UCLA GALACTIC CENTER GROUP

A New Window on Star Formation History at the Galactic Center

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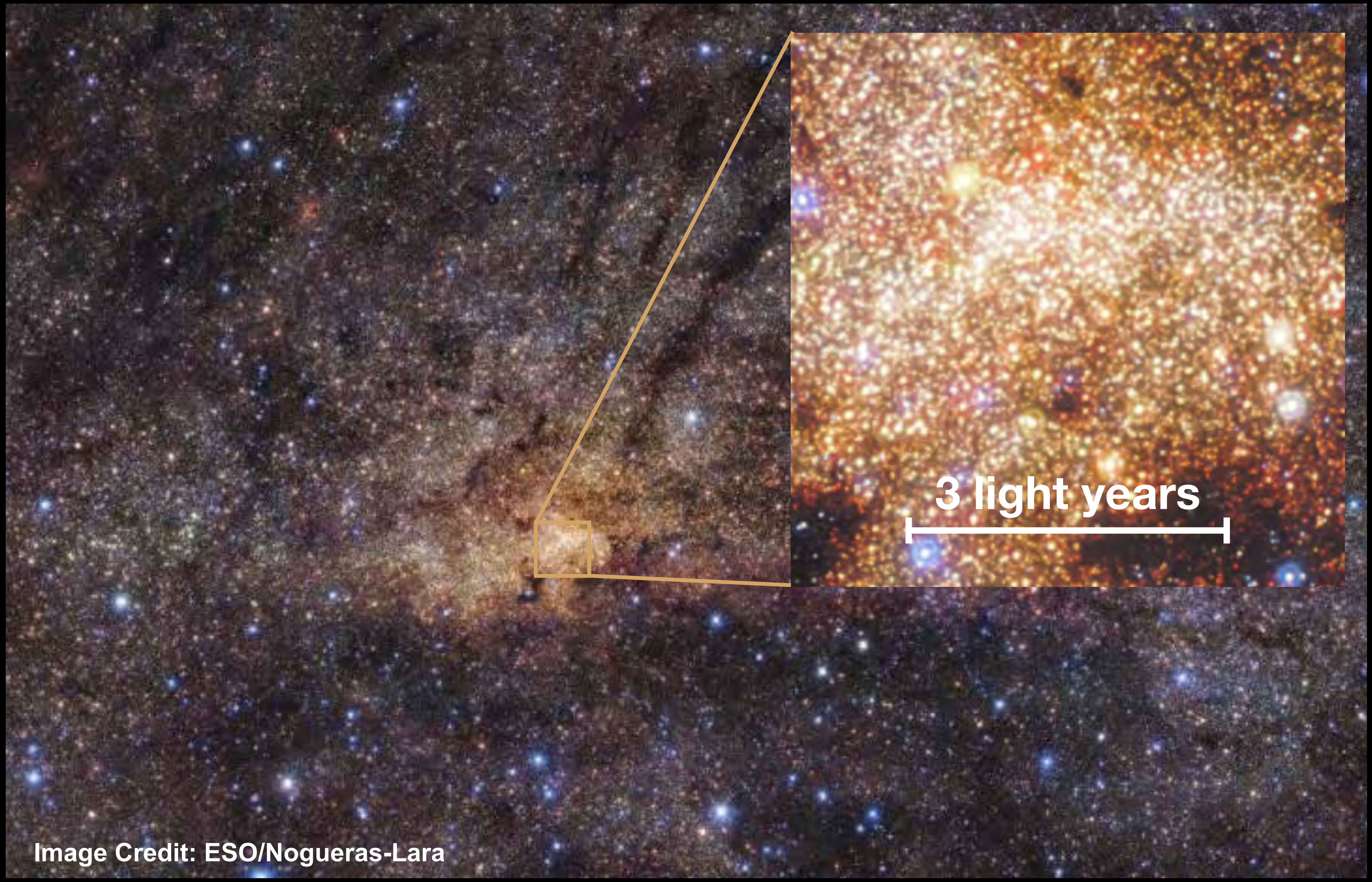
Image Credit: NASA/ESA/Hubble Heritage Team/STScI/AURA/T. Do&A. Ghez, UCLA/V. Bajaj, STScI

We find that the center of our Galaxy may be surprisingly young



Two groups of stars:	
Group1	90% @ 4 billion years old
Group2	10% @ 1- 4 billion years old

- First time the metal abundances of stars are used to determine the star formation history in the Galactic center

- Half the age as previously thought, challenging to explain for current formation & evolution scenarios

