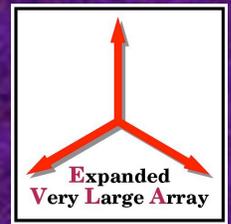
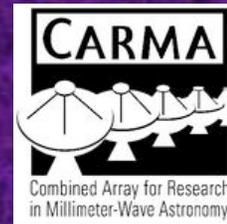
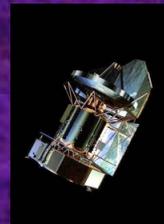
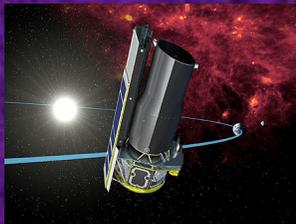


Observing Extragalactic Star Formation in the Next Decade



Kelsey Johnson

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Motivation:

If we want to understand star formation, it's not a bad idea to observe stars while they are forming.

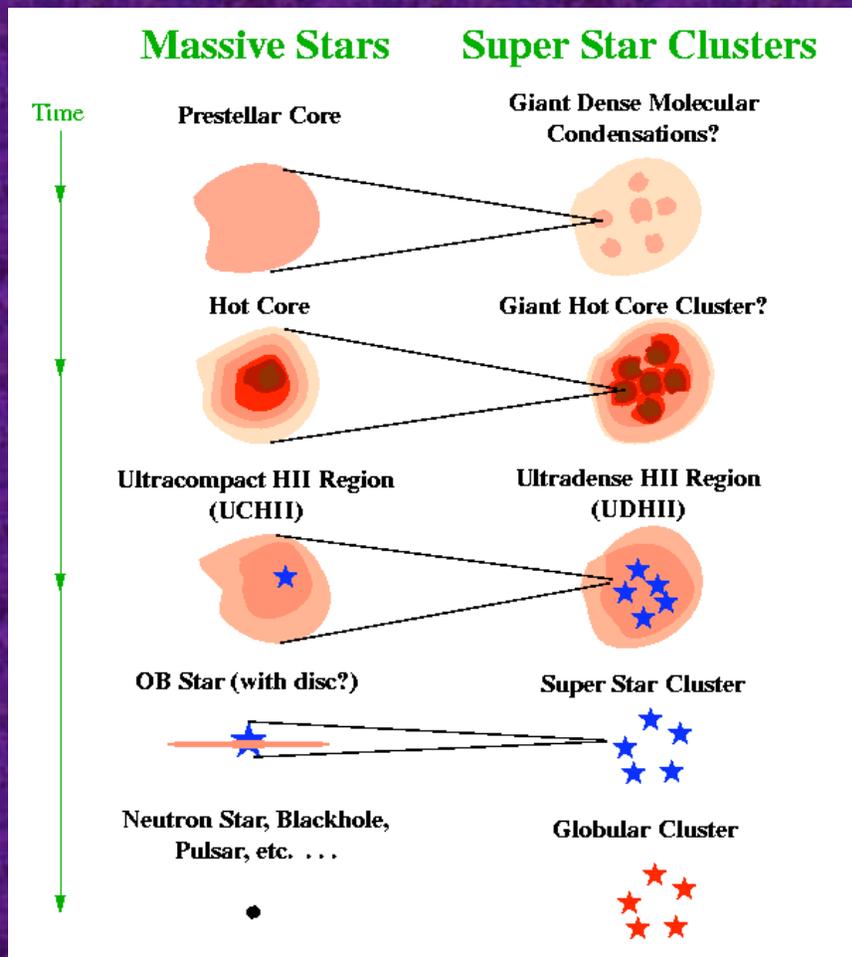
If we want to understand star formation in the rest of the universe, it's not a bad idea to look outside the Milky Way.

Current facilities have insufficient resolution and sensitivity to accomplish these goals.

