The Fate of Metals Synthesized in Population III Supernovae

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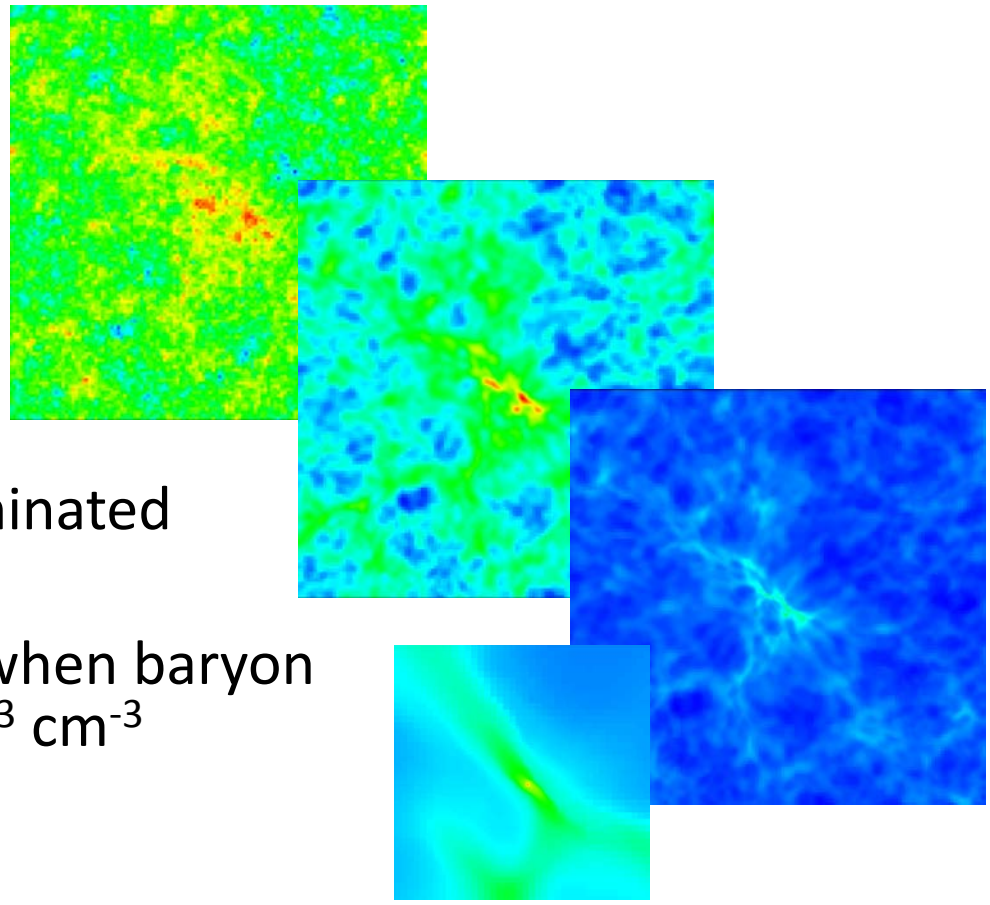
Motivations

- Metal emissions observed from stars
  - Enhanced α-element abundances
  - Heavy elements only produced by supernovae
  - No known metal-free stars

- Initial metal enrichment by first stars
  - Dark matter mini-halo collapse
  - Massive ionizing Population III star
  - Supernova blowout and feedback
  - Recollapse in more massive atomic cooling halo

