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Office Bearers : 1997 - 2000



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# FROM THE EDITOR

*Dudley Creagh*

Australia is in the throes of establishing a new uranium mine: one which will use the technique of sulphuric acid leaching to extract the uranium ore. I understand that this type of mining is not encouraged elsewhere. I would value some objective information about the pros and cons of this type of mining. < P>The situation is that the orebody is in a stable regime between two large but stable faultlines. The existing groundwater is not potable and not connected to the Great Artesian Basin, which lies under the surface of this, the driest continent on earth. Of course the pros point to these very facts and argue that the technique is therefore entirely suitable. The cons argue that there is already an oversupply of uranium, the method is very dangerous and the long term consequences to the environment are potentially disastrous. Neither side has sought to put forward a considered argument: something which is common in this day and age.

It seems to me that few scientists and engineers think about the effects of ageing on the systems they are developing. Given the problems which exist with the early use of nuclear technology, I wonder why they do not. And even stable geological systems may not remain so stable over a period of time measured in centuries.

The ageing process is as significant in machines and devices as it is in man: yet we rust these systems completely. Modern aircraft for example are constructed using composites and alloys for which the effective operational life has not been determined. Worse: almost nothing is known of the mechanisms of degradation and the effects of corrosion and abrasion.

My point is that we should focus on a timescale much longer than the design life of the machines, devices and extraction technologies (as intended now). Many aircraft still flying have exceeded their original design life by several hundred percent. And we should look more widely into the long-term direct and indirect effects before we embark on the production stage.

We are consistently being made aware of problems caused by decisions made in good faith in the past.

Perhaps we should slow the rate of change of technology to enable better considered evaluations to be made of the effects of technology on our world.

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# Letters to the Editor

Dear Dr Creagh

**Explaining radiation to the non-professional**

I read your editorial in the November IRPS Bulletin with interest. Here's a web page that might interest you:

http://www.medinfo.ufl.edu/other/cameron/rads.html

*Dr Barry Werner*
*Wayne PA U.S.A.*

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Many thanks; pleased that somebody reads the editorials!

*Ed.*

REPORTS FROM MEMBERS



## The Comprehensive Nuclear-Test-Ban Treaty and its Verification Regime

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The Comprehensive Nuclear-Test-Ban Treaty (CTBT) was adopted by the United Nations General Assembly on 10 September 1996 and opened for signature on 24 September 1996. Up to 3 February 1999, 152 states signed it and 29 ratified it.

The Treaty is an important date in the History of disarmament. It was the result of sustained diplomatic efforts, which began almost at the beginning of the nuclear age in order to slow down the nuclear arms race and limit the nuclear proliferation:

> *In 1959* was signed the Antarctic Treaty, providing with the demilitarization and denuclearization of the Antarctic continent.
>
> *In 1963* the Partial Test Ban Treaty, banning nuclear explosions in the atmosphere, outerspace and underwater but not underground was signed by the Soviet Union and the USA.
>
> *In 1968* the Treaty of Non-Proliferation of Nuclear Weapons (NPT), obligating the non-nuclear weapon states parties not to possess, manufacture or acquire nuclear weapons or other nuclear explosive devices and the nuclear weapon states parties not to transfer nuclear weapons or other nuclear explosive devices and committing them to the goal of nuclear disarmament was opened for signature. At the end of 1996, this Treaty was signed by 186 states.

*In 1974* the Soviet Union and the USA signed the Threshold Test Ban Treaty, limiting the yield of underground nuclear test explosions at 150 kilotons of TNT2.

It was only after the Cold War had ceased, that Russia, the UK, the USA and later France and China announced moratoria and cessation of nuclear testing. The CTBT was adopted by the UN General Assembly just after the cessation of this nuclear testing.

It bans any nuclear weapon test explosion or any other nuclear explosion anywhere in the world.

It establishes a global monitoring system to enforce and verify adherence to the Treaty and to detect any violation. It will enter into force when the 44 states known to have nuclear research or power reactors ratify it.

