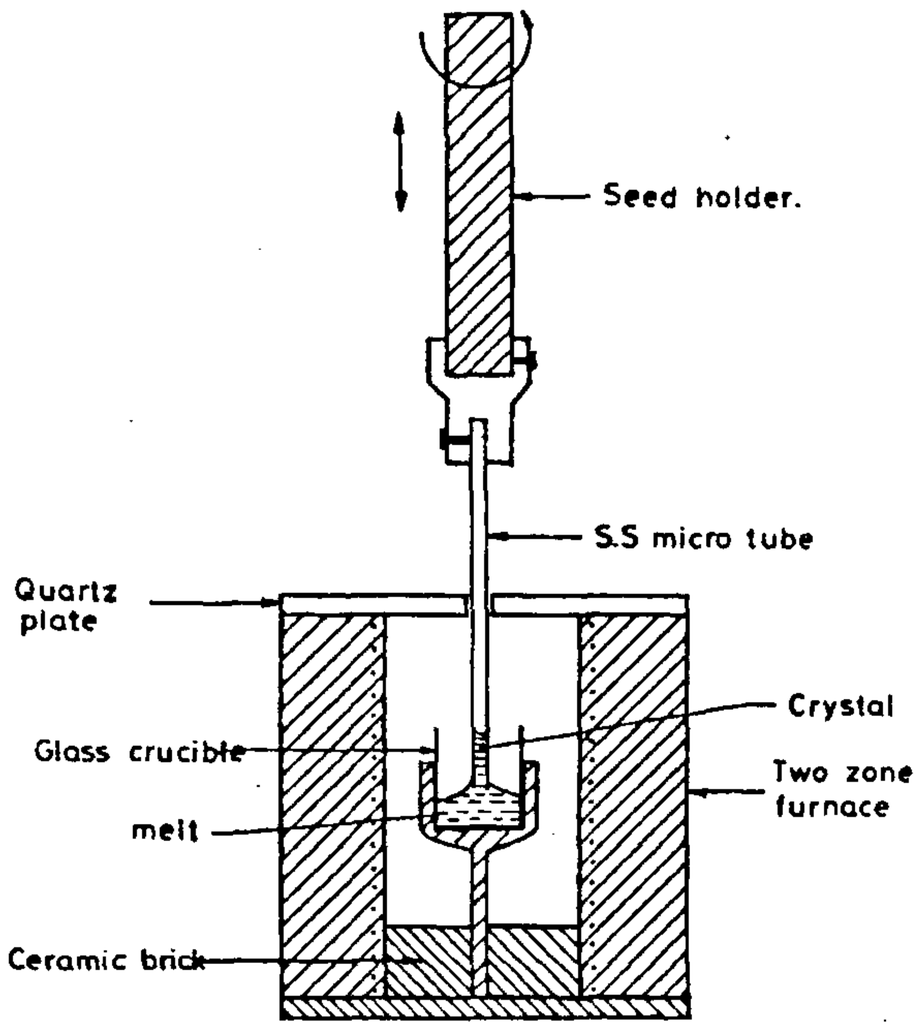

Figure 2. A schematic diagram of the experimental setup. Reprinted from *Journal of Crystal Growth*, vol. 193, K. Sankaranarayanan and P. Ramasamy, 'Microtube-Czochralski technique (μT-Cz): a novel way of seeding the melt to grow bulk single crystal', pp. 252–256, © 1998, with permission from Elsevier Science.

nucleation inside the tube is controlled by the following experimental parameters: radius and rotation rate of the microtube, melt temperature at which the microtube seeding is made (t_{ms}), pulling rate, axial temperature gradient and the length of the microtube underneath the melt surface (l_{ums}). The authors have reported three growth runs corresponding to $l_{ums} = 0.5$, 1 and 1.5 mm. Once the growth run is completed, the system temperature has to be reduced at the rate of 1°C/h. Any rapid cooling results in a crack in the crystal grown. For $l_{ums} = 1.5$ mm and with modified axial gradient a benzil single crystal with high quality transparency, having near planar crystal–melt interface is obtained. The crystal pulling rate is maintained at 1.2 mm/h at $t_{ms} = 90$°C. The crystal rotation rate is 6 rpm. There also exists a critical rotation rate relative to the radius of the microtube. Only below this rate, the change in crystal rotation is influential in deciding .the morphology of the resultant crystal. They have also analysed the effect of l_{ums} on the nucleation. If the melt level and the crystal orientation inside the tube along two sides are the same then the value of l_{ums} is not vital. If the crystal orientation along two sides of the tube are different then the value of l_{ums} plays a crucial role. The value of l_{ums} should be sufficient enough to allow any one of the orientations at the end of the microtube as the deciding crystal orientation. This technique is viable to grow a bulk single crystal from the melt without a pre-grown-seed and the reproducibility for getting single crystals is about 80%.

1. Sankaranarayanan, K. and Ramasamy, P., *J. Crystal Growth*, 1998, **193**, 252.

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Nuclear structure and dynamics*

A national workshop was organized to take stock of the present research accomplishments in nuclear structure physics and to set the agenda for the coming decade.

B. K. Jain (BARC, Mumbai) in his inaugural address, pointed out several examples like studies on long-lived isomers which have the capability to spring new technological applications. Ranjan Bhowmik (NSC, Delhi) presented a special talk on 'Nuclear Structure at the Nuclear Science Centre – Present and future', and emphasized the role of NSC in providing a world class experimental facility to universities. He also presented an overview of the future experimental facilities like the upgradation of the existing pelletron accelerator by adding superconducting linac modules and also the proposed setting up of a national gamma detector array. Addition of a gas-filled recoil separator will make this facility one of the few in the world. H. C. Jain (TIFR, Mumbai) presented a similar talk on the existing facilities at TIFR, Mumbai and unveiled the future expansion plans of the TIFR pelletron.

