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Atomic physics, spectroscopy and applications of tungsten

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Tungsten (W, Za=74) is now considered one of the best candidate materials for fusion reactors: it carries away heat efficiently, has the high melting point, low sputtering yield and tritium retention. The ability to melt during the transient events and large Z are among critical issues for tungsten application in fusion reactor and should be investigated in detail. Recently, W divertor was implemented in the ITER project and it became possible that W plasmas can reach the reactor core and then attain very high temperatures. Hence, tungsten might radiate a very broad spectrum from a few times ionized up to more than sixty times ionized, which is very challenging for the interpretation and comprehensive analysis. In this talk, we consider dielectronic recombination as a very important atomic process in laboratory and astrophysical plasmas and present the calculations of relativistic energy levels, radiative probabilities and autoionization rates of W in a very broad range of ionization stages from Yb-like W^{4+} to Cu-like W^{45+} to such very high ionization stages as Li-like W^{71+} [1-3]. A comparison between the results from various relativistic atomic structure codes and accuracy of atomic data is discussed. Another important application of tungsten is in Z-pinch physics: wire arrays that consist of hundreds of micron diameter W wires can be imploded at multi-MA currents and generate the highest radiation yield out of all other wire materials. Not only muti-MA but also 1 MA university-scale pulsed power generators are able to produce multiply-ionized high-Za plasma [4-5], which is illustrated in this talk for W Z-pinches. In particular, x-ray spectra from 1 to 10 Å from W wire loads are presented and analyzed. Future work relevant to both atomic and nuclear physics is discussed. This research was supported by National Nuclear Security Administration under DoE grants DE-NA0003047 and DE-NA0002945.

Biography

Alla S Safronova received her Ph.D. degree in atomic physics from the Institute of General Physics, Russian Academy of Science (RAS), Moscow, in 1986. She joined University of Nevada, Reno (UNR) in 1994, where currently she is a Research Professor. She has published more than 220 papers on atomic and plasma physics. Her former PhD students are working at Sandia National Laboratories, Naval Research Laboratory, at UNR and also abroad. She organized, chaired and co-chaired the series of International workshops on Radiation from High Energy Density Plasmas (RHEDP 2011, 2013 and 2015) and the 10th International Conference on Dense Z-pinches (2017).

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