- Types of extragalactic objects we want to observe
- What we know we don't know about them
- Cutting-edge facilities coming on-line
- What we might expect to see with the new observatories

Massive Star Forming Regions:

Ultracompact HII Regions to Proto Globular Clusters



Key Questions:

How do the properties of star formation scale?

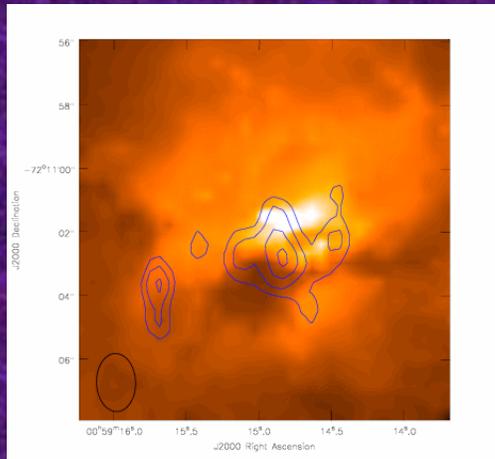
How do the properties depend on environment?

UCHIIs → linear res < 0.5pc

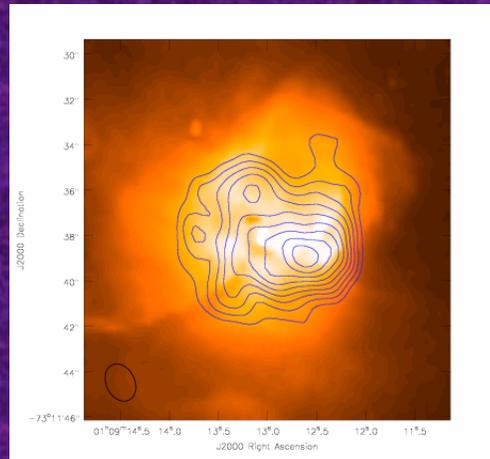
UDHIIs → linear res < 10pc

Magellanic Clouds Survey

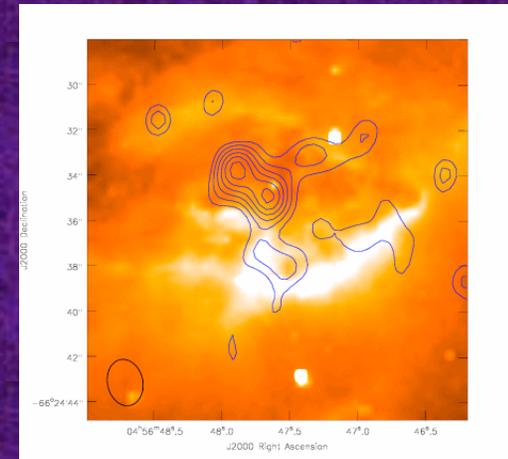
(selected regions)



N66



N81



N11

Color scale: H α (from HST) **Contours:** 3cm (from ATCA)

Linear Resolution ~ 1 pc

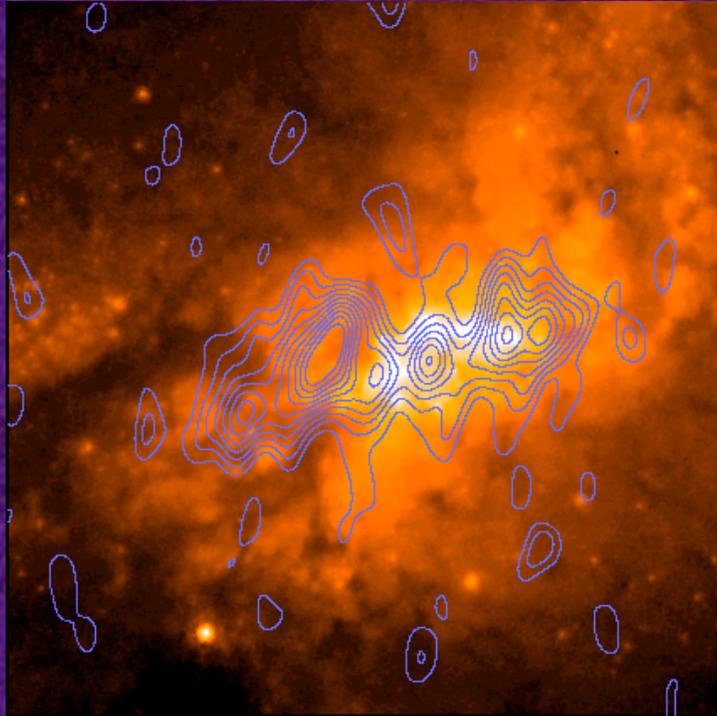
$N_{\text{Lyc}} \square$ a few $\square 10^{49} \text{ s}^{-1}/\text{cluster}$

