

Star and Planet Formation

Jessica R. Lu, Greg Herczeg

ISDT Synergy

Star and Planet
Formation

Exoplanets

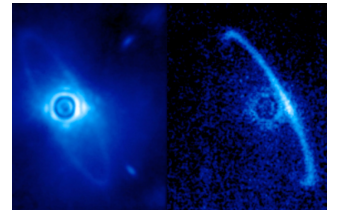
Milky Way and
Nearby Galaxies

High-Redshift
Galaxies

Key Programs #1

Planet Formation: Terrestrial Planets and Moon Formation

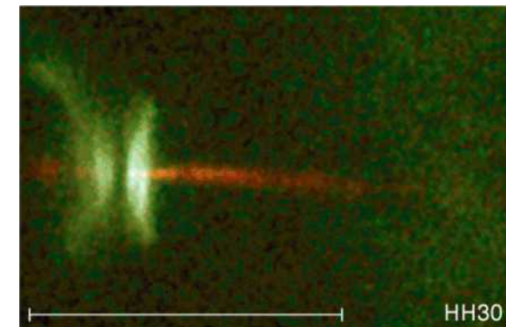
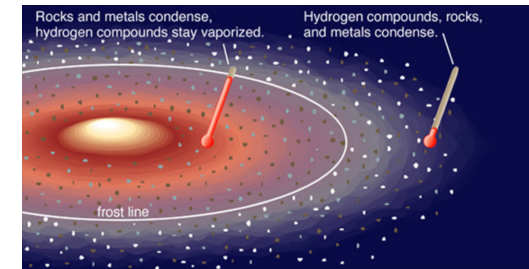
- joint science case with exoplanet direct imaging
- disks in scattered light in the era of terrestrial planet formation
 - high-contrast polarization
 - blue side of NIR
- proto-lunar disks around gas giant planets
 - CO disks, H-alpha emission
 - accretion rates onto planets
 - R=300-3000 IFU spectroscopy
- demands several fainter guide stars in the high-contrast AO instrument (I>11)



Key Programs #2

Planet Formation: Gas Disks during Giant Planet Formation

- Conditions and time-scales for gas-giant planet formation
 - dust/gas structure in young inner disks (warmer/closer than ALMA)
 - resolved snow lines
 - water lines vs. stellar mass
 - mid-IR, AO-fed, IFU spectroscopy at $R \sim 100,000$
- Spectro-astrometry of the inner disk
 - inner-most gas structures
- Ancillary Science: AU scale star formation
 - outflows, jet-launching



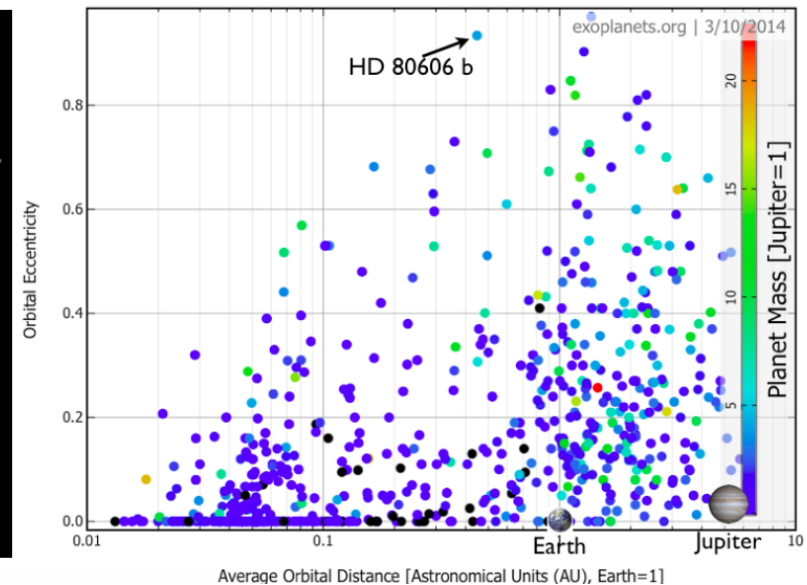
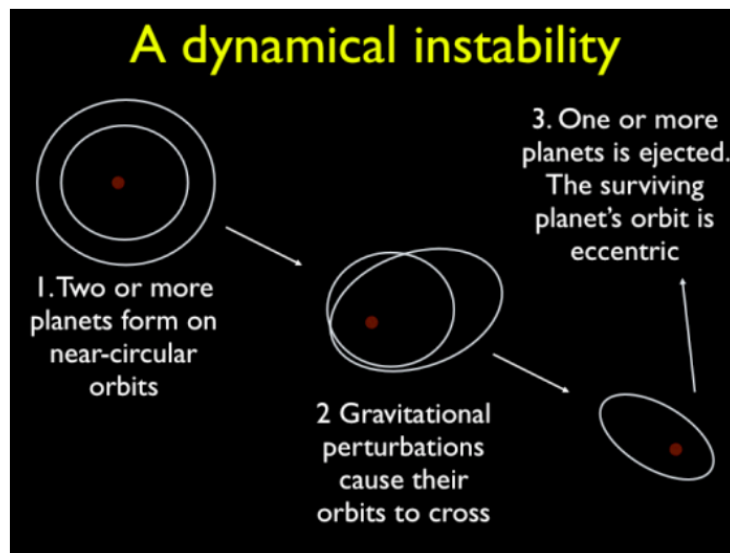
Key Programs #3

