it cannot change shape in a continuous way. It builds up stress until the crust suddenly cracks, causing a glitch.

But the two observed glitches in the Vela pulsar made such an explanation much less likely because it should take many centuries of slowing down to build up strains comparable to those that were supposed to be relieved in the much larger Vela glitch.

Building on the hypothesis of a solid core, though, Pines, Shaham and Ruderman now postulate that instead of a crustquake, one is observing a so-called "corequake" in Vela. As Pines explained at Boulder, they assume that Vela is slightly heavier, so that it has a higher central density, at least higher than 1.5×10^{15} gm/cc, the value that might mark the onset of a solid core. On the other hand the Crab would have a slightly lighter core; so it does not solidify. Because a neutron core crystal is enormously stiffer and stronger than the crust matter, all the phenomena are modified. When the core cracks, the effect is a hundred times bigger than a surface quake.

Pion interior. Another possibility for a neutron-star interior was proposed by Raymond Sawyer[4] and by Douglas Scalapino[5] (University of California, Santa Barbara). Speaking at the Boulder meeting, Sawyer suggested that instead of picturing the interior as a Fermi gas primarily composed of neutrons (with some protons and electrons), when the densities grow larger than nuclear densities it is possible that the interior consists of a condensed phase of negative pions neutralized by an equal number of protons, and that the system also contains some number of neutrons. He originally had suggested that this transition would occur at a density of about 1 baryon/cubic fermi. Scalapino, on the other hand, found that at a critical baryon density, which could be as low as 0.25 baryons/cubic fermi, a negative pion condensate will start forming. As the density increases beyond the critical value, the density of negative pions and protons increases continuously from zero towards a limit in which two-thirds of the baryons are protons. In further work in which realistic nuclear forces, pion-nucleon interactions, and pion-pion interactions are taken into account, Sawyer and Scalapino predict a critical density of between 0.5 baryons/cubic fermi and 1 baryon/cubic fermi. Sawyer believes that it is much too early to determine the effect of a pion condensation on slowing-down times and starquakes. However he believes that there will be significant reductions of the star's radius at a given mass and of the maximum neutron-star mass due to a softening of the equation of state in the high-density region. GBL

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Ultraviolet and x-ray observatory in orbit

Copernicus, the most recent of NASA's Orbiting Astronomical Observatories, has been placed in orbit and is operating successfully. The ultraviolet and x-ray telescopes it carries are both reported to be in good order, and the pointing system that aims them for observation is operating at better than expected accuracy.

First observations with the ultraviolet telescope were made on Zeta-Ophiuchi, a 2.6-magnitude star in our own galaxy about 500 light years away. The x-ray telescope was first trained on the known x-ray source Scorpio X-1 for calibration and then it was turned to Cygnus X-3. This latter source was determined by ground-based observations to have flared up recently.

The ultraviolet telescope is the main experiment on Copernicus and it is contained in the Princeton Experiment Package. The primary mirror is 82 cm in diameter and the telescope itself is three meters long. The telescope focuses the ultraviolet light of a selected star onto an ultraviolet spectrometer and the spectral data is then relayed to earth.

From the data sent back by the telescope, the experimenters hope to be able to study the abundances and temperature distributions of the interstellar gases. This will be done by an analysis of the ultraviolet absorption spectra of the gases. The structure of the stellar atmospheres of young hot stars will be examined by the data contained in their uv emission spectra. The researchers plan to make measurements of the relative amounts of various elements in the young stars and in the gases that they are thought to evolve from.

The Princeton telescope also contains the sensors for the stabilization and control systems that align the craft in space so that the telescopes will point toward the objects to be studied, and keeps them locked on during observation with very high accuracy. The control system was designed to be accurate to within 0.1 arc second, but NASA's spokesman told PHYSICS TODAY that the actual accuracy at which the spacecraft has been performing is about 0.3 arc seconds. The drift rate, or the ability of the craft to maintain position when not conducting observations, was said to be "the best of any spacecraft we have ever sent up."

The other experimental package aboard Copernicus was provided by University College London, under the sponsorship of the United Kingdom Research Council. This package is mounted in an upper bay of the main body of Copernicus and consists of three small telescopes and a collimated proportional counter to study x rays in space at various wavelengths up to 70 Å. This experiment is intended to pinpoint more accurately many of the recently discovered x-ray sources and to investigate their structure and nature.

—SMH

Helium-three

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pressurization data. The liquid, however, did show marked changes in magnetic behavior at the transitions: As the pressure increased from point A to point B (the "liquid A" region) the liquid signal shifted toward higher frequencies, with the magnitude remaining about constant, and, finally, at B the liquid signal shifted back to its original position and its magnitude dropped to about half the initial value.

With the field gradient removed, resonance spectra were obtained at various resonant frequencies. Sweeping the radiofrequency now gave frequency profiles rather than position profiles and confirmed the existence of a shift in the resonant frequency of the liquid. As the pressure was increased above P_A a satellite peak split off the main absorption line and moved toward higher frequencies; the split is 1230 Hz at a reduced pressure [$p = (P_{obs} - P_A)/(P_B' - P_A)$] of 0.426 and is 3420 Hz at p equal to 1.638 (the supercooled region). At P_B the satellite disappears, but it reappears if the pressure is again dropped below $p = 1$.

According to the Cornell group, their results are strongly suggestive of a shift in the Larmor frequency of the liquid, a shift that is uniquely determined by the liquid pressure, temperature and applied magnetic field. They note that:

- the amount of shift is a unique function of cell pressure and is independent of the solid fraction present.
- the magnitude of the shifted peak decreases only slightly as the solid fraction increases.
- the shape of the shifted line closely resembles that of the initial liquid line, even when the line shape is complex, and does not distort even when the ratio of splitting to linewidth is as high as fifteen to one.
- the nuclear relaxation time of the