Population Properties of Brown Dwarf Analogs to Exoplanets

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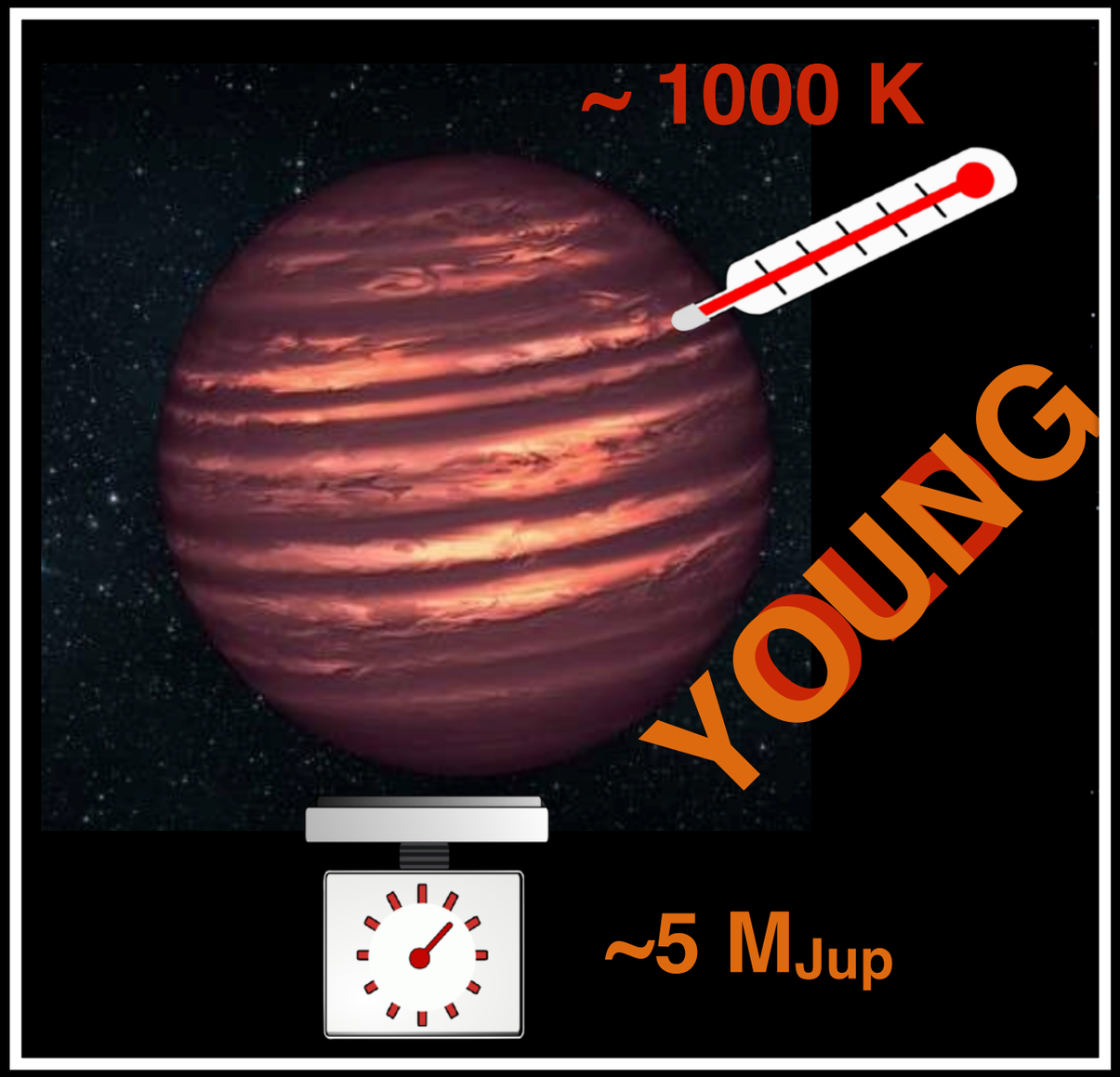
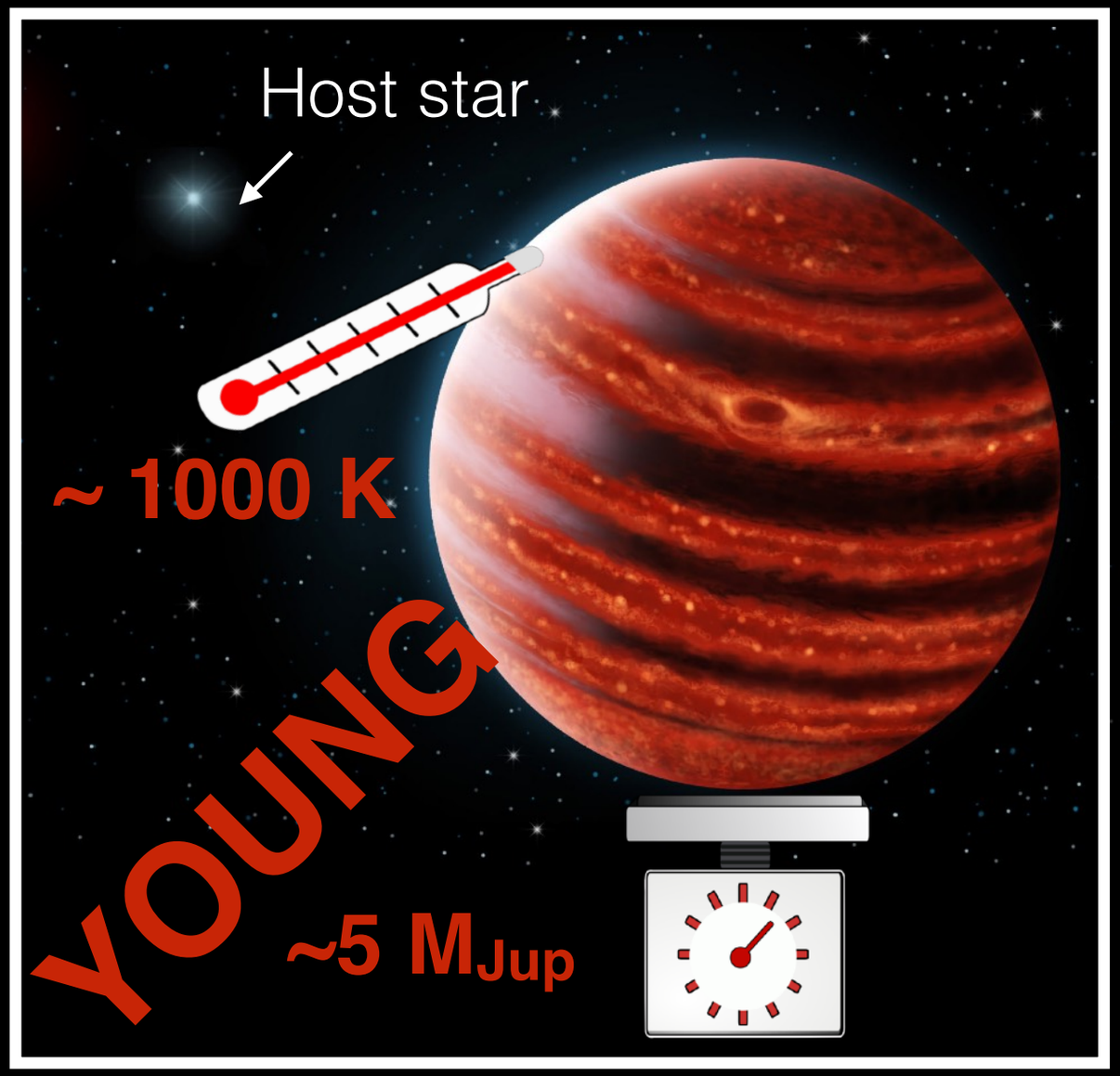
Two Important Categories of Brown Dwarf Analogs to Exoplanets

"Brown Dwarf"

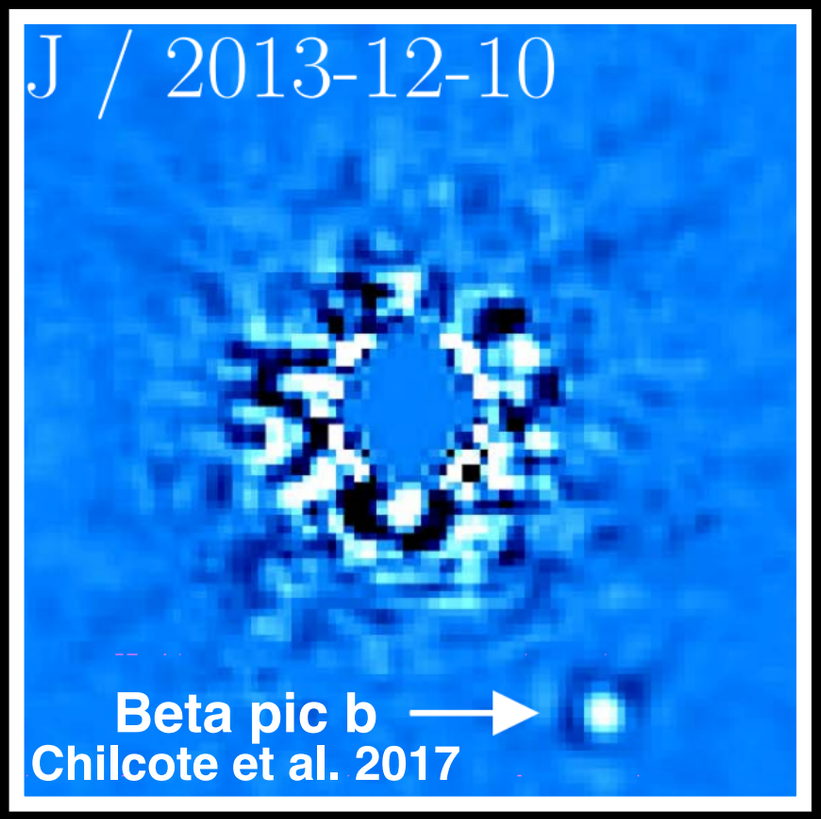


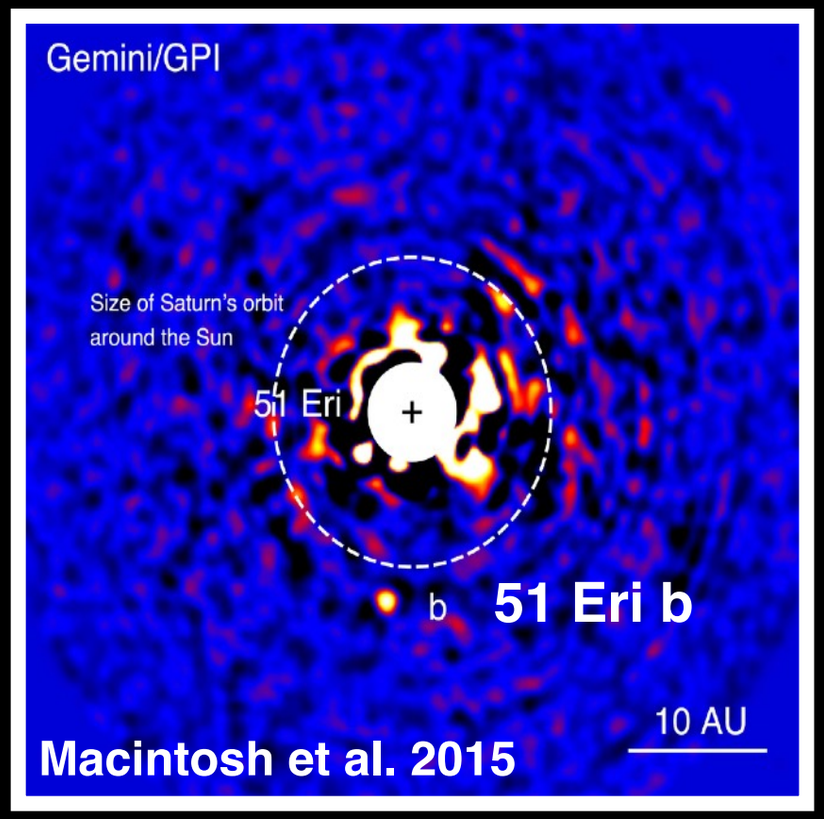
"Exoplanet"

