

Summary Record of Discussions of the Nineteenth Meeting of Scientific Advisory Committee to the Cabinet (SAC-C) held on 13th February, 2010, at New Delhi.

The nineteenth meeting of the Scientific Advisory Committee to the Cabinet (SAC-C) was held on 13th February, 2010, under the Chairmanship of Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India (PSA to GOI) and Chairman, SAC-C.

The agenda of the meeting and the list of participants are at **Annexure-I** and **Annexure-II** respectively.

M19A1 Opening remarks by Chairman, SAC-C.

At the outset, the Chairman welcomed all members and introduced the new members of the SAC-C, Prof. Ajay Sood, President, Indian Academy of Sciences, Bangalore and Prof. S.V. Raghavan, Scientific Secretary, Office of the Principal Scientific Adviser to the Government of India. He mentioned that one of the topics for discussion is on nurturing gifted children and explained that the difference between the talented and gifted children lies in the fact that the innate abilities of talented children have got translated into achievements whereas the innate abilities of gifted children are yet to be identified. This is difficult particularly in the field of science and mathematics. He then requested Prof. V.S. Ramamurthy, Director, National Institute of Advanced Studies, Bangalore, to give his presentation on the proposed project for gifted children.

M19A2 Identifying and Nurturing Gifted Children.

Prof. Ramamurthy stated that a round-table discussion on identification of giftedness with special focus on science and mathematics was held at INSA, New Delhi during January 27-29, 2010. Important aspects brought out were:

- Early identification and nurturing of the gifted children using methods sensitive to local conditions
- Research efforts in this field are fragmented and sub-critical and should be strengthened by establishing a network of researchers.

- Establish large network of teachers and mentors with extensive training programmes.
- Implementation of outreach and nurturing programmes.
- Maintenance of database of gifted children and monitoring their needs and progress.

He stated that the first year of operation of the project will consist of the following activities:-

- Two round table discussions/workshops.
- Formalisation of partnerships with international bodies.
- Two training programmes for teachers and mentors.
- Outreach programmes using media.
- Pilot project implementation with institution groups having common management and education system like Atomic Energy Education Society, Novodaya, DPS, 'Agastya' Foundation, etc.

Thereafter, Chairman added that the project needs to start modestly and use existing educational systems. He then requested members to give their comments.

Important observations were:

- The method for choosing the talented people can depend on eminent retired/ serving teachers who can serve as role models and the language used for communication should be such as to bring out the hidden talent.
- Chairman mentioned that the characteristics of gifted children for identification should be decided since this would have an impact on the number of children and also the test methodology suitable for Indian condition should be evolved.
- Teachers need to be sensitized by training, workshops, etc. to select the gifted children.

- Considering the fact that early identification of giftedness is important for full development of the child, the identification process may start as early as 3-5 years.
- Ultra-gifted children generally have psycho-social problems. Research team should consist of child psychologists and psychiatrists to evolve suitable methodologies and medical support for children as well as for parents.
- Special tests need to be included at national level in primary education to identify the traits of gifted children.
- Elements of conviction with parents and the teachers about the possibilities of bright students and exposure to fun based science education would help in identification and nurturing of gifted children.
- Secretary, DDR&D stated that Defense Institute of Psychological Research (DIPR) of DRDO had customized few imported software packages for psychological assessment of gifted children of armed forces and suggested that research team may include DIPR also.
- Early carrier and traits of Olympiad gold medalists may be studied as part of the project.
- Research team may also have to evolve the processes not only for identification but also for nurturing the identified children

The Chairman concluded the discussions by stating that preliminary project can be for one year and can facilitate development of the tests and methodologies and training of the teachers of established schools like Sainik Schools, Navodaya, etc.

M19A3 The National Photonics Initiatives.

PSA started the discussions on the topic by saying that in the report of the Steering Committee on S&T chaired by him and submitted to Planning Commission in December, 2006, a budget for Photonics has already been included. The scope of photonics is very wide and so should be limited to focussed areas. DAE, DRDO, DST, CSIR and DIT are involved in supporting R&D projects in Photonics. He stated that though a certain amount of duplication would be desirable, it would be better to 'synergise coherently' the

activities of various institutions working in this field. Then he introduced Dr. Bhawalkar to members and requested him to give his presentation on Photonics.

