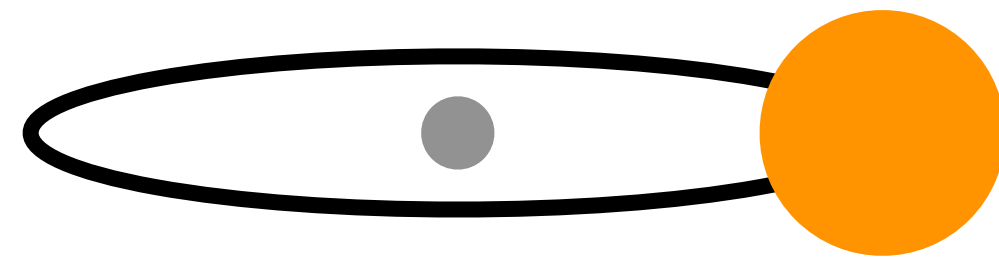


# Planets around massive white dwarfs



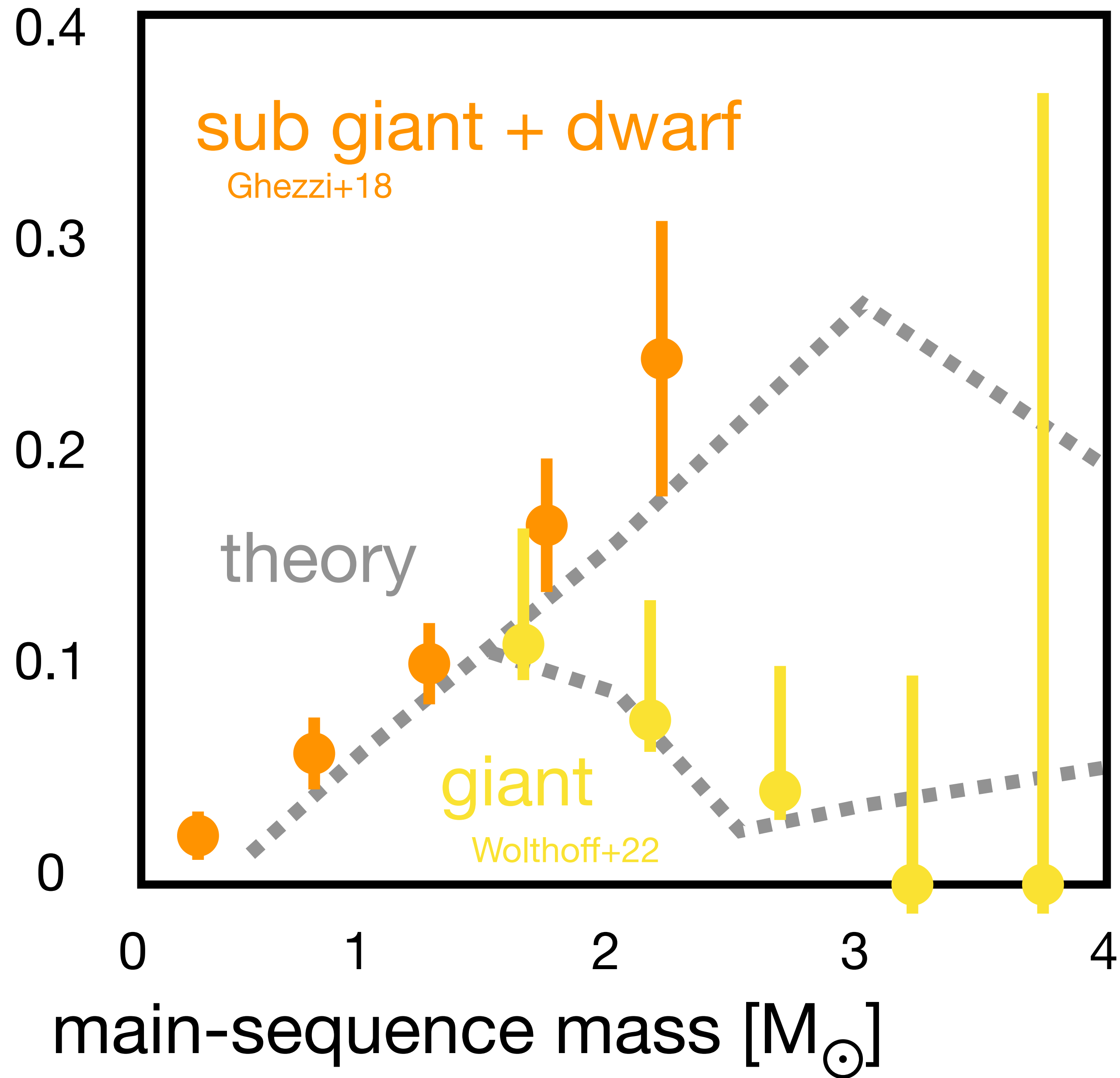
**Sihao Cheng (程思浩)**

Institute for Advanced Study  
& Perimeter Institute

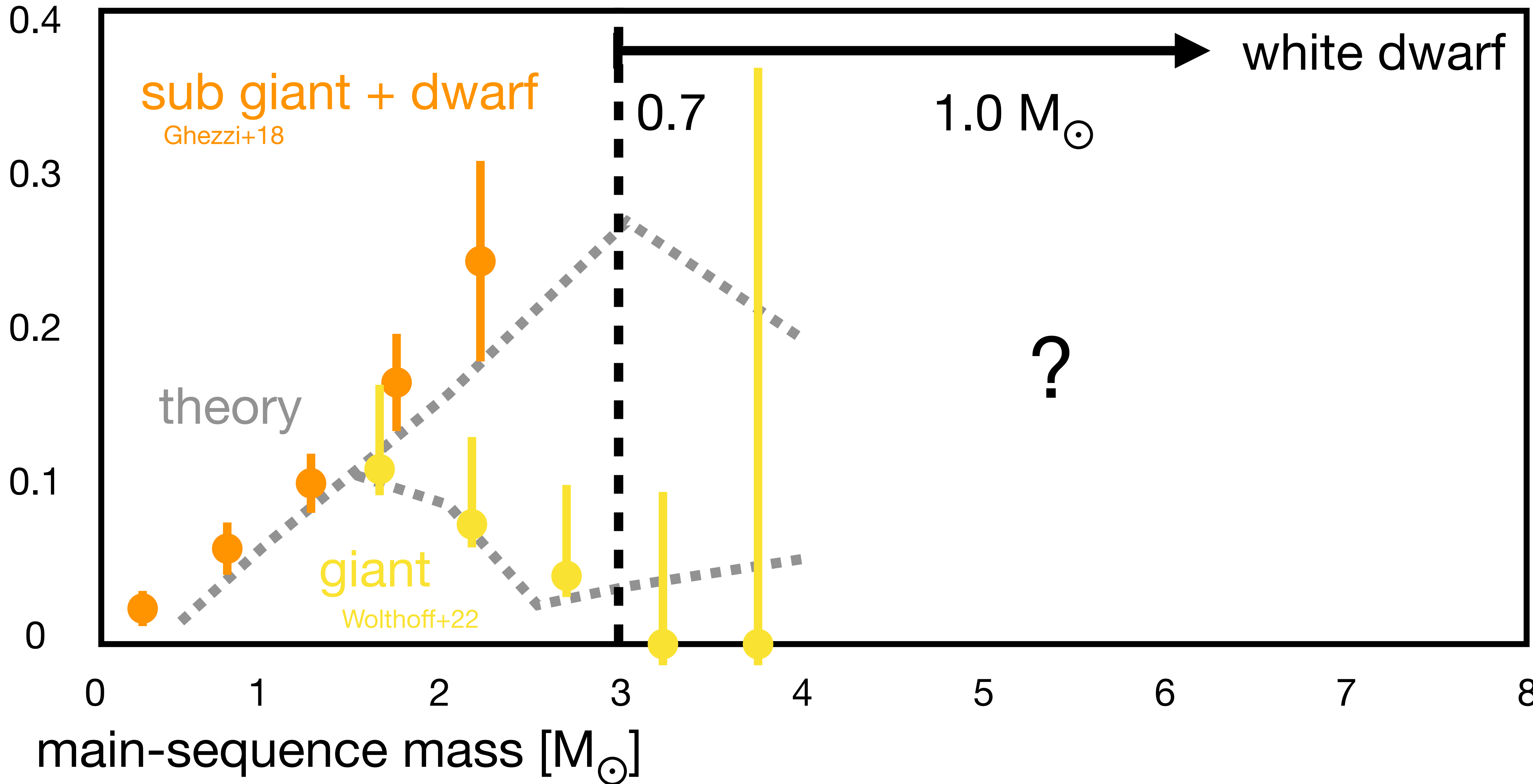
Nov 17th, 2022, KITP  
White Dwarfs from Physics to Astrophysics

