

Processing of Interstellar Silicate Grains by Cosmic Rays

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Abstract

Observations have shown that an appreciable fraction of silicates formed in the outflows from red giants and supergiants have a crystalline structure. Yet, the fraction of crystalline silicates in the interstellar medium is very small, pointing towards an efficient crystalline-to-amorphous conversion process. Here we report experimental and modeling results that show that low energy (0.1–5 GeV) heavy ion cosmic rays can rapidly amorphize crystalline silicate grains ejected by stars into the ISM. We have also examined the effects of cosmic ray processing of silicates in the solar system and in stellar debris disks. In the latter systems, cosmic ray processing may play a role for grains trapped in resonance with planetary companions. Similar effects on the evolution of interstellar dust grains are likely to be even more important in the early universe and in forming (starburst) galaxies, which have higher cosmic ray fluxes due to much larger star formation rates and emerging active black holes.

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