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Atomic Astrophysics Under Extreme HED Conditions[1]

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Astrophysical sources reveal the most extreme physical conditions in nature, from the primordial plasma following the Big Bang to the enormous energy output of black hole environments that powers active galaxies and quasars. Spectroscopic studies based on AMO physics are the key to understanding the matter-light interactions such as radiation transport and plasma opacities. Contemporaneously with astrophysical research, laboratory studies on fusion plasma sources have now reached a stage where extreme conditions may be created such as in stellar interiors. Basic physical processes under extreme conditions on the one hand, and the necessity for high precision on the other hand, may be exemplified by a recent and perplexing problem in solar astrophyscs. Newly determined abundances of the most abundant light elements in the Sun, C, N, O, etc., are up to 30-40% lower than the standard values long supported by astrophysical models, helioseismology, and meteoritic measurements. While this problem is of fundamental importance in astronomy, its solution entails a multi-disciplinary approach involving atomic physics, plasma physics, and astrophysics. A summary of current and planned work in this and other areas of atomic astrophysics will be presented.

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