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Office Bearers :1997 - 2000

- From the Editor
- President's Column
- Letters to the Editor
- Ideas
- Submitted Papers
- World News
- New Members and Address Changes

Return to Archive Home Page

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Main

FROM THE EDITOR

Dudley Creagh

Travelling in planes for long periods of time can at times be a very interesting experience. I recently had a long trip to the USA in which I had a quite illuminating experience. I had seen the person in the adjoining seat to mine arrive at the airport: deeply tanned, trendily dressed, driving a luxury 4-wheel drive vehicle, talking loudly into his mobile phone.

"What are you going to do in the USA?" he asked after we were seated. I replied that I was going to evaluate a new x ray system for a client. "X rays!! They kill you!!" he replied. Thereafter I had a lecture on the hazards of radiation: how the proposed Australian research reactor was a disaster because it would spew radiation all over Sydney; that the mining for uranium in the middle of a World Heritage Listed Park was unconscionable; that "radiation was bad for you"…and so on.

I enquired about his ability to speak so knowledgeably on the topic. He said he "read a bit". He was, in fact, an account executive who reached Year 10 level in science in Secondary school.

Did he know that he would receive a large dose of radiation during this flight, I asked? Would that stop him from flying? And that mobile phones emitted microwaves? Would he throw the contraption away? And what about his time spent on the beach? Did he know that ultraviolet rays caused skin cancer…? Did he know the mine he referred to was on the edge of the park, and was initially not included in the gazettal? ..... and so on.

There ***is*** a moral to this story. The world is populated by almost educated people who believe that they know something about radiation because they have read it in the newspapers and books. They then form judgements complicated by their complete ignorance of the scientific case.

We should actively try to inform people of the benefits and the hazards of the use of all forms of radiation.

Main	Next

PRESIDENT'S COLUMN

Bikash Sinha

Radiation comes in many splendours: light in the form of gamma rays; heat, black body radiation; cosmic ray particles which include electrons, neutrinos, alpha particles in abundance, and even heavier nuclei. It is very regrettable however that radiation to the average educated man is perceived as the horror of nuclear bombs, reactor disaster, radiation burning, and allied problems such as cancer.

The beauty of the play in which the radiation family performs now has at centre stage the group of neutrinos. These are a marvel for theoretical physicists, a nightmare for experimentalists, inevitably elusive, and full of delightful dark mysteries. Originally proposed by Pauli to explain beta decay (radiation), neutrinos keep coming up time to time as the Prince Charming of the most fundamental puzzles of physics. Neutrinos demand a very large scale detecting system (only a few thousand gallons of the appropriate stuff!). Thus it is only in recent times, pioneered by Leon Laderman that the three varieties of neutrino are here to stay for definite nu-mu, nu-electron, nu-tau.

The neutrino which started their long unhindered (by definition) journey some one hundred fifty thousand years ago from the Large Magellanic Clouds, just so many light years away, reached the Japanese and American detectors in February 1987, unfolding the dramatic cinema of the supernova explosion exactly so many years ago as it took ‘light’ to reach the earth, the illusive stars of the cinema the neutrinos, started the detectors clacking in February 1987.

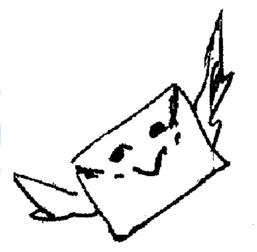
Then, yet another puzzle: - extremely patient yet determined experimentalists found that there are just not so many neutrino coming from our old sun, as expected theoretically.

Most recently, the Dark Prince of Particle Physics has sprung another surprise, which threatens the edifice of our of understanding of particle physics, the standard model, causing it to crumble, if not at least crack. The nu-mu and the new-electron change or rather oscillate, at least, so it seems, from one form to the other as if the forms are trying to shield their initial identity starting as one and changing over to the other. The major centres of the world agree more or less that this means there is a finite mass, attached to the neutrinos and that the difference of the square of the mass, Δm^2 is non zero. So far neutrinos have been thought to have no mass whatsoever (a $\ell\hat{a}$ standard model).

