The SN-remnant scenario implies that a galaxy's luminosity in γs should scale roughly like the rate at which it produces supernovae times its total mass of gas. And indeed that's what is seen in figure 2, which compares the γ luminosities of the two starburst galaxies with those of the more quiescent Milky Way and LMC. The starburst galaxies exceed the Milky Way's meager SN output of a few per century by an order of magnitude, and the gas in their star-forming cores is extremely dense.

Mapping the LMC

Small and staid though it may be, the LMC offers several important advantages in the search for CR origins: It's very close by, we see it almost face-on, and it harbors a localized region of vigorous star formation—called 30 Doradus—more active than any neighborhood in the Milky Way. *Fermi*'s angular resolution is not nearly good enough to localize γ emission to known starburst regions within M82 and NGC 253 from a distance of 12 Mly. But it can do just that in the LMC, a mere 150 kly away.

Figure 3 is a map of the LMC's γ luminosity produced by a *Fermi* team led by Jürgen Knödlseder of the Center for the Study of Space Radiation in Toulouse, France.[5] Contour lines indicate hydrogen gas density, symbols mark the locations of known SN remnants and other stellar evidence of active star formation, and colors indicate γ luminosity divided by local gas density. All three indicators peak at 30 Doradus, a starburst region about 400 ly across.

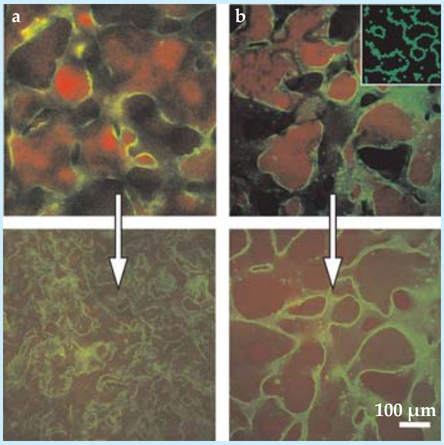
That's what's expected if the CRs are produced in SN remnants and then show themselves by colliding with gas. Strictly speaking, the LMC map—and the starburst-galaxy results—tie the CRs only to star-forming regions and not specifically to SN remnants. It could therefore be that Wolf–Rayet stars—massive young stars in prolonged windy death throes—which also abound in such regions, play a role in CR accelera-

physics update

These items, with supplementary material, first appeared at http://www.physicstoday.org.

A new look at friction. We learn in introductory physics classes that the friction force is the product of a friction coefficient and the force normal to the interface. That relationship, embodied in the first of Guillaume Amontons's two laws of friction, has been superseded over the past 50 years by the recognition that the lateral friction or retention force is, in fact, proportional to the true contact area (see PHYSICS TODAY, September 1998, page 22). Amontons's law turns out to be a special but common case in which the contact area scales linearly with the normal force. In new measurements of liquid drops on surfaces, Rafael Tadmor and colleagues at Lamar University in Beaumont, Texas, observe the opposite behavior: a lowered lateral force despite a larger normal force and an increased contact area. Key to the observations was the ability to decouple the normal and lateral forces while monitoring the drop. To achieve that separation, the researchers mounted the sample at an adjustable angle in a horizontal centrifuge arm, shown here, that could be rotated about the vertical axis at a variable speed. A comounted camera wirelessly transmitted video to a nearby computer. Comparing the situation in which the drop of liquid was on top of a horizontal substrate to that in which the drop was hanging below a horizontal substrate, the team found that the hanging drop had the larger lateral retention force, despite a smaller contact area and a smaller normal force. That counterintuitive result agrees with theories that incorporate the effects of surface deformation and molecular reorientation. (R. Tadmor et al., *Phys. Rev. Lett.*, in press.) —RJF

Arresting colloidal gel structures. The tunable elasticity and porosity of colloidal gels lead to some interesting applications, among them tissue scaffolding and drug delivery. Conventionally, colloidal particles interact and assemble under entropic and electrostatic forces to form predictable structures. But greater control can be achieved from an approach developed by Paul Clegg, Michael Cates, and their collaborators at the University of Edinburgh in the UK. The researchers disperse silica particles in the single-phase region of two partially miscible solvents—water and the organic base 2,6-lutidine. When the solution is heated above a critical temperature, the solvents separate and the particles become trapped at the liquid–liquid interfaces. The bulky particle domains then jam together and arrest the solvent separation, forming a two-phase network the researchers call a bijel. But cool the solution and remix the solvents too soon and the distinct structure disappears, as shown in the two left images in which the colloids appear green, the water black, and the lutidine red. Now the researchers have discovered an approach to stabilize the bijel structure. When the phase-separated solution is allowed to sit for at least 24 hours before it is cooled, the bijel surprisingly keeps its shape, as shown in the two right images. (Movies accompany the online version of this item.) From Monte Carlo simulations, the researchers deduce how the resulting network of colloidal monolayers, or monogel, stays intact: The particles become compressed by capillary forces, remain attracted by van der Waals forces, and are kept from collapsing into each other by repulsive electrostatic forces. (E. Sanz et al., *Phys. Rev. Lett.*, in press.) —JNAM



Musicality of speech changes with mood. Loud, fast, rhythmic music is exciting. It mirrors aspects of human behavior—we are loud and active when excited. Likewise slow, soft, static music mimics how we behave when subdued. That congruence might explain why music affects us as it does. Also, melodies in a major key generally come across as happy; minor melodies are sad. But why those tonalities have their particular emotive effects is not clear. Now, Duke University neuroscientist Dale Purves, his graduate student Daniel Bowling, and colleagues report that qualities of major- or minor-key melodies also mirror human behavior—specifically, speech—according to the mood of the speaker. One of their analyses focuses on the intervals (tone pairs) implied by melodies. Major-key melodies emphasize the major-third interval, whose two notes have a frequency ratio of about 5:4. Minor-