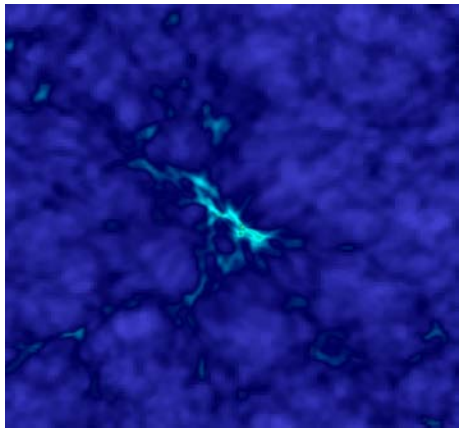
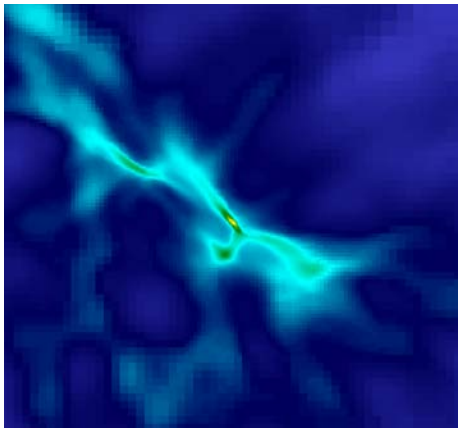
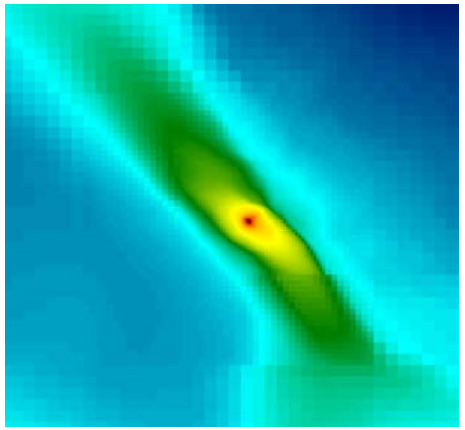
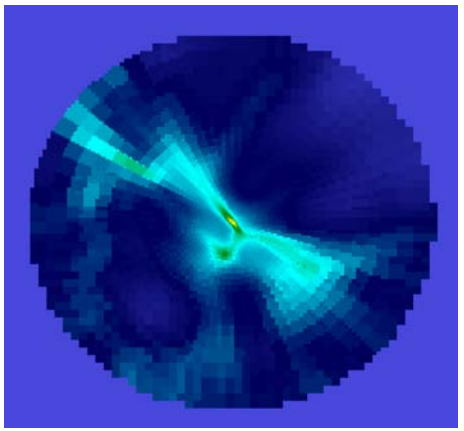
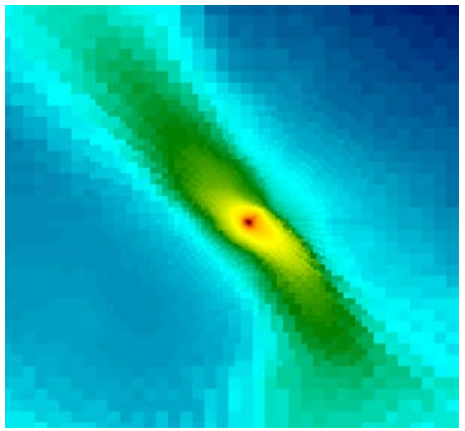
Cosmology

- Initialized in the post-recombination epoch with ΛCDM and primordial baryonic chemistry
  - Initial redshift z = 145.5
  - Ω_{Matter} = .275
  - Ω_{Λ} = .725
- Dark Matter mini-halo
  - Collapse redshift z = 20
  - H_2 molecular cooling dominated
  - Mass $M_{vir} \geq 10^6 M_{\odot}$
  - Star formation assumed when baryon number density $n_{max} \geq 10^3$ cm^{-3}



HII Region

- Density mapped to radial HEALPixels (Górski et al. 2005 http://healpix.jpl.nasa.gov)

HII Region

- Ionizing photons balance recombinations

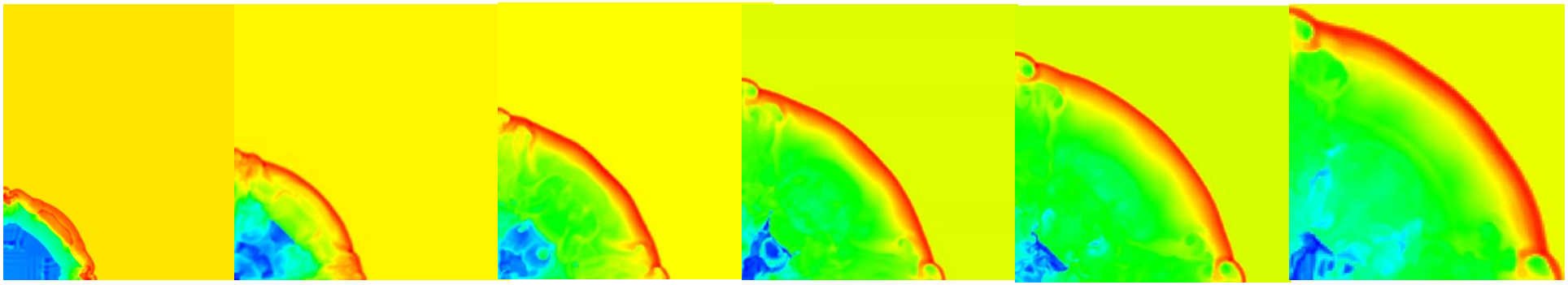
$$N\gamma = 4\pi \int_0^{R_s} \alpha_B n_H^2 r^2 dr$$

