Exploring the Great Beyond: The Hunt for Supernovae

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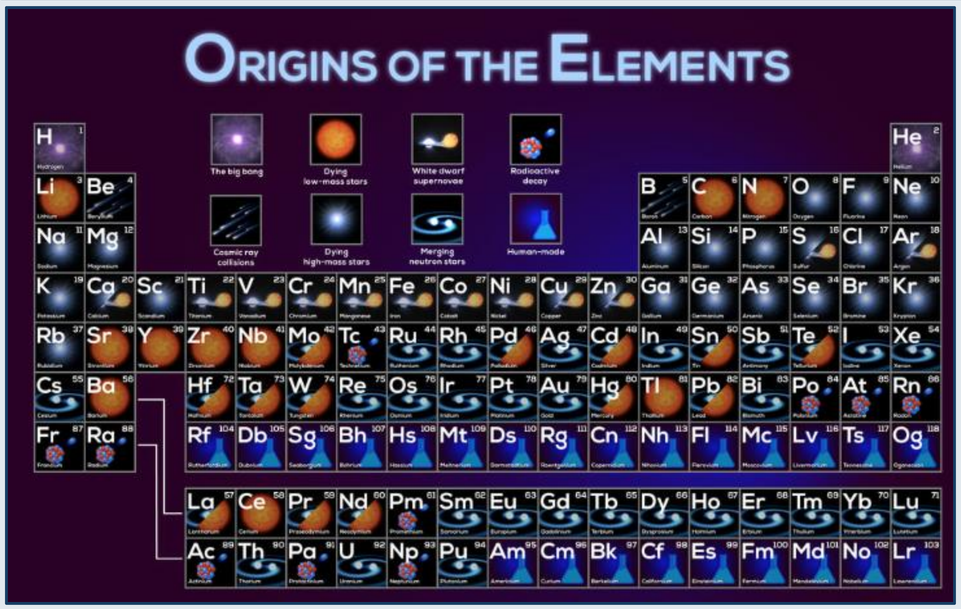
Introduction/Background Information

- A supernova is an exploding phenomenon at the end of stellar life and gives us valuable information about the history of the universe for both chemical enrichment and expansion history.
- However, it is a rare event, it happens only once in 100 years per galaxy. Thus, we need to monitor many galaxies.
- Understanding supernovae is crucial for unraveling the conditions that made Earth uniquely suited for life among billions of discovered planets.
- This research will support the next phase of our mentor's project: investigating why supernovae occur in specific locations, how they influence their surroundings, and ultimately training AI to identify supernovae in space images.

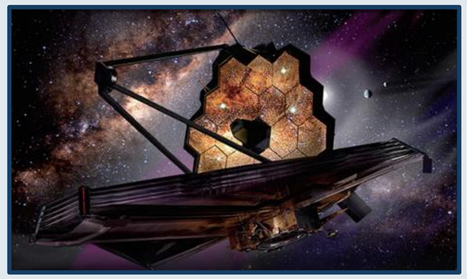
Supernova!



- Alchemists failed to create gold, and we still can't. So where did it come from? Supernovae! All elements heavier than helium form through stellar processes & supernovae, meaning your body is literally made of stardust!
- We are still uncovering how and when supernovae enrich the universe with elements. Telescopes act as time machines, allowing us to investigate the past.

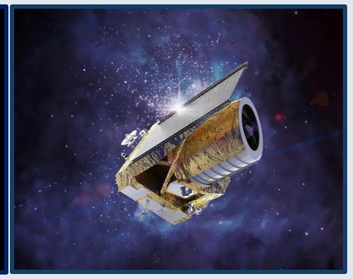
Methods & Space Telescopes

- To detect potential supernovae, we utilized high-resolution images from three advanced space telescopes: the Hubble Space Telescope (HST), the James Webb Space Telescope (JWST), and the European satellite Euclid.
- HST is 30 years old, but JWST and Euclid are brand-new telescopes, and the new data is coming in as we speak.
- In the past, supernovae were discovered by comparing the images taken by the same telescope/camera.
- We are developing a new technology to identify supernovae by comparing images taken from different telescopes.
- Through ongoing data collection and analysis, we aim to identify 50 to 100 new supernovae, contributing to a deeper understanding of stellar evolution and cosmic phenomena.
- Eventually, we would like to use Machine Learning / AI, but its training set must be created first, and we do that through visual inspection and organization.



