

# Catching Element Formation In The Act

## The Case for a New MeV Gamma-Ray Mission: Radionuclide Astronomy in the 2020s

A White Paper for the 2020 Decadal Survey

Currently Over 200 Co-Authors

# Executive Summary

... New science will be driven by time-domain population studies at MeV  $\gamma$ -ray energies. This science is enabled by next-generation  $\gamma$ -ray instruments with one to two orders of magnitude better sensitivity, larger sky coverage, and faster cadence than all previous  $\gamma$ -ray instruments. This transformative capability ...

# Supernovae And Other Cosmic Explosions

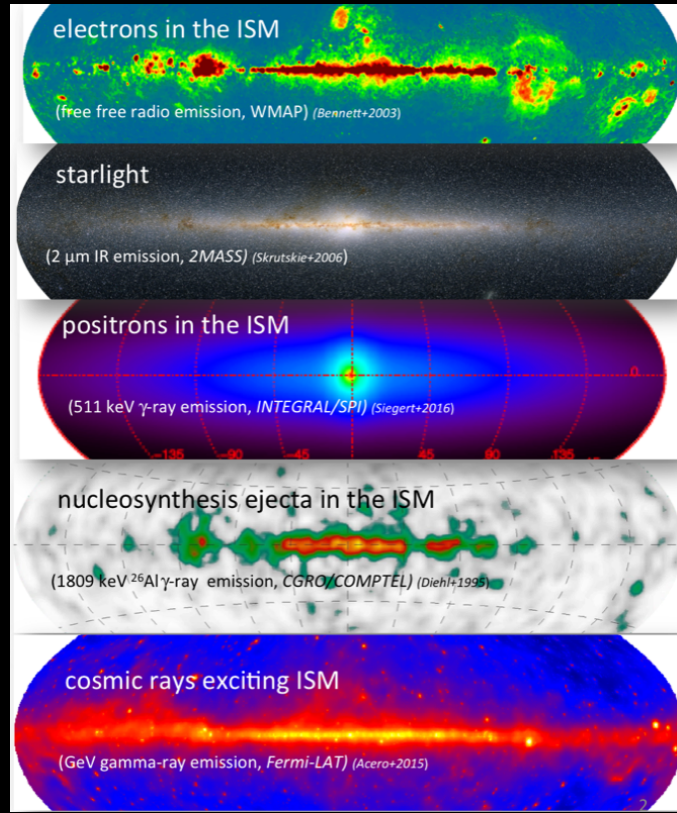
...This bonanza of astrophysical puzzles, plus the fact that essentially all SNIa light originates in the nuclear  $\gamma$ -rays from radioactive decay of the  $^{56}\text{Ni}$  isotope synthesized in the explosion and thus are the cleanest way to measure the  $^{56}\text{Ni}$  mass, highlights the need for a multi-spectral approach to study such explosions - extending to the deployment in space of a new and significantly better  $\gamma$ -ray telescope.

A line sensitivity ...

# Tracing Chemical Evolution

The star-gas-star cycle operating in the evolution of galaxies includes at least four phases where MeV  $\gamma$ -ray astronomy provides unique and direct diagnostics of cosmic explosions and chemical evolution.

(1) The ejected yields ...



# When Opportunity Knocks

A new MeV  $\gamma$ -ray observatory offers considerable serendipitous science for uncommon or surprising events such as a nearby CCSN, neutron star merger, or fast radio burst. Their detection in  $\gamma$ -rays could entirely restructure our understanding of both the transient itself and its implications for astrophysics as a whole. For example ...

# Imagining the Future

The time is ripe for the astronomy community to strongly advocate for a new MeV  $\gamma$ -ray mission to be operational in the 2020s. Such ...

... A new MeV  $\gamma$ -ray mission will open unique windows on the Universe by making pioneering observations of cosmic explosions and the flow of their newly created elements into Galactic ecosystems.

The full Decadal submission is at  
<https://v1.overleaf.com/read/xwcpjztfcdfq>

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