**Astronomy Research for Credit**

**Stars, Clouds and the Structure of the Galaxy**

**as revealed by GAIA Mission**

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The GAIA European space mission launched 4 years ago is soon going to provide unprecedented 3-D spatial and kinematics measurements of one billion of the stars that populate our Galaxy. Even though this huge number of stars represents only 1% of the total Galactic stellar population, they will reveal, for the first time, the detailed three dimensional structure of the Milky Way out to several kilo-parsecs. The first GAIA dataset, which was released one year ago (the second one is expected April 2018), gives a first look at the stars being mapped and is a foundational dataset for planning science with the second data release. It is the second data release that will provide an avalanche of high-accuracy distances and motions that will lead to discoveries that bring new light onto the composition, formation and evolution of the Galaxy. We are particularly interested in the capability of these data to enable maps of the 3-D structure of the stars and the gas in the Galaxy through its extinction affects on the stars. There is a lot of groundwork to be done to be in a position to produce such maps.

This research project involves using the Tycho-GAIA (TGAS) catalog[[1]](#footnote-1) that is part of the GAIA first release and other stellar catalogs (Spitzer, 2MASS, WISE, SDSS) to build the Spectral Energy Distribution (SED) of the stars of all spectral types that are located at less than 100-200pc away from us. We will use these empirical SEDs to test the accuracy of theoretical stellar spectra and to look at the empirical variation in the SED of the stars belonging to a same spectral class. The goal is to have ground-truthed SEDs from stars with known spectral types which we can then apply to stars out to kilo-parsec with unknown spectral types.

This knowledge will allow us to take the second step to unveil gas distribution in Galaxy out to a few kilo-parsecs and to study the relationship between the gas and stars. We are particularly interested in the relationship between the gas and young stars in the local Galaxy.

The precise definition and extend of this research project will depend on the level of the student or students) and his/her/their specific skills and credit level. The project will involve reading and discussion of scientific articles, using databases queries, building catalogs, running scientific software/routines, visualization and computer analysis of datasets. This project can be done by one individual or by a small team (2-3) working together.

Further reading related to the project:

ESA GAIA home page: <https://gaia.esac.esa.int>

GAIA Mission Summary: https://www.spaceup.fr/presentations/Gaia%20Mission%20Summary%20-%20Torgeir%20Paulsen.pdf

GAIA PPT from ESA GAIA: https://www.cosmos.esa.int/web/gaia/presentations

GAIA Astrometry: <https://www.cosmos.esa.int/documents/915837/915858/GaiaDR1-Astrometry-LL.pdf>

ESA Hipparcos Mission : <https://www.cosmos.esa.int/web/hipparcos>

Tycho 2 catalog : https://www.cosmos.esa.int/web/hipparcos/tycho-2

Overview of stellar spectral classes : <https://en.wikipedia.org/wiki/Stellar_classification>

Overview of interstellar dust : https://ned.ipac.caltech.edu/level5/Mathis/Mathis1.html

Overview of structure of our Galaxy: https://en.wikipedia.org/wiki/Milky\_Way

1. Hipparocs was the previous astrometric space mission that collected enough data on a subset of stars to allow the GAIA at the first release to give the parallaxes of all the stars of the sub-catalog [↑](#footnote-ref-1)