



# Hidden Gems in the Hearts of Nearby Galaxies

Evolution of Young Massive  
Star Clusters in Circumnuclear Rings

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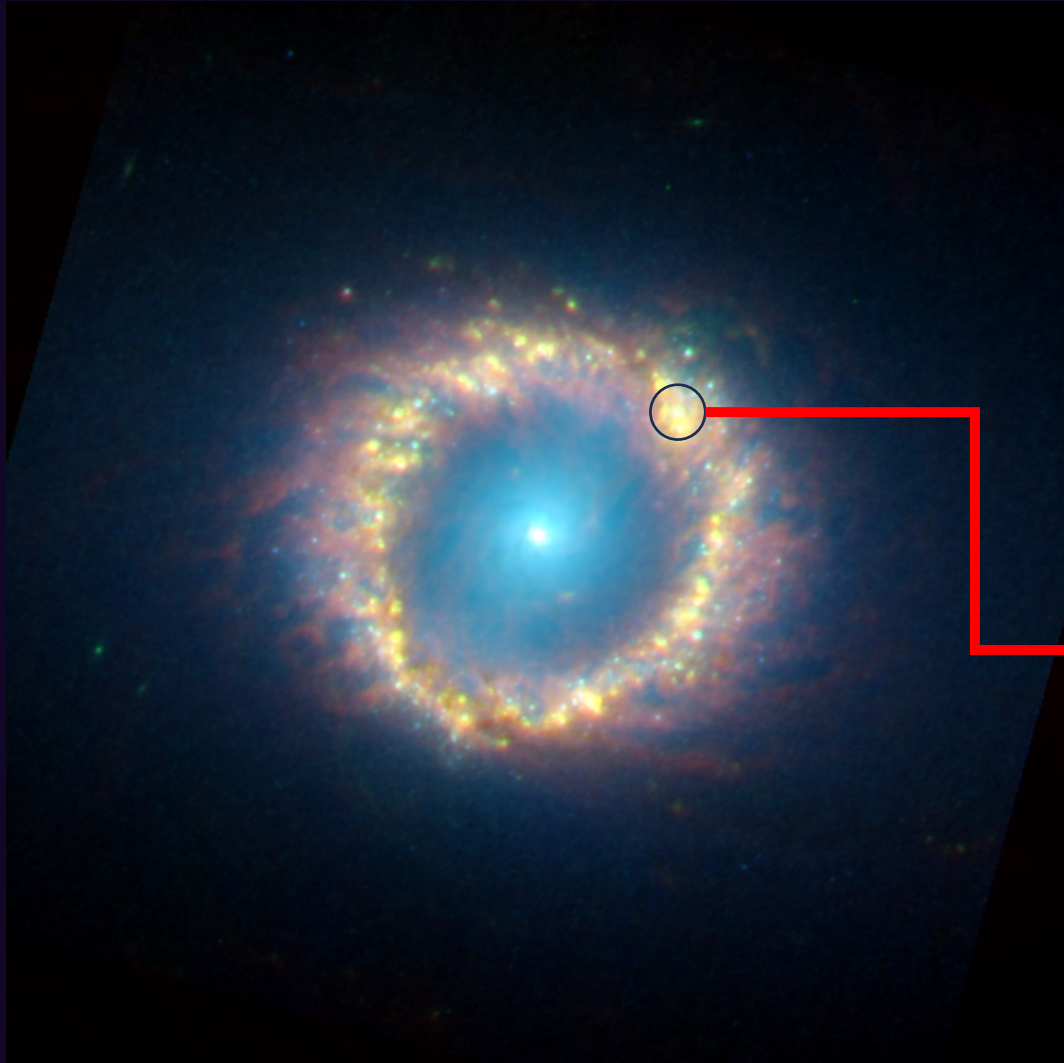
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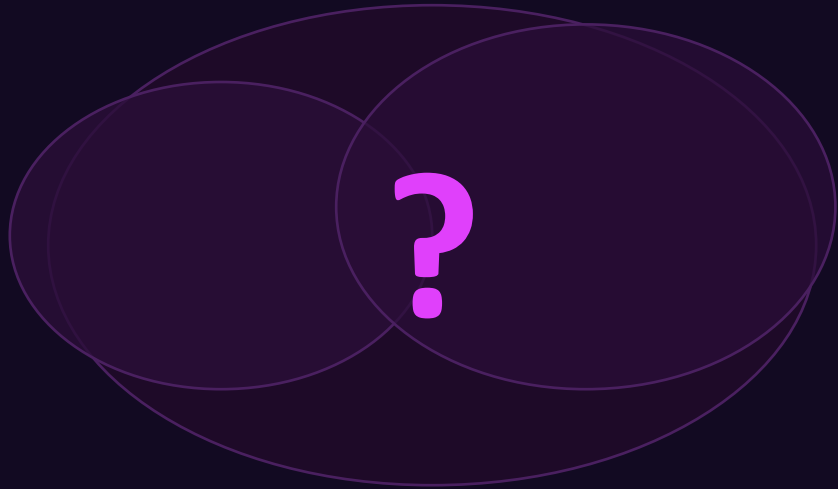
# Young Massive Clusters are Extreme Stellar Nurseries



