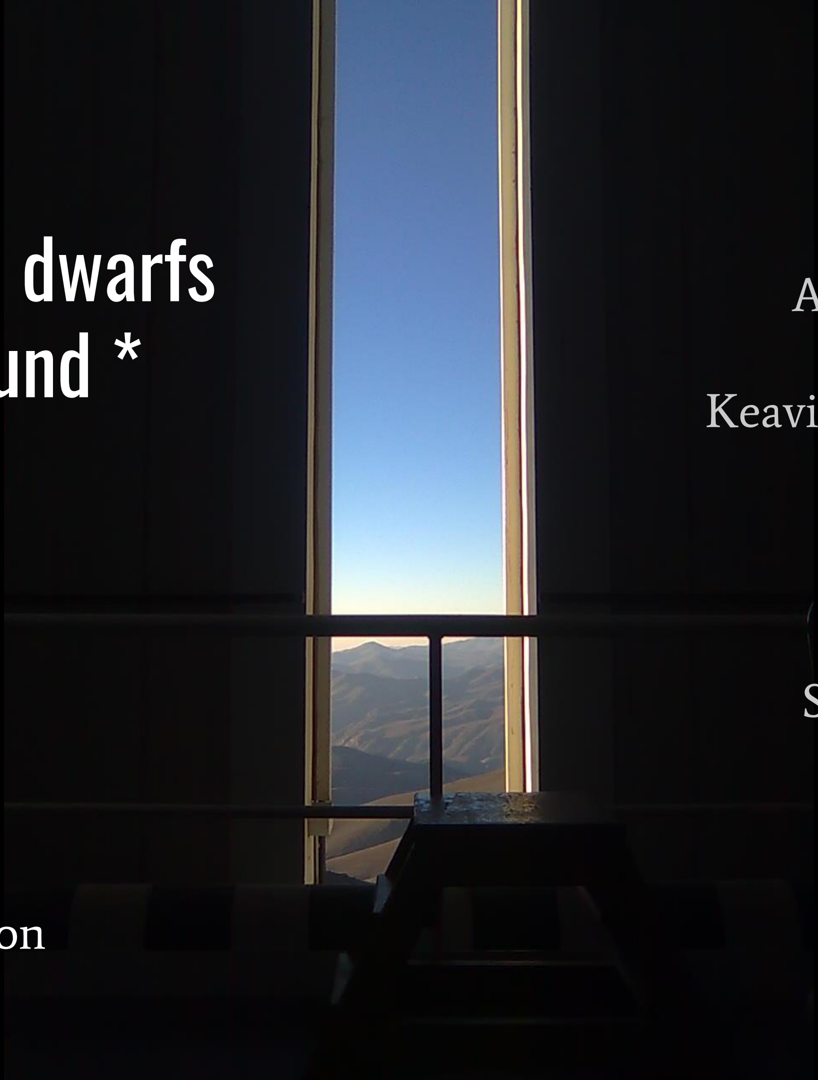
Watching brown dwarfs go round and round *



Aleks Scholz (St Andrews)

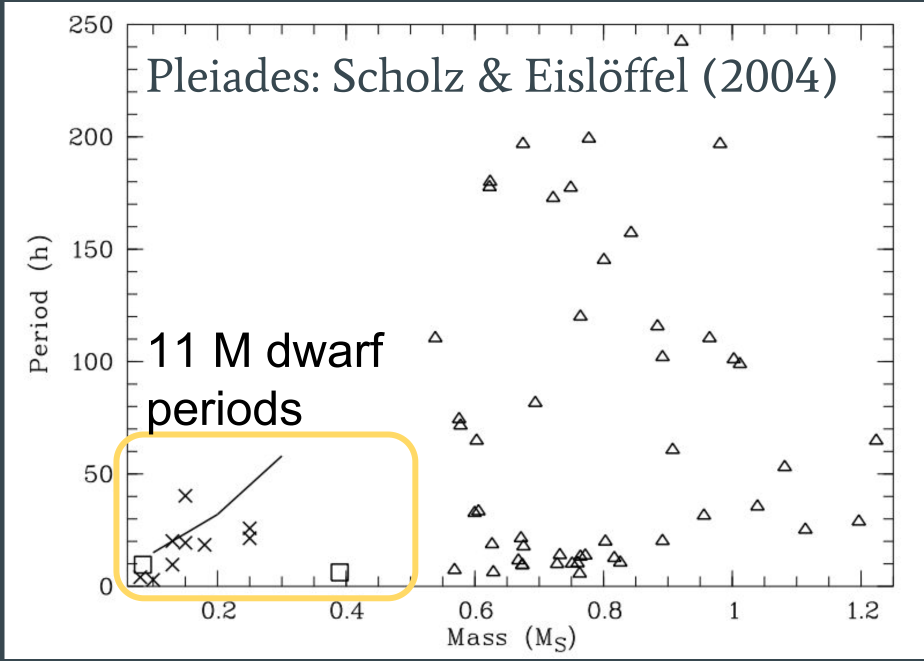
Keavin Moore (York→McGill)
Dawn Peterson (SSI)