Dr. Bhawalkar began his presentation by stating that the enabling technology of the twenty first century would be Photonics. He also added that the new frontiers in the area of photonics were TerraHertz radiation , photonics band-gap materials, nanooptics, Meta materials, High Field Physics, etc. Specifically he explained about development of Meta-materials for optical applications like focusing, cloaking device, etc. and about the development of materials for Photonic crystals. Low loss communication using optical fibers would be one such application for these crystals. He stated that at the initiative of the PSA, two meetings on photonics were held in the PSA's office in September, 2006 and November, 2007. In those meetings, it was decided:

- To identify areas for intensive R&D work
- To constitute an oversight committee by funding agencies
- To set-up centers of excellence for photonics on similar lines to those for nano-electronics
- To use international collaborations wherever necessary
- To prepare an approach document. An approach document was prepared including the following priority areas:
 - Photonics band gap materials, meta-material, doped fiber
 - Opto-electronic devices optical MEMS, Band-gap engineered devices, etc., in semiconductors
 - Laser and optical fiber sensors for detection and measurement of pollution, quality of water, explosive, drugs, etc.
 - Optical Imaging, particularly terahertz imaging and optical coherence tomography
- Laser pumps, high power fiber lasers, multi-wave length lasers, femto second lasers, Quantum cascade lasers, tunable lasers, blue lasers, etc.
- White LEDs

- Optical communication devices like integrated optics, photonics crystal fibers, fiber amplifiers, etc.
- Laser devices for basic sciences, like Quantum computing, Quantum cryptography, high field physics, etc.
- HRD Synergy between Industry and universities and national labs.
- Photonic centres at universities
- Since limited scientific manpower is available, few areas of those listed above should be chosen carefully
- To succeed in this initiative, a multi-institutional programme with close cooperation is needed. This has to be done through a National Photonics Initiative.
- An apex committee needs to be constituted for this purpose. Individual efforts are sub-critical and so different facets have to be studied by different people to bring out an impact on the growth of photonics.
- Like in the case of China, formal collaboration with Indian scientists working abroad should be encouraged. China recognized the importance of photonics in 1980 – and now China supplies half of the laser crystals and lasers to the world.
- Also scientists need to be allowed to work in industry. This will allow easy absorption of technology by the industry.

PSA to GoI stated that Rs. 100 crores were included for photonics in the said Steering Committee report for Planning Commission but this did not include the budget for the extensive programmes of DRDO and DAE, which are separately included in their own Departmental programmes. He then requested Dr. V.K. Saraswat, Secretary, DDR&D & SA to RM, to give brief introduction to the activities of Photonics in DRDO.

Dr. Saraswat stated that Photonics phase-I of DRDO was started in 1998 and has since been completed. This was basically for defence applications but also had civilian spin-off. He added that to pursue these activities further, a phase II programme had been conceived and would focus on applications in the areas of IR FPA and laser seekers.

After this brief introduction of photonics, Dr. A.K. Gupta of the IRDE, DRDO, gave a detailed presentation about Phase I programme and also about the objectives of Phase II programme.

Phase I programme focussed on integrated optics, optical image processing, adaptive optics, diode pumped eye safe laser range finder, high power laser diode arrays and laser detection and ranging for chemical and explosive detection. In this phase, infrastructure was established and some basic components, devices and techniques were developed. In phase II, a focused programme was undertaken during 2004 to develop fiber optic gyro with integrated optics, holographic sight for small arms, periodically poled Lithium Niobate chip for generation of tunable lasers in 2-5 microns spectral region for IR jamming, etc. An adaptive optical system for high resolution imaging, differential absorption based laser detection system for chemical analyses and 100W laser diode arrays at 808 nm are in final stages of realization. This project will come to an end in September, 2010.

After initiating work in the area of photonics technologies under phase I, twelve years ago, and now further technologies have emerged, with some of them having promising defence applications viz.

1. Micro optics
2. Photonic crystals
3. Metamaterials
4. Plasmonics
5. Terahertz source and detectors
6. Fiber laser
7. Quantum well and quantum dot based devices and strained layer superlattice detectors
8. Solar blind UV detectors

These are usable in vision based surveillance, counter measures as navigation sensors and seeker devices and also in communications. National and International status and focused areas in which DRDO will work with short, medium and long term goals were also presented.

