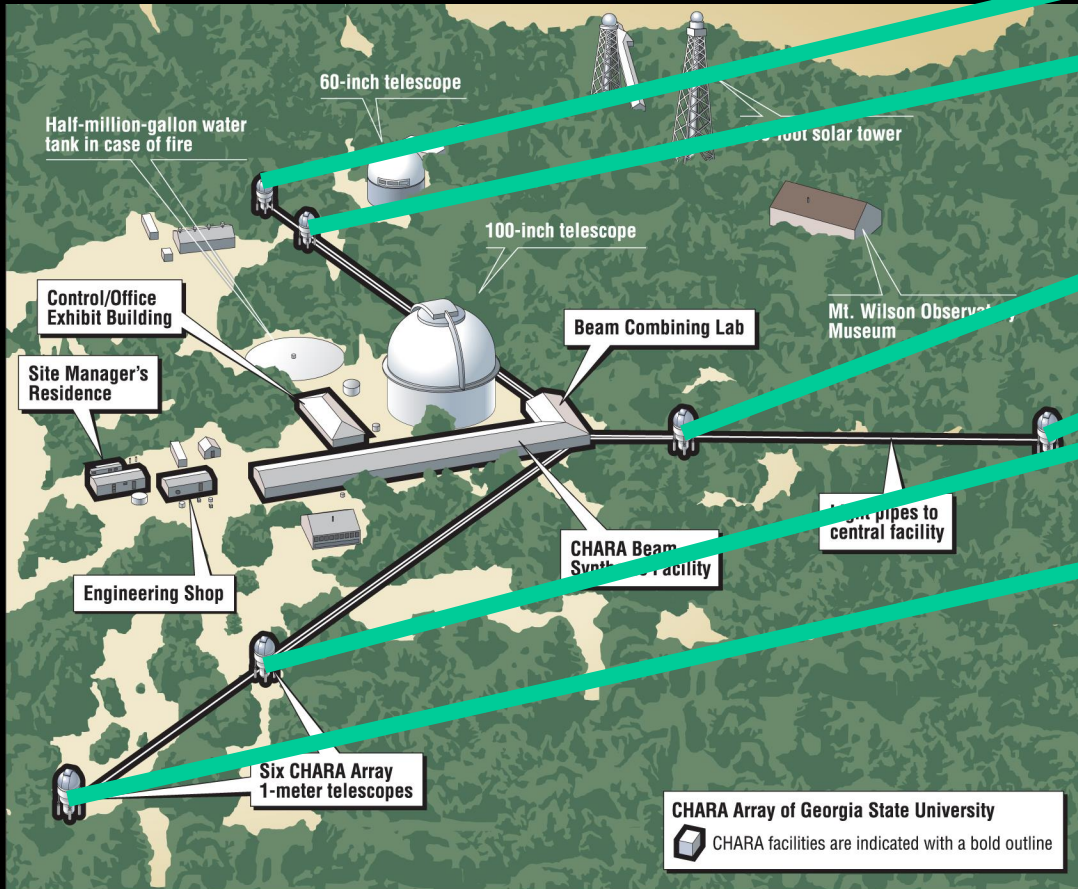




# Ages of Stars

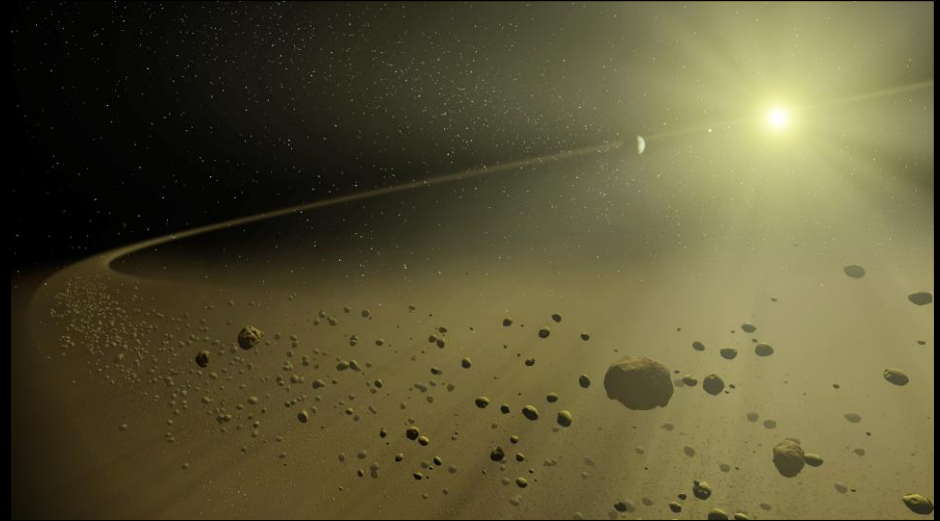


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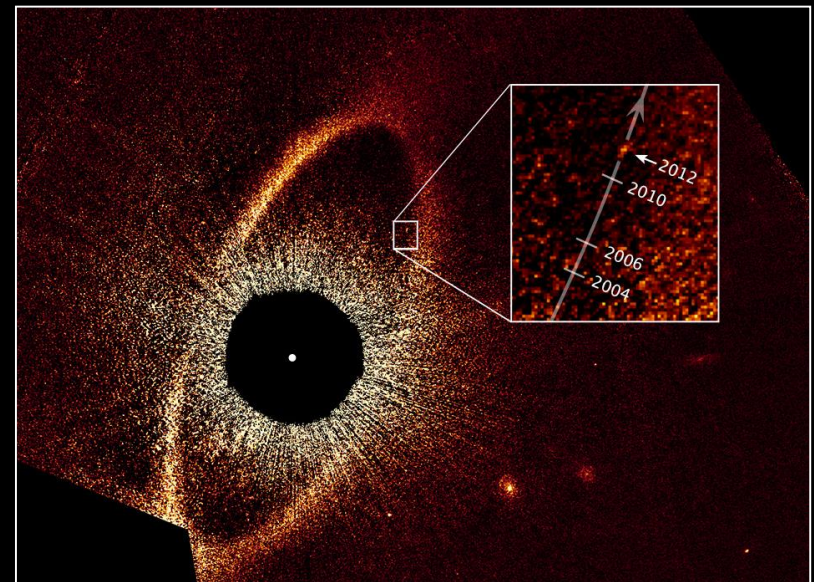
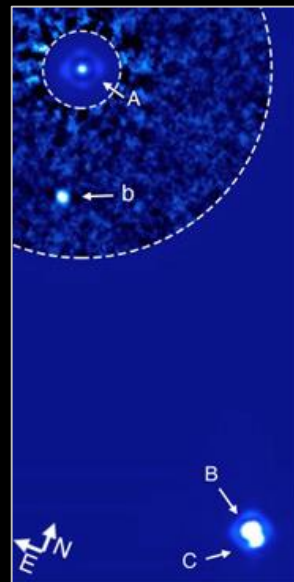
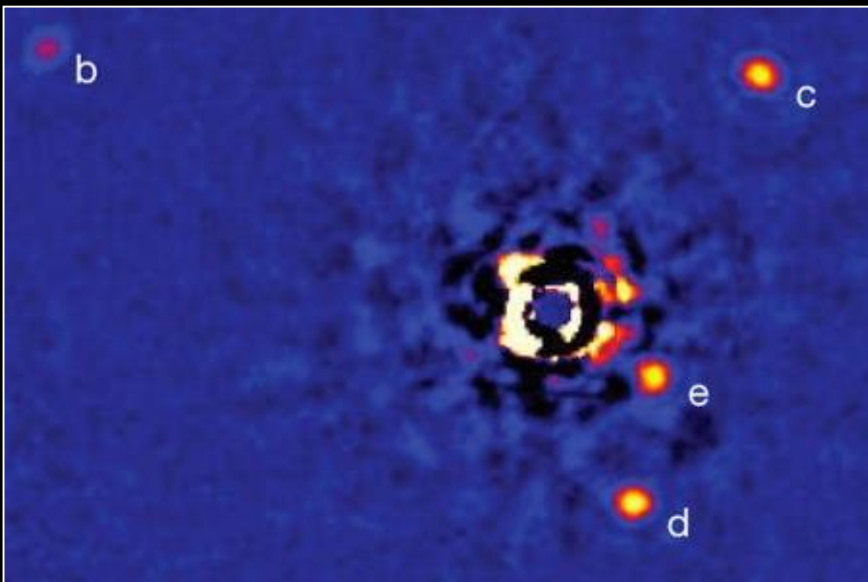