\square compact to ultracompact HII regions

Indebetouw, Johnson, & Conti (submitted)

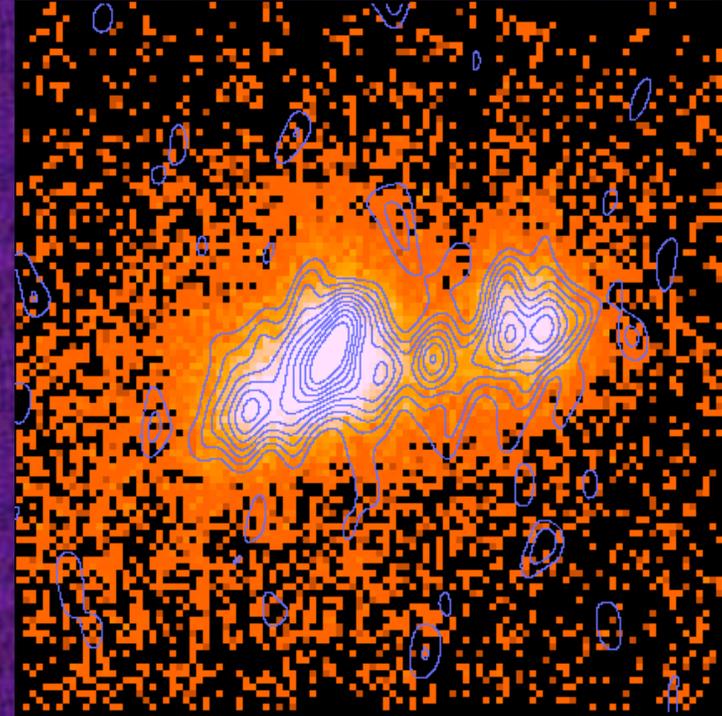
Henize 2-10

(9 Mpc, linear res ~ 20pc)



VLA 2 cm contour, HST V-band color-scale

(Kobulnicky & Johnson 1999, Johnson & Kobulnicky 2003)



VLA 2 cm contour, Gemini 10 μ m color-scale

(Vacca, Johnson, & Conti 2002)

Three brightest radio sources alone account for at least 60% of the mid-IR flux from the entire galaxy

Some of the things we'd like to do:

- *Directly measure densities, pressures, temperatures
(use IR forbidden lines, molecular lines, RRLs)*
- *Directly measure radii with high resolution
(EVLA coming soon, SKA at some point)*
- *Determine how much ionizing radiation escapes
(need bolometric luminosities)*
- *Determine star formation efficiency
(high resolution HI, CO, H₂)*
- *Find out if the individual stars have individual cocoons?
(does this depend on the stellar density and evolutionary state?)*
- *Determine how clumpy the dust is
(high-resolution imaging and SED models)*
- *Determine the temperature profiles
(high-resolution photometry and SED models)*

