



Random Thoughts on Star Formation for Astro2020

Sean Carey
Spitzer Science Center
IPAC/Caltech

Studies of Dust Should Still Be Vital

Large grain end of grain size distribution
function in ISM – growth of planetesimals

Emissivity variations

Need wavelength coverage from UV to
millimeter

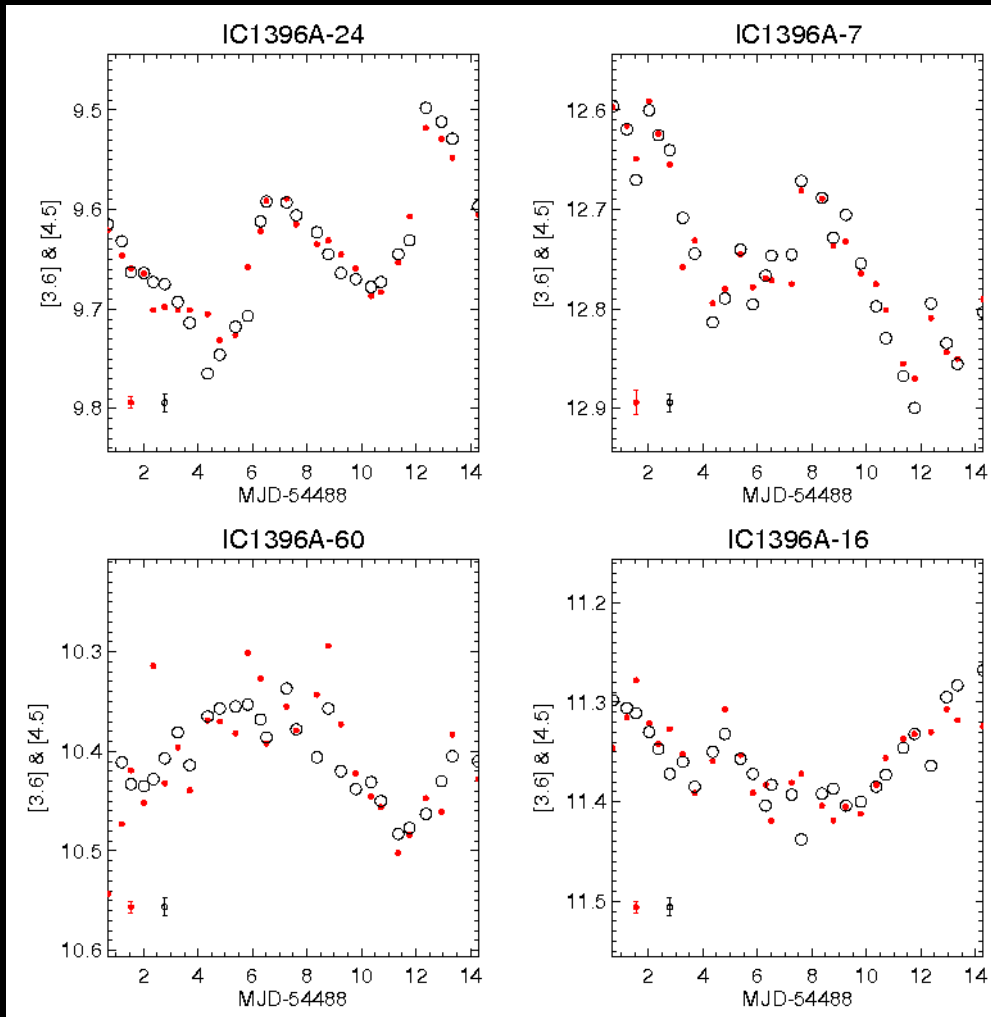
Should engage the laboratory astrophysics
community

Synoptic Studies of Star Formation

Wide variety of light curves in our reasonably small samples – expand temporal and wavelength coverage

