A Super Star Cluster is Born

Presenter: Dr. Isha Nayak (NASA GSFC)

Email: omnarayani.nayak@nasa.gov

Phone: (408)668-5867

PI of JWST and ALMA Data: Dr. Margaret Meixner (NASA JPL)

PI of Chandra Data: Dr. Laura Lopez (OSU)

Collaborators: Dr. Nolan Habel (CalTech), Dr. Alec S. Hirschauer (Morgan State University, STScI), Jeroen Jaspers (Maynooth University), Dr. Olivia C. Jones (UKATC), Dr. Patrick Kavanagh (Maynooth University), Dr. Lachlan Lancaster (Columbia), Dr. Laura Lenkíc (CalTech), Conor Nally (UKATC), Jennifer Rodriguez (OSU), Dr. Anna Rosen (SDSU), Trinity Webb (OSU)

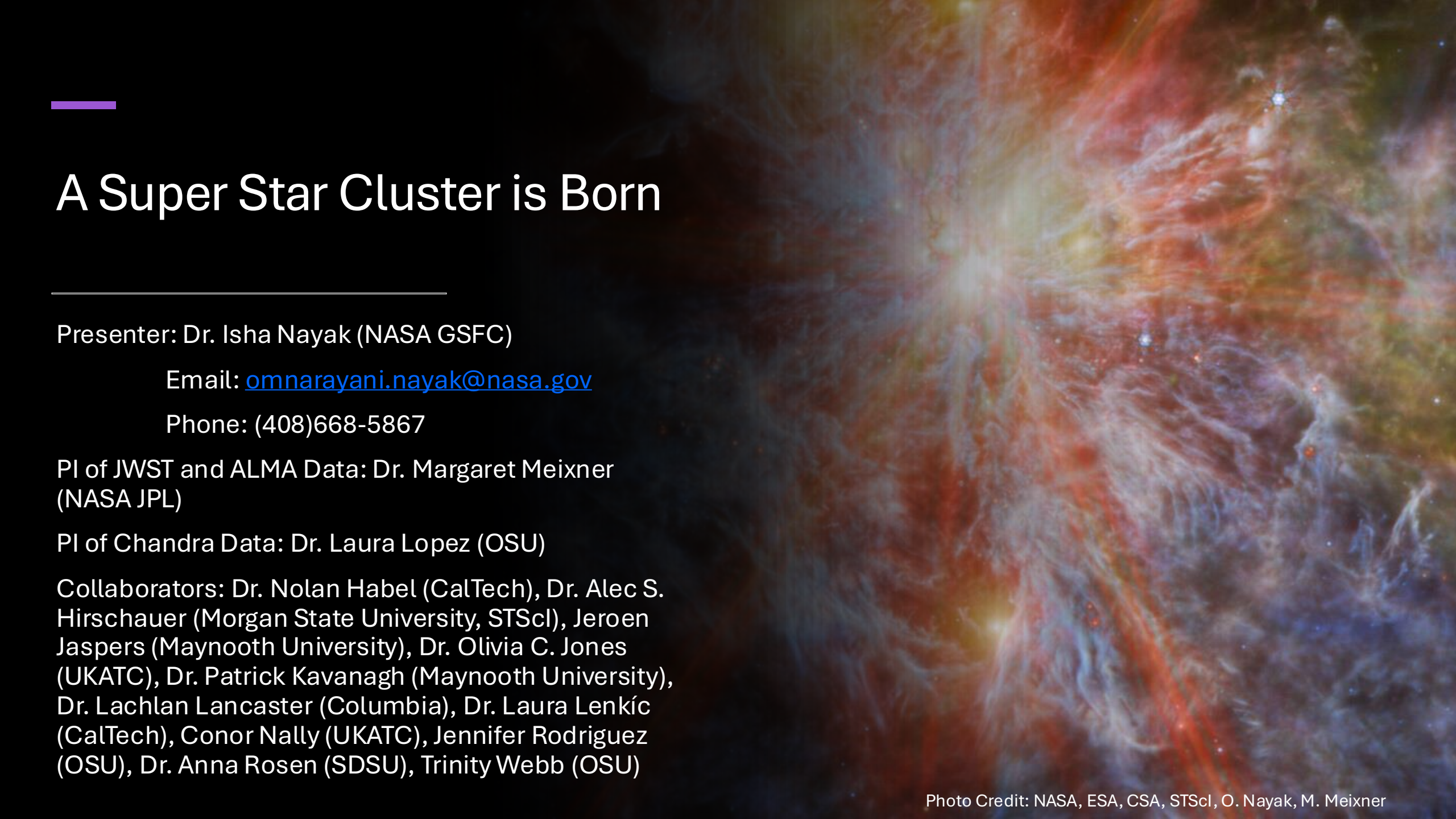


Photo Credit: NASA, ESA, CSA, STScI, O. Nayak, M. Meixner

Why Study Super Star Clusters?

Super star clusters used to be the main mode of star formation 6-7 billion years ago.

Super star clusters are now rare.

Only three known super star clusters in Milky Way and the Large Magellanic Cloud and they are all between 3-30 million years old.

Photo Credit: NASA, ESA, CSA, STScI, O. Nayak, M. Meixner

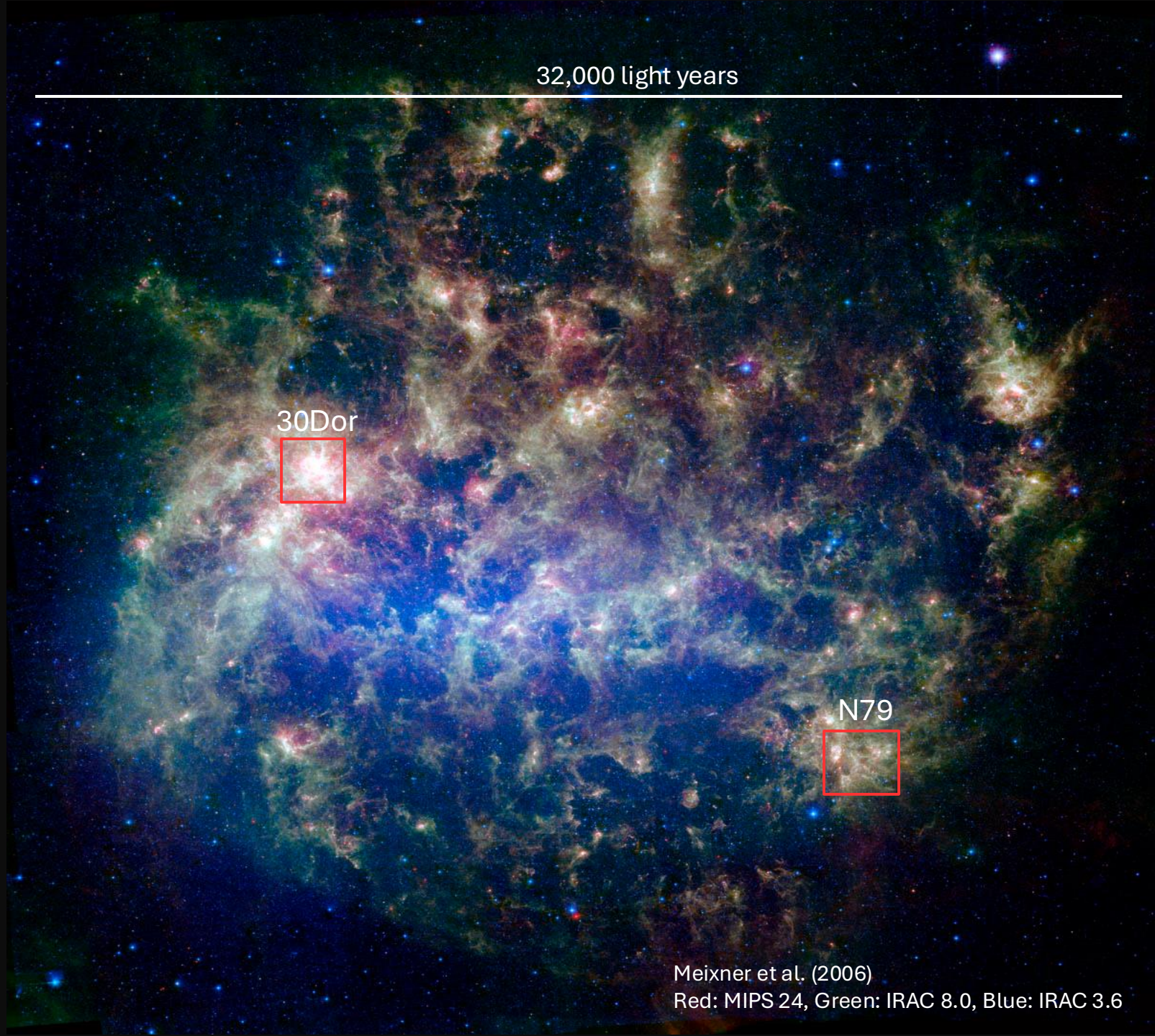
The Large Magellanic Cloud is Our Nearest Neighbor