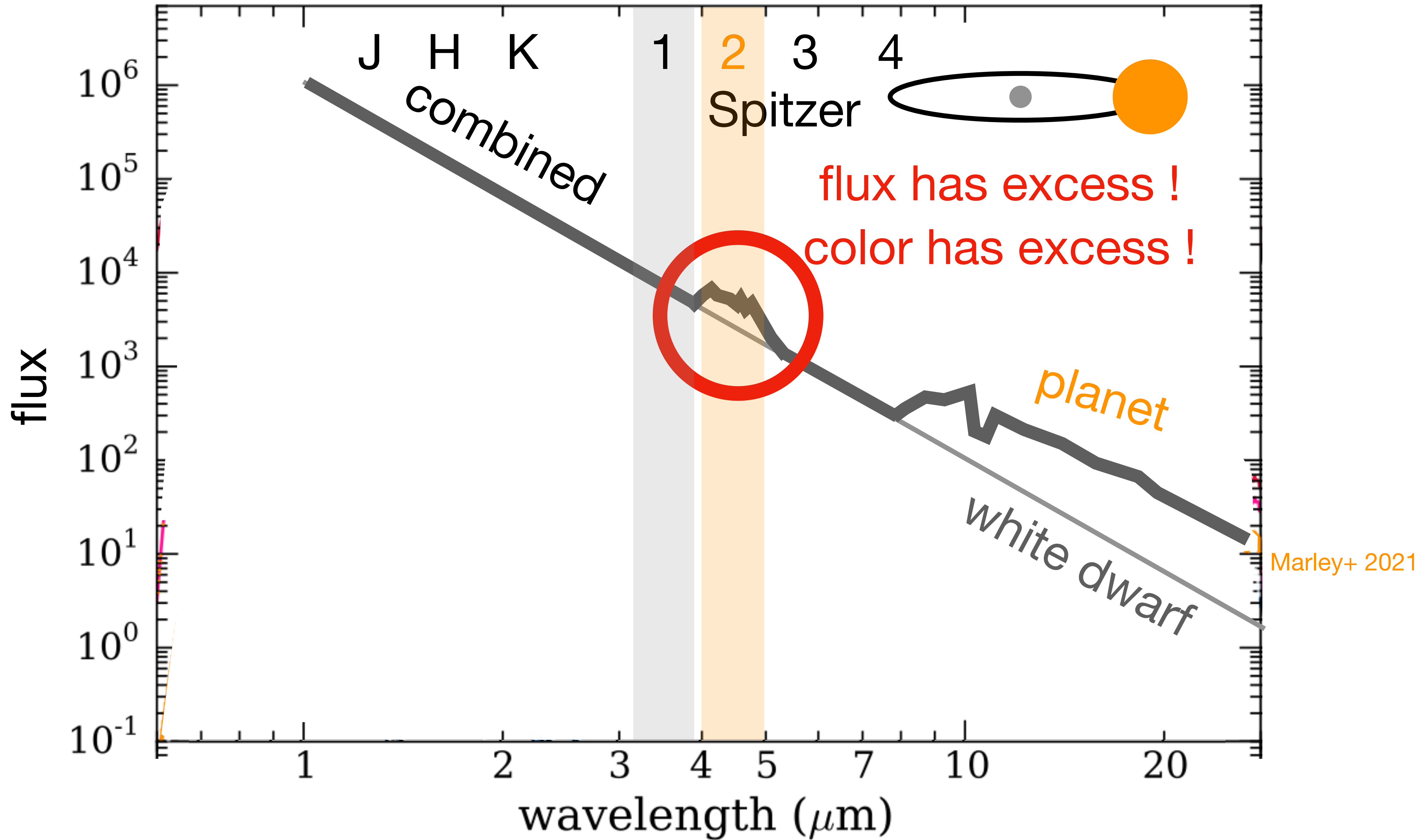
with Kevin Schlaufman

# Occurrence of giant planets

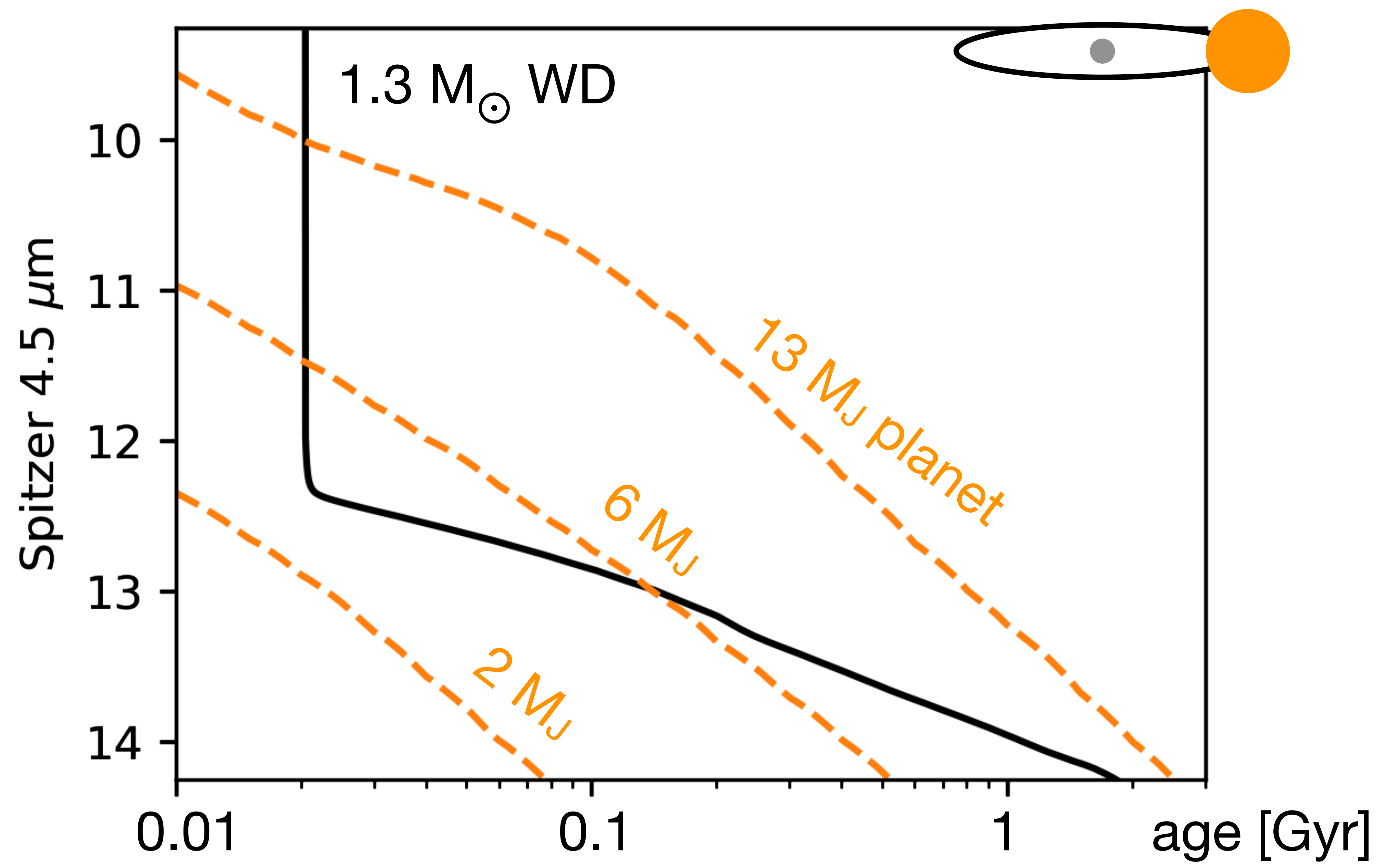


