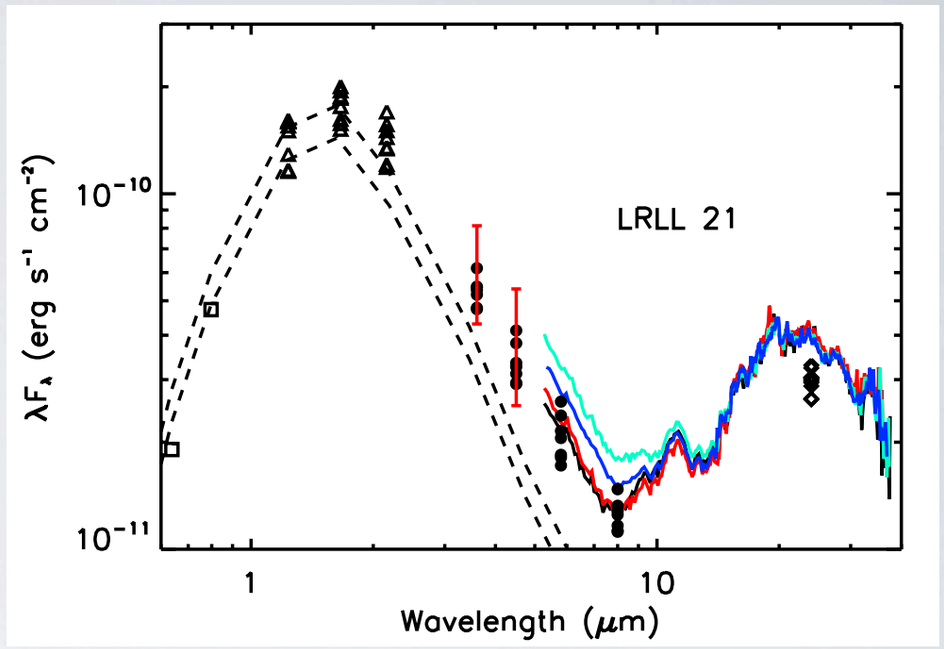
Why?

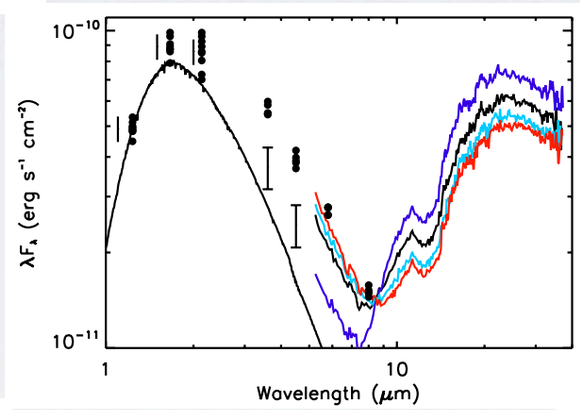
# What is happening?

