GCE model requirement discussion

B. O'Shea
(with thanks to Grant Mathews and Jason Tumlinson)

Suggested structure for discussion/brainstorming

- Desired inputs to models

- Properties that models must have

- Desired outputs to models (from observers)

- What JINA projects to nucleate around?

What we want models to do

- To model star formation as a function of galaxy mass, redshift, metallicity, formation environment

- ... within models that take into account the nature of hierarchical structure formation (mature)

- ... and which realistically include the behavior of gas (maturing)

- ... and to make predictions about the multiple stellar populations in our galaxy in a way that can be directly compared to observations (photometric, low- and high-res spectroscopic, ...) (in development)

- ... with the basic function of acting as the framework which synthesizes the individual pieces of nuclear+astro-physics.

General classes of questions to address

- The distribution of stellar and ISM elemental abundances as a function of kinematic properties, locations, ages

- Explain the properties of the MW and external galaxies along with how they form and evolve

- Understand the star formation environments of halo stars, dwarf galaxy stars (both classical and ultrafaint)

- Constrain properties of stellar populations that are no longer visible (Pop III, ...), as well as IMF as $f(Z,z,M, ...)$

What we need, I

- A database of nucleosynthesis yields, stellar lifetimes, remnant masses, ejected energies in winds/SNe/etc. based on various stellar evolution models as a function of progenitor mass, metallicity, rotation (a homogeneous, well-sampled grid).

- A grid of models that samples stars in a way that is useful for time-dependent evolution codes (lots of low-mass stars!) and for a wide range of metallicities!

- We don't need "perfect", we just need "good enough." We currently have almost nothing!

- If the grids are constructed to be easily digested, then CGE models can work iteratively to help improve and refine the input yields by comparing them against data.

What we need, II

- Some sense of which abundance yields are reliable (relatively independent of code, assumptions about mixing processes, ...) and which are not

- Could define two or more sets:

  - "Best bets" for production.

  - "Beta" or "Test" grids with new physics.

- We'd like to be able to test outputs from multiple groups against one another.

What we need, III

- Easily accessible (queryable!) databases of observed stars w/locations and abundances (both photometric and spectroscopic). Proper motion would be nice.

- Ways to statistically compare models to observations (quantify errors, identify key parameters, ...)

A proposal?

JINA GCE yields working group, with near term goal of collecting a "good enough" or "working set" of yields covering the major nucleosynthetic groups that can enter the development stage of new generation of semi-analytic and numerical CGE codes.

Suggested structure for discussion/brainstorming

- Desired inputs to models

- Properties that models must have

- Desired outputs to models (from observers)

- What JINA projects to nucleate around?