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Investigating stellar magnetism (in evolved stars) in Mexico

L. Sabin, J. Ramiréz Veléz, D. Hiriart, J. H. Castro Chacón, M. Nuñez and J. Valdez

Universidad Nacional Autónoma de México, Instituto de Astronomía, Km 103 Carretera Tijuana - Ensenada C.P. 22860, Ensenada, B.C, México (E-mail: lsabin@astro.unam.mx)

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Abstract. We present the latest instrumental and theoretical developments performed at the Universidad Nacional Autónoma de México (UNAM) regarding the search and analysis of magnetic fields in various type of stars among the more evolved ones. This work is the prelude to a wider assessment of magnetism across the Hertzsprung-Russell diagram.

Key words: polarization – magnetic fields – radiative transfer – instrumentation: polarimeters – stars: magnetic field

1. Introduction

Polarimetric data have been used to determine the geometry and intensity of magnetic fields of astronomical objects along the Hertzsprung-Russell diagram. However, in the case of intermediate evolved stars (e.g. Post-AGB stars and PNe), few observational data regarding the measurement of the magnetic fields intensity using optical spectropolarimetry (Sabin et al., 2015), have been so far obtained. We therefore present the latest instrumental and theoretical developments performed at UNAM regarding the detection and analysis of magnetic fields in various stars and particularly the evolved ones.

2. FICUS: The FIber Coupled Unit System

The 2.1m telescope at the San Pedro Mártir Observatory in Mexico (OAN-SPM) is now equipped with a polarimetric unit designed and built at the Institute of Astronomy of UNAM in Ensenada (Mexico). FICUS, the FIber Coupled Unit System, is a polarization module that can be connected to the spectrographs of the OAN via a set of optical fibers (Fig. 1–left). This system would thus provide good quality polarimetric data. Only the polarimetric module is attached to the telescope, and since the spectrograph is detached, more stability is obtained for the spectropolarimetric data. Finally, as its name suggests, FICUS can be coupled to any spectrograph located at the OAN, implying that either low, medium or high resolution are achievable. FICUS is now in its ultimate commissioning phase with the low resolution Boller & Chivens spectrograph.

3. Spectropolarimetic data analysis with the PCA/ZDI method

In order to analyse the data obtained with FICUS (or any other spectropolarimeter) and study the magnetic fields, a new data inversion code has been developed at IA-UNAM (Fig. 1–right). The latter is based on the technique of Principal Components Analysis (PCA) associated to theoretical radiative transfer models (PCA/ZDI). It will therefore be possible to have a robust estimation of the intensity (Ramírez Vélez et al. 2016; Ramiréz Veléz, in prep.).

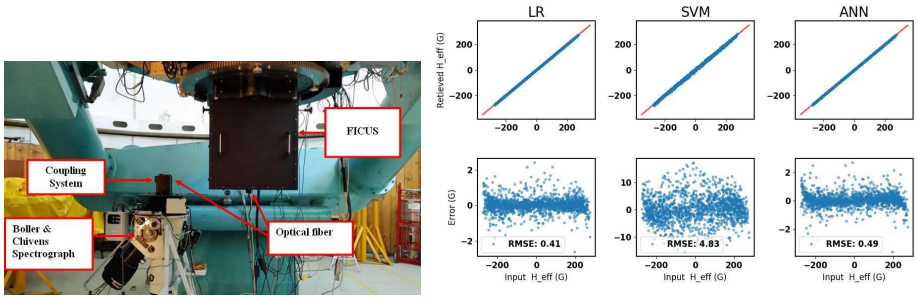

Figure 1. *Left*: Full polarimetric system mounted on the 2.1m with the Boller & Chivens spectrograph. *Right*: Accuracy of the inversions of a sample of 1 500 MZS, using three different algorithms, all based in a machine learning approach. With LR: Linear Regression (Bayesian Ridge), SVM: Support Vector Machine, ANN: Artificial Neuronal Network. (Ramírez Vélez et al., in prep).

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