NEWS AND VIEWS

One Way for Neutron Stars to Pulse

ALMOST everybody agrees that the mechanics that keep pulsars ticking away must be the rotation of neutron stars—the range of periodicities which have been recorded sees to that—but the question of why neutron stars should emit radiation in such quantities is still as wide open as ever. With well over forty pulsars now listed, there is an embarrassment of observational detail to explain. Two pulsars have aroused most interest, NP 0532 in the Crab Nebula supernova remnant and PSR 0833–45 which is believed to be associated with the suspected supernova remnant Vela X. Both are famous for their rapid periodicities of 30 and 10 pulses per second respectively and for the surprising irregularities which they have shown in their pulsations, and it is through the irregularities that the Crab and Vela pulsars are believed to hold the key to the structure of neutron stars. But an understanding of the emission mechanism is more likely to come from a distillation of the features of the radio signals from all forty or so pulsars.

There is a lot to account for, and the value of the article by M. M. Komesaroff (of CSIRO) on page 612 is that it is a hypothesis against which future observations will be measured. The basis is the oblique rotator model which has it that the magnetic axis of the spinning neutron star is at a large angle of tens of degrees to the rotation axis. Komesaroff gives reasons why the radiation should be emitted in a hollow conical beam which is coaxial with the axis of the dipole magnetic field. The spin of the neutron star sweeps the narrow beam around, and depending on how the beam crosses the observer the double-pulse structure of some pulsars and the single-pulse structure of others can be synthesized.

Any theory, of course, has to account for the intensity of the radio emission, and this involves large numbers of particles radiating in phase. According to Komesaroff, most of the radiation comes from particles within a few radii of the surface moving along lines of magnetic field near the magnetic pole. The radiation, however, is not the ubiquitous synchrotron radiation of particles gyrating around field lines, but rather arises simply from the acceleration of particles which describe a curved path, in this case relativistic particles in a field of something like 10^{12} Gauss.

As such, the model of Komesaroff is a crystallization of two ideas—the notion that a narrow beam could be obtained if the radiation comes from near the magnetic pole (Radhakrishnan and Cooke) and the notion that the radiation could be from the curved paths of particles along field lines rather than from synchrotron radiation (Radhakrishnan).

Despite the impressive list of features of the radio pulses which Komesaroff has accounted for, nobody is going to say that this is the answer. For one thing, the model does not account for everything, although this is hardly surprising. For another, not enough is said in the article about the polarization of the signals which most people suspect must hold the key to the emission mechanism. But what Komesaroff has succeeded in doing is to set up a feasible Aunt Sally against which the measurements can be matched, and the outcome should be a better realization of what properties the ultimate model should have.

What Sigma Factor Does

UNTIL last year it was far from clear how the enzyme RNA polymerase recognizes the sites on DNA where transcription is to be initiated. But then Burgess *et al.* reported fractionation on phosphocellulose columns of the RNA polymerase from *E. coli* into a "core enzyme" and a "sigma factor" (*Nature*, **221**, 43; 1969). The former comprises protein of four subunits with a combined molecular weight of about 400,000, and the latter a single polypeptide chain of molecular weight about 95,000. The core enzyme retains the ability to catalyse the synthesis of RNA chains under direction from a DNA template *in vitro*, quite efficiently when alien calf thymus DNA is provided as template but with a great reduction in activity when the DNA comes from its usual source, *E. coli* or phage T4. But in the latter case the addition of sigma factor restores the synthetic activity of the core enzyme, and later work (see, for example, *Nature*, **222**, 537; 1969) showed that the factor acts on the initiation of RNA synthesis. It associates with the core enzyme to yield a "complete enzyme" complex, which then binds to the DNA template; once the synthesis of RNA by the core enzyme is under way, the sigma factor is released from the transcription complex, and can be used again to initiate transcription by another molecule of core enzyme.

An obvious possible use of this mechanism is for selecting the genes at which transcription is to take place. Indeed, Bautz *et al.* have shown (*Nature*, **223**, 1022; 1969) that the sigma factor may play such a part when *E. coli* cells are infected by phage T4. An analysis of the RNA synthesized *in vitro* on T4 templates showed that addition of the sigma factor specifically stimulates the core enzyme into transcribing those genes of the phage which are usually expressed *in vivo* during the first minute after infection. In the absence of factor, RNA chains are initiated at random sites along the whole T4 DNA molecule.