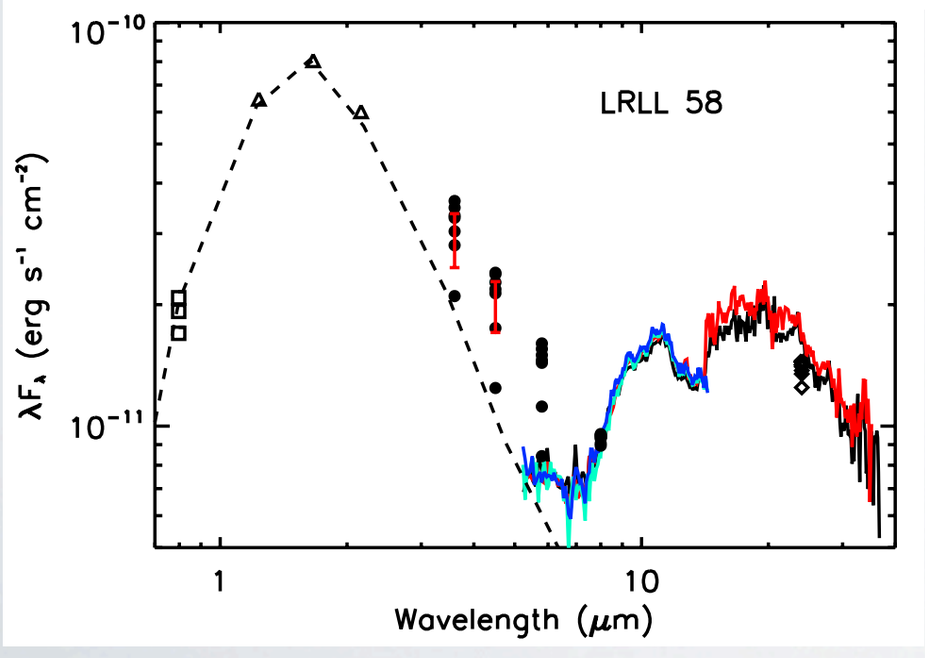



Flaherty et al. 2011

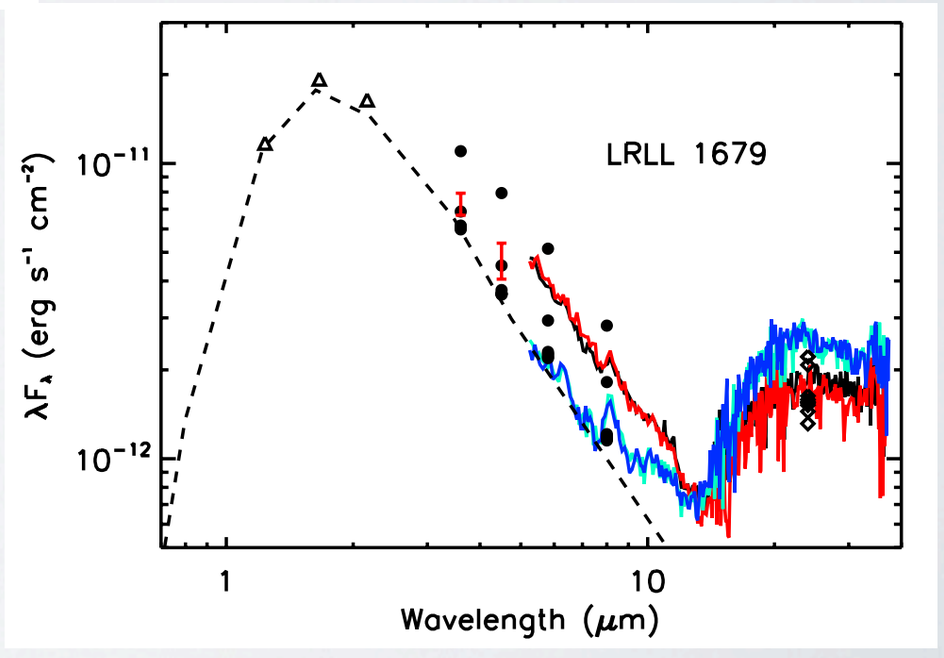


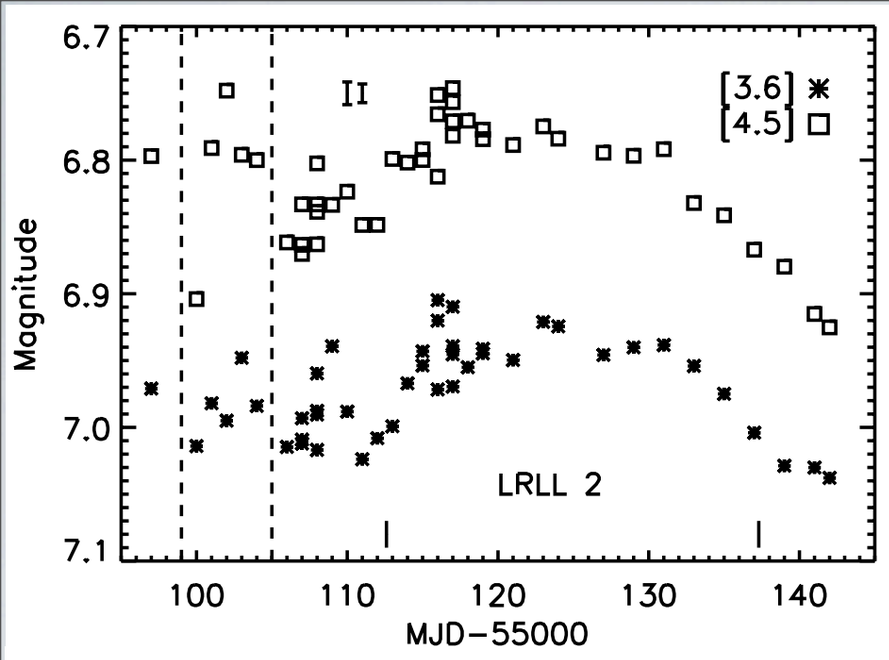