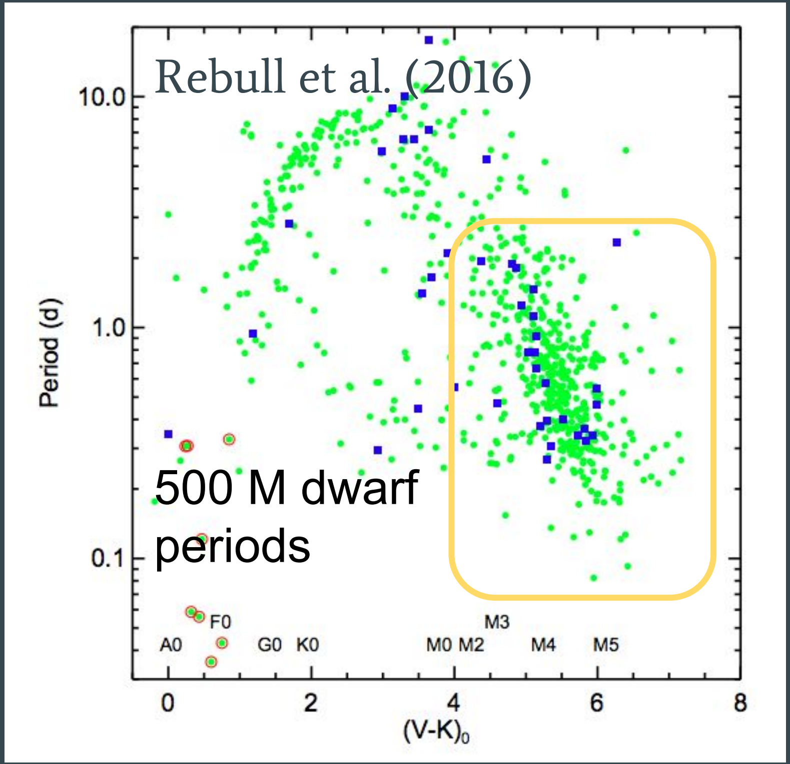
Ray Jayawardhana (York→Cornell)
Suzanne Aigrain (Oxford)
Beate Stelzer (Tübingen)
Veselin Kostov (NASA)
Koraljka Muzic (Lisbon)

* Thanks to John Lennon and Scott Wolk

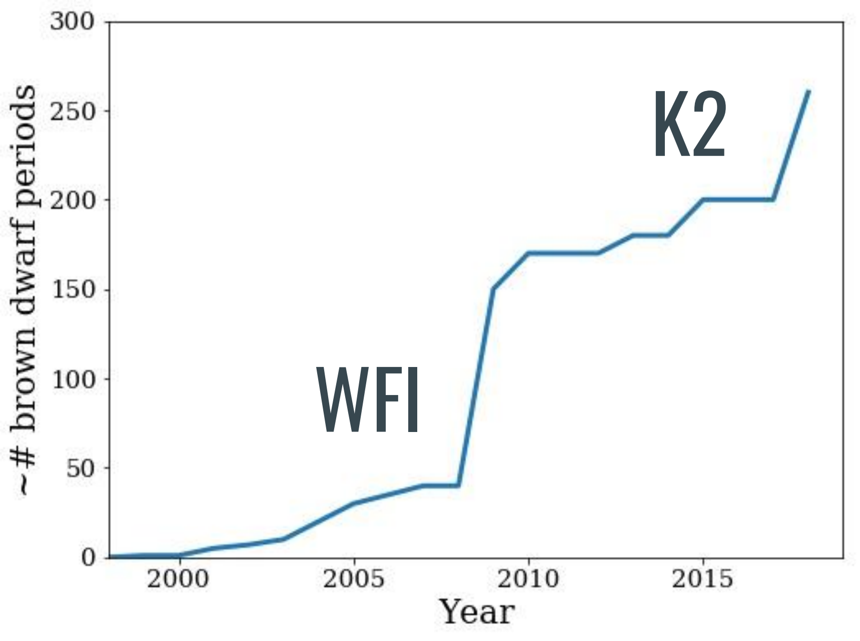
Why didn’t Amundson fly to the pole with a helicopter?

Why didn't I wait for K2 to do my PhD thesis?