# Ages of Stars: Who Cares?

## Planet/Disk Formation & Evolution

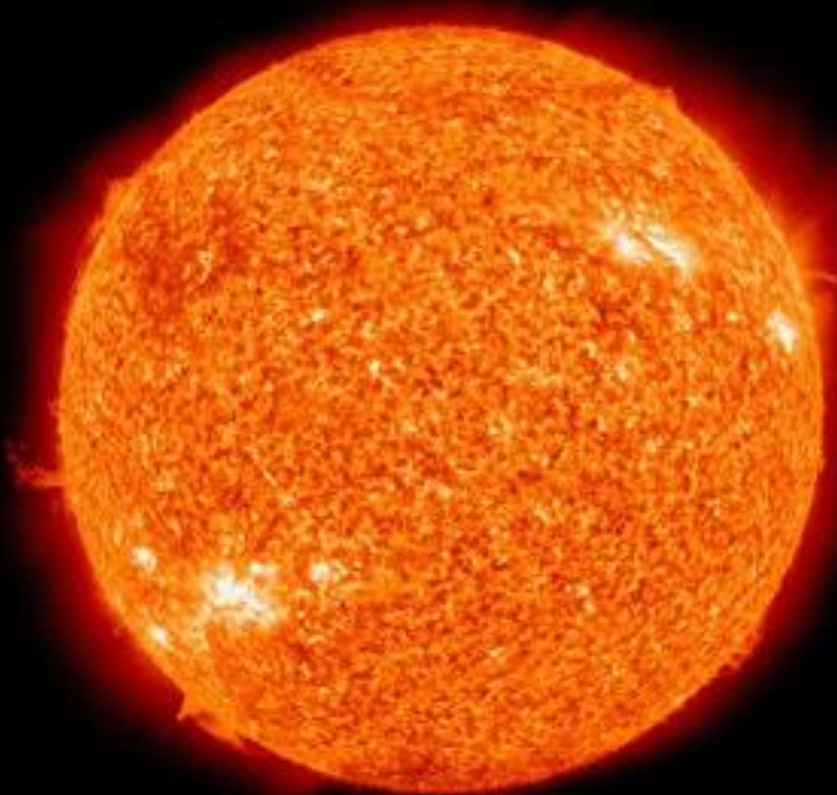


## Directly Imaged Planet Masses





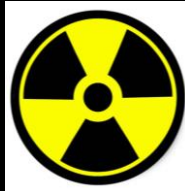
# Methods for Estimating Ages



## Ideal Criteria for Ages

- Model-Independent
- Highly Precise
- Absolute Ages

## Only One Method

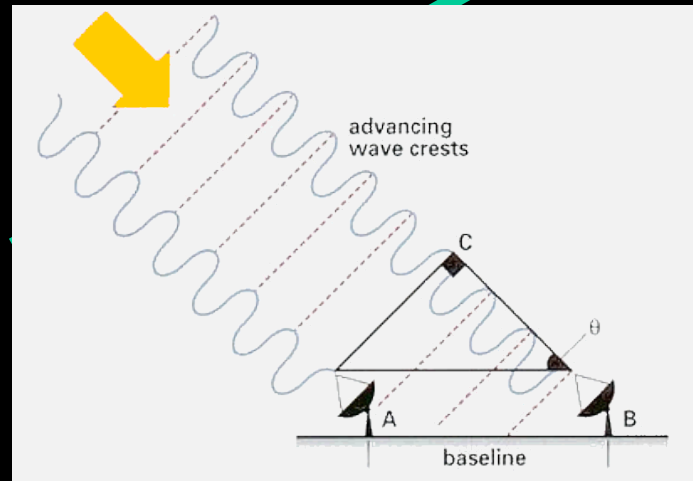
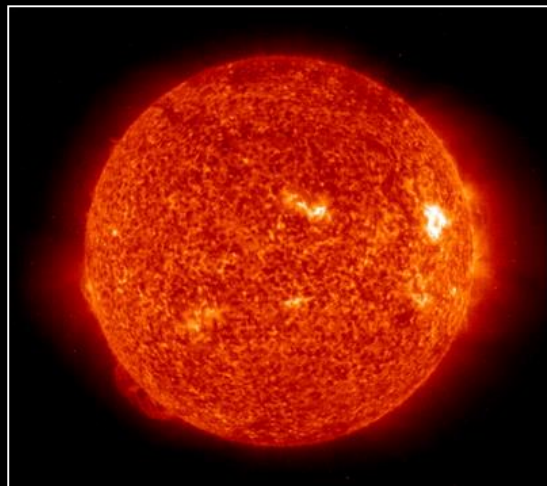
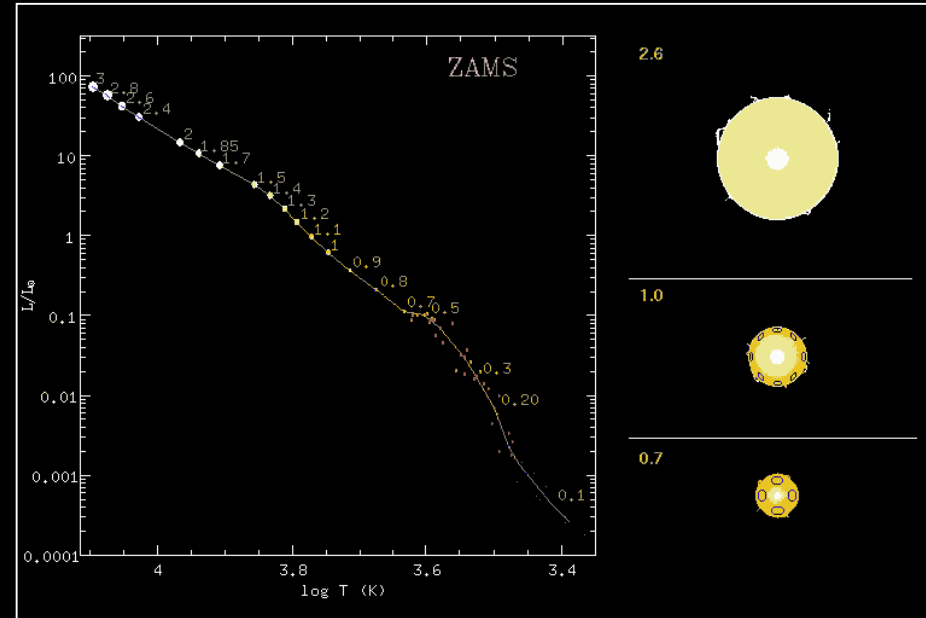