Only 160,000 light years away

Proximity and face-on orientation make the Large Magellanic Cloud an ideal laboratory to study star formation

30 Doradus is host to a super star cluster 25-30 million years old

JWST confirms N79 is host to another super star cluster less than 100,000 years old



R136 Super Star Cluster in 30 Doradus

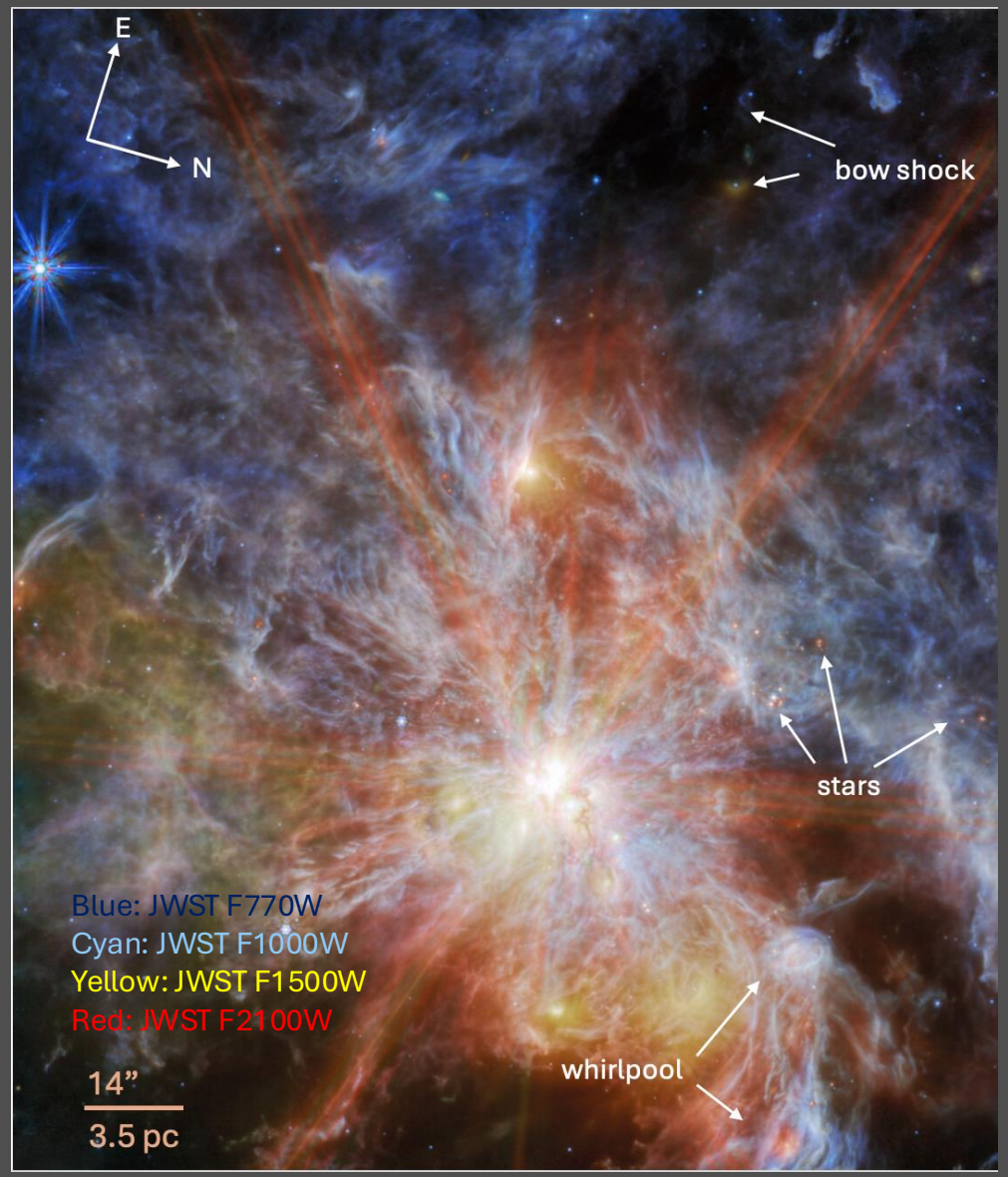
Photo Credit: NASA, ESA, CSA, STScI, Webb ERO Production Team