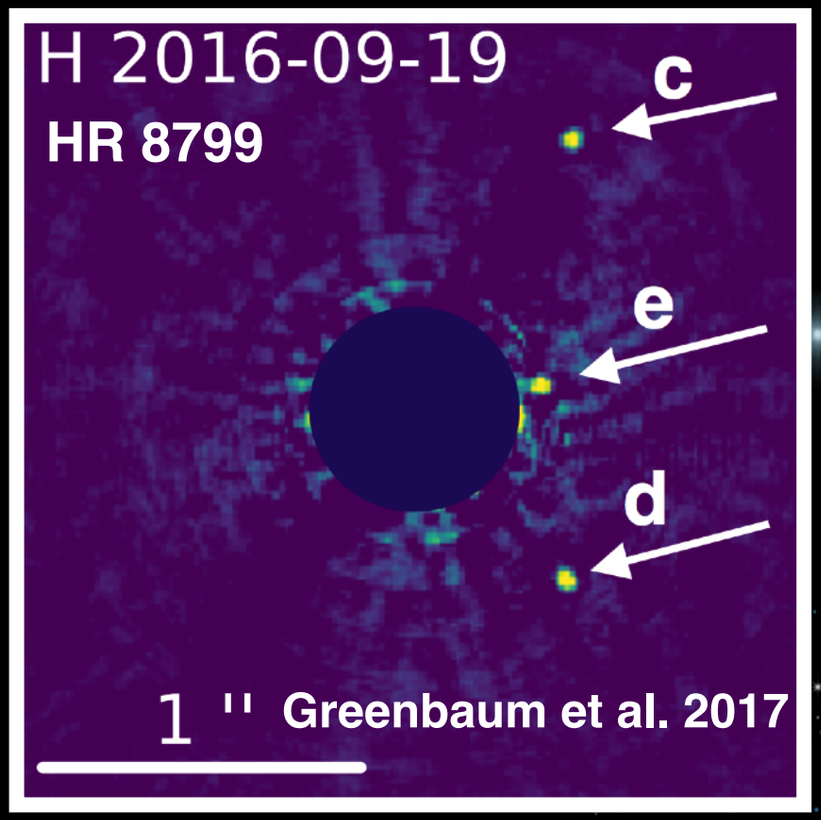


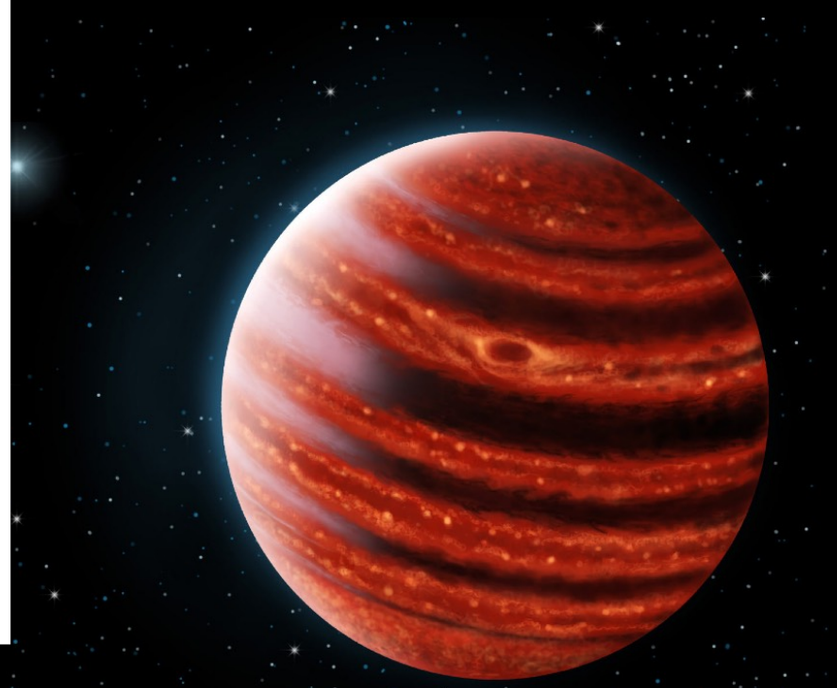
(1) Same Temperature, Different Mass
(2) Same Temperature, Same Mass (see Faherty+2016)