# Methods for Estimating Ages

## Indicators of Youth (not Ages)



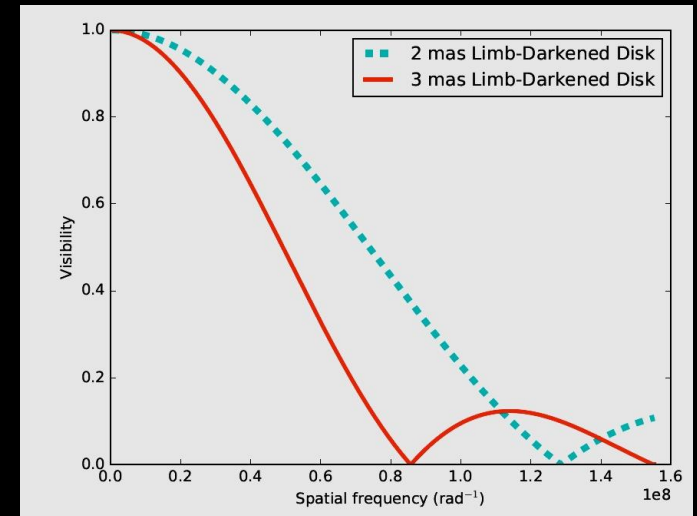
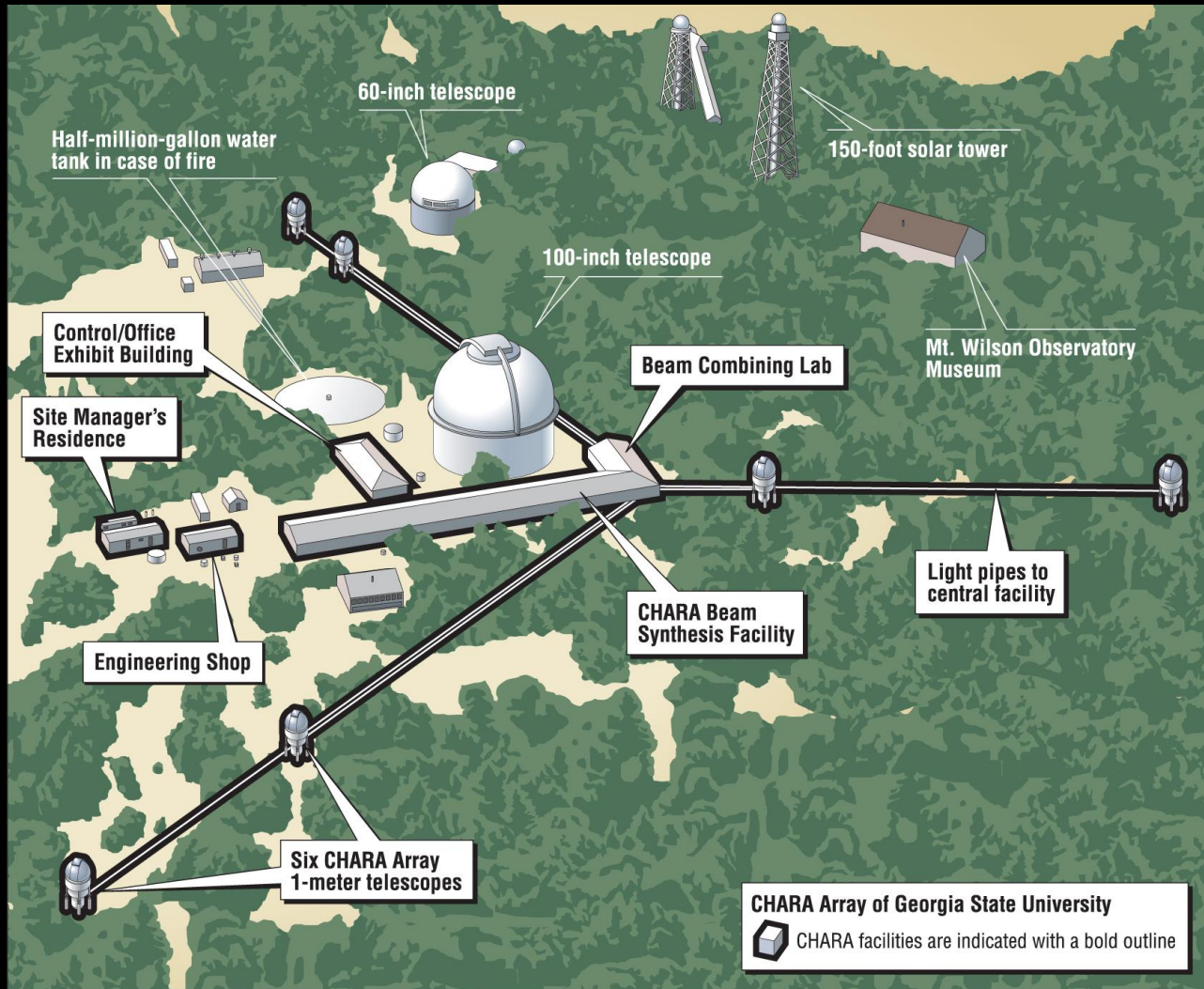
## Ages with Evolution Models





# What CHARA Brings to the Table

## Angular Diameters



With Additional Data:

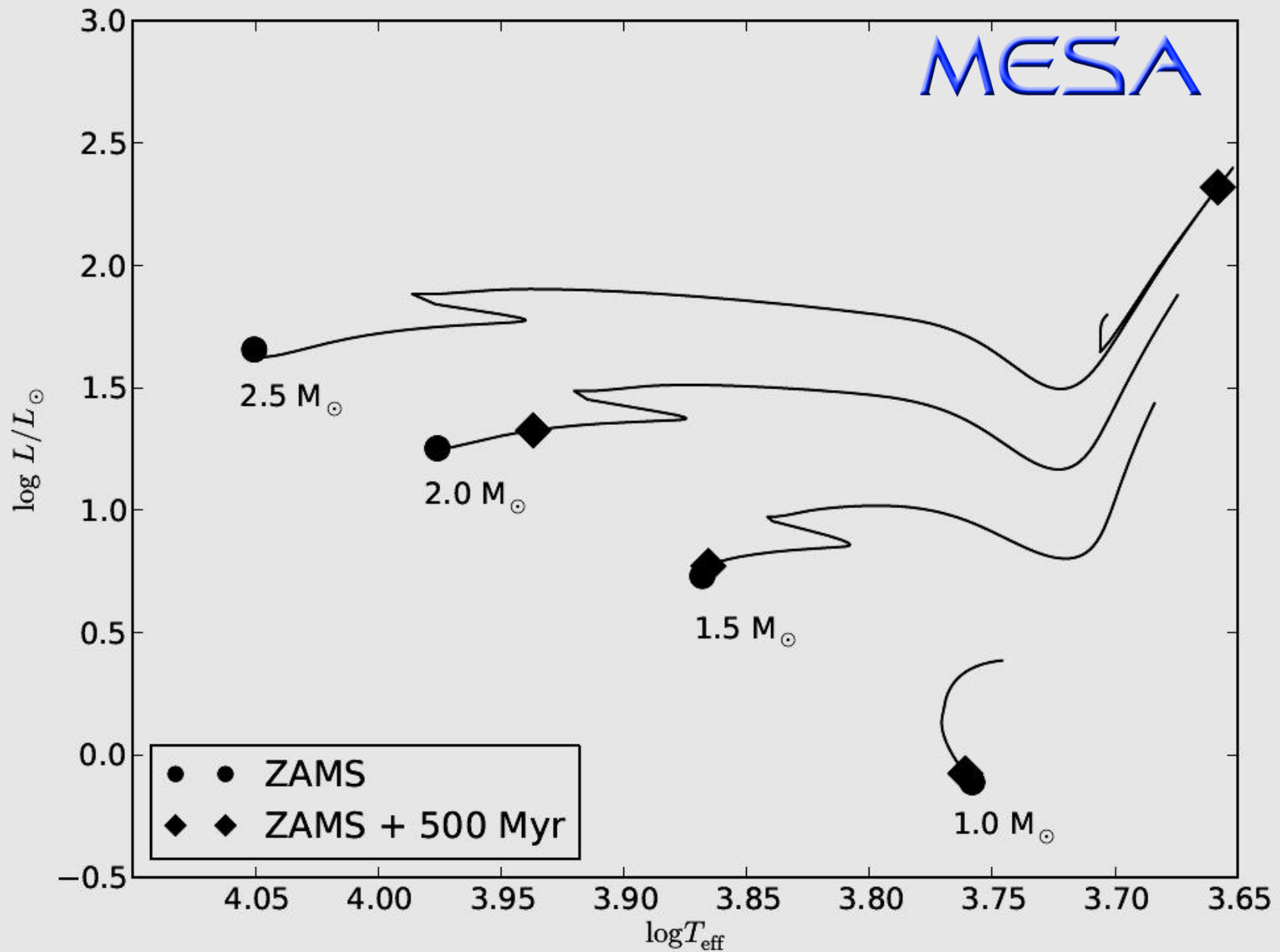
- Stellar Radii
- Effective Temperature
- Bolometric Luminosity

# Isochrone Fitting



[www.spacetelescope.org](http://www.spacetelescope.org)