Free-Floating Planet Mass Function

- Complete samples of planetary mass objects in nearby young clusters
 - planet migration/ejection scenarios
 - “stellar-like” planet formation
 - near-IR photometry, astrometry over wide(-ish) field
 - spectroscopic follow-up
- Sample of clusters - different ages, densities
 - need to get out to 1 kpc to get sample of ~25 clusters

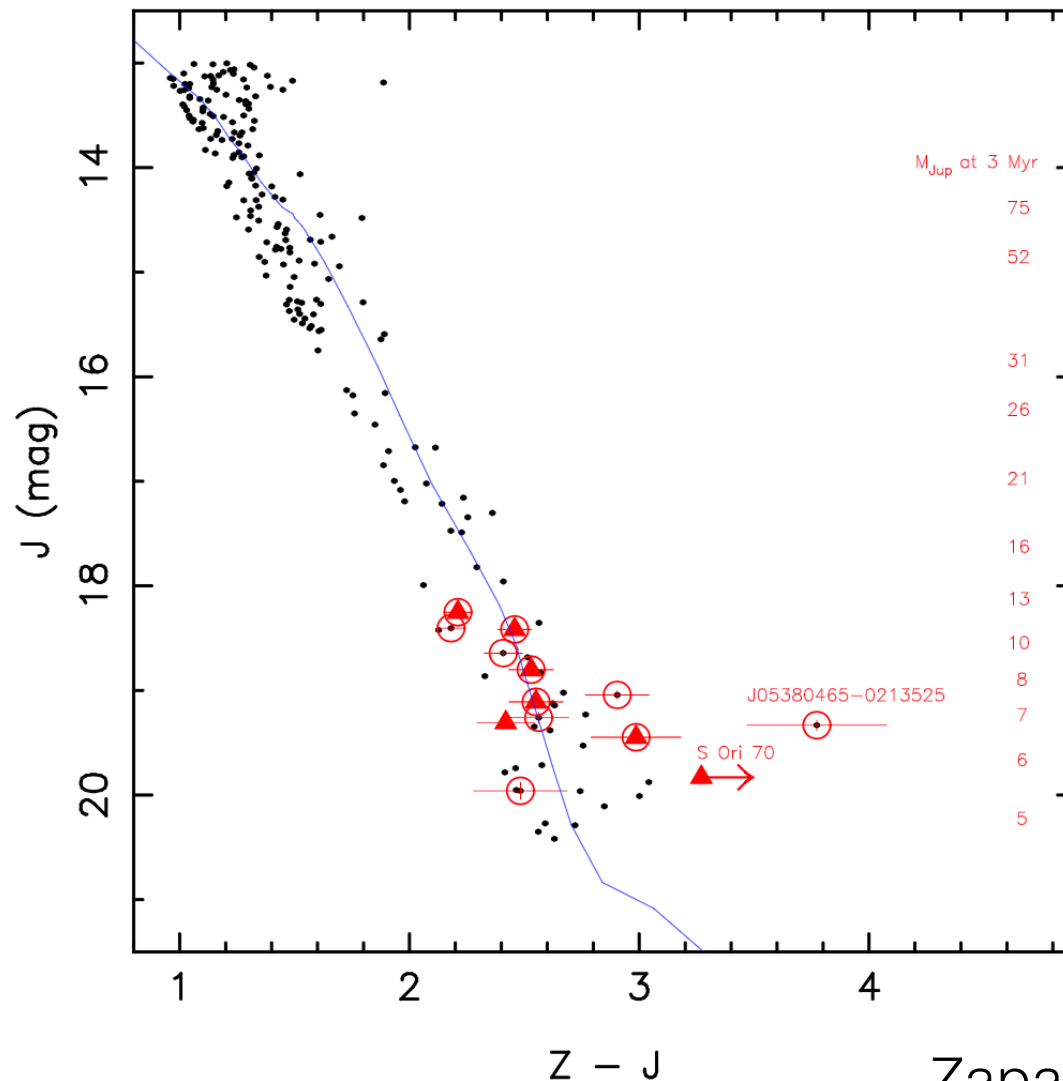
Free-Floating Planets

- Planets without host stars
- Probably form in low numbers as failed stars
- More probably formed through ejections of planets after protoplanetary disk dissipation
- **Their mass distribution bears the fingerprints of the formation and subsequent evolution of planetary systems**