# Star Clusters Are Born Hidden Behind Dust

OPTICAL TELESCOPE

*Visible light*

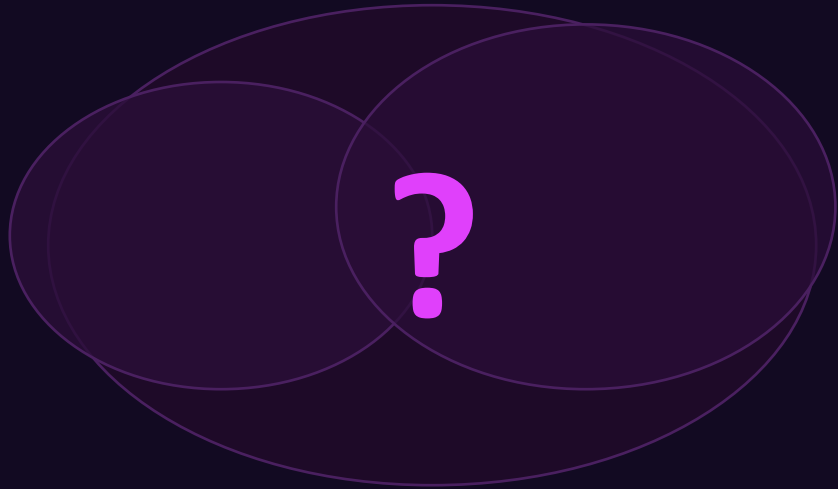


**Completely invisible**

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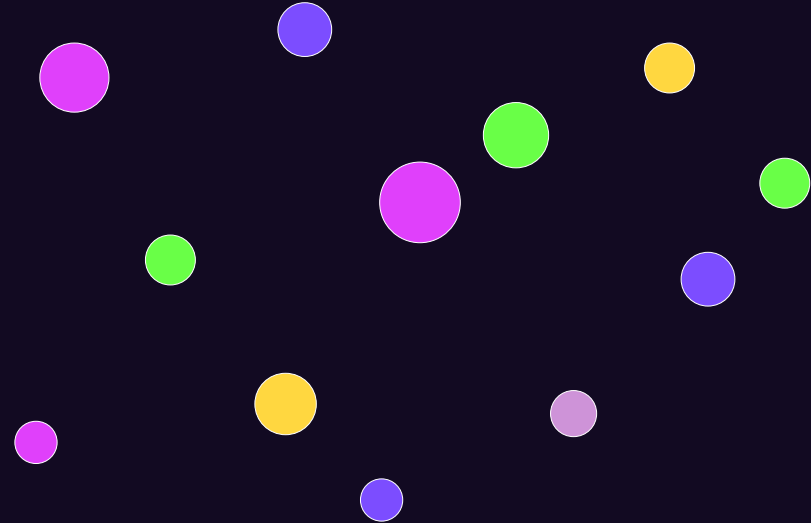


