

Source velocity in collisions of 2.1 GeV and 3.6 GeV protons with gold target

S. P. Avdeyev^{1,2*}, W. Karcz¹, Z. Igamkulov^{1,3}, G. D. Milnov^{1,2}, P. A. Rukoyatkin¹,
V. I. Stegaylov¹, A. S. Botvina⁴

¹Joint Institute for Nuclear Research, Dubna, Russia

²Dubna State University, Dubna, Russia

³Jizzax Politehnika Instituti, Jizzakh, Uzbekistan

⁴Frankfurt Institute for Advanced Studies, Frankfurt am Main, Germany

*e-mail: avdeyev@jinr.ru

The investigation of multiple emission of intermediate mass fragments (IMF) from a highly excited nuclear system give information on the possibility of the «liquid-gas» phase transition in nuclear media and hence basic knowledge of nuclear matter properties. This work studies the process of thermalization of the system at break-up in collisions of 2.1 GeV and 3.6 GeV protons with gold target. Beams of 2.1 GeV and 3.6 GeV protons were obtained from the Dubna superconducting accelerator NUCLOTRON. Intermediate-mass fragments spectra from target spectator were measured with the 4π setup FASA [1], [2], which contains thirty ΔE -E telescopes and 58 CsI(Tl) detectors covering 81% of 4π . To check whether this state of the emitting system is close to thermal equilibrium, the plot of the fragment invariant probability distribution in terms of the longitudinal-versus-transversal velocity components of IMF were studied. This analysis was performed for fragments with different charges. The source velocity decreases by a factor of three when going from lithium to carbon for a 2.1 GeV proton beam. Similar measurements performed for a 3.6 GeV proton beam showed that the source velocity is practically independent of the fragment charge. This behavior can be understood if «kinetic equilibrium» occurs prior to fragment emission for both 2.1 GeV and 3.6 GeV protons. But at the same time, «chemical equilibrium» is observed in the interaction $p(3.6 \text{ GeV}) + \text{Au}$, and is absent in the interaction $p(2.1 \text{ GeV}) + \text{Au}$.

References

1. S. P. Avdeyev [et al.], Nucl. Instrum. Methods. A **332**, 149 (1993).
2. V. V. Kirakosyan [et al.], Instrum. Exp. Tech. **51**, 159 (2008).