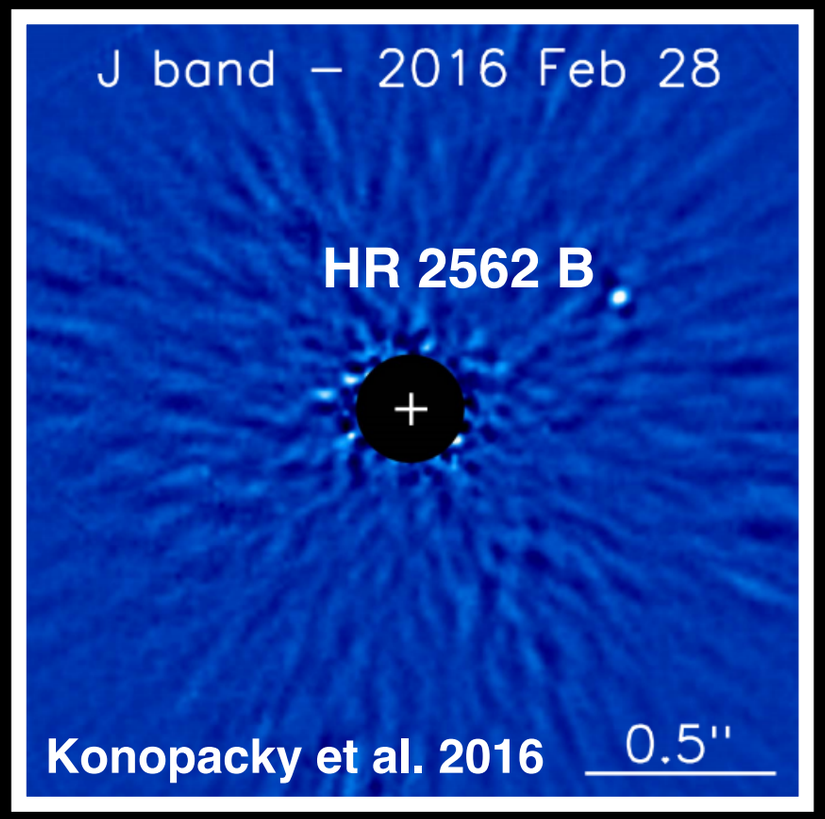
GPI Discoveries





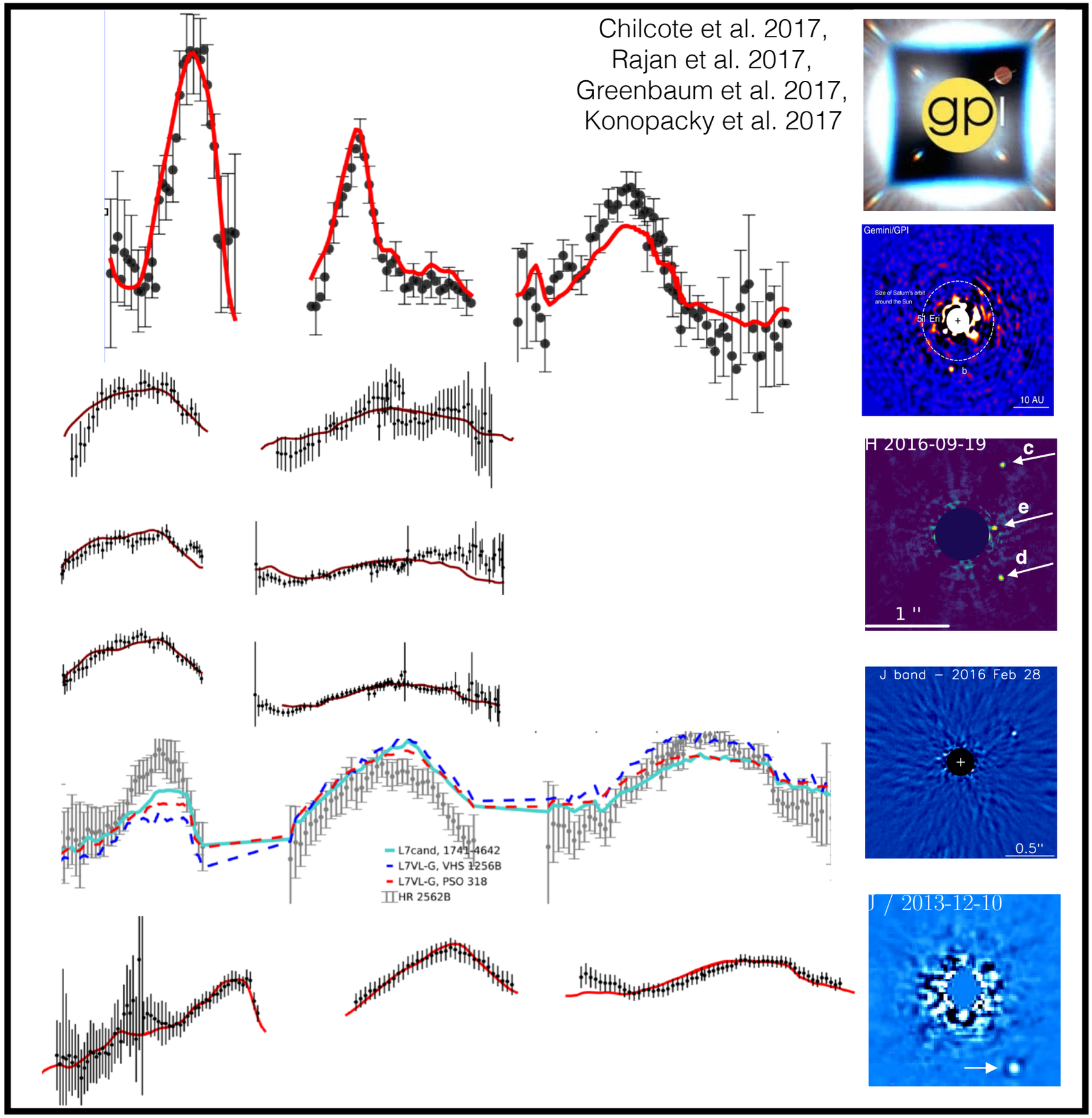






GPI Spectral Library

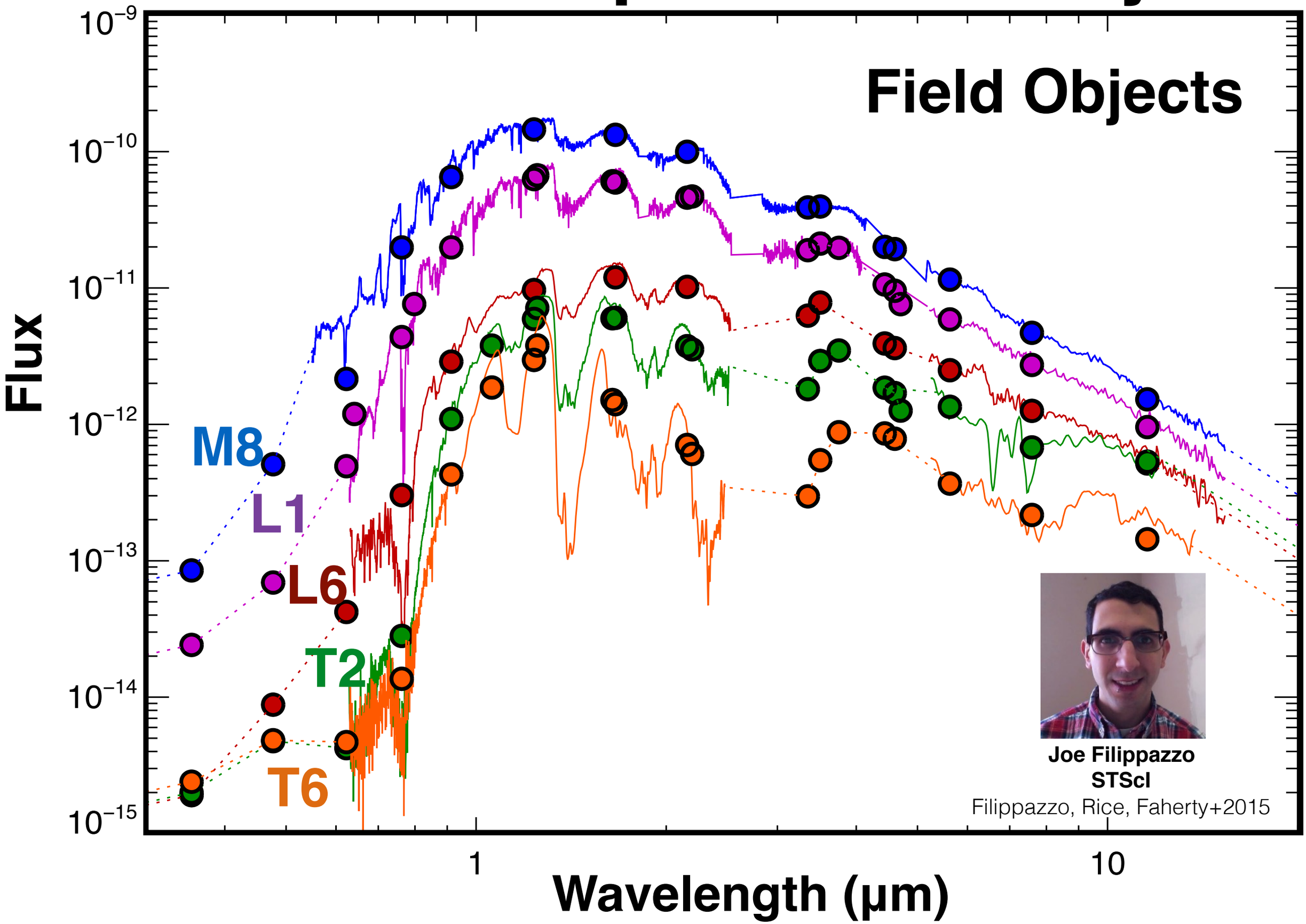
Chilcote et al. 2017,
Rajan et al. 2017,
Greenbaum et al. 2017,
Konopacky et al. 2017



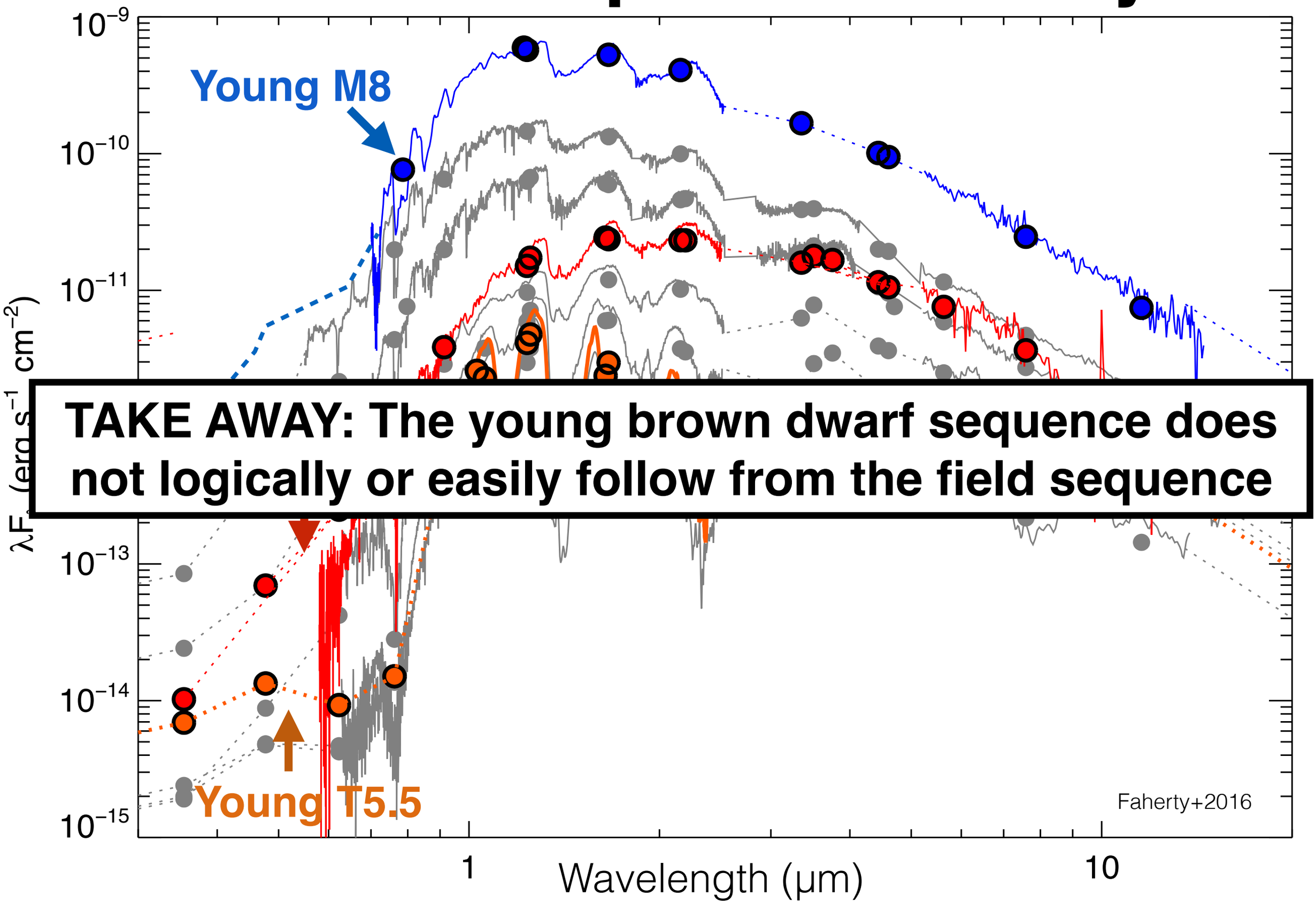
Flux

Wavelength (μm)

BDNYC Spectral Library

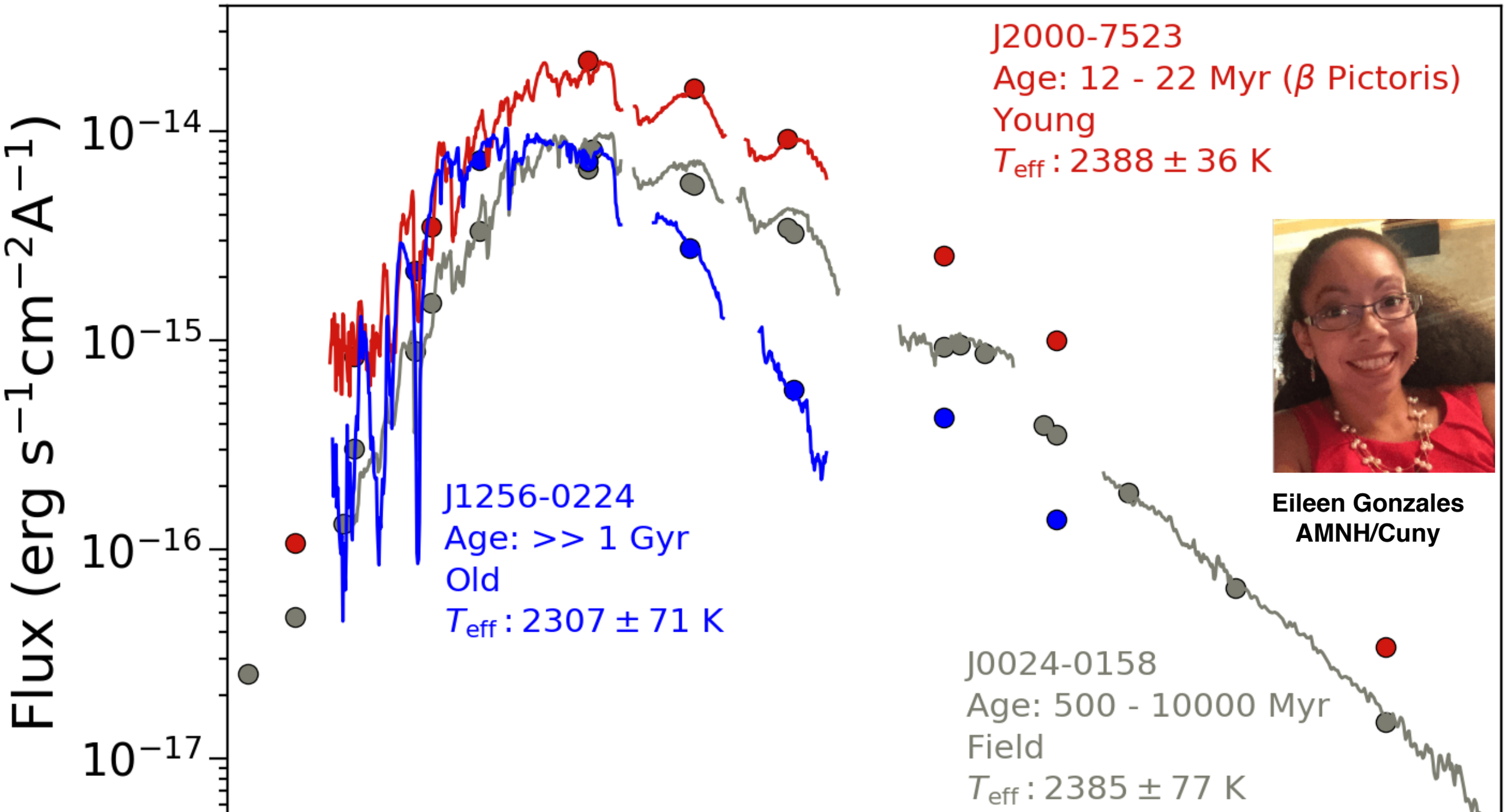


BDNYC Spectral Library



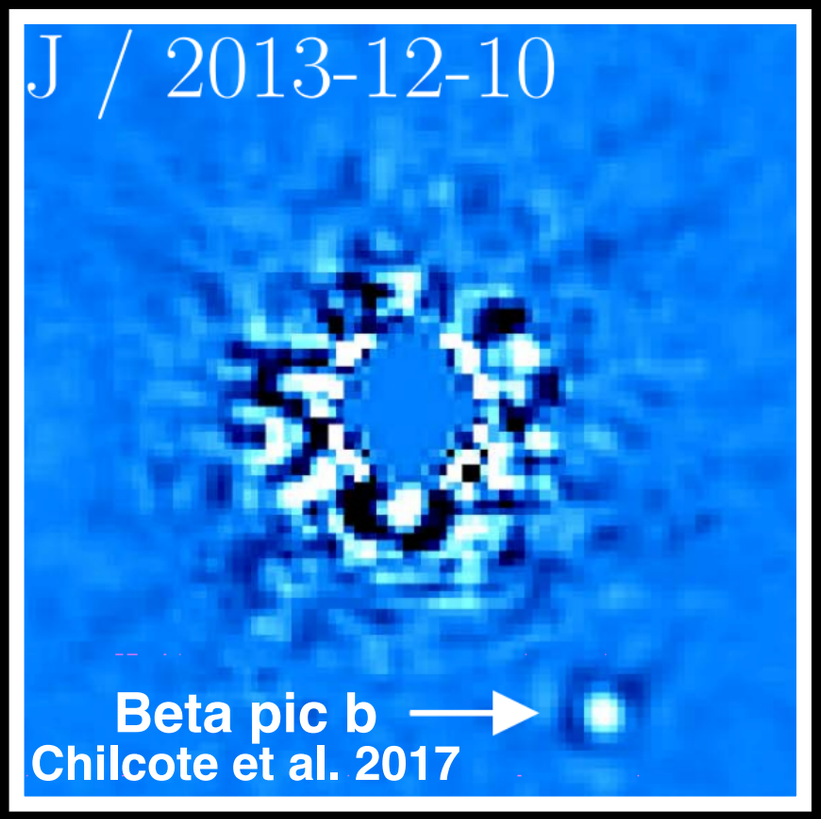
TAKE AWAY: The young brown dwarf sequence does not logically or easily follow from the field sequence

