Many-body quantum clustronics

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Quantum many-body problems remain largely unsolved because quantum information grows exponentially with particle number and additionally becomes entangled by interactions. I will overview why identifying particle clusters yields a realistic first-principles description of diverse many-body and quantum-optics problems, and why it introduces the control of clusters – clustronics – as a powerful approach to theoretically predict dynamic, nonequilibrium, and macroscopic quantum effects in condensed matter systems. I will illustrate the clustronics insights through several experimentally relevant examples involving semiconductors and strongly interacting atomic Bose–Einstein condensates.

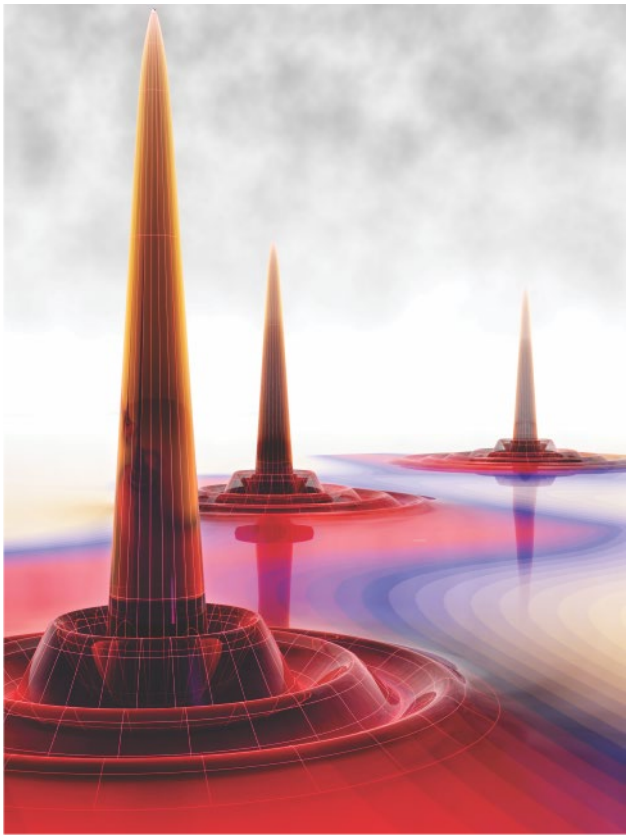

Illustration of one of the newest semiconductor quasiparticle clusters – the dropleton – in terms of how electron–hole pairs configured with respect to one another.