Dr. Saraswat briefed that DRDO will take up the above areas and emphasized the need for investment in creating good infrastructure for fabrication, testing, characterization and packaging of devices. He also stressed that in the end of the programme, usable system devices based on functional materials should emerge. He proposed to collaborate with leading academic R&D institutes in the country in these futuristic areas.

After the conclusion of these presentations, PSA had requested for the views of the members.

Dr. Sikka explained that three projects, which are related to photonics, have been initiated by the office of the PSA to GoI over the years and these were for developments of Quantum Well IR photodetectors, White LEDs and writing of waveguides in different types of glasses. He stated that industry was involved from the beginning stages of development so as to ensure ultimate transfer of technology from developer to industry.

Prof. Mohan mentioned that in a recent meeting, Department of Information Technology evinced interest in integrated optics for development of waveguides, optical sources, etc. and agreed to fund the setting-up of nano fabrication facilities for this purpose at Indian Institute of Science (IISc.) and Indian Institute of Technology Bombay (IITB). He also stated that an ongoing nano-electronics user programme at IISc. is particularly useful for universities and he offered the existing facilities for development of optical MEMS and integrated optics by user agencies such as DRDO, ISRO, DAE etc. DAE is already collaborating with IISc. for the last few years in the area of development of lasers. He also added that in addition to DIT related projects, two national

programmes viz., NPSM and NPMASS are also supporting the creation of design centres at many universities and the development of optical MEMS, fiber optics, etc.

Prof. Vasi stated that expertise has been built at IITB in the area of III-V materials for development of Quantum Well Infrared Detectors, HEMS, Spintronics. These materials are useful for integrating photonics with nano-electronics in a common semiconductor device.

Dr. S. Banerjee stated that photonics community is not large and interactions are already taking place. He quoted the examples of collaboration between RRCAT and CGCRI in development of laser glass. He also emphasized the need to develop a programme for the use of beamline of INDUS-2 at RRCAT for lithography. RRCAT also has a strong programme in the areas of bio-photonics and ultra fast lasers. It also has developed recently a high level particle accelerator for use in studies in basic sciences.

Dr. Ajay Sood expressed the view that activities related to development of laser systems should be spread to universities like it happened in the case of nano-electronics. There is a need for the national labs to involve the industry in the manufacture of femto lasers so that the laser devices need not be imported and made easily available to universities for enlarging the R&D base.

Dr. Deepak Mathur, Senior Professor, Atomic and Molecular Sciences, TIFR, said that the TIFR is already having a programme for material modification of bulk media by using ultra-fast lasers, thanks to the project sanctioned by the PSA's office. This will lead to miniaturization of devices. Few cycles laser systems already developed by TIFR in collaboration with universities may find applications in defense. Control of Malaria by changing the elasticity of cell membrane is another area of interest in which TIFR had achieved expertise.

Dr. L.M. Gantayet, Distinguished Scientist and Director, Beam Technology Development Group, BARC, said that in a brainstorming session during the recent

National Laser Symposium organized by DAE, the focus of the discussions was in the areas of laser materials processing and development of laser devices like photo-diodes, silicon photo-multipliers and their applications. General suggestions given in the symposium were about creation of suitable foundries and characterization facilities and standardisation. It was also suggested that the degree of M.Sc. (Photonics) being offered by many universities should be included in the qualification requirements of mission-oriented agencies like ISRO, DAE, DRDO, etc. in order to increase the scientific manpower.

Dr. Saraswat suggested that in addition to basic research in photonics, a network of nano-photonics facilities for materials research and prototype development should be created at academic institutions but funded by user agencies. Also he stated that there is a need to create multi-disciplinary capabilities for building process machines, measurement devices and product engineering since these are denied to India by foreign countries.

The PSA to GoI concluded by noting that the subject of photonics is handled by multiple Departments in the Government of India, viz. the Department of Information Technology (DIT), by the Department of Defence Research and Development (DDR), the Department of Science and Technology (DST), the Department of Atomic Energy (DAE), etc. It would be scientifically more productive if the fragmented/ segmented efforts of those departments are coherently synergized for maximizing the corresponding scientific benefits. Furthermore, there are no accepted norms for multi-departmental/ multi-ministerial funding of a given project in the Government of India. For example, if a given project proposal is to be funded by more than one Ministry/ Department, it has to go through a review process in each of those Ministries/ Departments, thereby unnecessarily increasing the lead time to its formal sanction.

