Cluster Structure, Halos, Skins and S-Factors in Fermionic Molecular Dynamics (FMD)

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The internal structure of light nuclei up to the drip lines is studied using FMD many-body states. The calculations make no a priori assumptions about a core or single particle-states and energies. The same correlated two-body interaction is used for all nulei. Continuum effects are included.

Energies, mass and charge radii, as well as electromagnetic transitions are calculated without using effective charges. Both, variaton after projection on total angular-momentum eigenstates and configuration mixing are important to understand the changes in structure with increasing neutron number. For example, the binding energies and radii near the driplines can only be reproduced when the halo neutrons are swaying collectively against the rest of the nucleus. Intrinsic clusterization is essential for a quantitative description of low lying states (e.g. C, Ne isotopes).

Low energy fusion cross sections for neutron rich Oxygen isotopes show a strong increase in the S-Factor compared to ^{16}O + ^{16}O and thus a substantially enhanced reaction rate in pycnonuclear reactions.

The FMD representation provides not only a very intuitive and descriptive picture of nuclear structure and reactions but also quantitative predictions.

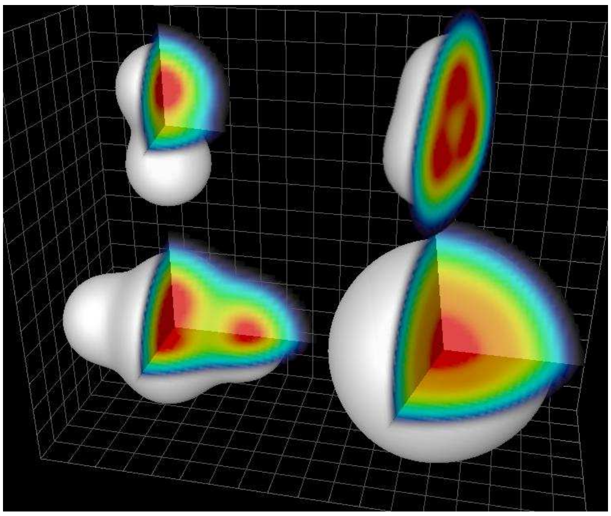

Figure 1: *Intrinsic α-cluster structure in ^{8}Be, ^{12}C (above) und ^{20}Ne (below left), compared to shell model configuration of ^{40}Ca (below right). Cluster structures are often encounterd in light nuclei, especially in excited states where they play an important role in stellar processes. Shown are the one-body densities of the intrinsic states as calculated in FMD. White surface indicates half, red colour full nuclear matter density, respectively.*