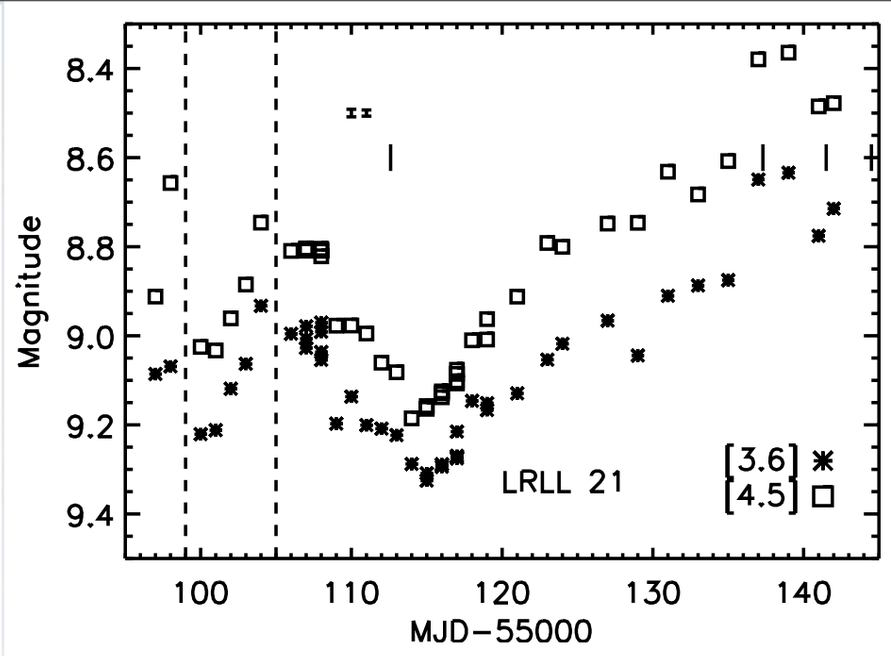



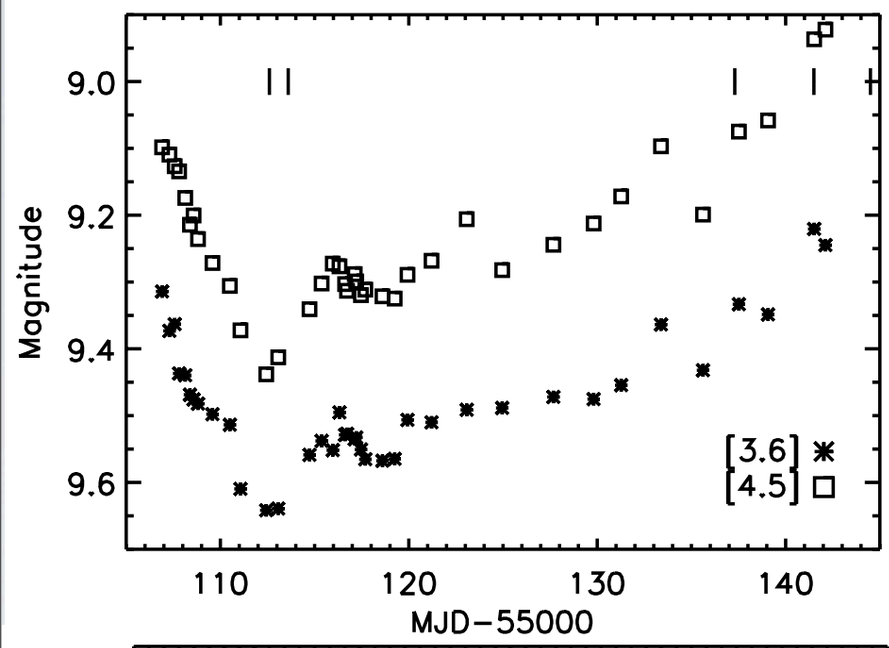



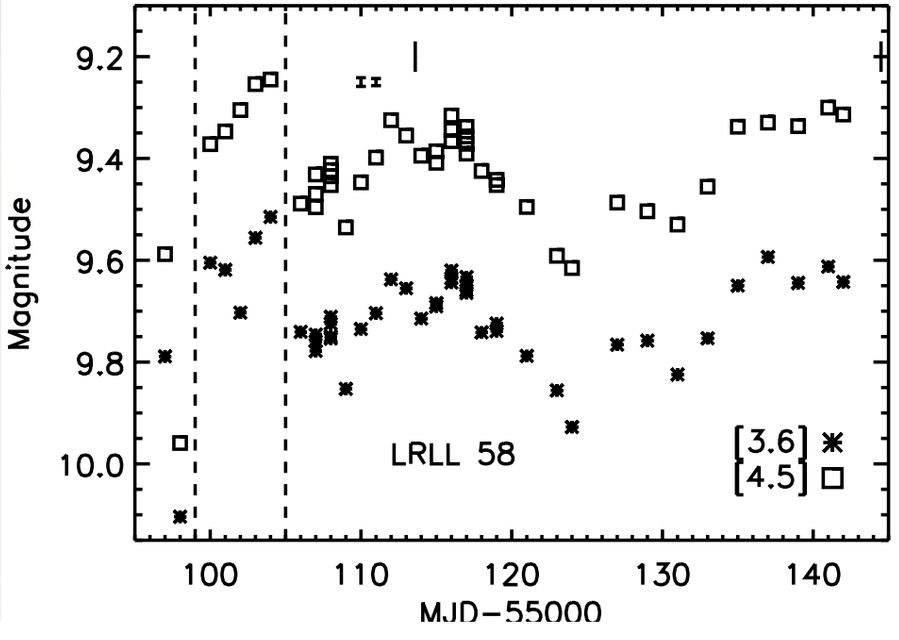

+ others (Espaillat et al. 2010)

