experiment could be wrong only if a series of unlucky coincidences had occurred. He commented that the evidence could be strengthened by studies with an O^{16} beam. Ghiorso himself was very confident of his group's results; he felt that production of element 106 was proved better than any other element in history. —BGL

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Silicon-monoxide maser

continued from page 17

tern from 18-cm OH masers. With the aid of Frank Lovas and Donald Johnson of the National Bureau of Standards, they tentatively identified the complex spectrum as the Doppler velocity shifting of the rotational $J = 2 \rightarrow 1$ transition of the first vibrational state ($v = 1$) of the SiO.

Subsequently, several sets of observations confirmed this analysis. The first was made by John Davis, Guy Blair and Howard Van Till of the University of Texas and Patrick Thaddeus of the Goddard Institute for Space Studies, who used the 16-foot antenna of the Millimeter Wave Observatory at the University of Texas. They detected a line in Orion near 129.3 GHz that could be the $J = 3 \rightarrow 2$, $v = 1$ transition in SiO.[2] Next, Thaddeus, John Mather (Goddard Institute for Space Studies), Davis and Blair used the same telescope to find lines at 43.1 GHz that would correspond to the $v = 1$, $J = 1 \rightarrow 0$ transition. These lines were sighted in both Orion and in the M-type star W Hya.[3]

In a survey of maser emission from the $v = 1$, $J = 2 \rightarrow 1$ transition of SiO, Kaifu, Buhl and Snyder of NRAO found that the only sources outside Orion were a number of late M-type variable stars, many of which have both OH and H_2O emission.[4] Buhl, Snyder, Lovas and Johnson have since observed the $v = 2$, $J = 1 \rightarrow 0$ transition and have failed to find the $J = 1 \rightarrow 0$ transition of either the third vibrational state or the ground state[5] (see figure). The missing lines place constraints on any models of pumping mechanisms.

Buhl and Snyder point out that the pumping of the observed maser lines requires excitation temperatures as high as 3520 K (for the second vibrational state). Red giants possess the required energy but interstellar clouds do not, in agreement with the observations. The problem is to explain how this tremendous amount of energy is transferred to the SiO molecules. Possible mechanisms have been proposed by theorists such as Charles Townes and Thomas R. Geballe of the University of California at Berkeley,[6] John Kwan (Institute for Advanced Studies) and Nicholas Scoville (Cal Tech)[7] and Mather and Marvin Litvak (Harvard) who described their model at the American Astronomical Society meeting at the University of Rochester in August. However, most agree that it is too early to comment on these models.

Thaddeus felt that the models of the SiO maser may prove to be more tractable than those of either the OH or H_2O masers; SiO has neither the chemical interactions of the OH molecule (because of its closed shell) nor the complicated rotational structure of the H_2O molecule. Townes further commented that we know the location of the SiO molecules better than we do that of OH or H_2O.

Applications. The new maser emissions may teach us something about the infrared stars from which they come. Buhl explained that the velocity spectra contain information about processes in the circumstellar envelope; the large Doppler shifts observed in all maser radiation indicate the very turbulent motion that occurs both as matter rushes outward in the death of a star and as it rushes inward in the formation of a star. Thaddeus pointed out that because the SiO maser is a point source it can reveal something about the small regions of space, especially when combined with optical observations of the same star. Further, each of the several observed transitions in SiO is an independent channel of information.

The maser lines may have some very important practical applications as well. Because they are point sources, the SiO masers can be used to test the millimeter-wave interferometers now being developed. Townes said that, in turn, these interferometers may better resolve the location of the maser sources and may possibly indicate how large the infrared stars are. Because the maser lines from the first vibrational state are so strong, Snyder feels they can be used to detect new infrared stars. Finally, the SiO masers can serve as point sources for the calibration of millimeter-wave telescopes, and Buhl and Snyder have already devised such a calibration technique for the NRAO dish.

Many astrophysicists are very excited at this first maser in the millimeter region and look forward to perhaps more maser discoveries at still shorter wavelengths. —BGL

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Bevalac makes a successful debut

On 1 August, physicists at the Lawrence Berkeley Laboratory successfully accelerated carbon-12 ions in the Bevalac. This new heavy-ion accelerator is a hybrid of existing accelerators; the SuperHILAC serves as the injector and the Bevatron provides the final acceleration (see PHYSICS TODAY, June, page 20). On the initial run, the carbon ions achieved an energy of 2.1 GeV per nucleon. Before the Bevalac, the most powerful heavy-ion accelerator was one in Canberra, Australia, with an energy of 20 MeV/nucleon.

Now in routine operation for nuclear physics and biomedical research, the Bevalac has accelerated neon as well as carbon, with intensities of 5×10^8 and 4×10^9 particles/pulse respectively, and, most recently, argon (2 GeV/nucleon). The Berkeley group will have to improve the vacuum system before still heavier ions can be accelerated.

Construction of the Bevalac began some eighteen months ago under the direction of Hermann Grunder. Albert Ghiorso, also of LBL, originally conceived the idea of pairing the two accelerators. Future plans include a time-sharing system, to be completed next spring, that will enable the SuperHILAC to be time-shared between the Bevalac and its own experimental program.

Stellarator moves from Culham to Wisconsin

The small stellarator, Proto-Cleo, which has been in use at Culham Laboratory (UK) for five years, has been moved to the University of Wisconsin, Madison. J. L. Shohet heads the NSF-sponsored move. Believed the largest fusion experiment to be transported, Proto-Cleo is the first complete fusion-experiment system to cross the Atlantic. Initial operation of the system in its new home is expected later this year.

With the coming of Proto-Cleo, the US will once again have a stellarator facility in operation. The large stellarator, Model C, was modified into the ST Tokamak at Princeton in 1969. □