Classical experiments on visual deprivation and the formation of cortical ocular dominance columns (reviewed by T.N. Wiesel, Rockefeller University) were extended by the demonstration that here too patterns of impulse traffic are critical for the formation of segregated afferent territories (M.P. Stryker, University of California, San Francisco). I reported my own studies of Siamese cats which show that some genetically determined abnormal patterns of afferent activity can establish functional territories at subcortical but not at cortical levels, and the remarkable modifiability of the developmental programme of cortical and subcortical segments of these pathways was demonstrated by prenatal destructions of parts of the visual pathways of monkeys (P. Rakic, Yale University).

The possibility that an analysis of the development of complex motor patterns or perceptual capacities can usefully involve some of the same ground-rules that have been used for studying the development of single cells or of the intricate retinogufugal pathways was stressed by a consideration of the development of birdsong (P.R. Marler, Rockefeller University), which has a 'critical period' and involves the selection during maturation of a limited set of phrases from a larger initially acquired vocabulary; and by studies showing that one-month-old-human infants distinguish sound patterns used in speech as well as do adults, and on the basis of the same acoustic clues. During development the infant loses the capacity to make distinctions that play no part in its adult language (P.D. Eimas, Brown University). Although it is tempting to interpret developmental processes in terms of a few speculative generalizations such as selection, competition and activity dependence, a large gap still needs to be filled before cell biologists and behavioural biologists can share mechanisms as well as concepts. □

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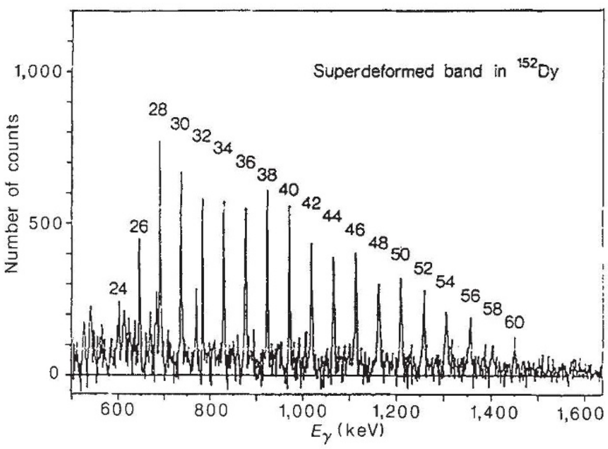
Nuclear structure

Dizzily deformed dysprosium

from J.D. Garrett

THE recent observation of gamma-ray transitions between a sequence of superdeformed states in the rare-earth nucleus dysprosium-152 up to an angular momentum of 60 ±2 units has caused considerable excitement among nuclear structure physicists. Not only does this measurement[1], made at Daresbury Laboratory, Warrington, United Kingdom, by a Daresbury/University of Liverpool/Niels Bohr Institute group, unambiguously establish superdeformed nuclear shapes, but the technical achievement of finding a state of the nucleus with 60 units of angular momentum represents a 'quantum leap' forward in large angular momentum nuclear structure studies. The largest angular momentum previously reported[2] was 46 units, and recent advances have been in steps of one or two units[2,3]. Indeed, 60 units approaches the angular momentum limit above which dysprosium-152 undergoes fission[4].

About 2 per cent of the dysprosium-152 nuclei formed in the reaction of 205 MeV calcium-48 with a palladium-108 target populate the superdeformed states. For an angular momentum of 60 units the angular frequency of rotation is about 2×10^{20} revolutions per second. The nucleus slows down by emitting electric quadrupole gamma rays. The intrinsic structure of the nucleus, however, is not affected by this 'rotational braking'. A spectrum of the gamma-ray transitions between the sequence of superdeformed states depicting this process is shown in the figure.



Gamma-ray energy spectrum[1] showing discrete transitions between superdeformed states in dysprosium-152. The various gamma-ray lines are labelled by the angular momentum associated with the decaying level, which is uncertain within two units. (Courtesy of Daresbury Laboratory.)

The constant separation of the gamma-ray energies of neighbouring transition both confirms this picture and provides a measure of the nuclear moment of inertia. The observed 47-keV separation corresponds to a moment of inertia of a prolate ellipsoid with a major to minor axis ratio of 2:1 rotating about a minor axis. This is precisely the condition that produces a balance between the single-particle and collective nuclear effects that stabilizes the nuclear shape[5]. Indeed, for actinide nuclei, where the fission barrier is lower, delayed fission[6] has been attributed[7,8] to quasi-stable 2:1, or superdeformed, shapes.

The observations of superdeformed states allow the detailed study of three distinct coexisting shapes in dysprosium-152: slightly oblate ellipsoid[9] (major: minor axis (a:b) ≈ 1.15:1); prolate ellipsoid[10](a:b ≈ 1.25:1); and superdeformed prolate ellipsoid (a:b ≈ 2:1). An oblate ellipsoid has two major (longer) and one minor axes (the shape of a doorknob); the prolate ellipsoid has one major and two minor axes (egg-shaped).

The reported population of the superdeformed configuration in dysprosium-152 is greater than 100 times that of the most strongly populated 2:1 fissioning configuration in the actinides[8]. The enhanced population, coupled with improved arrays of high-resolution, low-background gamma-ray detectors becoming available[11,12], heralds the opportunity to study nature's only strongly interacting, many-body quantum system in a new extreme condition. Such studies have already been initiated at several laboratores in the United States and in Europe.

The myriad of questions concerning the details of the the nuclear potential at very large deformations (for example, the radial dependence, the spin-orbit force, the angular-momentum dependence, higher-order terms and the existence of pair correlations, as well as the interaction of configurations corresponding to various coexisting shapes) led Nobel laureate Ben Mottelson recently to charactize nuclear structure physics as an immortal phoenix which is undergoing yet another reincarnation. □

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