# Occurrence of giant planets

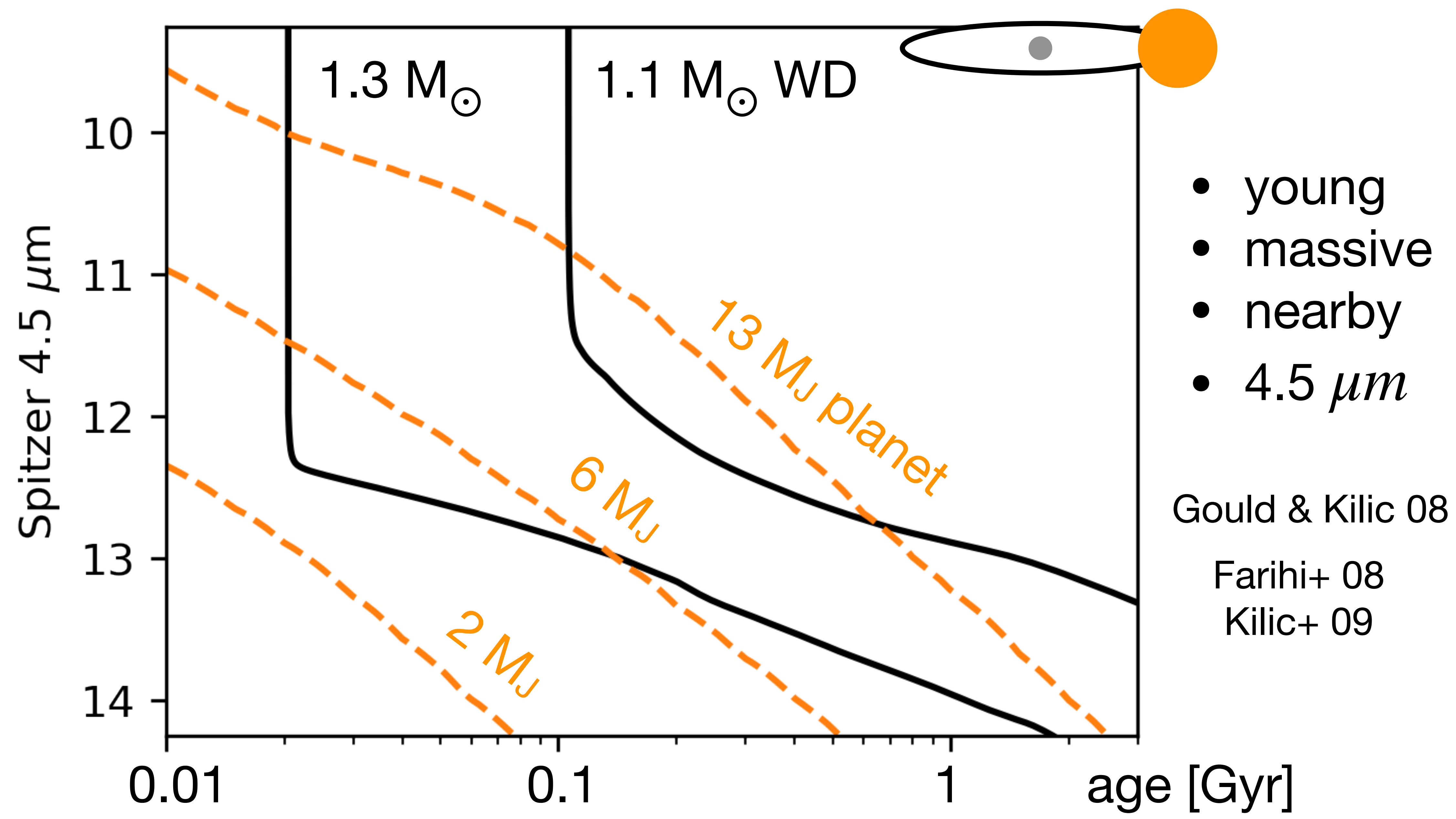


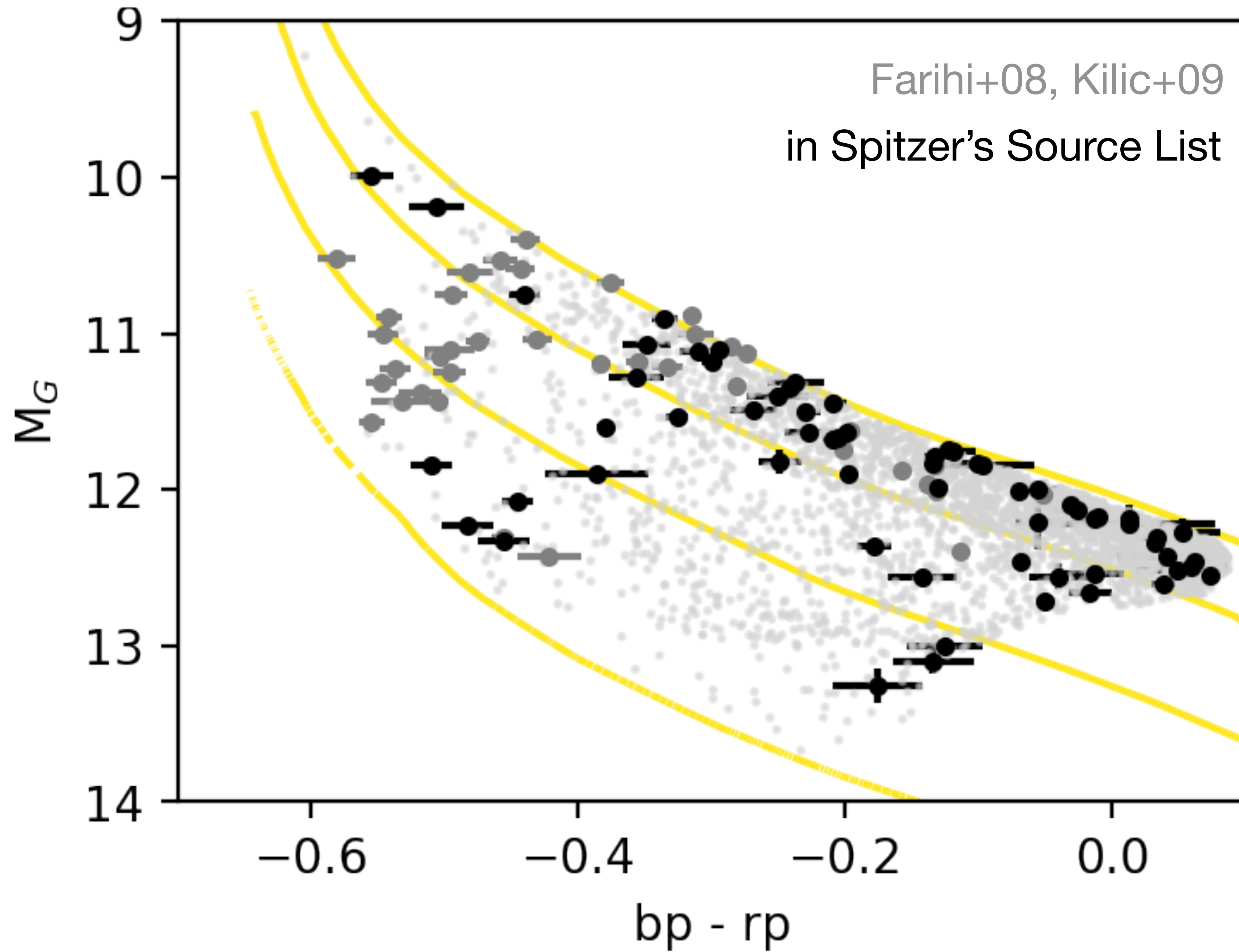


# Cooling of white dwarfs