The 1/3 Geometric Constant: Scale Invariance and the Origin of 'Missing Energy' in 3D Quantum Fragmentation

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We report the discovery of a universal geometric constraint on the detection of kinetic energy release (KER) in three-dimensional quantum fragmentation. By investigating the dissociation of localized Slater-type orbitals, we demonstrate that the $4\pi r^2$ radial volume element inherently masks the majority of a system's energy budget, imposing a fundamental peak-to-mean energy bound of $R_E < 0.5$. We introduce a dimensionless scaling law, $M = \alpha\zeta/Q$, and prove that the resulting energy detection ratio is scale-invariant across twelve orders of magnitude, bridging the gap between atomic and subatomic physics.

Remarkably, we identify a **"Geometric Zero-Point"** at $R_E \approx 0.33$, which precisely replicates the 7 eV "missing energy" anomaly observed in attosecond H_2^+ fragmentation benchmarks. Furthermore, we demonstrate that this 1/3 ratio provides a robust geometric baseline for the historical average-to-endpoint discrepancy in beta decay. Our results suggest that a significant portion of what is historically categorized as "missing energy" may be a topological artifact of 3D quantum geometry rather than an exclusive signature of undetected particles. This work establishes a universal master curve for energy reconstruction and identifies a **"detection crisis"** in highly localized systems, where the true interaction energy becomes effectively invisible to peak-centric experimental calorimetry.

Reference paper: https://arxiv.org/abs/2601.08255