**Completely invisible**



RADIO TELESCOPE (ALMA/VLA)

*Radio waves*



**Hidden clusters revealed!**

**Radio waves pierce dense dust clouds**

# Two Nearby Galaxies with Ring-Shaped Star-Forming Zones



# Two Nearby Galaxies with Ring-Shaped Star-Forming Zones



NGC 3351 · ~100 million light-years



NGC 1097 · ~140 million light-years

# We use two NRAO radio telescopes



Atacama Large Millimeter/Submillimeter Array (ALMA), Chile



NRAO Very Large Array (VLA), New Mexico

# ~50 Hidden Stellar Nurseries Discovered

NGC 3351



26 radio sources

53

Radio  
Sources

0%  
false detections

NGC 1097

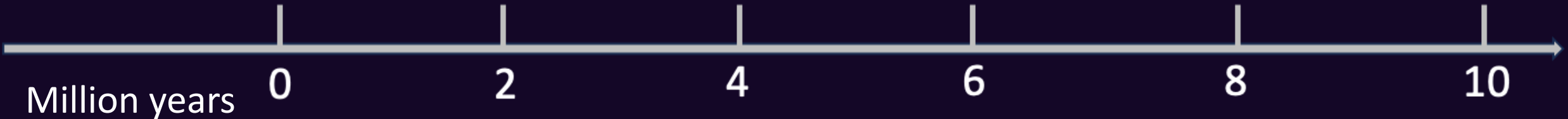


27 radio sources

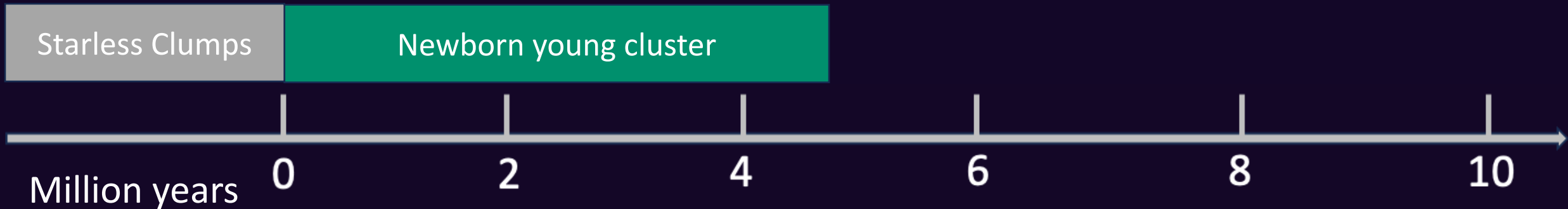
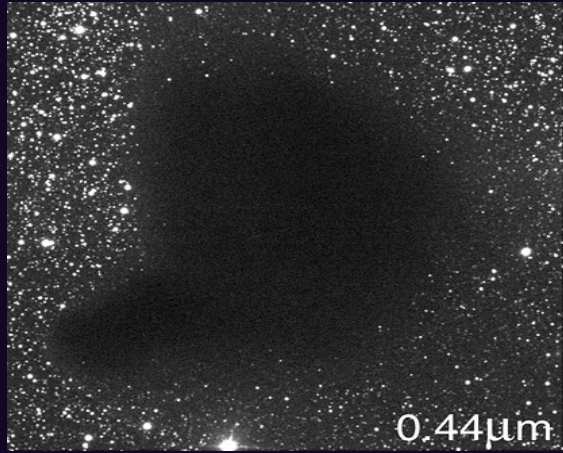
# We can determine the duration of each stage



