NASA science plan: Sharing vs. shootout

Over the years, the efforts of NASA's various divisions to pursue their diverse activities — ranging from astronomical observatory satellites to interplanetary probes and now a space station — sometimes have been, if not combative, at least competitive. Now the agency's Office of Space Science and Applications (OSSA) is undertaking a new approach, presenting a "strategic plan" that in a sense embodies a radical departure: cooperation.

Even before the Challenger explosion 28 months ago, the preparation of the annual NASA budget was an occasion for each proposed project's advocates to try to get their objective inaugurated as a "new start," symbolized by the appearance of its own "line item" in the budget documents. "Think about how this used to go," says OSSA head Leonard A. Fisk. "I mean, there was the annual 'spring shootout' of new starts — not a very positive effort — winners, losers — people might be unsupportive of the other programs. So what we've tried to do here is say, 'Here, there is a queue. There is an order to these things.' "

Fisk's plan, contained in a new report, proposes no new missions. Instead, it is more of a method, offering OSSA's specific list of space science priorities that also happens to call for a "new start" of some sort, whether large or small, every year.

Some planetary scientists, for example, have been pushing for a mission called the Comet Rendezvous Asteroid Flyby (CRAF), as well as another known as Cassini, to orbit Saturn and send a probe down through the atmosphere of its moon Titan. NASA now hopes to build CRAF and Cassini using two variants of the same kind of spacecraft, a planned multipurpose vehicle called Mariner Mark II. Competing for "new start" status with the two projects, however, is another major project, an earth-orbiting observatory called the Advanced X-Ray Astrophysics Facility (AXAF).

CRAF/Cassini and AXAF top the priority lists in two separate divisions of NASA's space science office — Planetary Exploration and Astrophysics — and they are just two of the numerous projects in the plan, all of which already have won endorsement by various NASA advisory bodies and other organizations. The project teams could fight it out and hope for shares in the agency's budget (which is also straining to accommodate development of a permanent U.S. space station). But the message of the new plan, says Fisk, is "balance and order and a decision-making process" rather than the less coordinated process of past years.

Is anybody paying attention to one more document about what NASA ought to do in space science? "Well, that's the hope," says Fisk, who has presented the plan to a host of advisory panels, scientific meetings and the like, in hopes of both paving the way and gauging the reception for a "united front" rather than a wrangle.

A Congressional Budget Office study noted recently that the costs of some of NASA's increasingly interdependent activities, such as the space station, may force increasingly difficult choices in planning for the future, which could add to the need for laying out a course. Yet there are already signs the coordinated approach may be finding acceptance among scientists, Fisk said in an interview. One example, he notes, is that "the planetary community is very supportive of AXAF. Now, I'm sure they think it's good science, but I'm also sure they think that it needs to fly — it needs to be a new start, in order that CRAF/Cassini can be the *next* new start. If AXAF is unsuccessful in '89, it will be back in '90, and that will get in the way of CRAF/Cassini. I'm sure they're pragmatic enough to understand that.

"I think there's been a crying need for such a plan. It's my perception that the community has said, 'Well, I may not be happy that I'm at the bottom of the queue — either I'm second or I'm third, and I'd rather be first. Nonetheless, I like the fact that there is planning so much that I will accept my position, just knowing that there *is* a position.' "

The OSSA plan does not set priorities for the whole of NASA, however. Besides the controversial (and costly) space station, an inhabited lunar base and human exploration of Mars could have major effects on the amount of money available for science. In producing the report, says Fisk, "I wanted to set out, as clearly as I could, what the base science program of the agency ought to be. And I would argue vehemently that if the agency decided, for good reasons, to go to Mars to do a Mars Rover/Sample Return mission, it shouldn't come at the expense of that [OSSA] program. It should come in addition to that program.

"Let me put it even more specifically in the case of planetary: The United States 'owns' — if you want to use that word — the outer solar system. We're the only people who've ever [sent spacecraft there], and this is a key scientific study that ought to be done. It's just as interesting to go to Saturn, or to study comets in the outer solar system, or to go to Jupiter, as it is to go to Mars, if we want to understand the solar system. I think it would be an unfortunate decision if we decided that we were going to focus all our resources on the Mars Rover/Sample Return and cut out the Mariner Mark II program in the outer solar system. That would be an unwise scientific decision, in my judgment." — *J. Eberhart*

Fish antifreeze with an electrical twist

To survive temperatures at which their body fluids normally would freeze, fish living in the icy waters of polar seas produce special proteins that act as an antifreeze. These proteins inhibit the formation of large ice crystals, which would otherwise damage biological tissue and cause death. Researchers now have worked out the three-dimensional structure of one of these antifreeze proteins. Its coiled arrangement, they say, suggests one way in which such proteins may bind ice nuclei to keep them from growing.

Daniel S.C. Yang of the University of Pittsburgh and his colleagues worked with an antifreeze protein — rich in the amino acid alanine — isolated from the winter flounder. Their crystallographic studies reveal that the protein, only 5 nanometers long, looks like a tiny corkscrew. Such a molecular structure is known as an alpha-helix.

"This is the first report of a polypeptide of this size that is a single alpha-helix," the researchers write in the May 19 NATURE. Other, comparable protein molecules have a more complicated structure that often includes less orderly amino-acid arrangements.

Previous research established that an alpha-helix protein is an electric dipole. In other words, the molecule acts as if one end has a negative charge and the other end a positive charge. When a protein is electrostatically attracted to an ice crystal, all its molecules tend to line up in one particular direction with respect to the crystal.

At the same time, side-chain molecular groups along the protein's helical strand can swivel to facilitate bonding with atoms on ice surfaces. "The flexibility of the side chains means that many patterns of hydrogen bonding can exist," the researchers say.

The possibility of an electrical interaction between a protein molecule and an ice crystal seems to explain why antifreeze proteins bind to certain faces of an ice crystal. Earlier theories, while suggesting that such an alignment happens, had failed to specify why it occurs in a certain orientation (SN: 11/22/86, p.330).

Fish and other organisms resistant to cold temperatures carry a mixture of different antifreeze proteins. Whether a similar binding mechanism applies to all antifreeze proteins remains unknown. Researchers must devise experiments both to test the proposed binding mechanism and to establish the three-dimensional structures of more antifreeze proteins. — *I. Peterson*