ANALOGY BETWEEN NUCLEAR CLUSTERS AND FULERENES

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The last experiment on anomalous large angular scattering of alpha-particles on 28S,32S gives a signal of a bosonization in light nuclei [1]. This signal is the fragmentation of cluster states. The moment of inertia deduced from the band structure of the rotational states indicates that there are a few alpha particles orbiting a core. The analogy between fragmentation into parts of nuclei and buckyballs has lead us to the idea of light nuclei as quasi-crystals. We establish that the quasi-crystalline structure can be formed when the distance between alpha-particles is comparable with the length of the De Broglia wave of the alpha-particle. The dying behavior of the microscopic wave function of the alpha-particle in the intrinsic region of the nucleus indicates that the clusters are in the surface region. Relying on the experiment we suppose the structure of excited 32S to be crystalline. In the vertexes there are alpha-particles or solitons described by Bloch functions. The phonon excitation of a quasi-crystal leads to the appearance of a fragmentation of the states inside the rotational bands. The number of states is determined by the shape of the nucleus. Applying this model to the scattering of alpha-particles we obtained that the form factor of the clusterized nucleus can be factorized into the form-factor of the cluster and the density of clusters in the nucleus. It gives us the possibility to study the distribution of clusters in nuclei and to resolve what kind of distribution we are dealing with: a surface or volume one. Similar circumstances take place at the scattering of electrons from metal clusters and fullerenes.

References

[1] M. Brener et al., Heavy Ion Physics 7, 1998, 355