expected from the general extinction of the right amount of small graphite spheres required to match the 2200Å peak. The calculations on which this conclusion is based rest on classical Mie scattering theory, and there is some evidence (still unexplained) that experimental determinations of the ultraviolet behaviour of such small particles show a much higher extinction than the theoretical prediction (Day & Huflman *Nature* **243**, 50; 1973).

It appears that for the present, despite the qualms about growth shapes, that small graphite spheres remain the best candidate for explaining the 2200 Å absorption. Yet work on alternative explanations is very important, particularly in the hope that an absorber can be found which not only accounts for this feature, but also for many of the broad shallow absorption features found in the optical spectral region and known as the 'diffuse interstellar bands'. These have been observed for many years, but still defy convincing identification. There is no evidence that graphite spheres would supply such optical features, but on the grounds of simplicity it seems unsatisfactory to invoke yet more components of the interstellar medium to explain them, particularly as additional types of dust must already be proposed to account for the observed continuous extinction over the optical spectrum.

# Two-neutron transfer heavy-ion reactions

*from P. J. A. Buttle*

THE growth in recent years of heavy ion physics, in which target nuclei are bombarded with nuclei accelerated in a heavy ion accelerator, has led to many interesting new phenomena in nuclear physics, but as is often the case with a new field of study, has introduced many new problems. Among the simplest types of reaction which can occur is the transfer of a single nucleon from one nucleus to the other. Apart from a few anomalous cases, these single nucleon transfer reactions are reasonably well understood and it has been possible to obtain useful information about the wavefunctions describing the state of the transferred nucleon in the two nuclei. Reactions in which two nucleons are transferred have been more problematical, theoretical calculations often underestimating the yield of the reactions (or the cross section) by at least an order of magnitude.

Part at least of the difficulty is that the two nucleons can be transferred either simultaneously or in two separate steps (sequentially), whereas theoretical analyses have often been optimistically confined to only one of these mechanisms. To complicate matters further, the distinction between silmultaneous and sequential transfer is not very precise, so that the inclusion of both processes in a calculation involves a certain amount of double counting. Full analysis shows that a 'non-orthogonality' term should be subtracted from the amplitude to allow for this.

A recent careful study of the two neutron transfer reaction

$$^{208}\mathrm{Pb} + {}^{16}\mathrm{O} \rightarrow {}^{206}\mathrm{Pb} + {}^{18}\mathrm{O}$$

at Minnesota (Franey *et al. Phys. Rev. Lett.* **41**, 837; 1978) confirms that both simultaneous and sequential transfer are important. The experiments were done at a series of energies low enough (69–73 MeV) that the Coulomb repulsion between the charged nuclei prevents nuclear collisions. The relative motion of the nuclei is then well understood and the transfer of nucleons from one to the other can be investigated without having to face the complexities of a full nuclear collision. The reaction is reasonably 'well matched', that is, the transfer of energy is fairly small so that the classical trajectories followed by the nuclei are not strongly perturbed by the transfer.

The single nucleon transfer reactions

$$^{208}\mathrm{Pb} + {}^{16}\mathrm{O} \rightarrow {}^{207}\mathrm{Pb} + {}^{17}\mathrm{O}$$
$$^{206}\mathrm{Pb} + {}^{18}\mathrm{O} \rightarrow {}^{207}\mathrm{Pb} + {}^{17}\mathrm{O}$$

to a series of excited states in $^{207}$Pb and $^{17}$O were also studied in order that both steps in the sequential transfer be properly understood.

Two types of calculation were reported; the first a semi-classical calculation (Broglia & Winther *Phys. Rept.* **4C**, 153; 1972) in which the relative motion of the nuclei is treated classically. This is a reasonable approximation since the wavelength for classical motion is small compared with the size of the nuclei. Simultaneous, sequential and non-orthogonality terms contribute approximately 50%, 80% and −30% of the total amplitude, and the result is in excellent agreement with experiments.

The second, fully quantal calculation (second order DWBA) gave a similar ratio for the simultaneous to sequential amplitudes. The non-orthogonality term could not be calculated and was assumed to contribute in the same proportion as in the semi-classical calculation. The overall magnitudes were however smaller, leading to an underestimate of the cross section. This may indicate that the non-orthogonality correction should be smaller in the quantal calculation, or that a more sophisticated treatment of the bound state wavefunctions is needed for simultaneous transfer, as suggested by Feng, Udagawa and Tamura (*Nuclear Phys.* **A274,** 262; 1976).

The general agreement between theory and experiment for two-neutron transfer is in accord with the analysis of Feng *et al.* for calcium targets, and gives more confidence in our understanding of these well matched reactions. Difficulties remain, however, for less well matched reactions which have smaller yields, and for two-proton transfer reactions where theoretical calculations still underestimate experimental results by a large factor. □

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# Pleiotypic effects of hormones

*from Robert Shields*

LONG before the dawn of molecular biology endocrinologists were aware that steroid hormones exert generalised trophic effects on their target tissues. For instance, oestrogens promote the growth and development of the uterus, glucocorticoids are trophic in the liver and androgens affect male accessory tissues such as the prostate and seminal vesicle. However, these effects are often conveniently forgotten by biologists attempting to understand the action of steroids at the molecular level. Concentrating their efforts on the effects of steroids on a handful of specific proteins such as the egg white proteins of the chick oviduct, workers in this field have made impressive progress culminating in the successful cloning of the ovalbumin gene (Dugaiczyk *et al. Nature* **274**, 328; 1978; Mandel *et al. Cell* **14**, 641; 1978). It will not be long before we understand how steroids act at the molecular level in at least a few restricted cases. The time has now come when the more general (and equally important) trophic effects of steroids should be re-examined.

While the general trophic (or pleio-

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