Brown dwarf rotation: the database for 0.02-0.08 Msol



1-2 Myr: ~120 periods

Rodriguez Ledesma 2009, ***Scholz 2018, +***

3-20 Myr: ~100 periods

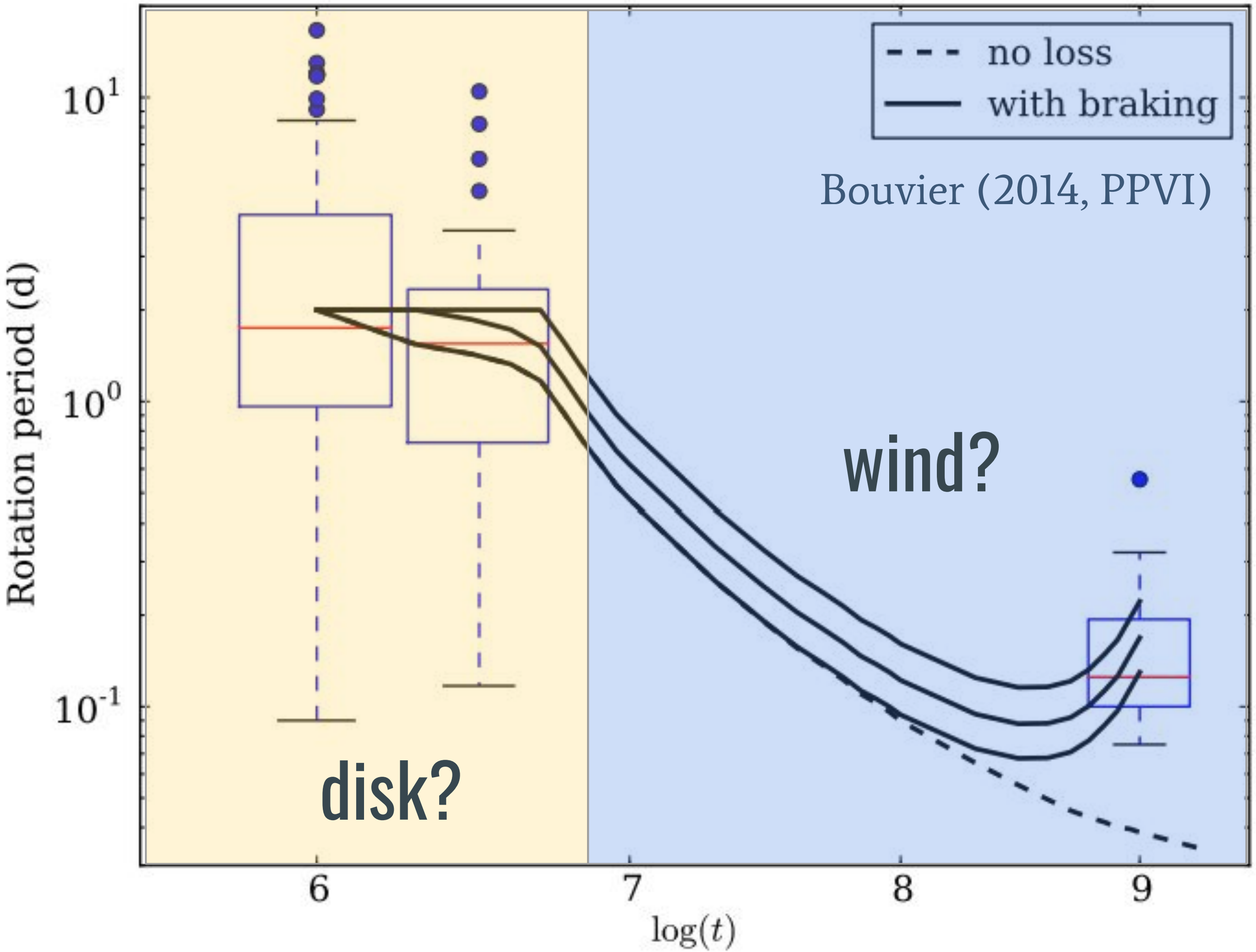
Scholz 2004/05, Cody 2010, ***Scholz 2015***, Rebull 2018, ***Moore 2018, +***

Field: ~20 periods, plus vsini

Many papers

Brown dwarfs: fast rotators

But how fast? And why?

