take the form of a linear accelerator, or linac, tens of kilometers long.

Muons might offer the advantages of an electron collider without the expense of a huge linac. Because of their larger mass, they lose much less energy in the form of synchrotron radiation, so they can be accelerated in relatively small circular machines. "You don't have to build full-energy linacs," says Sessler. A 1-TeV muon collider "can fit on an existing laboratory site and use some of the existing infrastructure, and that is a tremendous advantage," adds William Marciano of BNL. What's more, because of muons' mass, their collisions spark physical processes that should generate Higgs particles far more efficiently than electrons can. "We can build a Higgs factory," says Sessler.

But producing and handling muons are still largely terra incognita, says Alvin Tollestrup of the Fermi National Accelerator Laboratory near Chicago, one of the proponents of the muon-collider idea. Muons are scarce in nature because they survive for only a few microseconds before decaying into electrons and neutrinos. In current designs, the first step toward making them is to collide an intense proton beam with a liquid metal target, producing quark-antiquark pairs called pions. The pions then decay into muons. In what Tollestrup calls "the critical part of that sequence," these muons have to be "cooled"—marshaled into a beam in which they all move at the same velocity. Only then can they be accelerated to nearly the speed of light, which extends their lifetime through Einstein's time dilation.

Sessler and his colleagues are now hoping to test muon-cooling schemes, which would rely on arrays of magnets and energy-absorbing materials. "We are proposing a $30 million experiment to be put in Fermilab," says Sessler. They expect to complete the final proposal early this year and hope to win funding in the fiscal year 2000 science budget.

Still, any push for a muon collider will encounter plenty of skepticism. Alvaro de Rújula, a theoretical physicist at CERN, acknowledges that the "clean physics" of a muon collider would be attractive. But he thinks the technical problems with these machines are daunting. "There are two types of machines of the future: the hadronic machine, where the experiments are extremely difficult, and the muon machine, where the machine is difficult."

–Alexander Hellemans

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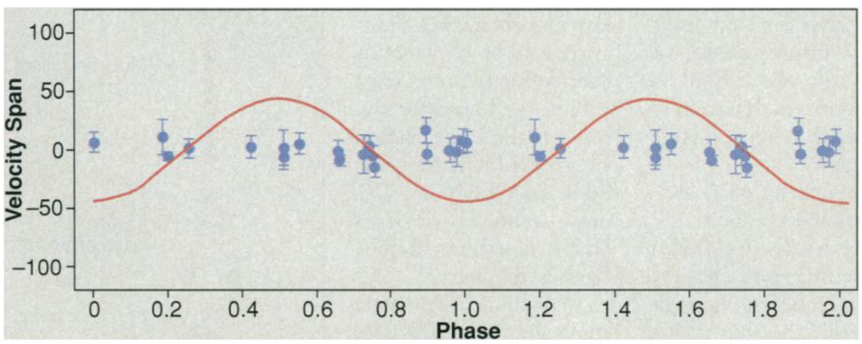
ASTRONOMY

Far-Off Planet Makes a Comeback

"It looks like we're back to an ugly old planet," says David Gray. Nearly a year ago, the University of Western Ontario astronomer had issued a serious challenge to the case for an extrasolar planet—the first to be discovered around a sunlike star. He presented evidence that slow jitters in the spectrum of the parent star, thought to result from a planet's periodic tug, were actually due to a pulsation of the star's gases (*Nature*, 27 February 1997). The ensuing debate was at times less than civil. But harmony has been restored: Gray and at least three other groups say they have been unable to reproduce his earlier results. What looked like a planet killer may have been just a chance alignment of noisy data points.

One group, led by Artie Hatzes of the University of Texas, Austin, published its results in yesterday's issue of *Nature* alongside Gray's concession. A paper by another group, led by Timothy Brown at the High Altitude Observatory in Boulder, Colorado, has been accepted at *Astrophysical Journal Letters*. And a third group, at the University of Paris, is still finishing its analysis but also sees "no indication" of pulsations of the star, 51 Pegasi, says team member Jean Schneider. "The only reasonable explanation for the velocity wobble is [still] a planet," concludes Didier Queloz, who made the discovery with Michel Mayor at the Geneva Observatory (*Science*, 20 October 1995, p. 375).

Mayor and Queloz, who is now at the Jet Propulsion Laboratory in Pasadena, California, had monitored hundreds of dark absorption spikes carved into 51 Peg's spectrum by elements in the star's atmosphere such as iron and calcium, which filter out specific frequencies of light. In light from a stationary star, the frequencies would remain fixed. But the observed frequencies shifted up and down by small amounts over a 4.23-day period. Mayor and Queloz inferred that a roughly Jupiter-size planet was whipping around 51 Peg in an orbit much closer than Mercury's around the sun, causing the entire star to wobble and shifting the spike frequencies by the Doppler or train-whistle effect.



Steady as a rock. A measure of the shape of spectral lines from 51 Peg, expected to show regular variations (red) if the star is pulsating, reveals no changes.

Then came Gray's challenge. Using a spectrograph most astronomers describe as somewhat outmoded, he monitored a single absorption spike and found that asymmetries in its shape also changed over a 4.23-day period. A simple Doppler shift couldn't cause the distortion, but Gray believed that both the shape changes and the frequency shifts could be due to a bizarre type of "nonradial" oscillation never seen in a sunlike star: a slow sloshing of the star's surface gases. Because his 39 noisy data points were scattered over 7 years, however, Gray and others now emphasize that there was roughly a one-in-300 chance that a spurious 4.23-day signal might show up by chance.

That appears to be what happened. "I have to conclude that nature played a dirty trick on him," says Brown. In the most conclusive of the new measurements, Hatzes and co-workers made about 120 measurements of several absorption lines at more than twice Gray's spectral resolution and saw no changes in the line shapes. Neither did Gray when he made further observations with his original apparatus. His earlier results, he says, were either a fluke or a transient phenomenon that has since stopped.

But as the technical disagreement fades, the dispute has thrown light on the underside of a high-stakes field where new claims are followed like sports scores by the wider public. Astronomers grumbled privately about the attacks on Gray's work that appeared on an elaborate Web site—complete with links to corporate sponsors—maintained by the planet searcher Geoff Marcy of San Francisco State University. Gray responded in kind on his own Web site, calling some objections "arguments of ignorance." Tempers have since cooled, but Hatzes says: "I didn't like to see that. It should have been a more civilized debate."

–James Glanz