and planets



# Cooling of white dwarfs and planets

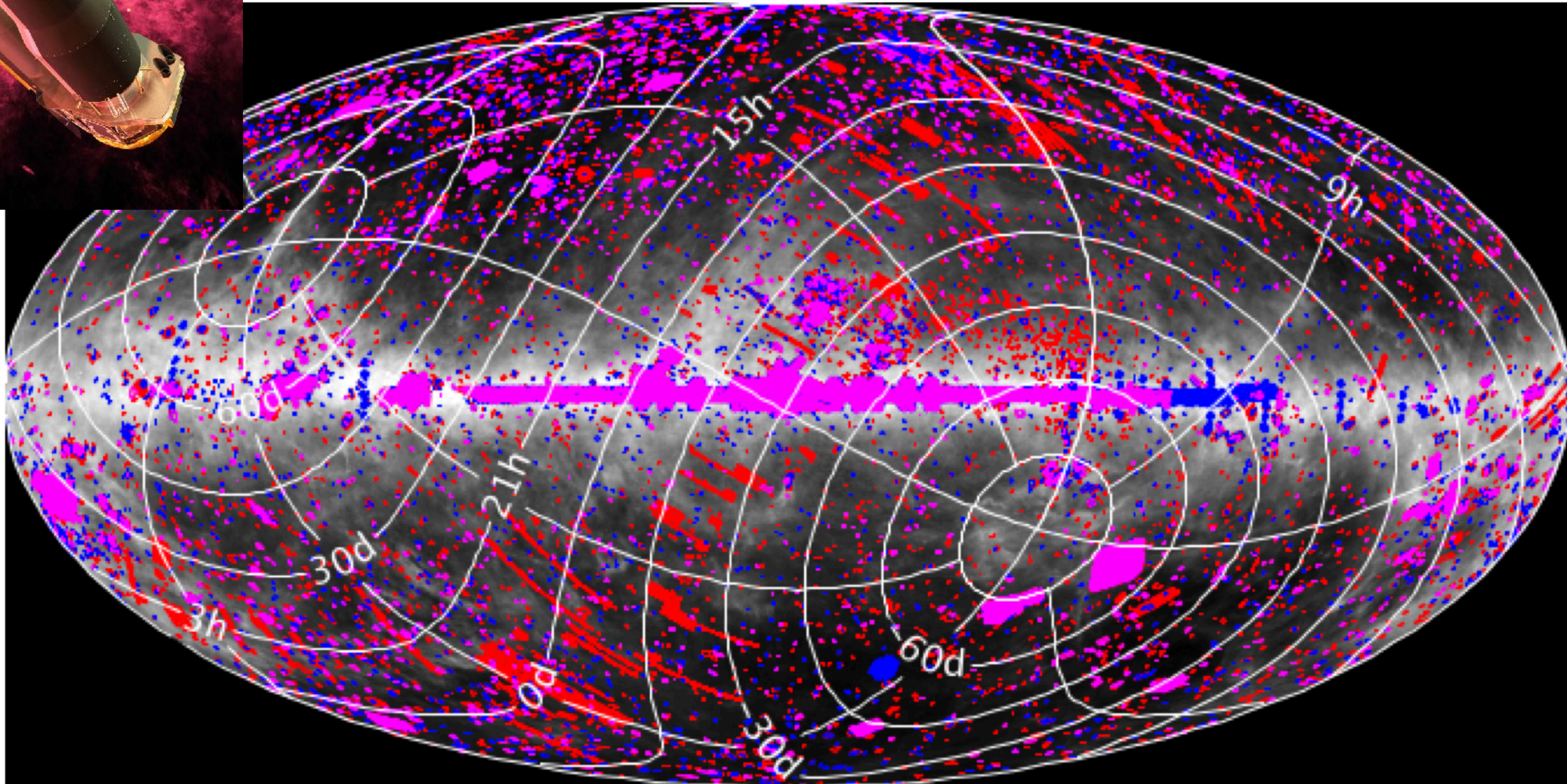
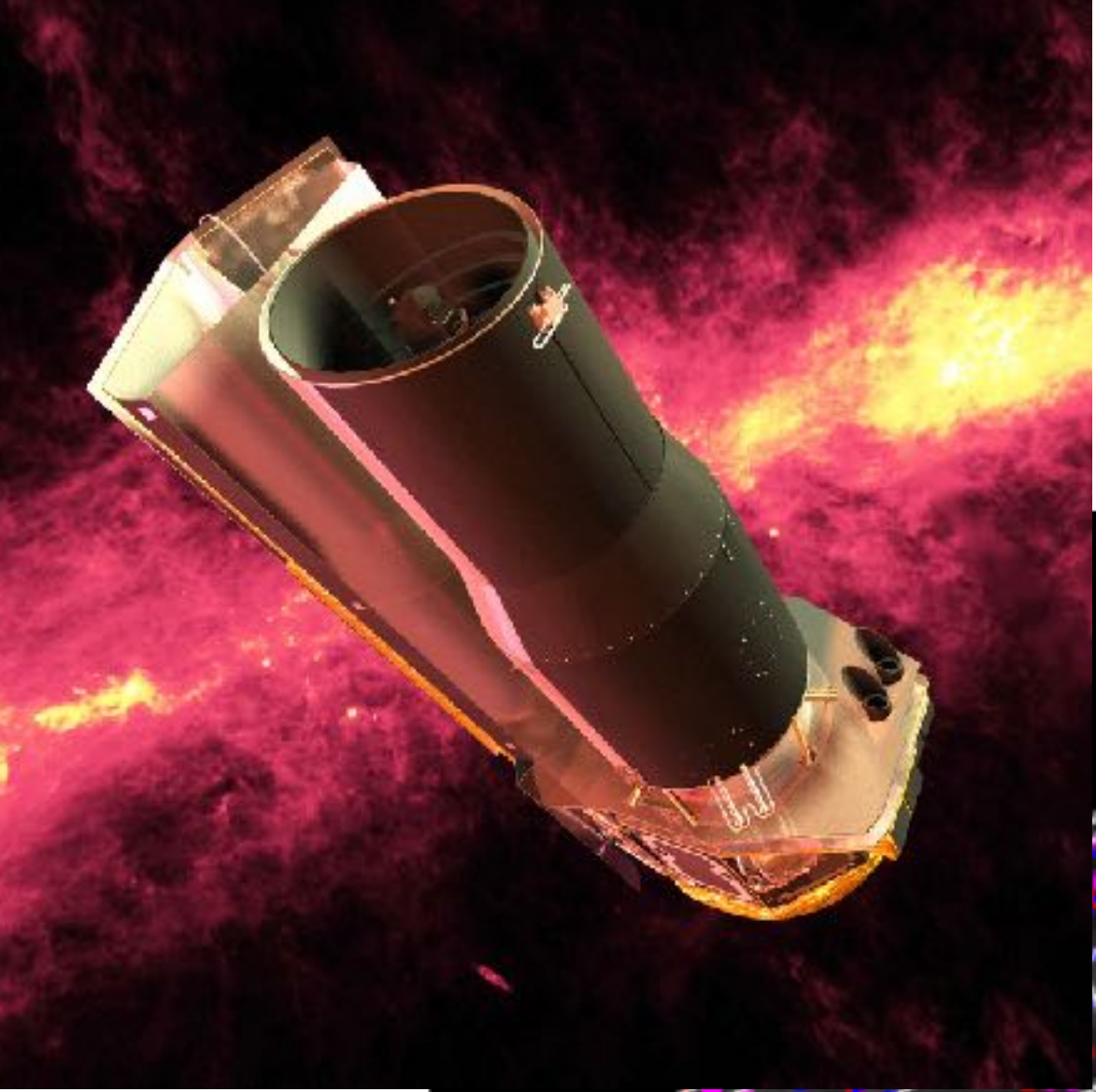