The SAC-C, therefore, decided to set-up an Apex Committee to review and recommend project proposals on photonics for multi-departmental/ multi-ministerial funding, with the condition that once a given project proposal has been recommended by

that Committee, it will not be subjected to any further review by any of those Ministries/ Departments.

As already accepted by him subsequent to the SAC-C meeting, Dr. A.K. Sood, Professor, Department of Physics, Indian Institute of Science, Bangalore and President, Indian Academy of Sciences, Bangalore, will chair that Committee which will have representation from all the interested Departments, viz. the DIT, the DDRD, the DST, the DAE, as well as the Department of Space. Dr. D.D. Bhawalkar, Former Director, Raja Ramanna Centre for Advanced Technology, Indore, will be an Adviser to that Committee.

He also added that fabrication of components, processes and test instruments by the industry needs to be encouraged by providing a quantum of agreed profit alongwith the actual cost. This incentive should be given for the first few units and after that, industry will have to find suitable markets.

M19A4 Enhancing Academia-Industry Interaction: Going beyond present efforts.

PSA to GoI stated that due to lack of sufficient time, this topic is postponed to subsequent meeting of SAC-C. However he added that the purpose of the discussions would be to identify those industries where India could become global leader and accordingly form Core Advisory Groups with participation of academia for such groups. Similar advisory group has been formed for the automotive sector and the machine tool sector by the office of PSA.

The meeting ended with a vote of thanks to the Chair.

Nineteenth Meeting of the Scientific Advisory Committee to the Cabinet (SAC-C)

Date : 13th February, 2010.
Time : 1030 hrs.
Venue : Committee Room 'A', Vigyan Bhawan Annexe, New Delhi.

Agenda

- M19A1** Opening remarks by Chairman, SAC-C.
- M19A2** Identifying and Nurturing Gifted Children.
- M19A2P1** Prof. V.S. Ramamurthy, Chairman, BOG, Indian Institute of Technology, Delhi and Prof. M. Vijayan, President, INSA
- M19A3** The National Photonics Initiatives.
- M19A3P1** Dr. V.K. Saraswat, SA to RM, DRDO and Dr. D.D. Bhawalkar, former Director, Raja Ramanna Centre for Advanced Technology, Indore
- M19A4** Enhancing Academia-Industry Interaction: Going beyond present efforts.
- M19A5** Any other item with the permission of the Chair.
- M19A6** Concluding remarks by the Chair.

List of participants of the nineteenth meeting of the Scientific Advisory Committee to the Cabinet (SAC-C)

