EGU22-1363
https://doi.org/10.5194/egusphere-egu22-1363
EGU General Assembly 2022

Laboratory Simulation of the Dust Interaction with Energetic Particles and its Implication for Interstellar medium

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Dust in the interstellar space is illuminated by cosmic radiation that consists of photons of different wavelengths and energetic charged particles. Whereas the photoemission is rather well understood, charging of dust grains due to interaction of with energetic charged particles was not experimentally studied in detail so far. We report the first laboratory experiment dealing with the interaction of a cosmic dust simulant with energetic charged particles emitted from a radioisotope. Measurements of the charge of micrometer silicate dust grains with an accuracy of one elementary charge revealed several processes leading to the dust charging. The observed average rate of charging events agrees well with prediction of a model based on the continuous slowing down approximation of energetic particles inside the grain. Charge steps larger than one elementary charge were attributed to emission of secondary electrons excited by the primary particle slowing down. The determined yield of secondary electron emission is approximately inversely proportional to the grain radius. The experimental results led us to the formulation of a possible scenario of interstellar dark clouds charging.