Future Capabilities

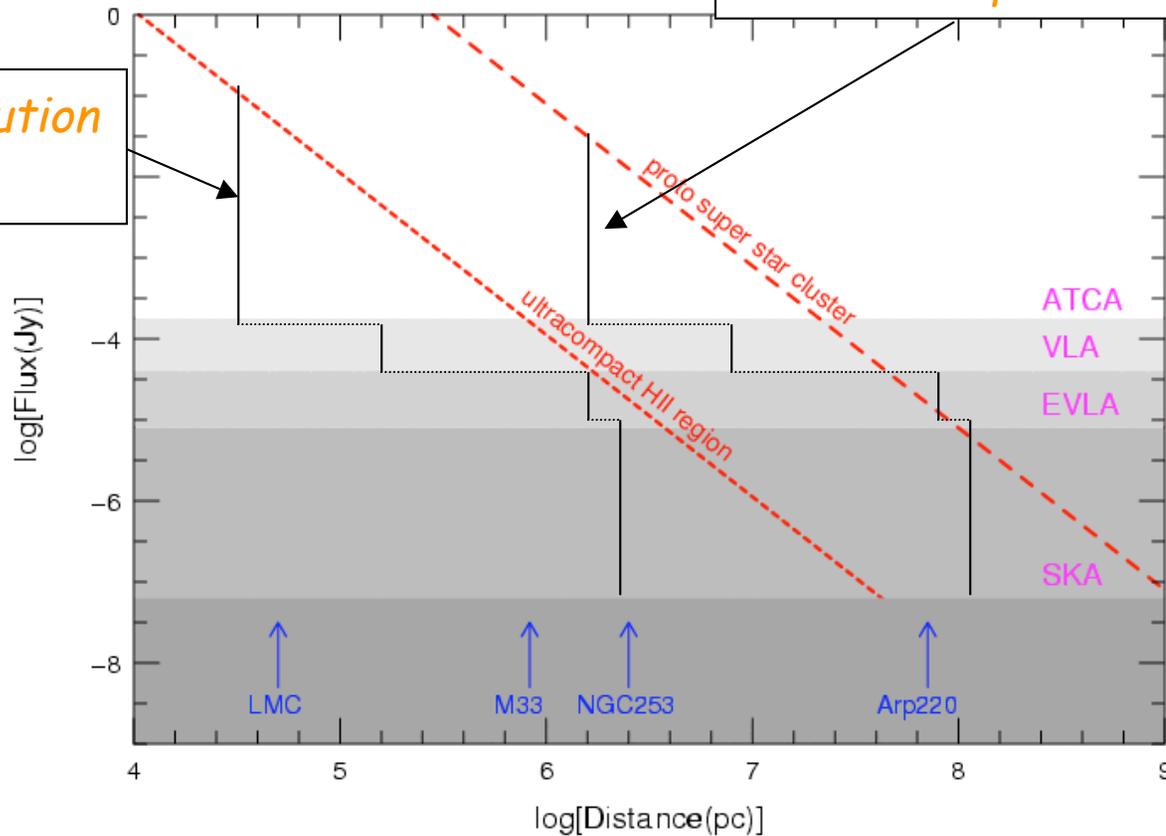
(radio)

