information on the superconductivity[7], has not been achieved with spatial resolution so far. The other implication of the study is that at the transition from the insulator to the pseudogap matter, some sort of phase separation takes place (if the pseudogap qualifies as a phase) between insulating and pseudogap regions. The interpretation of experiments averaging over a finite sample volume, such as photoemission[12], will have to account for this inhomogeneity — and the data should contain signatures from both regions.

At first sight, the results by Kohsaka *et al.* seem to give theoretical models in which the pseudogap is a precursor to superconductivity an edge over competing order scenarios. However, more experimental evidence is needed to firmly establish whether superconductivity and pseudogap are really locally correlated. So, there is still room for more discoveries before our understanding of the uncharted lands in the cuprate phase diagram is complete. ❐

Peter Wahl is at the Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, D-70569 Stuttgart, Germany and SUPA, School of Physics and Astronomy, University of St Andrews, North Haugh, St Andrews, Fife KY16 9SS, Scotland, UK.
e-mail: wahl@fkf.mpg.de

References

1. Dagotto, E. *Science* **309,** 257–262 (2005).
2. Kohsaka, Y. *et al. Nature Phys.* **8,** 534–538 (2012).
3. Norman, M., Pines, D. & Kallin, C. *Adv. Phys.* **54,** 715–733 (2005).
4. Timusk, T. & Statt, B. *Rep. Prog. Phys.* **62,** 61–122 (1999).
5. Bardeen, J., Cooper, L. N. & Schrieffer, J. R. *Phys. Rev.* **108,** 1175–1204 (1957).
6. Renner, Ch., Revaz, B., Genoud, J-Y., Kadowaki, K. & Fischer, Ø. *Phys. Rev. Lett.* **80,** 149–152 (1998).
7. Deutscher, G. *Nature* **397,** 410–412 (1999).
8. Sachdev, S. *Science* **288,** 475–480 (2000).
9. Emery, V. J. & Kivelson, S. A. *Nature* **374,** 434–437 (1995).
10. Vershinin, M. *et al. Science* **303,** 1995–1998 (2004).
11. Kohsaka, Y. *et al. Nature* **454,** 1072–1078 (2008).
12. Shen, K. M. *et al. Science* **307,** 901–904 (2005).

PARTICLE PHYSICS

X marks the spot...

In some sense, the exploration of particle physics is following a map — its outline sketched by the earliest bubble-chamber discoveries, more contours added with the cementing of the standard model, and a way ahead that might lead to the confirmation of the Higgs mechanism for electroweak symmetry breaking. But all roads don't necessarily lead to the Higgs, and physicist-explorers do well to remain circumspect. In *Physical Review Letters*, the CDF collaboration documents a more free-ranging quest into the unknown, for a particle they simply label 'X' (T. Aaltonen *et al. Phys. Rev. Lett.* **108,** 211805; 2012).

Their motivation is, however, quite specific. Both CDF and its sister collaboration D0, studying proton–antiproton collisions at Fermilab's Tevatron, have recorded a value for the forward–backward asymmetry in top-quark production — literally, a difference in how the debris from the symmetrical collisions is thrown in the forwards and backwards directions in the detector — that is significantly larger than the value predicted in the standard model. A heavy particle *X*, whose existence would enhance the forward–backward asymmetry above the standard-model prediction, has been postulated. Various models exist, but one class of model also predicts that *X* could be produced alongside a top quark in proton–antiproton collisions. CDF decided to explore the possibility.

They targeted a particular signature of *X* production: *X* and a top quark are created in the collision, and *X* decays to an anti-top quark and a light quark; the top and anti-top quarks each decay to a *W* boson plus bottom quark; one of the *W* bosons then decays to a lepton (such as an electron or muon) and a neutrino, the other to a pair of quarks. It may sound complicated, but the probabilities for these decay channels are favourable and contaminating background from other standard-model processes is manageable. In the data, the clues are easily found: an electron or muon, missing transverse momentum (carried off by a neutrino), three jets of particles from the light quarks, and two jets of particles at least one of which is recognizable as coming from the bottom quarks.

Alas, CDF has not found *X*. The collaboration has set limits on the cross-section for its production, for *X* masses all the way from 200 to 800 GeV c^{-2}. Still this maps out only a small region of the parameter space for *X*, given the Tevatron forward–backward asymmetry measurement. A similar search with data now accumulating from the Large Hadron Collider should push further into this unknown territory.

ALISON WRIGHT