Meanwhile, the States Parties constituted a Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation and a Provisional Technical Secretariat, installed in Vienna, which was tasked to build a vast network of stations all over the world for monitoring nuclear explosions. This network should be ready to operate when the Treaty enters into force.

Should the Treaty not enter into force within three years after its opening for signature, a Conference of States that have ratified it is foreseen to accelerate the ratification process.

The verification regime is a set of measures used to verify compliance with the Treaty. It has three main components:

1. An International Monitoring System (IMS) constituted by a world-wide network of stations, which permanently monitor the atmosphere by radionuclide and infrasound sensors, the oceans by hydrophones and island 'T-phase' seismic sensors and the underground environment by seismometers,
2. An International Data Centre (IDC) being installed in Vienna, which receives the data transmitted via satellite by the IMS stations, processes and analyses them in order to locate and characterize the events. States Parties are entitled to get from IDC all the data they need to identify possible nuclear explosions by their own technical means,
3. On site inspections (OSI) may be conducted at the request of a State Party in case of suspected violation of the Treaty.

The IMS comprises 321 stations of which 170 are seismic, 60 infrasonic, 80 of radionuclide type and 11 hydroacoustic. There are beside, 16 supporting radionuclide laboratories.

Seismic stations are either primary or auxiliary. The 50 primary seismic stations transmit uninterrupted data to the IDC and the 120 auxiliary seismic stations are available to transmit their data immediately atany time. Seismic stations are either of three component types or of array type. Three component stations consist of three seismometers detecting the vertical and horizontal components of ground motion. Array stations are sets of sensors, arranged geometrically over large areas, which can determine the direction of the frontal wave, hence better locating the seismic source.

Radionuclide stations are of two types. There are 40 stations of particulate type, detecting aerosol radionuclides retained in filters ($^{140}$ Ba, $^{95}$Nb/$^{95}$Zr ratio…) and 40 others, detecting noble gas radionuclides ($^{135}$Xe/$^{133}$Xe ratio). Particulate monitoring detects atmospheric explosions. Noble gas monitoring beside detects underground and oceanic explosions as noble gases, virtually not retained in soil or water, are released in the atmosphere. The 16 supporting radionuclide laboratories are drawn up by the Secretariat of the CTBTO to perform analysis of samples from different stations.

A nuclear weapon test in the atmosphere releases a large amount of acoustic energy (sound) of which the sub-audible part below 20 Hz, called infrasound, can travel thousands of kilometres almost without being attenuated. This part is promptly detected in infrasound stations by sensors called microbarometers, arranged in arrays to determine the direction of approach of sound waves.

Similar to atmospheric explosions, underwater nuclear tests release large amount of acoustic energy into the water. Because sound waves in the ocean are guided by temperature and density variations through the so- called SOFAR channel, the signals from underwater explosions can travel many thousands of kilometres and still have amplitudes large enough to be detected by hydrophones. The Treaty specifies a network of 6 hydrophone stations and five T-phase stations. These are island-based seismograph stations that can detect an ocean acoustic wave when it converts to a seismic wave upon striking the ocean bottom near the island. The hydroacoustic monitoring network has fewer stations than any other network because of the high efficiency of propagation of signals in the ocean.

All the stations transmit directly or indirectly their data via a global communication infrastructure to the International Data Centre in Vienna (IDC).

At the IDC, the data are automatically processed to detect and locate events, producing a daily event bulletin that is available on-line in near real time to States Parties. In addition to the event bulletins, States Parties may receive any or all of the data at their own data centres. Each State Party makes its own assessment of the events, and may also use evidence gathered by its own national technical means.

Since analysis capabilities and requirements vary from a State Party to the next, the IDC is designed to provide a range of products and services, from raw data to event bulletins that make use of agreed-upon screening criteria.

The challenge to all parties is to identify events-to distinguish data coming from a banned nuclear explosion from similar data from many other sources, such as earthquakes, lightning, meteors, radioactive releases from nuclear reactors and mining explosions or collapses.

The Treaty makes it clear that the responsibility for compliance assessment, which requires a combination of technical and political judgement, resides with the States Parties and that the role of the CTBTO is to help them to make these judgements. If a State Party's assessment is that a violation may have occurred, the Treaty prescribes that it may request more data from the IDC or another State Party and may request that the Executive Council of the CTBTO initiate an on-sight inspection.