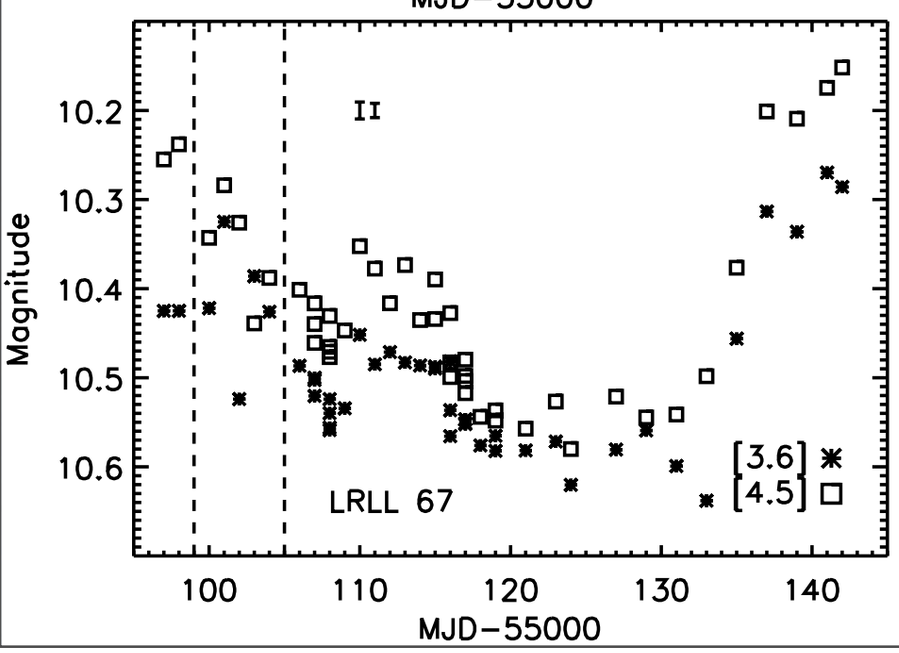


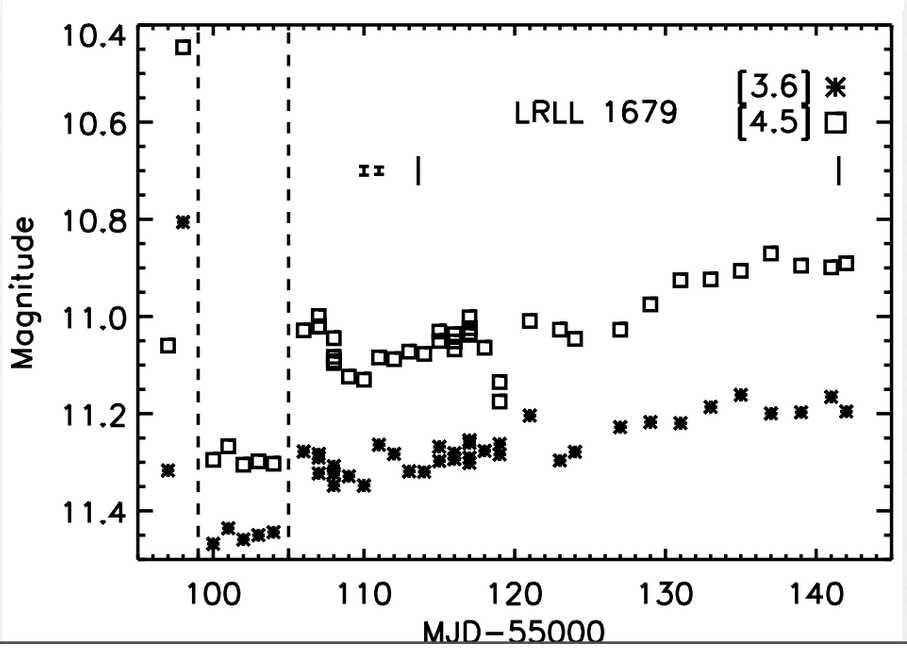


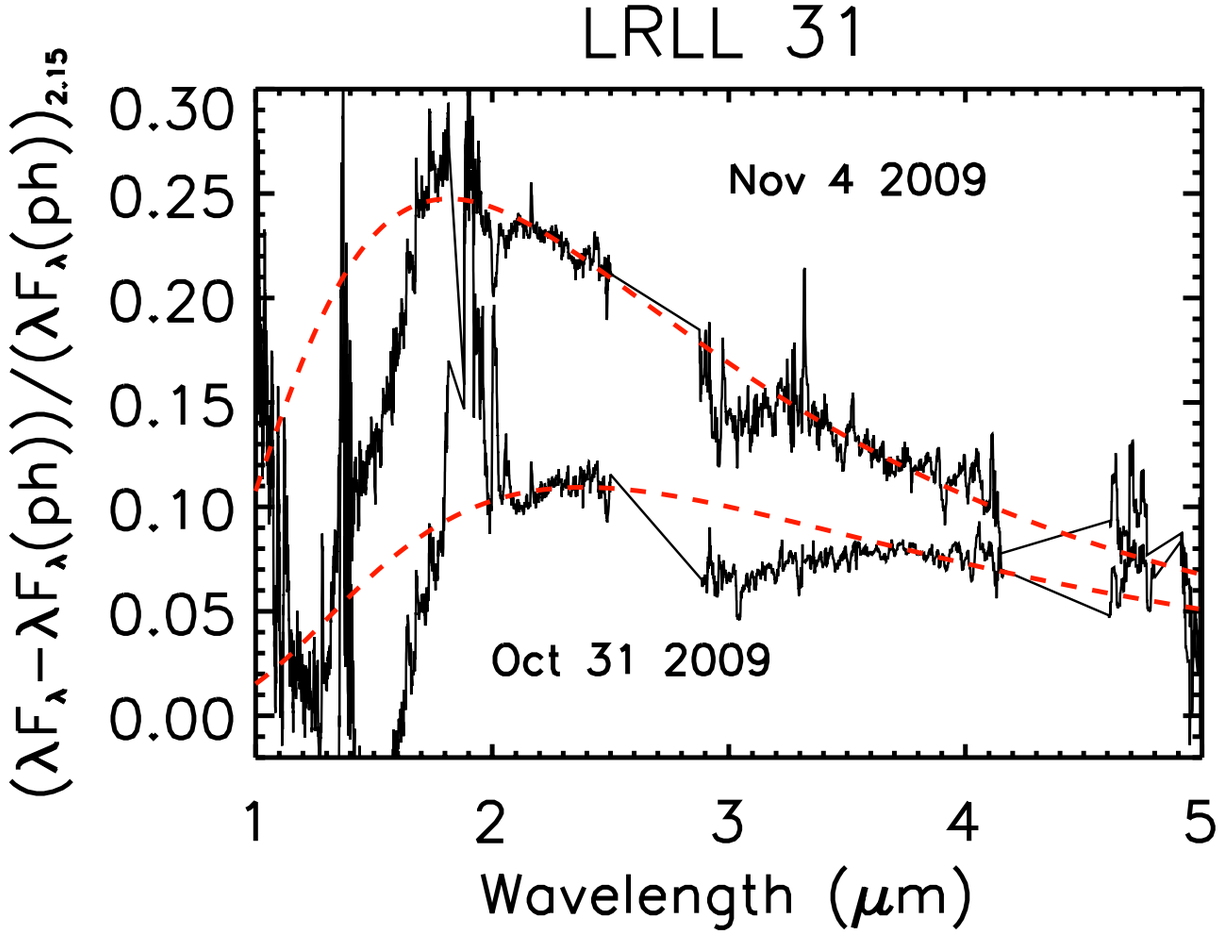