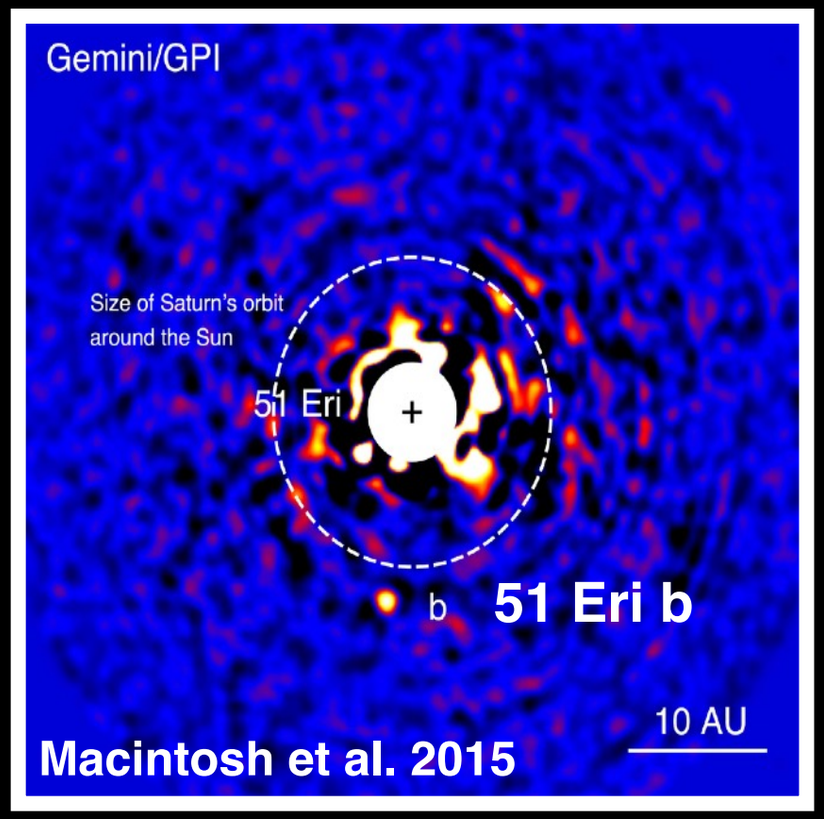
SED's of Old, Young, Field at the same Teff

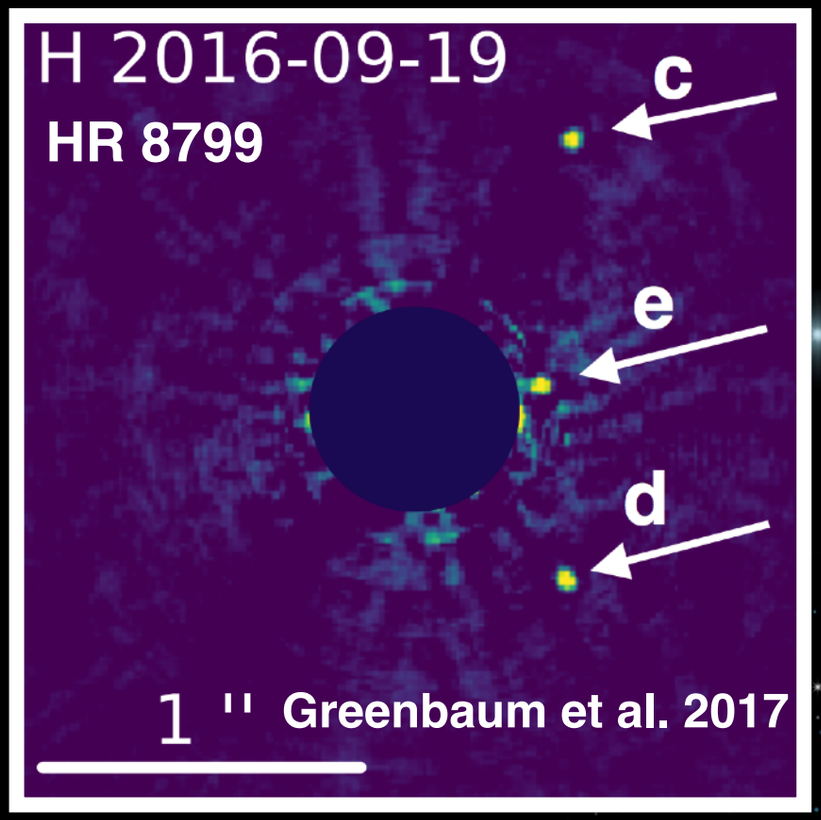


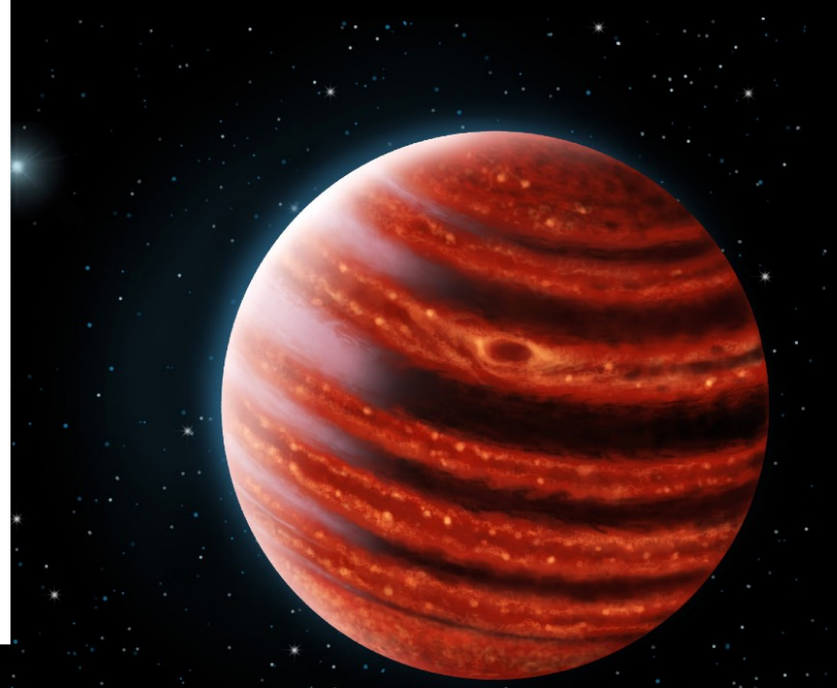
TAKE AWAY: Clouds are prominent in young brown dwarfs and lacking in equivalent temperature old objects

