

The old Milky Way: Spectro-Photometric Method for Accurate Atmospheric Parameters for the Metal-Poor Stars

Deepak

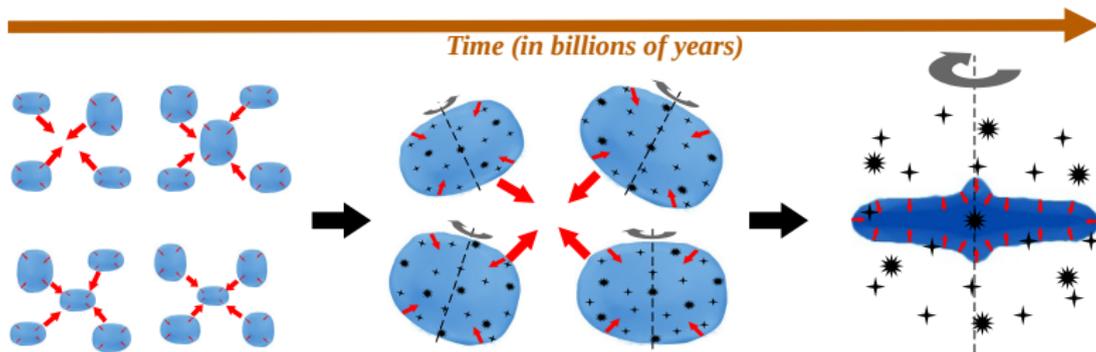
Centrum Astronomiczne im. Mikołaja Kopernika (CAMK), Warszawa

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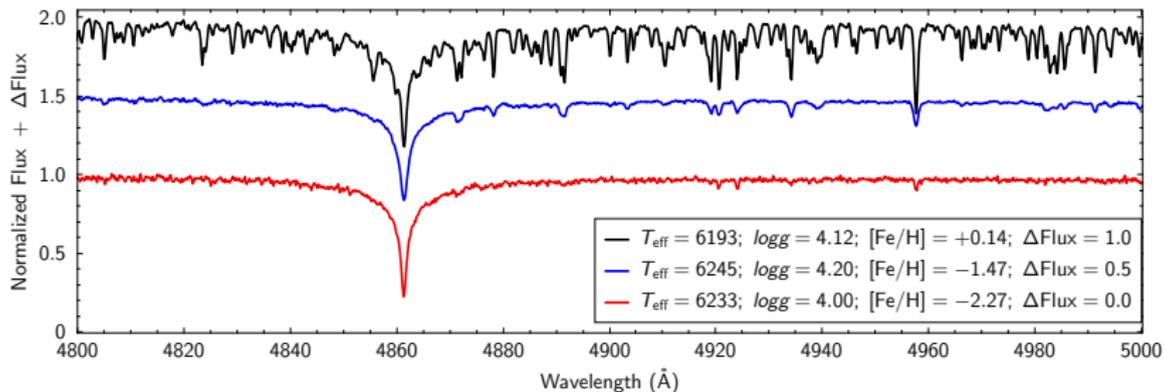
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The old Milky Way

Formation and evolution histories of the Milky Way ?



To find answers, we need to study metal-poor stars ! But getting accurate stellar parameters for metal-poor stars is difficult due to weak metallic lines and NLTE effects.

