Experimental stellar opacity and simulation

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The understanding of the structure of the Sun depend strongly on the opacities, indeed the opacity is used to calculate the energy transport. Our star is composed mainly of 73.5% hydrogen, 24.8% helium and only less than 2% of heavier atoms ([1]N. Grevesse and A. J. Sauval, Space Science Reviews, 1998). However, these heavy atoms participate in the majority of the opacity of this star, up to 83% of the global opacity ([2]Bailey et al., Physic of Plasma, 2009). In a measurement of the opacity of iron under solar conditions (Te 200eV, near the solid density), which could be achieved with the Z-machine (Sandia National Laboratory), large discrepancies between atomic codes and measurements could be revealed ([3]Bailey, et al., Nature, 2015). Thus, there is a need for new opacity measurements using another method to achieve these high temperature and density conditions. This extrem conditions are hard to reach in laboratory. Therefore, the focus here is on intense laser heating of typical target (compound of the element of interest) so that the opacity can be measured in the future. This work is a preliminary study for future experiments. These simulations, using the characteristics of the Apollon laser (CEA), have shown that we can reach about more than 100 eV et solid density.

References

[1] N. Grevesse and A. J. Sauval, Space Science Reviews (1998)
[2] Bailey, *et al.*, Physic of Plasma (2009)
[3] Bailey, *et al.*, Nature (2015)