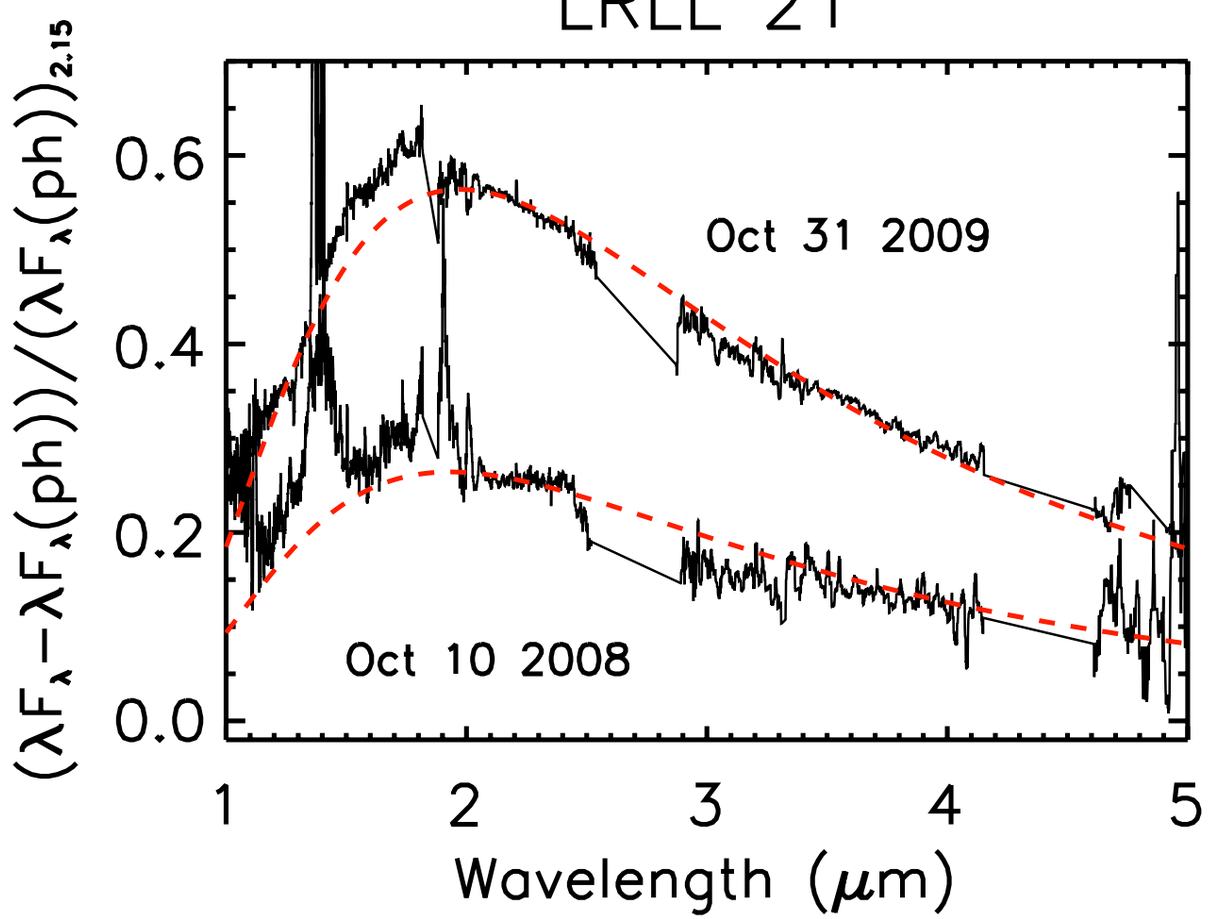




Models can explain this with scale height fluctuations of the inner disk

(Espaillat et. al 2010, Flaherty et al. 2010)




