Course: **Galactic Astronomy: structure, composition and evolution of our galaxy**
Lectures: 4 lectures (1.5h each)
Professor: Francesca Figueras, University of Barcelona (Spain)
School: ISYA-Cape Town, November 2020

Short description of the course

In this course, we will learn on the global structure and evolution of the Milky Way by studying the properties of the stars, the building blocks of our cosmological laboratory. Having the privilege and the complexity to look our galaxy from inside, we will learn on the at present efforts to accurately measure distances, motions, ages and chemical compositions of the stars. Our final goal will be to characterize the origin and evolution of the Galactic components and to look forward a chemo-dynamical model of the Milky Way.

Syllabus:

1. Introduction to Galactic Astronomy (1.5h)

Historical overview
Global description of the Milky Way: our present knowledge
Basic concepts on astronomical measurements
- Stars: distances, ages and chemical composition
- The role of the interstellar extinction
- The motion of the stars

First overview on Gaia mission: goals and products
- The Gaia archive: public, already available and easy to use
- The contents Second and Third Gaia Data Releases (DR2, eDR3)

2. Galactic Structure and the stellar components (1.5h)

Statistical Astronomy: the fundamental equation
- Apparent distribution of stars
- The Stellar Luminosity Function
- The Initial Mass Function and the Star formation History

Galactic models for star count predictions
- Overall structure and ingredients
- Practical use of the Besançon Galaxy Model

3. Galactic kinematics and evolution (1.5h)

The Galactic disc
- Overview on the thin and thick discs structure and evolution
- The spiral arms: proposed mechanisms and nature
- The inner disc: the galactic bar and bulge
- The Outskirts of the Galactic disc: warp and flare

The Galactic Halo
- The stellar component
- The dark matter density profiles

The Milky Way satellite galaxies and accreted structures
First steps on the Gaia Science Exploitation, first discoveries

4. Next decade: towards a chemo-dynamical model of the Milky Way in the Gaia era (1.5h)

An introduction to the chemical evolution of the Milky Way
Present and future large-scale surveys: astrometry, photometry and spectroscopy
Few examples of the current and future challenges and research topics

Requirements (hardware, software):

The students will have the opportunity to develop group projects dealing with the scientific exploitation of the 3rd Gaia data release (expected to be public on October 2020). It will be optimal for the students to have internet access on their computers to query the public Gaia Archive (https://gea.esac.esa.int/archive/), and also to have installed the TOPCAT interactive graphical viewer (http://www.star.bris.ac.uk/~mbt/topcat/) .

Bibliography:

BINNEY, J. ; MERRIFIELD, M. Galactic astronomy. Princeton University Press, 1998.
MIHALAS, D. ; BINNEY, J. Galactic astronomy: structure and kinematics. 2nd ed. Freeman, 1981.
SPARKE, L.S., GALLAGHER, J.S., Galaxies in the Universe: An Introduction, Cambridge Univ. Press (2007)