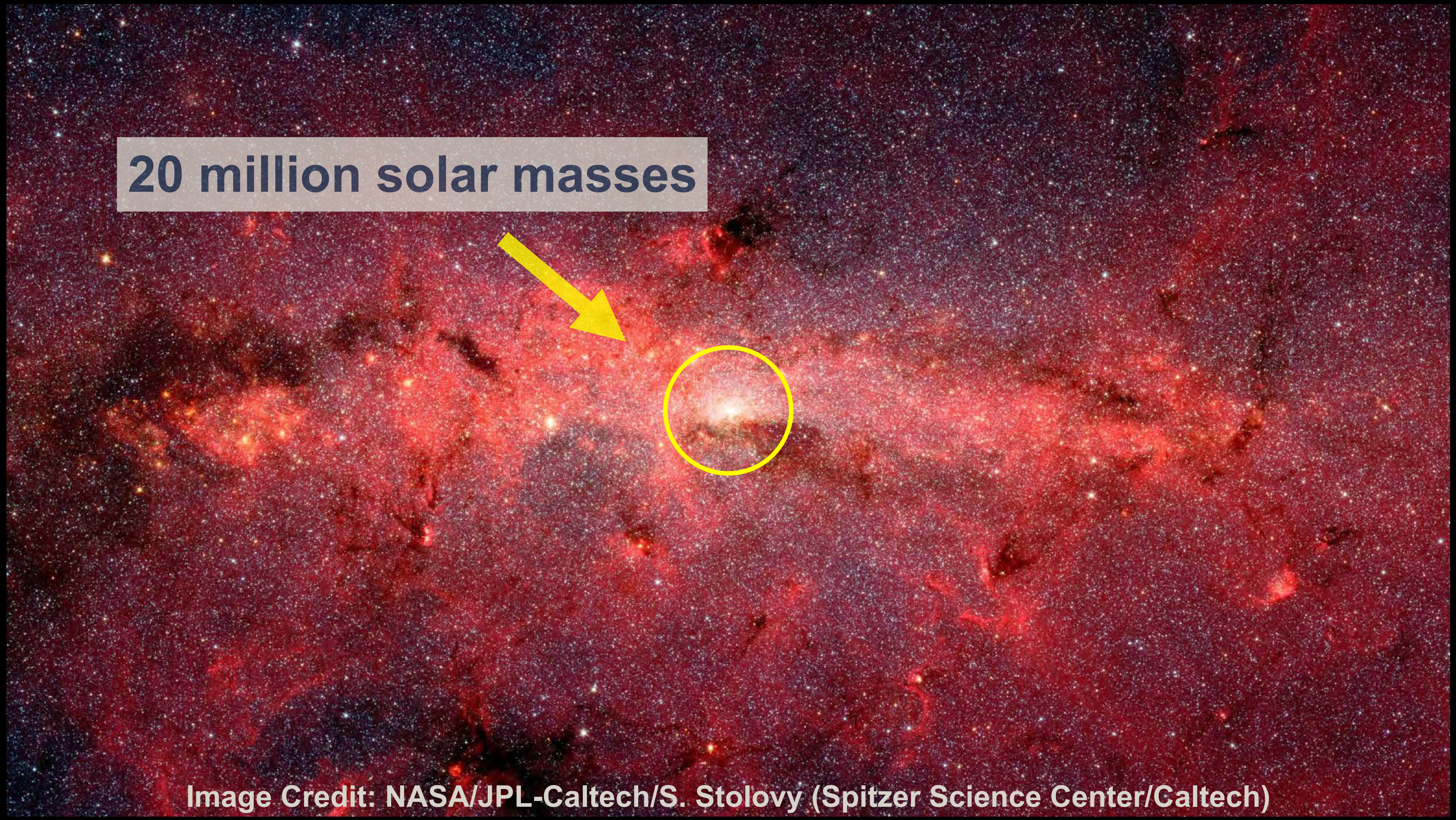
- We can make more accurate predictions of number of compact objects (white dwarfs, neutron stars, stellar-mass black holes)

Milky Way's Nuclear Star Cluster is the only resolved galactic nucleus with a central Supermassive Black Hole

Nuclear star cluster

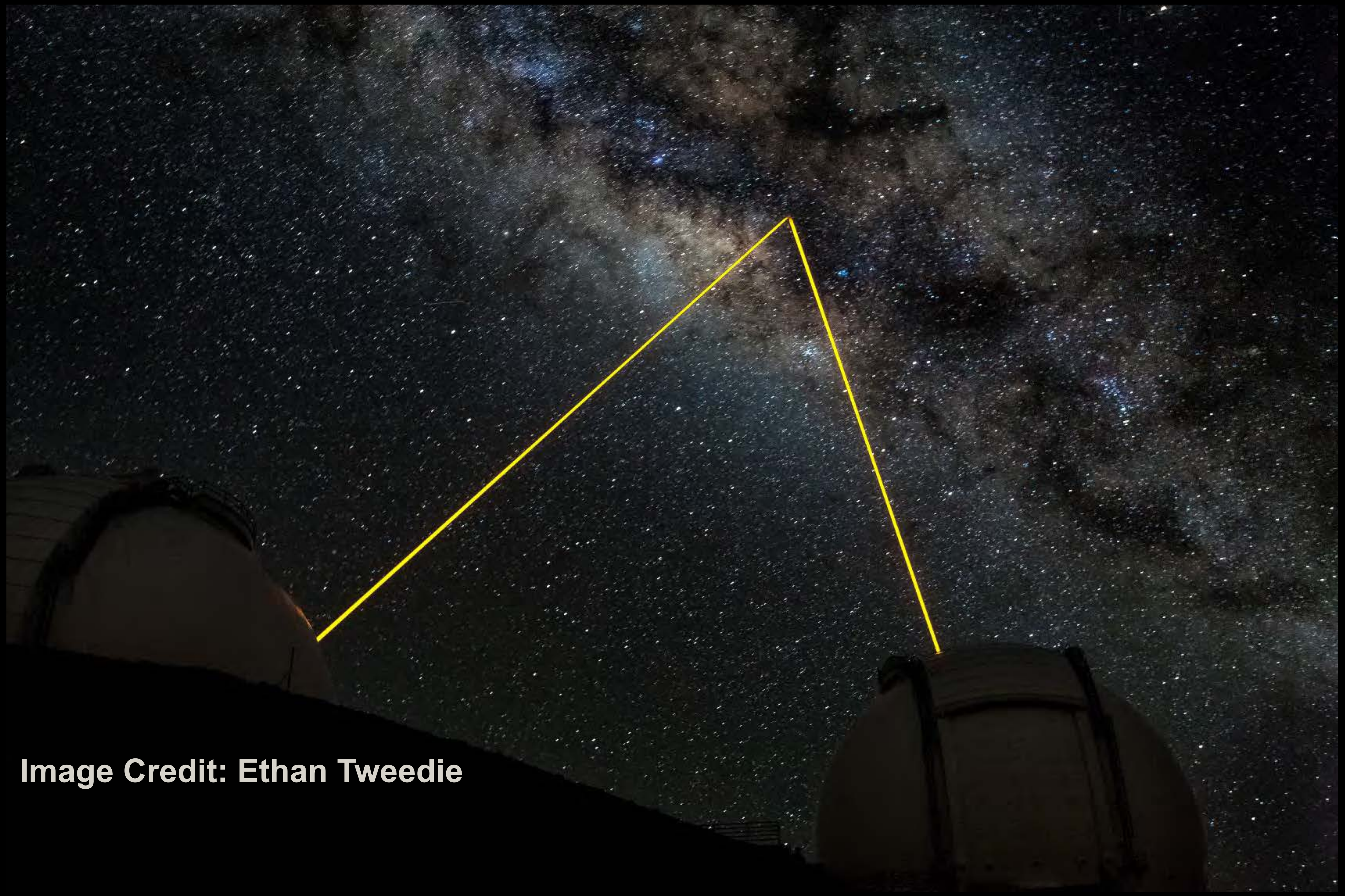
Most massive & densest star cluster in the Milky Way