On-sight inspections may use different techniques to verify compliance with the Treaty:

- Visual observation, video and photography to search for anomalies or artefacts;
- Measurements of levels of radioactivity and gamma spectrometry;
- Environmental sampling and analysis;
- Passive seismological monitoring for aftershocks;
- Resonance seismometry and active seismic survey for underground anomalies;
- Magnetic and gravitational field mapping to detect anomalies or artefacts;
- Drilling to obtain radioactive samples.

It is clear that the verification regime is by itself deterrence to violating the Treaty.

So, it is an important step towards a world safer and more secure. Furthermore, any State Party may use the immense data bank stored in the IDC for scientific purposes in Geology, Seismology, and Meteorology as natural events, we hope, will be detected more frequently than nuclear explosions.

[1] IRPS Advisory Board member, former IRPS vice president for Africa and Middle East and ISRP6 Organising Committee chairman in 1994.

[2]The Hiroshima and Nagasaki nuclear bombs had a yield of about 20 kilotons of TNT

*References:*

http://www.ctbto.org is a sight, which gives information about the Treaty and its Organization

http://www.ctbt.rnd.doe.gov is a sight, which gives information about the verification regime research and development Programme of the U.S. Department of Energy

## Light for the New Millenium

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The research centre DESY in Hamburg, Germany, will take part in the World EXPO 2000 with a 300 m long superconducting X-ray laser, which presently is under construction. The X-ray laser will go into test operation in 2002 and be used for research from 2003.

DESY provides one of ten Worldwide Projects launched by the city of Hamburg for the first World EXPO in Germany. So far, there are more than 160 registred EXPO 2000 Projects in Germany, and some 110 more in other countries. Focused on the central theme of EXPO 2000: Humankind – Nature – Technology, these decentralized projects should present initiatives searching for local answers to global challenges. They should aim for paving the way for new relations between humankind, nature and technology. To obtain the official approval as EXPO 2000 Projects, they should be particularly innovative and solution-oriented and demonstrate possibilities for a future worth living for. Even after EXPO 2000 they should have lasting impact. The Worldwide Projects are thus amongst the major elements of EXPO 2000.

The DESY EXPO 2000 Project is a socalled Free-Electron Laser, where laser action is achieved without reflecting mirrors. It is based on a beam of electrons packed into tiny bunches, which are accelerated by superconducting magnets. The laser delivers tightly bundled X-ray light of smallest wavelengths. The DESY X-ray laser microscope is the worldwide first and only instrument of its kind. It is presently being developed and constructed at DESY by an international team.

The superconducting X-ray laser microscope will open up exciting possibilities in physics, chemistry, biophysics and materials science. Thus it will be possible to study physical, chemical and biological processes within time and space scales of femtoseconds and nanometres. Like an ultrafast stroboscope, the X-ray laser will freeze movements in time and allow observations of atomic processes, such as chemical reactions in catalysts or the propagation of microcracks in materials. The extreme shortness and intensity of the X-ray light pulses will make it possible to take snapshots of living cells without the picture being blurred by the motion of atoms or molecules.

With its EXPO 2000 Project, DESY wants to present itself to a wide audience. Visitors will be able to look at the X-ray laser on the spot and to witness its construction. In a 1200 m2 exhibition hall, they will experience the fascination of the new scientific device and learn more about research at DESY. The exhibition will be open to the public from June 1 to October 31, 2000, at the DESY site in Hamburg.

*Source:* http://www.desy.de/expo2000/

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# Fourth Symposium of the Croatian Radiation Protection Association

*Bogomil Obelic*

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The Fourth Symposium of CRPA was held in Zagreb, Croatia, from November 11 to 14, 1998. The co-organizers were Hazardous Waste Management Agency, Institute for Medical Research and Occupational Health, and Rudjer Boskovic Institute in Zagreb. IRPS was one of the sponsors of the Symposium.

