# GAIA/RVS and stellar parameters

## what do we expect to achieve?


**Vitalii Makaganiuk**
vitaly@astro.uu.se

**Andreas Korn**
akorn@astro.uu.se

**Bengt Gustafsson**
Bengt.Gustafsson@astro.uu.se

**Ulrike Heiter**
Ulrike.Heiter@astro.uu.se

**Bengt Edvardsson**
Bengt.Edvardsson@astro.uu.se

**Department of Astronomy and Space Physics Uppsala University, Uppsala, Sweden**

**Frédéric Thévenin**
**Observatoire de Cote d'Azur (OCA)**
frederic.thevenin@obs-nice.fr


The Gaia Radial Velocity Spectrograph (*RVS*) will allow us to observe objects of visual magnitude V ~ $11^m$ with S/N ~ 100 (at the end of the mission) and spectral resolution R ~ 11500. Its primary goal is to determine radial velocities for all stars down to $16^m$. But we can also use the RVS spectra to learn something about the physical parameters ($T_{eff}$, log $g$, [$m$/H]) and the composition of all kinds of Galactic objects.

*RVS* observations will be performed in the 847 – 874 nm region, primarily due to the presence of the strong Ca II triplet lines (849.8, 854.21, 866.21 nm). The intensity of these lines decreases with increasing surface gravity in late type stars. The *RVS* spectral region contains also some unblended or weakly blended lines of α-elements (Mg I, Si I) and iron (Fe I; see Fig. 1). In addition, the cooler stars contain molecular lines of CN and TiO.

Early type stars (e. g. hot stars) show spectral features due to N I, Ca II, He I and He II. As with the Ca II triplet lines, their strength decreases with increasing surface gravity.

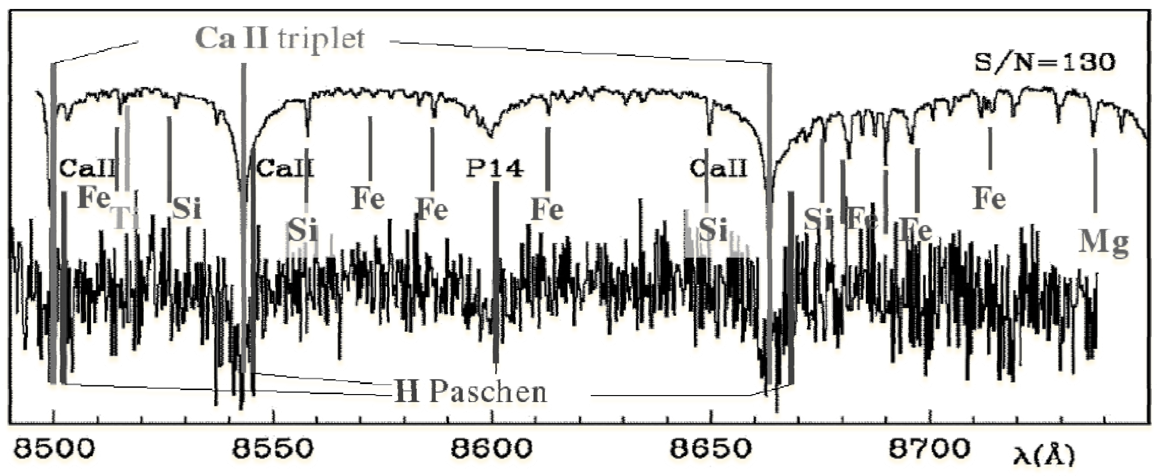


*Figure 1. Example of line identifications for one F3 III star, with different signal to noise ratios, in the RVS wavelength range and R=11 500.*

