

## Multiple-core hole states production in the interaction of solid-state density plasmas with a relativistic optical and x-ray free electron laser

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Much research on SCH and DCH states have been carried out in the past decades<sup>1-3</sup>, however, very few work is reported in the literature on the observation of production for triple-core-hole (TCH) states<sup>4</sup>. The investigation of TCH states gives rise to a great challenge both experimentally and theoretically. Multiple-core states of a silver foil are investigated in the interaction with a relativistic femtosecond optical laser and x-ray free electron laser. Strong x-ray emission of TCH atoms with three L-shell electrons being ionized can be observed at pulse intensities of  $3 \times 10^{21} W / cm^2$ . Detailed kinetic calculations showed that the emissivity originating from the TCH states exceeds that from the single- and double-core-hole states in Ne-like Ag<sup>37+</sup> and is comparable in the neighbouring ionization stages of Ag<sup>36+</sup> and Ag<sup>38+</sup> in the produced plasmas at electron temperature of  $\sim 500$  eV and radiative temperature of  $\sim 1500$  eV using optical laser. These extremely exotic dense matter states are produced by an intense polychromatic x-ray field formed by hot electrons produced in the interaction of the laser. This work opens new ways to the deep insight into investigation of extremely exotic states properties which is important in high energy density physics, astrophysics and laser physics.

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