OR1905

Predator-prey dynamics stabilised by nonlinearity explain oscillations in dust-forming plasmas

Annie Ross, David McKenzie

The University of Sydney, Sydney, Australia

a.weeks@cantab.net

Dust-forming plasmas are ionised gases that generate particles from a precursor. In nature, dust-forming plasmas are found in flames, the interstellar medium and comet tails. In the laboratory, they are valuable in generating nanoparticles for medicine and electronics. Dust-forming plasmas exhibit bizarre and thus far puzzling behaviour in which they oscillate with timescales of seconds to minutes. Here we show how the problem of understanding these oscillations may be cast as a predator-prey problem, with electrons as prey and particles as predators. The addition of a nonlinear loss term to the classic Lotka-Volterra equations used for describing the predator-prey problem in ecology not only stabilises the oscillations in the solutions for the populations of electrons and particles in the plasma but also explains the behaviour in more detail. The model explains the relative phase difference of the two populations, the way in which the frequency of the oscillations varies with the concentration of the precursor gas, and the oscillations of the light emission, determined by the populations of both species. Our results demonstrate the value of adopting an approach to a complex physical science problem that has been found successful in ecology, where complexity is always present.

Keywords
dusty plasmas
plasma modelling