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Symmetry breaking puzzles in inner-shell photoionization of symmetric linear molecules[1]

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Core-level photoionization of small molecules, followed by Auger decay, generally leads to molecular fragmentation. Modern momentum imaging (COLTRIMS) techniques, combined with coincident measurement of all charged particles produced by a single photoabsorption event, allow one to reconstruct photo- and Auger electron angular distributions in the body frame, which are generally far richer than conventionally measured laboratory-frame angular distributions. In this talk, I will discuss two cases where such measurements on symmetric linear target molecules have revealed interesting symmetry paradoxes. The first case involves K-shell ionization of molecular nitrogen where experimental measurements raise familiar questions about whether the photoprocess creates a localized hole at one of two equivalent, but spatially well-separated sites or rather a delocalized hole, smeared over the equivalent sites, preserving the symmetry of the molecule. The second example involves carbon 1s ejection from the symmetric CO_2 molecule and the origin of observed asymmetry in the molecular-frame photoelectron angular distributions. In both cases, theoretical calculations assist in interpreting the experimental findings.

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