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Study of nuclear multifragmentation induced by ultrarelativistic mu-mesons in nuclear track emulsion

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The formation of high-multiplicity nuclear stars was observed upon irradiating nuclear track emulsions with ultrarelativistic muons [1-3]. Kinematical features studied in this exposure of nuclear track emulsions for events of the muon-induced splitting of carbon nuclei to three alpha particles are indicative of the nucleardiffraction interaction mechanism. The irradiation of track emulsions with these particles makes it possible to study concurrently the multifragmentation of nuclei under the effect of a purely electromagnetic probe. Multiphoton exchanges or transitions of virtual photons to vector mesons may serve as a fragmentation mechanism. At CERN, a track-emulsion sample was exposed to 160-GeV muons. The samples under study were placed in front of the target of the COMPASS experiment at a distance of about 25 cm from the beam axis (halo), where the intensity amounted to about 10ˆ6 particles per centimeter squared per cycle. The track-emulsion samples 9 × 12 cm in area and about 100 μm in thickness were oriented both along and across the beam. A nine-hour irradiation in the case of the transverse orientation proved to be the most favorable for our analysis. Scanning led to finding, in irradiated track emulsions, about 300 stars containing not less than three target fragments. Seventy-two stars containing only triads of b particles stopped in the track emulsion were associated with the breakup process 12ˆC -> 3α. Alpha-particle ranges and spatial emission angles were determined on the basis of coordinate measurements for tracks. The alpha-particle energy was estimated on the basis of the SRIM model. Its mean value proved to be 5.3 ± 0.1 MeV (RMS = 1.3 MeV). These observations, which are of a preliminary character, indicate that a full-scale investigation of a complete muon-induced disintegration of nuclei on the basis of multilayered assemblies from thick layers of substrate-free nuclear track emulsion is highly promising. 1. The BECQUEREL Project. http://becquerel.jinr.ru 2. Slavich Company JSC. www.slavich.ru, www. newslavich.com 3. D. A. Artemenkov et al., Physics of Atomic Nuclei, 2015, Vol. 78, No. 5, pp. 579–585

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