BUBBLE CHAMBERS

New Ones on the Way

FUTURE bubble chambers could be very much more flexible in use than their predecessors and one of the ultimate goals is to make an almost continuously sensitive bubble chamber which can be counter controlled (in the same way as a spark chamber system) and photographed only when an interaction of particular interest has taken place.

Until a year or so ago the bubble chamber was accepted by elementary particle physicists as a particle detector which, by its nature, could only be expanded every few seconds regardless of the interactions which had taken place inside it. The laborious scanning of the photographs for interesting interactions was a satisfactory procedure as long as interaction cross-sections (probabilities) remained fairly high. But as interactions of lower cross-section are looked for, fewer and fewer of the photographs contain useful material.

The new bubble chambers have come to be known collectively as fast cycling chambers and these divide naturally into those which operate on a variation of the traditional bubble chamber principle (pressure lowering by the rapid release of a piston) and the more esoteric varieties such as sonic and ultrasonic chambers. The rapid cycling chambers broadly include those which can be photographed at rates in excess of 20 per second. (Several existing chambers have, however, been modified so that they can be expanded ten or so times during a typical accelerator pulse (about 1 second), but this is about the limit.) Although a great deal of pioneering work has been done at accelerator laboratories around the world including Dubna (USSR) and the Rutherford High Energy Laboratory (UK), perhaps the greatest interest at the moment centres on a rapid cycling chamber which the Bubble Chamber Development Group at Stanford are building for use in the experimental programmes at the linear accelerator. The diameter of the sensitive volume is about 40 cm, a dramatic improvement on the 5 cm chamber which they successfully operated at 90 Hz in 1969. The expansion system is essentially an electromagnetically driven piston whose natural vibration frequency is 120 Hz—but to ensure proper recombination of the bubbles between cycles, it is only planned to use it at 60 Hz.

It is quite probable therefore that a combined spark chamber–bubble chamber arrangement will soon be in operation at Stanford. In general terms this means that it will be possible to use the hydrogen in a rapid cycling chamber as the target for interactions and for detecting decays and other events of interest which take place very close to the interaction vertex; these would probably be missed if a separate target was placed in front of a set of sampling detectors such as spark chambers.

In many ways, the sonic and ultrasonic chambers are rather lagging behind the rapid cycling chambers. The principle of operation of both is that the pressure changes necessary for bubble formation and recombination are created by a standing acoustic wave. Because sound waves with frequencies of a few kHz have wavelengths comparable with typical chamber dimensions, the sensitivity to traversing particles varies from one part of the chamber to another and consequently more effort has been directed towards the ultrasonic chambers which operate at frequencies of about 100 kHz (helium) and 450 kHz (hydrogen). In these chambers alternate closely spaced striations are sensitive to the passage of charged particles and resolutions of about 2 mm have been achieved. But in practice there is an important snag, especially for the hydrogen chambers which are most likely to be of use in experimental particle physics; it turns out that there is a large impedance mismatch between the piezoelectric crystals which generate the ultrasound and the cryogenic liquid, although the problem is not so great for helium as for hydrogen. The situation was highlighted recently at a meeting held on March 18 at the Rutherford Laboratory under the auspices of the Institute of Physics and the Physical Society. In particular, Dr R. C. A. Brown reported the work of the CERN group which has been hampered recently by breakages and over-heating of crystals during attempts to deliver sufficient energy into liquid hydrogen. They have, none the less, observed some tracks in hydrogen ultrasonic chambers but are intent at present on developing coatings for the piezoelectric crystals which would reduce the mismatch.

Slowing Down RNA Polymerase

IN recent years antibiotics have provided molecular biologists, not least those investigating RNA synthesis, with more than one lucky break, for compounds which the pharmaceutical industry has isolated because of their bactericidal properties have proved to interfere specifically with such processes as protein synthesis and transcription. Rifampicin, for example, has as its target the act of initiation of transcription; in its presence no new RNA chains are initiated, although those already begun are completed, and the drug has, of course, helped greatly in sorting out precisely how the synthesis of an RNA begins. Streptolydigin, another antibiotic, inhibits RNA polymerase at all stages of transcription and as Cassani *et al.* report in next Wednesday's *Nature New Biology*, it does this by reducing the rate at which RNA chains grow without affecting the fidelity of transcription. As a result, by judiciously manipulating doses of rifampicin and streptolydigin, biologists can control not only the initiation but also the rate of elongation of RNA chains being synthesized by bacterial RNA polymerase.

Binding studies reported by Cassani *et al.* indicate that streptolydigin binds either to RNA polymerase or to the complex of RNA polymerase and its DNA template but not to the DNA template alone. This binding is weak and readily reversed, but when the drug is bound to the enzyme-template complex it freezes the complex and prevents the growth of the nascent RNA chain without causing the enzyme and the RNA product to dissociate from the DNA template. Furthermore, measurements of the binding of the four nucleoside triphosphate precursors to the enzyme-template complex suggest that in the presence of streptolydigin the affinity for CTP is increased slightly whereas that for UTP is decreased. These changes do not, however, greatly affect the fidelity of transcription, for messenger RNAs made, albeit slowly, in the presence of the drug are functional. In short, this antibiotic seems to tighten the interaction between enzyme and template and so reduces the rate at which the enzyme moves along the template.

A drug which is likely to become widely used by biologists probing transcription by mammalian rather than bacterial RNA polymerase is α amanitin. A cyclic peptide produced by the toadstool *Amanita phalloides*, α amanitin specifically inhibits the RNA polymerase found in the nucleoplasm of mammalian cells and can be used to distinguish this enzyme from the RNA polymerase in nucleoli. In *Nature New Biology* next Wednesday, Fiume *et al.* describe a new technique for promoting the uptake of amanitin by liver cells. They have shown that by coupling the β form of amanitin first to albumin and then tagging this complex with fluorescein the toxicity, which reflects uptake, is enhanced some three to four-fold compared to that of amanitin coupled only to albumin. Admittedly the ability of the complexed drug to inhibit RNA polymerase is reduced some five-fold, compared with that of amanitin alone, but when it comes to investigating the effect of drugs inside cells it matters little how potent the drug is at inhibiting a particular enzyme if the drug is not readily taken up by the cells in question.