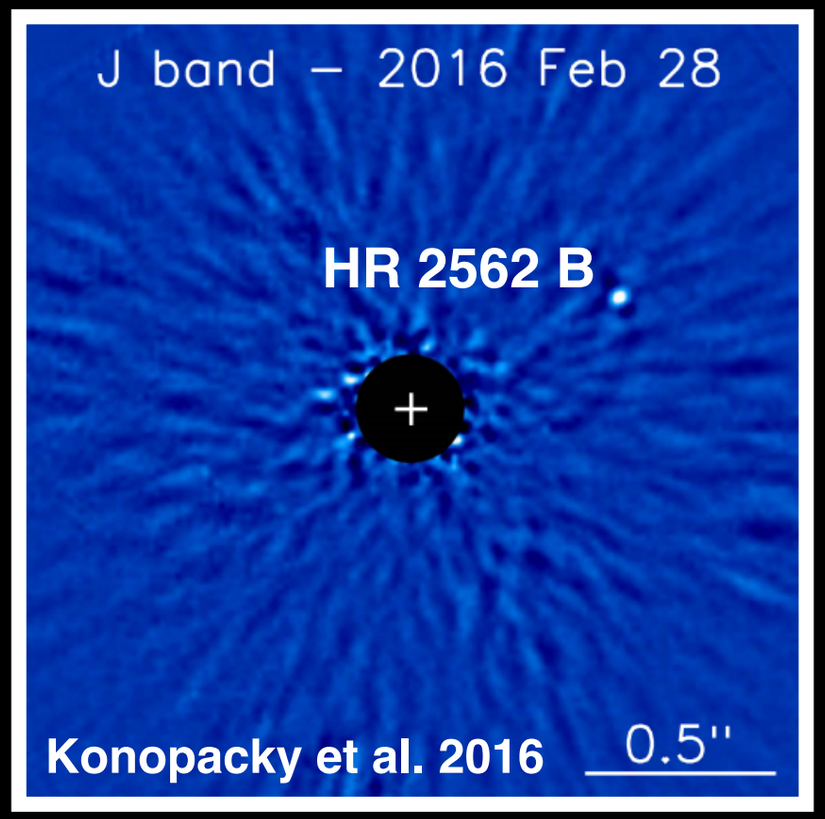
GPI Discoveries



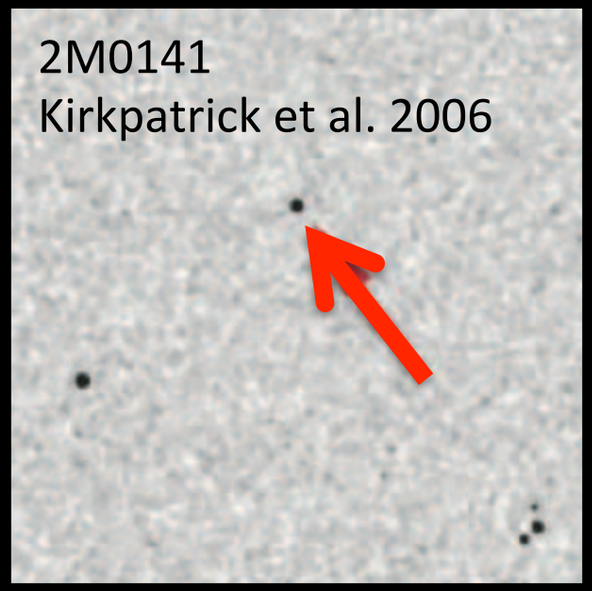


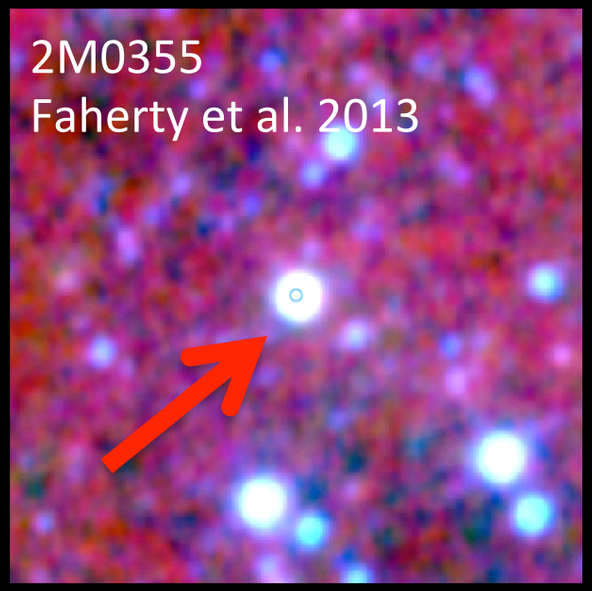


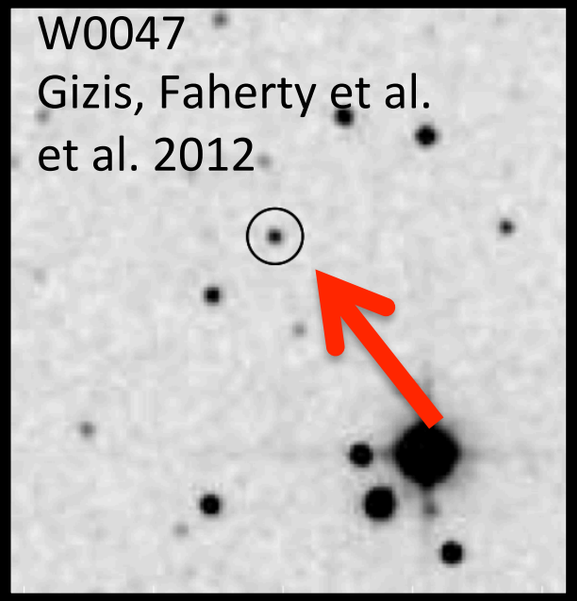


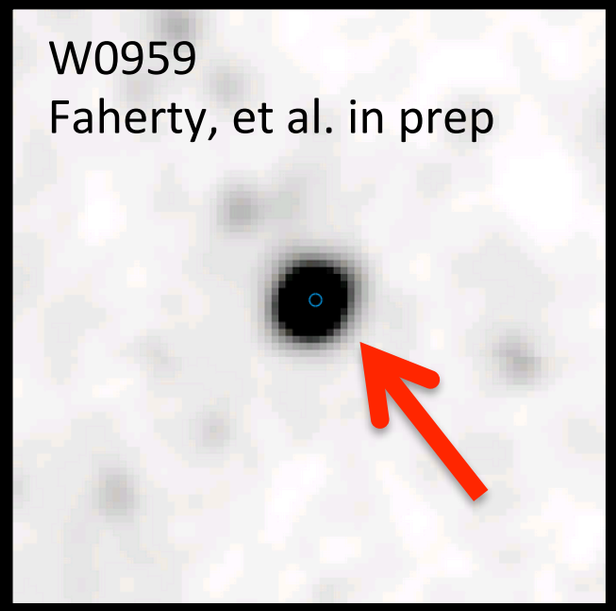


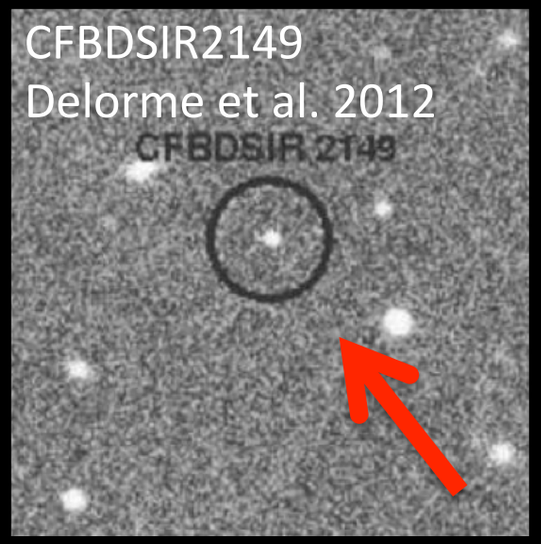
Brown Dwarf Analogs to Directly Imaged Exoplanets

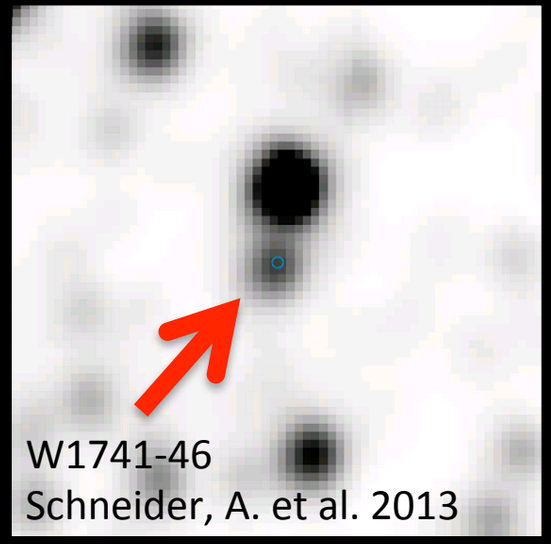


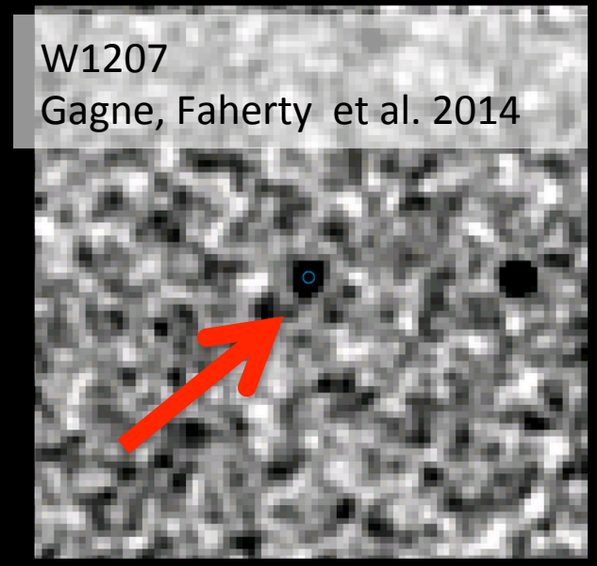












T_{eff}: 1000 K - 2500 K

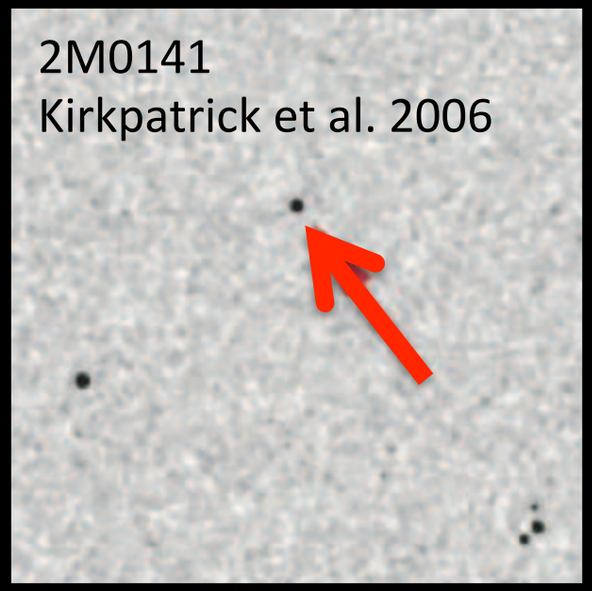
Age: 10 - 130 Myr

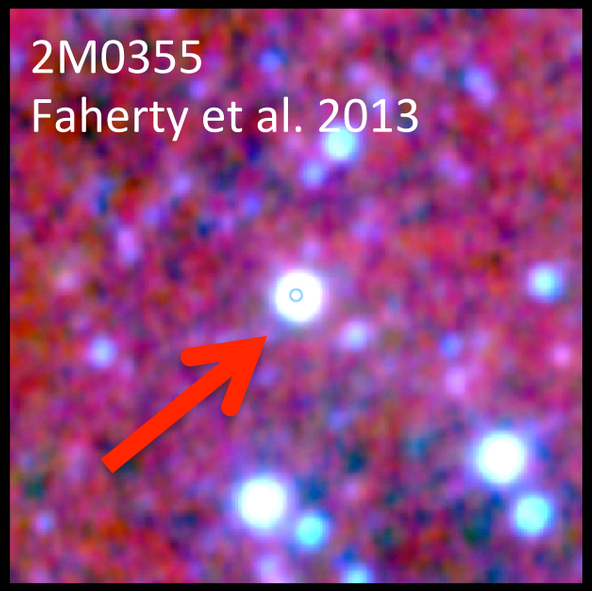
Mass: ~6 - 30 M_{Jup}

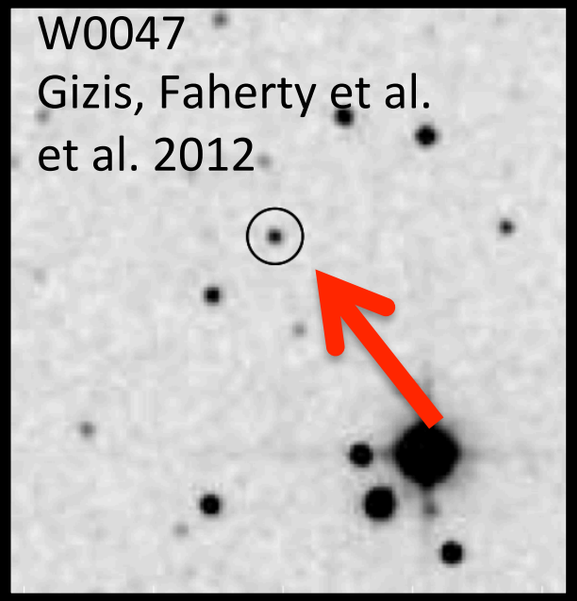
Brown Dwarf Analogs to Directly Imaged Exoplanets

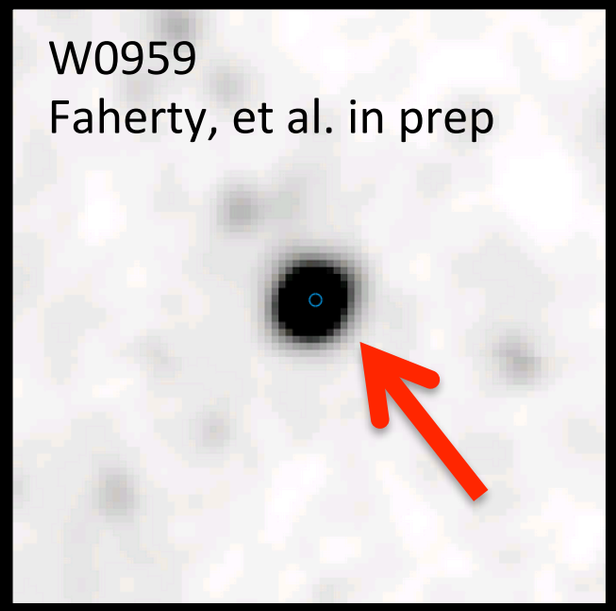
5 - 9 M_{Jup} planet

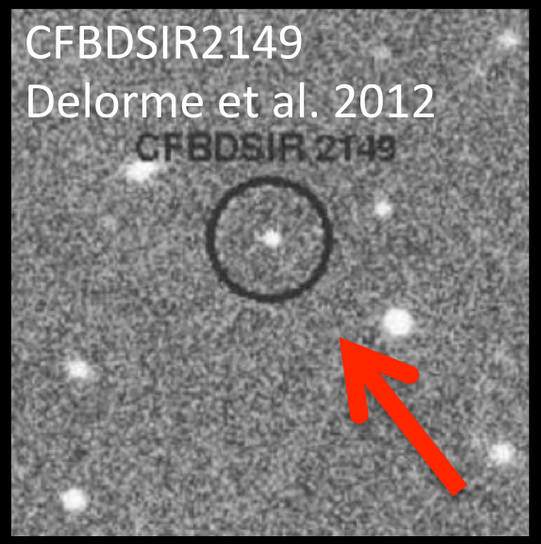
Brown Dwarf Analogs to Directly Imaged Exoplanets