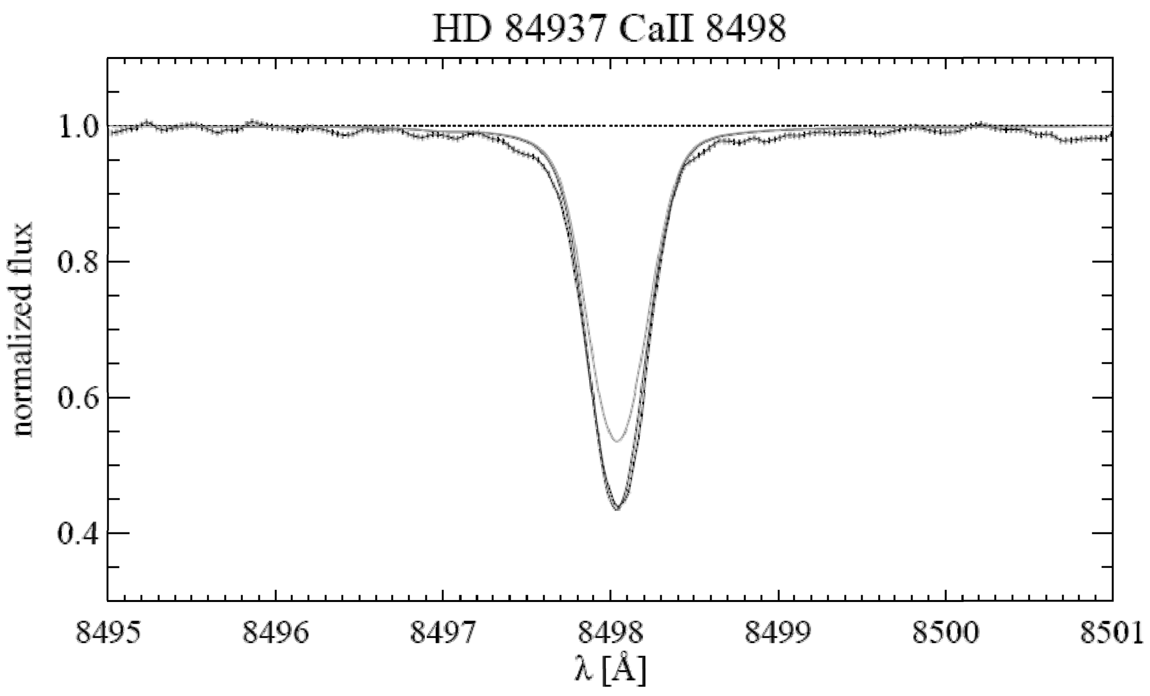


*Figure 2. Fit of theoretical profiles, calculated under the LTE assumption (light grey line) and NLTE (black line).*

The stellar-parameter determination from RVS spectra will be done with the help of the *MATISSE* algorithm (The Matrix Inversion for Spectral Synthesis, Recio-Blanco et al. 2006). This method will allow to determine stellar parameters efficiently, with good accuracy and stable results. However, any code is only as good as the input physics and the theoretical stellar spectra which are used to classify the Gaia targets rely on questionable basic assumptions like

- **Local Thermodynamic Equilibrium (LTE)**
- **1D T-τ relations with mixing-length convection** *and*
- **chemical homogeneity throughout the stellar atmosphere**.

Over the years, these assumptions have been shown to be invalid for a variety of stellar classes. They turn out to be particularly unsuitable for stars of the Galactic halo. We are trying to lift these assumptions in order to sharpen Gaia's view of the earliest phases of Galactic chemical evolution.

In Mashonkina et al. (2007), the formation of optical and near-IR Ca I and Ca II lines were studied using NLTE techniques. It was shown that the profiles of the IR Ca II lines for standard stars (Sun, Procyon, HD 103095, HD 84937, HD 140283) can be described well, only if departures from LTE are considered. They strengthen the line core and decrease the abundance by as much as 0.3 dex (see Fig. 2). We are now in the process of implementing similar NLTE calculations into the computation of theoretical spectra of the MARCS grid (Gustafsson et al.) which will cover stars of all luminosities between 4000 K < $T_{eff}$ < 8000 K.

In a later stage, we hope to extend these investigations to NLTE line formation in 3D hydrodynamic model atmospheres.