Sensitivity of nuclear emulsions to low-energy positrons

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In this work a new study of the sensitivity of nuclear emulsions to low-energy positrons is presented. Since more than a century, nuclear emulsions are an efficient instrument for charged particles tracking in high energy physics experiments. Nowadays their contribution remains fundamental, especially in those experiments where high spatial resolution is needed. Recently, thanks to their unmatched position resolution they were successfully employed in a positron interferometry experiment, where a submicron resolution was required. Emulsions are composed of silver bromide (AgBr) mixed with a gel in a 1:1 ratio and were specially prepared without the standard protective layer. On the other hand, positrons are produced by the b^+ decays of a ^{22}Na source, moderated by a tungsten thin film at about 2 eV energy and finally guided and accelerated in a purely electrostatic variable energy beam. The beam energy range used in this work is between 0.2 keV and 17 keV. The experiment makes use of the positron beam facility of the L-NESS laboratory in Como. The work starts from the preparation of the emulsions by mixing the sensitive AgBr grains of 200 nm in diameter with a gel that allows spreading the mixture on glass substrates of 5×5 cm^2. Subsequently, the emulsions were exposed at different positron energies. After the expositions, the emulsions were developed to take a digital tridimensional grains reconstruction of the optical images. From the data analysis, it is possible to discriminate the signal from noise. The results clearly indicate that emulsions are sensitive to the positron beam, even at energies lower than 1 keV.

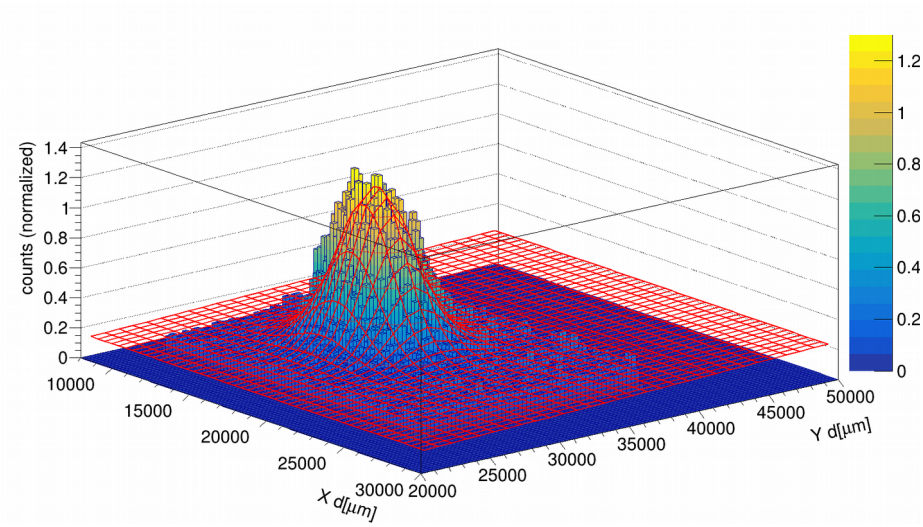

Figure 1. Example of 1 keV positrons detected with a nuclear emulsion.

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