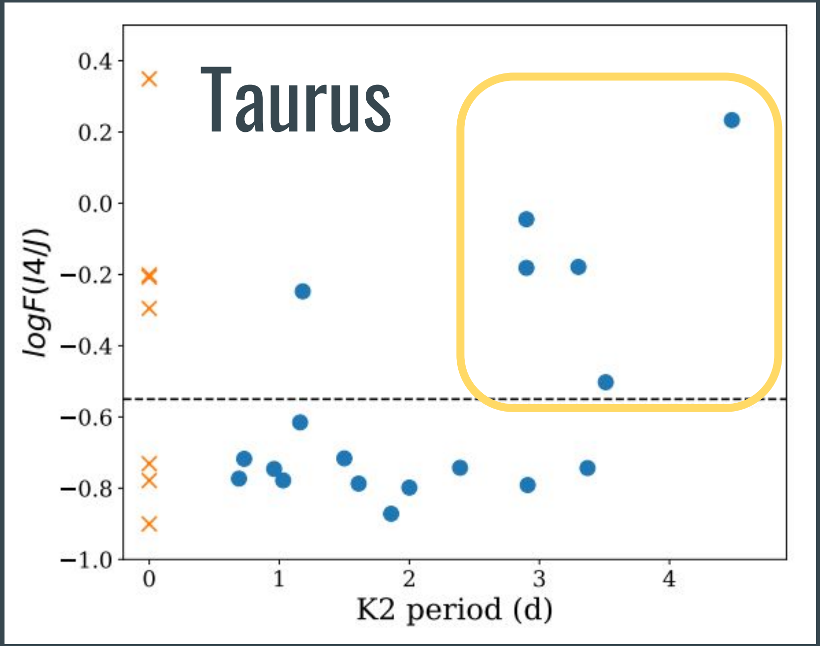


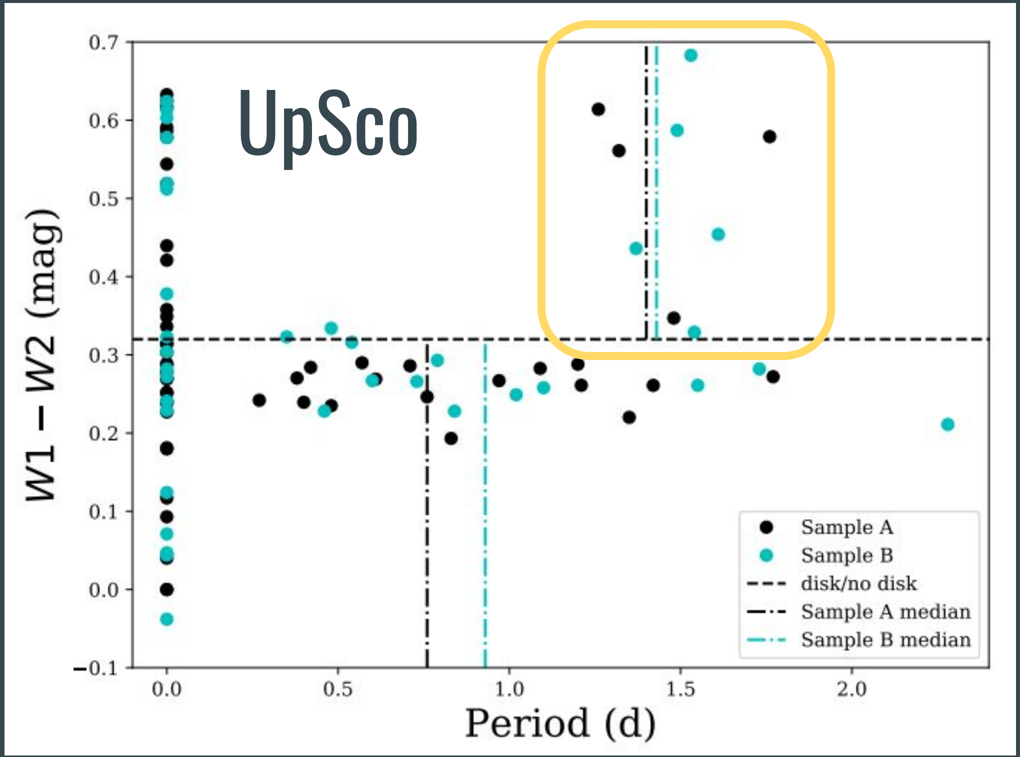
no loss
with braking
Bouvier (2014, PPVI)
wind?
disk?
Rotation period (d)
10^1
10^0
10^{-1}
6
7
8
9
log(t)

Wind braking: very weak*

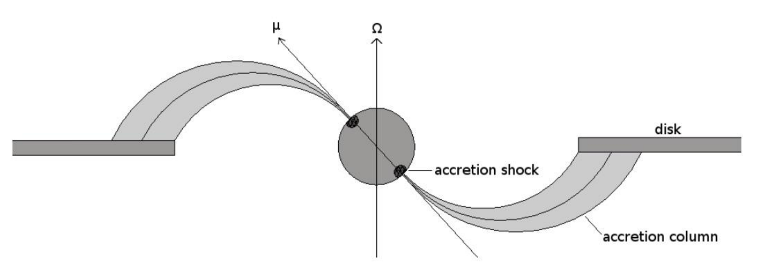
* factor 10000 weaker than in solar-type stars