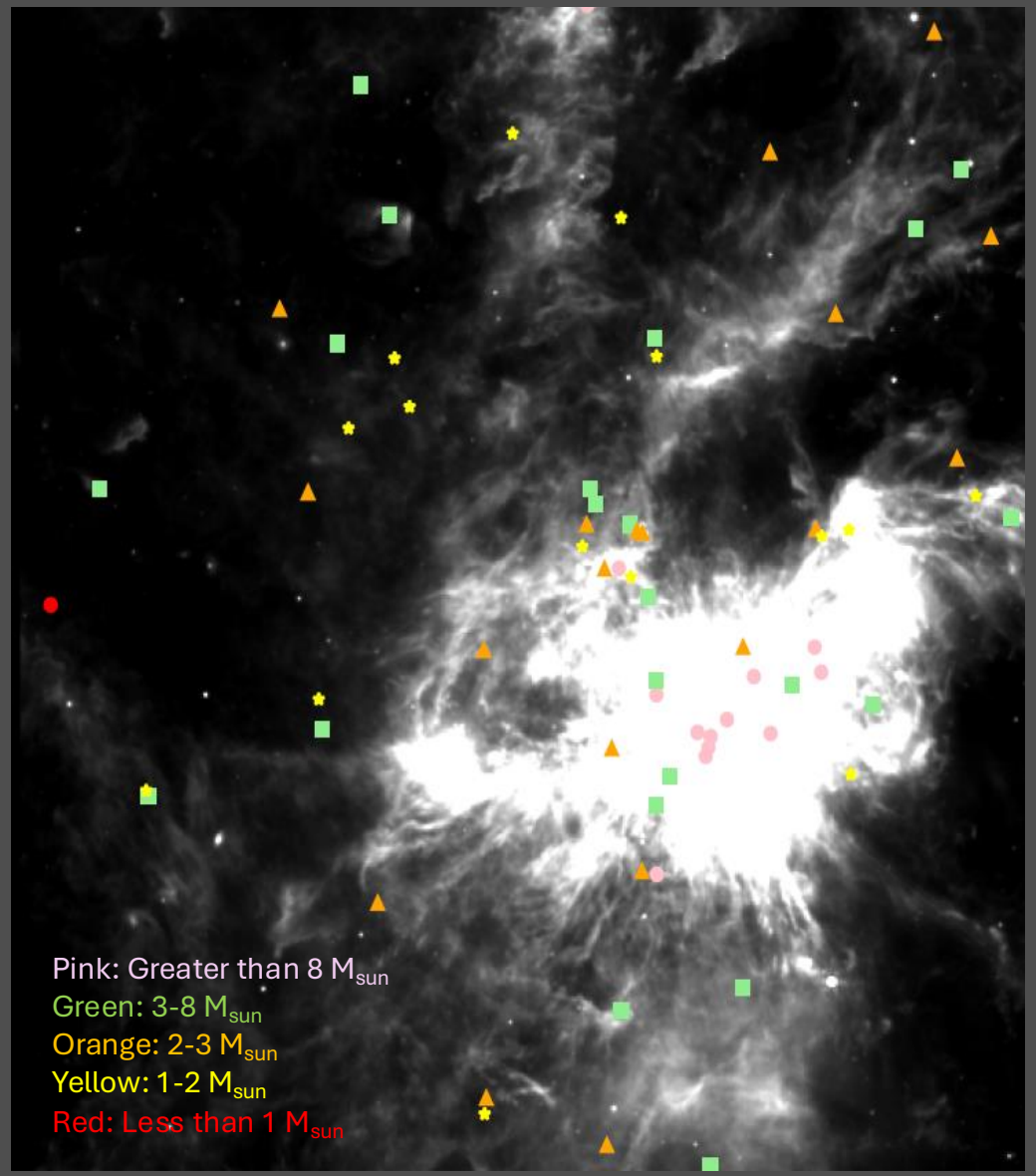
H72.97-69.39 Super Star Cluster N79

Photo Credit: NASA, ESA, CSA, STScI, NRAO, O. Nayak, M. Meixner

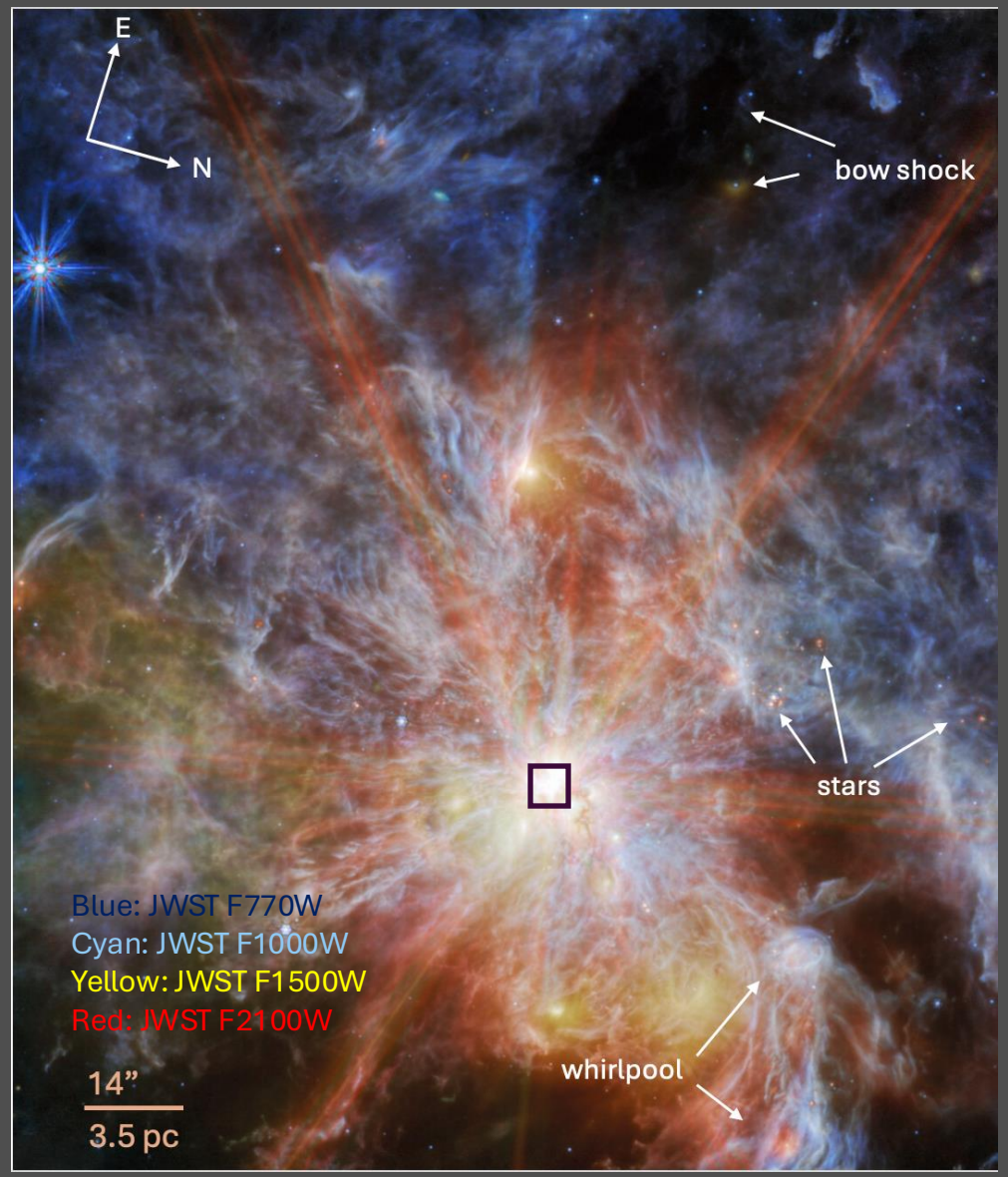
Photo Credit: NASA, ESA, CSA, STScI, NRAO, O. Nayak, M. Meixner

