cians have been able to calculate on computers that the conjecture is true for n up to 100,000, but they do not know whether it is true in general.

The surfaces associated with the Fermat curves have two or more holes. So, according to Mordell's conjecture, they must have only a finite number of rational solutions. This, of course, does not prove that the only rational solutions are zero, but it certainly says a lot more about the solutions to the Fermat equations than ever was known before.

Other equations that, according to the Mordell conjecture, must have a finite number of rational solutions, can be more complicated. Mathematicians have a formula to decide how many holes are in the geometric surfaces associated with the equations, and the evaluation of the formula depends on how smooth the geometric surfaces are. The Fermat curves, for example, have perfectly smooth surfaces associated with them. All nonsingular equations of degree four are associated with surfaces with two holes. Nonsingular equations of degree five are associated with surfaces with five holes.

Equations that have singularities are associated with surfaces that have rough spots. To calculate the number of holes in these surfaces, mathematicians count up the number of singularity and rate each singularity according to how bad it is. Then they subtract a correction term that accounts for these singularities from the formula telling how many holes there would be if the surface were completely smooth.

In proving the Mordell conjecture, Faltings drew on a large body of work in algebraic geometry, particularly results of John Tate of Harvard University and the Russian mathematicians I. R. Shafarevich, A. N. Parsin, Y. G. Zarkin, and S. Arakelov. This work involved Abelian varieties, which are higher dimensional algebraic spaces defined over number fields. "The Russians showed that the Mordell conjecture follows from specific facts about Abelian varieties and experimented with a 'theory of heights.' Faltings saw very clearly what to do with that theory and how to do it," Mazur says.

Although Faltings did not have to develop new techniques to solve the Mordell conjecture, mathematicians nonetheless are enormously impressed that he was able to do it. "It's a sensational result. Many people spent lots of time working on that problem," says Graham. "It's a wonderful piece of work," says Mazur. "Nobody thought the tools were there to resolve the conjecture and no one thought anyone could ever solve it," says Bloch.

Now mathematicians plan to study the proof and its implications in great detail. Those who have had a chance to study the proof will be giving courses on it in the fall. Bloch, who will be teaching such a course, remarks that he will have a great deal to say. "I hope I can do it in a year. The proof doesn't look that hard but the ramifications are enormous," he says.—GINA KOLATA

Fermilab Energy Saver Hits 500 GeV

Most of the high-energy physics news has been coming from Europe lately, but the momentum may be starting to shift back across the Atlantic. On 3 July, the Fermi National Accelerator Laboratory (Fermilab), while testing its new superconducting proton synchrotron, reached a record energy of 512 billion electron volts (GeV). Although this energy is a scant 7 GeV above the previous mark held by the laboratory's original accelerator, the achievement is a major breakthrough. The new machine, temporarily dubbed the energy saver because its superconducting magnets consume less power than conventional electromagnets, conclusively demonstrates that physicists have mastered the complex technology of superconductors and thereby paves the way for the next generation of ultrahigh-energy proton synchrotrons. The energy saver itself is destined to be transformed into the Tevatron, when it reaches 1 trillion electron volts (TeV) in the near future.

Starting up a new accelerator is always a nerve-wracking business because the mathematical equations that describe the orbits of the accelerated particles are not exactly soluble. Physicists are therefore at least a little uncertain that their machine will work until it is turned on. In Fermilab's case, the new superconducting technology made the apprehension even worse. A counterbalancing source of confidence was the ability to make unusually detailed simulations of the orbits of the proton beam because the characteristics of each magnet was stored in a computer. So far, says J. Richie Orr, the head of Fermilab's accelerator division, the simulated and actual behaviors have been nearly identical. "The champagne went up for grabs when we hit 512 GeV," adds Orr.

The first round of experiments is scheduled for this fall and will run at a modest 400 GeV. Before that time, two things need to be accomplished. One is to increase the beam current. All the tests so far have been with short pulses of 3×10^{10} protons with the pulses coming at intervals of about 20 seconds. Fermilab has promised experimenters they will have from 1×10^{13} to 3×10^{13} protons per pulse. The second thing is to learn how to extract the protons from the synchrotron and guide them to the numerous experiments. Buoyed by the success of the computer simulations in predicting machine performance, Orr expects no difficulty with the extraction at 400 GeV. A bigger problem will come in extracting a 1-TeV beam. As few as 10^9 protons per square centimeter that are lost from a beam of this energy during this process and that bombard the superconducting magnets could cause them to quench (lose their superconductivity), which halts experiments.

Experiments at 1 TeV await the 1985 upgrading of the experimental areas (radiation shielding, improved detectors, and so on). A year after that, Fermilab hopes to be able to collide a 1-TeV beam of protons against a 1-TeV beam of antiprotons. The W and Z^0 that were so proudly found at the European Laboratory for Particle Physics (CERN) earlier this year with its 270×270 GeV, nonsuperconducting proton-antiproton collider would be produced in much greater numbers at the higher energy, allowing more detailed examination. Other particles, predicted and unpredicted, presumably await, as well.

The leap into superconducting accelerators, a gamble undertaken alone by American physicists, had paid off. "The machine was so speculative, it is really a good feeling to see it work the way it is supposed to," concludes Orr.

—ARTHUR L. ROBINSON