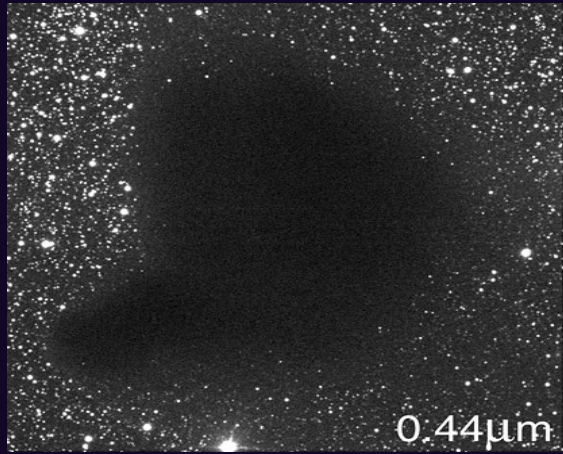
Starless Clumps



# We can determine the duration of each stage



# We can determine the duration of each stage



Starless Clumps

Newborn young cluster

Exposed cluster

Million years

0

2

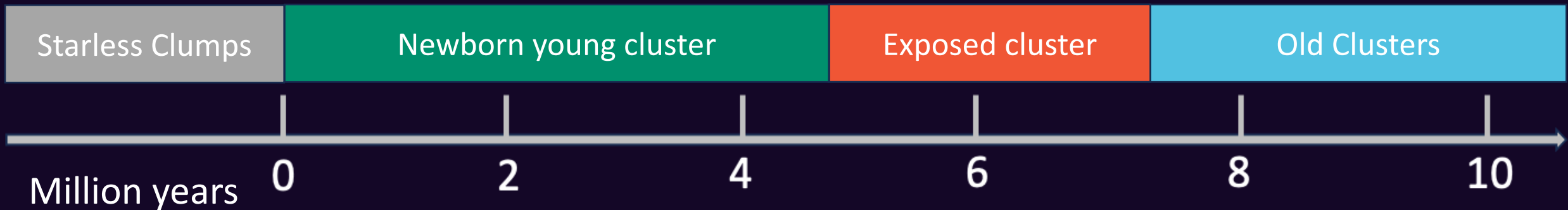
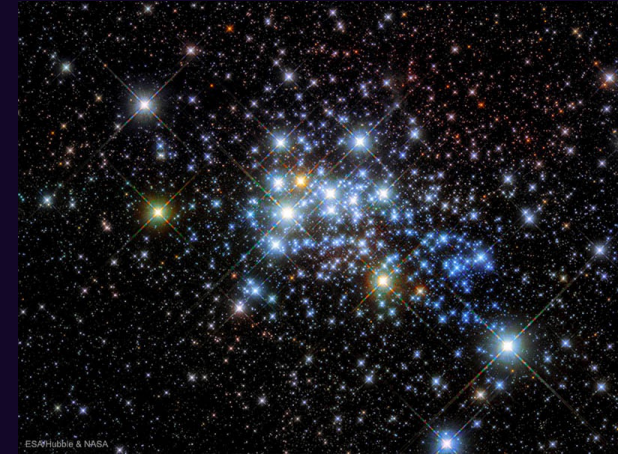
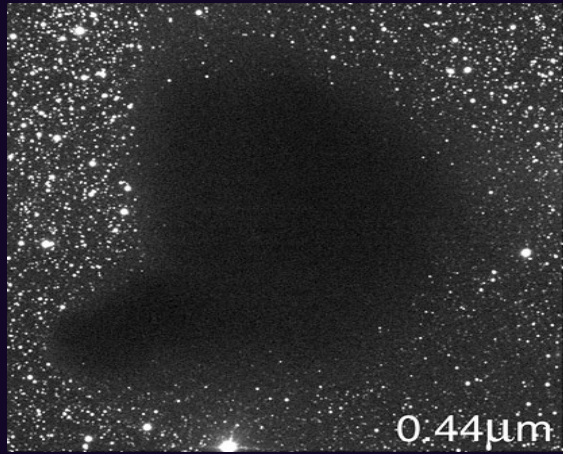
4