Flux changes (but temperature doesn't)

↓

emitting area is changing

↓

emitting area is proportional to radius and scale height of disk

radius of inner disk set by illuminating flux

↓

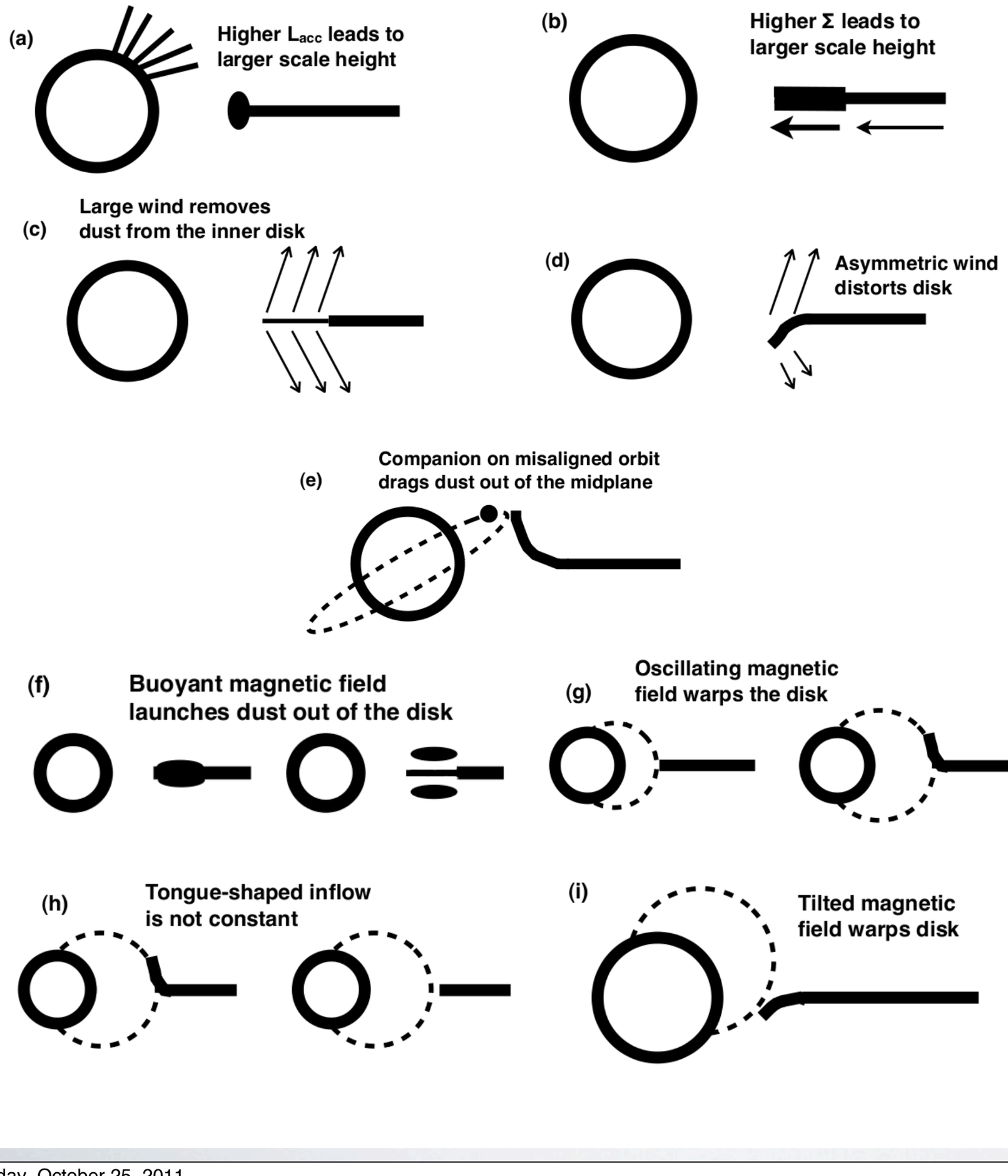
illuminating flux is constant

↓

radius is constant

