Progress of the Nuclotron Accelerator and the Hypernuclear Program

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Extracted beams of the new Nuclotron accelerator [1] at JINR, Dubna are coming more slowly as one could expect [2], but, on the other hand, we have obvious progress continuously which has stimulated new proposals and calculations for the hypernuclear program.

The discussed approach of hypernuclear investigations is a natural heritage of our previous experiments [4] based on an idea to produce hypernuclei via the excitation of beam nuclei. Using such a method ,the hypernuclear production cross sections and lifetimes of ${}^{3}_{\Lambda}H$ and ${}^{4}_{\Lambda}H$ were measured in the synchrophasotron ion (${}^{3}He$,${}^{4}He$,${}^{6}Li$) beams using the streamer chamber. In future experiments, the data collection rate can be increased by a factor of 200-300 at the Nuclotron due to a scheduled long duty cycle and using proportional chambers instead of the streamer chamber. Unfortunately, the planned beam parameters have not been reached up to now. For example, the beam spill duration is of the order of 0.3-0.4 s instead of the expected 12-15 s. Nevertheless, beam properties are improved run by run. Just a pessimistic forecast allows one to hope to start hypernuclear experiments in 2002.

Lifetime and production cross section measurements for the lightest hypernuclei will be performed using the trigger tuned to select the pionic decays of hypernuclei. In such an approach, the influence of systematic errors does not exceed 1 % of the result. It is quite a realistic task to measure the lifetimes of the lightest hypernuclei within 2-3% statistical errors. The same trigger will be used to investigate the Coulomb dissociation cross section of loosely bound ${}^{3}_{\Lambda}H$. The cross section is inversely proportional to the value of Λ binding energy which can be measured within a good accuracy.

Recently, L.Majling has suggested to investigate a set of hypernuclei which decay via intermediate ${}^{8}Be$ with a subsequent emission of two alpha particles. At first sight, such experiments seem too difficult to be carried out due to heavy trigger background conditions and a low resolution of proportional chambers which will be used in the first experiments. However, a more careful Monte-Carlo simulation and analysis of the tested Cerenkov counter properties allow one to design not a very large area high resolution detector and a set of Cerenkov counters which will allow the task to be solved.

References

[1] I.Issinsky et al., Proc. of the Particle Accelerator Conf. (Vancouver,1997), IEEE, Vancouver, V. 1, 181, 1997.

[2] J.Lukstins, Proc. of "Mesons and Light Nuclei '98", WS, Singapore, 1999, 198.

[3] J.Lukstins, Frascati Physics Series; Vol. XVI, PHYSICS AND DETECTORS FOR DANE, Instituto Nazionale di Fisica Nucleare, SIS-Ufficio Pubblicazioni, Frascati (Roma),1999, 719.

[4] S.Avramenko et al., Nucl.Phys. A 547 (1992) 95c.