Understand timescales and diversity of YSOs and protostars

Learn about accretion physics – work with AGN and black hole researchers



**Light
curves
at 3.6,
4.5 μ m
for
stars
in
IC1396
3.6= \bullet ; 4.5= \circ**

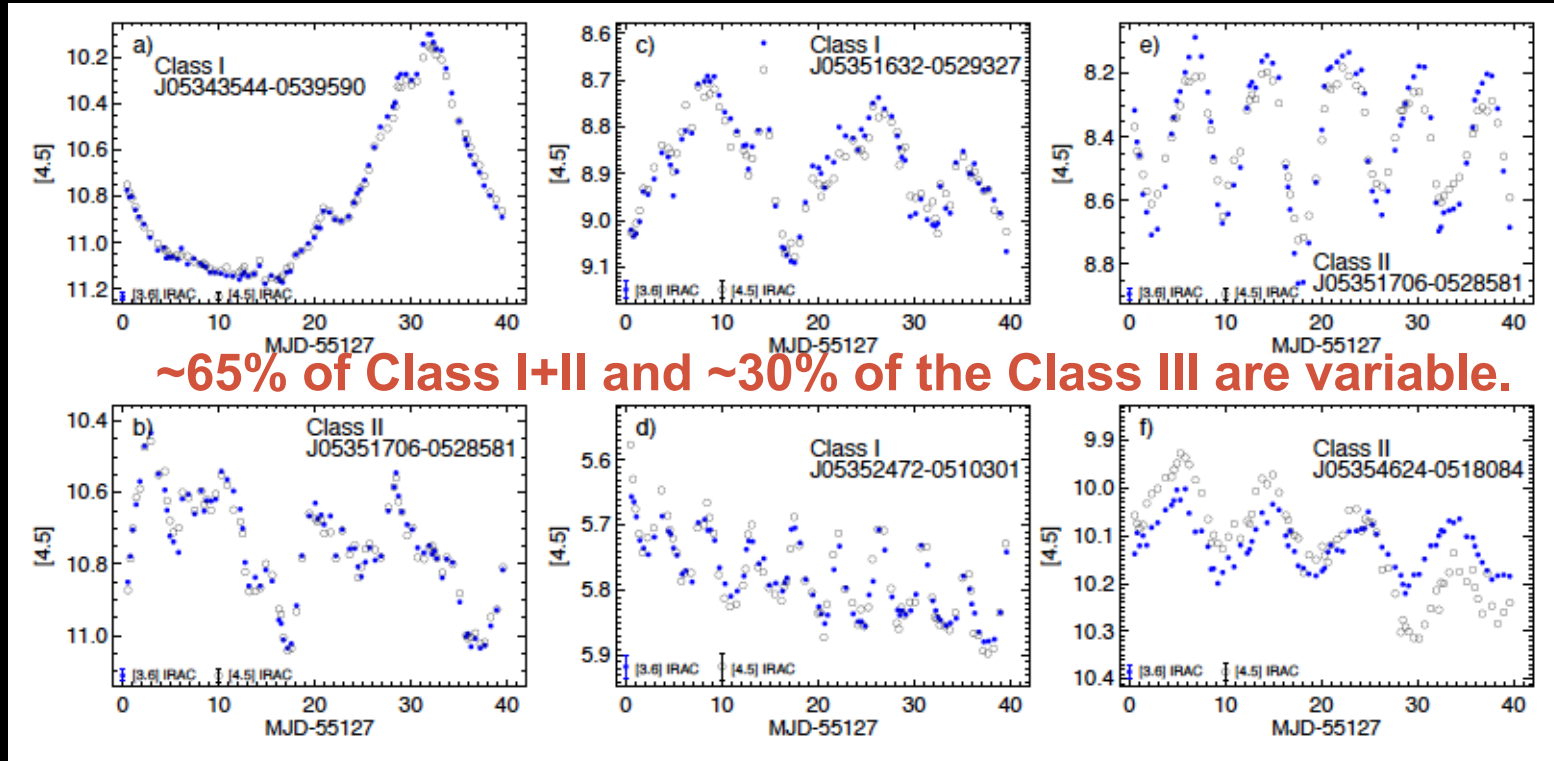
YSOs do,
indeed,
vary in the
IR!