$t < 1.5$  Gyr  
 $M > 0.7 M_{\odot}$   
 $d < 200$  pc

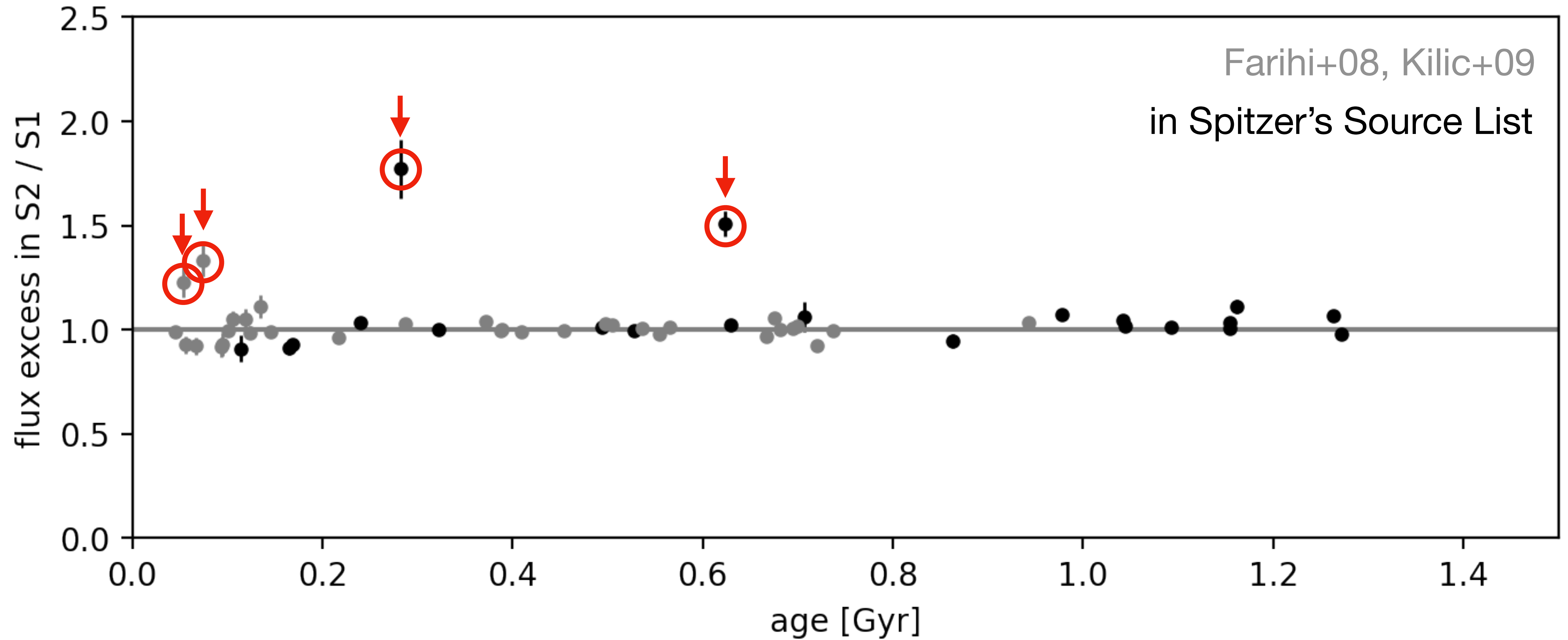
Gould & Kilic 08  
Farihi+ 08  
Kilic+ 09

