Abstract Submitted
for the DAMOP18 Meeting of
The American Physical Society

X-ray emission in Clusters Exposed to Intense X-ray Free-electron Laser (XFEL) Pulses[1] PHAY HO, CHRIS KNIGHT, LINDA YOUNG, CHRISTOPH BOSTEDT, Argonne Natl Lab — We present a theoretical study in the effects of non-linear x-ray ionization dynamics on x-ray emission processes in clusters in intense XFEL pulses. We employ Monte-Carlo/Molecular Dynamics calculations to investigate the x-ray processes as a function of pulse parameters (photon energy, intensity and pulse duration) and cluster shape. We found that the nano-sized Ar cluster x-ray emission spectrum in the high-intensity ($>10^{20}\,\mathrm{W/cm^2}$) pulse is very different from the Ar atom spectrum. Most notably, the Ar cluster spectrum depicts stronger fluorescence lines for K_α and K_α^h. Moreover, their satellites which are negligible in the atomic spectrum, become very pronounced in the Ar cluster spectrum. Our analysis shows that recombination processes are an important contribution to these fluorescence features, in which recombination processes enable additional pathways to reach the required electronic configurations for fluorescence transitions. Interestingly, we found that the x-ray emission profile can be modulated by changing the shape of cluster.

[1]This work was supported in part by the U.S. Department of Energy, Office of Science, Basic Energy Sciences, Chemical Sciences, Geosciences, and Biosciences Division under Contract No. DE-AC02-06CH11357.

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Date submitted: 24 Jan 2018 Electronic form version 1.4