# MAGNETIC FIELDS OF NEWLY-IDENTIFIED MCP STARS IN THE KEPLER FIELD

***I. A. Yakunin*** [a*], ***I. I. Romanyuk*** [a], ***Z. Mikulášek*** [b], ***J. Janík*** [b], ***A. Moiseeva*** [a], ***S. Hümmerich*** [b]

[a] *Special Astrophysical Observatory, Russian Academy of Sciences, Nizhnii Arkhyz, Russia*

[b] *Masaryk University, Brno, Czeck Republic*

We present first results of the ongoing search for magnetic fields in eight Ap/CP2 stars and one candidate in the Kepler field using the spectropolarimeter of the 6-m SAO telescope in Russia. Five stars (KIC 4180396, KIC 5264818, KIC 5473826, KIC 6065699 and KIC 8324268) were found to harbor a strong magnetic field. Very likely, KIC 6864569 is also a magnetic star, but more observations are needed. The status of KIC 8161798 and KIC 10324412 remains as yet unclear; no significant field was detected for the CP2 star candidate KIC 6278403. The resulting sample will facilitate research on the connection between magnetic field topology and surface chemical structures in mCP stars.

**Keywords:** stars: chemically peculiar – stars: magnetic fields

## 1. INTRODUCTION

We present first results of a search for magnetic fields in eight Ap/CP2 stars and one candidate in the Kepler field. These upper main-sequence objects are characterized by peculiar photospheric abundances thought to be produced by selective processes (radiative levitation, gravitational settling) operating in their calm radiative atmospheres. CP2 stars belong to the magnetic chemically peculiar (mCP) stars, which possess strong global magnetic fields, possibly of fossil origin. In many mCP stars, the overabundant chemical elements are concentrated into chemical spots or patches. These objects display strictly periodic light, spectrum and magnetic variations, which can be well described by a rotating star

* E-mail: elias@sao.ru

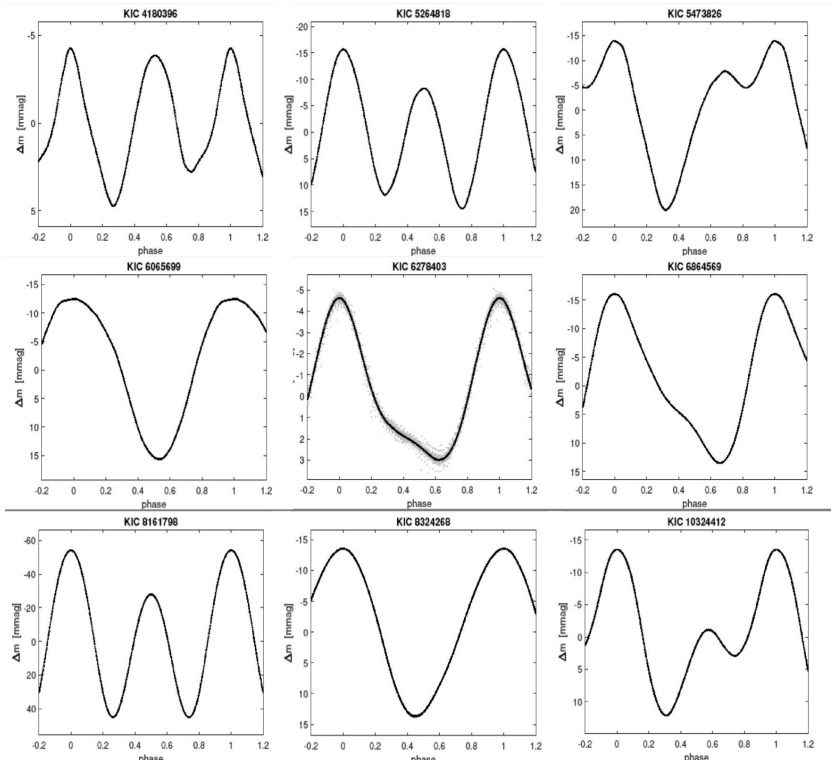


**Fig. 1.** Kepler light curves of the eight CP2 stars and the CP2 star candidate KIC 6278403, represented by normal points. All objects have been selected from the list published by Hümmerich et al. [1], except for KIC 4180396 and KIC 5264818 (as yet unpublished).

model with a non-axial stable magnetic field and persistent chemical structures. However, the physical connection between the magnetic field topology and the structure of the chemical surface inhomogeneities is not yet understood or well explored.

Our intended project "Probing the role of the magnetic fields in the physics of chemically peculiar stars using BTA-6 spectropolarimetry" aims to assess and better comprehend the role of the global magnetic field in the process of the formation and sustaining of the chemical surface abundance inhomogeneities of mCP stars by using high-quality spectropolarimetry from the 6-m telescope and ultra-precise photometric data from the Kepler and TESS satellites. These data will offer unique and detailed information about chemical structures and magnetic field geometry for a representative sample of mCP stars. As a pilot study, we have observed eight Ap/CP2 stars and one candidate in the Kepler field, which were selected from the list of [1] and unpublished observations (see Table 1 and Fig-

ure 1). Our data constitute the first spectropolarimetric measurements of these objects.

