Pop III stars

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Major recent accomplishments

- Binary Pop III seen in simulations (Turk, Abel, O'Shea '09)
- Multiple-star systems also seen (Greif et al. 2011, 12; Clark et al. 2011)
- Simulations include MHD (Turk et al. 2011, Schleicher et al. 2011, Schober et al. 2012)
- No Pop III stars observed yet!
- Extremely metal-poor DLA observed: Cooke et al. 2011 (and possibly explained via Pop III enrichment: Kobayashi et al. 2011)

Specific open questions

- What is the typical multiplicity (and variation) of Pop III star formation?
- What are the distribution of rotation rates in Pop III stars?
- What is the likely initial mass function of Pop III stars? (From first principles / observationally)
- What are the fundamental challenges for nucleosynthesis codes w.r.t. Pop III stars?

How can one address these questions?

- Improved (and converged) simulations of Pop III star formation w/MHD, improved chemistry, under a wide variety of conditions.
- Stellar evolution calculations for Pop III stars w/varied rotation rates, E_{SN} over ~10-100 Msun range (maybe even SAGB) - comparison to low-metallicity stars in UFDs, stellar halo
- It'd be nice if we found a Pop III star somewhere (empirical test of high-mass IMF theory)

What is needed?

- Improved primordial chemistry/radiative cooling models, particularly at high density.
- Converged nucleosynthesis calculations that cover range of masses, rotation rates, explosion energies.
- Chemical evolution models that reliably tie Pop III to z=0 stellar populations (particularly, low [Fe/H] ones).

In what direction should this area evolve?

- See previous slide: integration of star formation, nucleosynthesis, GCE models.

Intersection w/other subfields

- Primary intersection w/nuclear physics is through stellar evolution/nucleosynthesis calculations!
- Obvious relationship b/w theory and observation; between theory and computation