Figures
from L.
Rebull and
YSOVAR
team

Slow $\Delta\dot{M}$? Self-shadowing?

Flares

Periodic (spots, warps)



~65% of Class I+II and ~30% of the Class III are variable.

$\Delta\dot{M}$ geom? Unstable osc.?

??

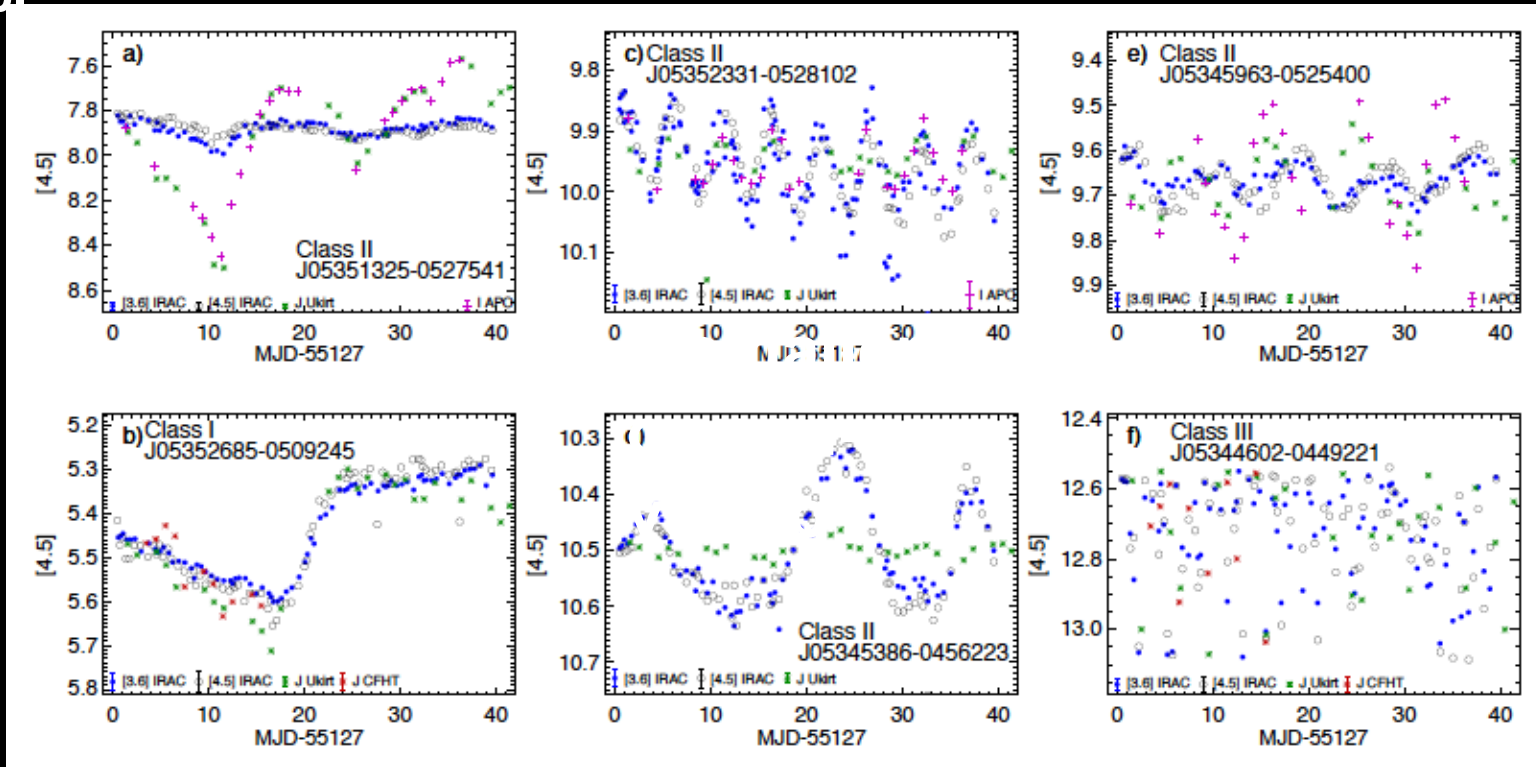
Morales-Calderon et al. (2011)