The Croatian Radiation Protection Association was established as a national organization in 1979, and since the breakdown of former Yugoslavia in 1991 it is the member of International Radiation Protection Association. The society gathers specialists from all Croatia and works under the auspices of the Ministry of Science and Technology and Ministry of Health of the Republic of Croatia. The basic aims of the Association are protection of the population and human work and living environment from harmful radiation, as well as promotion of scientific insight to the effects of radiation. The first symposium of CRPA was organized yet during the war in Croatia in 1992, and since that time – in spite of limited funds – the symposia were organized regularly every 2 years.

About hundred scientists and specialists, mostly physicists, chemists, biologists and physicians, attended the symposium. They presented 55 lectures. Participants from Slovenia, Bosnia and Herzegovina, Hungary, Slovakia and Poland were also presented.

The introductory lecture was dedicated to the 100th anniversary of the discovery of radium. Radium euphoria from the beginning of the century, when it was considered to be the savior of the mankind from many diseases, finally declined in fifties because of its unfavorable effects and when it was realized that the use of radium could remain harmful for thousands of years. The conditioning of radium sources represents nowadays an important radiation protection task.

After introductory lectures the following main topics were considered: General topics of interest for radiation protection, Biological effects of radiation, Radioactive waste management, Radioecology, Dosimetry and instrumentation, Radiation protection in medicine and Radon.

Among the general topics of interest for radiation protection belongs in any case the new Croatian act on ionizing radiation protection. Legal regulations from the former state, still valid in the Republic of Croatia, should be replaced very soon with new ones, based on the new Basic Safety Standards of IAEA (IAEA Safety Series 11, 1996). New BSS recommends considerably lower radiation doses for population in respect to the previous one.

About 15 lectures dealing with biological effects of radiation and radiation protection in medicine were presented. Results of several experiments, carried out mostly on animals, were discussed. A special attendance was paid to the radioecology and measurements of radon concentration in dwellings and spas.

Two lectures were dedicated to the investigation of natural radioactivity of thermal waters. The estimation of doses obtained by visitors or tourists during their stay in spas is interesting for wider community because the spas are popular in Croatia in medicine therapy and for recreative bathing.

Radioactive waste management was the topic of a particular session. This is an important problem for Croatia, because up to now the decision for the location of the low and intermediate level waste repository in our country was not brought.

Several lectures were dedicated to non-radioactive radiation, as the effect of exposition to radar and to the use of ultrasound in medical diagnostic. There is the common opinion that the echoscopy by devices that satisfy regulation is not harmful. On the contrary, it was stressed that unnecessary and excess irradiation by X-ray diagnostic devices should be avoided.

A social program was inevitable to balance the intellectual pressures of the scientific sessions. In this respect, the opening was accompanied by a chamber string concert performed by two talented students of the Middle music school in Zagreb, who played sonatas of Paganini and Vivaldi. During the coffee breaks canapé sandwiches, cookies, coffee, tea and soft drinks were served. The farewell lunch was rich by home-made specialties.

The Organizing Committee and the Scientific Committee made great efforts in order to make the conference the success that it was and to enable that all the papers were published in the Proceedings on time, just before the beginning of the Symposium.

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WORLD NEWS



# Neutron Summer School Uses Both Neutrons


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*Source: Neutron News, Vol.10 No 1, 1999, pp7-8*

The third Neutron Summer School for young scientists in Japan, organized by the Neutron Scattering Association of Japan (NSAJ), was held both at KENS (Neutron Scattering Facilities, KEK, Tsukuba) and JRR3M (JAERI, Tokai) from July 20-24, 1998. KENS has a pulsed neutron source of an accelerator base, while JRR-3M has a reactor-based steady neutron source. Participants used both pulsed and steady state neutrons. Consequently, the school was divided into two parts, in which the first half from July 20-22 was held at KENS. The content involved lectures on pulsed neutron scattering and educational experiments with FOX (diffractometer for a single crystal), MRP (multipurpose diffractometer), VEGA (powder diffractometer), PorePore (polarized neutron reflectometer), CAT (crystal analyzer type spectrometer) and INC (chopper type spectrometer) using pulsed neutrons.

