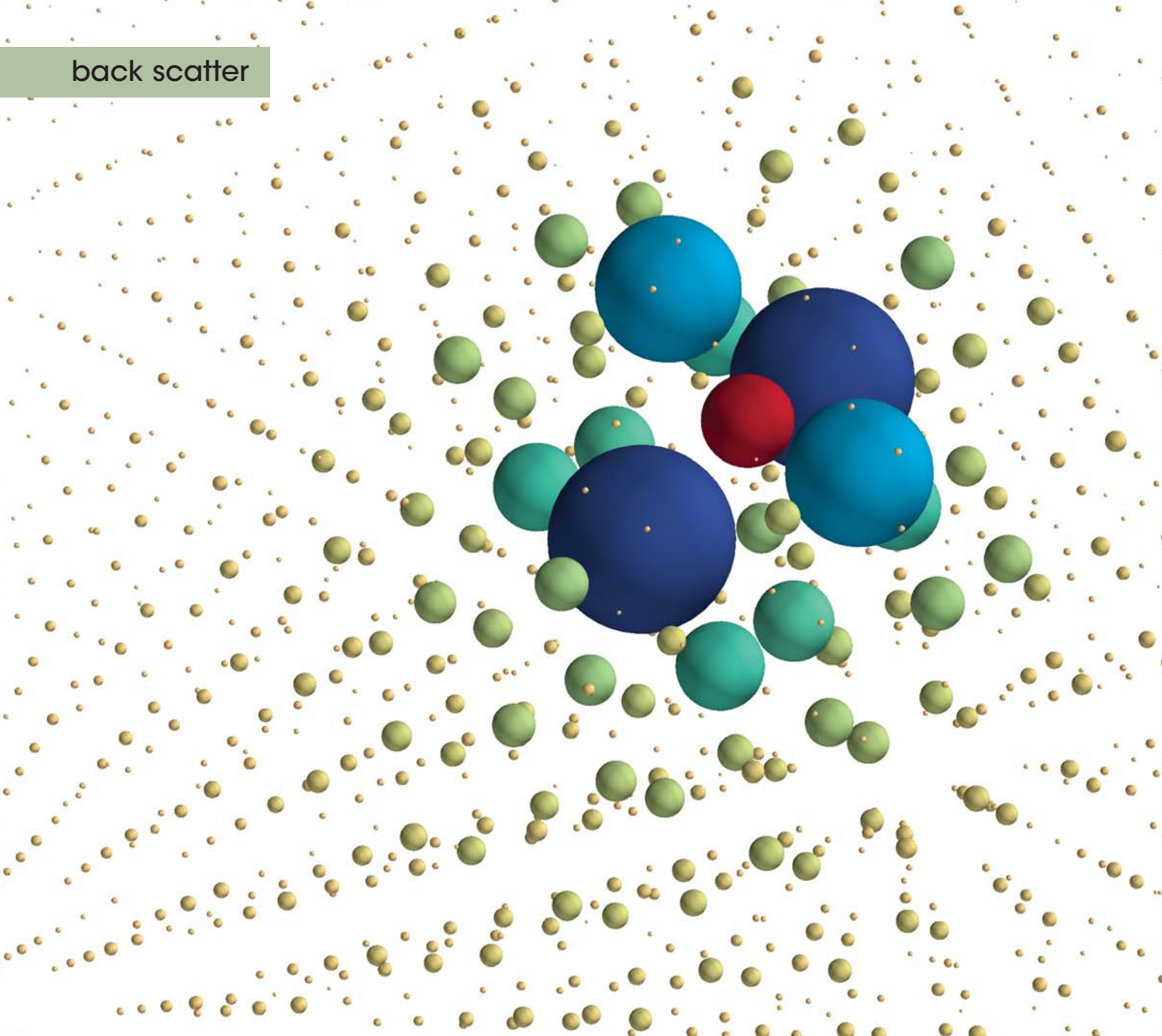




Enhanced electrolyte conduction in strong electric fields

Ohm's law is a cornerstone of electricity and magnetism, but deviations from it in solid and liquid electrolytes in moderate to high electric fields were well established experimentally nearly a century ago. In such systems, the conductance increases with field strength; the increase is particularly pronounced in weak electrolytes, which are only partially ionized. As Lars Onsager explained in 1934, a strong electric field significantly enhances the dissociation and thereby liberates additional current-carrying charges. Surprisingly, the enhancement, known as the second Wien effect, is universal in weak electrolytes, independent of initial charge density and mobility, and Onsager's theory has been applied to a wide variety of scenarios, including photocurrents in solar cells, proton transport in water ice, and magnetic monopoles in spin ice (see *PHYSICS TODAY*, March 2008, page 16).

The details of the Wien effect have now been captured in numerical simulations by Vojtěch Kaiser, Steve Bramwell, Peter Holdsworth, and Roderich Moessner. Performing their calculations on a diamond lattice, which embodies features of many technologically relevant solid electrolytes, the researchers computed the influence of temperature and electric field on macroscopic properties—the density and conductivity of free charges—and on the underlying microscopic correlations. Shown here is one such correlation: The likelihood of finding a positive charge is plotted, by color and size, at the lattice sites surrounding a negative charge (red sphere). The lattice approach, argues the team, should in the future allow the influences of the specific detailed interactions in individual real systems to be explored. (V. Kaiser et al., *Nat. Mater.*, in press. Image by the London Centre for Nanotechnology.)

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