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Observation of Soft-X-ray Superradiance in Hypervelocity (v>100 km/s) Impact of Nanoparticles YOUNG BAE, Y.K. Bae Corporation — Anomalous particle detector signals were discovered by Bae and his colleagues in hypervelocity (v > 100 km/s) impact of nanoparticles, such as water clusters and biomolecules, at Brookhaven National Lab in 1994. The estimated 1-D shock pressure range of the Bae et al's experiments is 20 Mbar – 2 Gbar. Because the atomic range theory predicts that the nanoparticles cannot penetrate the detector window, thus cannot generate signals, the origin of the signals has been a mystery for more than a decade. In 2007, Winterberg proposed metastable quantum states can be formed with innershell electrons, which would decay by emitting intense x-rays, when atoms are under "sudden" compression with pressures in excess of 100 Mbar. The compression in Bae et al.'s experiments can be considered to be "sudden", because its time scale (10-100 fs) is much shorter than the ion-electron thermalization time scale (>1 ps). The detailed analysis of the anomalous detector signals revealed that they resulted from intense soft-x-rays generated in the nanoparticle impact, and the radiation energies are 75 – 100 eV in agreement with Winterberg's. The conversion efficiency from the initial nanoparticle kinetic energy to the x-ray radiation energy was as high as 38 %, owing to the Dicke superradiance mechanism, because the size of impact volumes is smaller than the radiation wavelength.

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