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The Dawn of the New Age of Experimental Astrophysics at Cosmic Conditions: Astronomy becomes an experimental science¹

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We can now achieve cosmic conditions in the laboratory. We will discuss the consequences of this relatively new circumstance for astrophysics and physics. We establish the context of the “at-parameter” experiments of the Wootton Center for Astrophysical Plasma Properties (WCAPP). This suite of experiments all produce macroscopic plasmas under the density and temperature conditions we find in the cosmos. Current WCAPP experiments focus on 1) stellar interior opacity, 2) atomic kinetics, x-ray heating, and temperature of photoionized plasmas, 3) accretion-powered matter and radiation, and 4) white dwarf photospheres. We will briefly summarize the results of this suite of experiments to-date, with an emphasis on the White Dwarf Photosphere Experiment (WDPE). Nearly all stars either are, or will become, white dwarf stars, giving them broad relevance. The astrophysical questions they can help us answer include the age of the universe, the age and history of star formation of our Galaxy’s varied morphological components, and the evolution of stars. The compact and dense nature of these stars means that their atomic physics is not well constrained, even in the outermost layers. We briefly describe the astrophysical and physical problems associated with white dwarf photospheres and our recent progress.

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