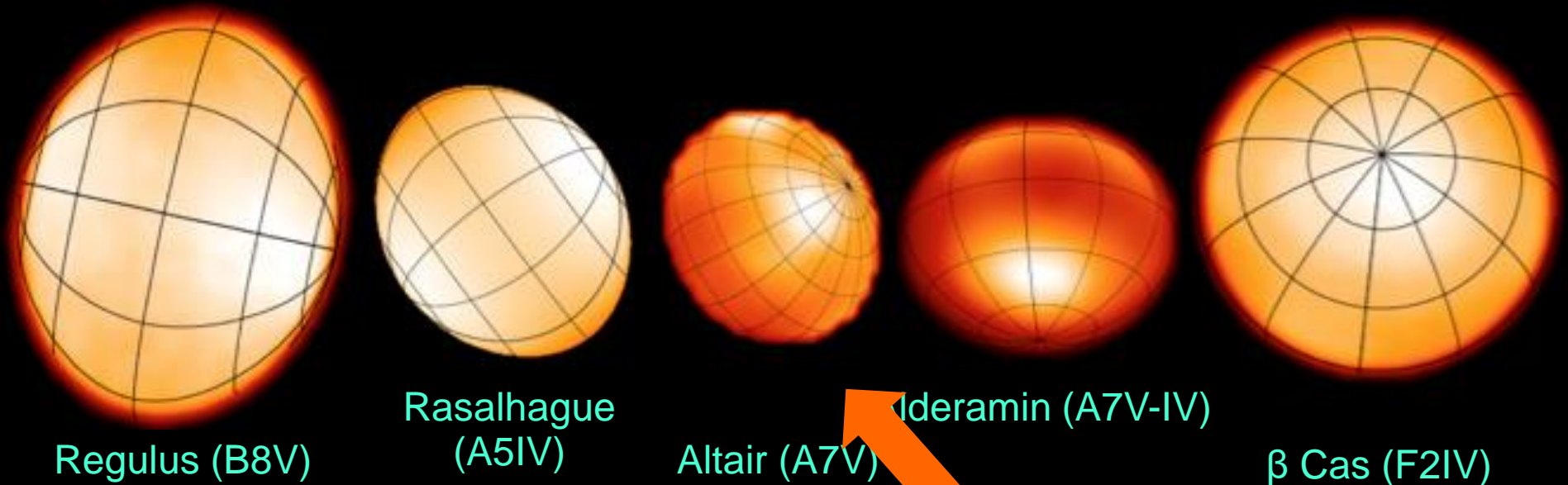
# Isochrone Fitting



# Special Case: Rapid Rotation

## Rotation Affects HRD Placement

“Rapid” means  $v \sin i > \sim 150$  km/s



Notice the gravity darkening

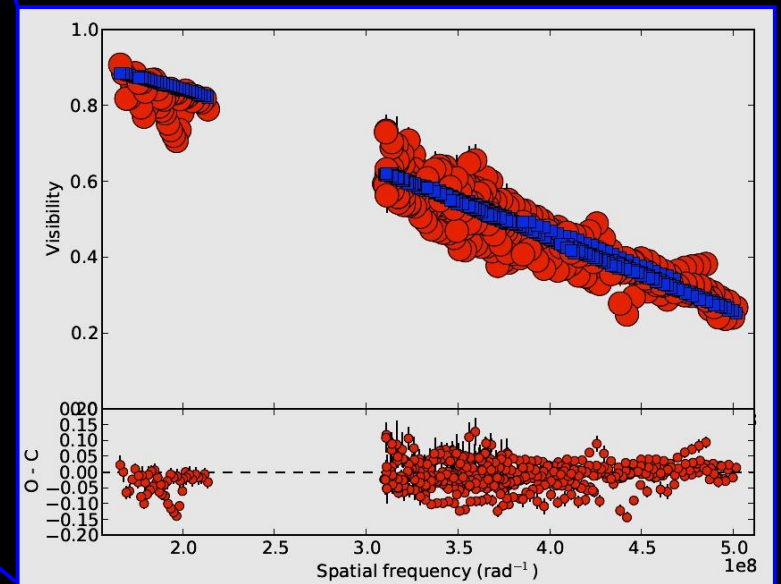
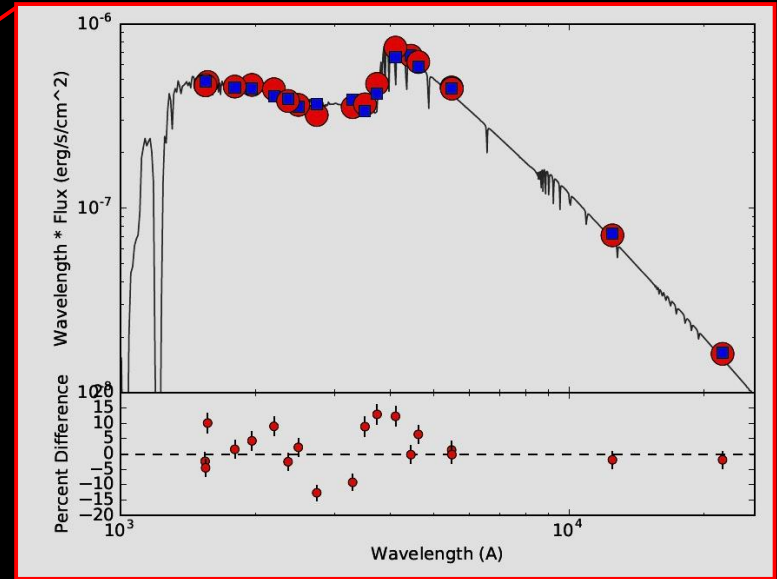
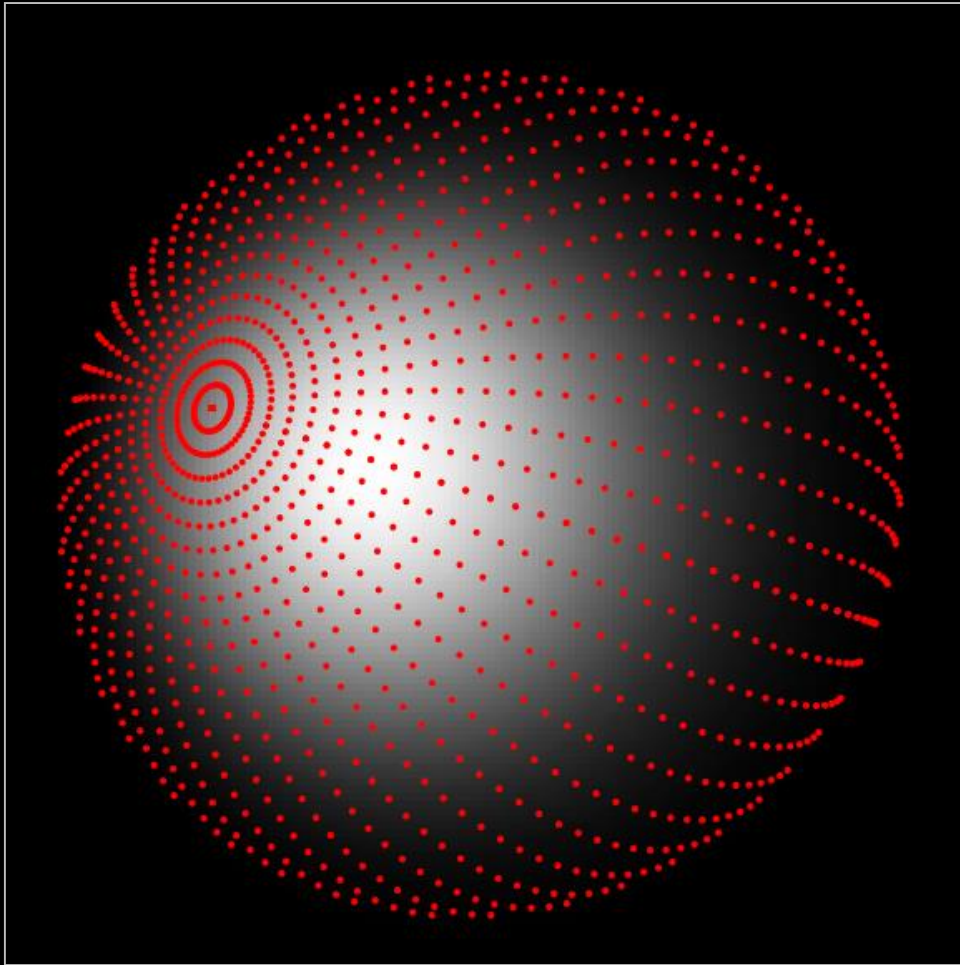
Monnier et al. 2007; Zhao et al. 2009; Che et al. 2011

