Space UV and Visible Spectropolarimetry for Stellar Physics

M. Smith[1], A. ud-Doula[2], T. Ayres[3], A. Fullerton[4], B. Brown[5], D. Cohen[6], S. Cranmer[7], R. Ignace[8], J. Sundqvist[9], R. Townsend[5], B. Wood[10]

[1]National Optical Astronomy Observatory; [2]Penn State University; [3]University of Colorado; [4]Space Telescope Science Institute; [5]University of Wisconsin; [6]Swarthmore University; [7]Harvard-Smithsonian Center for Astrophysics; [8]East Tennessee State University; [9]University of Delaware; [10]U.S. Naval Research Laboratory

We propose to develop a high-resolution spectropolarimeter working in the UV and visible spectral range. The goal of a space mission equipped with this instrument would be to study the formation, structure, evolution and environment of virtually all types of stars, i.e. to provide new insights in stellar physics. During the formation and the entire life of stars, several physical processes influence their dynamics and thus impact their evolution. In particular magnetic fields and winds are key factors. They directly impact the internal structure of stars, the transport of angular momentum, and of course the close circumstellar environment. They thus often drive stellar evolution. Studying various types of stars with a UV and optical spectropolarimeter would in particular help understand how the first stars formed, evolved and influenced their environment, enriching it in various elements and leading to new generations of stars. They will therefore also allow us to pinpoint the mechanisms by which stars and their planetary systems form today. Finally, they will provide clues about how a stellar environment influences its planets and thus life on the planets.

The most recent space astronomy missions dedicated to UV spectroscopy ended in 1996 (IUE, mid UV) and 2007 (FUSE, far UV). A lot of progress has been made since then, in particular concerning stellar winds and their environments, but these missions also raised many new questions that remain currently unanswered. A new UV spectroscopic space mission will help us resolve many of these issues. For instance, adding polarimetric power to this device will multiply tenfold the capabilities of extracting information on stellar magnetospheres, winds, disks, and magnetic fields, and therefore will be a novel and transformational tool. Moreover, polarimetry is not restricted to magnetic fields. The scope of stellar polarimetry is much broader, in particular with respect to circumstellar processes. In addition, covering the UV and optical spectral domain at the same time is necessary to study the star and its environment simultaneously.

This spectropolarimeter can be mounted on a dedicated MIDEX mission. This will allow for the observations of a high number of stars and long time series. Such time series document phenomena on stars that can be impulsive (flares, infall), periodic (pulsations, rotational migration of spots, co-rotating clouds), quasi-periodic (evolution of blobs from hot winds), and gradual (evolution of spots).
The spectropolarimeter could also be installed among a suite of instruments on a Large UV and Visible Observatory (LUVO). In this case the synergy of the spectropolarimeter with other techniques (e.g. a seismometer) would increase the science return for stellar physics, and the spectropolarimeter could benefit other science drivers as well.

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