АСТРОФИЗИКА

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NOTES

PHYSICAL AND CHEMICAL PARAMETERS OF HgMn STARS ON THE BASIS OF THE AVAILABLE DATA

1. *Introduction*. HgMn stars are among the quietest stars of the main sequence. They represent the A2-B5 subclasses, being slow rotators, and they are more often in binary systems than in normal stars. Their effective temperatures are in the range from 10000 K to 16000 K and the existence of the magnetic field in their atmospheres is still subject of debates. HgMn stars belong to the group of Chemically Peculiar (CP) stars, and as a separate subgroup they are characterized by unusually strong lines of HgII and MnII. The HgMn stars often show mild helium deficiencies, and sometimes the presence of other peculiarities has been reported: for instance, isotopic anomalies in platinum and mercury are mentioned in some of them.

To see the trends of chemical abundances in those stars, I used the elements abundances expressed by solar values and the final results are compared with the ones compiled by Smith [1]. For the first time, such kind of search for all known CP stars was done in [2]. These works opened the way for further investigations.

2. *Methods and Results*. To gather chemical abundances of spectroscopically observed HgMn stars and published since 1993, we have taken into account and compared them with review [1]. As a result of this search, more than 65 elements and ions abundances were compiled for 130 HgMn stars and rescaled assuming solar abundances given in [3], which facilitate the comparison process. Just in a few cases, when stellar abundances had been expressed by solar values in the used papers [4,5], no rescaling process has been applied. The plot for the compiled and rescaled chemical abundances via atomic number was created (see Fig.1). (All the papers used as the source of abundance results are mentioned in the figure legend).

It is worth to mention that the U abundance is available only for HD 193452 (see [6]). We could not find any other paper relevant to U abundances which is not surprising if we take into account the difficulties arising when this element spectral features are to be measured.

