Observation of superheavy hydrogen isotopes in pion absorption by ^{9}Be

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Search for superheavy hydrogen isotopes has been performed using stopped π^--absorption by ^{9}Be nuclei. The experiment was carried out at LEP channel at the LAMPF by means of a semiconductor spectrometer [1]. Charged particles produced in pion absorption were detected by two telescopes located at 180° opposite on another. States of ^{4}H, ^{5}H and ^{6}H isotopes have been observed as peaks in missing mass spectra. Energy resolution account on ~1.0 MeV. Experiment statitistics is much high in comparison with other experiments.

The formation of resonance states of ^{4}H isotope are observed in ^{9}Be(π^-,dt)X reaction. The best description missing spectrum is reached at the following parameters for the ground and excited states ^{4}H:

$E_{g.s.}$ = 2.0±0.2 MeV, $\Gamma_{g.s.}$ ~ 1.2 MeV

E_{1x} = 5 ± 1 MeV, Γ_{1x} ~ 1.3 MeV

Resonance states of ^{5}H are observed in two channels. Missing mass spectra of ^{9}Be(π^-,pt)X and ^{9}Be(π^-,dd)X reactions have been described simultaneously with one set of resonance parameters:

$E_{g.s.}$ = 5±1 MeV, $\Gamma_{g.s.}$ ~ 3 MeV

E_{1x} = 10±1 MeV, Γ_{1x} ~ 4 MeV

E_{2x} = 18.0±0.5 MeV, Γ_{2x} ~ 4 MeV

E_{3x} = 26±1 MeV, Γ_{3x} ~ 2.5 MeV

Preliminary results on formation of ^{6}H isotope have been obtained in ^{9}Be(π^-,pd)X channels. The best fit yields a triplet of states with following resonance parameters:

$E_{g.s.}$ = 9.5±1 MeV, $\Gamma_{g.s.}$ ~ 6 MeV

E_{1x} = 14.6±0.5 MeV, Γ_{1x} ~ 3 MeV

E_{2x} = 21.0±0.5 MeV, Γ_{2x} ~ 3 MeV

The important result of our measurement is the decrease of the binding energy with increase in neutron number. It contradictory to conclusion made in [2] that a neutron pairing leads to increase of binding of the superheavy hydrogen isotopes.

Up to now experimental information about high excited states close to drip line is extremely restricted. For superheavy hydrogen isotopes the revealed levels of excitation do not exceed several MeV. In such situation the excited states of ^{5}H and ^{6}H observed by us are of most interest. Obtained values of excited energies are superior to energy required for nuclei decay on 5(6) nucleons. The excitation of this free nucleon systems is rather high as for most excited state it amounts up to 18 MeV (or 3.6 MeV/nucleon). Nature and production mechanism of this state are not known us.

References

1. M.G.Gornov et al., NIM, **A446**, 461 (2000).

2. A.A.Korsheninnikov et al., Phys. Rev. Lett., **87**, 092501-1 (2001).