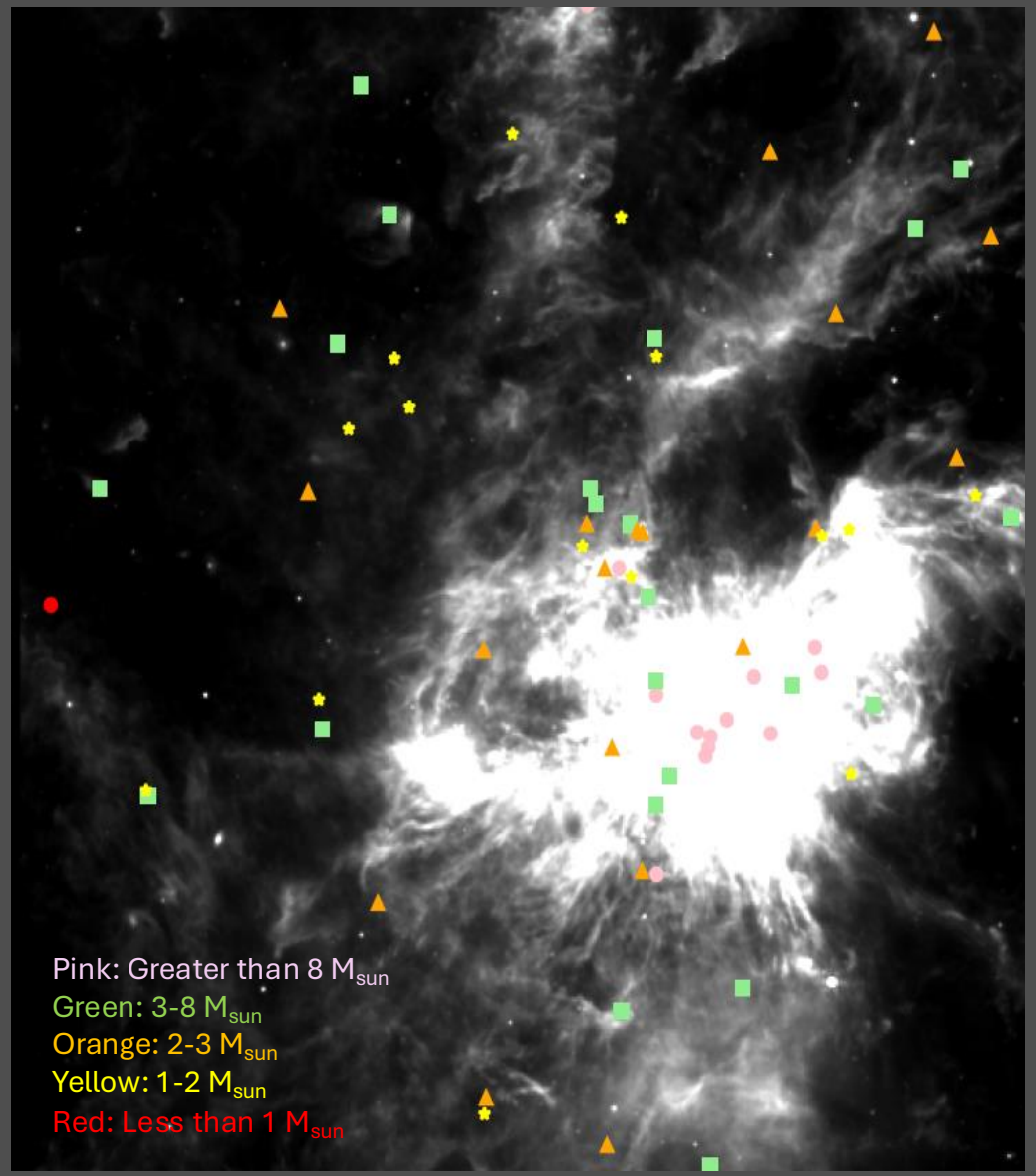
Photo Credit: NASA, ESA, CSA, STScI, NRAO, O. Nayak, M. Meixner



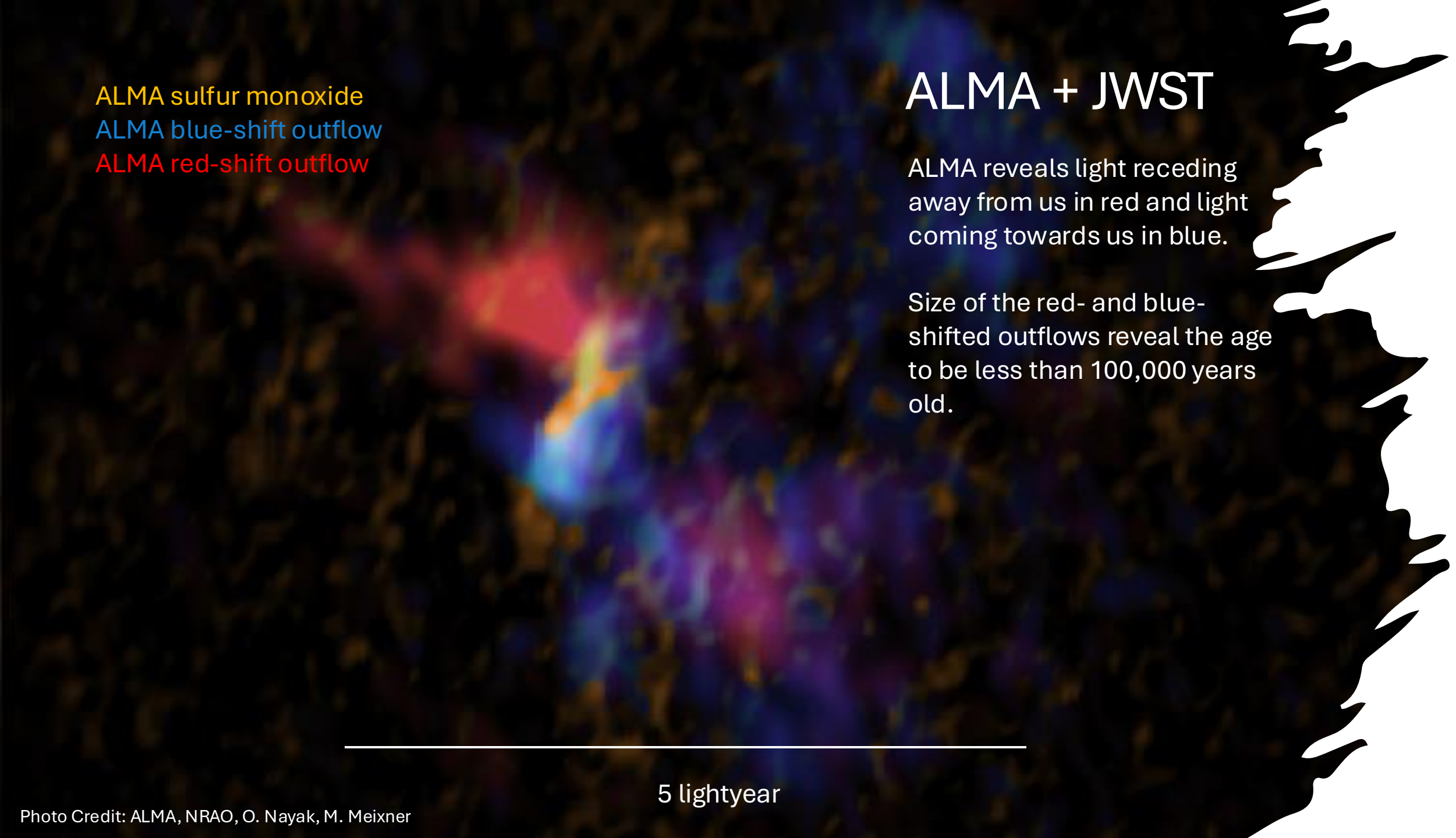


Nayak et al. (2024)





Nayak et al. (2024)

