ASTRONOMY

Dietrick E. Thomsen reports from San Diego at the meeting of the Astronomical Society of the Pacific

A fuzzy question about quasars

"Who the hell is Rula Lenska?" So reads a tee shirt that was in the shops a few years ago. Today the shirt has returned with "Rula Lenska" crossed out and "Pia Zadora" written above it. Quasar fuzz could be treated the same way. Quasar fuzz is supposed to be famous, but the reason why is not immediately apparent. What the hell is quasar fuzz? Twice.

Quasar fuzz is a faint luminosity that surrounds certain quasars. Observers have been able to determine the spectrum of some of this fuzz and find that it resembles starlight. The simplest conclusion, then, is that the fuzz is a galaxy. Is the galaxy associated with the quasar that appears inside the fuzz or is it somewhere between us and the quasar? Astrophysicists who favor theories that make quasars the centers of galaxies would like to find out that the fuzz is associated with the quasar. Those who believe that quasars are images formed by the focusing of light from some distant object as it passes through the gravitational field of a dense galaxy, the so-called gravitational lens effect, would like to find that the fuzz is an intervening galaxy, that is, the lens. Astrophysicists who do not necessarily believe in gravitational lenses, but who favor theories in which quasars are not at all related to galaxies, would also like to believe that the fuzz is intervening.

J. Anthony Tyson of Bell Laboratories reported on the case of the fuzz around quasar 3C273, in which gravitational lensing has been suggested. He used color images made with the high sensitivity of charge-coupled-device light receivers to identify and study the surface colors of 3C273's fuzz. Comparison of these surface colors with those of images of standard galaxies of different classes leads to the conclusion that the fuzz is a cluster elliptical galaxy located at the distance of the quasar. Thus there is no evidence for lensing, he says. However, the quasar is not in the center of the brightness contours of the galaxy. It is about 10 kiloparsecs off the center. So what *is* happening in 3C273?

Mystery of metals in the galactic disk

The disk of our galaxy, like the disks of many others, contains clouds of gaseous matter. This is the reservoir of matter out of which new stars form. It is also a sink for material given off by existing stars during their lifetimes. In a galaxy as old as ours, the disk matter will thus be a mixture of primordial and processed material.

The challenge for theorists is to derive a "mass function," a mathematical history of the evolution of the disk, out of which the disk's composition at any time might be derived. According to Bruce Twarog of the University of Texas, theorists use certain particularly abundant elements, oxygen, iron, carbon and hydrogen, as markers for the history of the disk. Stars with large masses produce much oxygen; stars of low mass yield a lot of carbon and iron. Hydrogen is primordial. The theorist figures the ratios of oxygen to iron, oxygen to hydrogen, iron to hydrogen and carbon to hydrogen characteristic of the nuclear processes in stars and tries to fit them together in such a way as to come up with the present composition of the disk.

The bottom line, says Twarog, is that under the ordinary assumption that all stars contribute their share, you can't make a mass function that yields the proper abundances of these elements. If you take out a lot of the highest and lowest mass stars and say they don't contribute, you can do it, he says. But why should certain stars not contribute? That is a problem in stellar nucleosynthesis, the theory of the processes and rates by which different kinds of stars process nuclei of light elements into heavier ones. The answer, says Twarog is: "We don't really know."

Another mystery is the composition of disk matter in other galaxies, which is different from ours. Why is it?

SPACE SCIENCES

Mars: Still an uncertain magnet

Despite all the spacecraft sent to Mars, scientists remain unsure about whether the planet has a magnetic field. Some of the probes have lacked the necessary instrumentation; others did not get close enough. Soviet researchers have reported positive signs, but their analyses have been disputed.

A typically tantalizing hint was provided by the U.S. Viking 1 landing craft as it began its descent to the Martian surface on July 20, 1976. An instrument called a retarding potential analyzer, measuring the ionosphere on the way down, showed what principal investigator William B. Hanson of the University of Texas at Dallas described as a transition boundary in the concentration of electrons about 2,000 kilometers above the surface. This, he suggested, could represent the shock wave, or "bow shock," formed by the solar wind's interaction with Mars, an interaction whose position could be critical in determining whether the planet indeed has a magnetic field (SN: 10/2/76, p. 212).

From that early look, however, it was impossible to rule out the chance that the solar wind was instead being held off merely by the pressure of the charged-particle plasma beneath the observed "boundary." It would take, Hanson guessed, several weeks to be sure.

Now, six years later, after considerably more study of the ionospheric data, Hanson and UT colleagues Bruce L. Cragin and Supriya Sanatani have broached the subject again, as part of a report in the June 1 JOURNAL OF GEOPHYSICAL RESEARCH. The result? Still inconclusive.

"I'm reasonably confident now that Mars does in fact have a small magnetic moment," Hanson says, adding that "under certain conditions" it even appears substantial enough to hold off the solar wind. The problem is that this conclusion depends on the validity of a comparison between Mars and Venus — a comparison for which the evidence is incomplete.

At Venus, the researchers say, the pressure of the ionospheric plasma — a combination of ions and electrons — appears sufficient by itself to hold off the solar wind, leaving open the possibility that the planet has no intrinsic magnetic field at all. In that plasma, says Hanson, data from the Pioneer Venus spacecraft indicate that the electrons are about twice as "hot" as the ions. For the less-dense Martian plasma to be as effective a "buffer" for the solar wind, however, he notes, the electrons would need to be about 10 times as hot as the ions. And the Viking measurements, made in a low-voltage mode where even tiny instrumental variations can cause significant misreadings of the electron temperatures, are simply too uncertain for such a conclusion.

Without such actual data, Hanson says, what's missing is knowledge of whether a 2:1 ratio of electron to ion temperatures in the Venus plasma necessarily implies the same thing for Mars. But if that's so — if the electrons in the Martian plasma are not for some reason several times hotter than those around Venus — then the Martian plasma is too weak to keep the solar wind as far from the planet as the transition boundary detected by Viking's sensor. And if it is not the plasma forming the barrier, the likeliest alternative is a magnetic field.

This still does not mean that it is necessarily part of Mars itself, born of a present or former dynamo in the planet's interior; instead, it could be merely an external field caused by a current induced in the ionosphere by the solar wind. But Venus only occasionally shows signs of an induced field, and Mars, with a less extensive atmosphere, offers even fewer chances for collisions with the charged solar-wind particles. Thus, the UT researchers note, it seems unlikely that enough current flows across the Martian ionopause (at the top of the ionosphere) to keep an induced magnetic field going.

The question remains open.