lava flow to predict its direction but is instead a convenient means of getting the right answer. It's based on the idea that given a terrain map of an area, calculating the path of steepest descent is easy. But that calculated path doesn't fully represent the lava's path. First, because terrain maps have finite resolution, the terrain is not exactly known. Second, a stream's depth affects its flow: A deep enough stream can surmount obstacles to send branches flowing off in multiple directions.

The DOWNFLOW model accounts for both of those complications by randomly varying each point on the terrain within a range defined by the terrain's uncertainty and the expected flow depth. The path of steepest descent is calculated for the modified terrain. That process is repeated many times—usually thousands or tens of thousands—and the flow area is taken to be the union of all the computed paths, as shown in figure 2a. When the model is applied in practice, as it has been for recent eruptions of Mount Etna in Italy, flow lengths are estimated based on the statistics of past eruptions. Says Favalli, "I am still surprised that such a simple model is able to predict so well the areas invaded by gravity-driven fluids."

To combine the models, Wright and colleagues used FLOWGO to compute the expected termination of each path computed by DOWNFLOW. Even with the extensive repetition, results can be generated more quickly than with other simulation techniques: Some 10 000 paths can be computed in just 20 minutes, whereas other methods take several hours. Furthermore, as Wright explains, "When we compared the DOWNFLOW/FLOWGO combination with other models, we found that it performed as well, and, in fact, better."

The researchers are still working on implementing their model in real time. To test it, they instead used the early 1990s eruption of Mount Etna. Figure 2b shows the results for the effusion rate measured on 2 January 1992; the actual extent of the lava flow is shown by the largest outlined area in figure 2a. For that date and several others during the same eruption, the model's results agree well with observations. Says Wright, "The model doesn't predict every twist and turn that a lava flow might take. Then again, no model can do that."

Johanna Miller

References

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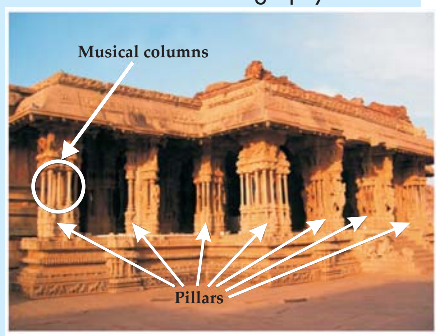
physics update

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

Simulating whistler turbulence. In plasma physics as in fluid dynamics, turbulence remains one of the most challenging fundamental problems to understand. The nonlinear processes that lead to characteristic turbulence power spectra observed in the solar wind—the plasma that flows from the Sun out through the solar system—are poorly understood. So too are the dissipation mechanisms by which plasma turbulence transfers its energy to plasma electrons and ions. Most research in plasma turbulence has assumed that dissipation is weak and the plasma may be approximated as a fluid. But interest has increased in the so-called short-wavelength regime, in which dissipation plays out. Recently, an international team performed the first kinetic, particle-in-cell simulations of decaying short-wavelength whistler-mode turbulence in a collisionless plasma, using parameters similar to those of the solar wind near Earth. (Whistlers acquired their name from World War I radio operators who frequently heard what they thought were outgoing artillery shells, brief whistling sounds that decreased in frequency.) Limited not by any approximations but only by computing resources, the researchers found steep power-law magnetic fluctuation spectra consistent with those observed in space. In addition, they found and analyzed anisotropies in the turbulence whereby stronger initial fluctuations generated more magnetic energy perpendicular to the background magnetic field than along it. Because of the anisotropies, the whistlers were found to be more compressible than expected. The physicists also demonstrated the first simulation results of whistler turbulence dissipation by showing signatures of two well-known types of wave–particle interactions. (S. Saito et al., *Phys. Plasmas*, in press.) —SGB

Musical pillars made of solid granite. The Vitthala Temple in the south Indian city of Hampi is more than 500 years old. The image here shows its most curious feature—numerous pillars, each of which includes separate columns that sound musical notes when struck with a finger. Different columns in a pillar produce sounds of different frequencies. Moreover, several multi-columned pillars make sounds similar to specific Indian musical instruments such as the ghanta (bell), mridanga (percussion), or veena (strings). Well known for centuries, the musical pillars are only now beginning to be studied scientifically. Anish Kumar of the Indira Gandhi Center for Atomic Research in Kalpakkam, India, and colleagues took the first steps to characterize the columns: The physicists applied three techniques to learn about the structure of the columns and also analyzed recordings of generated sound. In situ metallography showed the granite to have typical microstructures; both low-frequency ultrasound and impact-echo testing revealed all the columns to be solid shafts. From those studies and spectral analyses, the researchers conclude that the pillars' sounds arise from the flexural mode of vibrations. Next on their agenda is to study how the columns can be excited by just the tap of a finger. (A. Kumar et al., *J. Acoust. Soc. Amer.* **124**, 911, 2008.) —SGB



Finding the Ω_b^- baryon. The Ω^- baryon played an important role in the evolution of particle theory. Its much heralded discovery in 1964 at precisely the mass (1.67 GeV) predicted by symmetry arguments about charge and strangeness led promptly to the quark model of the strongly interacting particles. The quark model described the Ω^- as a bound state of three strange (s) quarks. The relatively straightforward "naïve" quark model has long since been incorporated into quantum chromodynamics, a much more complete theory from which, however, precise predictions are notoriously hard to extract. But QCD does predict that the Ω^- should have a heavy-quark analogue, called Ω_b^-, with a mass of about 6.0 GeV—more than six times that of the proton. In the Ω_b^-, one of the three s quarks is replaced by the much heavier bottom (b) quark. Now,