2  $R_{\text{sun}}$



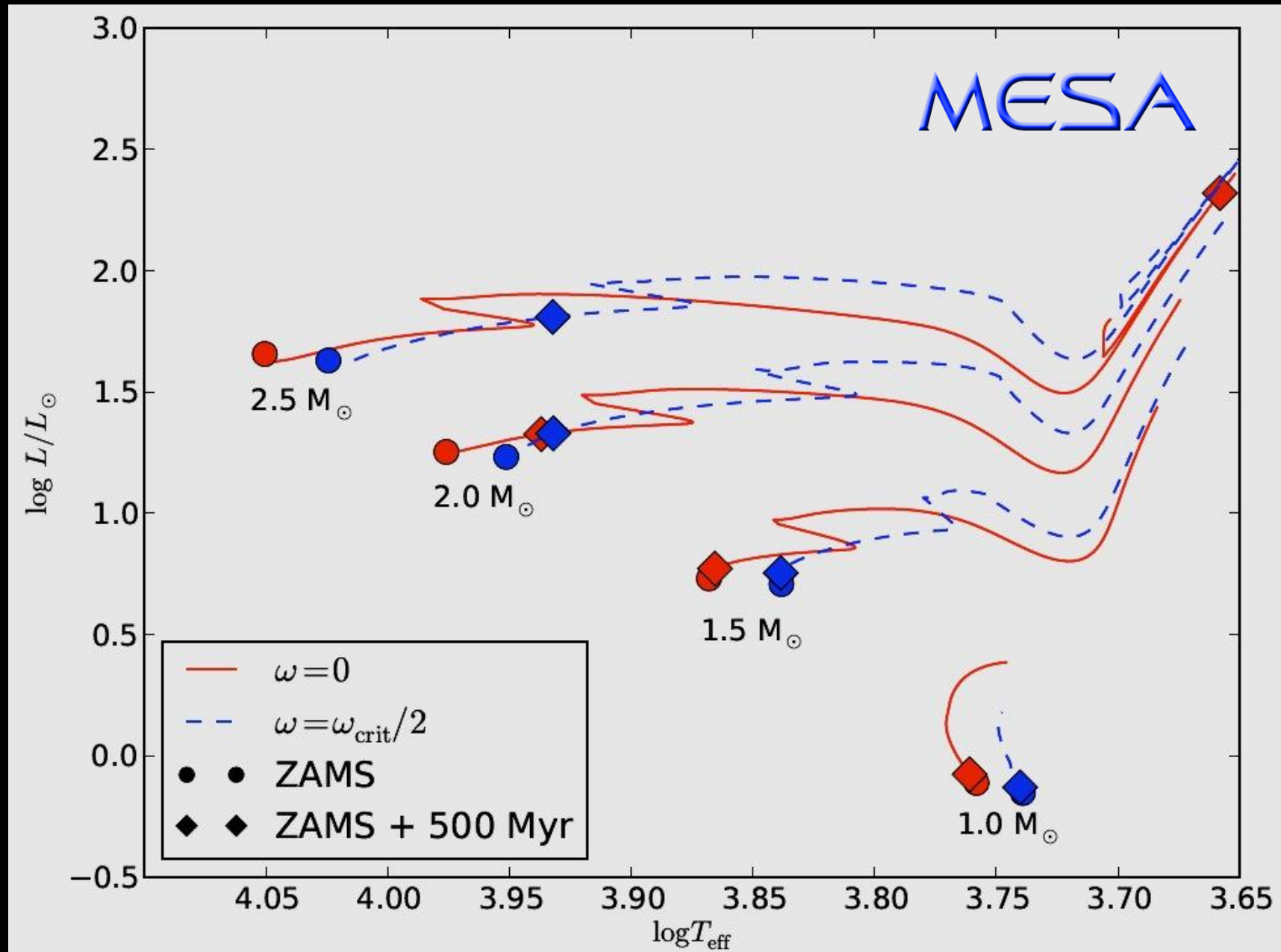
# When You Can't Image It, Model It

## Fitting to Visibilities **AND** Photometry!



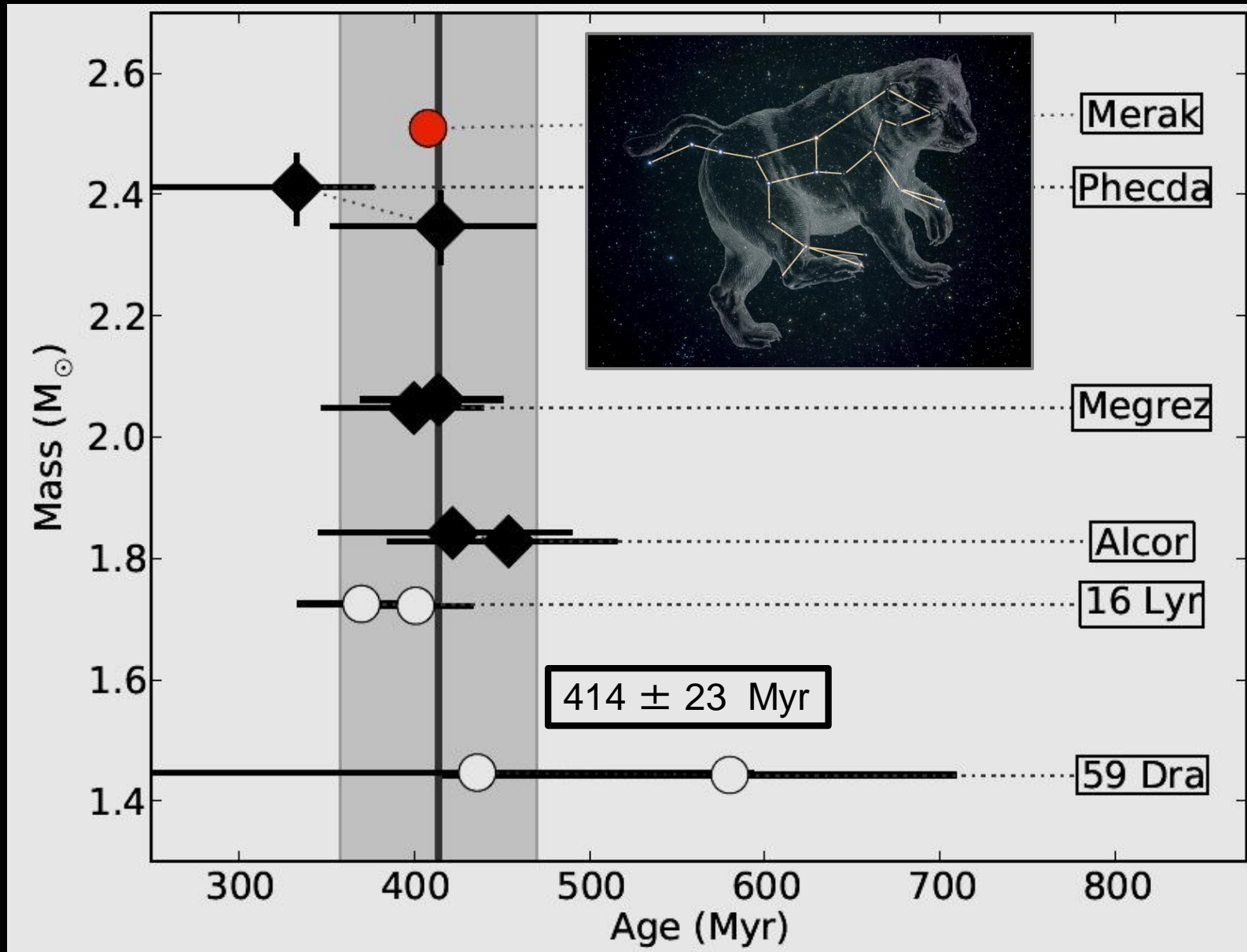