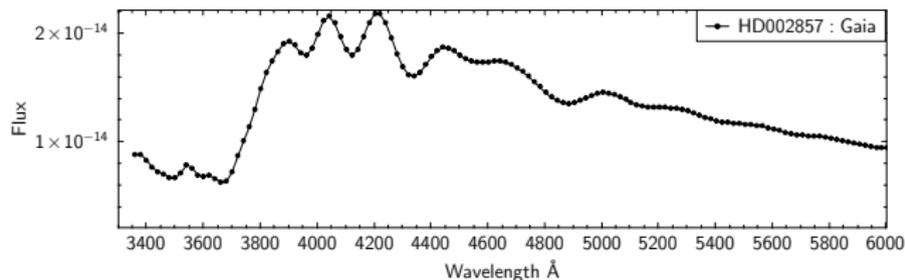
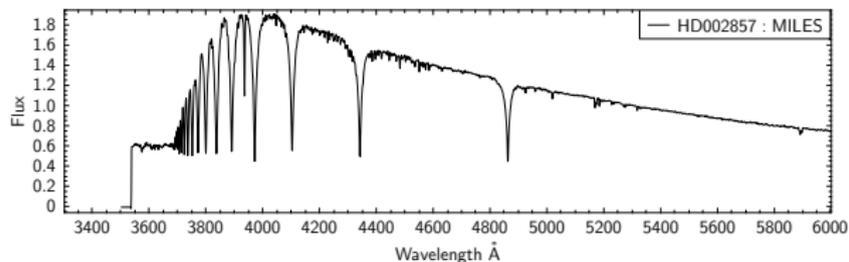
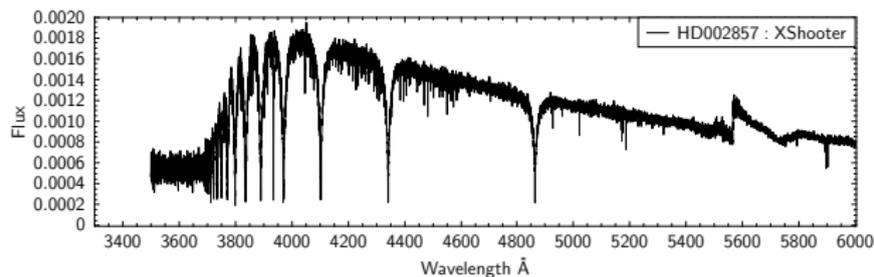


Shape of the Balmer Jump at different spectral resolution for HD 2857

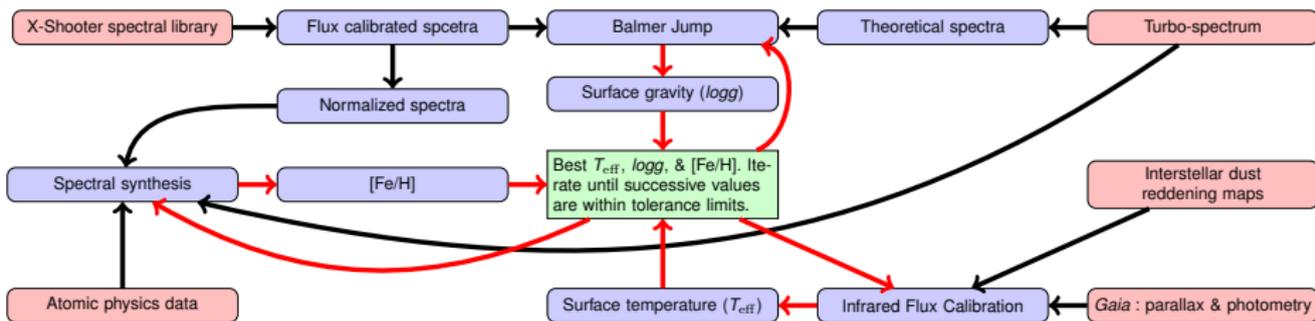
X-shooter's $R \sim 10000$;

MILES's $R \sim 1000$;

Gaia's BP-spectra $R \sim 50$



Simplified flowchart for the developed method/pipeline !



Flowchart of the developed method, highlighting the input data (orange blocks) and sequential steps. The steps connected by red arrows are iterated repeatedly until the successive values of the stellar atmospheric parameters (T_{eff} , $\log g$, & [Fe/H]) converge within tolerance limits.

