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Modelling 20Ne-20Ne collisions at the LHC

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The studies of 20Ne–20Ne collisions are included in the system-size scan program at the LHC [1] to explore the origin of the collectivity in the overlap region of light colliding nuclei. Nuclear matter outside the overlap remains relatively cold and forms spectator matter. Spectator nucleons and fragments propagate at small angles to the beam direction and thus can be registered by Zero Degree Calorimeters (ZDC) [2]. It is expected that the yields of spectator fragments depend on the structure of the ground state of colliding nuclei. In particular, the fragmentation of 16O has been found sensitive to the presence of the alpha-clustered states in 16O [3]. The exact density profile of 20Ne is still under discussion, but significant contributions of clustered states are reported by several authors [4,5]. Therefore, a proper modelling of ZDC signals from 20Ne–20Ne collisions at the LHC requires a reliable model to calculate the yields of spectator fragments and their momenta taking into account the clusterization in 20Ne.

In this work, 20Ne–20Ne collisions at the LHC were simulated by means of Abrasion-Ablation Monte Carlo for Colliders (AAMCC) model [6] with MST-clustering [7,8]. The nuclear density of 20Ne was parameterized either as a deformed Wood-Saxon profile or as an alpha-clustered bi-pyramid [4]. The results of AAMCC were compared first with available experimental data on Ne fragmentation at lower energies [9,10]. The contribution of clustered configurations in neon nuclei was estimated. Then, 20Ne–20Ne collisions at $\sqrt{s_{NN}}$ = 7 TeV were simulated to calculate the yields of spectator nucleons and various nuclei as spectator fragments and their transverse momentum and pseudorapidity distributions. The relation between the yields of spectator neutrons, protons and 4He was considered as a possible probe of intranuclear clustering. The obtained results can help in evaluating the performance of ZDC in future 20Ne–20Ne runs at the LHC.

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