Once again, Pauli’s mysterious neutrinos take the centre stage, some radiation! Please don’t worry, as you are reading this, non trivial number of neutrinos are passing through you constantly and of course you not only completely unaware of their presence but you are ignorant of whether they have changed their clothes or as they pass through!

Previous	Main	Next

LETTERS TO THE EDITOR



To the Editor:

Sir

I wish to express my concern about the recent nuclear test by India and Pakistan, which are near neighbours to Sri Lanka. For the people in Sri Lanka this may not be too much of a bother since they are struggling everyday with the usual bombs that explode quite often in almost every part of the country. But people here definitely know the adverse effects of these bombs and won't support the recent nuclear test by its neighbours, which has pushed this region into a future of uncertainty, ethical confusion and multiplying strategic threats.

First India exploded the nuclear bomb and demanded that it should be accepted as the six nuclear weapon states. With this, a nuclear arms race has been initiated in the sub-continent and Pakistan has immediately followed with its own nuclear blast and declared itself as another nuclear weapon state.

Now these tests have been carried out we can't do anything with that. So we must start from here and try to find what should be done to safeguard the future of this region and the world. As far as these two countries are concerned they have proved that they both have nuclear weapon capacity. But, what is ironic is that they had nuclear bombs before they proved it by exploding them. This suggests that they may have many more nuclear bombs in their store. This rules out nuclear war between them and leaves only one option- that of negotiations. This was clearly stated by the Chairman of Atomic Energy Commission (India), Dr.R Chidambaram. He said that "the greatest advantage of recognized strength is that you don't have to use it".

India's nuclear doctrine is quite complex and it had been crafted through a prolonged encounter with the efforts of the other nuclear weapon states led by the U.S., the only country to have ever utilised nuclear weapons. Pakistan too does not have a clear nuclear doctrine and strategy and the country has a track record of military coups and counter coups. With this they cannot prevent any accidental deployment of nuclear weapons. So what they should understand first is that no amount of technological sophistication could eliminate the risk of a nuclear attack or war even among the most advanced nuclear weapon states. Such risks are high in the case of these two countries. They lack the required technology and financial means to protect themselves even from their own accidental nuclear leakage. Also the cost of nuclear deployment and the threat of the nuclear exchange are just too high and this will definitely divert the attention away from the grave problems facing this sub-continent- hunger, poverty, health, illiteracy,...etc.

This really worries all the neighbours including Sri Lanka, Bangladesh, Bhutan Nepal and Maldives since nobody here wants any more regional tensions in south Asia in a time when they are trying to develop themselves. Although one does not know whether these countries too have any nuclear bombs in their arsenal. Any future conflict between India and its nuclear-armed neighbours now carries with the threat of nuclear exchange which will only lead to mutual annihilation of this South Asian regions. Even a limited nuclear exchange, either by accident or war will devastate both countries, causing long-term damage to the land its people.

The people of India, and Pakistan who loves the peace between the two countries, should act immediately to stop this in future. The government of both the countries must halt the programme of weaponisation and must not induct or deploy nuclear weapons. These two countries should together take the initiative to convene a global convention for the elimination of nuclear weapons. They must return to the global nuclear disarmament agenda and stop any further measures towards the induction and deployment of nuclear weapons in the sub-content. They must vigorously campagin to dismantle the global discriminatory nuclear regime and initiate moves towards global nuclear disarmaments.

There are lots of perssures on these two countries to sign the Nuclear Non-Proliferation Treaty (NPT) and Comprehensive Test Ban Treaty (CTBT) immediately from P-5 and G-8 countries. If they are serious about NPT and CTBT, they must pursue a credible programme for the distruction of nuclear weapons globally, starting with their own. There already exist global treaties, signed by all countries, prohibiting the use of chemical and biological weapons and for destroying existing stockpiles of such weapons of mass destruction. I cannot find any reson why a similar global treaty cannot be signed by all countries to prohibit the use of nuclear weapons and to eliminate the existing stockpile of nuclear weapons with a time-bound frame work. There should be no nuclear tests anywhere in the world and all nuclear weapons should be destroyed at once all over the world so that human beings may live fearlessly and peacefully. We as concerned citizens of this world should direct our efforts not only at pressurising the governments of India and Pakistan, but also at mobilising world public opinion for such a goal.

