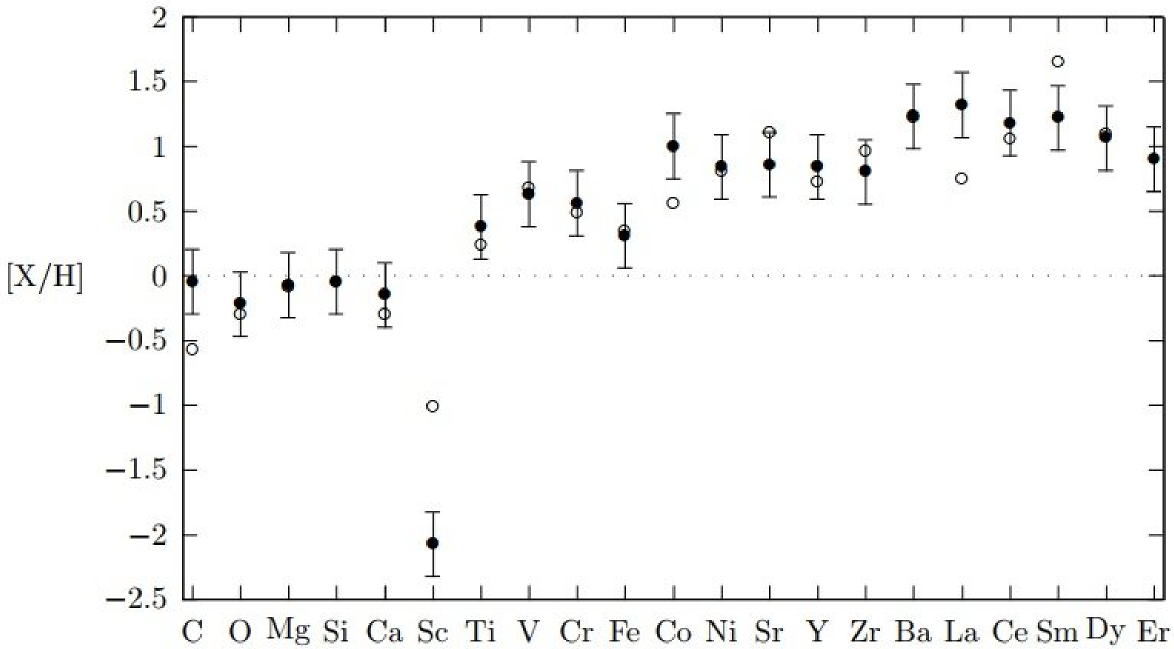
Researchers conduct more accurate chemical analysis of the star 68 Tauri

October 3 2017, by Tomasz Nowakowski



The found abundance pattern in 68 Tauri: circles (Adelman and al.), dots (this work). Credit: Martinet et al., 2017.

(Phys.org)—French astronomers have recently presented a new abundance analysis of the star 68 Tauri (also known as HD 27962), which determines its chemical composition more precisely than previous studies. The results of the research are available in a paper published Sept. 28 on the arXiv pre-print repository.

Located some 150 light years from the Earth, 68 Tauri is a binary star in the Hyades open cluster. With an effective temperature of 9,025 K and a mass of nearly 2.3 solar masses, it is the hottest and most massive member of this cluster.

68 Tauri was initially classified as main-sequence star of spectral type A. However, subsequent observations have shown that it is a chemically peculiar metallic-line star (Am star) due to its distinct underabundance of scandium and overabundances of the iron-peak and heavy elements.

Given that the last abundance analysis of 68 Tauri was performed in 2003, Sebastien Martinet of the Grenoble Alps University and Richard Monier of the Paris Observatory decided to conduct a new study with the aim of learning more about the composition of this star. The researchers used updated atomic data hoping to redetermine and expand the star's chemical composition.

"We have modeled the high resolution SOPHIE (R=75000) spectrum of 68 Tauri using updated model atmosphere and spectrum synthesis to derive chemical abundances in its atmosphere. In particular, we have studied the effect of the inclusion of the hyperfine structure of various barium isotopes on the determination of the baryum abundance in 68 Tauri. We have also derived new abundances using updated accurate atomic parameters retrieved from the NIST database," the paper reads.

The new analysis allowed the scientists to determine abundances of 68 Tauri more accurately, improving our understanding of chemical composition of this star.

For instance, the team found that 68 Tauri exhibits underabundance of scandium and slight underabundances in carbon, oxygen, magnesium, silicon and calcium, mild overabundances of the iron-peak elements and large overabundances of the rare-earth elements.

Furthermore, as a result of including hyperfine structure of various isotopes of Barium, they found that the abundance of this element is significantly lower when compared to the study published in 2003. According to the study, this highlights the importance of hyperfine structure in such analyses.

"We find a large difference on the barium abundance when including the full hyperfine structure. (…) We stress the importance of taking into account the hyperfine structure for all isotopes when available in order to derive accurate abundances," the researchers wrote in the paper.

When it comes to abundances of other elements, the new study shows that they are consistent with the values presented in the previous study, except for scandium. The authors noted that the newly determined values generally differ from 0.01 dex up to 0.4 dex as a result of adopting new atomic data, confirming that 68 Tauri is a chemically peculiar Am star.

More information: Hyperfine Structure and Abundances of Heavy Elements in 68 Tauri (HD 27962), arXiv:1709.10068 [astro-ph.SR] arxiv.org/abs/1709.10068

Abstract
HD 27962, also known as 68 Tauri, is a Chemically Peculiar Am star member of the Hyades Open Cluster in the local arm of the Galaxy. We have modeled the high resolution SOPHIE (R=75000) spectrum of 68 Tauri using updated model atmosphere and spectrum synthesis to derive chemical abundances in its atmosphere. In particular, we have studied the effect of the inclusion of Hyperfine Structure of various Baryum isotopes on the determination of the Baryum abundance in 68 Tauri. We have also derived new abundances using updated accurate atomic parameters retrieved from the NIST database.

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