Contains a 4 million solar mass supermassive black hole



How did all these stars get there?

How do the stars interact with the supermassive black hole?



Data from Gemini, VLT, and Keck

For the first time, we can use measurements of the metal contents of stars when determining the star formation history

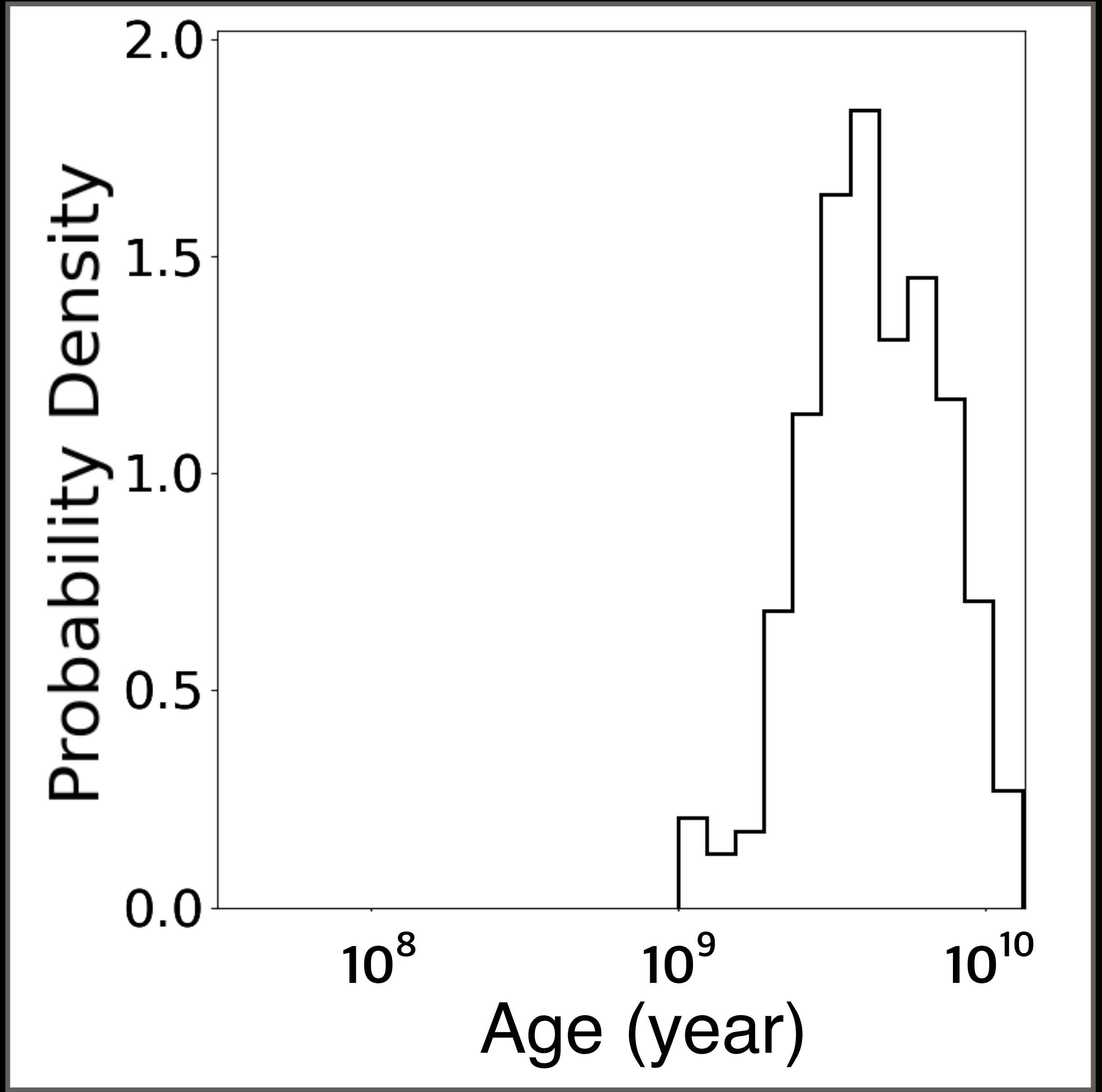
Metal abundance: - Amount of elements heavier than Helium compared to the Sun
- Affects the brightness and our measurements of age of stars

Group 1

92% of stars are born with:

Age$_1$ = 4.0$^{+2.1}_{-2.0}$ billion years

Metal-rich: ~ 3 times higher than solar

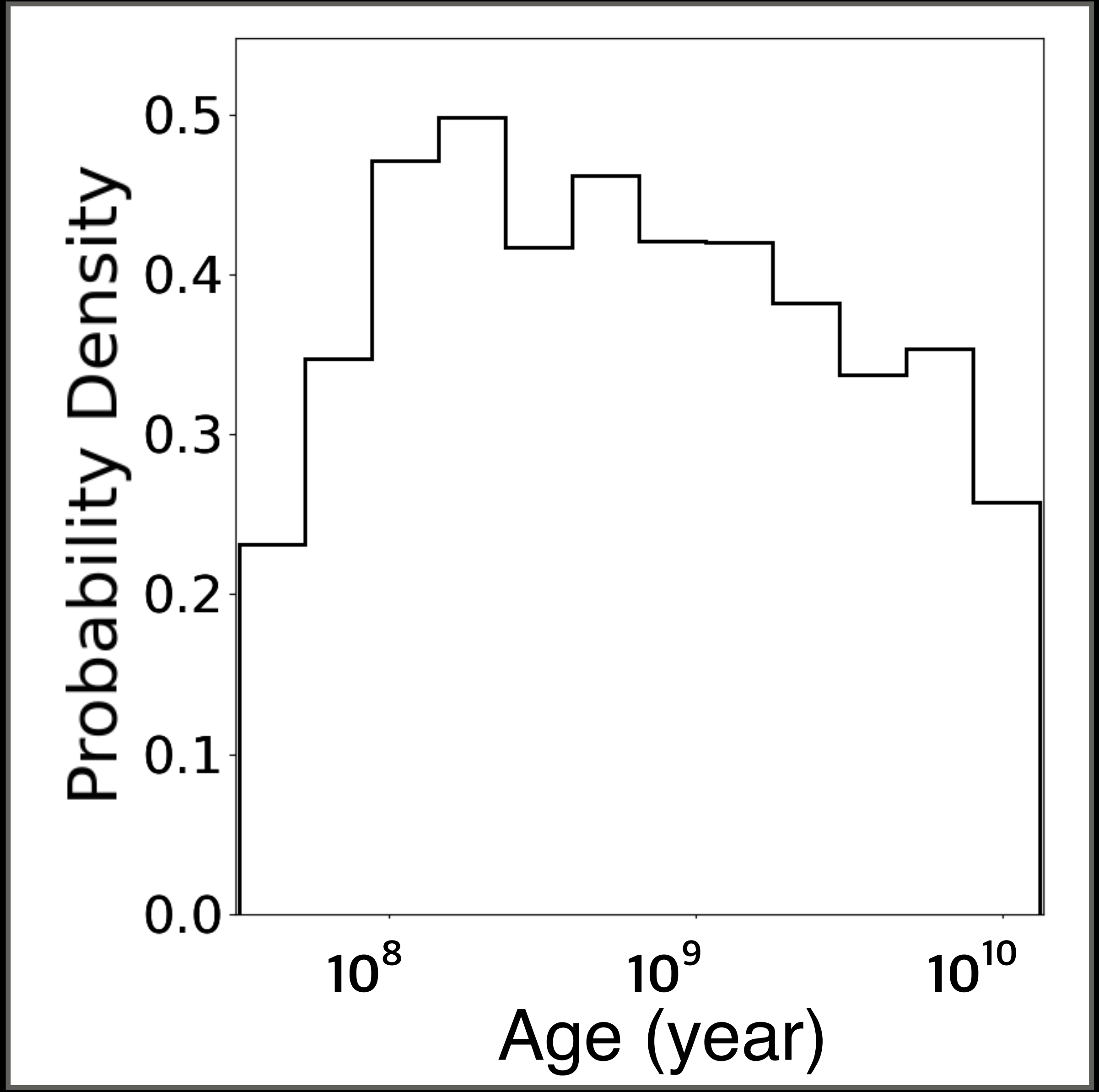


Group 2

8% of stars are born with:

Age$_2$ = 1.1 - 4.0 billion years

Metal-poor: ~ One tenth of solar



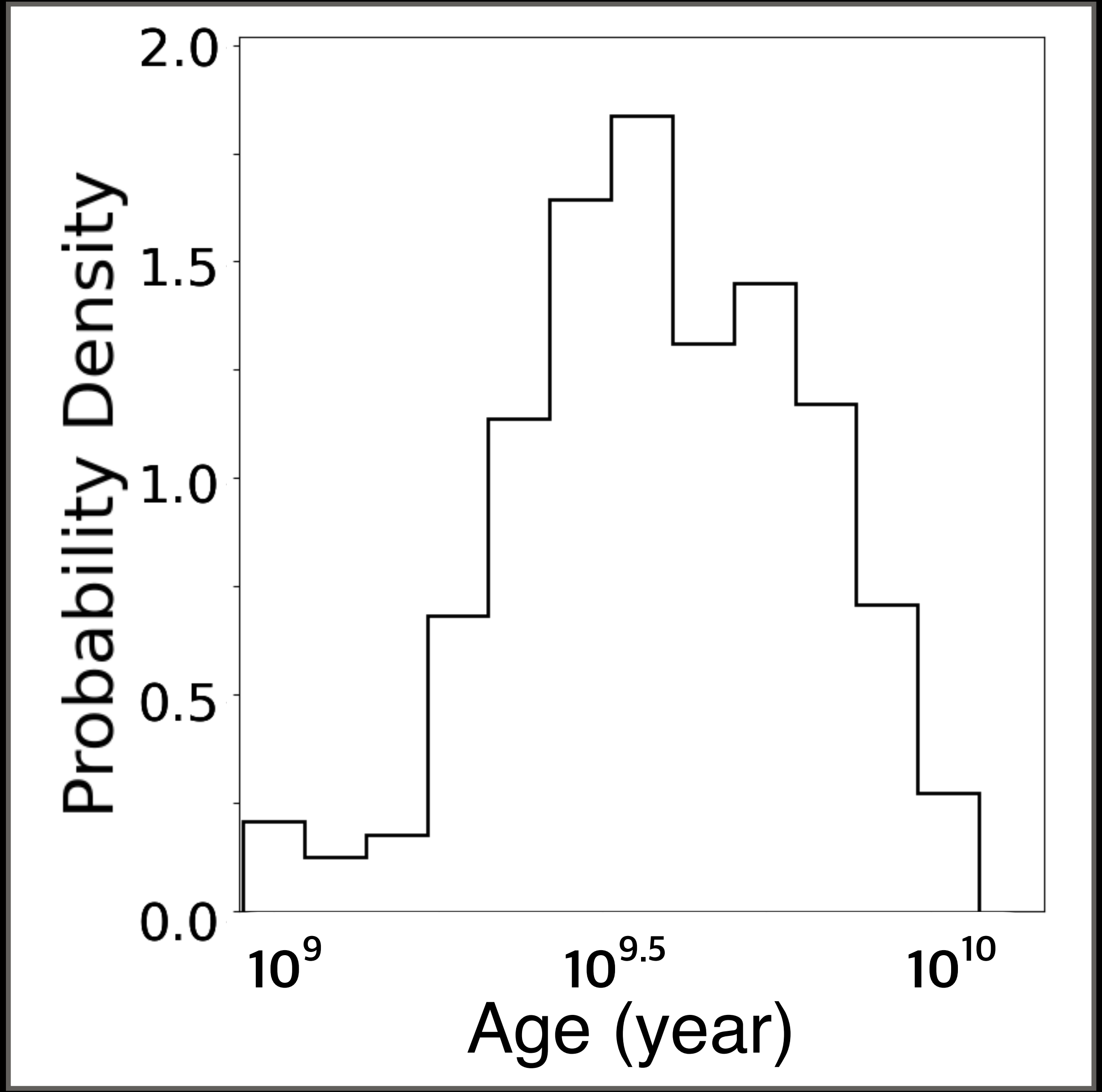
Chen et al., in prep

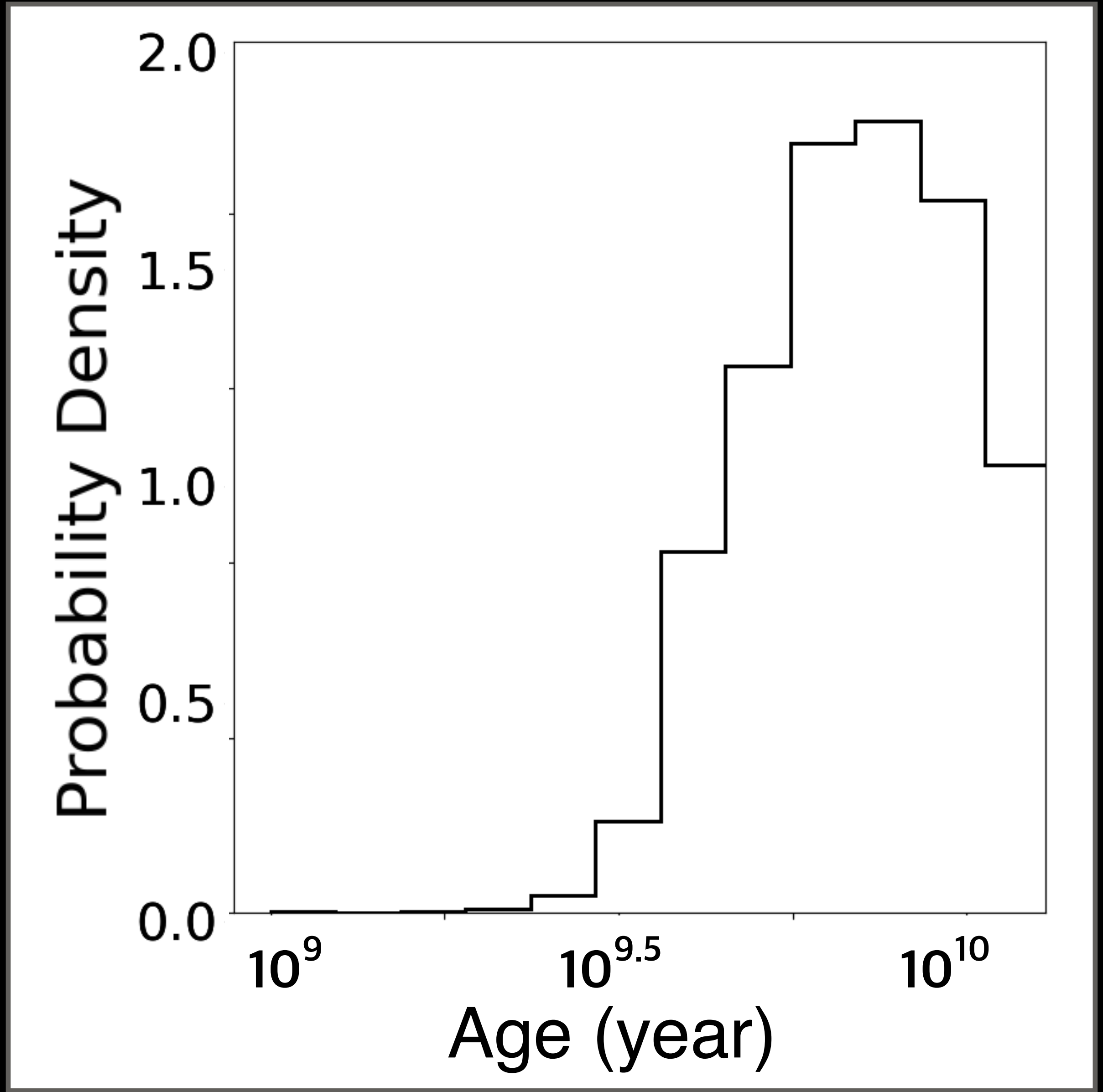
Assuming solar metal abundance significantly increases the age