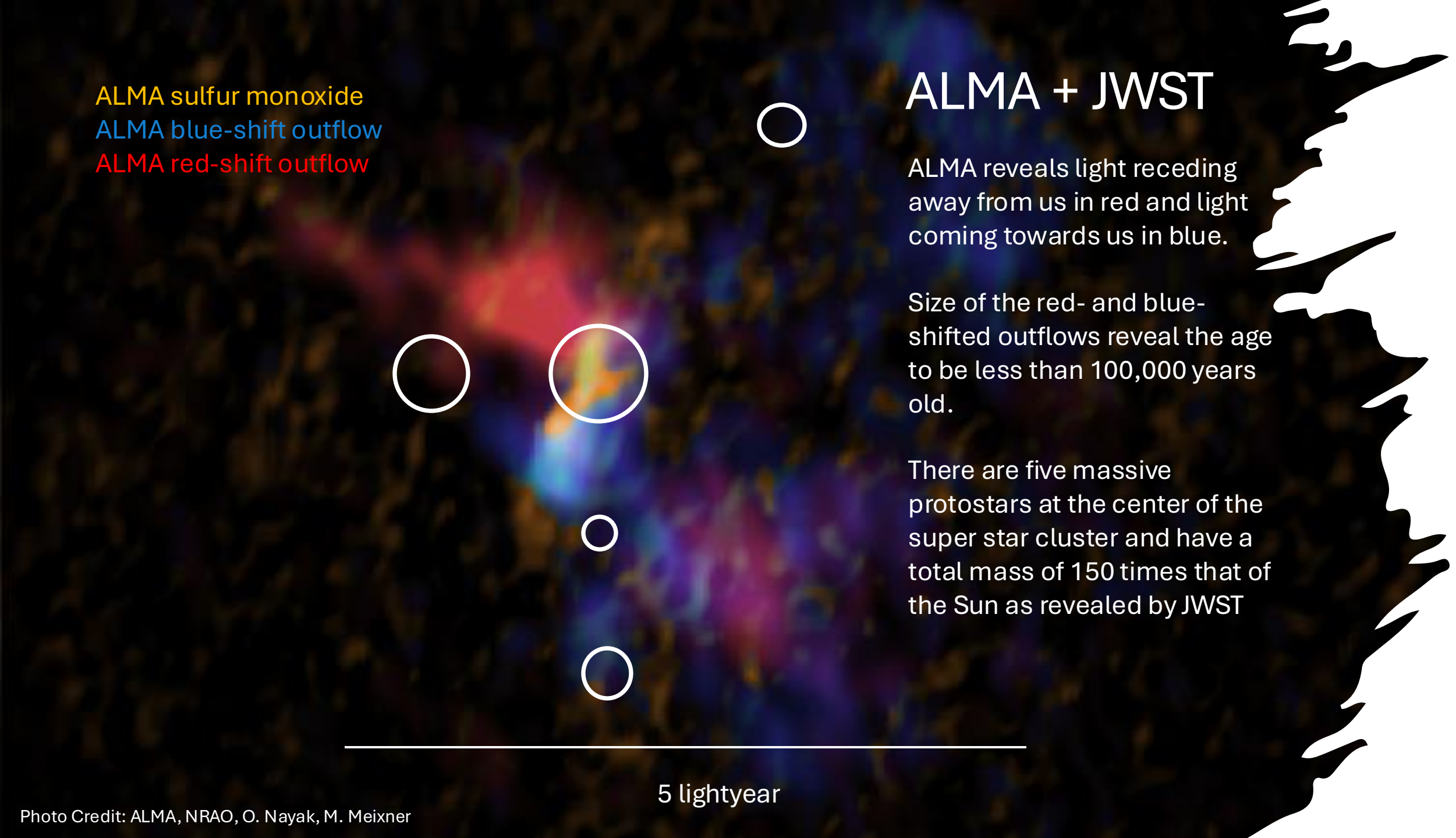


ALMA + JWST

ALMA reveals light receding away from us in red and light coming towards us in blue.

Size of the red- and blue-shifted outflows reveal the age to be less than 100,000 years old.

Photo Credit: ALMA, NRAO, O. Nayak, M. Meixner



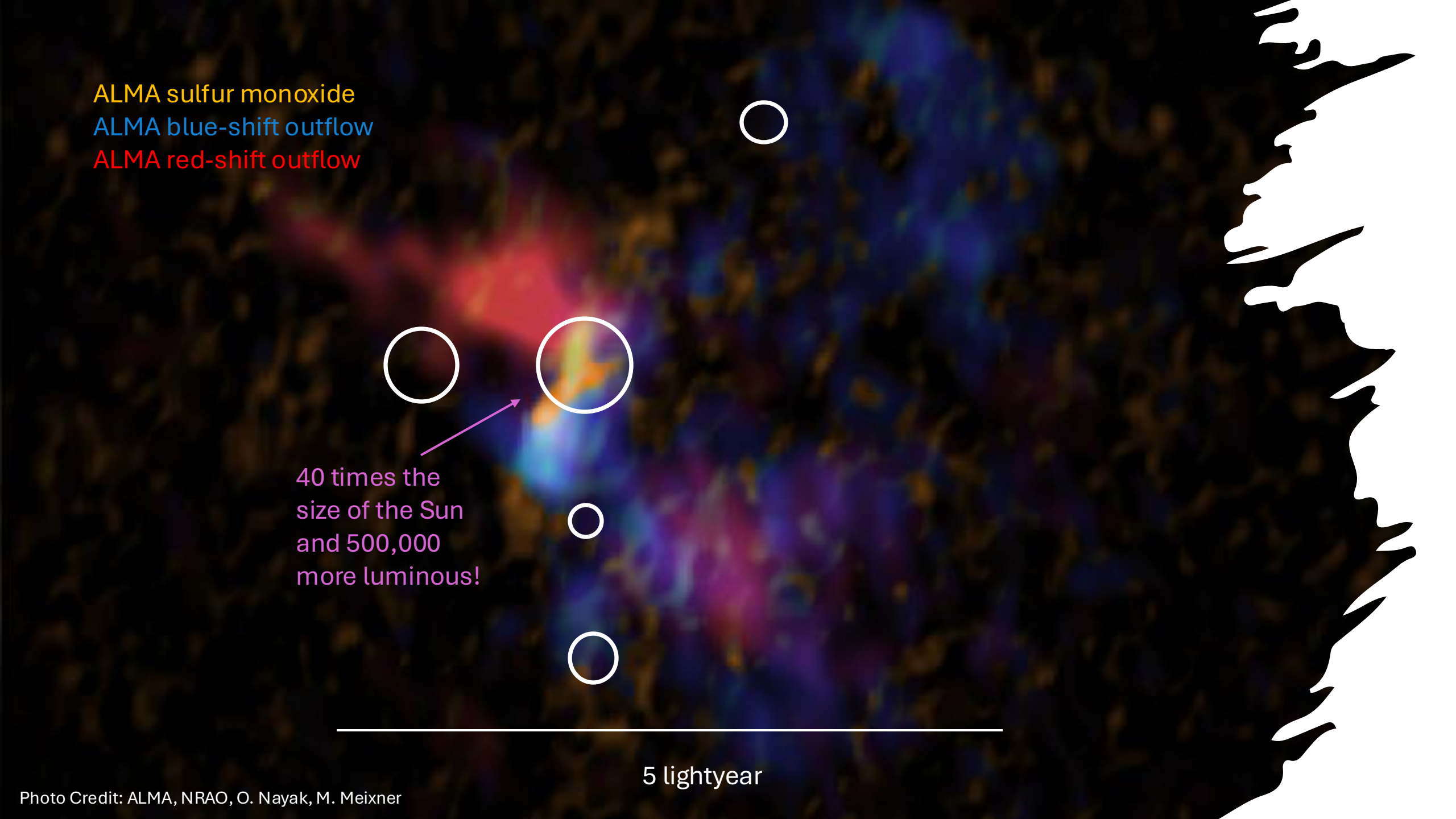
ALMA + JWST

ALMA reveals light receding away from us in red and light coming towards us in blue.