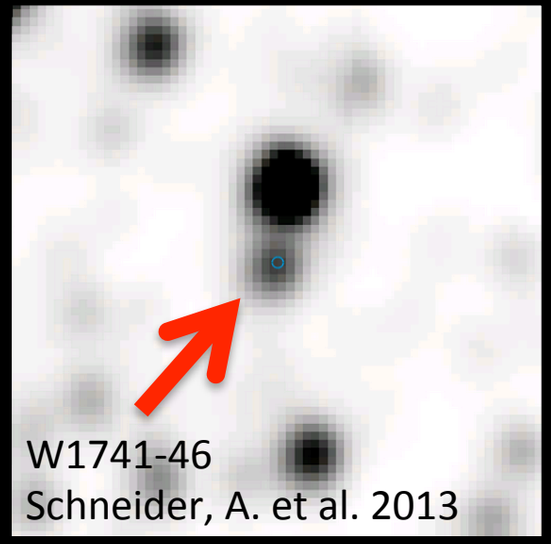


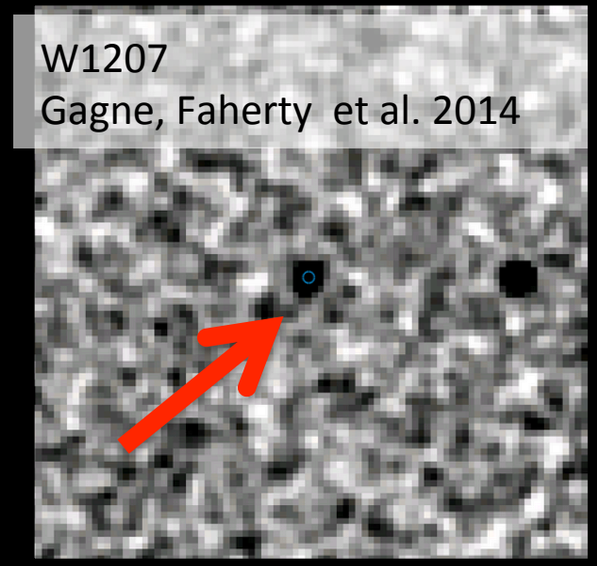












T_{eff}: 1000 K - 2500 K

Age: 10 - 130 Myr

Mass: ~6 - 30 M_{Jup}

Associations of Young Stars Near the Sun

Banyan Sigma Models are blue ellipses

Gagne+Faherty+ et al. 2018

Associations of Young Stars Near the Sun

More new members on the way!
Faherty et al. 2018
Gagne & Faherty 2018
Gagne & Faherty & Mamajek 2018 in press

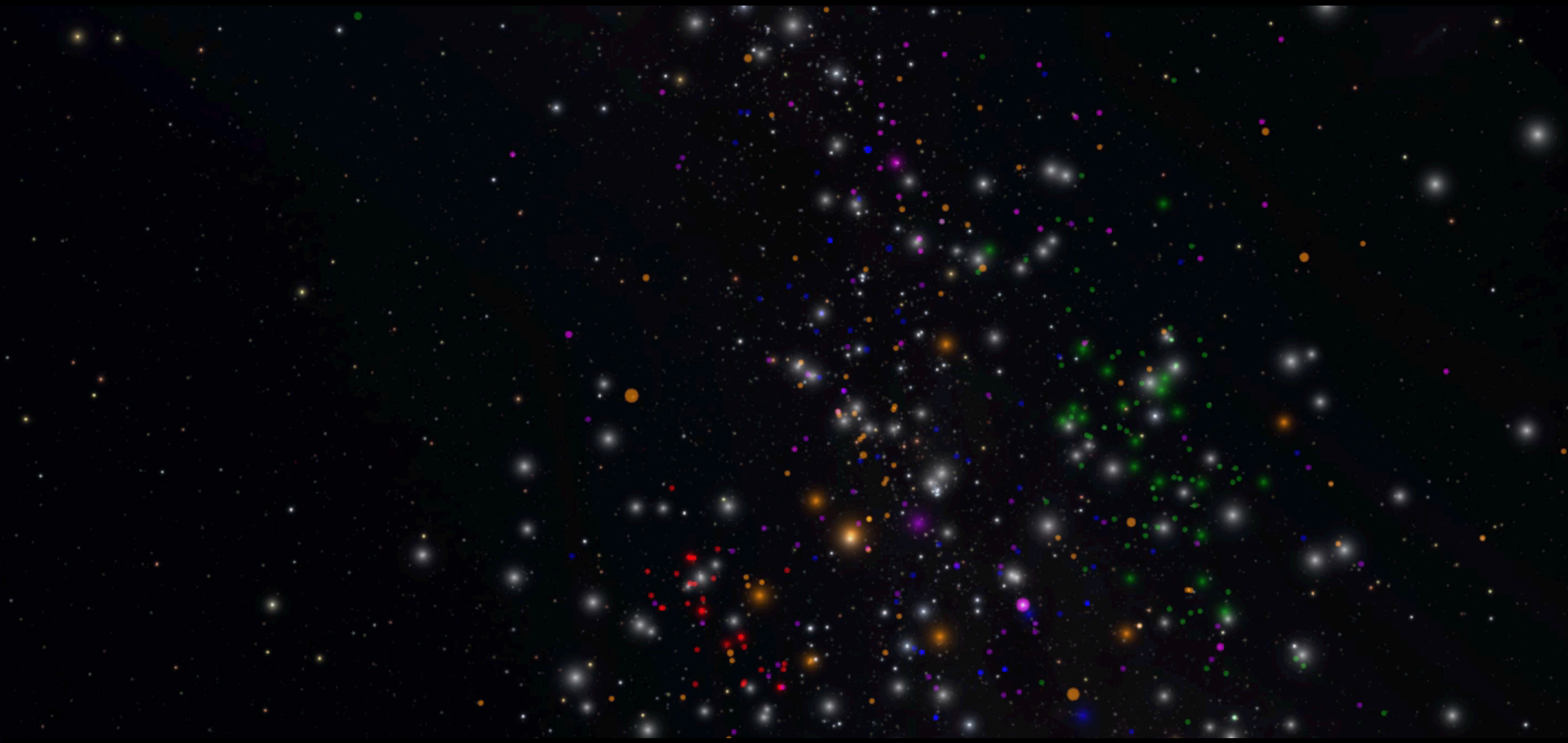
TAKE AWAY: Gaia is a revolutionary catalog with unprecedented insight into nearby star formation

Oh17 Catalog of Co-moving Stars

23 new associations, two within 100pc

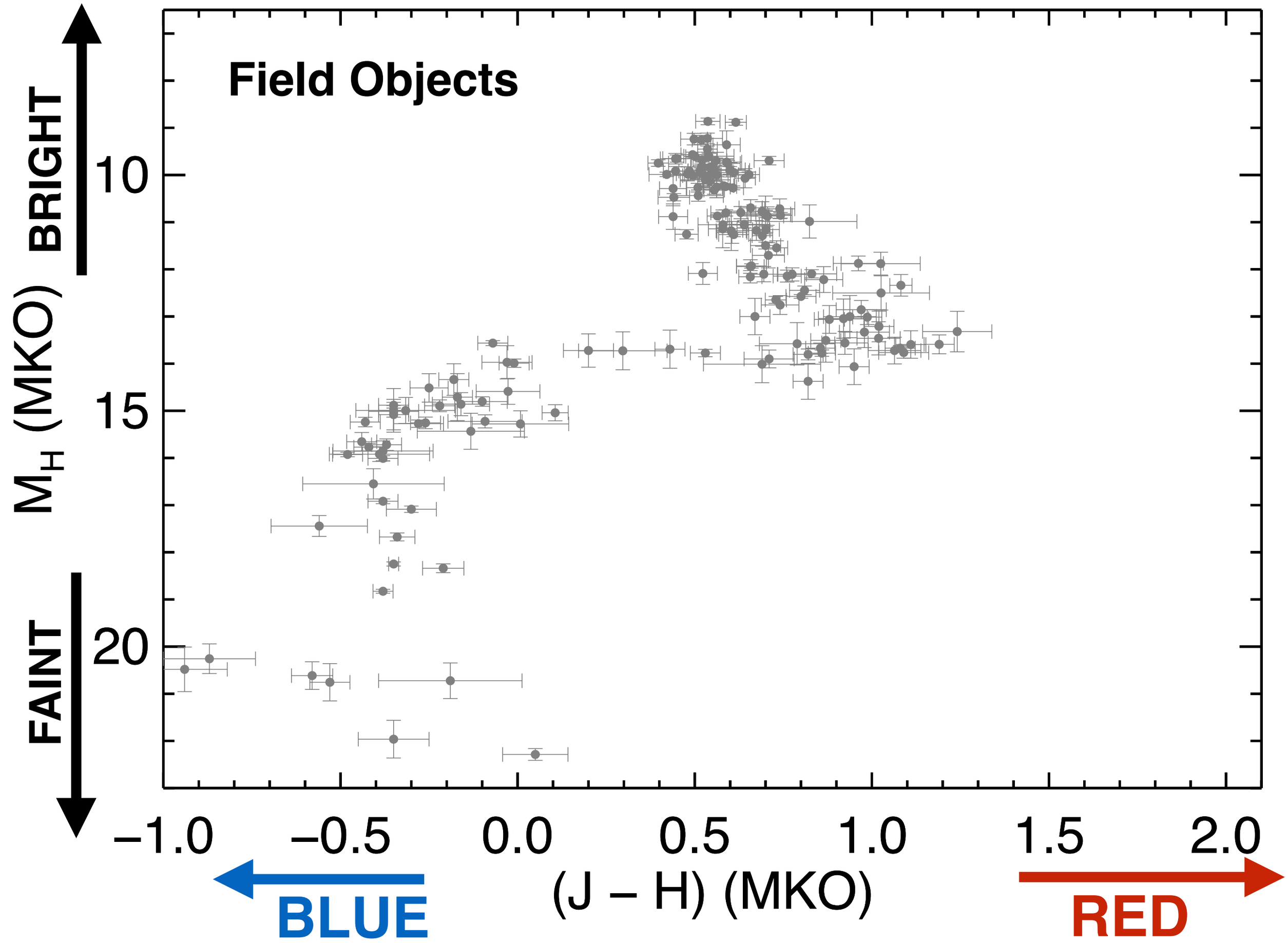
Faherty et al. 2018; Gagne & Faherty & Mamajek 2018 in press