6

8

10

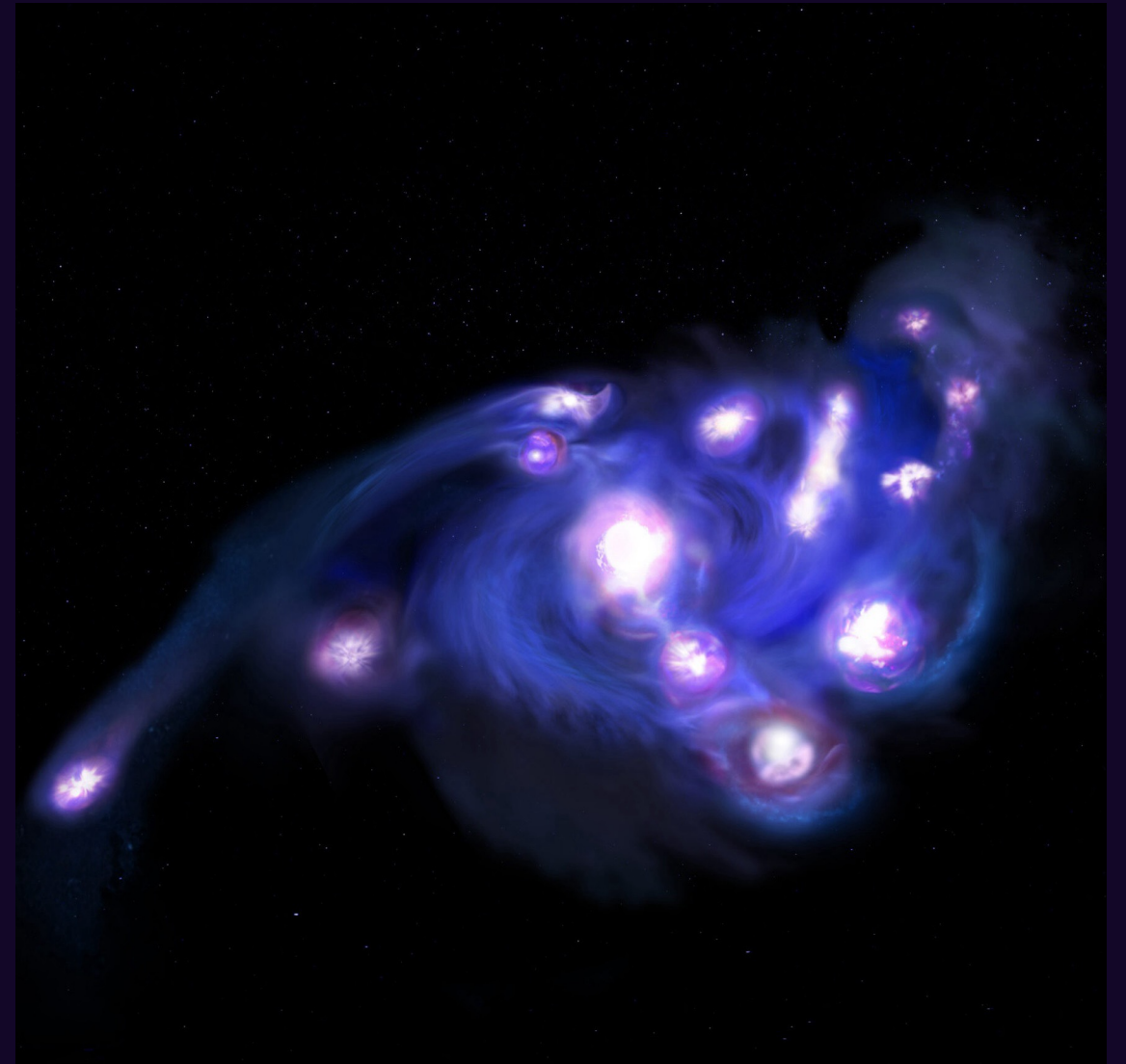
# We can determine the duration of each stage



# A Glimpse into How the Early Universe Formed Stars



Extreme Star Formation at redshift~0



Typical Star Formation at redshift~6

## Conclusions and Takeaways

53 **very massive** stellar nurseries found hidden inside dust clouds

Detected by ALMA + VLA radio telescopes, confirmed by JWST

Ages span <1 to 8+ million years: all evolutionary stages present

Nearby galaxies recreating conditions from billions of years ago!

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