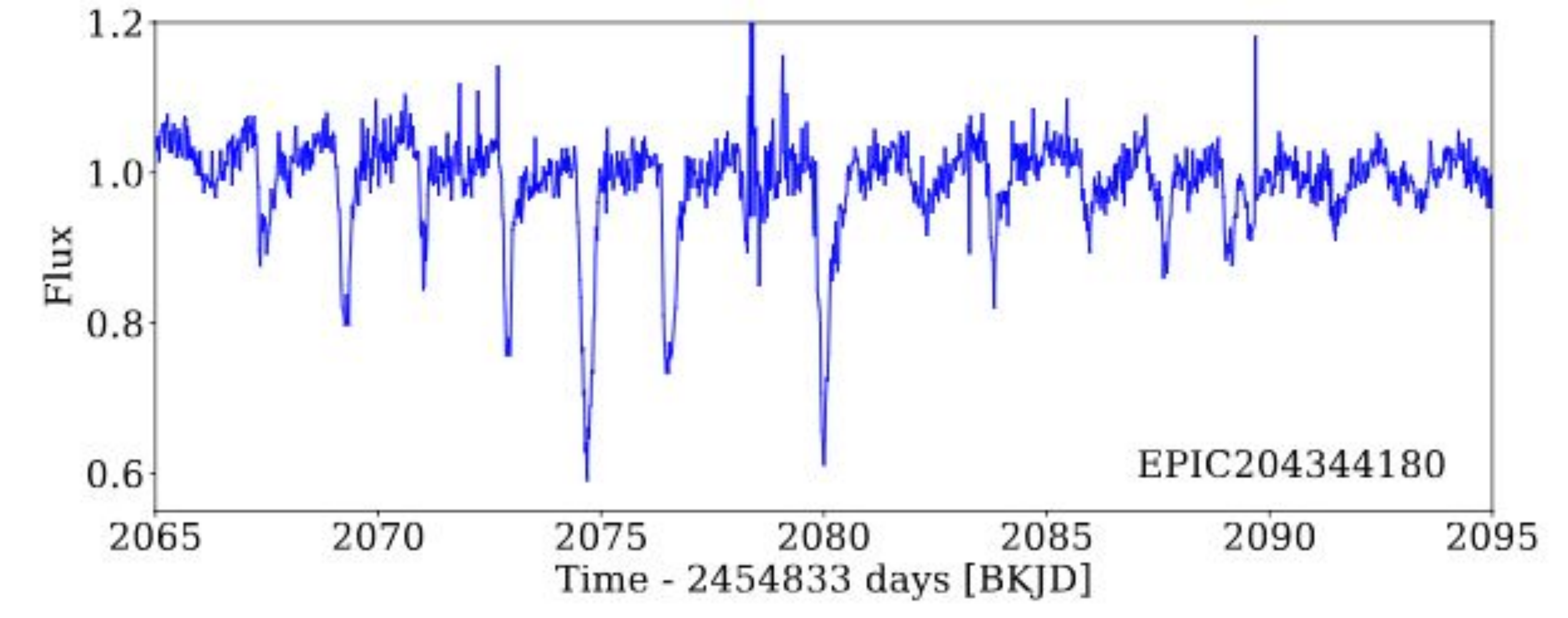
Finally: Rotation vs. disk





Dippers: locked rotation

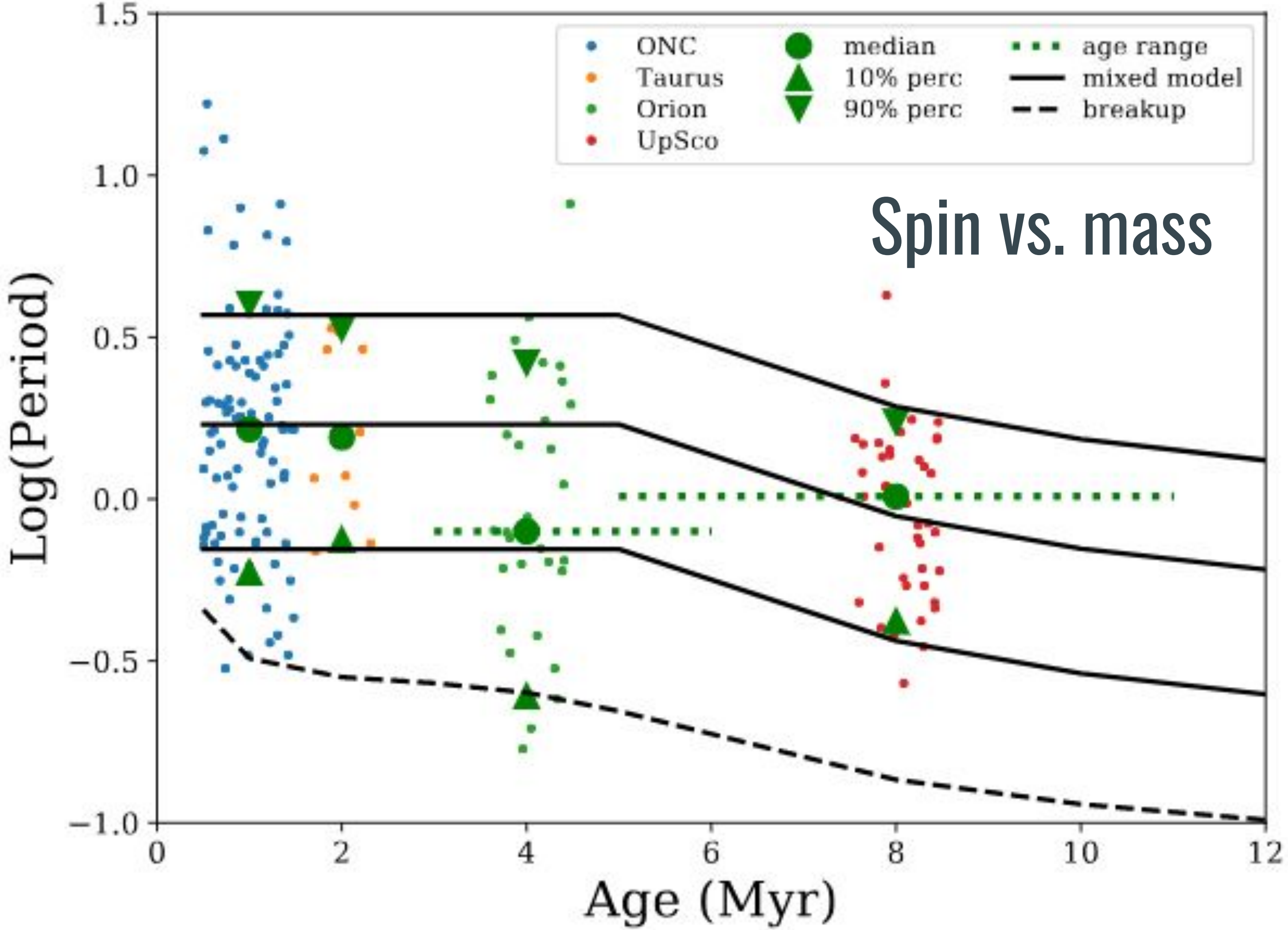




Rotation period: 1.79 d

Dipper period: 1.9 d

Spin vs. mass

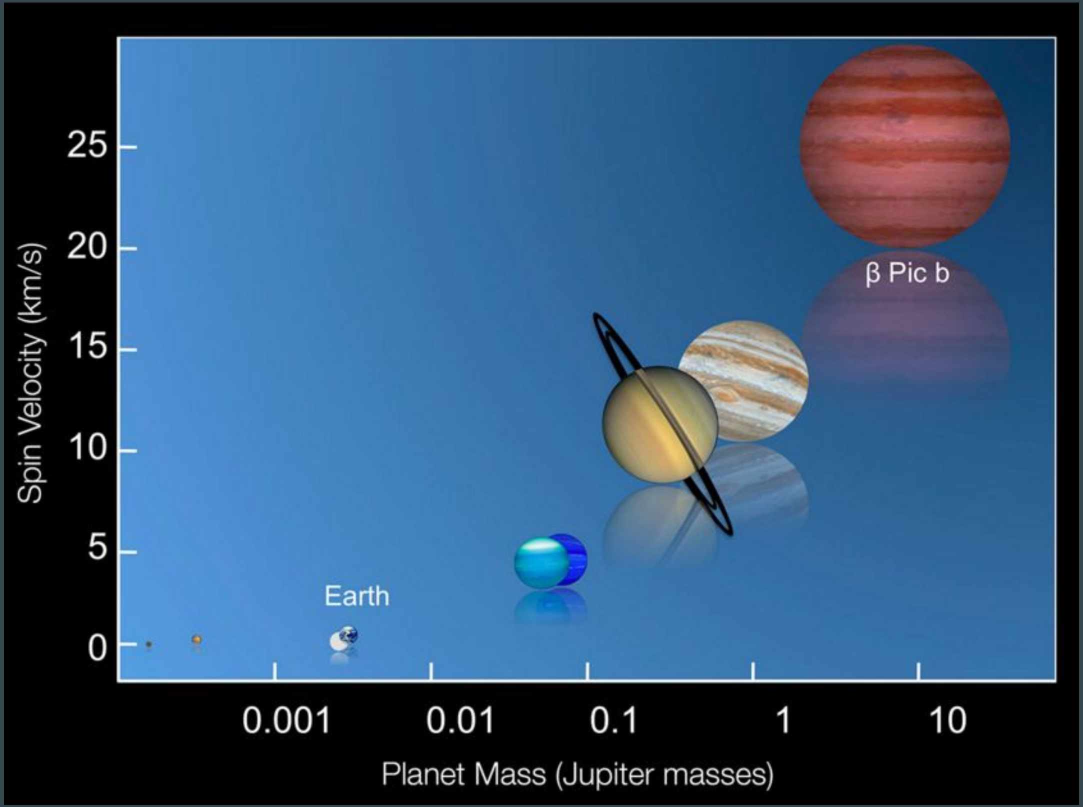


ONC
