The age of the Vela pulsar, measured as time elapsed since its production by a supernova, was estimated as 1.1×10^4 years by Paul E. Reichley, George S. Downs and George A. Morris Jr (Jet Propulsion Laboratory) from the rate at which the pulse period is lengthening (*Astrophys. J.* **159,** L 35, 197); this age is short compared to the time required for the ions of the Gum nebula to recombine.

A wide variety of observations led to the Goddard–Kitt Peak model; Crawford, working at Cerro Tololo, made photoelectric measurements of a group of B stars that appears to surround γ^2 Velorum. From these data one gets a distance to the star group of 460 parsec with the Sun lying outside. Previous distance estimates had ranged from 200 to 460 parsec, with the Sun possibly included within the nebula. Information on the electron content of the nebula came from Gum's Balmer-α surface-brightness observations and from radio observations of the frequency dependence of pulse arrival times. (It appears that PSR 0833-45 is near the center of the nebula and that three other pulsars lie beyond the nebula.) The amount of neutral hydrogen in the line of sight was taken from Stecher's rocket measurements of Lyman-α absorption in the uv spectra of γ^2 Velorum and ζ Puppis. Brandt and his collaborators believe that most of this neutral hydrogen lies in the roughly 60 parsec that separate the earth and the edge of the nebula.

Are we likely to see any more fossil Stromgren spheres? The Crab nebula may have one, but it is 1700 parsec away and has a higher galactic latitude; so there is less neutral hydrogen available for ionization. There is some evidence for a similar 100-parsec "hole" in the neutral hydrogen around the remnant of Tycho's supernova of 1572 AD. —GBL

Lifetime of heliumlike metastable ions measured

To an atomic physicist the 2^3S state of helium represents the classic metastable state. Lying nearly 20 eV above the 1^1S ground state, it can not emit radiation and drop to the ground state without violating the selection rules that an S state can not decay to an S state and terms of different multiplicities do not combine (that is, triplet states do not decay to singlet states). Usually, helium excited into this metastable state stays there until a collision with another atom or with a wall allows it to drop down; if neither an atom nor a wall obliges soon enough, the state will eventually decay by some "forbidden transition" that violates the selection rules. (Such a situation probably arises for helium atoms in planetary nebulae.) All this is true also for other members of the helium isoelectronic sequence—atoms or ions with but two electrons.

Now the transition has been observed, both in the laboratory and in the solar corona, and theoreticians have calculated the lifetime of the state.

The laboratory observations[1] were by Robert Schmieder and Richard Marrus, of Lawrence Radiation Laboratory at Berkeley. Noting that the calculations of Charles Schwartz (Berkeley) showed that the lifetime of any two-electron atom in the 2^3S state varies as the tenth power of the nuclear charge Z, they used, not helium, but argon ($Z = 18$) that had lost 16 electrons. The resulting argon ion, with two electrons left, resembles a helium atom but with $Z = 18$. Schmieder and Marrus accelerated Ar^{14+} ions (that is, argon nuclei with four electrons) down the Berkeley heavy-ion linear accelerator (HILAC) and into a beryllium-foil target. Some of the argon ions emerging from the target had lost two more electrons, becoming Ar^{16+} and joining the helium-like isoelectronic sequence, and in addition some of these ions had been excited into the 2^3S metastable state. Further along the flight path of the ions was a detector sensitive to the 3.1-keV photons emitted during the "forbidden transition" to the ground state. The lithium-doped silicon x-ray detector gave a clear peak at 3.1 keV, with a signal 50–100 times background. The distance from foil to detector could be varied, from about 75 cm to about 200 cm, to give a decay curve and hence a lifetime measurement. The result, 172 ± 30 nanosec, is independent of the choice of foil material and other variables such as beam current.

Solar observations. In 1969, Alan Gabriel and C. Jordan (Harwell)[2] identified transitions in the spectrum of the solar corona as being these forbidden transitions in the helium-like sequence C V to Si XIII. (This is spectroscopists' notation, in which C I means the spectrum of neutral carbon, C II is the spectrum of singly ionized carbon, and so on. Thus C V is the spectrum of carbon minus four electrons, and Si XIII is that of silicon minus twelve electrons. In each case, two electrons, the "helium electrons," remain.)

Gabriel and Jordan proposed that the metastable state decays primarily by magnetic-dipole emission. Previously the transition has been thought to occur (in astrophysical situations) by a two-photon electric-dipole process—the single-photon electric-dipole decay is the one that is forbidden for this state in ordinary spectroscopy. Two-photon decay has recently been observed for another helium metastable state, 2^1S_0,[3] and for hydrogenlike argon in the $2^2S_{1/2}$ state.[4]

New calculations by G.W.F. Drake (University of Windsor, Ontario)[5] show that for the 2^3S state in heliumlike atoms the magnetic-dipole transition is indeed the one that determines the lifetime. He takes the transition-integral expansion for magnetic-dipole decay to terms of higher order in the fine structure constant than has previously been done and finds a lifetime for the neutral helium 2^3S state of 7870 sec—exceedingly long by the usual time scale for atomic radiation. The corresponding lifetime for Ar XVII metastables is 212.7 nanosec. Schwartz has made a similar calculation, but with different wave functions, and obtains a lifetime for Ar XVII of 208 nanosec. These results are close enough to Schmieder and Marrus's 172 ± 30 nanosec to be interesting but far enough away to encourage continued effort all round. —JTS

References

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One-dimensional antiferromagnets

Solid-state physicists have been talking about one-dimensional systems for many years. Recently neutron-scattering experiments have been performed on two different materials, which exhibit one-dimensional behavior. Tetramethyl ammonium manganese chloride, $(CD_3)_4\ NMnCl_3$, appears to act like a nearly ideal one-dimensional antiferromagnet, down to at least 1.8 K, according to M. T. Hutchings and Gen Shirane (Brookhaven), Robert J. Birgeneau (Bell Labs) and S. L. Holt (University of Wyoming).[1] Shirane, John Skalyo Jr (Brookhaven), S. A. Friedberg and H. Kobayashi (Carnegie-Mellon University) had earlier found[2,3] another substance, cesium manganese chloride dihydrate, $CsMnCl_3{\cdot}2H_2O$, that also had some one-dimensional character, although not quite as striking.

Finding such a simple magnetic system should help theorists to better understand the role of dimensionality in the behavior of magnetic materials.

In the tetramethyl ammonium manganese chloride the manganese chloride chains are kept apart by the $(CD_3)_4N^+$ organic radicals, so that the chains essentially never see each other magnetically. The experimenters scattered neutrons from the sample, studying the Fourier transform of the