The plot of this compilation shows some interesting features with under-

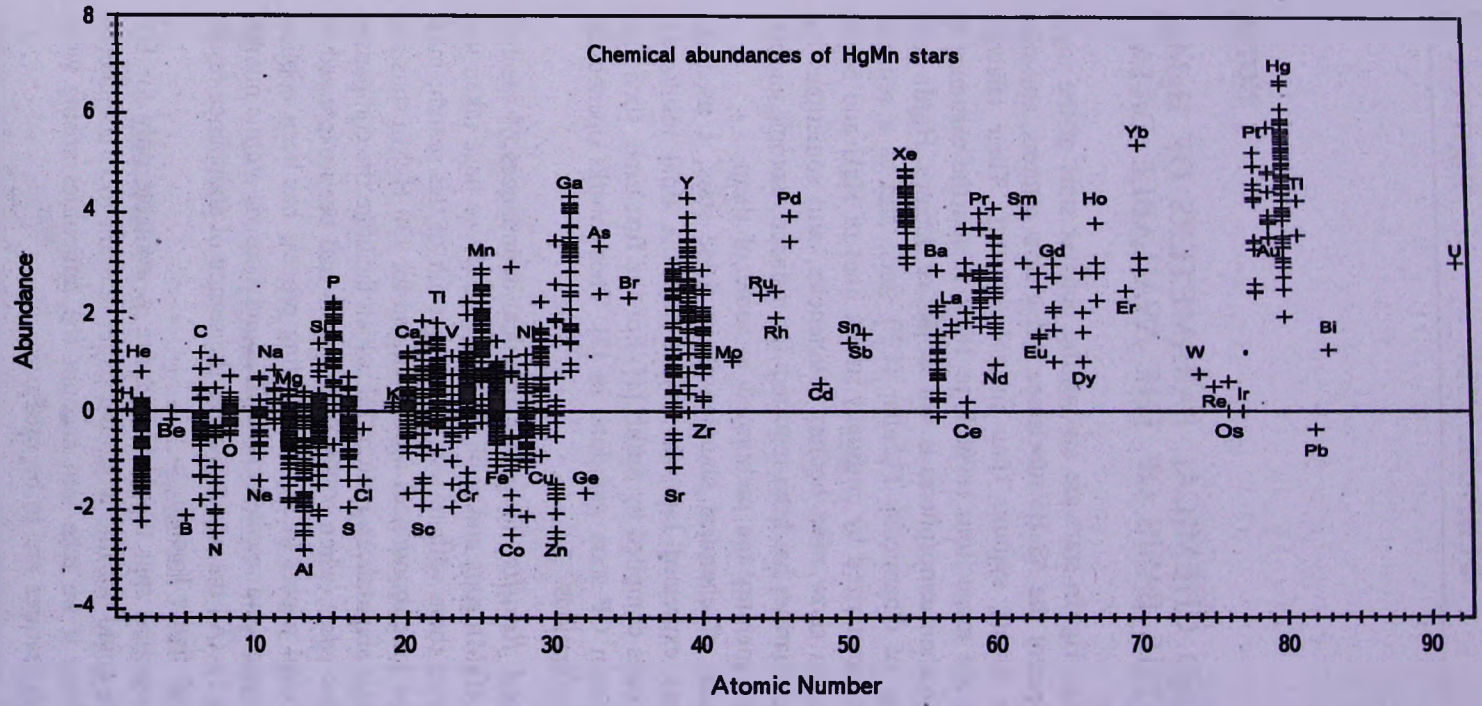

Fig.1 Here the abundances (relative to the Sun) versus atomic numbers are plotted. The black line denotes to the Solar abundances. To create this plot following papers were used: Adelman et al. 1996; Adelman, Gulliver and Rayle, 2001; Adelman et al. 2001; Adelman et al. 2006; Alecian et al. 2009; Anders and Grevesse 1988; Asplund et al. 2009; Bohlender et al. 1998; Castelli and Hubrig 2004; Catanzaro et al 2003; Catanzaro et al 2006; Catanzaro 2010; Cowley et al. 2007; Dolk et al. 2002; Dolk et al. 2003; Dworetsky et al. 1998; Dworetsky and Budaj 2000; Dworetsky 2004; Dworetsky et al. 2008; Fossati et al. 2011; Hubrig et al. 1999; Jomaron et al. 1999; Khokhlova et al., 1995; Kochukhov et al. 2005; Leckrone et al. 1999; Niemczura et al. 2009; Pintado and Adelman 1996; Ryabchikova et al. 1996; Ryabchikova 1998; Ryabchikova et al. 1999; Saffe et al. 2011; Savanov and Hubrig 2003; Smith 1993; Smith and Dworetsky 1993; Smith 1994; Smith 1996; Smith 1997; Tkachenko et al. 2013; Usenko et al. 2001; Wahlgren et al. 2000; Wahlgren and Hubrig 2000; Woolf and Lambert 1999; Woolf and Lambert 1999a; Yushchenko et al. 1999; Yushchenko et al. 2004 and Zavala et al. 2007.

lying physical sense to be considered later on. First of all should be mentioned the statement of an interesting fact (see [2] and [1]) that all the heavy elements are systematically overabundant in HgMn stars. Second, the underabundance of He in these stars seems to be less pronounced than it was in Smith's review. One should mention that there are some elements, namely, As, Br, Mo, Ru, Rh, Pd, Cd, Sn, Sb, Pr, Eu, Dy, Gd, Er, Au, W, Re, Ir, Tl, Pb, Bi and U, which are not represented in Smith's compilation. Abundances for the most of the elements have a huge dispersion.

