**MEASURING THE EQUATION OF STATE OF BORON NITRIDE IN EXTREME CONDITIONS**

K. Batani1, D. Singappuli2, M. Huault2, P. Nicolaï2, D. Raffestin2, D. Batani2, T. Buriuan3 R. Dudzak3,
M. Krůs3, S. Pikuz4, W. McKenzie4, A. Martynenko5, L. Giuffrida6, Y.I. Chen7, S. Mateti7, Q. Cai7

*1) Institute of Plasma Physics and Laser Microfusion, Warsaw, Poland*

*2) CELIA, University of Bordeaux, France
3) Prague Asterix Laser System, Prague, Czech Republic
4) HB11 Energy, Australia*

*5) GSI, Darmstadt, Germany*

*6) ELI Beamlines, Prague, Czech Republic
7) Institute for Frontier Materials, Deakin University, Australia*

The study of the equation of state of boron compounds in extreme pressure conditions is important for several fields of physics. In particular, boron nitride has been proposed as alternative ablator in Inertial Confinement Fusion experiments thanks to its high tensile strength [[[1]](#endnote-1)] and also because boron and nitrogen, which both undergo reactions with neutrons and protons, offer the potential for using additional nuclear reactions to better constrain the shell areal density and ablator mix at burn time [[[2]](#endnote-2)].

From the point of view of material science, boron compounds are also very interesting. In particular, the phase diagram of boron nitride is similar to that of carbon, incorporating phases at high temperatures and pressures whose structures and physical properties resemble diamond [[[3]](#endnote-3)].

However, there are at today only a few experimental data on boron nitride. Results obtained with the Omega laser, using the direct-drive approach, cover the range 10 to 20 Mbar. It is therefore interesting both to increase the statistics in this range and to explore higher pressures [[[4]](#endnote-4)].

In this context, we are performing a series of experiments at the PALS laser facility with the goal of obtaining new EOS data along the principal Hugoniot for boron nitride targets in the pressure range 10 to 35 Mbar.

In the experiment, we use the PALS laser beam converted to third harmonic (E= 150 J in 300 ps at wavelength 0.44 µm) to create a strong pressure shock travelling in targets which include a base (plastic ablator and aluminum pusher) and two steps of quartz (reference material) and boron nitride. These have been produced at Deakin University.

The shock propagation is diagnosed using a streak chronometry diagnostic (SOP) and a velocity interferometer (VISAR). Due to the short duration of the laser pulse the shock pressure will decay in time allowing in the same laser shot to obtain and measure several states of the samples at decreasing pressure [[[5]](#endnote-5)].

In the poster, the preparation of the campaign and of the diagnostics, and some preliminary results obtained with the SOP diagnostics will be presented.

1. Heather D. Whitley, et al. “Comparison of ablators for the polar direct drive exploding pusher platform” [↑](#endnote-ref-1)
2. Probing the Physics of Burning DT Capsules Using Gamma-ray Diagnostics, A. C. Hayes-Sterbenz, G. M. Hale, G. Jungman, and M. W. Park, LA-UR-15-20627. [↑](#endnote-ref-2)
3. #  [Elise Knittle](https://www.nature.com/articles/337349a0#auth-Elise-Knittle), [Renata M. Wentzcovitch](https://www.nature.com/articles/337349a0#auth-Renata_M_-Wentzcovitch),  [Raymond Jeanloz](https://www.nature.com/articles/337349a0#auth-Raymond-Jeanloz) & [Marvin L. Cohen](https://www.nature.com/articles/337349a0#auth-Marvin_L_-Cohen) “Experimental and theoretical equation of state of cubic boron nitride” [Nature](https://www.nature.com/) volume 337, pages 349–352 (1989)

 [↑](#endnote-ref-3)
4. Shuai Zhang, et al. “Equation of state of boron nitride combining computation, modeling, and experiment” PHYSICAL REVIEW B 99, 165103 (2019) [↑](#endnote-ref-4)
5. “High-Pressure Equation-of-State Studies Using Laser-Driven Decaying Shocks” J. E. Miller, University of Rochester Laboratory for Laser Energetics, 48th Annual Meeting of the American Physical Society Division of Plasma Physics Philadelphia, PA 30 October–3 November 2006 [↑](#endnote-ref-5)