Size of the red- and blue-shifted outflows reveal the age to be less than 100,000 years old.

There are five massive protostars at the center of the super star cluster and have a total mass of 150 times that of the Sun as revealed by JWST

Photo Credit: ALMA, NRAO, O. Nayak, M. Meixner


ALMA sulfur monoxide
ALMA blue-shift outflow
ALMA red-shift outflow
40 times the size of the Sun and 500,000 more luminous!
5 lightyear
Photo Credit: ALMA, NRAO, O. Nayak, M. Meixner

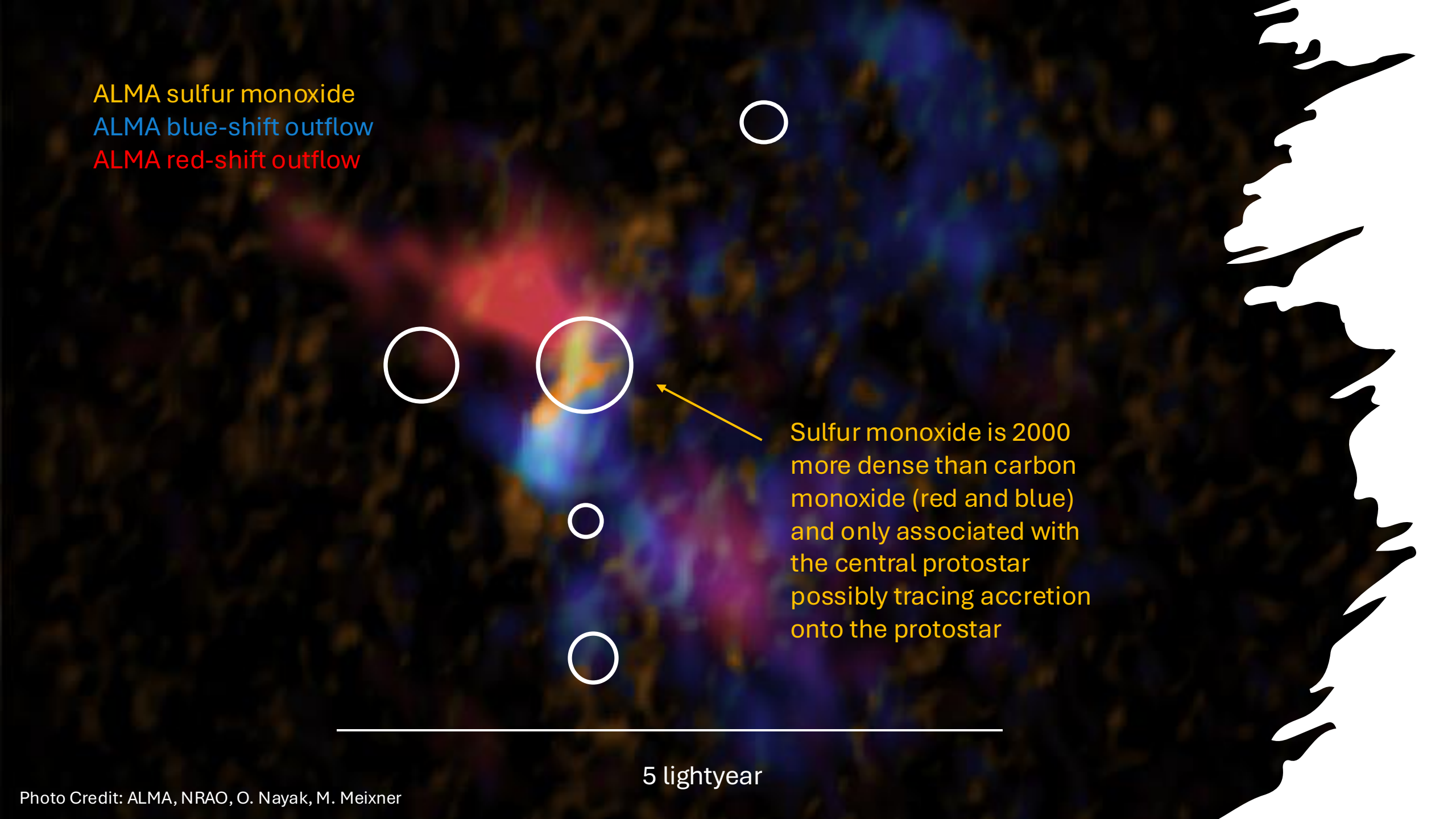


Photo Credit: ALMA, NRAO, O. Nayak, M. Meixner

Chandra observations confirm this region is less than 100,000 years old originally found with ALMA observations.