Taurus
Orion
UpSco
median
10% perc
90% perc
age range
mixed model
breakup
Log(Period)
Age (Myr)
1.5
1.0
0.5
0.0
−0.5
−1.0
0
2
4
6
8
10
12

Disk braking in brown dwarfs*

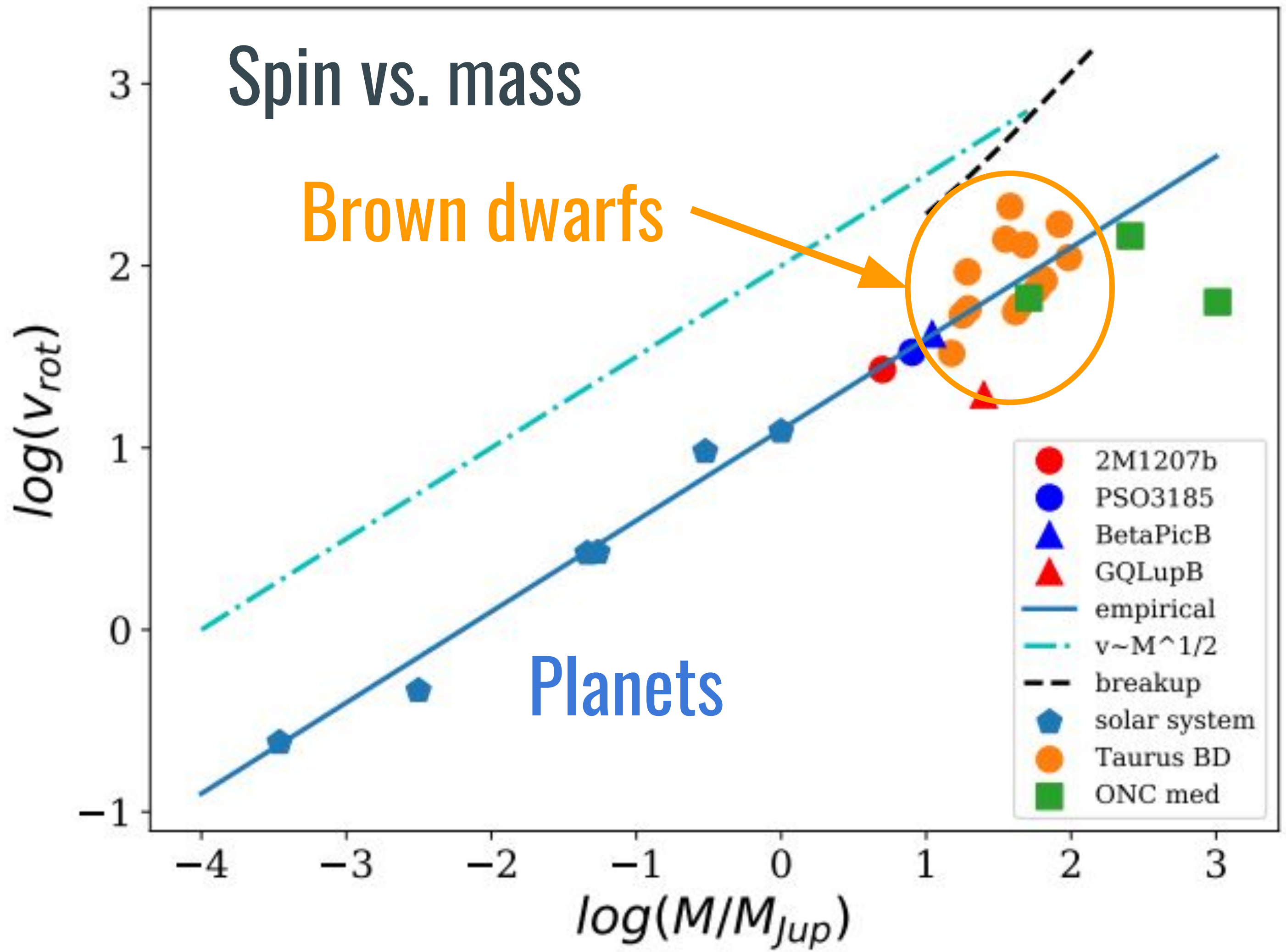
* Moore, Scholz, & Jayawardhana, ApJ, submitted