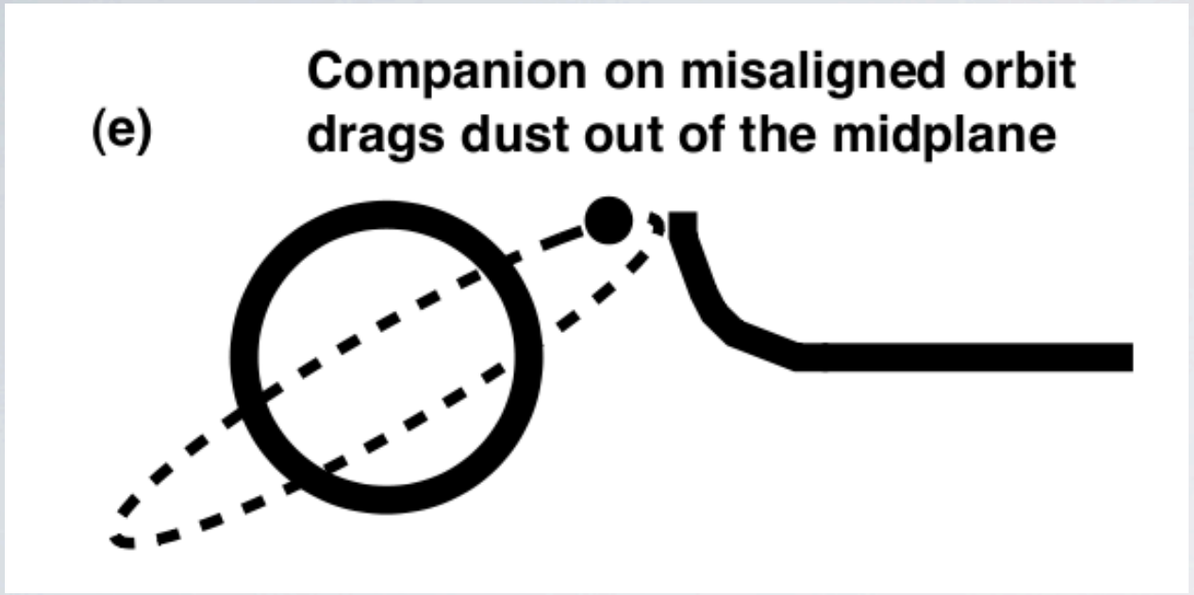
**scale height of inner disk is changing**

# Why?

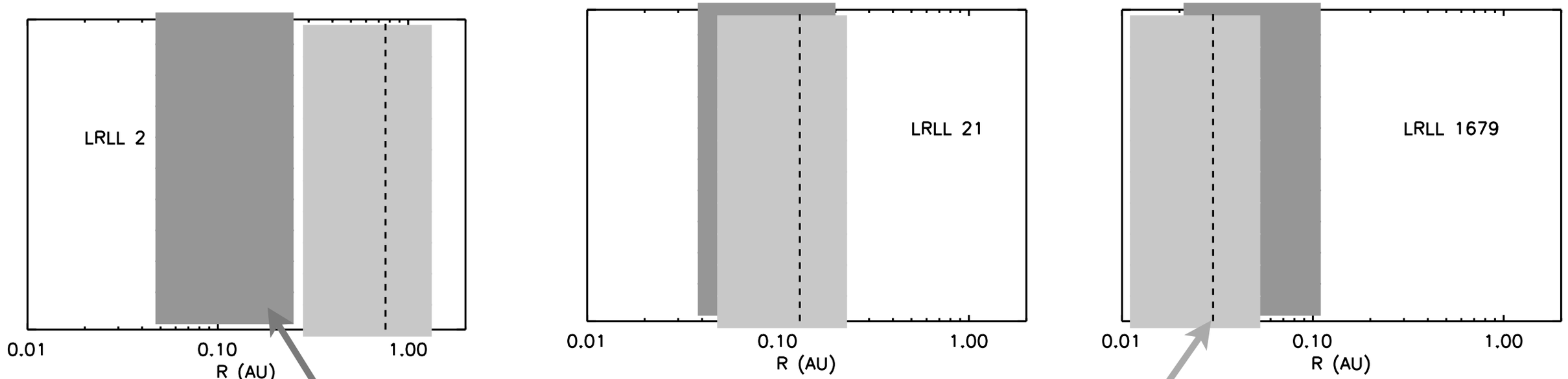



# Why?

Flaherty et al. 2011




Fragner & Nelson 2010




Flaherty et al. in prep

Lack of periodicity and presence of hot dust helps rule out a companion from some orbits

