The life cycles of stars and the evolution and recycling of heavy elements (metals) in galaxies is referred to as galactic chemical evolution.

Galaxy Assembly with Merger Trees for Modeling Abundances (GAMMA) is an existing computational model of this process. It orchestrates the generation and combination of chemical evolution models of stellar populations to reproduce galactic chemical abundances based on merger trees provided by cosmological dark matter simulations (Côté et al. 2018).

We aim to obtain a set of GAMMA input parameters that produce the best model fit to this new observational data.

- GAMMA’s computation time is too large to efficiently search the model’s parameter space for a set of best-fit parameters.
- Gaussian Process regression was used to create model emulators for GAMMA, trained on two sparsely sampled sets of input parameters across two model emulator generations.

We have identified the likely conditions under which the chemical composition of the Milky Way and its satellite galaxies evolved.

Probability Densities of GAMMA Parameters

- The model emulators cut computation time by 1000x (50 hours to 60 seconds for 10000 GAMMA samples)
- The peaks in the probability density function of certain model parameters (see Fig. (2) and caption) indicate values of that parameter that have a high probability of being the best value to shape the stellar mass-metallicity distribution to reflect the observations.
- The varying number of Type 1a supernovae per stellar mass was not included in the GAMMA calculations, which is why a flat probability density function is produced. This works as a consistency check to verify whether the MCMC simulations were correctly run, because it suggests the parameter values have a negligible impact on shaping the modelled distribution.
- The multiple peaks in the probability density function of the GIR coefficient show multiple best-fit values for the parameter. Further investigation is needed to determine if the PDF is truly multi-modal.

Additional Markov Chain Monte Carlo simulations comparing to other observational values, such as the stellar mass versus dark matter mass relationship.

- Integrate the many cosmological dark matter simulations from the Caterpillar Project (www.caterpillarproject.org) as an additional parameter.