Harvesting the decay energy of 26-Al to drive lightning discharge and chondrule formation. A. Johansen[1] and S. Okuzumi[2], [1]Lund Observatory, Lund University, anders@astro.lu.se, [2]Department of Earth and Planetary Sciences, Tokyo Institute of Technology.

Introduction: Chondrules in primitive meteorites likely formed by recrystallisation of dust aggregates that were flash-heated to nearly complete melting. Chondrules may represent the building blocks of rocky planetesimals and protoplanets in the inner regions of protoplanetary discs, but the source of ubiquitous thermal processing of their dust aggregate precursors remains elusive. Here we demonstrate that escape of positrons released in the decay of the short-lived radionuclide 26-Al leads to a large-scale charging of dense pebble structures, resulting in neutralisation by lightning discharge and flash-heating of dust and pebbles. This charging mechanism is similar to a nuclear battery where a radioactive source charges a capacitor. We show that the nuclear battery effect operates in circumplanetesimal pebble discs. The extremely high pebble densities in such discs are consistent with conditions during chondrule heating inferred from the lack of volatile gradients within chondrules. The sedimented mid-plane layer of the protoplanetary disc is also prone to charging by the emission of positrons. Heating by lightning discharge in this relatively low-density environment would result in complete sublimation of solids and recondensation of the vapour as metal grains and small silicate grains similar to the matrix present between chondrules in meteorites. Our results imply that the decay energy of 26-Al can be harvested to drive intense lightning activity in protoplanetary discs. The total energy stored in positron emission is comparable to the energy needed to melt all solids in the protoplanetary disc. The efficiency of transferring the positron energy to the electric field nevertheless depends on the relatively unknown distribution and scale-dependence of pebble density gradients in circumplanetesimal pebble discs and in the protoplanetary disc mid-plane layer.