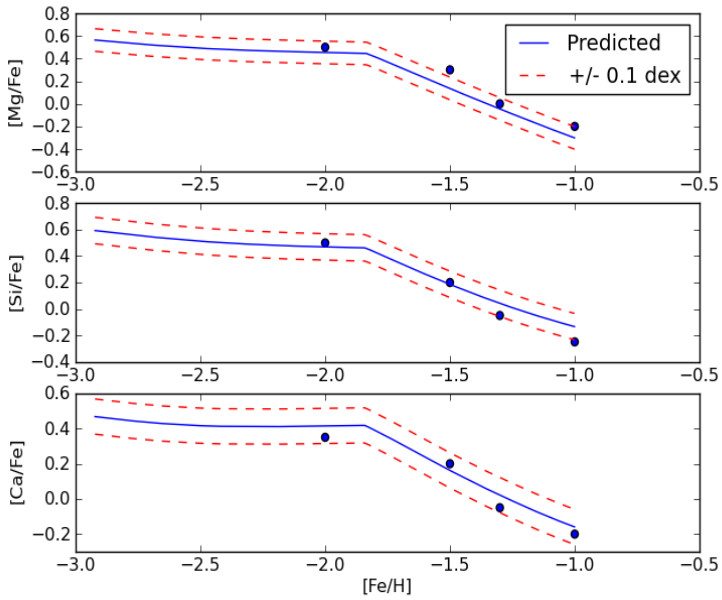
The Joint Institute for Nuclear Astrophysics

Using Chemical Evolution to Determine Critical Areas for Future Research in Dwarf Galaxy Formation and Evolution



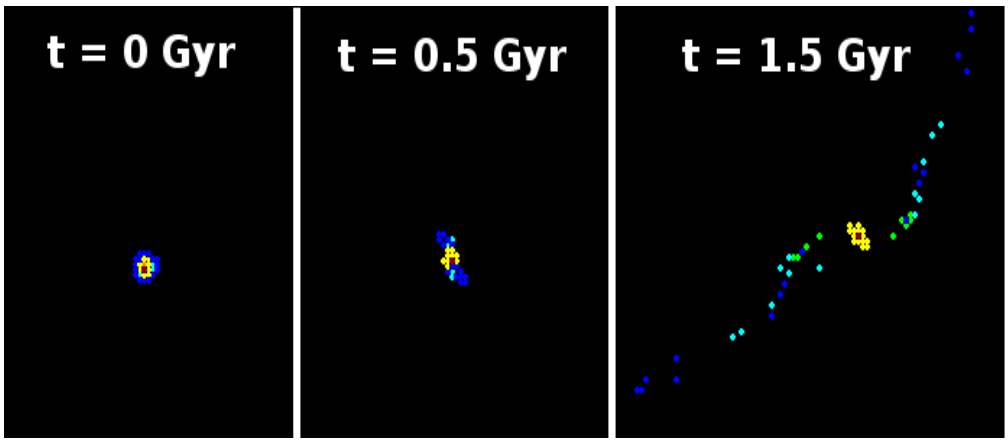
Evolution of the abundances of alpha elements relative to iron for Sculptor with SNIa beginning at about 0.5 Gyr, SFR falling off sharply around 0.5 Gyr, and a roughly 1 $M_{\odot}$/year mass loss rate. Solid points are binned averages of abundances measured by Kirby et al. (2011).

Chemical evolution histories were simulated for a dwarf galaxy with approximately the mass of Sculptor while parameters governing the mass loss rates, mass accretion rates, star formation history, and onset of SNe Ia were varied across simulations. Out of over 800,000 simulations, the top 0.1% and top 5% of fits to the chemical abundance observations of Kirby et al. (2011) were examined for common features and patterns and compared to the rest of the sample.

Several similarities were found across the best fits, including that star formation had fallen off sharply between 0.4 and 0.6 Gyrs, and that Sculptor likely started with a much higher mass but has since lost up to 90% of it. Several mass loss mechanisms were investigated. An N-body code to simulate mass loss due to tidal stripping by the Milky Way showed that a galaxy a few times sculptor's size, traveling along Sculptor's orbit, would lose significant amounts of mass during each approach to perigalacticon. Such tidal disruptions appear to become significant starting around 0.5 Gyrs into one orbit, suggesting that tidal disturbances may be a factor in the fall off in SFR suggested by the chemical evolution code.

We recommend further research into the interplay of SFR and various mass loss mechanisms in dwarf galaxies, especially tidal striping and ram pressure stripping. Additionally, a better understanding of the production of r and s process elements would help to further constrain these models.

N-body simulation of the mass loss of Sculptor due to tidal stripping by the Milky Way. Bluer points represent material that is initially far from the center of Sculptor, while redder material begins nearer the center. Noticeable tails begin to form around 0.5 Gyrs, around the same time that star formation rate must drop in chemical evolution simulations. Results were similar when the galaxy starts with a higher ellipticity, suggesting that these timescales are not strongly dependent on the dwarf's initial geometry.



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