Siva, Sri Lanka

Previous	Main	Next

! ! ! ! !
IDEAS ! ! ! ! !

Give us a job!!!

Do you need a Ph.D. student? Do you need a research assistant? Are you looking for a Postdoc position?

We are considering having a slot in the Bulletin for vacancies and posts wanted. It would be a way to advertise these positions, wanted or vacant, within the IRPS membership with no cost. If this idea interests you, contact the editorial members of the Bulletin and we can place your 'advertisement' in the next issue and put it on the web page.

E-mail Addresses

We would like to have a register of the e-mail addresses of members. This would facilitate our ability to communicate rapidly with you. Please send your e-mail address by e-mail to :

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Previous	Main	Next

SUBMITTED PAPERS

X-ray diffraction inspection for the detection of contraband

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In a previous edition of the IRPS Bulletin Malcolm Cooper wrote an article of current trends in airport security ("Fighting crime with x-rays", IRPS Bulletin, Volume 12, No.1). This piece follows up on one of the techniques that Malcolm highlighted, that of low angle x-ray diffraction. This, unlike most security-based techniques has enjoyed significant reporting in open scientific literature in recent years. The "news blackout" regarding some of the other techniques usually has more to do with commercial interest than any security implications and often many of the techniques employed in security imaging systems have been taken from previous widely published developments in the medical field, for example dual energy imaging and computerised tomography. Diffraction techniques are rather different however in that they are currently being developed for both medical and industrial techniques simultaneously in both academic and industrial quarters.

One of the main criticisms that the neutron community often have of x-ray inspection is that x-rays are not material specific. Well this may be true in terms of the total attenuation but is clearly untrue if we consider the interaction mechanisms responsible. The photoelectric interaction, for example, leads directly to x-ray fluorescence, an unarguably elemental specific phenomenon (although the very low fluorescent energies of organic compounds make the technique impracticable for the detection of concealed contraband). Another photon interaction is Rayleigh scattering, defined as the elastic and coherent scattering of x-rays from bound atomic electrons and is the process that leads directly to diffraction. The phenomenon of x-ray diffraction was first investigated at the beginning of the century by the likes of the German physicist von Laue and the two English physicists W.H.Bragg and his son W. L.Bragg; the latter who went on to derive the famous diffraction law which bears their name. It was not however until the mid 1980's that this interaction was first proposed as a non-invasive probe for materials characterisation, most notably in the medical field looking for increased contrast between biological media. Over the last ten years the potential applications of this form of analysis have increased dramatically, with the detection of concealed contraband being one of several currently being exploited.

One of the greatest threats to aviation security comes from sheet explosive concealed in passenger luggage. Plastic explosives are organic and therefore low-Z and when formed into thin sheet (of the order 5 mm) are difficult to detect by conventional transmission methods. In recent years a number of groups have investigated the use of x-ray diffraction as a material specific technique for the detection of explosives. Many explosives are crystalline in structure and therefore produce characteristic diffraction effects when irradiated by photons. This may be measured either angular dispersively whereby mono-chromatic photon scattering is measured as a function of angle or by energy dispersive means where the scattering of photons from a poly-chromatic source i.e. conventional x-ray tube, is measured at a fixed angle. Both of these methods produce data which, whilst varying with angle and energy, is invariant in momentum transfer and therefore directly comparable. Figure 1 shows the x-ray diffraction from calcium carbonate as a function of both energy and scattering angle. Whilst it can be seen that varying either the energy or the scattering angle causes an appropriate shift in the other parameter the fundamental diffraction data is unchanged. Either of the approaches produce a unique diffraction profile or "signature" of the irradiated material and figure 2 shows a typical energy dispersive diffraction profile of a notorious explosive often the stock weapon in the terrorist armoury, namely Semtex.

