

# Collisional-radiative models for the next generation solar Spectroscopy (XUVSun)

V. Andretta

INAF, Osservatorio Astronomico di Capodimonte, Naples, Italy

# XUVSun: CRM models

## Background

Standard tools used to interpret spectra from coronal or other optically thin plasmas such as nebular plasmas typically assume that all lines are formed by excitation from the atom/ion ground level, followed by spontaneous radiative emission. However, with the availability of increasingly accurate atomic data and of high quality observations, the need is becoming evident of taking into account all the relevant processes determining level populations of atomic and ionic states, including the presence of metastable levels and of radiative (photoexcitation/ionization) processes.

The generalization of the standard coronal/nebular approximations is sometimes referred to as **Collisional-Radiative Model (CRM)**

## Description

The proposed work follows on the work by Del Zanna et al. 2020 on a CRM model for helium, valid in the solar corona.

The specific goal is to provide predictions of the expected line radiances of the helium lines observed in the visible and near-infrared range. The tasks needed for that goal include: improving the CRM model described in that paper, thus updating the emissivities of lines such as He I 587.6 and 1083.0 nm as functions of temperature, density, and photoexciting/ionizing radiation field, and then synthesizing the expected line radiances in a variety of coronal features.

The expected radiances will be finally be compared with the measurements soon available from the CryoNIRSP spectropolarimeter mounted on DKIST, the 4m telescope just ending its commissioning phase.

## Participant:

V. Andretta (INAF/OACN)

## Collaborator:

G. Del Zanna (Univ. Cambridge, UK)

## Requests

Item	Year 2022	Year 2023
Exchange visits	3500 Euro	3500 Euro
Conference (Europe)		1500 Euro

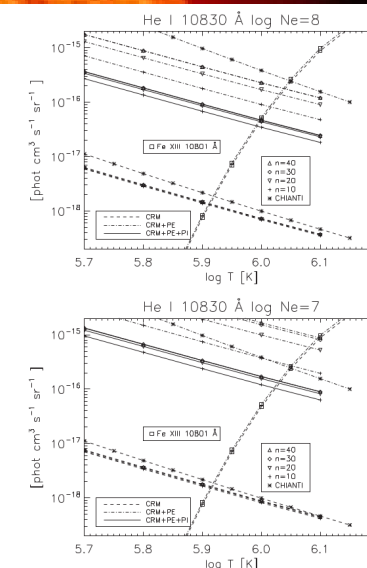
## Links

Plasma@Lab4Space: *Plasma Spectropolarimetry from Laboratory to Astrophysics (and Back !!!)*

## References

Del Zanna et al. 2020 *ApJ* **898** 72: *Helium Line Emissivities in the Solar Corona*

Del Zanna & Storey 2022 *MNRAS* **513** 1198: *Helium line emissivities for nebular astrophysics*



**Figure 7.** Emissivities of the 10830 Å line obtained with the four collisional-radiative models, without photoexcitation (PE) and photoionization (PI), dashed lines), with PE (dotted-dashed lines), and with both PE and PI (full lines). The emissivities calculated with the CHANTI He model are also shown, as well as those of the Fe XIII NIR line (with and without PE—PI is not affecting this ion). The top plot shows the values at a density for the solar quiet corona near the limb and with PE/PI at  $1.05 R_{\odot}$ . The lower plot shows the values at a lower density of the outer corona and with PE/PI at  $1.5 R_{\odot}$ .