Researchers replicate white dwarf photospheres in lab using X-ray machine

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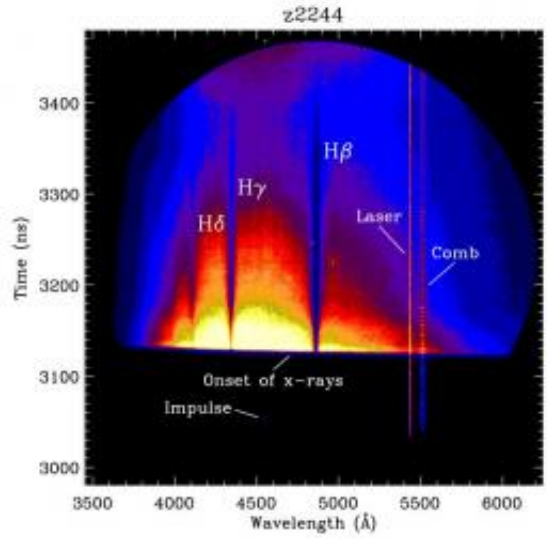

Time-resolved spectrum of hydrogen Balmer lines in absorption from experiment z2244. Credit: arXiv:1210.0832 [astro-ph.SR]

(Phys.org)—Researchers at Sandia Labs have used a large x-ray machine to create high-density plasma that approximates the photosphere of white dwarf stars. The team has posted a paper describing the process and how it can be used to assist astronomers to the preprint server arXiv.

White dwarfs are stars that have used up most of their fuel—they're made of mostly carbon and are covered by gasses similar to an atmosphere. Scientists use spectroscopy to identify the elements that make up the photosphere of such stars, and then use the blurring—the

result of surface pressure—to work out each star's gravity. With that information, researchers can calculate the star's radius and mass. This method is not precise, however, as researchers have found differences between calculations made using this method versus those found by measuring a star's movement through space.

To gain a better understanding of the nature of the gasses that surround white dwarfs, the research team at Sandia used an x-ray machine called the Z Pulsed Power Facility to heat a thin strip of gold held inside a hydrogen filled chamber. At temperatures of 10,000K, the hydrogen becomes high-density plasma (ionized gas), which, the team reports, bears a striking resemblance to gases covering white dwarf stars.

The researchers explain that by re-creating the conditions that exist in the photosphere surrounding white dwarfs they will be better able to understand what is going on with the stars themselves, as they cannot be seen through the gasses. Changing the conditions under which the plasma is created in the lab allows for the creation of a variety of gas cloud types which, in turn, allow the researchers to fine-tune their results. Eventually, they will be able to mimic conditions on individual white dwarfs, resulting in improved calculations used to describe the underlying star.

The x-ray machine is also capable of generating magnetic fields that are similar to those of white dwarf stars. By exerting such fields on the plasma generated, the researchers hope to gain a better understanding of how magnetic fields near white dwarfs impact the spectra of the gasses that surround them, which should help give a clearer picture of the stars themselves.

More information: Creating White Dwarf Photospheres in the Laboratory: Strategy for Astrophysics Applications, arXiv:1210.0832 [astro-ph.SR] arxiv.org/abs/1210.0832

Abstract

Astrophysics experiments by Falcon et al. to create white dwarf photospheres in the laboratory are currently underway. The experimental platform measures Balmer line profiles of a radiation-driven, pure hydrogen plasma in emission and in absorption for conditions at T_e ~ 1 eV, n_e ~ 10^17 cm^-3. These will be used to compare and test line broadening theories used in white dwarf atmosphere models. The flexibility of the platform allows us to expand the direction of our experiments using other compositions. We discuss future prospects such as exploring helium plasmas and carbon/oxygen plasmas relevant to the photospheres of DBs and hot DQs, respectively.