Linear resolution

~10 pc

Linear resolution

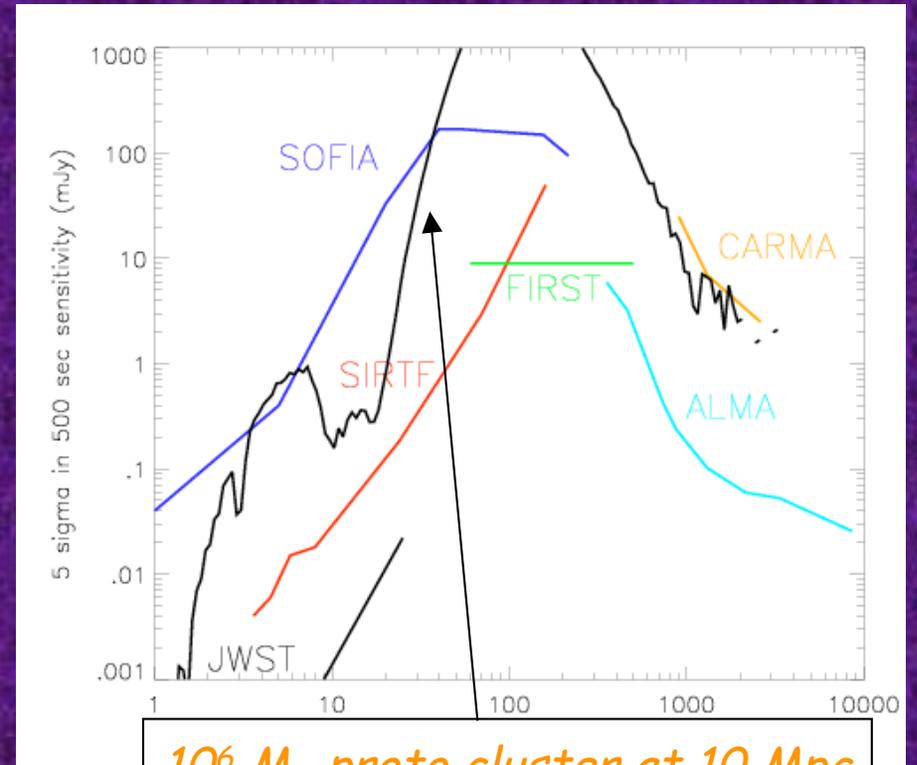
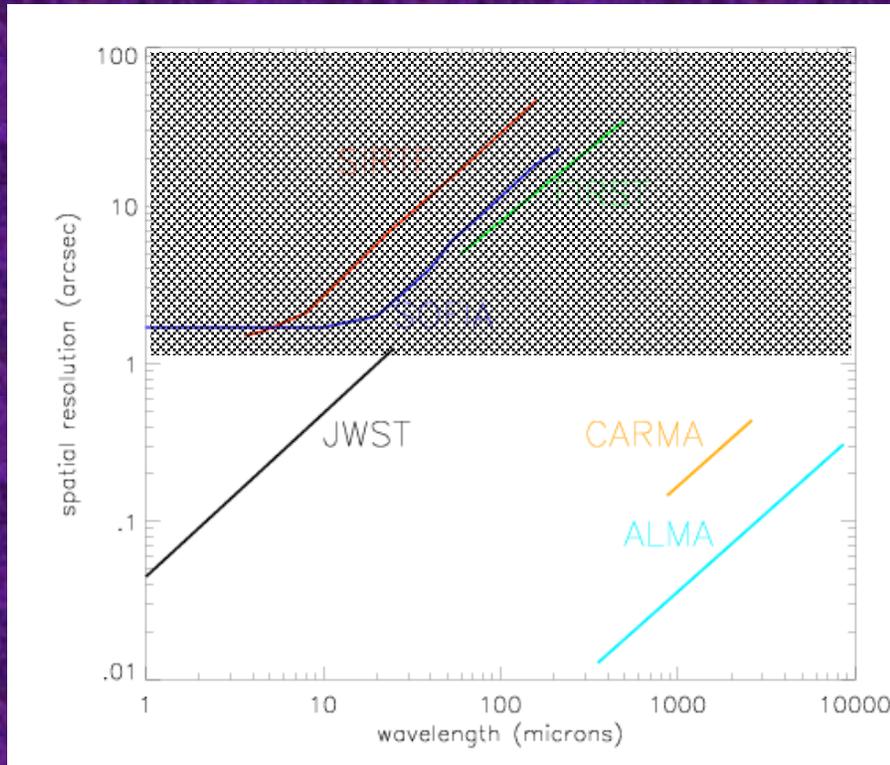
~0.5 pc



