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Dust charging and levitating in a sheath of plasma containing energetic particles

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When plasma surface interaction in a tokamak device, the process of plasma surface interaction will produce the atomic impurities and dust particles. The formation of dust particles can potentially cause several effects on the tokamak operation including dust chemical activity, radioactivity and tritium retention. The study of dust have been carried out widely to understand the dust particle generation and growth, motion and remobilization, dust-plasma interaction etc. As seen from some tokamaks experimental results, the production of dust rates depends on the heating scenario. Since the energetic particles can appear in the edge region during radiofrequency wave heating or neutral beam injection and the presence of energetic particles influences the sheath structure. A natural question is whether energetic particles produced by the heating scenario can influence dust charging and levitating in a sheath of plasma containing energetic particles. In order to provide some insight on the effect of heating scenario on the dust charging and dynamics of the dust in the plasma sheath, we developed a sheath model based on a set of one-dimensional fluid equations to investigate the dust charging associated with the energetic particles including secondary emission of dust. It is found that the types of energetic ion(hydrogen or deuterium) and energetic electron determine dust charging and levitating in the sheath. In additional, for the different wall materials (e.g. beryllium, tungsten), dust will levitate at different position in the sheath when energetic electron component is presented.