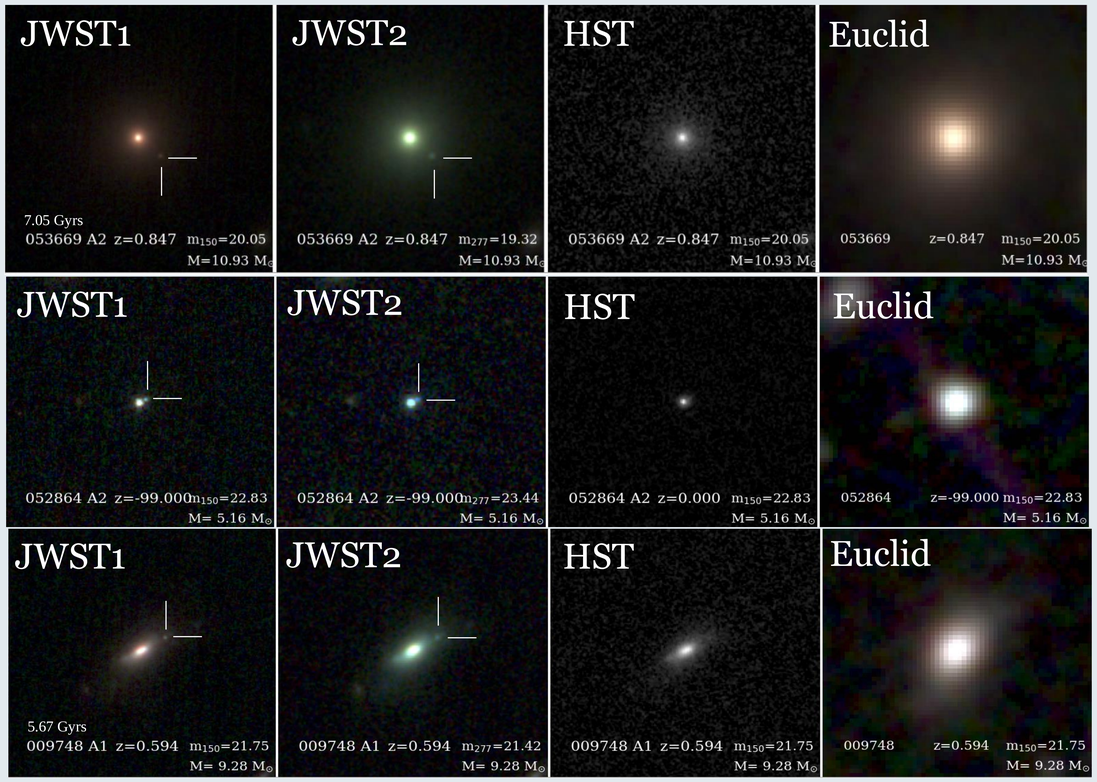
James-Webb Space Telescope

Hubble Space Telescope



European Satellite Euclid

Results : Supernova Discoveries!!!



- This work is expected to provide valuable insights into stellar evolution, the life cycle of stars, and the broader cosmic environment.
- This AI will be designed to efficiently identify potential supernova candidates, streamlining the manual process.
- Our continued efforts will contribute to a more comprehensive understanding of these extraordinary celestial events and their implications for astrophysical theories.

References

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2. Yin, Kai et al. "Supernovae Detection with Fully Convolutional One-Stage Framework." *Sensors (Basel, Switzerland),* vol. 21, no. 5, 9 Mar. 2021, pp. 1926. doi:10.3390/s21051926