5 σ sensitivities for 8 hours at 6cm

Future Capabilities

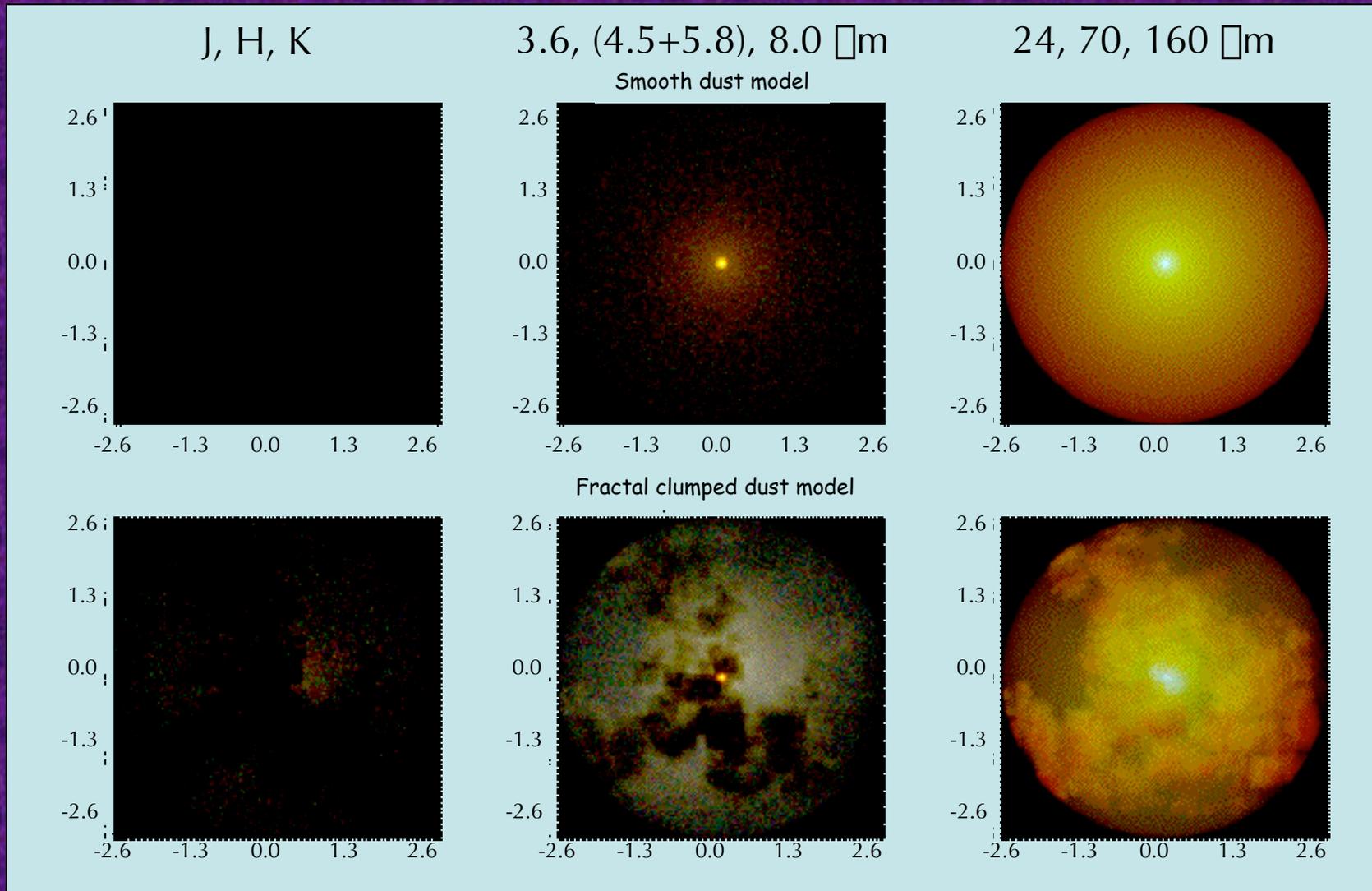
(IR - mm)



10⁶ M_⊙ proto cluster at 10 Mpc

Predicting what might we see

3D Monte-Carlo Radiative Transfer: UCHIIs & UDHIIis



Whitney et al 2003