On the other hand, the last half of the school from July 22-24 was held at the JRR-3M reactor, Tokai. The lectures here were on neutron scattering based on steady state neutrons. All participants joined in to do demonstrative experiments with HQR (high Q resolution triple axis spectrometer), HERMES (high efficiency with medium resolution powder diffractometer), SANS-U (small angle neutron scattering instrument) and BIX-II (diffractometer for biological crystal with imaging plate) using steady state neutrons. This schedule might have seemed a little tight for one week, but participants seemed to enjoy all of programs, lectures, experiments, presentations, receptions, and discussions.

The majority of the school' s teachers are staff at KENS, the neutron scattering laboratory of ISSP (Institute for Solid State Physics), the University of Tokyo and ASRC (Advanced Science Research Center), JAERI. The number of students, 20, is limited by the capacity of the beam time assignments for the experiments. The students were graduate students, postgraduate students, post-doctoral fellows or young staff at universities, national laboratories or industry-based institutes, and two were guests from Taiwan. They came from the disciplines of physics and chemistry. The summer school was intended as a general introduction to neutron scattering with lectures and learning experiments. We hope that the school entices young scientists to come into neutron scattering from the different disciplines in physics and chemistry .

The school proved to be very successful and the participants, lecturers and representatives from the facilities who directed the experiments found it to be an enjoyable experience. Perhaps the success of the school can be gleaned from a comment by one student, "I really enjoyed the summer school. I thought every program was pitched at the right level. I got help with my studies from this school, so I can discuss my proposal with my supervisor. "

*The participants and lecturers of the neutron summer school gather at the entrance of the Hamon facility.<,/I>*

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# *Farewell Meeting of INS-SOR Users Union*


Taizo Sasaki

*J.A.S.R.I.*


*Source: Synchrotron Radiation News, Vol12 No 1, 1999, p.6*

INS-SOR, the earliest Japanese synchrotron radiation users union, which had been active since 1963, ceased its activities last year when the dedicated light source "SOR-RING" was closed down. To commemorate the union's achievements and services, Prof. Hanyu, the last chairman of the union, convened a farewell meeting at the old Tanashi campus of the Institute for Nuclear Study, the University of Tokyo. Both the 1.3 GeV electron synchrotron, which served as the initial radiation source in the early 1960s, and the SOR-RING, a storage ring built by volunteers from INS-SOR as a dedicated light source in 1974, were operated at the Tanashi campus until their shutdown.

The meeting was attended by more than 50 old and young users, and also by several notable guests, who kindly gave their encouragement and substantial support to this users group since its earliest phase of operation, specifically Professor K. Fusimi, the former president of the Japanese Science Council, and Professor Y. Toyozawa, the former Director of the Institute for Solid State Physics (ISSP). After the session was over, participants had a final glimpse of the SOR-RING, which was soon to be dissolved. A plan is underway to transfer a substantial part of this retired machine and exhibit it to the public in a science museum. After this last visit, there was a pleasant party attended by all the participants and several prominent guests, who kindly noted INS-SOR's contributions to science. A fraction of the "old-timers" continued the party in their favorite hideaway outside. >

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# *Nanotubes Separate Isotopes*

*Source: "Post Deadline", Physics World, Vol 12 No 3, 1999, p.5*

Researchers at the University of Pittsburgh and Carnegie Mellon University in the US have proposed a novel way to separate light and heavy isotopes of the same element. Their computer simulations suggest that carbon nanotubes - rolled-up sheets of graphite just a few angstroms in diameter could be used as "quantum sieves" to separate mixtures of molecular hydrogen and its radioactive isotope tritium (Q Wang et al. 1999 Phys. Rev Lett. 82, 956). Quantum sieves might one day be used to remove radioactive or "heavy" water molecules from the cooling tanks used to store nuclear-fuel rods.