# But:

(1) dust can extend close to the companion in narrow streams and

(2) a companion may not cause periodic fluctuations

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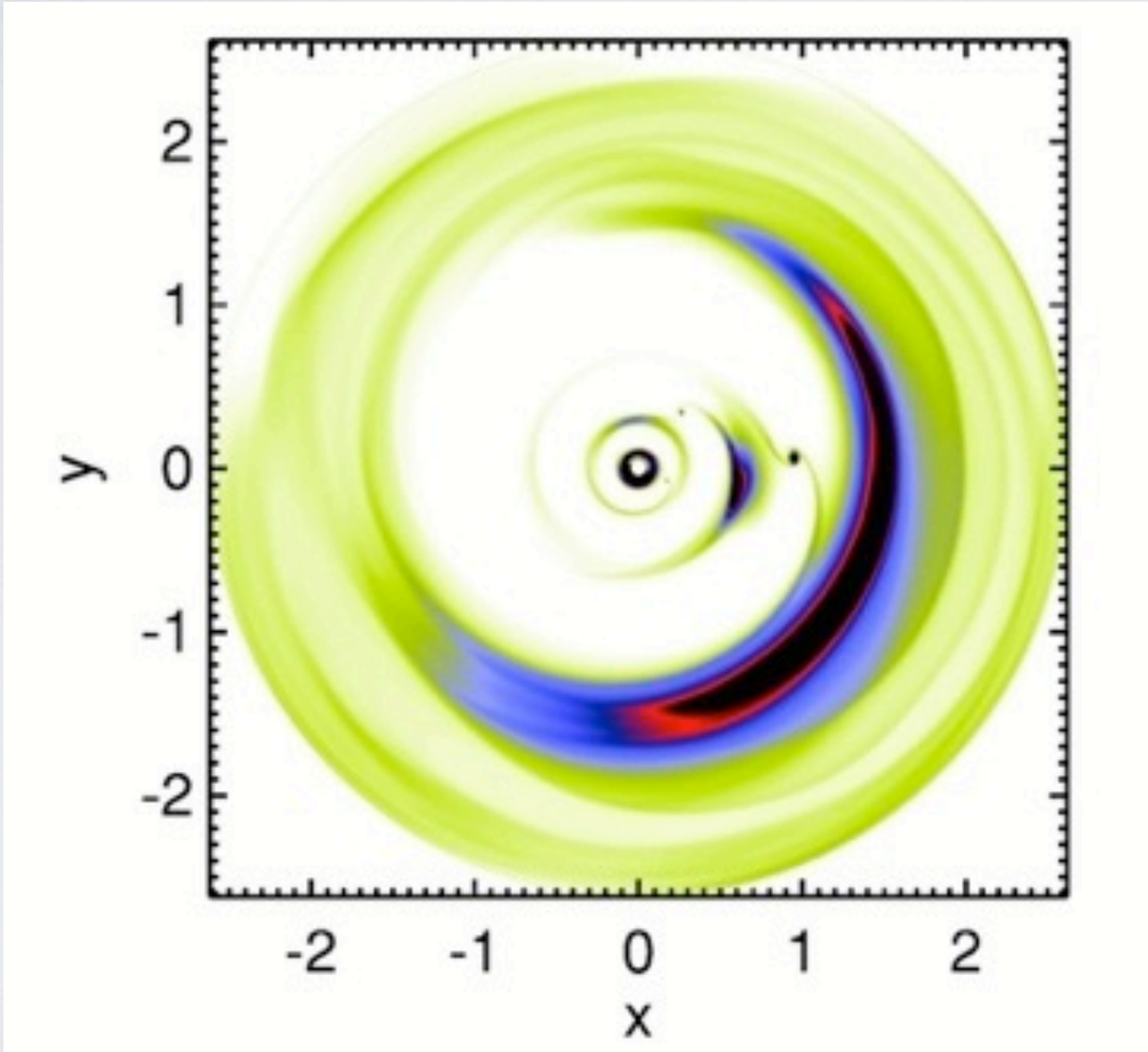
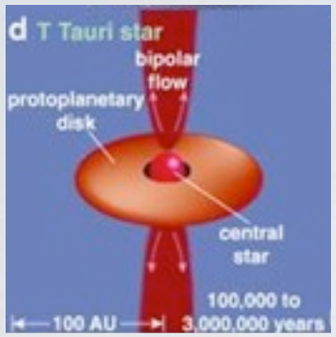



Dodson-Robinson & Salyk 2011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bipolar flow
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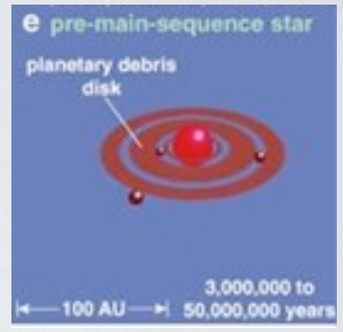
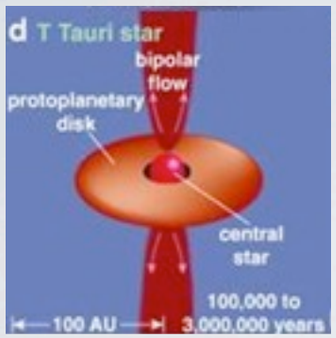
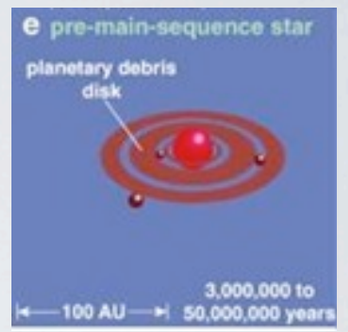

e pre-main-sequence star
planetary debris disk
100 AU
3,000,000 to 50,000,000 years

# Inner disk scale height rapidly varies

(Muzerolle et al. 2009, Espaillat et al. 2010, Flaherty et al. 2011, Flaherty et al. in prep)




# Changes in disk structure may be caused by the perturbations from a companion

(Flaherty et al. 2011, Flaherty et al. in prep)