Problem Set on chairs

Test in one week (!)

test prep advice } posted later
last yrs test } today or tomorrow

OPEN book
NO calculators (or other electronics)
+ extra review session weds 9:15pm

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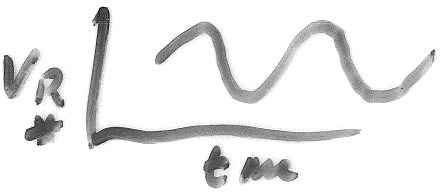
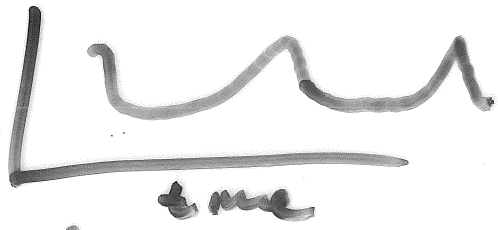
lots of hot Jupiters



by now: planets in much longer orbits (few years)
→ highly elliptical orbits in some cases
↓
non-sinusoidal velocity curves



HD209458

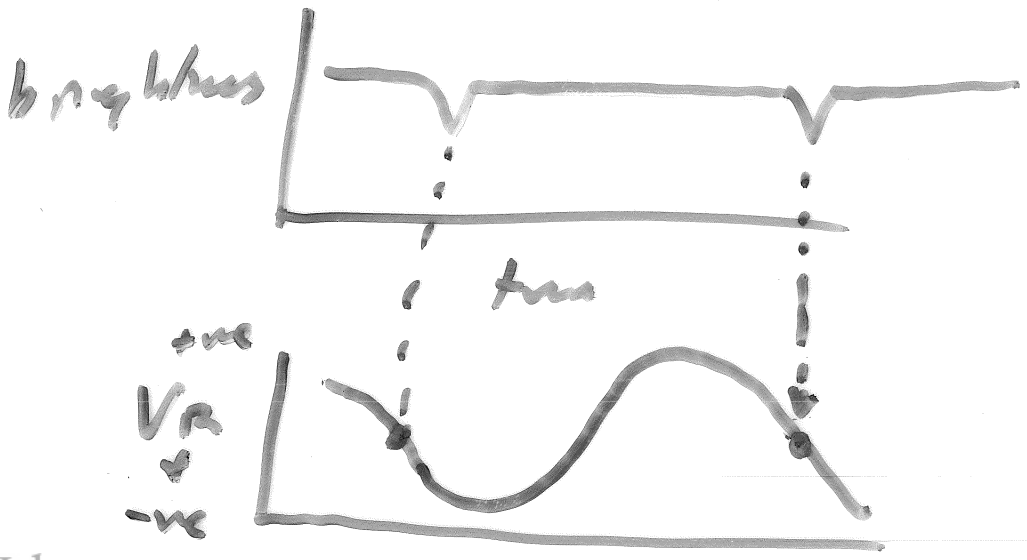
↳ hot Jupiter discovered by radial velocities.

and then...

TRANSITS DISCOVERED

dip in light due to planet passing across the star

requires precisely edge-on alignment



This works out

Finding Planets Directly from Transits

observe a cluster of stars
30,000 stars
↳ sun-like

from radial velocities
~ 1/10 stars have hot Jupiters

~ 1/100 hot Jupiters is aligned properly to get a transit

⟹ predict: 30 TRANSITS

result: ZERO transits

WHY?

1) in clusters stars collide or near collisions disrupt planetary orbits

2) stars are more likely to have planets if high

amounts of heavy elements

stars are mostly H, He

"metallicity" ≡
fraction of elements heavier than H, He

Sun's metallicity ~2%

high metallicity stars
(> solar)
MORE likely to have planets

STAR CLUSTER ARE
LOW METALLICITY

So... no planets

NEXT EXPERIMENT

center of galaxy
lots of stars but less dense than in center of cluster

High metallicity stars

If you have both radial velocity measurements → mass of planet

AND transits → radius of planet

THEN density = ρ = $\frac{\text{mass}}{\text{volume}}$

$= \frac{M}{\frac{4}{3}\pi R^3}$

water: 1 gm/cubic centimeter

= 1000 kg/cubic meter

rocks = much higher density

hot Jupiters have low density ⇒ ice balls

surface temperature ~1000 degrees

current thinking

MIGRATION

make Jupiter in outer solar system

→ migrate into inner solar system

big things melt slowly

surface area is low volume

consequence:

no terrestrial planets

orbits are disrupted by migrating Jupiter

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problem with migration:

needs to work, but not always

could work too well