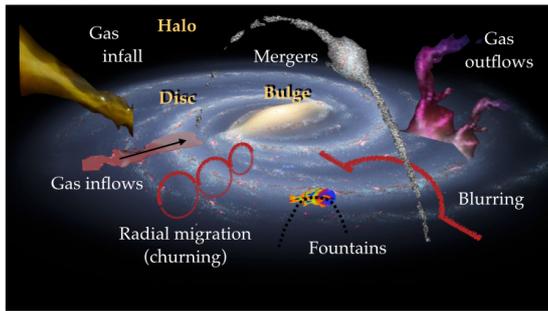




# Galactic Archaeology and the Gaia mission



## SUMMARY.

Galactic Archaeology consists in deciphering the Milky Way formation and evolution history through the study of the stars composing its different Galactic populations. Such studies are now possible on large scales thanks to devoted Galactic ground-based and space surveys, as the ESA Gaia mission. This METEOR will particularly focus on the Gaia spectroscopic survey that collects tens of millions of stellar spectra of any type. Thanks to such unique data, our Galaxy is mapped spatially, kinematically and chemically.

Keywords: Near field cosmology - The Milky Way as a spiral galaxy. Stellar populations and local environment

## — OBJECTIVES —

- The students will have a global view of the Milky Way formation and evolution history, thanks to lectures on Galactic stellar populations. In particular, they will study how kinematics and chemical information allow for the exploration of the Milky Way and its history. The main recent results obtained on Galactic Archaeology and based on the Gaia survey will also be described.
- Practical applications of Galactic data analysis will be performed by the students, focussing on observations collected with Gaia.

## — PREREQUISITES —

- ☒ S1. General astrophysics
- ☒ S2. Stellar physics

## — THEORY —

by ALEJANDRA RECIO-BLANCO

Galactic Archaeology aims to reconstruct the history of the Milky Way by analyzing stars, just as the history of life was deduced by examining rocks. Stars record their past in their ages, chemical compositions and kinematics and can thus provide unprecedented constraints on the early phases of galaxy formation back to redshifts greater than two (a look-back time of about 10 billion years). How did our galaxy form? What is its place and ours in the cosmic evolution? We will also deeply discuss how these questions could be addressed through many ongoing and planned spectroscopic surveys of the Milky Way, culminating in the Gaia mission, which have been

revolutionizing our knowledge about Galactic stellar populations during the last two decades.

by PATRICK DE LAVERNY

We will focus on the analysis of stellar spectra and stellar parameterization, including reviews on stellar evolution. Then, we will study how to kinematically characterize stars belonging to the Milky Way and how to identify the different stellar populations of the Galaxy.

by PEDRO ALONSO PALICIO

The Galactic chemical evolution will be studied, including lectures on stellar nucleosynthesis, chemical yields and chemical evolution models. The origin and chemo-dynamical properties of Galactic populations, as revealed by current surveys, will be also introduced.



*The ESA Gaia mission mapping the Milky Way*

## — APPLICATIONS —

Practical studies on Galactic stars characterisation based on Gaia astrometric, photometric and spectroscopic data will be proposed. The main topics covered will be: (i) Statistical analysis of large samples of stellar chemo-dynamical properties, (ii) Derivation of

Galactic chemical gradients and metallicity distributions and (iii) Modelling of the Galactic Chemistry.

## — MAIN PROGRESSION STEPS —

- Tiers 1 & 2: courses A/B/C and exercices
- Tier 3: personal project

## — EVALUATION —

- Theory grade [30%]
  - Written exam (70%): theoretical questions from lectures
  - Presentation of an article (30%): critical spirit and answer to questions
- Practice grade [30%]
  - Exercices (30%): thought-process and results
  - Project (70%): initiative, progress, analysis
- Defense grade [40%]
  - Oral and slides quality
  - Context
  - Project / Personal work
  - Answers to questions

## — BIBLIOGRAPHY & RESOURCES —

- The ESA/Gaia website and archive
- *The Milky Way*, Combes & Lequeux, 2016
- *The origin of the Galaxy and Local Group*, Bland-Hawthorn, Freeman & Matteucci, 2013, Springer

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