Molecular filters are already widely used to separate different types of molecules based on their size or chemical properties. However, these filters cannot separate hydrogen from tritium because the two molecules are very similar in size. In contrast, a filter made from carbon nanotubes could exploit quantum mechanical effects to separate the isotopes. In principle, a hydrogen molecule placed inside a nanotube would vibrate so much that it would escape. In contrast, the heavier tritium molecule would vibrate much less and could therefore be adsorbed more easily. Bundles of carbon nanotubes have the correct pore size to effectively sieve a mixture of hydrogen and tritium gas by soaking up the tritium molecules.

Although quantum sieving was first proposed by researchers at Leiden University in the Netherlands, they limited their work to the study of the adsorption of hard spheres by hard cylindrical pores at zero temperature and pressure. In the new study, the team from Pittsburgh and Carnegie Mellon use a more realistic description of the molecules and examine what would happen under more realistic conditions. The new simulation was performed for sieves at a temperature of 20 K and for pressures ranging from 10–14 to 100 torr.

The researchers found that the most effective sieving was achieved with nanotubes much narrower than those that can be currently fabricated. However, they suggest that it should be possible to get round this problem by bundling the nanotubes together so that the gaps between them are smaller than the diameter. The simulations showed that nanotubes with diameters of 13.6Å which is very close in size to a diameter that can be produced in high concentrations bundled together are highly effective at separating hydrogen and tritium.

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# *19$^{th}$ Meeting of PRC/US Joint Committee on HEP*

Hou Rucheng

*Source: BEPC News, Vol 11 No 2, December 1998, p.1*

The Nineteenth Meeting of the PRC/US Joint Committee on High Energy Physics was held at the Institute of High Energy Physics (JHEP), the Chinese Academy of Sciences (CAS) from November 16 to 17, 1998. During the meeting, both sides reviewed with satisfaction the PRC/US collaborative efforts for the past year and discussed enthusiastically the collaborative items proposed by the Chinese side for the coming year. Following the friendly discussions and consultation between the two sides, a unanimous agreement was reached on the PRC/US Cooperative Program on High Energy Physics for November 1998 to November 1999. This program contains 29 collaborative items involving the upgrade of the Beijing Electron-Positron Collider (BEPC) and BES (BEijing Spectrometer), synchrotron radiation application and the Shanghai Synchrotron Radiation Facility of the Chinese side and SPEAR III, the experiments of D0, MINOS, BaBar and CMS of the American side.

During the meeting, both sides introduced their own long-range plan of high energy physics research. Some American participants spoke highly of the long range plan of China's high energy physics presented by Professor Chen Hesheng, Director of IHEP.

On November 17, 1998, Premier Zhu Rongji met with all members of the American delegation at Zhongnanhai. He listened attentively to the proposals, made by the three senior high energy physics (HEP) advisors to the CAS, for the development of China's high energy physics. Zhu expressed deep concern over the current condition of IHEP infrastructure and gave his strong support to the development of high energy physics in China.

Prior to the meeting, Professor W K H Panofsky, Professor F Gilman and Professor M Tigner, senior advisors on HEP to CAS conducted a review of the work of IHEP in the past year and exchanged views with Director Chen Hesheng over the future development of IHEP.

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# *Two-dimensional SmallAngle x-ray Scattering Apparatus*

Sheng Wenjun

*Source: BEPC News, Vol 11 No 2, December 1998, p.4*

Since 1997, a two-dimensional small angle x-ran scattering apparatus has been prepared and constructed at the Small Angle x-ray Scattering (SAXS) Station in Beijing Synchrotron Radiation Facility (BSRF).

One-dimensional SAXS apparatus can only be used to study spherical and near-spherical materials, so, the region of research is very limited. Nowadays, SAXS stations are widely built in the synchrotron radiation facilities, and most of them are equipped with two-dimensional apparatus. We designed and manufactured equipment at the beginning of 1998 and got two-dimensional SAXS profiles successfully in the dedicated run this winter. With it, the study region can be greatly widened, for example, to structural analysis of oriented samples.

Compared with the one dimensional SAXS, the two-dimensional one is more difficult in choice of vacuum sealing material, which must be not only of proper strength, but also of good transparency and low scattering for x-ray. In addition, both the adjustment of beamstop and focussing are knotty problems.

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## *Welcome to New Members . . . .*

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