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Cluster formation in spectator matter in collisions of relativistic nuclei

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Nucleons which escape interactions with nucleons of the collision partner in collisions of relativistic nuclei move forward and form spectator matter. Reliable models describing the properties of spectator matter are of particular interest for modeling the response of forward calorimeters in experiments at NICA [1,2] and at the LHC [3]. In ultracentral collisions of nuclei a fireball with a large volume is formed, and residual spectator matter has a characteristic shape of a narrow crescent. In contrast to more peripheral collisions, the loss of cohesion between very few spectator nucleons can be expected and the spectator system does not reach thermal equilibrium. It can also happen in collisions of light nuclei like ^{16}O. However, traditional abrasion-ablation models consider spectator matter only as a single excited nuclear system in full equilibrium with its subsequent decays.

In order to improve the description of spectator matter we have developed an advanced algorithm of the prefragment clusterization based on the construction of a minimum spanning tree (MST). The algorithm is implemented into the AAMCC model [4,5] to calculate the yields of spectator fragments taking into account all secondary decays. The developed MST clustering is based on the Kruskal algorithm [5] and takes into account the expansion of excited spectator matter by considering the correlation [7,8] between the matter density and its excitation energy.

With AAMCC model supplemented by the MST clustering we study the properties of spectators in ultracentral ^{208}Pb—^{208}Pb collisions. In the absence of the MST clustering the number of free spectator nucleons is overestimated, while the agreement with data is restored with MST. Our approach allows us to describe better the data on fragmentation of ^{16}O in nuclear emulsions [8,9]. However, due to neglecting alpha-clustering in initial ^{16}O nuclei in the present version of the model the fractions of events with two and three alpha-particles are underestimated. AAMCC-MST model can be used to predict the production of spectator fragments in ^{16}O —^{16}O collisions at the LHC in future runs [10].

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1. M. B. Golubeva et al., Phys. Atomic Nucl. **76.1**, 1-15 (2013).
2. V. Golovatyuk et al., Nuclear Physics A. **982**, 963-966 (2019).
3. B. Abelev et al., Phys. Rev. C. **88**, 044909 (2013).
4. A.O. Svetlichnyi, I.A. Pshenichnov, Bull. Russ. Acad. Sci. Phys. **84**, 911 (2020).
5. I.A. Pshenichnov, U.A. Dmitrieva, A.O. Svetlichnyi, Bull. Russ. Acad. Sci. Phys. **84**, 1007 (2020).
6. T.H. Cormen et al., Introduction to algorithms. MIT press (2009).
7. J.N. De et al., Phys. Lett. B. **638**, 160 (2006).
8. V.E. Viola et al., Phys. Rev. Lett. **93**, 1 (2004).
9. M.S. El-Nagdy et al., J. Phys. Commun. **2**, 035010 (2018).
10. Zhang Dong-Hai, Chin. Phys. Soc. **11(12)**, 1254-05 (2002).
11. J. Brewer, A. Mazeliauskas, W. van der Schee, https://arxiv.org/abs/2103.01939

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