# Spitzer Space Telescope

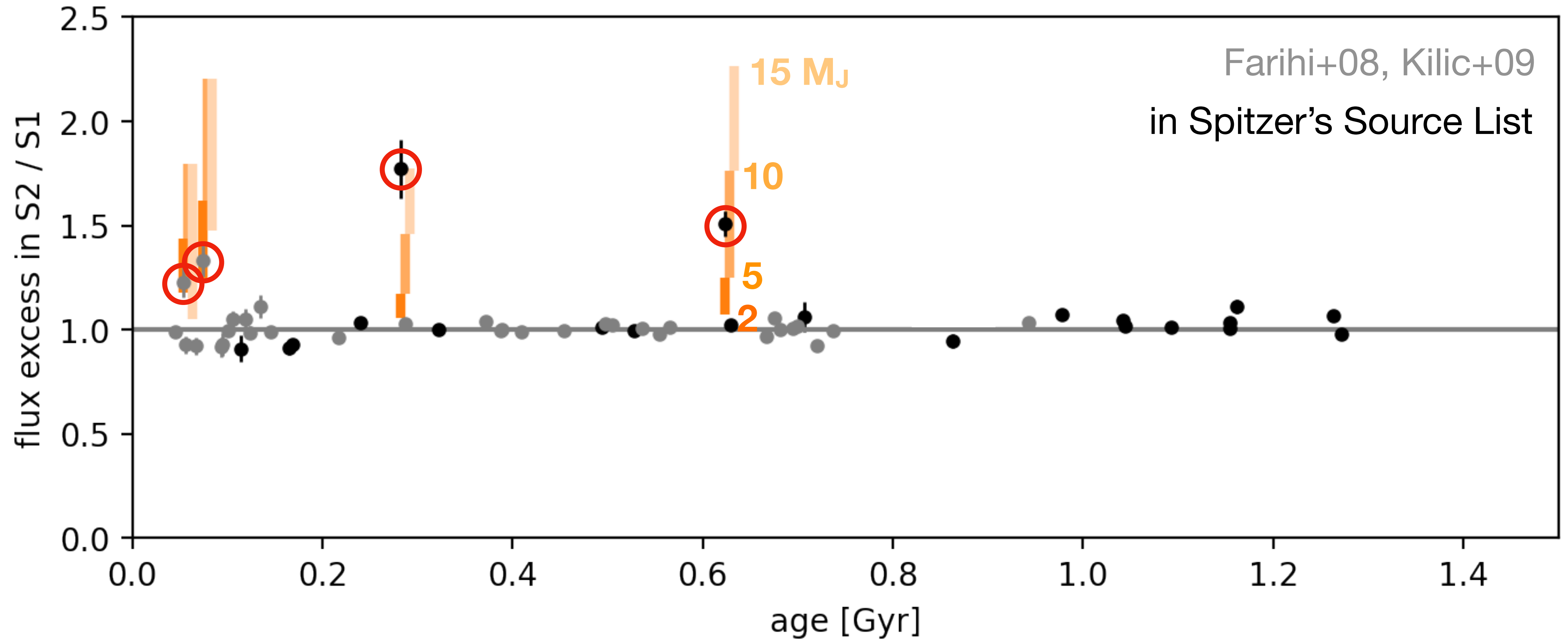




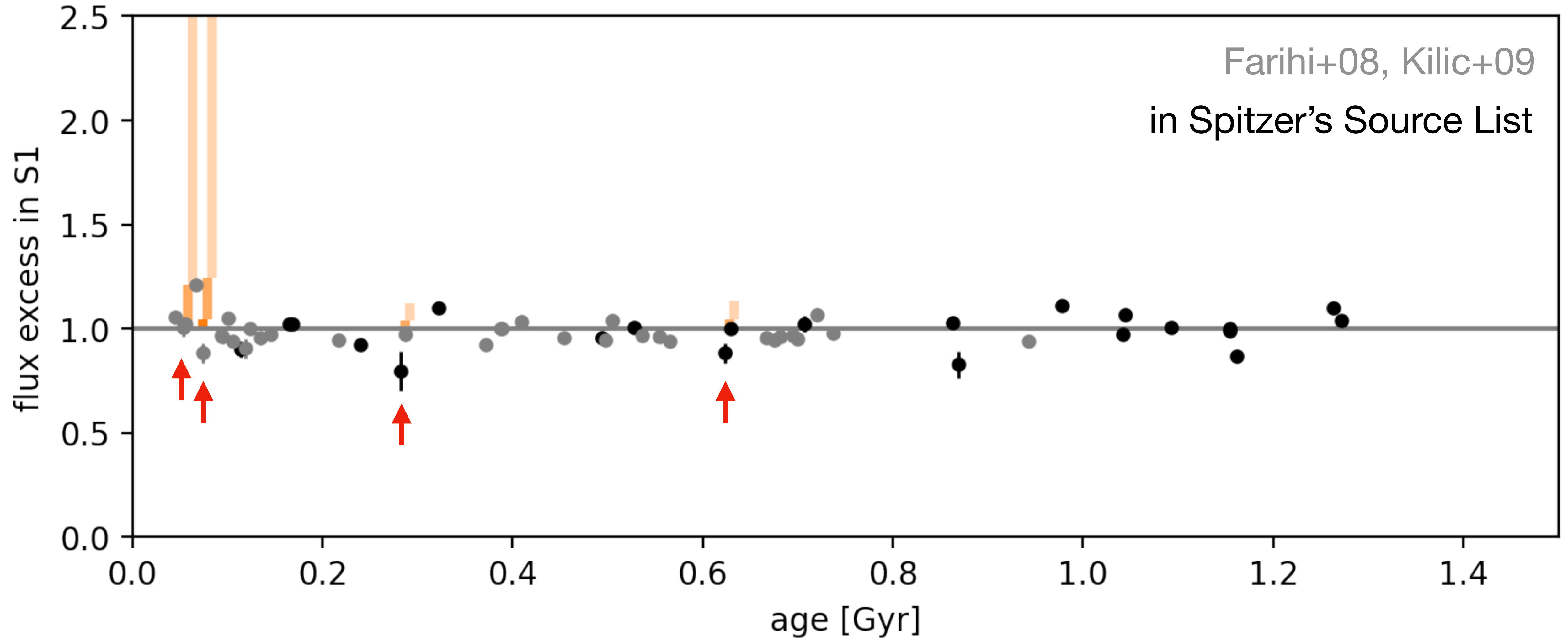
# color excess between band 1 and 2



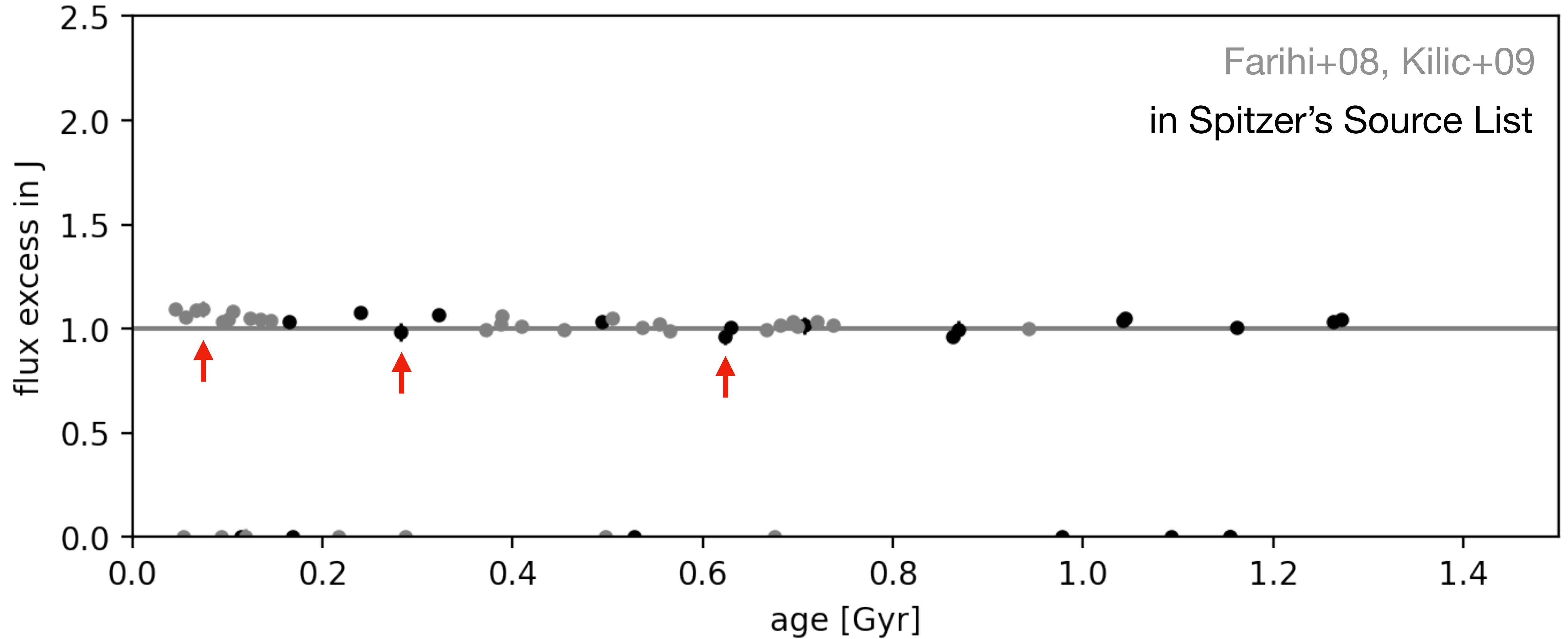