The Nuclear Star Cluster is ~HALF as old if metal abundances are included

This work
Age = 4.0 $^{+2.1}_{-2.0}$ billion years
Metal-rich: ~ 3 times higher than solar

Assuming stars have solar metal abundance (as done by previous work)
Age = 7.1 $^{+2.9}_{-2.3}$ billion years

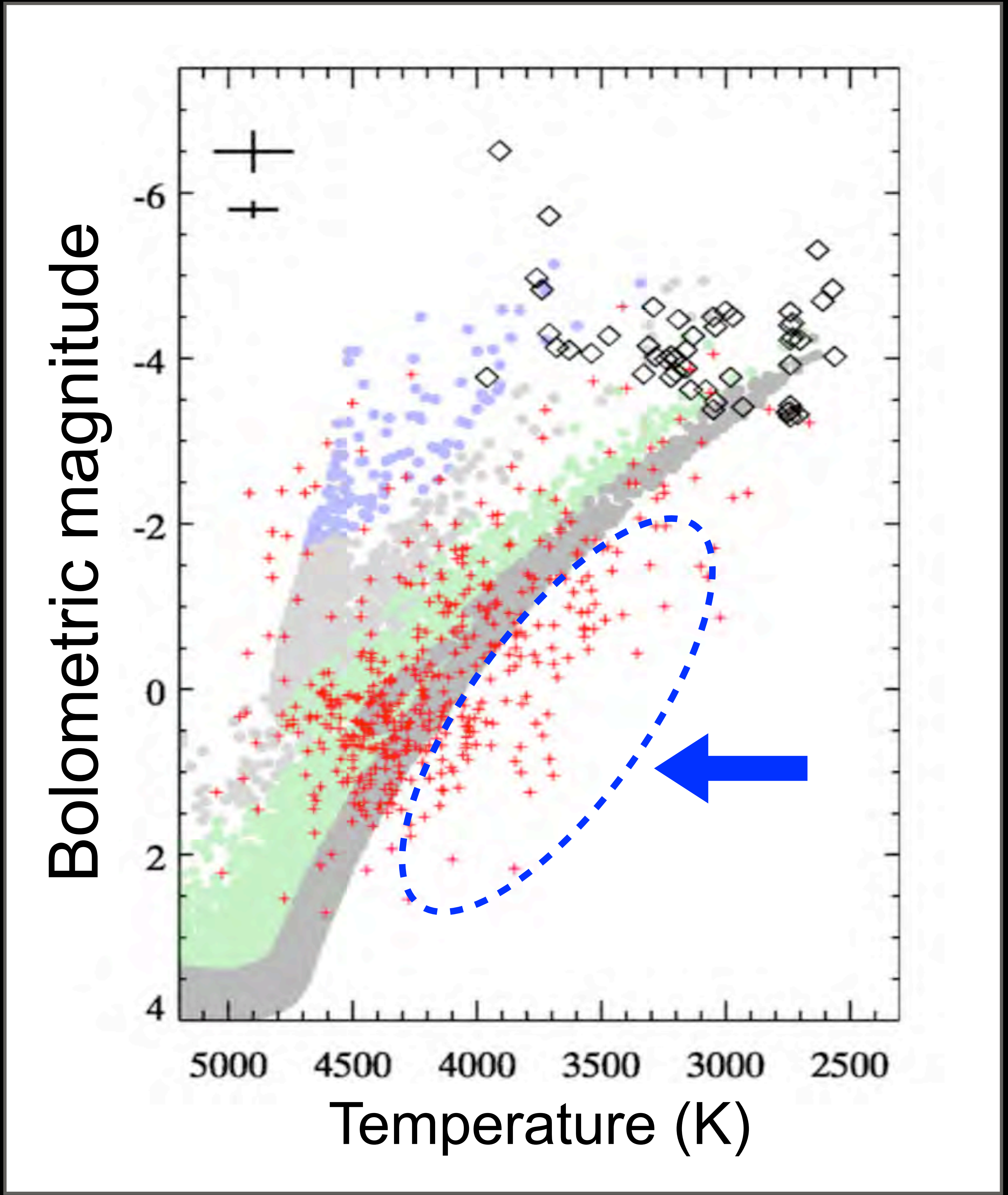




Chen et al., in prep

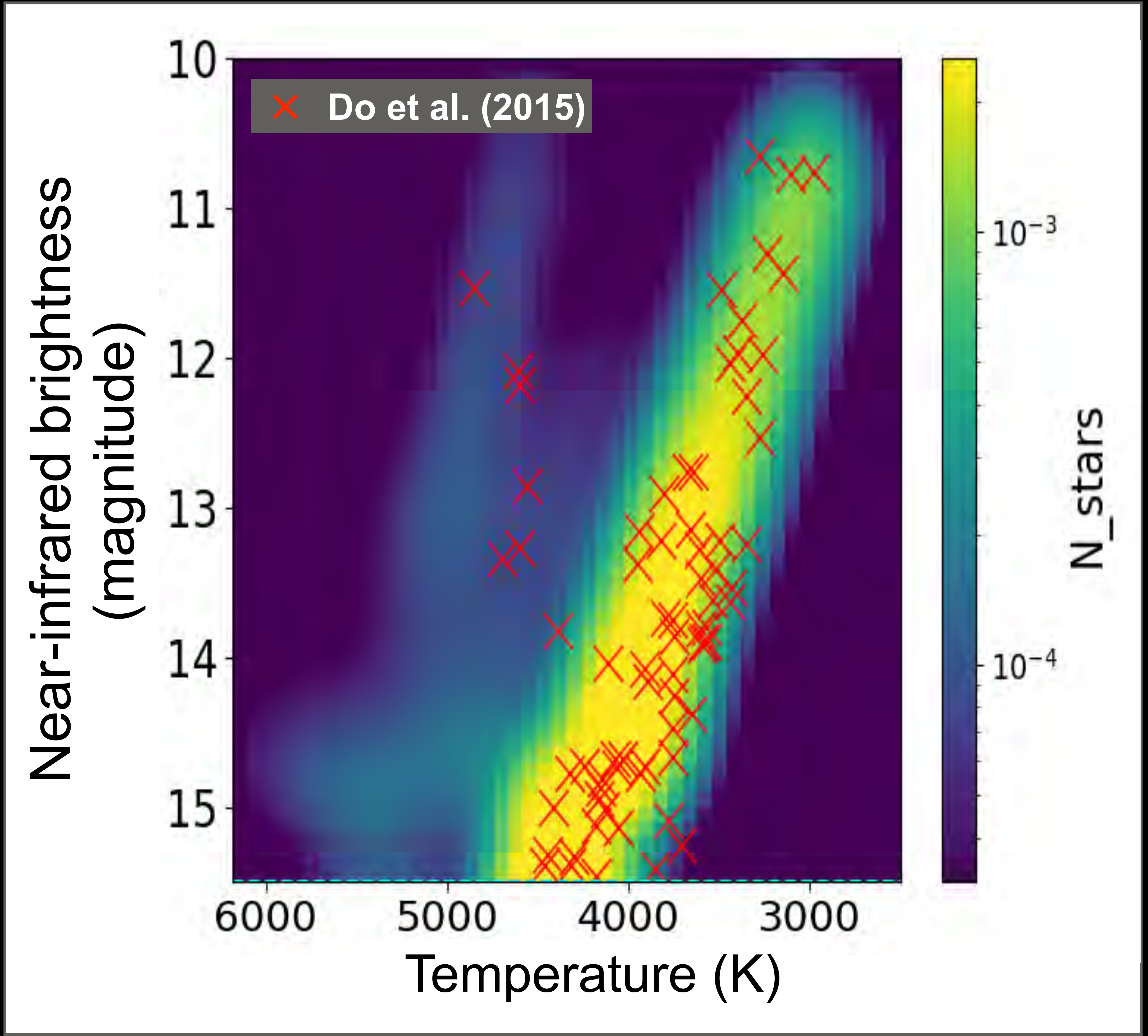
We are able to fit the low-Temperature stars for the first time

Assuming solar metal abundance



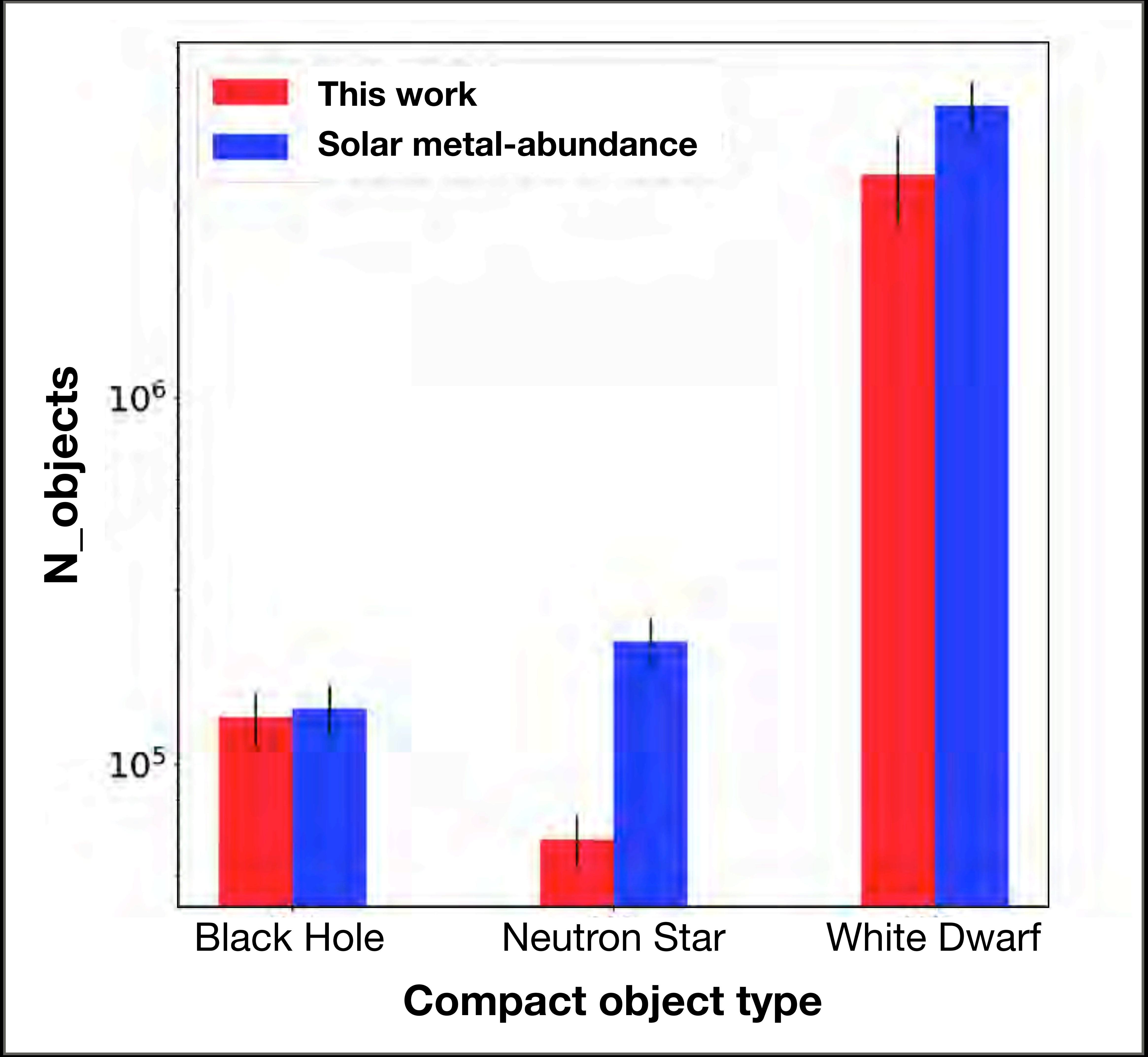
Pfuhl et al. (2011)