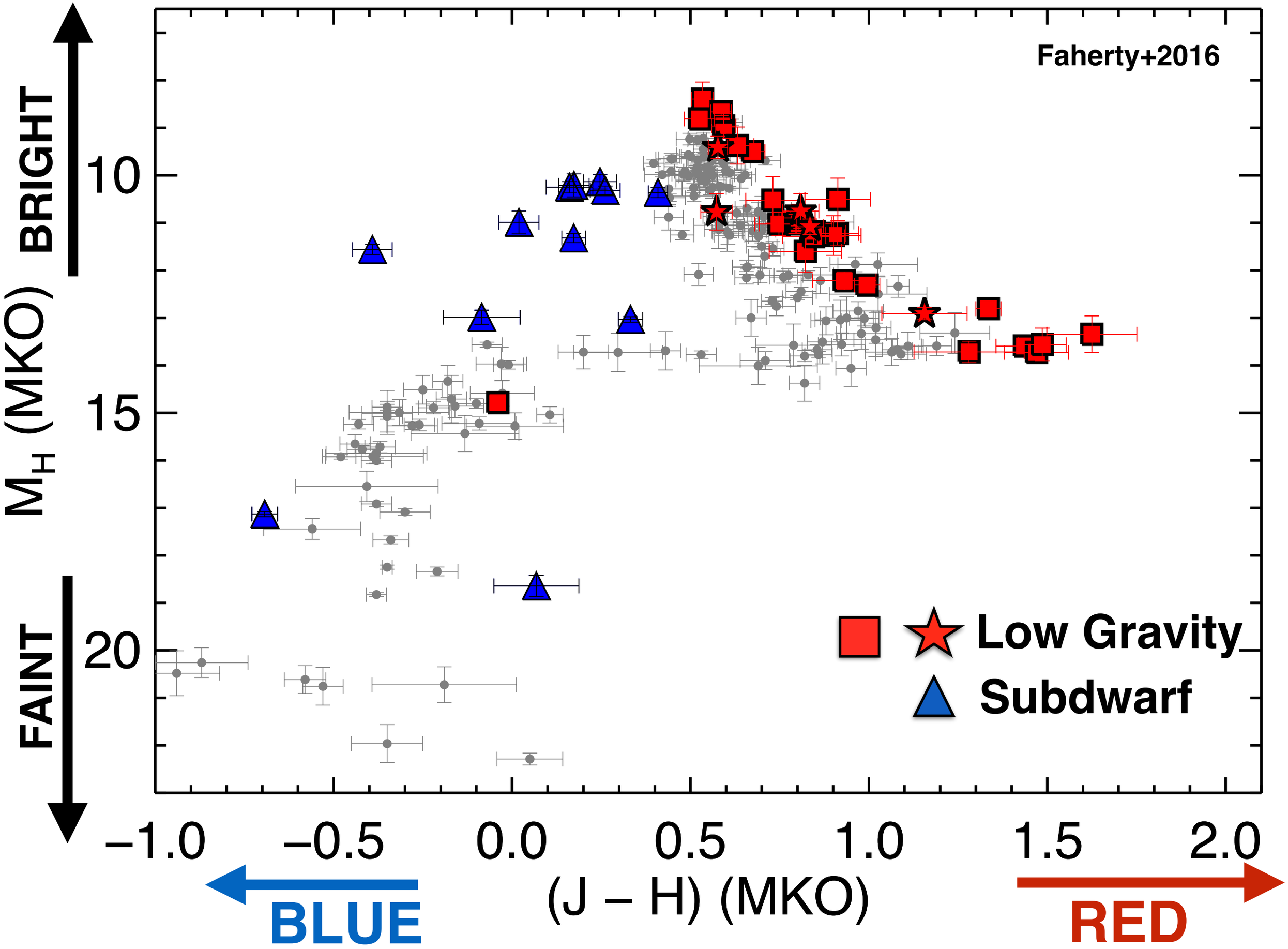
Brown Dwarf Members of Young Associations

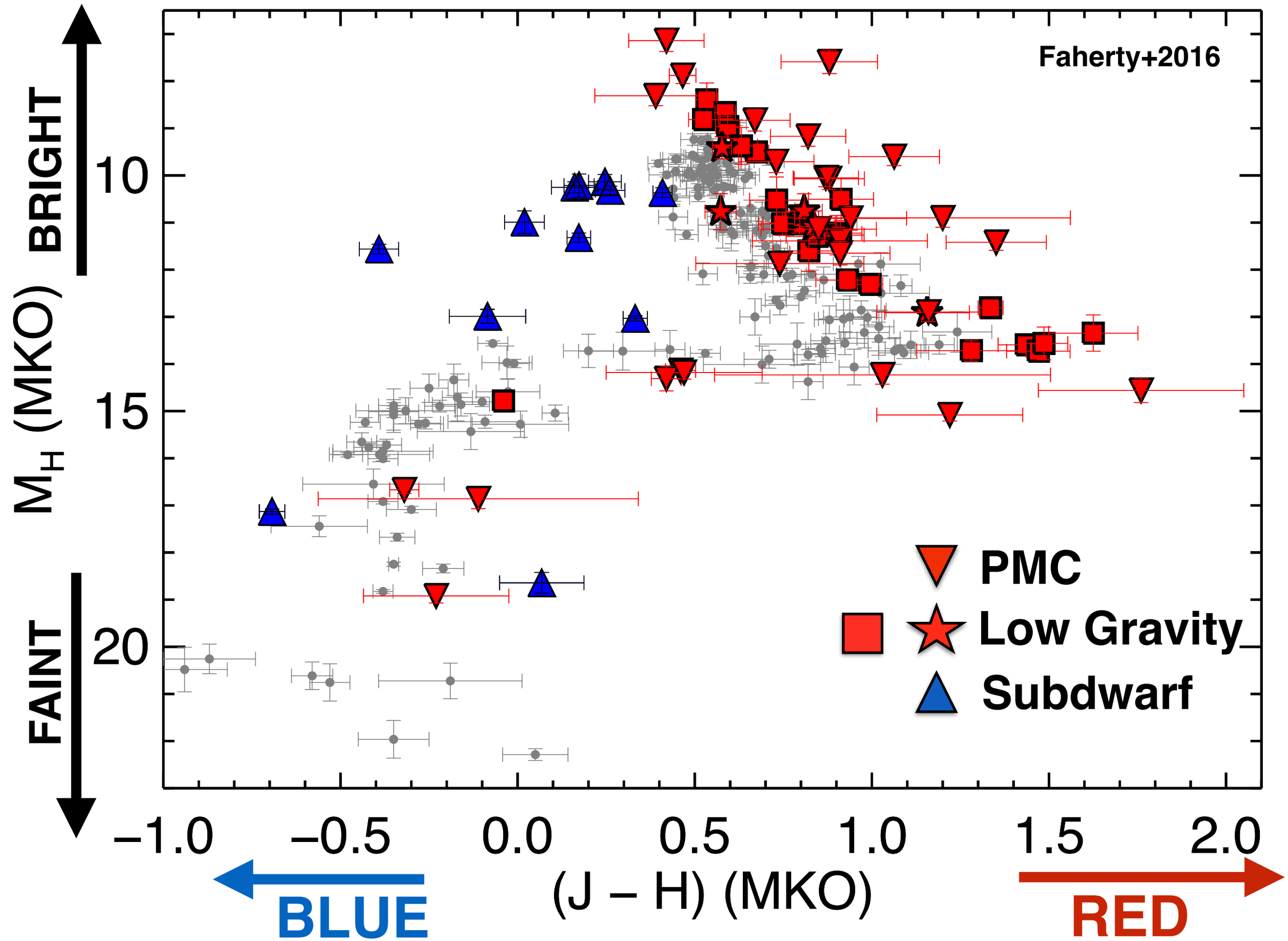


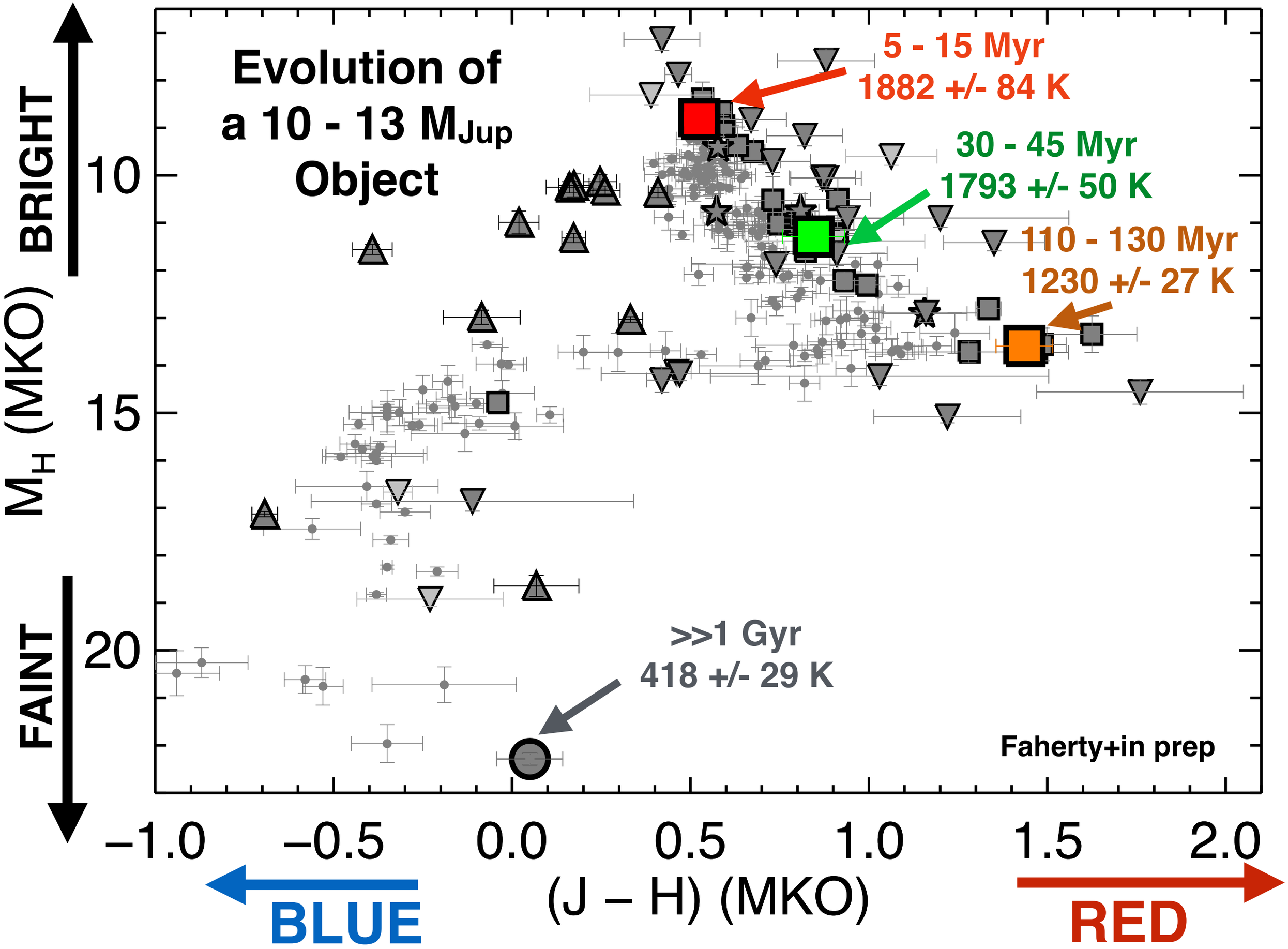
150 objects, 45 confirmed in groups

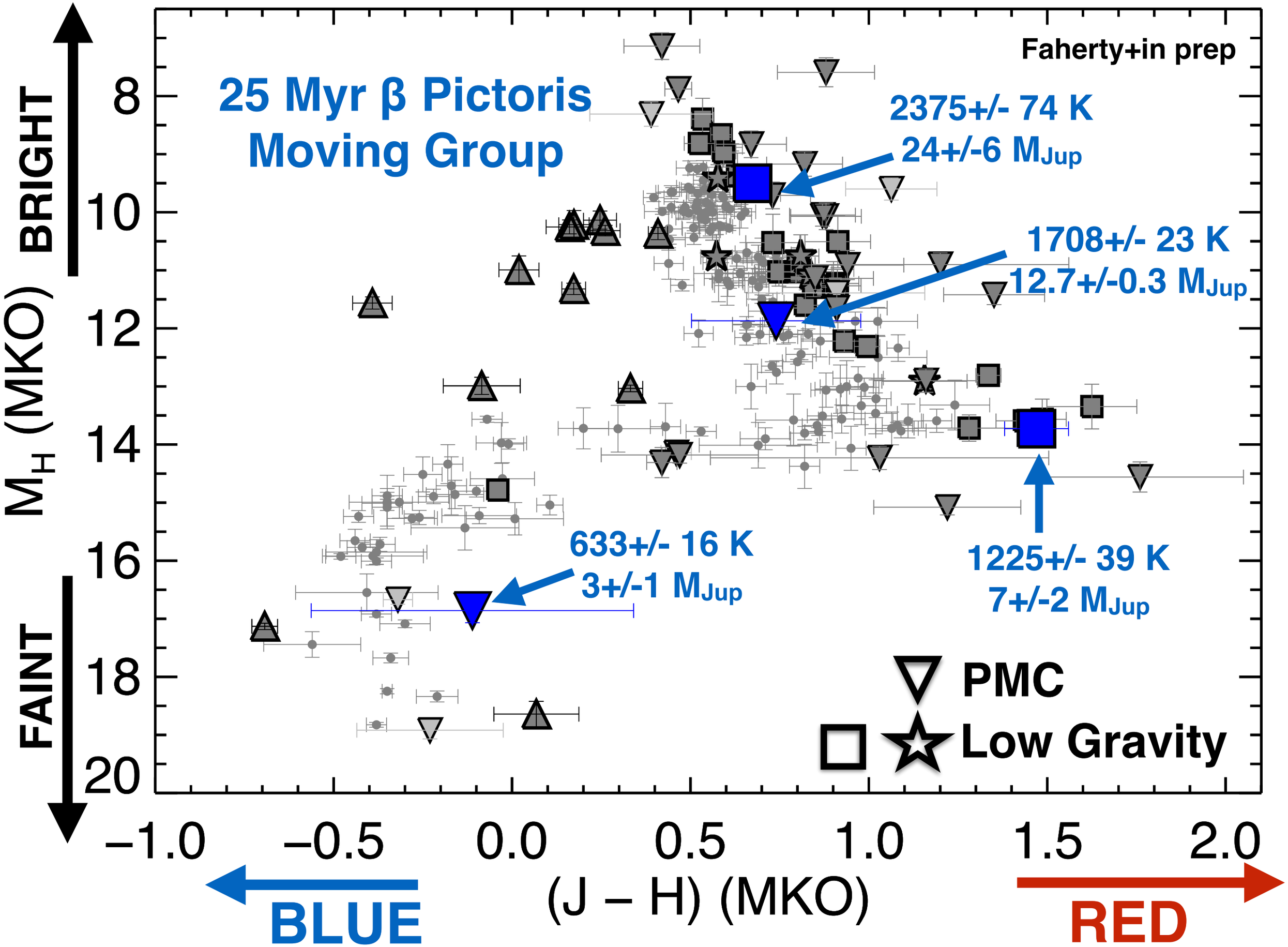
Faherty et al. 2016; Faherty et al. in prep