## 2. OBSERVATIONAL DATA

In April and May 2019, we obtained a total of 31 spectra for all nine objects using the Zeeman analyzer. Strong magnetic fields were found in five stars (KIC 4180396, KIC 5264818, KIC 5473826, KIC 6065699 and KIC 8324268). Very likely, KIC 6864569 is also a magnetic star, but more observations are needed. The status of KIC 8161798 (only one spectrum) and KIC 10324412 (five spectra) remains as yet unclear. No significant magnetic field (amplitude $40 \pm 140$ G) has been detected in the only CP2 star candidate of the sample, KIC 6278403.

## 3. CONCLUSIONS

The here presented results from our pilot study in the framework of the proposed Czech-Russian project collaboration are very promising and confirm the feasibility of the chosen approach. With the ongoing collection of more and more spectra, we will be able to significantly enlarge the sample of mCP stars with accurate phase-resolved magnetic measurements. The resulting sample, which will also boast ultra-precise light curves from satellite photometry, will be unique and

**Table 1.** Essential data for the nine stars from the Kepler field chosen as targets for the 6-m SAO telecope spectropolarimetric observations. From left to right, the columns denote: (1) KIC identification; (2) other conventional identification; (3) G magnitude from GAIA DR2; (4) spectral type; (5) period, d; (6) effective amplitude of light variations, $A_{eff}$; (7) number of newly obtained magnetic spectra, $N_m$; (8) magnetic field detection. Unless indicated otherwise, spectral types were taken from [1].

| *KIC ID* | *Other ID* | *G, mag* | *SpT* | *Period, d* | $A_{eff}$, *mmag* | $N_m$ | *Magnetic field?* |
|---|---|---|---|---|---|---|---|
| 4180396 | HD 225728 | 10.388 | B9 IV Si | 3.6843458(3) | 7.7 | 2 | Yes |
| 5264818 | HD 180374 | 8.798 | A0 IV Si | 1.90505059(5) | 25.8 | 4 | Yes |
| 5473826 | HD 226339 | 10.813 | B9 V SiCr | 1.051203405(16) | 29.3 | 2 | Yes |
| 6065699 | HD 188101 | 7.720 | B7 V Si | 3.9873152(4) | 28.7 | 5 | Yes |
| 6278403 | HD 181436 | 8.758 | n/a | 1.19123857(4) | 7.2 | 5 | No |
| 6864569 | BD+42 3356 | 9.954 | B9 V Si | 2.32517273(4) | 27.2 | 2 | Likely |
| 8161798 | BD+43 3223 | 10.373 | A0 V SiCr | 2.20296272(5) | 90.5 | 1 | 1 spec |
| 8324268 | HD 189160 | 7.881 | A0 V SiCr | 2.00912016(7) | 27.1 | 5 | Yes |
| 10324412 | HD 176436 | 8.209 | A0 V Si | 1.73149557(5) | 21.0 | 5 | Unclear |

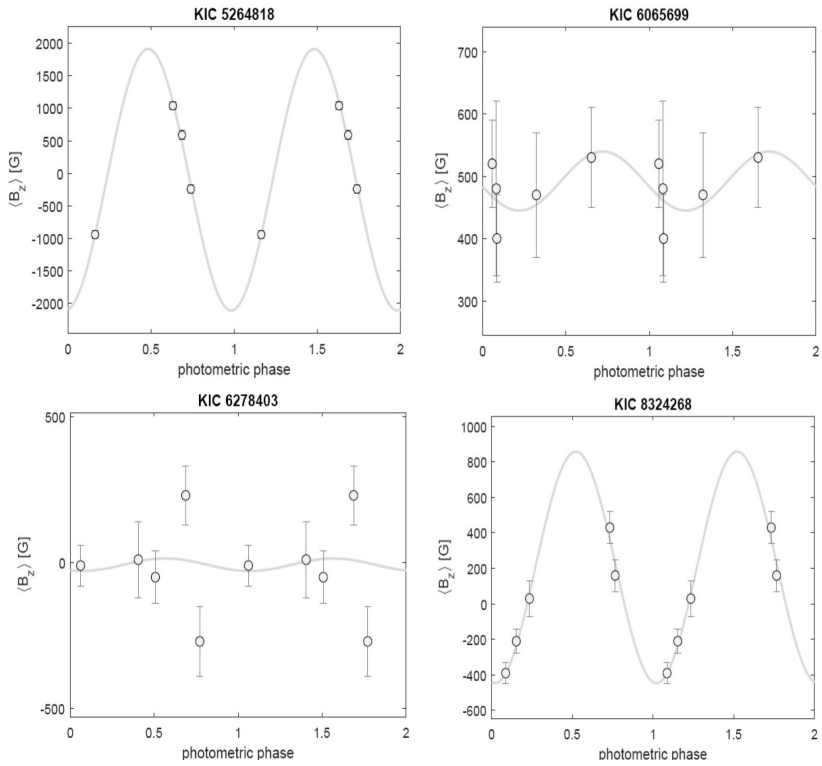


**Fig. 2.** Mean longitudinal magnetic induction plotted versus photometric phase. Ephemerides were based on our own observations (KIC 5264818) and taken from Hümmerich et al. [1] (all other stars).

greatly facilitate further research on the connection between the magnetic fields and other parameters in mCP stars.

## ACKNOWLEDGEMENTS

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## REFERENCES

1. Hümmerich S., et al., A&A, 2019, **619**, A98