Comparison of our results with the TITANS and X-shooter's estimates

This work :

$R = \lambda / \Delta\lambda \sim 10K$

TITANS :

$R = \lambda / \Delta\lambda > 40K$

Method :

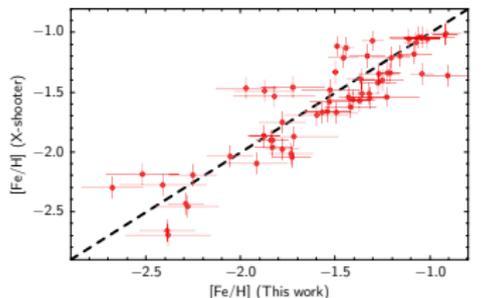
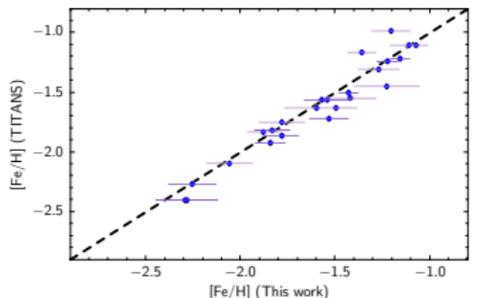
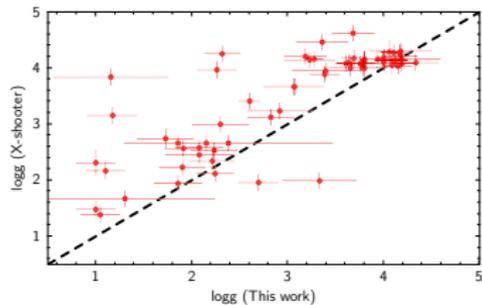
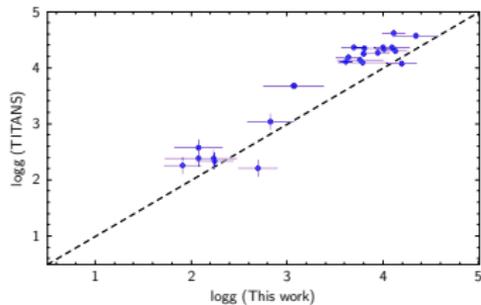
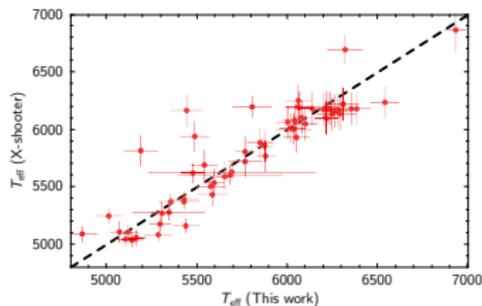
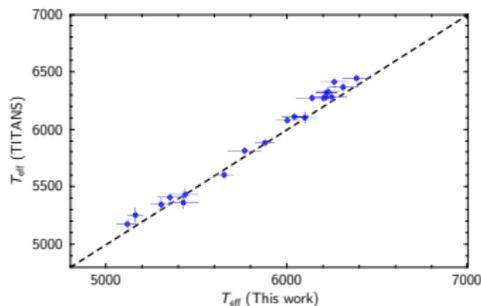
3D non-LTE $H\alpha$
profiles fitting

X-shooter :

$R = \lambda / \Delta\lambda \sim 10K$

Method :

Full spectral
fitting using the
University of
Lyon Spectroscopic
Software
(ULySS)



- Our method yields more accurate stellar parameters than traditional purely spectroscopic approaches, particularly for metal-poor stars.**
- For X-shooter, the method/pipeline is fully implemented and tested. However, the current sample of metal-poor stars with flux-calibrated spectra is too small, so we are planning to observe more stars and increase the sample.
(Targets for observations will be selected from the comprehensive catalog of metal-poor stars being prepared by Arthur Alencastro Puls – see next talk !)
- Our method shows no strict resolution dependence and can therefore be applied to low-resolution spectra from surveys such as DESI ($R \approx 2000\text{--}5500$) as well as very-low-resolution spectra from Gaia (BP/RP, $R \approx 30\text{--}100$).
- We are planning to use the method to create a catalog of accurate stellar parameters for thousands of metal-poor stars being observed in the DESI survey (and hence providing an opportunity to discover/identify new metal-poor stars).
- We plan to use the developed method/pipeline to get accurate stellar parameters for stellar observations with the CUBES spectrograph (to be installed on ESO's Very Large Telescope).

** *Preliminary results for metal-poor stars in the X-shooter library were presented in the "42. Zjazd Polskiego Towarzystwa Astronomicznego (PTA)"*

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Thank you for your attention !