The iron-peak elements (Cr, Mn, Fe, Co, and Ni) are broadly scattered around the solar abundances. It is worthwhile to note, that two stars in the HgMn group, χ Lup and 36 Lyn, have less manganese abundances compared with the solar properties. These observational results seem to confirm [7] suggestion that there is a separate group of hot, mild HgMn stars, which are difficult to identify by known classical observational techniques. The total range in iron abundance observed in this HgMn sample is around 2.5 dex, which is greater than that observed for any other group of chemically peculiar stars ([8]). HgMn stars are generally Co-deficient, although there are some examples with overabundances respect to solar values. The unusual overabundance is observed in the atmosphere of HD 143807 (see [9]) which needs further detailed investigations. The HgMn stars are generally Ni-deficient although there are some examples with abundances higher with respect to solar properties (see [10]). Although the high dispersion of iron-peak elements, heavy elements are more overabundant in the atmospheres of HgMn stars. For the others, the results are mostly the same as in Smith's outcome.

3. *Conclusion*. In current study the chemical abundances available for HgMn stars and published since 1993 were combined. The compilation results show that overabundance in the atmospheres of HgMn stars increases for heavy elements. The scatter of elements is not due to the errors of measures. It is due to a large variety of anomalies from star to star. In this paper many rare and heavy elements' abundances were added, which do not exist in Smith's compilation. Otherwise, these results are in good agreement with Smith's outcome.

This is just a preliminary conclusion. Our database is not homogenous because the HgMn stars were observed by different techniques and dissimilar methods. This means that all uncertainties for each abundance value need to be taken into account. The database will be supplemented in near future and a deeper study of those stars will be done. More chemical abundances will allow us to better understand the details of the physical processes in play in their atmospheres.

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Физические и химические параметры звезд HgMn на основе имеющихся данных. Для лучшего понимания деталей физических процессов, затрагиваюших по существу атмосфер звезд HgMn, химическое изобилие почти всех наблюдаемых звезд HgMn собрано и сравнено с данными, представленными в обзоре Смита [1]. Результаты этой компиляции показывают, что тяжелые элементы систематически избытны в звездах HgMn (см. [2] и [1]). Недостаток гелия кажется менее выраженным, чем в обзоре Смита. Для некоторых редких и тяжелых элементов никакое изобилие не показано в обзоре Смита, в то время как для других результаты главным образом совпадают. Однако, важно знать, что созданная база данных не однородна, потому что звезды HgMn наблюдались различной техникой и разнообразными методами. Следовательно, ошибки должны быть приняты во внимание, чтобы быть уверенной для каждого значения изобилия.

Ключевые слова: *HgMn звезды: физические и химические параметры*

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[1] V.A.Ambartsumian Byurakan Astrophysical Observatory, Armenia,
[2] Paris Observatory, Meudon, France,
e-mail: satenik.ghazaryan@obspm.fr

S.Ghazaryan
С.Казарян

REFERENCES

1. *K.C.Smith*, Astrophys. Spase Sci., **237**, 77, 1996.
2. *G.W.Preston*, ARA&A, **12**, 257, 1974
3. *M.Asplund*, *N.Grevesse*, *A.J.Sauval*, *P.Scott*, Ann. Rev. Astron. Astrophys., **47**, 481, 2009.
4. *E.Anders*, *N.Grevesse*, Geochimica et Cosmochimica Acta, **53**, 197, 1988.
5. *N.Grevesse*, *A.J.Sauval*, Space Sci. Rev., **85**, Issue 1-2, 161, 1998.
6. *S.Hubrig*, *F.Castelli*, *G.Mathys*, Astron. Astrophys., **341**, 190, 1999.
7. *C.R.Cowley*, Publ. Astron. Soc. Pacif., **92**, 159, 1980
8. *D.A.Ptitsyn*, *T.A.Ryabchikova*, In: C.R.Cowley, M.M.Dworetsky, C.Mégessier, (eds) Proc. IAU Coll. 90, Upper Main Sequence Stars with Anomalous Abundances, Reidel, Dorduht, p.425, 1980.
9. *T.Ryabchikova*, Contrib. Astron. Obs. Skalnaté Pleso, **27**, 319, 1998.
10. *K.C.Smith*, *M.M.Dworetsky*, Astron. Astrophys., **274**, 335, 1993.