●=[3.6], ○=[4.5]

•=[3.6], ○=[4.5], * or * =J, + =Ic

J similar shape, larger
ampl

Phase-shifted



J similar shape,
similar ampl

Morales-Calderon et al.
(2011)

Recovered
P~0.27d

What Role Should Surveys Play

How much do we need statistics?

How do we sell serendipity?

WFIRST could be very powerful for star formation and would be better if there was K band to probe through the Galactic Plane

Can we think of better ideas to handle survey data

Data Synthesis Needs to Be Highlighted

How much do we need statistics?

How do we sell serendipity?

WFIRST could be very powerful for star formation and would be better if there was K band to probe through the Galactic Plane

Can we think of better ideas to handle survey data

Origins Space Telescope

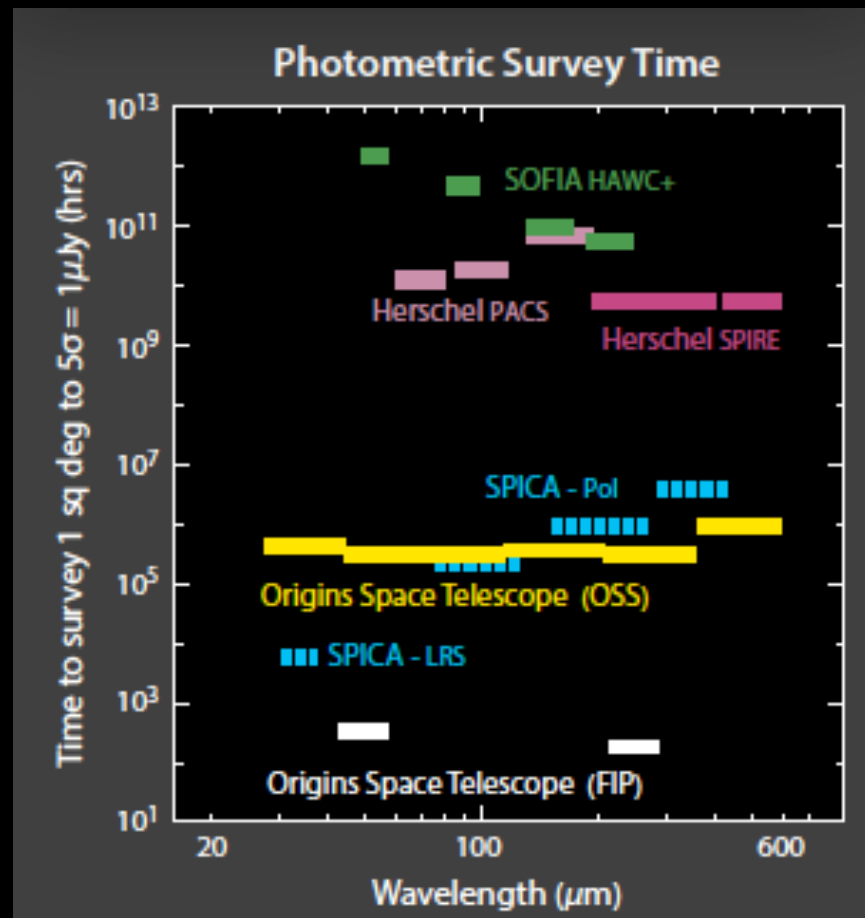
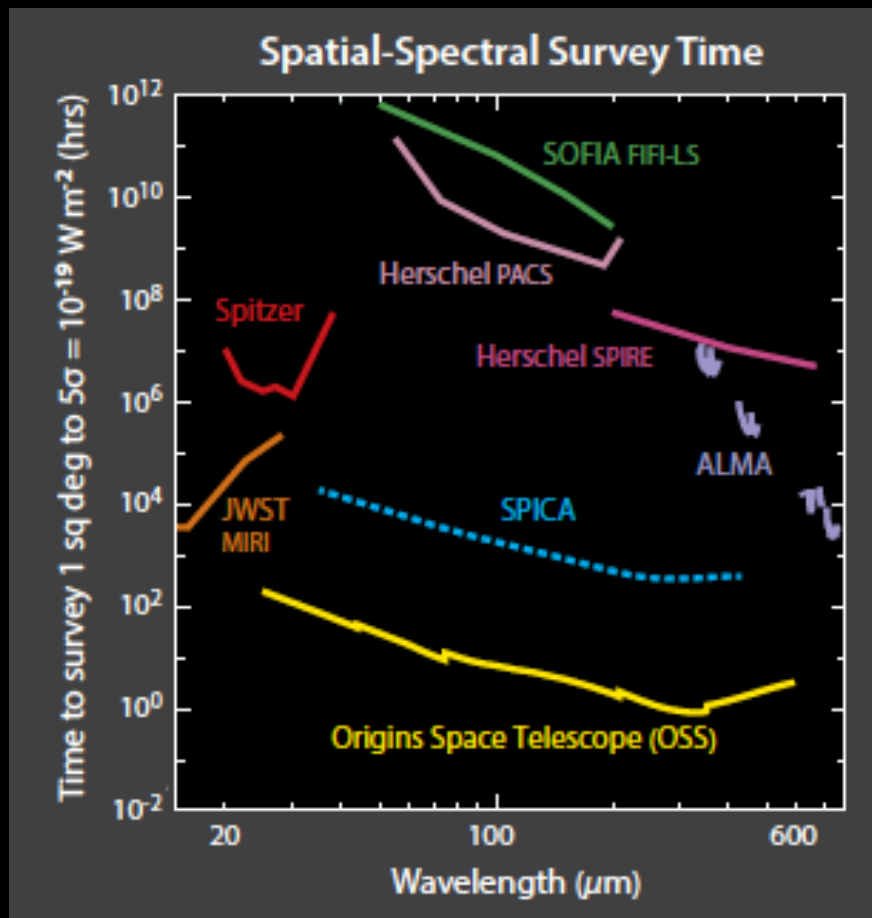
Key theme related to star formation is tracing the path of water from ISM to planets

Tons of star formation science can be done with a 5.9m telescope cooled to 4K

Origins Space Telescope Instruments

Instrument	Wavelengths (μm)	Instantaneous Field of View	Observing Modes
MISC Mid-Infrared Spectrometer	2.8–20	5" (2.8 - 10.5 μm) 3."4 (10.5 - 20 μm) set by field stop	Transiting exoplanet spectrometer
OSS Origins Survey Spectrometer	25–300	14' slit (grating mode); single beam (high-resolution modes)	$R = 300$ grating spectroscopy with wide-field survey capability $R = 43,000(112 \mu\text{m}/\lambda)$ FTS $R = 325,000(112 \mu\text{m}/\lambda)$ Etalon
FIP Far-Infrared Imager and Polarimeter	50 and 250	3!6 x 2!5 (50 μm) 13!5 x 9' (250 μm)	Broadband imaging, pointed observations or wide-field survey; polarimetry

Origins Space Telescope



Data Processing Technology Drivers

Synthesis of multi-wavelength data

Feature Identification

?