PHYSICAL SCIENCES

Dietrick E. Thomsen reports from Berkeley, Calif., at the International Conference on Nuclear Physics

Nuclear vibrations

The discovery of nuclear matter at about the turn of the century inaugurated the science of nuclear physics. In those days the nucleus appeared as a small hard center in the puffy and almost empty structure of the atom. As the nucleus has been examined more closely, it has been seen to behave at times as a single blob of matter, at times as a complex collection of neutrons and protons acting in interrelation with each other and at times as a collection of variously articulated bound groups of protons and neutrons interacting with each other in the whole.

Practical nuclear matter often indicates two or three of these aspects at once, and the study of nuclear matter is to see where each picture applies and where they overlap and from this to determine the characteristics of nuclear matter and how it affects the world around it.

One important question about the properties of nuclear matter is how compressible it may be. Answers to such questions have input into basic questions of the hardness of neutrons and protons and of the nature of the forces between them and, therefore, of the energy that may be stored in the nucleus.

These questions are studied by examining the resonant vibrations of the nucleus, vibrations excited by hitting it with an energetic particle, from a gamma ray to a medium-energy proton. The resonances go by their mathematical names according to the complexity of the shaking, the number of axes along which the nucleus pulses, monopole, quadrupole, octapole — there is even now a little evidence for a hexadecapole resonance.

To quote F. Bertrand of Oak Ridge National Laboratory, "If one knows the excitation energies of the 'great monopole resonance,' one can determine the compressibility of nuclear matter." Physicists are beginning to learn some of the details of how the monopole is excited in different elements—for example, that the excitation energy for the monopole and various heavy elements is the same.

Pieces of information like this are being put together to try to achieve the total picture. "Theoreticians understand how nuclei ought to vibrate," says G. Bertsch of Michigan State University. Experiments tell where the edges are. "We discuss what should happen next." Recently the physicists have been getting "stuff we've been wanting many years." Still the available data do not allow the choice of an unequivocal single mechanism, for example, for the M 1 resonance state.

Angular momentum

Nuclear matter also spins. The rotation of nuclei can be regarded as the spinning of "a classical rigid rotor," in the words of F.S. Stephens of the Lawrence Berkeley Laboratory, an undifferentiated ball, so to speak. But nuclei are composed of neutrons and protons that move in orbits and if these orbits or combinations of them are not properly aligned with the axis of rotation in the whole nucleus, they contribute effects that should result in gradual distortion of the spherical shape of the nucleus. B. R. Mottelson of the Niels Bohr Institute in Copenhagen remarked that in the last six months the gradual build-up of such oblate distortions has been seen at the Canadian Atomic Energy Research Laboratory at Chalk River, Ontario.

Theorists thus feel they are on the right track in using these ideas to elucidate the structure and behavior of fast spinning nuclei, "an enormously expanded domain of nuclear structure studies," Mottelson says. Expansion comes about largely through widespread use of the technique of colliding accelerated heavy ions with one another to form compound nuclei that cling together, spinning very fast, and then fall apart in what is called quasi-fission. Deformed nuclei also play a role in ordinary fission.

ENVIRONMENT

Engineering a toxic appetite

Microbes that dine on toxic chemicals may one day be employed to commercially digest hazardous wastes that today can only be disposed of safely through burial or incineration. It is with this in mind that George Pierce, John Rice and colleagues at Battelle Columbus Laboratories are studying the predilection of certain strains of *Pseudomonas* to eat such delicacies as the defoliant 2,4-D.

Rice explains that their work began when Pierce's interest in the microbial breakdown of "recalcitrant compounds" drove him to sample bacteria residing in soils where pesticides had been used. The 80 or so different isolates of *Pseudomonas* and *Pseudomonas*-like bacteria he collected yielded several species that consume 2,4-D as their source of carbon. The Battelle team now uses *Pseudomonas* as a model to understand how bacteria break down and metabolize toxic chemicals.

So far they have identified plasmids — circular pieces of DNA separated from the bacterial chromosomes — as the site for genes encoding the traits necessary to devour 2,4-D. Using genetic engineering techniques, the team is now removing those trait-specific genes and implanting them in *Pseudomonas* species that would otherwise shun a 2,4-D diet.

Describing research results so far as "encouraging," Rice says the Battelle researchers plan eventually to attempt gene insertion into bacteria other than *Pseudomonas* to map the range of life that might be programed by gene exchange to devour unwanted chemical wastes. Among such chemicals they are looking at are PCB's (polychlorinated biphenyls) and kepone.

Alaska lands: Will the House give in?

The Alaska lands bill that deadlocked in debate last year has finally passed the Senate in a 78 to 14 vote. It proposes setting aside an area larger than the State of California with 43 million acres going for national parks, another 43 million for wildlife refuges, and 18 million acres for national forests and additions to the National Wild and Scenic Rivers System.

Earlier, a more protective version of the bill passed the House by a 360 to 65 vote. But rather than permit differences in the bills to be ironed out in a joint House-Senate conference committee, the Senate has sent the House an ultimatum: Pass our version or forget passage altogether. Probably the key difference between the two bills is that the Senate would prohibit development of minerals and natural resources (oil, forests) pending further study while the House nixes even the commercial exploration and mapping of mineral and other natural resources.

How safe are pesticides?

Major improvements are needed, according to the General Accounting Office, if the Environmental Protection Agency is to ensure that hazardous pesticides are evaluated — and if necessary, banned. The same goes for ensuring that tolerance levels (pesticide-residue levels allowed to remain on food) are safe, it adds.

EPA began a reassessment of the 35,000 already registered commercial pesticide products two years ago. But the complicated project will be likely to take another 13 years to finish, GAO says, during which time public safety from exposure to these potentially dangerous chemicals will hang in jeopardy. In particular, it charges EPA with foot-dragging in its assessments of pesticides accused of causing serious environmental or health problems. Among its criticisms of EPA's program, GAO charges that the agency has yet to develop operating procedures, yet to set priorities on which chemicals to test first and yet to review procedures used to set the 6,000 tolerance levels now in effect.