Thus either pressure, P (of around 5 GPa, which is relatively modest by current standards), or doping can drive the materials across the AF–SC phase boundary.

Figure 1 gives an overview of the phase relationship of the pnictides constructed from the results of several different groups, showing where their AF, SC and paramagnetic (PM) phases arise on both x versus T and P versus T planes. That either x or P can drive these transitions suggests that some more-fundamental physical property, Z, dependent on both, is at the heart of such behaviour, which would be more generally described on a notional $Z(x,P)$ versus T phase diagram. Unfortunately, no one yet has much idea of exactly what Z corresponds to. Moreover, the behaviour depicted in each separate phase diagram is still incompletely understood. The vertical (temperature independent) phase boundary in particular is unusual for a PM to AF magnetic transition. Such a transition involves a change in symmetry and therefore cannot terminate at a critical point; consequently, it must intersect some other phase boundary or fall to zero. Some x–T phase diagrams in the literature have just assumed that this fall occurs[7], which requires a very sharp drop in the magnetic ordering temperature as the critical doping level, x_{cr}, is approached. But as yet there is no detailed mapping of this to definitively demonstrate such a calamitous collapse of the magnetic state. Other proposals simply pencil-in a narrow and mysterious vertical crossover region[8,9] (as shown in Fig. 1), denoting a first-order (discontinuous) transition. The P–T phase diagram contains the same peculiar feature. Although at lower temperature $T_c(P)$ for $BaFe_2As_2$ (ref. 5) and for $SrFe_2As_2$ (ref. 6) is easy to map out as a superconducting dome, the abrupt disappearance of magnetic order at higher temperature under pressure remains enigmatic. The connection of the magnetic transition to the structural transition remains an important question[9] in Hosono-type systems, however these transitions seem to be indistinguishable in $CaFe_2As_2$ (ref. 10) and $BaFe_2As_2$ (ref. 11).

Although Mazin and Johannes[3] do not provide any specific explanation of what it is about the ferropnictides that gives rise to antiphasons or the phenomena they mediate, the picture they propose has several important implications. One they did not mention pertains to the role of the paramagnetic state: Their picture of a magnetically disordered phase differs significantly from that of a conventional paramagnetic phase — which is characterized by a total absence of magnetic order and the presence of only weak, incoherent antiparamagnons — in that magnetic order survives at short length scales. Consequently, the paramagnetic band structure assumes less relevance to the behaviour of the pnictides. Many in the field of high-temperature superconductivity may find this disturbing, as the paramagnetic band structure contains strong nesting features (scattering processes focused at a certain momentum) that have been implicated as the mechanism causing the SDW, and a candidate to have a role in pairing. In this role, nesting has attracted much attention and stimulated many theoretical models. As in the copper oxide and heavy fermion superconductors, it seems that understanding the superconductivity in the ferropnictides will first require an understanding of their magnetic behaviour and how magnetic order within them vanishes. ❒

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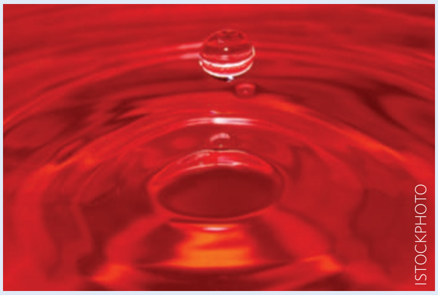
FLUID DYNAMICS

Bounce into chaos

Intuitively we expect that two volumes of the same liquid brought into contact will merge. But, let a droplet fall onto a vertically oscillating bath of the same fluid and, under the right conditions, it can be made to bounce indefinitely. The dynamics of such ‘bouncing’ droplets can be complex, displaying multiperiodicity and period-doubling transitions to chaos, as Tristan Gilet and John Bush show (*Phys. Rev. Lett.* **102,** 014501; 2009).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The study of the curious behaviour of bouncing droplets is not new — it's been around for more than a century — but only recently has the richness of its dynamics been revealed. For instance, a droplet can ‘walk’, due to the coupling between its bouncing self and the surface wave it generates on the bath; such self-propelled droplets have even shown diffraction and interference phenomena when passing through one or two slits limiting the transverse extent of their wave, prompting analogies to particle interference effects on the quantum scale.

The experiments performed by Gilet and Bush are conceptually simple: a submillimetre droplet of a glycerol–water–soap mixture is released onto a thin film of soap, which is driven by a sinusoidal force field tuned to counteract the energy dissipated on the droplet's impact on the film. From carefully compiled video images, spatiotemporal diagrams reveal a variety of more or less complex periodic bouncing states, as well as chaotic behaviour.

Taking advantage of the fact that the soap film behaves like a linear spring, with an effective spring constant depending on the surface tension, the authors have developed a force-balance equation that describes the experimental findings well. Further numerical analyses in terms of iterative maps and bifurcation diagrams show that the system in fact exhibits all the features of a classic, low-dimensional, chaotic oscillator.

DAN CSONTOS