This work



Chen et al., in prep

This work: Predicted number of Neutron stars decreases by a factor of THREE



Could this be part of the explanation for "Missing Pulsar problem"?

Has implications for gravitational wave mergers

Chen et al., in prep

The Nuclear Star Cluster is HALF as old with metal abundance constraints

- The Galactic Center has some of the highest metal stars in the Universe, taking this into account has decreased our estimate of the age of these stars

- Challenge the mutual evolutionary theory of the nuclear star cluster, the supermassive black hole and the inner bulge

- Challenge the globular clusters infalling scenario

- Make more accurate predictions of number of compact objects and rate of gravitational wave mergers

- Future works:
  - More observations of fainter stars with JWST
  - Calibrating the stellar evolutionary models for stars with high metal content will give more accurate measurements

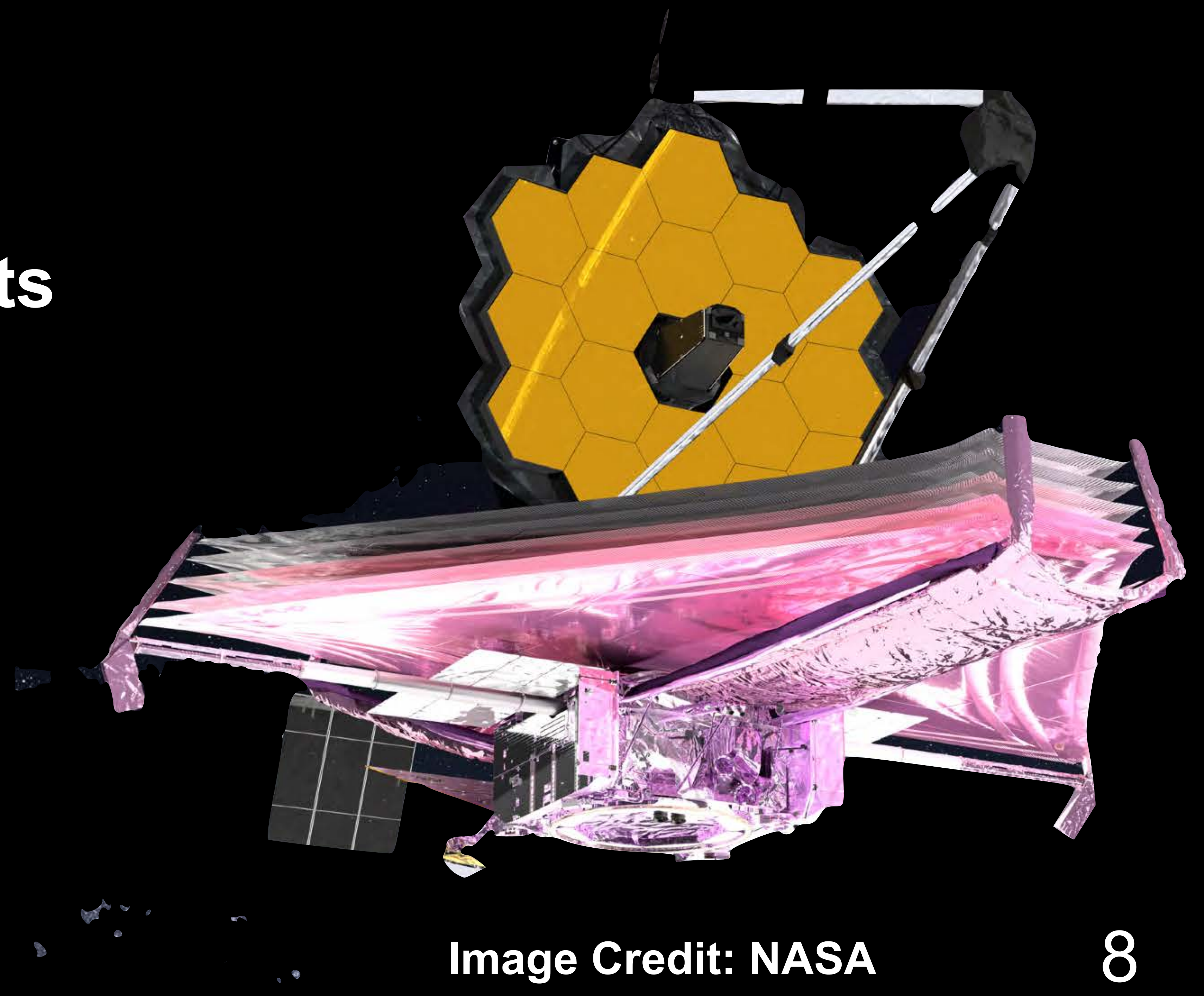


Image Credit: NASA

Summary

- We report the first star formation history at the Galactic Center with measurements of metal abundances from Gemini and VLT
- Nuclear star cluster is younger than any previously reported studies, which may challenge the current formation mechanism
- We predict three times fewer neutron stars

Acknowledgement

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