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Direct cascade of droplet fragmentation in sparkling fireworks CHIHIRO INOUE, The University of Tokyo, EMMANUEL VILLERMAUX, Aix Marseille Universite — Sparkling fireworks are popular in Japan for 400 years. They are made by a twisted paper simply wrapping 0.1g of black powder at the lower end. Ignited there, the powder melts in a fireball of molten salts, ejecting droplets seen as light streaks. The droplets successively fragment up to eight times leading to ever-smaller size and their branched light streaks traces are similar to pine needles. The phenomenon involves chemical reactions, thermal decomposition of metastable compounds, gas bubble nucleation and bursting, the formation of liquid ligaments, and droplets. We depict the features of this unique direct fragmentation cascade in nature, where thermal diffusion inside each droplet determines its lifetime. Droplet radius getting exponentially smaller until thermal production and heat losses equilibrate. We compute and document experimentally the number of fragmentation steps, and the overall size of the light streaks as well.

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