One of the focal points of research in nuclear physics nowadays is the synthesis of new elements both heavier than those found in nature and also away from the line of stability. Theories have long ago predicted the existence of an island of stability beyond the atomic number $Z = 114$. It has, however, not been able to reach this island so far. The elements $Z = 110$–112 were discovered at GSI, Germany a couple of years ago. A few months ago, labs in USA and Russia have made a breakthrough in synthesizing the element with $Z = 118$. This represents a major leap forward and has already initiated a race to build new elements. It is important that India has the capability to make these new

*A report of the National Workshop on Nuclear Structure and Dynamics, jointly organized by the University of Roorkee and the Nuclear Science Centre, New Delhi during 23–25 August 1999 at the Physics Department, University of Roorkee, Roorkee.

elements and exploit them for technological applications. These superheavy elements are expected to have very different properties and behaviour than the presently known elements.

Similar advances are also being made in synthesizing new elements away from the line of beta stability which have unusual neutron to proton ratios. With the advent of new generation of accelerators providing radioactive nuclear beams, more of such elements, known as the exotic nuclei, are being synthesized at present. Several talks focused upon these areas. In particular, R. K. Gupta, Chandigarh, provided insights into the theoretical aspects of this new game and A. K. Sinha covered the experimental aspects of the field. R. Shyam (SINP, Calcutta) gave an account of our present understanding of the exotic elements. Y. K. Gambhir (IIT, Mumbai) and Arun Jain (BARC, Mumbai) considered the treatment of the exotic nuclei from a relativistic mean field theory which is being considered as a powerful tool to understand nuclear properties.

A special evening session was devoted to a panel discussion to arrive at a consensus on the Future National Experimental Facilities. The discussion was coordinated by B. K. Jain. Many possible scenarios of future experimental facilities were presented by A. K. Sinha (NSC) and R. Pillay (TIFR). S. N. Chintalpudi (IUC–DAEF) presented the progress and difficulties in setting up a National Gamma Ray Array. A consensus was reached among the scientists to set up a National Gamma Array and a Radioactive Ion Beam Facility. A suggestion was made by R. Shyam for having a National Document in the area of nuclear physics research for the next five to ten years. This suggestion was supported by I. M. Govil (Chandigarh), L. Chaturvedi (Banaras) and A. K. Jain (Roorkee), Convener of the Workshop. It was agreed that this idea is very useful and steps should be initiated to prepare such a document as soon as possible.

Talks by many younger scientists were presented on the new modes of quantum rotation like magnetic rotation (Amita), Giant Dipole Resonances (V. Nanal) and high-spin features of $A = 70$ and 100 nuclei (G. Mukherjee and P. Joshi). It is known that only deformed nuclei can exhibit quantum rotational spectra. Studies of deformed shapes and high spin states (very large rotation) have occupied the centre stage of nuclear physics research. Magnetic rotation is a new mode of rotation discovered only a couple of years ago; here nearly spherical nuclei display rotational spectra, something quite unexpected. An explanation in terms of a shear mechanism where the neutron and proton blades of angular momentum, initially perpendicular to each other, close in to generate high spins, has been proposed recently. Following this discovery, new modes of rotation like anti-magnetic rotation are also being talked about. Topics like super-deformation and hyper-deformation (N. Singh and V. Ramasubramanian) were also discussed. Both of these are also high spin phenomena and have resulted in the observation of many unusual features like identical bands which still remain unexplained.

State-of-the-art of the various nuclear models being used at present and complete spectroscopy was discussed at length by V. K. B. Kota (PRL), R. Sahu (Berhampur), P. K. Raina (IIT, Kharagpur) and R. C. Nayak (Orissa). S. S. Malik and A. K. Jain presented an application of the semi-classical methods to nuclear systems which highlighted the renewed interest in classical dynamical methods and their applications to quantum systems by introducing quantization. Twenty-six invited speakers from all over India made presentations on the current topics and the work carried out in the country. A significant number of these talks were presented by young scientists who have completed their Ph D or, are in the process of completing it. Intense discussion was the hall-mark of the workshop with sufficient time provided for it.

The meeting concluded with a summary of the workshop presented by C. V. K. Baba (Hyderabad). The proceedings of the workshop will be published soon.

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Biogeochemistry of trace elements*

In the 5th meeting in a conference series started in 1990 the keynote lectures delivered by Leon Kochian (Cornell University) and by Iain Thornton (London) addressed complementary aspects, i.e. plant–soil interactions focusing on the rhizosphere and the food chain. Kochian provided a comprehensive review of the basic mechanisms and regulation of plant-based processes involved in the entry of toxic heavy metals into the food chain (via uptake into plants), the phytoremediation of metal contaminated soil and mechanisms of heavy metal tolerance by plant. Referring to the soil as a primary source of essential trace elements for plants, animals and therefore, for humans, Thornton pointed out that soil is also a source of heavy metals, though anthropogenic inputs of industrial and other emissions may greatly exceed natural geological sources.

The conference topics covered important aspects of fundamental research such as kinetics and mechanisms of the fate of trace elements, including radionuclides, in the soil and related ecosystems and methods of their assessment. The scientific programme comprised ten special symposia, emphasizing key areas in trace element research.

There were 298 oral presentations in 59 special symposia and technical sessions as also three poster sessions consisting of nearly 253 papers.

*A report of the International Conference on the Biogeochemistry of Trace Elements, held at the Technical University, Vienna, Austria during 11–15 July 1999.