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Migdal Effect Beyond the Dipole Approximation: Calculations for Fast Neutrons and Dark Matter Detection

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We present calculations of the Migdal effect using the Dirac-Hartree-Fock method without relying on the dipole approximation, enabling robust predictions at higher nuclear recoil velocities than previously accessible. We demonstrate that multiple ionisation may become significant for fast neutrons and derive semi-inclusive probabilities for processes producing one hard electron above a defined energy threshold, with any additional low-energy electrons remaining unobserved. Our results provide a foundation for interpreting both neutron scattering experiments and dark matter searches. Results are presented for noble elements up to xenon, as well as carbon, fluorine, silicon and germanium.

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Session Classification: Migdal search