| S. No. | Name, Designation and Address |
|--------|--|
| 1. | Dr. R. Chidambaram, Principal Scientific Adviser to the Government of India Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi - 110011 |
| 2. | Dr. Rohini M. Godbole, Centre for High Energy Physics, Indian Institute of Science, Bangalore - 560 012 |
| 3. | Dr. Jamshed J. Irani, Director, Tata Sons Limited Bombay House, 24 Homi Modi Street Fort, Mumbai-400001 |
| 4. | Dr. Deepak Pental, Vice-chancellor, University of Delhi, Delhi - 110007 |
| 5. | Prof. Vijayalakshmi Ravindranath, Professor and Chairman, Centre for Neurosciences, Indian Institute of Science, Bangalore - 560012 |
| 6. | Dr. Seyed Ehtesham Hasnain, Vice-Chancellor, University of Hyderabad, Central University P.O., Gachibowli, Hyderabad - 500046 (A.P.) |
| 7. | Dr. V. Sumantran, Scientific Consultant, Office of the Principal Scientific Adviser to the Government of India, Door 7/1, Valli Ammai Aachi Road, Kotturpuram, Chennai - 600 085 |
| 8. | Dr. S.K. Sikka, Scientific Consultant, Office of the Principal Scientific Adviser to the Government of India, 324A, Vigyan Bhawan Annexe, Maulana Azad Road, New Delhi - 110 011 |
| 9. | Prof. Pramod Tamdon, Vice-Chancellor, North-Eastern Hill University, Shillong - 793022 |
| 10. | Dr. Juzer Vasi, Professor, Indian Institute of Technology, Bombay, Powai, Mumbai - 400076 |
| 11. | Dr. S. Banerjee, Secretary, Department of Atomic Energy, Anushakti Bhavan, C.S.M. Marg, Mumbai - 400 039 |
| 12. | Dr. V.K. Saraswat, SA to RM, Defence Research & Development Organization, DRDO Bhawan, New Delhi - 110 011 |
| 13. | Dr. Shailesh Nayak, Secretary, Department of Earth Sciences, Ministry of Earth Sciences, Block No. 12, CGO Complex, Lodhi Road, New Delhi - 110003 |
| 14. | Dr. V. M. Katoch, Secretary (Department of Health Research) & Director-General, Indian Council of Medical Research, Post Box No. 4911, Ansari Nagar, New Delhi |
| 15. | Dr. A.K. Sood, President, Indian Academy of Sciences, C. V. Raman Avenue, Post Box No. 8005 Sadashivanagar, Bangalore 560 080 |
| 16. | Dr. K.K. Talwar, President, National Academy of Medical Sciences, Ansari Nagar, New Delhi |
| 17. | Prof. Asis Datta, President, The National Academy of Sciences, India, 5, Lajpatrai Road, New Katra, Allahabad - 211 002 |
| 18. | Prof. S.V. Raghavan, Scientific Secretary, Office of the Principal Scientific Adviser to the |

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| | Government of India, Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi - 110011 |
| 19. | Dr. Deepak Mathur, Senior Professor, Atomic & Molecular Sciences, Tata Institute of Fundamental Research,,1, Homi Bhabha Road, Mumbai-400 005 |
| 20 | Dr. P.D. Gupta, Director, Raja Ramanna Centre for Advanced Technology, Indore - 452013 |
| 21. | Dr. D.D. Bhawalkar, Former Director, Raja Ramanna Centre for Advanced Technology, Indore and Scientific Consultant (Advanced Instruments and Manufacturing) Office of the Principal Scientific Adviser to the Government of India, 26, Paramanu Nagar, Indore - 452 013 |
| 22 | Dr. L.M. Gantayet, Distinguished Scientist and Director, Beam Technology Development Group, Bhabha Atomic Research Centre, Trombay, Mumbai - 400 085 |
| 23 | Prof. V.S. Ramamurthy, Director, National Institute of Advanced Studies, Indian Institute of Science Campus, Bangalore - 560012 |
| 24 | Prof. S. Mohan, Professor, Department of Instrumentation, Indian Institute of Science Campus, Bangalore - 560012 |
| 25 | Shri S.S. Sundaram, Director, Instruments Research & Development Establishment (IRDE), Raipur Road, Dehra Dun - 248 008 |
| 26 | Dr. R. Muralidharan, Director, Solid State Physics Laboratory (SSPL), Lucknow Road, Timar Pur, Delhi - 110054 |
| 27 | Dr. A.K. Gupta, Scientist 'G', Instruments Research & Development Establishment (IRDE), Raipur Road, Dehra Dun - 248 008 |
| 28 | Dr. Sangeeta Mehta, Joint Director, ASSOCHAM, 1, Community Centre Zamrudpur Kailash Colony, New Delhi - 110 048 |
| 29 | Ms. Rashmi Chowdhary, Director, Ministry of Human Resource Development, Shastri Bhawan, New Delhi - 110001 |
| 30 | Dr. H.K. Mittal, Advisor & Head (NEB), Department of Science and Technology, Technology Bhawan, New Mehrauli Road, New Delhi - 110 016 |
| 31 | Shri B. Rajendiran, Adviser, Office of the Principal Scientific Adviser to the Government of India Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi - 110011 |
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| 33 | Shri Neeraj Sinha, Scientist 'E', Office of the Principal Scientific Adviser to the Government of India Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi - 110011 |
| 34 | Dr. Ketaki N. Bapat, Scientist 'D', Office of the Principal Scientific Adviser to the Government of India Vigyan Bhavan Annexe, Maulana Azad Road, New Delhi - 110011 |