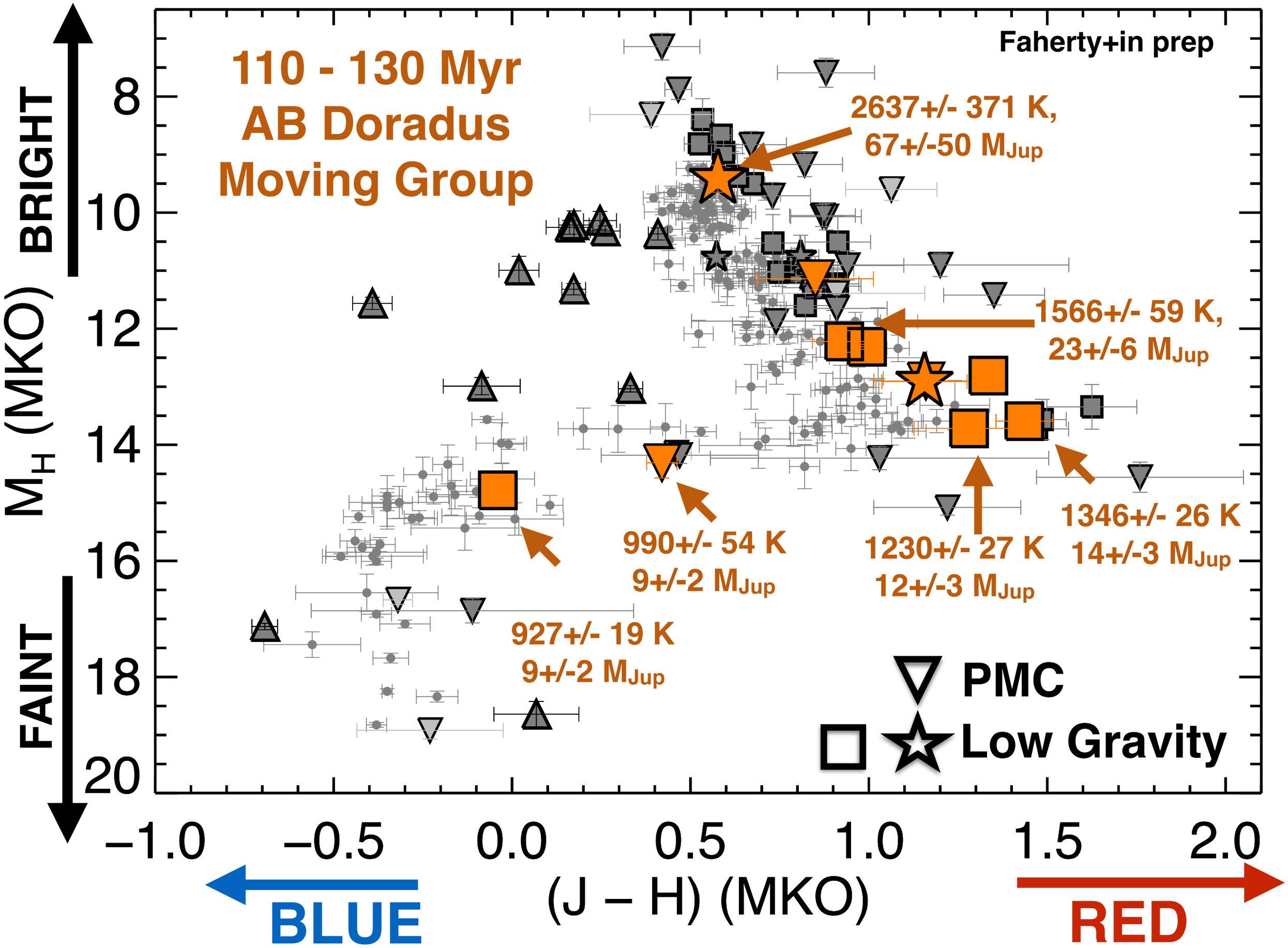

Field Objects
BRIGHT
FAINT
M_H (MKO)
10
15
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED

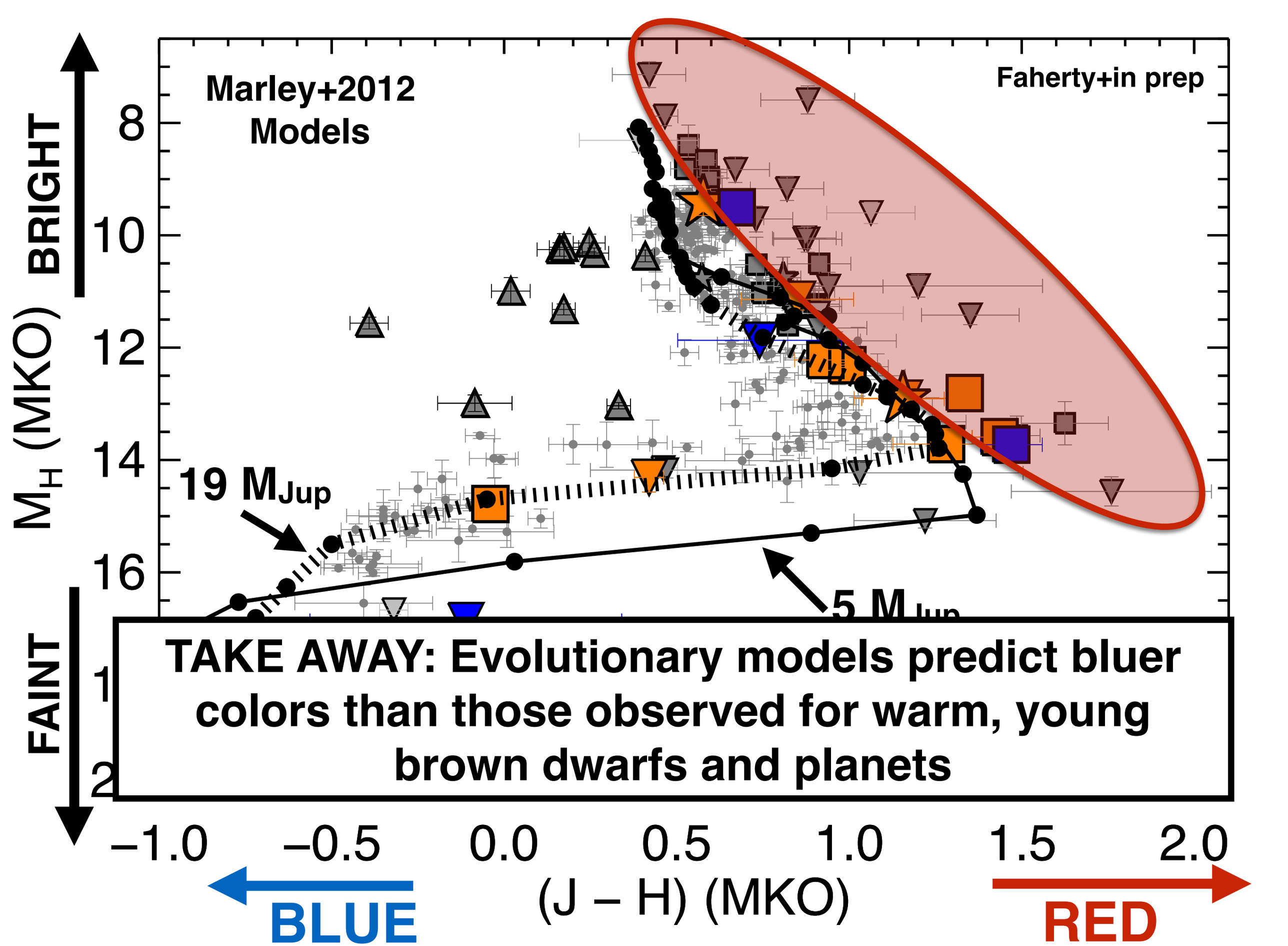

Faherty+2016
BRIGHT
FAINT
M_H (MKO)
10
15
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED
Low Gravity
Subdwarf


Faherty+2016
BRIGHT
FAINT
M_H (MKO)
10
15
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED
PMC
Low Gravity
Subdwarf


Evolution of
a 10 - 13 M_Jup
Object
5 - 15 Myr
1882 +/- 84 K
30 - 45 Myr
1793 +/- 50 K
110 - 130 Myr
1230 +/- 27 K
>>1 Gyr
418 +/- 29 K
Faherty+in prep
BRIGHT
FAINT
M_H (MKO)
10
15
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED


Faherty+in prep
25 Myr β Pictoris
Moving Group
2375+/- 74 K
24+/-6 M_Jup
1708+/- 23 K
12.7+/-0.3 M_Jup
633+/- 16 K
3+/-1 M_Jup
1225+/- 39 K
7+/-2 M_Jup
PMC
Low Gravity
BRIGHT
FAINT
M_H (MKO)
8
10
12
14
16
18
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED


110 - 130 Myr
AB Doradus
Moving Group
Faherty+in prep
2637+/- 371 K,
67+/-50 M_Jup
1566+/- 59 K,
23+/-6 M_Jup
990+/- 54 K
9+/-2 M_Jup
1230+/- 27 K
12+/-3 M_Jup
1346+/- 26 K
14+/-3 M_Jup
927+/- 19 K
9+/-2 M_Jup
PMC
Low Gravity
BRIGHT
FAINT
M_H (MKO)
8
10
12
14
16
18
20
–1.0
–0.5
0.0
0.5
1.0
1.5
2.0
(J – H) (MKO)
BLUE
RED



TAKE AWAY: Evolutionary models predict bluer colors than those observed for warm, young brown dwarfs and planets

TAKEAWAYS

J. Faherty BDNYC @jfaherty

- **The young brown dwarf sequence does not logically or easily follow from the field sequence**
- **Clouds are prominent in young brown dwarfs and lacking in equivalent temperature old objects**
- **Gaia provides new members of known groups (new targets for GPI!) and entirely new associations (new targets for GPI!)**
- **Young brown dwarfs show a diversity in their spectral features even though they have similar Teff, and age.**
- **Understanding gravity, metallicity, temperature, and age effects together is critical to interpreting future exoplanet spectra.**