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Prof. Zdeněk Doležal
Vice-Dean of Fac. Math. Phys.
Charles University
Praha, CZECH REPUBLIC

Dear Prof. Doležal:

At your request, I have studied the habilitation thesis of Dr. Daniela Korcakova of the Department of Astronomy, Charles University, and I am pleased to submit the following comments about the thesis and the published papers upon which the thesis is based.

The published discovery paper, with Dr. Korcakova as first author (Korcakova, Sestito, Manset et al. 2022, A&A, 659, 35), of the strong magnetic field in the FS CMa B[e] star IRAS 17449+2320 is a major result. It is indeed a worthy result for a habilitation thesis. In studying the paper to understand the process by which the strong B-field was demonstrated the explanation is presented in some detail. A knowledgeable referee for the paper was quite satisfied with the explanation, although for scientists less familiar with B[e] stars it would be helpful for details to be given as to how the variability of the line profiles was treated. The authors use the Lomb-Scargle method to determine time variability with the uneven time spacing, and they conclude that there is a non-uniform field over the stellar surface. This is an important result, and its significance merited plotting more figures of the line profiles at different times.

If the IRAS 17449 system is a binary, there is the possibility that some of the line splitting may due to other factors than just the Zeeman effect. In Fig. 2 of Dr. Korcakova's discovery paper, for example, the C I multiple at 9100 Ang shows different splitting at the two epochs, a possible indication that some of the absorption components may be caused by distinct velocity regions instead of Zeeman splitting. Also, one notes for some of the lines in the C I multiplet a definite red-blue splitting occurs, whereas for other members of the multiplet it does not, e.g., the C I 9112 line does not show splitting. This may be caused by the different effects of Zeeman splitting on the different fine structure members of the multiplet. Therefore, for the determination of the magnetic field, these possibilities might be discussed in more detail.

An important part of the habilitation thesis is the use of the photometric and spectroscopic characteristics of the FS CMa stars to propose a geometry that can explain the unusual observational characteristics of these stars. The geometry proposed by Korcakova et al. (2019, PubASP Conf Ser, vol 519, p. 155), and revised and improved as Fig. 3.4 in the thesis, is important in the interpretation of the spectra of FS CMa stars. Together with the discovery of the large 6 kG magnetic field of the IRAS 17449 star, the specification of the geometry that explains the dust; the non-LTE region that may have low density; the rotating disk; and the region that can support both infalling and ejected gas----all of these components represent important emitting regions that should be taken into account in future modeling of the spectra of FS CMa stars. Because some of the previous reliable radiative transfer studies have assumed spherical geometry, the use of the non-spherical Korcakova geometry will lead to mass loss estimates that are much more accurate, especially using Monte Carlo calculations.

The use of BPT diagrams is discussed on p. 37, where FS CMa stars can be distinguished from other types of objects such as PNe, H II regions, and symbiotic stars. As shown in Figure 3.2 on p. 38, there is no question that the diagrams are useful in demonstrating the different ionization conditions of FS CMa stars from other objects that emit forbidden lines. I do have several questions about their determination, however. The first has to do with the use of equivalent widths in determining the position of FS CMa stars in the diagrams. The traditional quantities plotted in BPT diagrams are the relative line intensities, not equivalent widths. Thus, if a comparison is to be made between FS CMa stars and other objects, one should use line intensities that do not involve EW's, which depend on the strength of the continuum. This relates primarily to the Hα line because of its higher optical depth and presence of an absorption component. In future discussions of the characteristics of FS CMa stars in BPT diagrams it will be important to explain exactly how the EW's have been used to determine the line intensities for the BPT diagrams.

My second comment has to do with the presence of the low ionization forbidden lines in FS CMa stellar spectra. The absence of [O II], which Dr. Korcakova and colleagues attribute to ionization, may in fact be due more to higher density than low ionization. In particular, for stars in which [N II] 6584 is observed, but not [O II] 3727, this may be an indication that the density of the forbidden line region is causing collisional de-excitation of the [O II]. If the spectroscopic capabilities at Ondrejov allow observations in the 3700 A region it would be very interesting to explore the presence or absence of [O II] in FS CMa stars, even though it is generally rather faint. I would recommend this for an observational program at Ondrejov, if feasible.

As a minor comment, on p. 35 the statement is made, ". . . . doublet Si II λλ 6347, 6371 A is magnetically very sensitive". This fact is important for the thesis results and it would be appropriate give a publication reference that explains why the Si II doublet is so sensitive to magnetic fields.

In addition, a statement on p. 36, bottom reads "[N II] λλ6716, 6731 A provide the same information, however, their presence in the spectra of FS CMa stars is very rare." The [N II] wavelengths should be corrected to λ6548/84. Also, if possible it would be useful to explain why the [S II] is so much stronger than the [N II], e.g., if it is abundance or ionization or density that is involved.

In summary, I recommend the original work of the Dr. Korcakova habilitation thesis to be approved. It is worthy of an appointment at the level of Associate Professor at Charles University. The spectroscopic observations of the FS CMa stars have been one of the productive programs for Ondrejov telescopes, and this is a credit to both Charles University and the Czech Academy of Sciences. The interpretation of the observations by Dr. Korcakova and her colleagues have contributed to our understanding of the diverse FS CMa stars. The thesis gives an account of their results, taking into account most of the detailed work that is described in papers that have appeared in refereed journals. Dr. Korcakova has been first author on the most significant of those papers, and second author on the others.

Because much of the thesis is based on Dr. Korcakova's publications one can understand why the originality check on plagiarism done by the Turnitin system found a relatively high percentage of coincidence. For example, virtually all of the figures in the thesis were taken from Dr. Korcakova's papers. The procedure Charles University follows in allowing a thesis to consist of a collection of published papers in the literature is now widely practiced in both Europe and the United States. Thus, the coincidence of material in the thesis is to be expected, and is justified in this case. The real value is that the papers reflect the original work of Dr. Korcakova, and we accept first or second authorship as valid evidence that the candidate is largely responsible for the work of papers that also include co-authors.

I am confident that Dr. Korcakova will continue her research in a productive way, and enhance the research and teaching of astronomy and astrophysics at Charles University.

Sincerely,

[redacted]

Robert Williams
Astronomer, Emeritus
&
Distinguished Osterbrock Professor
University of California, Santa Cruz