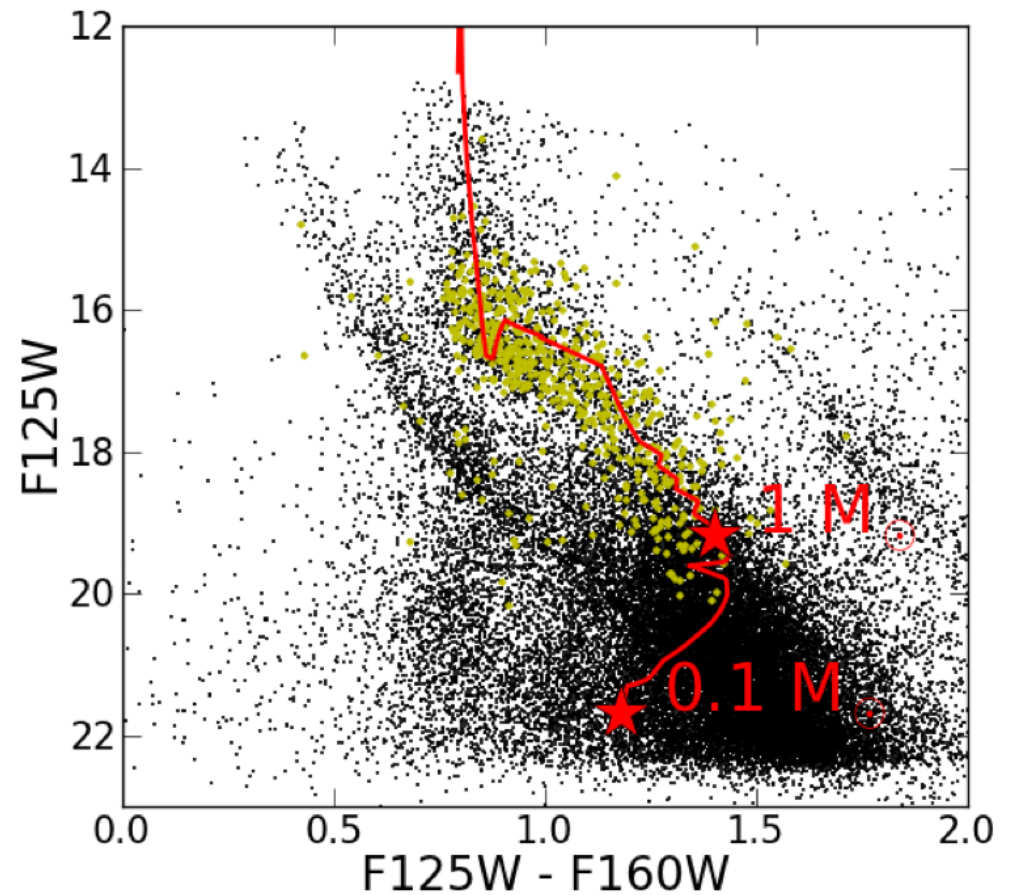
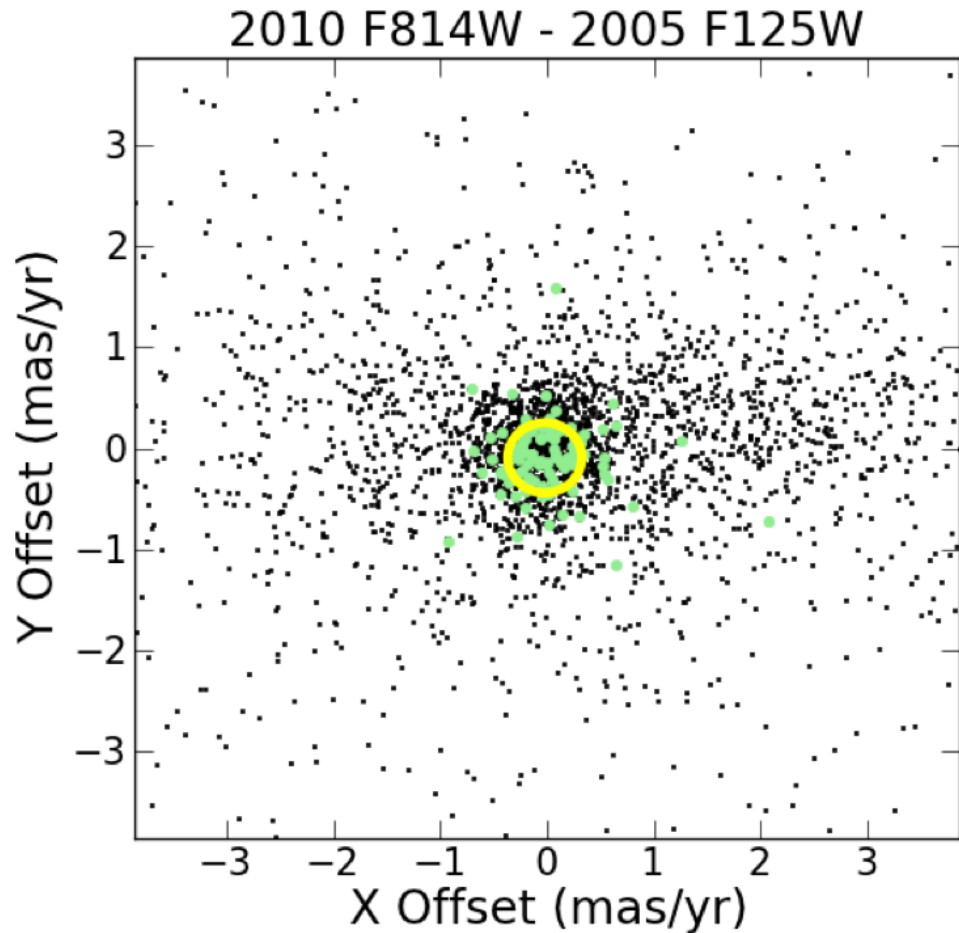


Slide credit Matthew Penny

Free-floating planet mass function requires deep photometry.



Astrometry needed to ID cluster members.



Westerlund 1 Cluster (5 Myr, $10^4 M_{\text{sun}}$)

