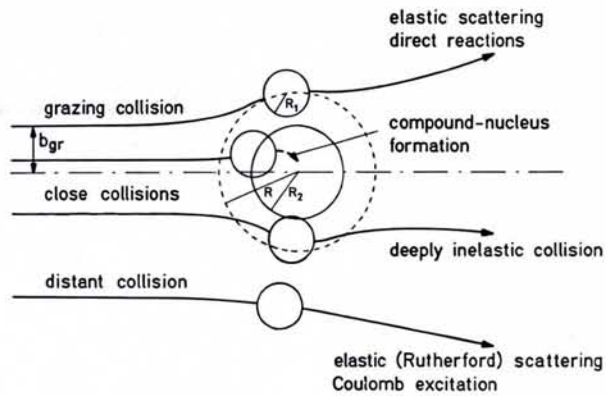
Fig. 1 Classical trajectories of two colliding heavy ions (W. Noremberg).

The abstracts of the papers presented at this conference are published in the first volume of the second series of *Europhysics Conference Abstracts.*



amount of the total relative kinetic energy is dissipated within a relatively short time (10^{-21}s) leading to strongly non-isotropic angular distributions. The theorists are still trying to explain the mechanism responsible for these collisions. Are we facing a new, so far unknown, relaxation phenomenon ?

Related to the above, the subject of resonant states observed in heavy ion collisions was given some attention too. The question to be asked here is the following : Would two colliding heavy ions coalesce immediately, mixing all their nucleons, or would they sometimes keep their identity for a longer time, say 10^{-21} - 10^{-20}s and form a "molecular" state ? Growing evidence exists for the creation of such states ; their detailed structure is still subject to speculations.

Several contributions were dedicated to the subject of collisions of very energetic heavy ions with nuclei. These collisions raise the problem of the passage of nuclei through nuclear matter at speeds higher than the speed of sound (in nuclear matter) and the consequent propagation of shock waves. The speed of sound in nuclear matter is expected to correspond to particles moving with 10-20 MeV/nucleon ; above that energy supersonic phenomena should start. For projectiles below A $\cong$ 100, this is within reach of, e.g. the GANIL accelerator.

It would be difficult to imagine that the discovery of element 126 recently reported by Gentry et al. could have escaped the attention of the Conference. Last minute contributions from Orsay, Darmstadt, Oxford, Heidelberg and Marburg were, however, rather unanimous in reporting no evidence for superheavy elements in monazite (or other materials) within very low limits. The Darmstadt group reported on an experiment performed under conditions similar to that performed with the Florida State proton pencil beam. While bombarding the samples with 7 MeV protons showed the supposed superheavy L_α X-ray shoulder, bombarding with 2 MeV did not, thus strengthening the possibility that the shoulder be of nuclear origin, e.g. from the ^{140}Ce (p,nγ) reaction.

How about producing superheavies in the laboratory? Recent results from Berkeley with a 300 MeV ^{48}Ca beam on ^{248}Cf gave negative results. No trace of superheavy elements in the region of Z = 110 - 116 was observed. Still, theoretical predictions are not that pessimistic. Calculations based on the transport theory for deep inelastic collisions predict a total cross section for the production of 25 superheavy elements around A = 298 to be 0.1 mb for the U + U and 1.5 mb for the U + Cf reactions respectively. It is true that these calculations give the above numbers with a safety factor of 50 ; *Chi vivra, vedra !*

N. Cindro

High Resolution Molecular Spectroscopy

The IIIrd All-Union Symposium on High Resolution Molecular Spectroscopy held in Novosibirsk from 13-16 September 1976, follows in the line of biennial meetings in the USSR. In Novosibirsk, I found that in addition to about 80 participants from within the country there were 13 foreign scientists, including visitors from the USA, France, England, the German Democratic Republic, Czechoslovakia and Hungary. Novosibirsk may then become a truly international forum in the future. Over three days some eighty papers were read on the theory of, and techniques for high resolution spectroscopy and its applications. The apparent goal is to call the attention of physicists and chemists in the Soviet Union to this quickly developing field. Part of the reason for the pace of development is the availability of lasers. Tunable lasers allow the recording of ultra-high resolution spectra whose analysis necessitates a deep understanding of the quantum-mechanical behaviour of molecules. The Hamiltonian function of electronic ground and excited state molecules must be known to a high degree of accuracy requiring corresponding computational techniques.

It appeared that a significant theoretical contribution was the development of algebraic treatments of the higher-order Hamiltonians and the group-theoretical discussion of their symmetry properties. Reported examples of such achievements were in the theory of ro-vibrational spectra of molecules possessing one or two grossly anharmonic vibrational amplitudes, the treatment of asymmetric top rotational Hamiltonians, and scrutinies of the perturbation techniques for the mathematical analysis of high resolution spectra. An example of theoretical developments was connected with spherical top molecules. The impetus for such studies is given by non-linear photophysical procedures used presently to separate isotopically substituted species of spherical symmetry, such as SF_6.