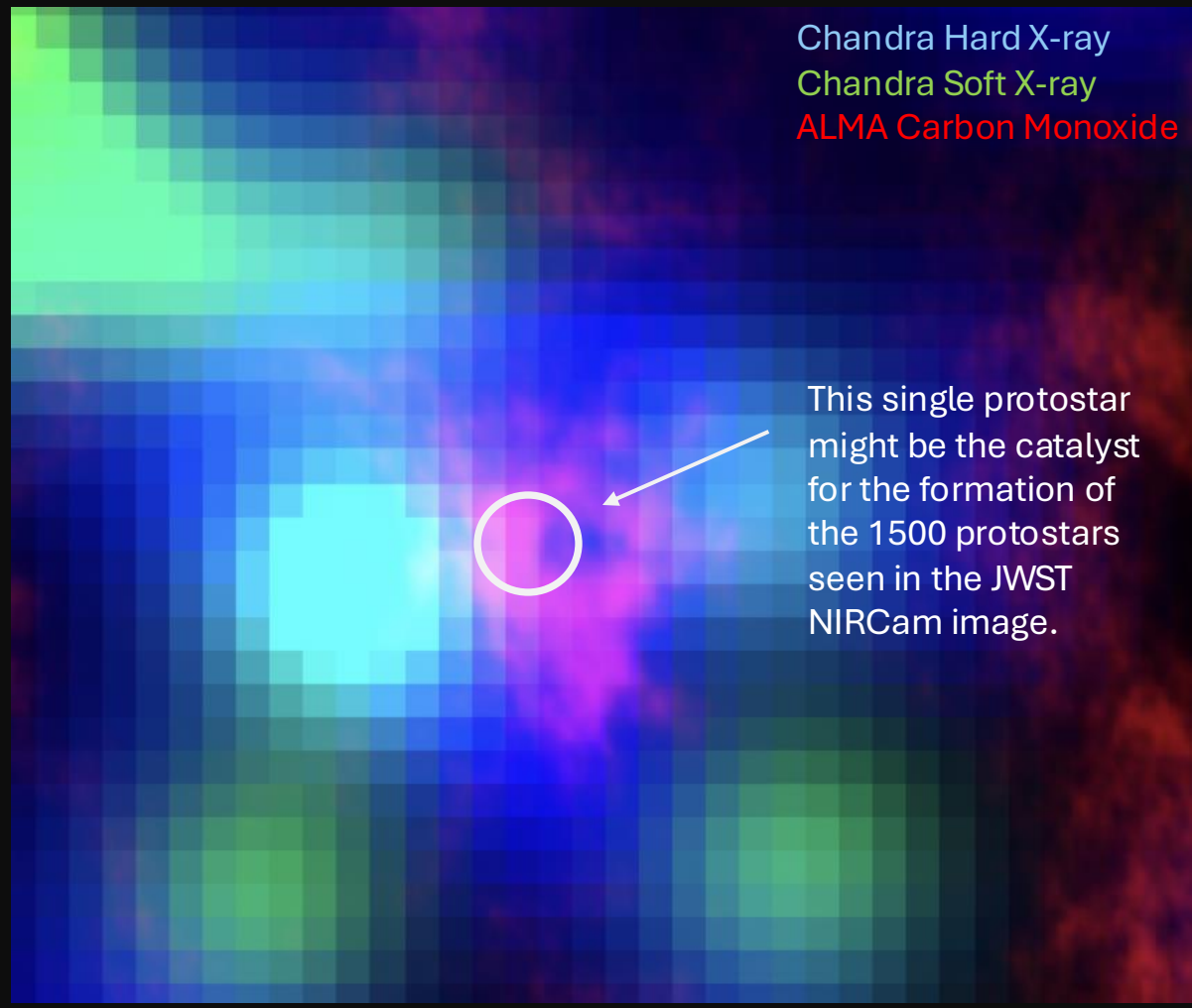


Photo Credit: ALMA, NRAO, Chandra, T. Webb, O. Nayak

Nayak et al. (2019), Webb et al. (2024)

JWST NIRCam observations confirm for the first time this is indeed a super star cluster

NIRCam observations reveal the region is forming new stars at a rate 2-4 times higher than the super star cluster in the 30 Doradus region of the Large Magellanic Cloud and twice the rate of stars forming in the entire Milky Way

Super star clusters used to be the main mode of star formation 6-7 billion years ago and we get the opportunity to use JWST to observe one in our neighboring galaxy with unprecedented detail

Super star cluster H72.97-69.39 is less than 100,000 years old

We will use this newly discovered super star cluster as a proxy for studying how some of the first super star clusters formed and shaped galaxies like the Milky Way billions of years ago

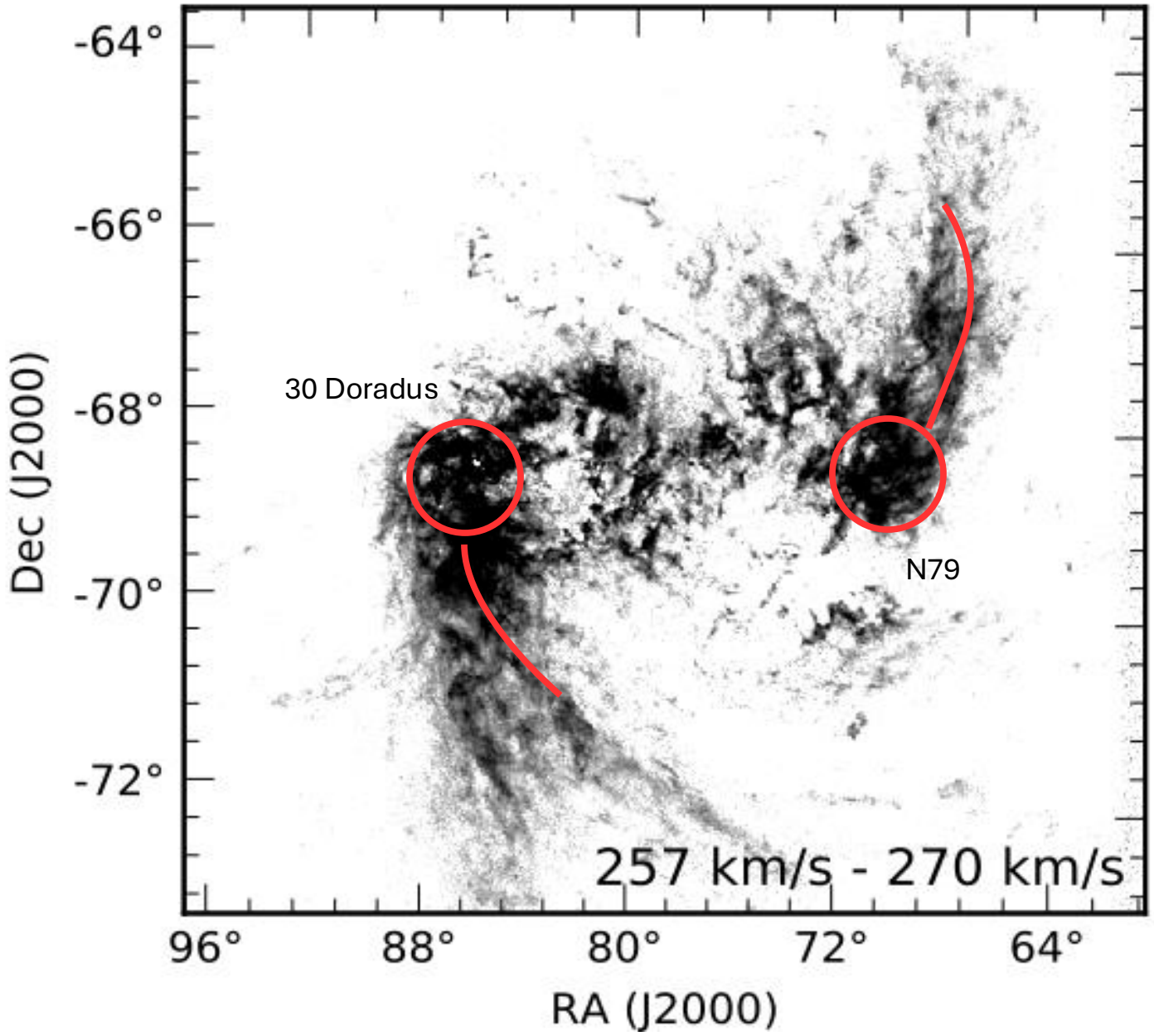
Photo Credit: NASA, ESA, CSA, STScI, NRAO, O. Nayak, M. Meixner

Presenter: Dr. Isha Nayak (NASA GSFC)
Email: omnarayani.nayak@nasa.gov
Phone: (408)668-5867