# Special Case: Rapid Rotation

## Rotation Affects Evolution



# Special Case: Rapid Rotation

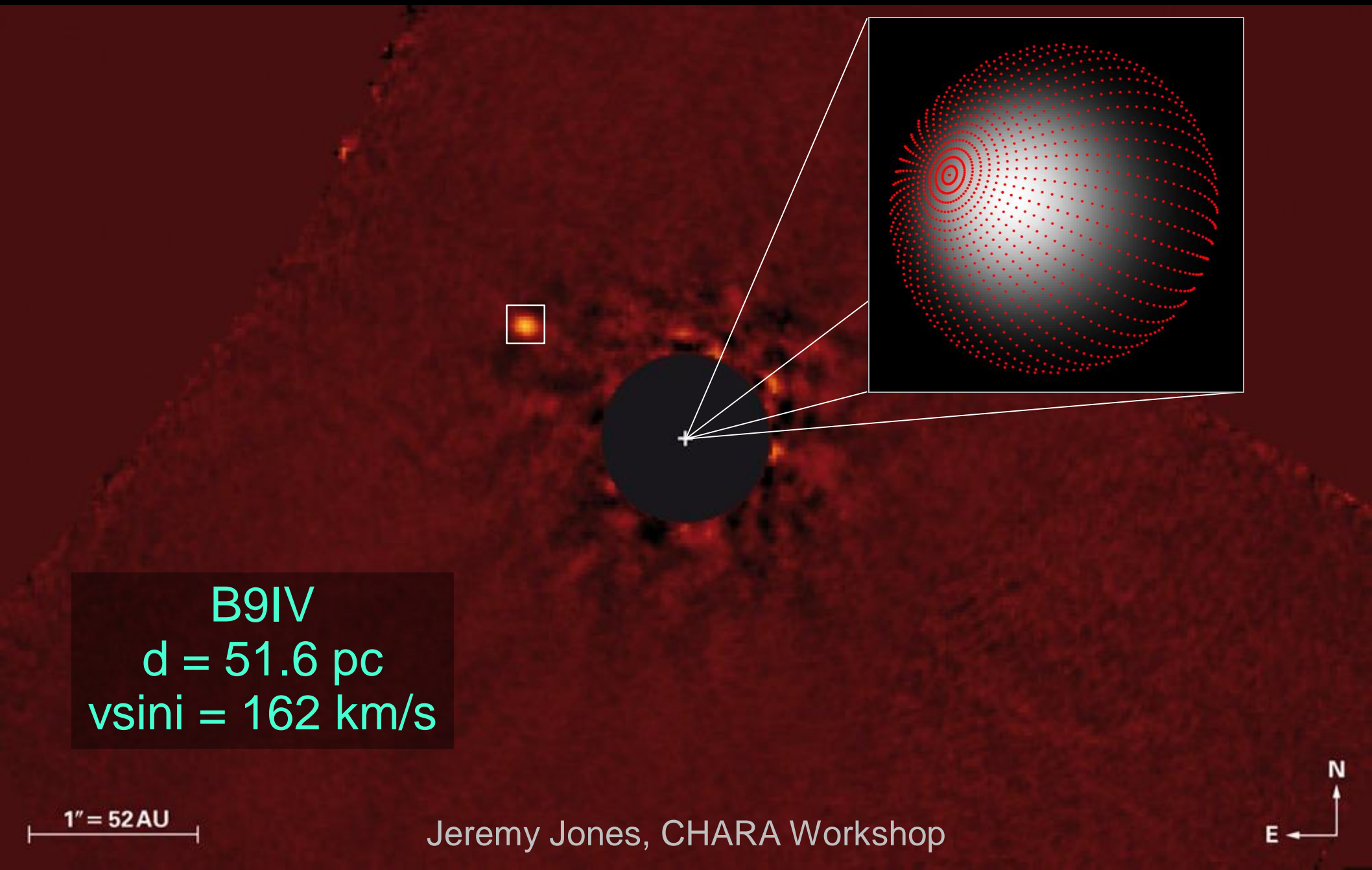
## The Ages of Rapid Rotators in UMa Group





