Natural Mars laser: A beacon for SETI?

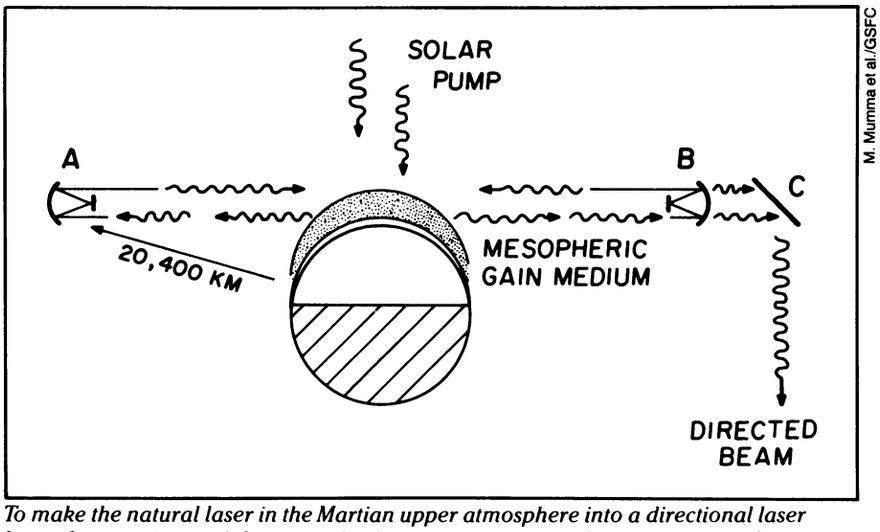
Three years ago, a group of scientists concluded from high-resolution spectral measurements that a laser is at work in the skies of Mars. It is not a product of otherwise undetected Martians, nor a device on some secret spacecraft sent from earth. Instead, they reported (SN: 10/25/80, p. 260), it is a natural effect, operating full-time on the planet's dayside and generated because molecules of carbon dioxide in the Martian atmosphere are stimulated into enhanced emissions by photons of light from the sun.

But even if intelligent, living Martians have nothing to do with it, two of the original researchers have now suggested that the natural laser might be adaptable into a powerful super-beacon, for use in communications attempts as part of SETI, the search for extraterrestrial intelligences that may exist among the distant stars.

The natural CO_2 laser was detected by the brightness of its emissions at 9.4 and 10.4 microns, using superheterodyne infrared spectroscopy. "The laser amplification which occurs in these lines is not large by the standards of laboratory technology," according to Drake Deming and Michael J. Mumma of the National Aeronautics and Space Administration's Goddard Space Flight Center in Greenbelt, Md. "However," they write in the September ICARUS, "the volume of gas present [at the altitude where excited CO_2 molecules dominate, making the lasing possible] is vast in comparison to laboratory samples, and the total solar pumping energy deposited in the region is certainly large in comparison to the power output of laboratory lasers."

But the natural laser's output is diffuse, its energy spread over the atmosphere's entire sunlit hemisphere. To concentrate a usable portion of it, Deming and Mumma envision placing two huge mirrors in synchronous orbit above the planet, facing each other so that the path between them penetrates the atmosphere at the proper altitude (about 70 kilometers), perpendicular to the incoming solar photons. The mirrors would thus define a laser "cavity," with the stimulated CO_2 emissions picking up a bit more energy each time they reflect from one mirror to the other.

Mumma, together with James Bogan of Jet Propulsion Laboratory in Pasadena, Calif., has been working on what such an actual system might imply. Subtracting losses in efficiency due to diffraction, scattering and other factors, the researchers estimate that a system using mirrors 50 km in diameter would have a net circulating gain of about 2 percent. Its power output, they calculate, would be between about 200 and 2,000 watts—seemingly not very much. But to an observer watching from the vicinity of another star, the system's intensity, concentrated into the narrow CO_2 lasing wavelengths, would be about 700 times brighter than that of the sun at the same wavelengths, making any modulations of the laser beam extremely conspicuous at interstellar distances. (To an observer technologically capable of spatially resolving an area as small as the disk of Mars, Mumma adds, the beam could appear 100 million billion times brighter than a corresponding area of the sun.)



M. Mumma et al./GSFC

To make the natural laser in the Martian upper atmosphere into a directional laser beam for extraterrestrial communications attempts, researchers suggest, two huge mirrors (A and B) would be placed in fixed orbital positions above the planet, forming a resonant cavity through the atmospheric level at which the lasing is most intense. A third mirror (C) would direct the resulting energy at distant targets.

Mirrors up to 10 km across could make possible an even more powerful laser beacon, the researchers note. (Larger ones than that would be a waste of money, since the diameter of the resulting laser cavity would be greater than the estimated thickness of the lasing region in the Martian atmosphere.) A 10-km system, calculates Mumma, could produce from 8 million to 80 million watts. An observer with a 10-meter telescope could spot a one-second burst from the resulting super-beam from a distance of 18,000 parsecs, roughly the far side of the Milky Way.

The Martian super-laser, by the way, Mumma says, would never make it as a weapon or death-ray. Even the version with 10-km mirrors, directed at earth, though it would cover a spot about 14 km across, would have an energy density of no more than about 0.4 watts per square meter — barely enough to warm your hand.

The natural laser, however, keeps going regardless. Theoretical calculations by Deming, Mumma and colleagues (reported in the same ICARUS) confirm the effect. In fact, they add, there appears to be a similar, though less efficient natural laser in the skies of Venus. —*J. Eberhart*

The Russians are not coming—to Beams '83

Beams '83, the Fifth International Conference on High Power Particle Beams, which met in San Francisco this week, was one of the first, if not *the* first international scientific meeting to convene in the United States since the destruction of the Korean airliner over Sakhalin. The expected Soviet delegation, seven persons, did not arrive. On Sept. 9, conference chairman Richard J. Briggs of the Lawrence Livermore National Laboratory in Livermore, Calif., received a very short telegram from the leader of the Soviet delegation, Leonid I. Rudakov of the Kurchatov Institute in Moscow: "USSR delegation cannot attend this conference. Hope possibility to discuss our problems in the future. Rudakov."

The Soviet Union has an extensive program in high power particle beams, a field that has applications to such things as thermonuclear fusion, free electron lasers, material science and possibly the kind of weaponry referred to in President Reagan's so-called star wars speech.

No reason for the cancellation was given. American sources said that visas had been issued to all the invited Soviets and that they had not been revoked. Speculation suggested travel difficulties due to the Canadian ban on landings by Aeroflot, the Soviet airline, in Montreal. Since Aeroflot landings in the United States were suspended in 1981, Montreal had been the only Soviet entry point in North America. This cancellation contrasts strongly to last month's 12th International Conference on High Energy Accelerators, which was held at the Fermi National Accelerator Laboratory in Batavia, Ill. Several Soviet scientists presented papers there. —*D.E. Thomsen*