field structures, such as those in degenerate multimode resonators, which involve both long-range interactions and short-range collisions in three dimensions, even powerful numerical solid-state methods such as the density matrix renormalization group are hardly applicable. The quantum field theoretical-path-integral-based methods presented by Gopalakrishnan *et al.* open a new route to theoretical analysis and even quantitative understanding of the underlying physical mechanisms. As an example, the authors study the formation of dislocations and domain boundaries in two-dimensional layered configurations that originate only from quantum noise in the zero-temperature limit. Ultimately, the corresponding experimental studies will, nevertheless, go beyond any theoretical predictability and allow us to simulate and study new solid-state and field-theoretical phenomena in a precisely controllable and directly observable fashion. ❐

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PARTICLE PHYSICS

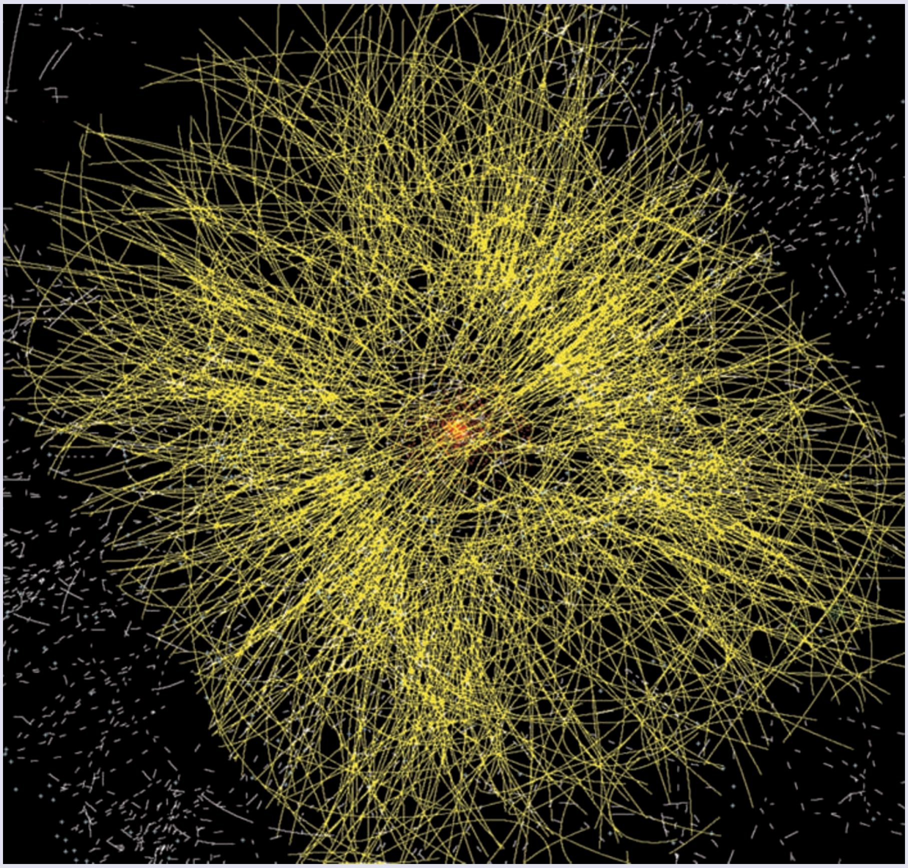
Environmental concerns

CERN's Large Hadron Collider (LHC) will fire up again this month, with its three detectors, ATLAS, CMS and LHCb, poised to begin close monitoring of the proton–proton collisions in pursuit of such novelties as supersymmetry and the Higgs boson. Also part of the programme are 'heavy ion' collisions — using the LHC to collide lead ions instead of protons, in the hope of creating quark–gluon plasma — for which a dedicated detector called ALICE has been built.

Heavy-ion physics poses particular challenges, owing to the terrific density of quarks and gluons involved in each collision. ALICE will have to cope with a multitude of tracks from the particles produced, as pictured in this simulation. For theorists, modelling the process is also tricky, but Korinna Zapp and colleagues have a proposal that may help (*Phys. Rev. Lett.* **103,** 152302; 2009).

Quarks and gluons (known collectively as partons) emerging from any type of collision may radiate a gluon. This can happen repeatedly, to create what is known as a parton shower; eventually the partons will group together (or 'hadronize') to form the composite particles that are observed in detectors. The process can be quite effectively modelled when the colliding particles are electrons or protons, but in the heavy-ion case the parton shower develops in a 'dense QCD-matter' environment, packed with other quarks and gluons that may also be radiating.

Zapp *et al.* have devised an algorithm to take account of the non-Abelian Landau–Pomeranchuk–Migdal effect — or rather, the quantum interference between spatially separated incidences of gluon radiation — which occurs in such an environment. They define a 'gluon formation time', based on the gluon energy and the transverse momentum of the gluon radiated previously. The Landau–Pomeranchuk–Migdal effect is then accounted for by requiring that, for a gluon radiated within the formation time, the momentum transfer is coherent; and for a gluon radiated later than the formation time, it is incoherent.



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The algorithm can be incorporated straightforwardly in so-called Monte Carlo simulations of heavy-ion collisions, ahead of the first heavy-ion run at the LHC, scheduled for late 2010.

ALISON WRIGHT