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Non-directional and directional detection of dark matter in universal bound states

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We study the signatures for internal structure of dark matter in direct detection directional and non-directional experiments in the context of asymmetric self-interacting dark matter. The self-interaction cross section of two dark matter particles at low energies is assumed to come close to saturating the S-wave unitarity bound, which requires the presence of a resonance near their scattering threshold. The universality of S-wave near-threshold resonances then implies that the low-energy scattering properties of a two-body bound state of dark matter particles are completely determined by its binding energy, irrespective of the underlying microphysics. The form factor for elastic scattering of the bound state from a nucleus and the possibility of breakup of the bound state produce new signatures in the nuclear recoil energy spectrum. Observations of these recoil structures will give a smoking gun signature of dark matter bound states.

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