measurement about the structure of neutrons, protons and related particles and about the nature of the quarks, the elemental objects that are supposed to build up those structures.

Magnetism is useful to the student of subatomic physics because it is a long-range effect by which macroscopic equipment can manipulate the behavior of subatomic structures, and because the magnetic properties of subatomic objects are connected to important characteristics of their structure. For example, spin. An object that has both electric charge and spin will be a kind of little magnet and will display a magnetic moment, a tendency to influence and be influenced by external magnetic fields.

A measurement of the magnetic moment can tell whether an object has internal structure, because a structured object tends to have more magnetic moment (an "anomalous part" as it's called) than it would have if it were unstructured or pointlike. A structured object is not elemental; a pointlike object may be.

Measurements of the magnetic moment of the neutron and the proton give evidence that these are structured objects. Theory has elaborated a structure for them based on the so-called quarks. The quarks are derived from a mathematical principle called unitary symmetry that builds orderly groupings of particles and explains their properties and behavior by making various combinations of a few generating elements. These generating elements have come to be called quarks.

Here at last we reach the neutral lambda hyperon and its significance. The lambda is a member of a group that includes the neutron and proton, the group called the baryon octet. Although quark theorists now talk of six varieties of quark, in the early days of the theory there were only three, and the baryon octet under consideration here needs only those three, called up, down and strange. The neutron and proton may be made with up and down quarks only, but the other members of the octet require the strange quark. The lambda has the useful property that inside it the spins, and therefore the magnetic moments, of the up and down quarks cancel each other. So, if you can measure the magnetic moment of the lambda accurately, you have measured the magnetic moment of the strange quark.

To do this the experimenters went to the Fermi National Accelerator Laboratory, one of the two places in the world where they could get beams of protons with 300 billion electron-volts' energy. The lambda particles produced when these very high energy protons strike a target tend to have their spins, and thus their magnetic moments, polarized and last long enough (before their eventual radioactive decay) to permit precise recording of the precession of their magnetic moments as they move through a magnetic field. From this precession the size of the moment can be calculated. The number comes out -0.6318 ± 0.0047 of a nuclear magneton.

Taking that number and assumptions from the theory, the experimenters calculate moments for the other two quarks in question here: 1.8875 for the up and -0.9438 for the down. They can then predict the moments of other baryons in the octet. Assuming that quarks are elemental and therefore pointlike particles, the results can be used to calculate their masses. The up and the down have the same mass, 0.331 billion electron-volts; the strange is 0.510 billion electron-volts. These values, the experimenters say, compare well with those derived by comparing the ratios and differences of the masses of particles made out of quarks, and so go to strengthen the feeling that quarks are pointlike, elemental particles. □

Carter space policy: The NASA view

Even before President Jimmy Carter's new U.S. civil space policy was announced about a month ago, some administration officials were likening its weight to that of President John F. Kennedy's declared national commitment of a manned lunar landing. The Carter policy was greeted with less-than-unanimous approval, however, and was accused in various pro-space quarters of being weak, overly conservative and short on specific commitments, either programmatic or financial.

Since — and perhaps because of — that initial reception, key officials of the National Aeronautics and Space Administration have expressed views on the matter. Whether from true conviction or administration solidarity (agency heads are presidential appointees), the official NASA view is a relatively optimistic one, or at least supportive.

According to NASA administrator Robert A. Frosch, the new policy, together with remarks made by the President shortly before and after its release, constitutes "a positive source of policy direction" for the space agency, "and indeed for all those with an interest in the future of our country's efforts in space."

Costs are a key thread in the Carter policy, weaving their way through most of its eight general areas of emphasis. These are: space applications (resources studies, weather monitoring, etc., with increased involvement of the private sector); science and exploration (with "short-term flexibility to impose fiscal constraints when conditions warrant"); use of the space shuttle "to reduce the cost of operating in space"; improved technology transfer, "thereby increasing the return on the $100 billion investment in space to the benefit of the American people"; assured American leadership in space; relevance to developing countries; cooperative (and thus cost-shared) international programs; and continued work on space as a legal regime.

These objectives were detailed in a White House "fact sheet" issued on the same day (Oct. 11) as the new policy. "To meet the objectives specified above," says the statement, "an adequate Federal budget commitment will be made." In fact, says Frosch, "Federal budget commitments will be not simply adequate, as has been reported, but adequate to [the objectives] specified in the statement." The fact sheet, however, leaves room for the redefinition of "adequate" in light of future developments. The sentence immediately preceding the budget reference says: "As the resources and manpower requirements for shuttle development phase down, we will have the flexibility to give greater attention to new space applications and exploration, continue programs at present levels or contract them."

In Frosch's view, however, the outlined emphases "are all straightforward directives and provide the basis for an exciting and productive space program in the years ahead."

The particular area of space exploration by interplanetary probes was addressed recently by A. Thomas Young, director of the planetary division in NASA's Office of Space Sciences (and who was named last week to become deputy director of the NASA Ames Research Center on Feb. 1). Speaking to the annual meeting of the American Astronomical Society's Division for Planetary Sciences in Pasadena, he outlined NASA's current planetary planning priorities. There is "not much in the bank for the future," he said — the only mission now being funded other than those already in space is Galileo, an orbiter and atmosphere probe of Jupiter.

The Carter space policy, however, Young said, is "positive," although "it is clearly not a blank check." Next on the NASA priorities list is a Venus orbiter equipped with an imaging radar system to map the planet's entire cloud-covered surface at high resolution. After that are a comet mission (possibly a flyby of comet Halley that would then rendezvous with comet Tempel II), a Mars sample-retrieval mission (or an advanced orbiter for global geochemical studies), a Saturn orbiter and atmosphere probe, and a possible asteroid rendezvous. "I think we will get approval for [these] programs ... ," Young said, "though maybe not as rapidly as we might want." An exception may be the costly Mars-sampling flight, which Young feels may well not take place "if the world forever stays as it is today." (Also troubled are studies of the Apollo lunar samples, whose fiscal 1979 funding was cut by more than 80 percent from the previous year with instructions to NASA and the National Science Foundation to reevaluate the program.) "Gloom is contagious," Young warned the DPS audience, "but success is contagious too." □