Properties of Nuclei in the Lead Region

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The structure of the nuclei in the vicinity of ^{208}Pb have become of great experimental and theoretical interest. Especially several new nuclides, such as ^{208}Hg and ^{202}Pt[1], have recently been synthesized in China. ^{208}Hg and ^{202}Pt have longer measured half-lives, 42^{+23}_{-12} min and 43.6h, than that of their lighter neighbours ^{206}Hg($T_{1/2} \simeq 8.15$ min) and ^{200}Pt($T_{1/2} \simeq 12.5$h) respectively. Klapdor et al. predicted the half-lives of these nuclei[2].

The structure characteristics of nuclei, such as ^{208}Hg, are determined by interaction between proton holes and neutron particles. For this kind of nuclei the proton holes are distributed in 50-82 shell and neutron particles in 126-184 shell, between them separated by the 82-126 shell There are only 5 nuclides ^{208,209,210}Tl and ^{207,208}Hg. That provide us with chance to investigate the residual interaction of these nuclei, it may be special

In the framework of large-basis shell model, we have investigated the properties of these nuclides. The Hamiltonian is:

$$H = H_{\rm core} + \sum_j \epsilon_j a_j^\dagger\, a_j + \frac{1}{4}\sum_{ijkl} V_{ijkl} a_i^\dagger a_j^\dagger\, a_l a_k$$

The core is the doubly closed core ^{208}Pb. ϵ_j is the single particle (or hole) energies with respect to the core, using the experimental values here. Schematic modified surface-delta interaction (MSDI) and realistic Kuo-Hering interaction were used to obtained the two-body matrix elements V_{ijkl}. We have calculated the low-lying states and electromagnetic transitions B(E2), B(M1) and B(GT) of these following nuclei:

(1) neutron holes nuclei, such as ^{206}Pb,
(2) proton holes nuclei, such as ^{206}Hg,
(3) neutron particle nuclei, such as ^{210}Pb,
(4) neutron particle and proton holes nuclei as stated above.

The theoretical results are in agreement with experimental data. It shows that the MSDI may be used nicely to describe the properties of ^{208}Tl. The initial results show that in order to explain the long half-life of ^{208}Hg, the ground state of ^{208}Hg and high excited states of ^{208}Tl should be determined precisely[3].

References

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