The planetary spin-mass relation



Snellen et al. 2014: first exoplanet spin rate

Power law relation between spin and mass from rocky planets to gas giants


Spin vs. mass
Brown dwarfs
Planets
$\log(v_{rot})$
$\log(M/M_{Jup})$
3
2
1
0
−1
−4
−3
−2
−1
0
1
2
3
2M1207b
PSO3185
BetaPicB
GQLupB
empirical
v~M^1/2
breakup
solar system
Taurus BD
ONC med

Young brown dwarfs:

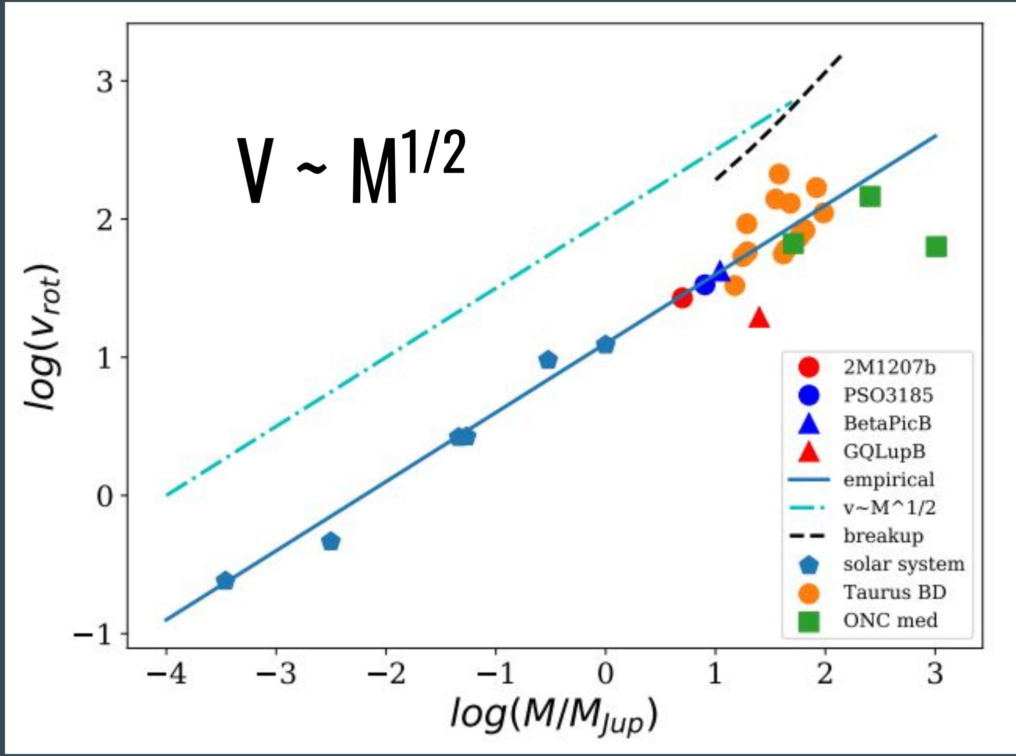
primordial rotation

Rotation as a limit for formation

Three formation paths, same v~M$^{1/2}$.

