Something New Under (the surface of) the Sun

"There is nothing new under the sun," said Koheleth, an ancient Hebrew monologuist (Ecclesiastes 1:9). Lately, however, there are a lot of new things inside the sun. The most recent is a claim made this week to the discovery of the gravity or g-mode vibrations of the sun by Claus Fröhlich of the Physikalisch-Meteorologisches Observatorium (known in English as the World Radiation Center) in Davos, Switzerland. If the claim is accepted, it would mark the discovery of a mode of vibration that the sun should have and that observers have sought for a long time. Solar vibrations have been observed since 1960, but up to now all the confirmed ones belonged to the pressure waves or p-modes.

Physically the sun ought to have both the p-modes, in which the restoring force that makes things go back and forth comes from the elasticity of the material, and the g-modes, in which gravity supplies the restoring force. Fröhlich and a number of others had been looking for the most fundamental g-mode predicted by the "standard model" of the physical conditions inside the sun, which should have a period about 35 to 36 minutes, and not finding it. Then, in the May 15 NATURE, Fröhlich read of the WIMP model, which proposes that weakly interacting massive particles (WIMPs), whose more detailed characteristics are yet unknown, inhabit the center of the sun and strongly affect energy transport there (SN: 5/24/86, p. 325). The WIMP model predicts that the most fundamental g-mode should be about 29 minutes.

Fröhlich went back to the data and looked for that. He found 29.85 minutes.

The data concern motions of the sun's surface that are composites of all the modes that may be ringing at any time. Computer programs analyze them looking for resonances that pertain to the individual components of the sum. To find a particular period the observer's program has to be tuned more or less specifically for it.

Fröhlich made his claim July 7 during the International Astronomical Union Symposium on Advances in Helio- and Asteroseismology held in Aarhus, Denmark. John Faulkner of the University of California at Santa Cruz, the principal author of the WIMP model, who spoke to SCIENCE NEWS from the meeting in Aarhus, says the claim got a mixed reception. In spite of some sharp criticism, however, it stimulated a great deal of interest on the part of other research groups, who intend to go back and recheck the data to see if they can confirm it. Fröhlich's discovery shows the predictive power of the WIMP model, Faulkner says, and so should strengthen its claim to accuracy. It doesn't yet prove the existence of WIMPs, however. Something else could be performing the function ascribed to them.

The WIMP model was developed to reconcile the sun's neutrino production with its previously known vibrations. For about a decade and a half now, measurements by Raymond Davis of Brookhaven National Laboratory in Upton, N.Y., have been showing that the sun emits only about a third as many neutrinos as the standard model would have it emit. A number of proposed alterations of the standard model can account for the lower neutrino flux, but according to Faulkner, they all modify the center of the sun in the wrong way to be compatible with the sun's pressure wave or p-mode vibrations — except the WIMP model.

The problem for the theoretical models is that lowering the neutrino emission means postulating a lower temperature in the center of the sun. Lowering the temperature generally also lowers the gas pressure. However, to hold up the sun's outer layers and provide proper physical conditions for the observed p-mode vibrations, the pressure should be maintained. The WIMP model, says Faulkner, is the only one that can lower the temperature while maintaining the gas pressure. It does so by bringing in extra hydrogen, which raises the density and so maintains the pressure in spite of the lower temperature. The central density of the sun in the WIMP model comes out to 196 grams per cubic centimeter instead of the 166 grams per cubic centimeter in the standard model. This change in density changes the predicted period of the sun's most fundamental (shortest) g-mode vibration from the 35 or 36 minutes predicted by the standard model to about 29 minutes.

So far nobody but Fröhlich seems to have reported looking for the 29-minute vibrations. However, during the discussion of Fröhlich's presentation, a group from Tenerife in the Canary Islands mentioned looking for periods around 30 or 31 minutes. While doing that they saw noise in the data that could be a kind of slopover from a 29-minute period.

— D. E. Thomsen

New quasar most distant object yet

A quasar dubbed 1208+1011 is the most distant object yet discovered in the universe, according to a report in the July 3 NATURE. Discovered and investigated by a team of astronomers from the United States and the United Kingdom, the quasar — a galaxy with an especially bright, compact center — lies at a distance about 90 percent of the way to the edge of the observable universe.

The astronomers measured the quasar's relative distance by examining how the light it emits changes as it travels to earth. "In a sense, light expands as the universe expands," says astronomer Wallace Sargent of Palomar Observatory in Pasadena, Calif. As the quasar travels away from earth, the wavelengths of light it emits grow longer, shifting toward the infrared region of the spectrum. This phenomenon, called redshift, indicates the speed at which the quasar travels away from us. By knowing how fast the quasar travels, scientists can estimate its distance.

The numeric value of the redshift indicates how far toward the infrared the quasar's spectrum has shifted as its light travels to earth; the higher the redshift, the more distant the object. The new quasar's redshift value of 3.8 is the highest ever found; four other quasars discovered concurrently in the same region of the sky all have redshifts greater than 3.5.

"High redshift quasars are all very bright," Sargent says. According to Sargent, quasars' brightness gives rise to the possibility that quasars may have formed when matter fell into black holes — very small regions of enormous gravitational pull. As the black hole sucked up the matter — probably galactic gas and dust left over from the formation of the galaxy — the black hole's gravity excited the matter into emitting light. Such a possibility may indicate that black holes in the early universe were all very large, and that distant quasars such as the recent discoveries are all very young. At the other end of the time scale, according to astronomer Alexei Filippenko of the University of California at Berkeley, perhaps 10 percent of nearby galaxies may be the dim remains of old quasars whose black holes are slowly starving.

Such galaxies, says Filippenko, emit light characteristic of quasars, but at levels too faint for easy detection.

Says Filippenko, "We think we can find even more distant quasars. It seems unlikely that we've had the good fortune to find the only one with a redshift as high as 3.8."

— T. Kleist