Star-Disk-Planet Timeline

- Star + disk
- PMS: accretes to disperses
- Giants & migration
- Earths
- Debris disks
- Exoplanets

Time (years):
- $10^5$
- $10^6$
- $10^7$
- $10^8$
- $10^9$
Star-Disk-Planet Timeline

- Star
- Disk
- Planet

- Star + disk
- accretes
- disperses
- giants & migration
- ~mm
- ~km
- PMS
- main sequence
- evolved
- debris disks
- earths
- LHB
- exoplanets
- found

Time (years):

$10^5$

$10^6$

$10^7$

$10^8$

$10^9$
Star-Disk-Planet Timeline

- **Star**: main sequence, evolved
- **Disk**: debris disks
- **Planet**: exoplanets found

Time (years):
- $10^5$
- $10^6$
- $10^7$
- $10^8$
- $10^9$

- **Star** + **disk**: accretes
- **PMS**: disperses, giants & migration
- **Earth**: LHB
**Star-Disk-Planet Timeline**

- **Star**: Star + disk
- **Disk**: accretes giants & migration
- **Planet**: ~mm ~km
- **PMS**: disperses earths
- **Main Sequence**: debris disks LHB
- **Evolved**: exoplanets found

Time (years):
- $10^5$
- $10^6$
- $10^7$
- $10^8$
- $10^9$
Star-Disk-Planet Timeline

- **Star**: PMS (pre-main sequence), main sequence, evolved
- **Disk**: accretes, disperses, debris disks
- **Planet**: ~mm, ~km, giants & migration, earths, LHB (Low-Hydrogen Boundary), exoplanets found

- Time (years): $10^5$, $10^6$, $10^7$, $10^8$, $10^9$
Star-Disk-Planet Timeline

- **Star**: main sequence, evolved
- **Disk**: disperses, debris disks
- **Planet**: accretes, giants & migration, earths, LHB, exoplanets found

Timeline:
- Time (years): $10^5, 10^6, 10^7, 10^8, 10^9$
Star-Disk-Planet Timeline

- Star
- Disk
- Planet

Time (years): $10^5$ to $10^9$

- PMS
- Main sequence
- Evolved
- Debris disks
- Earths
- LHB
- Exoplanets

- Star + disk
- Accretes
- Disperses
- Giants & migration
- Migration
- ~mm
- ~km

- Exoplanets found
Star-Disk-Planet Timeline

- Star + disk: time, planets, migration
- PMS: accretes, giants & migration
- Main sequence: disperses
- Evolved: debris disks, exoplanets found

Time (years):
- $10^5$
- $10^6$
- $10^7$
- $10^8$
- $10^9$
Star-Disk-Planet Timeline

- Star
  - star + disk
  - accretes
- PMS
- main sequence
- evolved
- Disk
- ~mm
- ~km
- giants & migration
- disperses
- Planet
  - earths
  - debris disks
- LHB
  - exoplanets found
- Time (years)
  - $10^5$
  - $10^6$
  - $10^7$
  - $10^8$
  - $10^9$
Star-Disk-Planet Timeline

- Star
  - star + disk
  - accretes
  - giants & migration
  - disperses
  - PMS
  - main sequence
  - evolved

- Disk
  - ~mm ~km

- Planet
  - earths
  - debris disks
  - LHB
  - exoplanets found

- Time (years)
  - $10^5$
  - $10^6$
  - $10^7$
  - $10^8$
  - $10^9$
Star-Disk-Planet Timeline

- Star
- Disk
- Planet

- Star + disk
- PMS
- main sequence
- evolved
- acquires
- disperses
- giants & migration
- earths
- LHB
- exoplanets
- debris disks

- Time (years)
  - $10^5$
  - $10^6$
  - $10^7$
  - $10^8$
  - $10^9$
Star-Disk-Planet Timeline

- Start
- Disk
- Planet

- PMS
- main sequence
- evolved
- giants & migration
- debris disks
- earths
- LHB
- exoplanets
- found

- ~mm
- ~km
- 10^5
- 10^6
- 10^7
- 10^8
- 10^9

Time (years)
Star-Disk-Planet Timeline

- **Star**
  - star + disk
  - time: \(10^5\) - \(10^6\) years

- **Disk**
  - accretes
  - time: \(10^6\) - \(10^7\) years

- **Planet**
  - ~mm, ~km giants & migration
  - time: \(10^7\) - \(10^9\) years

- **Main Sequence**
- **Evolved**

- **Debris Disks**
- **Exoplanets**
- **LHB**

- **Exoplanets**
- **Found**
detectable transits average density composition? origin??
newest super-Earth system has $20 \, M_{\text{Earth}}$ within 0.5AU

Solar System only has a few $M_{\text{Earth}}$ within 1 AU

probably not enough mass to form *in situ*
Migration results

- Works for a range of stellar masses
- Harder for higher stellar masses
Disks:
high resolution
Hα >270km/s
>10Å for low resolution

White & Basri 2003