Whether either dissipation mechanism occurs is hard to say, but the CoMP data contain a clue. As figure 2 shows, Tomczyk and McIntosh could identify whether waves travel out from the photosphere (prograde) or back down toward it (retrograde). The retrograde signal is one-third to one-half as strong as the prograde signal. Dissipation that occurred before the waves made their return trip could account for the deficit.

Nanoflares remain the leading candidate for heating the corona, even though no one has definitively observed them. They are thought to originate in the myriad thin flux tubes that together make up the thick coronal loops in figure 1. Stirring the photosphere's velocity field causes the roots of the loops and tubes alike to jostle violently and randomly, twisting the magnetic field lines. Eventually, when the twist becomes too great, the loops and tubes snap into a new configuration of lower curvature and energy.

At its most extreme, such reconnection hurls vast amounts of plasma back onto the Sun or out into space, knocking out satellites and power grids. When thin tubes reconnect, the result is a nanoflare, which impulsively heats the local plasma. Instabilities can also yield nanoflares. A constant, ubiquitous barrage of reconnection or instabilities could in principle heat the corona.

Unfortunately, evidence for nanoflares is even harder to obtain than it was for Alfvén waves. Not only are the events small in scale, they are also fleeting. At the temperatures and densities that prevail in the corona, thermal conduction is extremely efficient. When an individual nanoflare pops off, the local plasma temperature shoots up to 1 MK, then drops rapidly. Meanwhile, the density, and with it the observable intensity, also drops as the plasma sinks rapidly. Trying to see an individual nanoflare is like trying to hear an individual cicada.

The best prospect for observing nanoflares lies in the x-ray band, where the hot corona emits most of its photons. Space-based instruments can deploy filters as fine as CoMP's and can observe with the spatial and temporal resolution needed. The challenge used to be squeezing copious data into limited telemetry. Now, it's a matter of getting the right instrument into space.

If the nanoflare hypothesis is vindicated, Alfvén waves will remain important. Observing them provides crucial information about the strength and evolution of the coronal magnetic field. And regardless of what heating mechanisms they favor, solar physicists all want to observe the Sun with higher spectral, temporal, and spatial resolution.

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References

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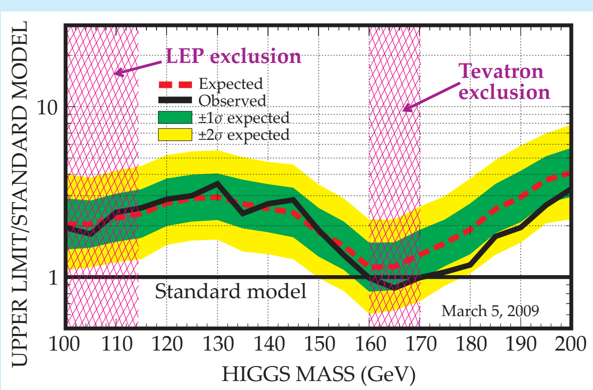
physics update

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

Constraining the Higgs mass. In the standard model of particle physics, the predicted and much-sought Higgs boson (H) remains the principal missing link. The theory attributes the nonzero masses of the quarks, leptons, and weak vector bosons to their interaction with the H's quantum field. Searches at CERN's Large Electron–Positron collider have put a lower limit of 114 GeV (about 120 proton masses) on the H mass, and theoretical analysis of a variety of well-measured particle-physics parameters suggests an upper mass limit of about 185 GeV. Now a significant bite has been taken out of the interval 114–185 GeV by a new analysis of Higgs-search data accumulated in nine years of running at Fermilab's 2-TeV Tevatron proton–antiproton collider. The analysis, a combined undertaking of the large CDF and D0 detector collaborations at the collider, concluded with a confidence limit of 95% that the H mass does not lie between 160 and 170 GeV—presuming that its production and decay properties are those predicted by the standard model (see the figure). The combined data set comes from 10^{15} proton–antiproton collisions, but the teams had to limit their searches to events that produced a W or Z weak vector boson. Only a few percent of H-producing collisions are expected also to produce a W or Z. But the decays of those very heavy particles are spectacular enough to provide a discernable signal under the haystack of routine events that would otherwise hopelessly obscure the tiny fraction of events that create an H. The two collaborations expect to accumulate a lot more data before CERN's new 14-TeV Large Hadron Collider joins the Higgs search early next year. (CDF and D0 collaborations, http://arxiv.org/abs/0903.4001v1.) —BMS



An asteroid's composition has been determined by sky and ground observations. How an asteroid reflects sunlight as a function of wavelength reveals something about the asteroid's make-up. Based on reflectance spectra, astronomers have developed a classification scheme for asteroids and noted that those of a given type tend to be formed in the same region of the asteroid belt. The composition of meteorites, most of which come from asteroids, can be determined in detail. Until recently, however, no meteorite could be unambiguously associated with a specific asteroid or even a spectral class. But now scientists have obtained reflectance and composition data for the same asteroid—2008 TC_3, which blew up over Sudan's Nubian Desert shortly before dawn on 7 October 2008. Its story was told recently by an international team led by the SETI Institute's Peter Jenniskens. The asteroid, also called Almahata Sitta, had been sighted 20 hours before it disintegrated—early enough for scientists to take reflectance measurements. And some of Almahata Sitta survived the explosion high above Earth and rained down to the surface. Students