# color excess between band 1 and 2



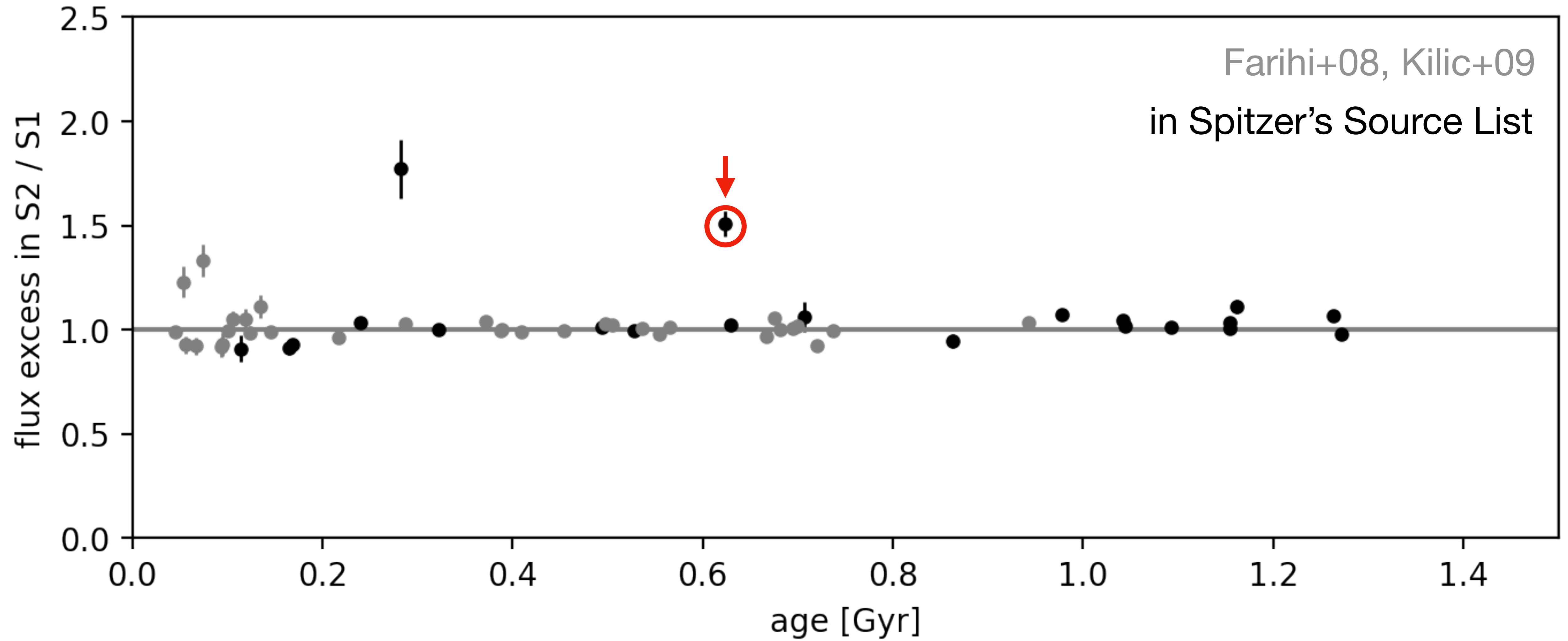
# Spitzer IRAC band 1 (sanity check)



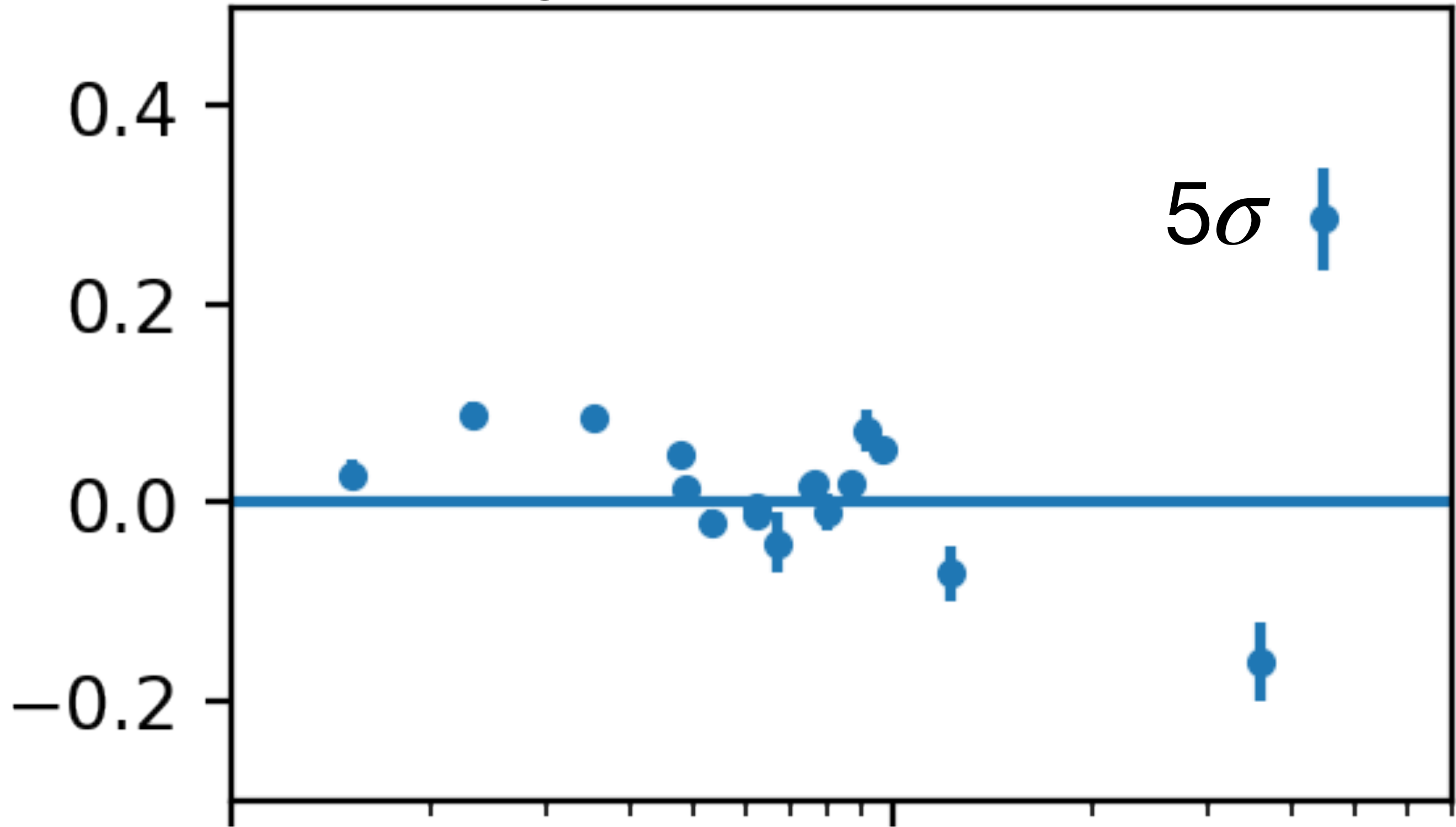
# J band (sanity check)