Key Programs #3

Free-Floating Planet Mass Function

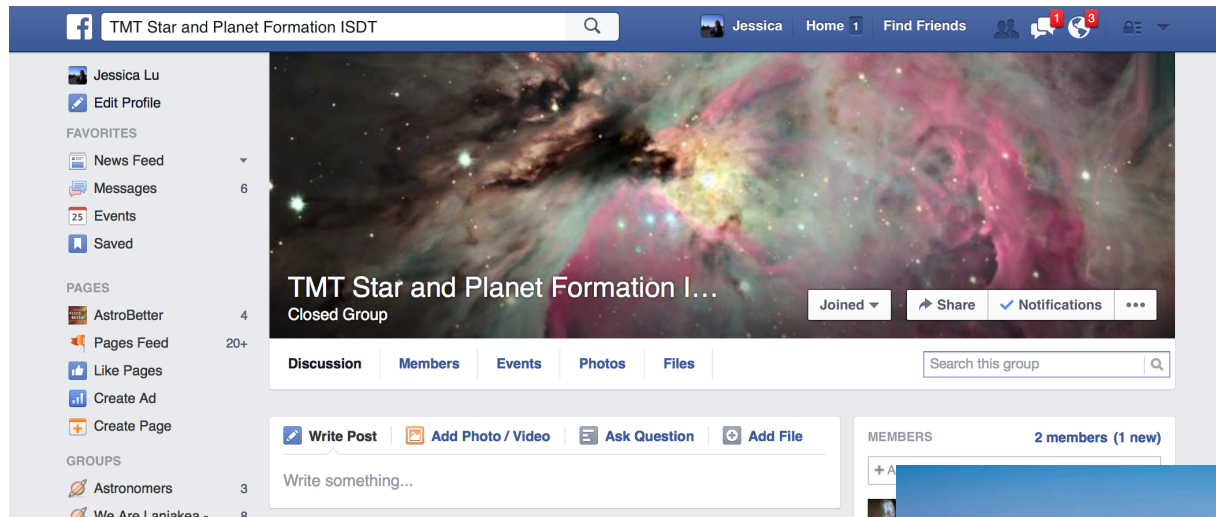
- Complete samples of planetary mass objects in nearby young clusters
 - planet migration/ejection scenarios
 - “stellar-like” planet formation
 - near-IR photometry, astrometry over wide(-ish) field
 - spectroscopic follow-up
- Sample of clusters - different ages, densities
 - need to get out to 1 kpc to get sample of ~50 open clusters

Instrument and Observatory

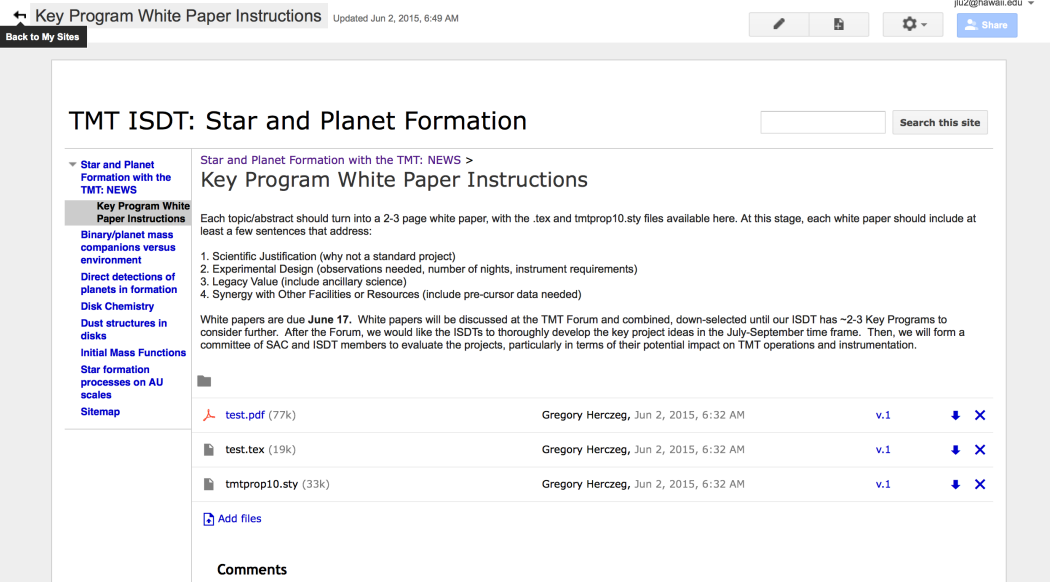
- PSI - ExAO with IFU spectroscopy, $R=300-3000$, polarization mode
- MICHU - $R \sim 100,000$ spectroscopy behind AO (IFU?)
- IRIS or IRMS imaging - astrometry/photometry
- IRIS, IRMS, IRMOS - AO multi-object NIR spectra
- Cadence observing and/or long-program
- mid-IR morning observing

ISDT Community

Facebook
Group



Google Site



Precursor Programs