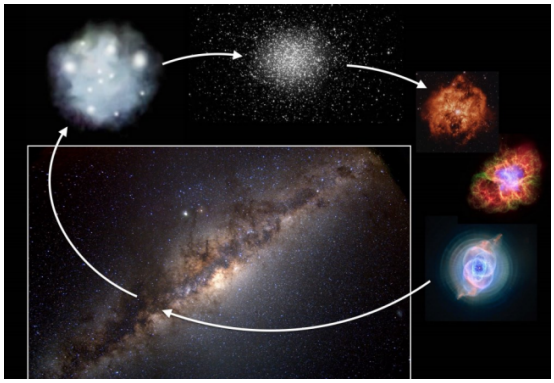
Galactic chemical evolution



SUMMARY.
Galactic Chemical Evolution models can trace element evolution from the early Universe, integrating nuclear physics, stellar evolution, and cosmology. By combining detailed stellar observations with sophisticated chemical evolution models that link nuclear physics and stellar evolution, we can unravel the processes of element creation and the complex story of how our Galaxy formed and evolved over cosmic time.

OBJECTIVES

- **Knowledge**
  Drivers of chemical enrichment in our Galaxy.
  Timescales of enrichment for different elements.
  Chemical signatures to look for and their implications.
- **Skills**
  Work with numerical simulations of chemical evolution.
  Compare stellar abundances to synthetic results.
  Minimize model parameters within a bayesian approach.

INSTITUTE

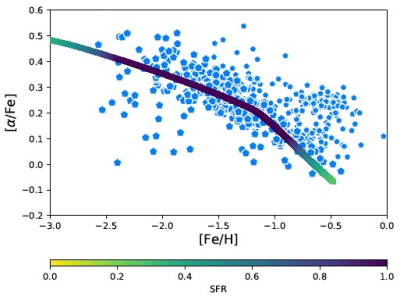
- Astronomy section of the Physics Department,
  Trieste University.
- Physics Department website
- The Astronomy section of the Physics department is located within the Trieste Observatory: INAF-Osservatorio Astronomico di Trieste Via G.B. Tiepolo, 11, 34143 Trieste, Italy

THEORY

Fundamental ingredients of chemical evolution: initial conditions, star formation, initial mass function, gas flows (infall and winds) and stellar nucleosynthesis. Analytic solutions (closed box) and their limitations. How to extend to an numerical model. Implementation of a standard homogenous model and a stochastic evolution model. Stellar evolution models with nucleosynthesis, the most recent sets.

APPLICATIONS

Comparison the GCE model results with chemical abundances measured in Galactic stars. From the classic case of the alpha-knee to the dispersion of the neutron capture elements. How to adopt a Bayesian approach to constrain Galaxy evolution and evaluate stellar nucleosynthesis.



[alpha/Fe] as a function of [Fe/H]. The cyan pentagons are stars measured by APOGEE, which belong to Gaia-Enceladus. The model is shown as a line and it is colour-coded according to the SFR (see colorbar).

MAIN PROGRESSION STEPS

- `Tier 1`: Theoretical basis of chemical evolution
- `Tier 2`: How to develop a numerical model
- `Tier 3`: Comparison with the data

EVALUATION

The student will be evaluated according to the capability to solve practical problems and based on the final project presentations. At this stage theoretical knowledge will be also investigated.

- `Theory grade [30%]`
  - Questions during the final presentation
- `Practice grade [30%]`
  - Based on the capabilities of the student to independently solve some scientific problems and to use, modify, and implement new features in a Galactic chemical evolution code
- `Defense grade [40%]`
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

BIBLIOGRAPHY & RESOURCES

- Matteucci 2012
- Rizzuti et al. 2021
- Spitoni et al. 2020
- Cescutti et al. 2020

CONTACT

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