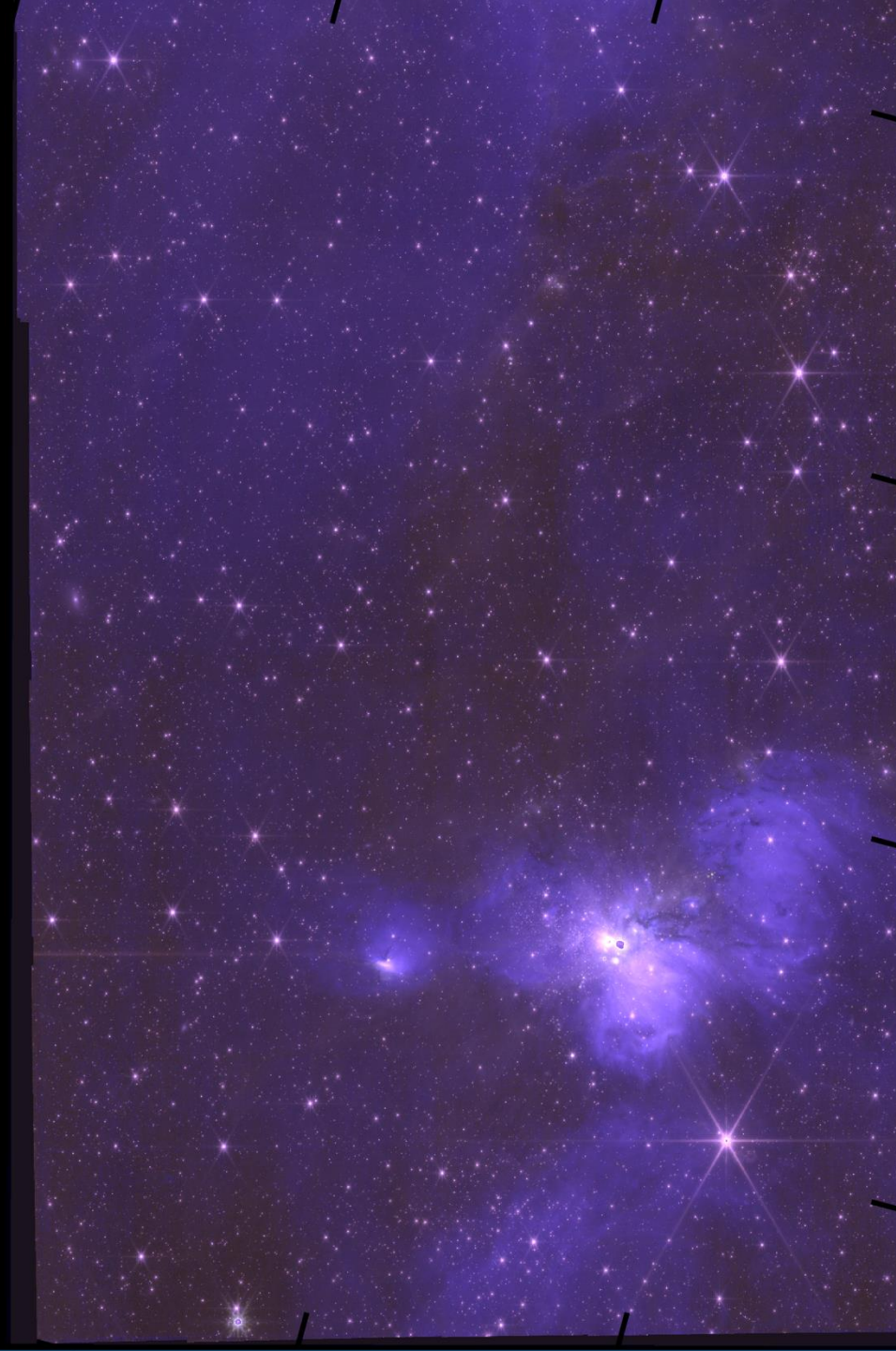
Photo Credit: NASA, ESA, CSA, STScI, NRAO, O. Nayak, M. Meixner

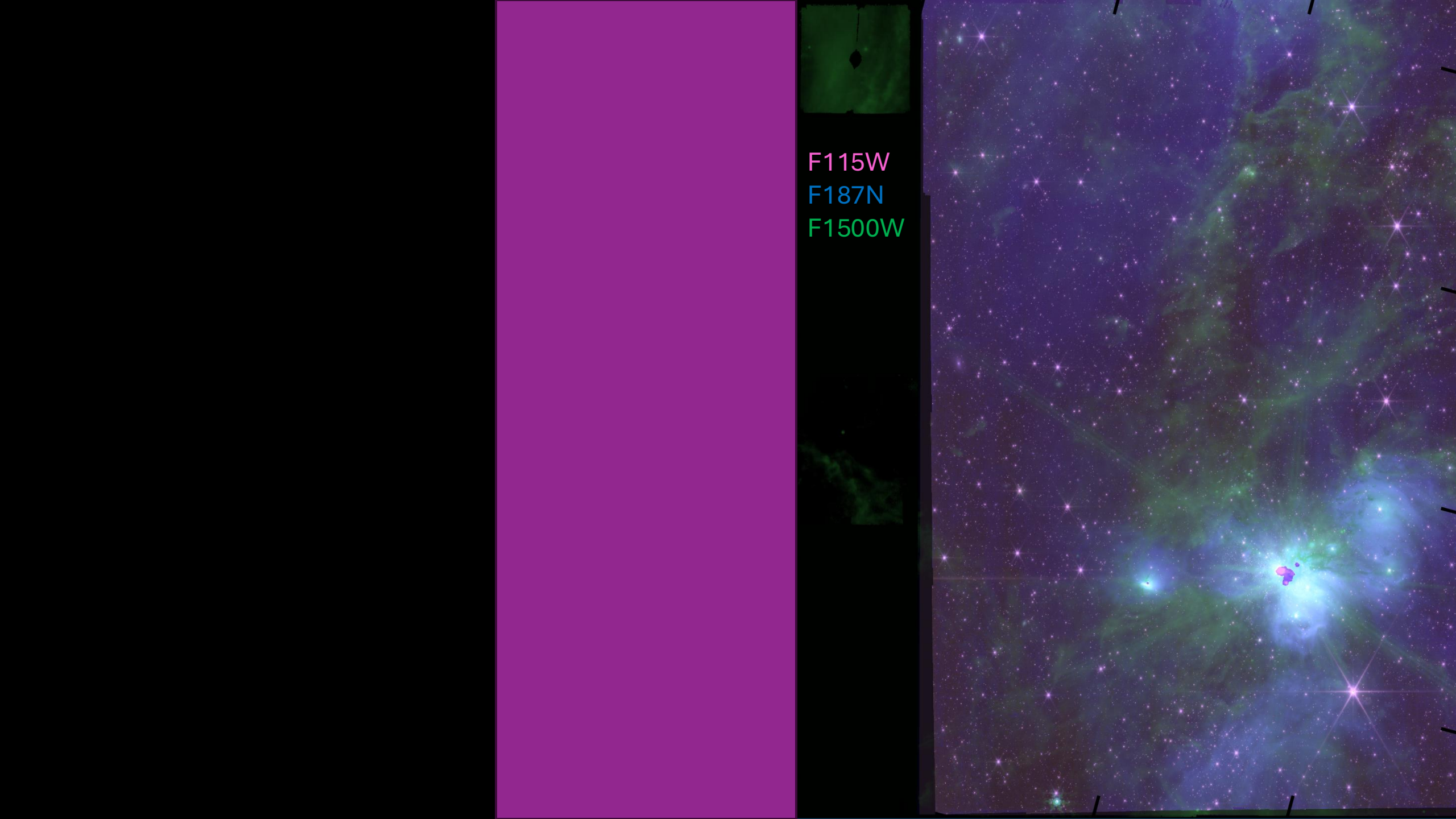
Backup Slides

HI flows are thought to be how massive star clusters can form, with a lot of gas funneling in through these flows and fueling the formation of some of the most massive stars.



F115W
F187N




F115W
F187N
F1500W