# Special Case: Rapid Rotation

## The Age of Planet Host $\kappa$ And



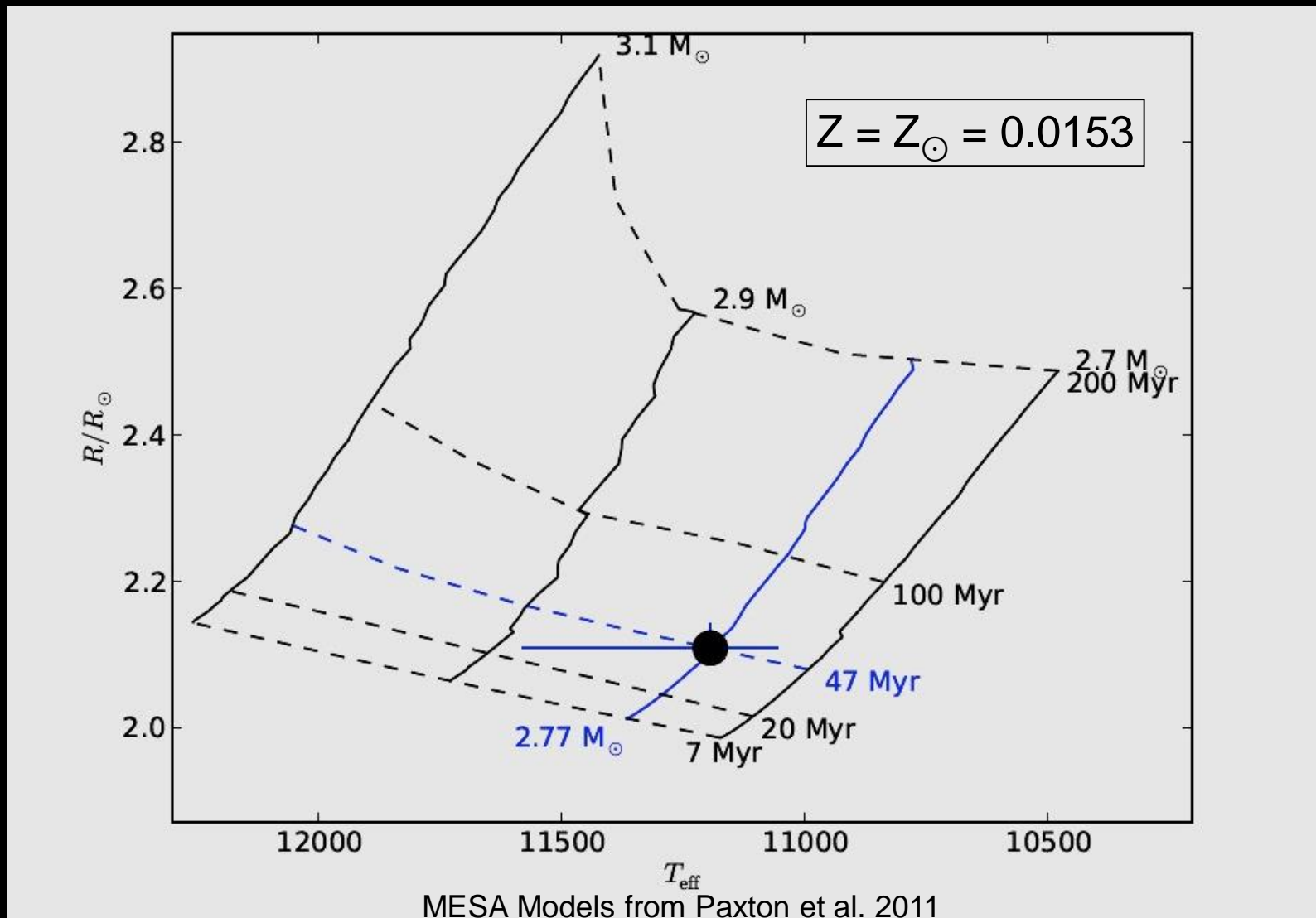
B9IV  
d = 51.6 pc  
vsini = 162 km/s

1" = 52 AU

Jeremy Jones, CHARA Workshop



# The Fruits of Our Modeling Labor: The Age of $\kappa$ Andromedae

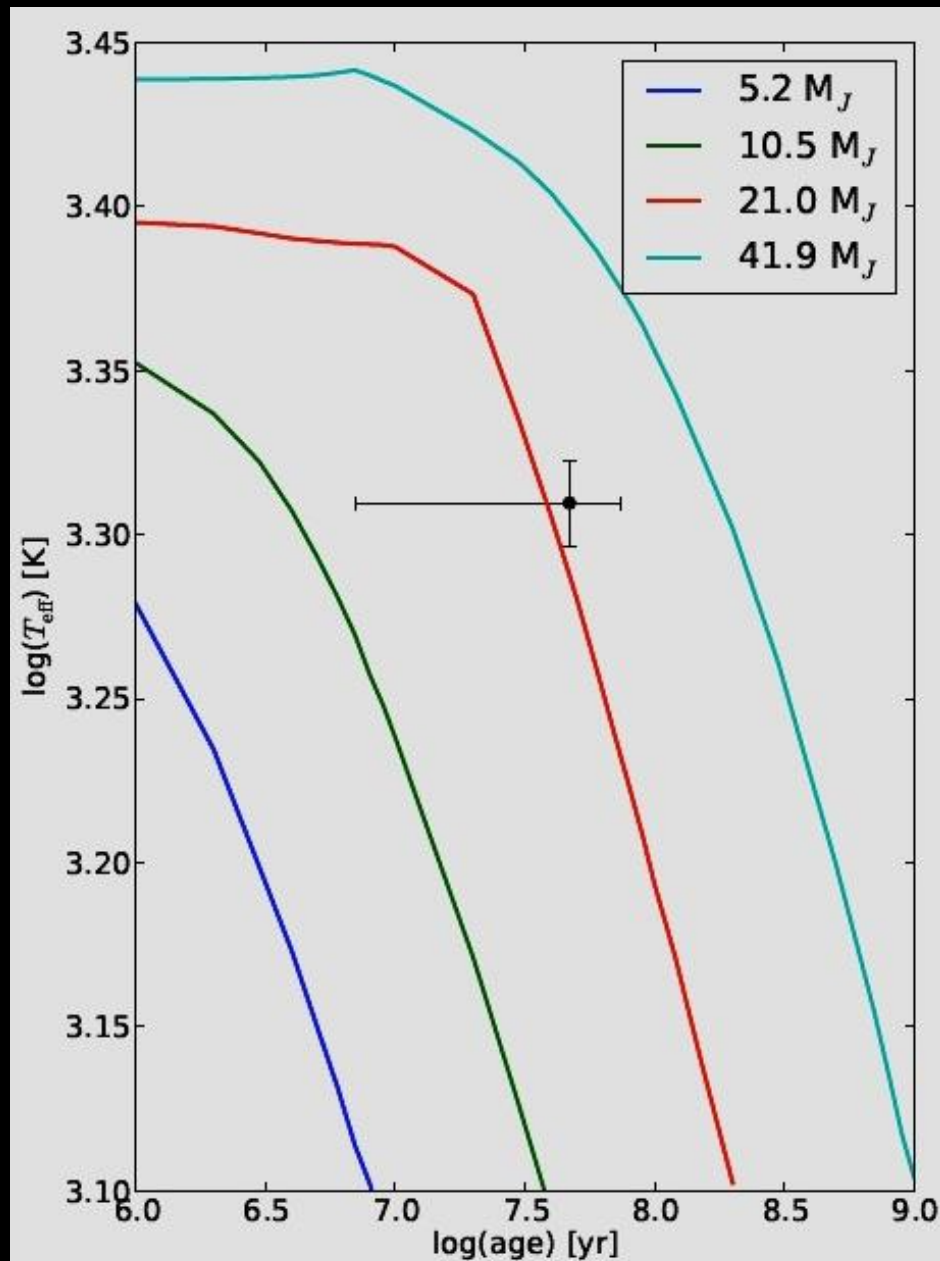


Age =  $47^{+27}_{-40}$  Myr

Mass =  $2.77^{+0.10}_{-0.11}$   $M_{\odot}$

MESA

# The Fruits of Our Modeling Labor: The Mass of $\kappa$ Andromedae b



$T_{\text{eff}} = 2040 \pm 60 \text{ K}$   
(Hinkley et al. 2013)



$a = 47^{+27}_{-40} \text{ Myr}$

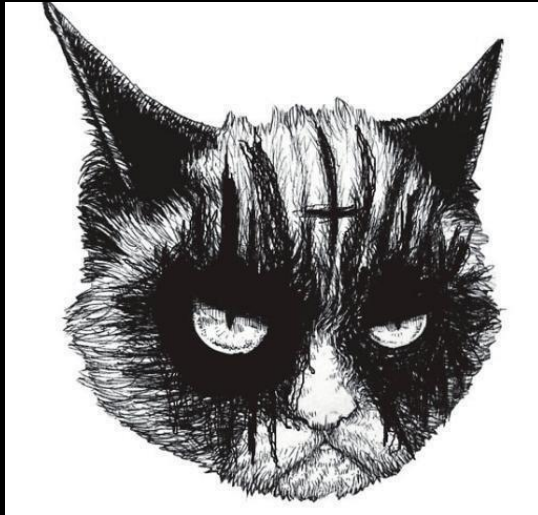
$M = 22^{+8}_{-9} M_{\text{Jup}}$

Jones et al. (2016)

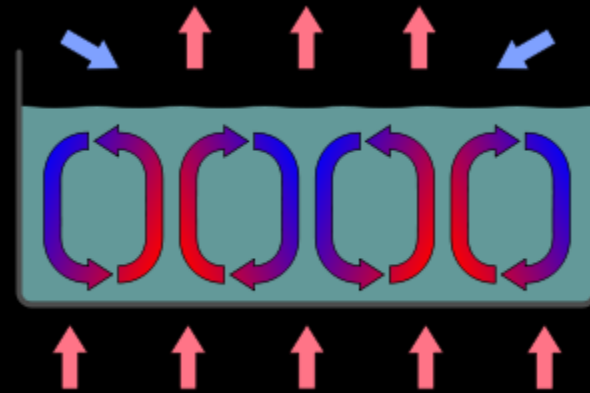


# Other Things to Keep in **M**ind

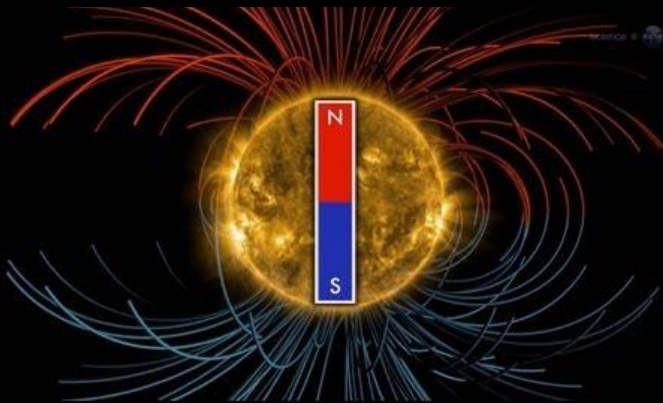
## **M**etallicity



## **M**ixing Length/ Convective Overshoot



## **M**agnetic Fields



# Conclusion