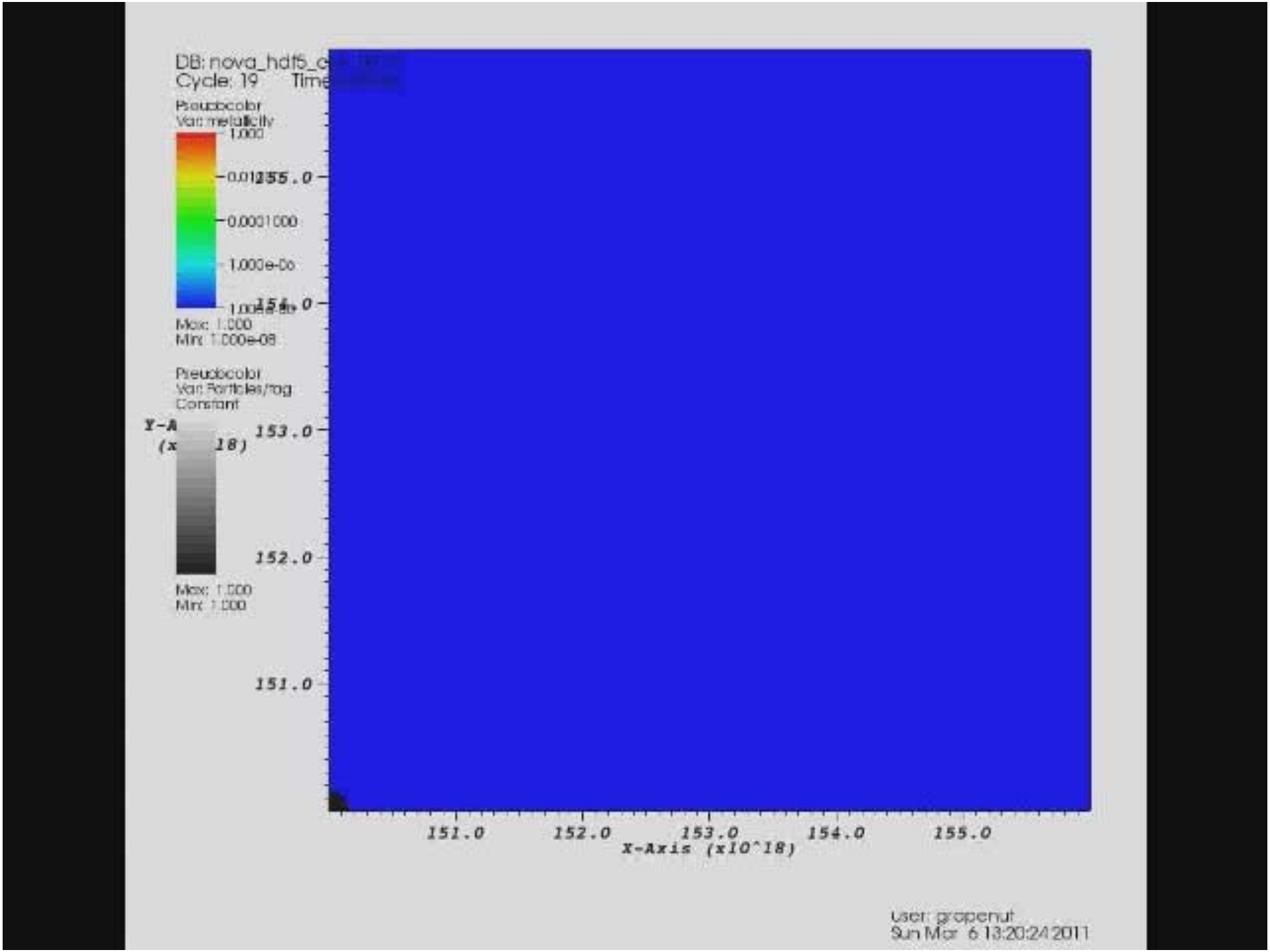
- Ionizing flux from point source introduced to heat the gas and induce pressure-driven expansion

Supernova

- Blastwave initialized in the free expansion phase
  - Metal species (C, N, O, Ne, Mg, Si, S, Fe)
  - Tracer particles

- Temperature and metallicity dependant radiative cooling of metal ions (Gnat et al. 2010)

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What will we find?

- Mass distribution function of metallicity
  - Model mass and metallicity using grid variables and particles

- How are the metals distributed when larger atomic cooling halos collapse?