# color excess



1.29 M<sub>⊙</sub> 35,500 K



DC?

Kilic+20

DBAH

Ilaria Caiazzo

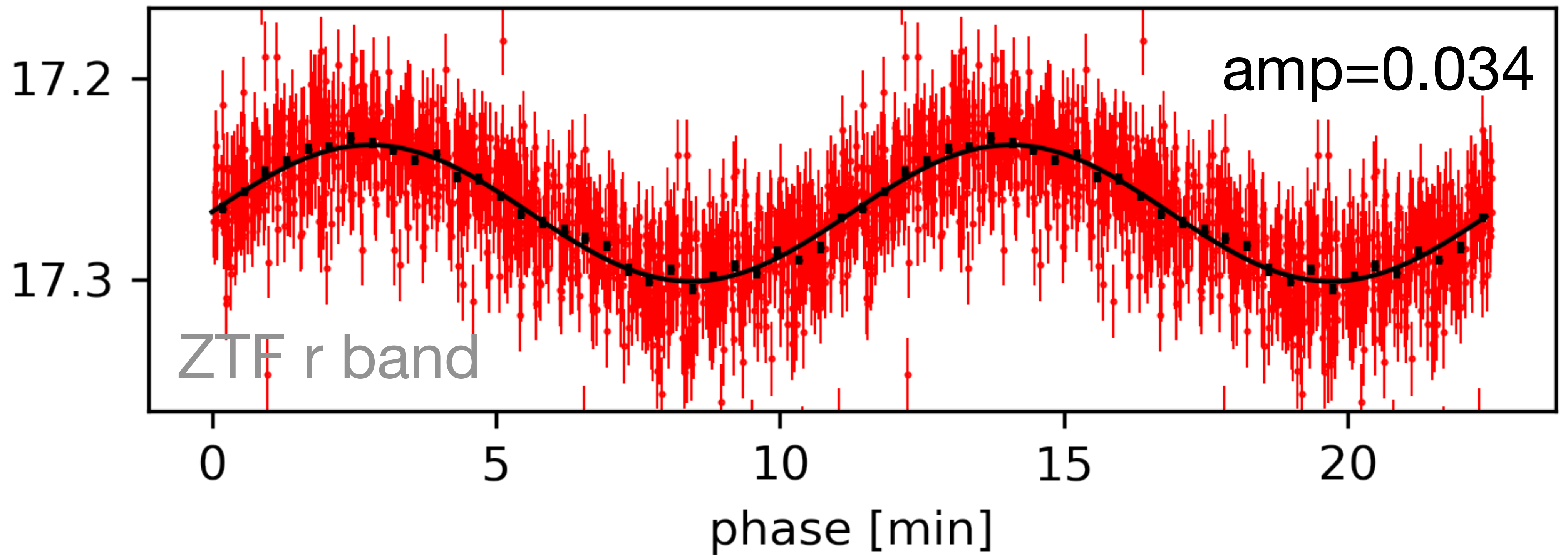
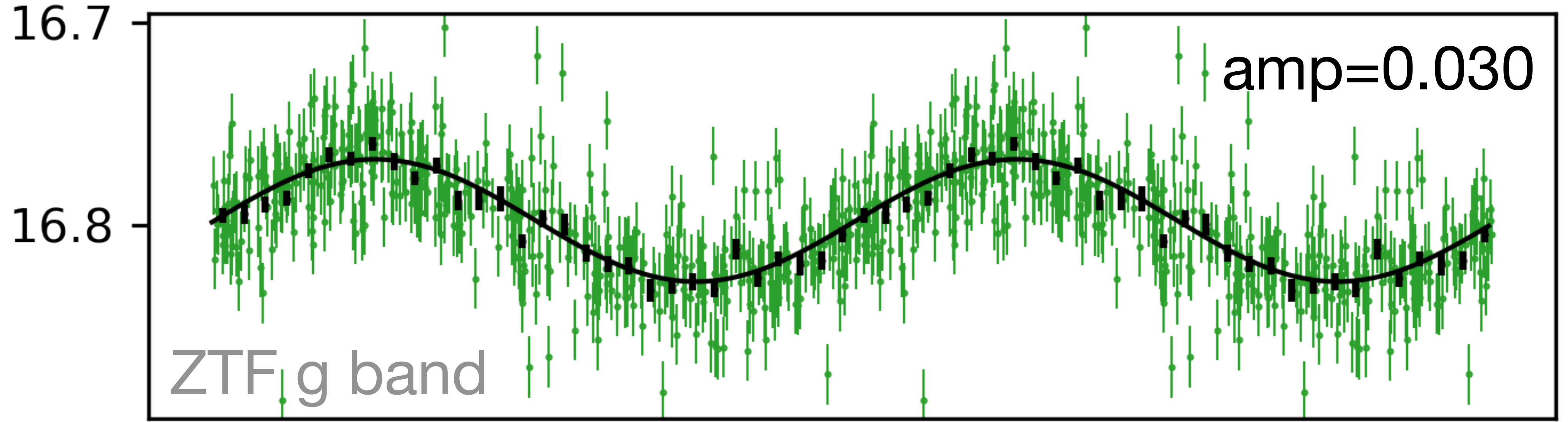
100nm

1μm

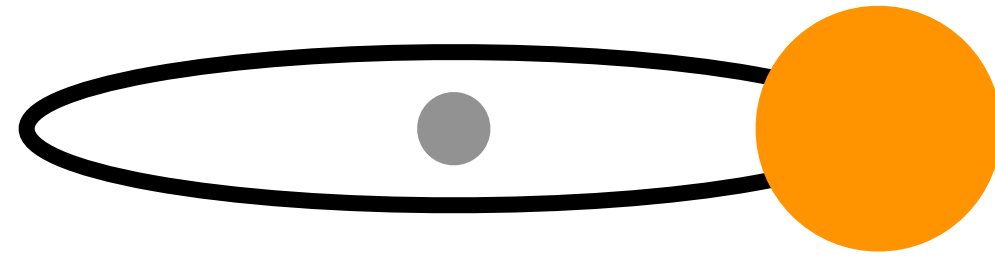
galex+gaia+sdss+spitzer

t = 11.7 min

variability  
rotation?



# Summary



giant planet rate

4.5  $\mu\text{m}$  excess