The reports on high resolution optical and microwave apparata proved the steady tendency in the USSR to create a home experimental basis. The most intriguing instruments were the spectroscopic laser devices and the now famous Gorky mm-wave spectrometer with an acoustic detector. The impact of laser technology upon spectroscopy is demonstrated by the twenty-odd papers given in this field.

Since the Symposium was organised by the Tomsk Institute of Atmospheric Optics numerous papers were devoted to atmospheric molecules, such as water, CO_2 and ozone. The physics of these studies is centred on intermolecular interactions influencing the shape of individual spectral lines. Future needs are for more experimental and theoretical work on line-contours.

The Novosibirsk Symposium fits well into the European series of high resolution spectroscopy meetings in Tours, France and Prague, Czechoslovakia. These conferences represent a turnabout from chemical spectroscopy towards the more quantitative methods of physical spectroscopy. The rigorous principles and procedures of atomic and diatomic spectroscopy find a broad field of application for the polyatomic molecules. The greatest contribution of the Novosibirsk meeting is the promotion of this kind of change of philosophy for polyatomics.

Finally let me add that Akademgorodok Novosibirsk had a display of young talent and enthusiasm, both important and promising for the future of this discipline.

I. Kovacs

Dilution Refrigeration and Its Applications

It is now more than a decade since the first dilution refrigerators were built and in the mean time these machines have become standard for reaching temperatures between 10 and 300 mK in a continuously operating mode. Moreover, the technique has spread beyond the area of purely low temperature physics and is now widely used in a number of fields.

Dilution refrigerators operate on a mixture of liquid ^{3}He and ^{4}He making use of the property that at low temperatures the liquid separates into two phases, usually known as the concentrated phase and the dilute phase according to the ^{3}He concentration. The thermodynamic properties of the two phases being rather different, cooling can be obtained by forcing ^{3}He atoms from the concentrated phase to the dilute phase, somewhat analogous to a simple evaporation refrigerator but in fact more similar to the Peltier cooling achieved by forcing electrons across the boundary between two dissimilar metals. The operation of the conventional dilution refrigerator, in which ^{3}He is drawn out of the dilute phase by a heated still and the cooling caused by the balancing flow from the concentrated phase, is sufficiently well understood that machines reaching 10-12 mK are available commercially.

However, in the past two or three years, a number of improvements and innovations have been made which have allowed continuous operation to temperatures of 3-4 mK, in other words not far above the liquid ^{3}He superfluid transition. Since a great deal of this recent work has been done in Europe it seemed both timely and appropriate for the EPS Low Temperature Division to sponsor a study conference on dilution refrigeration this summer.

The study conference format suited the subject admirably. Session leaders introduced the topic under discussion with short 30-40 minute talks, sometimes followed by one or two ad hoc "contributed" comments of a few minutes. Since refrigerators continue to be temperamental creatures, both in operation and concept, lively argument filled the greater part of the time.

The conference which took place in Lancaster from 25-27 September, was roughly divided into, day 1, the conventional refrigerator, or as the first session leader described it the "General Motors, rear-wheel-drive refrigerator": day 2, applications: and day 3, new or unconventional cycles.

Day 1 began with a historical introduction to dilution refrigeration and the basic thermodynamics of the cycle using the concept of the enthalpy balance to calculate the behaviour. The optimization of performance was then discussed with particular reference to the successful Grenoble machines that routinely reach 4 mK. One of the most significant results reported was that using very fine sintered silver heat exchangers these temperatures can be reached and, as important, that the performance of each section of the machine agrees reasonably well with calculations. The day finished on a second high note with a discussion of multiple mixing chambers which have been developed in Eindhoven and more recently at Grenoble. These devices allow with very little extra effort, final temperatures two to three times lower than the single mixing chamber to be achieved.

Day 2 saw the discussion of applications of refrigerators both for the relative beginner and the expert including a number of sophisticated uses in nuclear physics, and there was some discussion of the problems of making thermal contact to the mixing chamber. The day finished with a discussion of practical thermometry and there was lively argument here too, especially over the problems of dehydration of CMN and of local moments in platinum used for pulsed nuclear resonance thermometers.

The final day saw the introduction of the new cycle in which, instead of extracting ^{3}He from the dilute phase in the mixing chamber using a still, ^{4}He is pumped in through a superleak. This cycle offers the great advantage that the dilute and concentrated phases counterflow in the same tube, rather than in separated tubes and no heat exchangers are needed. The simple Leiden machine which reached 8mK very soon after having been commissioned was discussed. Hybrid machines in which a "Leiden" mixing chamber is piggybacked on a conventional refrigerator, and both ^{3}He and ^{4}He are separately circulated, as developed at Philips and Grenoble, were also considered. The meeting finished with an all-too-short session on running problems and trouble shooting including a very scientific look at leak detecting.

The meeting was held at the University of Lancaster, no great distance from the English Lake District and the