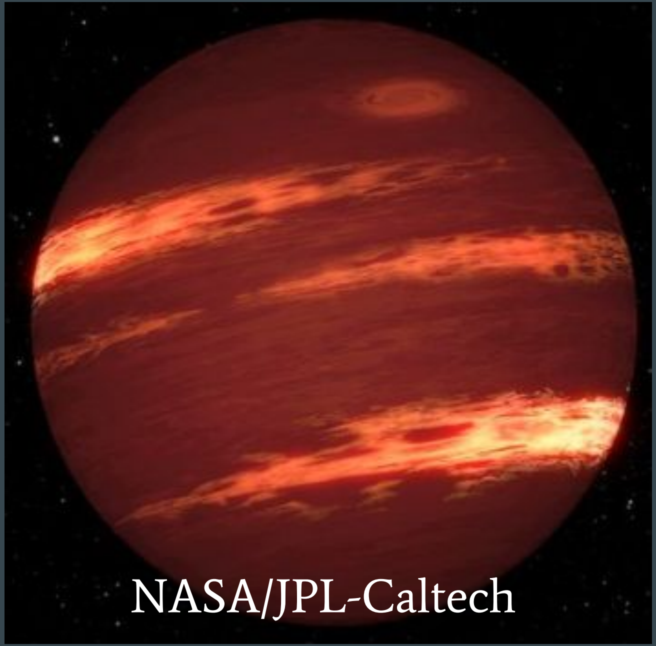
Breakup velocity provides scaling.

Accretion controlled by rotation.

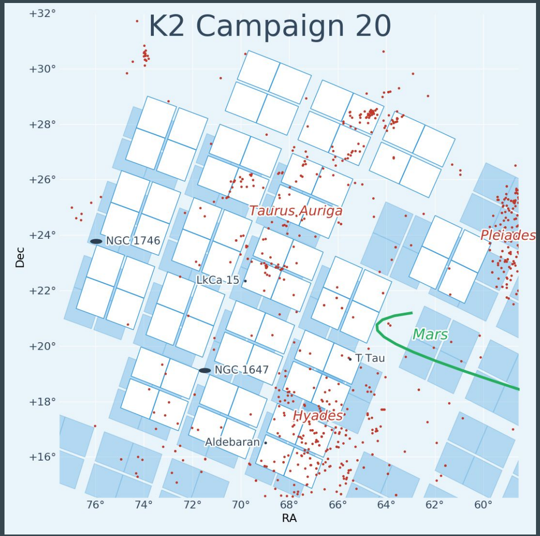


Scholz et al. 2018, ApJ

The impact of rotation: clouds, activity, accretion?



Wishlist: deep and wide survey with fast cadence



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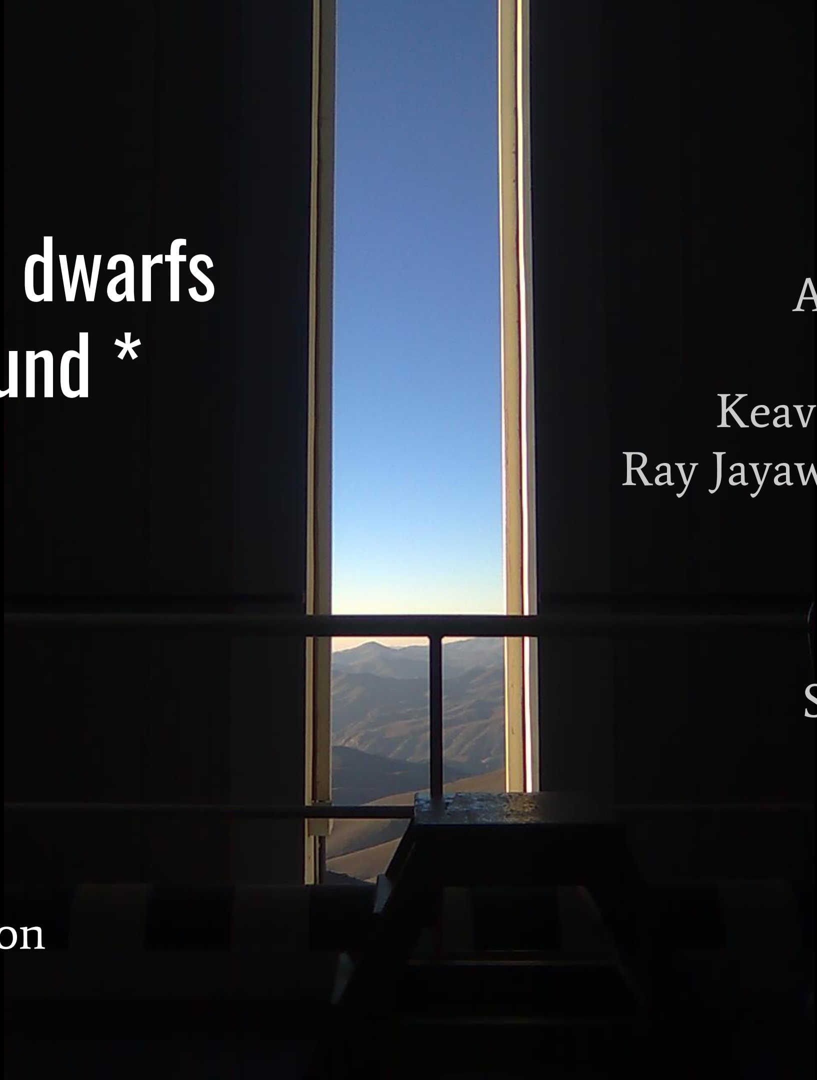

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