Whilst the profile does not have the resolution of conventional diffraction measurements it is unique to Semtex and easily identifiable. The problem comes when measuring the materials in a realistic situation, that is in a suitcase where overlying materials complicate the diffraction profiles and severely attenuate the data. In this situation reliable data analysis is essential. To this end various forms of pattern recognition analysis are being investigated, for example neural networks and multivariate statistical analysis have shown very promising results. Another approach is to measure both angular and energy dispersive data using an array of energy dispersive detectors and to locate regions in diffraction space associated with known explosives. This simplifies the analysis by using relative scattering intensities as the threat indicator. Whichever form of data collection and analysis is employed it is essential that the final system is fully automated to produce a quick "threat / no threat" decision without the need for human involvement. It is also clearly important that as with any security system the number of false positive decisions is minimised without compromising public safety. Whilst these requirements are technically

challenging they are being successfully addressed and several prototype systems are currently being deployed or in the development process. It is anticipated that in the next few years x-ray diffraction inspection will be another weapon in the increasing armoury of the law enforcement officer.

Having attended several security technology conferences over the past few years there seems to have been a definite shift in attitude regarding the range of potential technologies. Some years ago people would attend these meetings to promote their own field and to shoot down their competitors. The x-ray fraternity would say to the neutron people "Well the nitrogen in explosives looks the same as the nitrogen in broccoli, how can you possibly differentiate?", the neutron people would say to the nuclear quadropole resonance community

"What if the drugs are wrapped in tin foil, what happens to your signal then?" and of course the diffraction lobby would be asked "What if the drugs are diluted or the explosives are liquid, what happens to your long range order then?" To which of course we had no reply. More recently however people have realised there is no "Holy Grail" as far as contraband detection goes, no single technology that will accommodate all potential situations. The community, and the bodies funding the community, have realised that the solution involves all of the current technologies working in tandem and that the challenge for the future is to deploy them in the most effective manner, tailoring the systems to their specific requirements.

Previous | Main | Next

WORLD NEWS

Triple First

(From "Post-Deadline", Physics World, Vol. 11, No. 10, October, 1998, p.5)

A group of physicists from Japan and the US has observed the triple photoionization of lithium - in which a single photon simultaneously ejects all three electrons from an atom - for the first time (R Wehlitz et al. 1998 Phys. Rev. Lett. 81 1813). The team used extreme ultraviolet radiation from the Japanese Photon Factory, a synchrotron radiation source at the KEK lab in Tsukuba, to ionize the atoms.

Triple photoionization has been observed in neon and other atoms before, but it has been difficult to make comparisons with theory. In lithium all three electrons are ejected simultaneously, so only a single process has to be calculated. In heavier atoms, however, other ionization routes that involve the excitation of two or more electrons before ejection are involved. Furthermore, the larger number of electrons in the atoms generally complicates the calculations. There is, not surprisingly, a price to pay for the simplicity of lithium - a very low probability or "cross section" for triple photoionization.

Ionization is one of the most fundamental processes in physics, and experimental measurements of the process provide a good test of theories of many -electron systems. Ionization is also the key process in the formation of the plasma state - the state in which the vast majority of matter in the universe exists.

The Japan US team used time-of-flight spectroscopy to measure the ratio of the cross-sections for triple and single ionization from a photon energy of 203.4 eV, the threshold for triple ionization, to 424 eV. The cross-section for triple ionization rose from zero at the threshold energy to about 0.0066% of that for single ionization around 300 eV, and remained flat at higher energies. However, simple calculations give a ratio of 0.0015%, a factor of four lower than experiment, which means that for all lithium's simplicity, there is still plenty of work for theorists.

SOHO back in the sunlight

Edwin Cartlidge

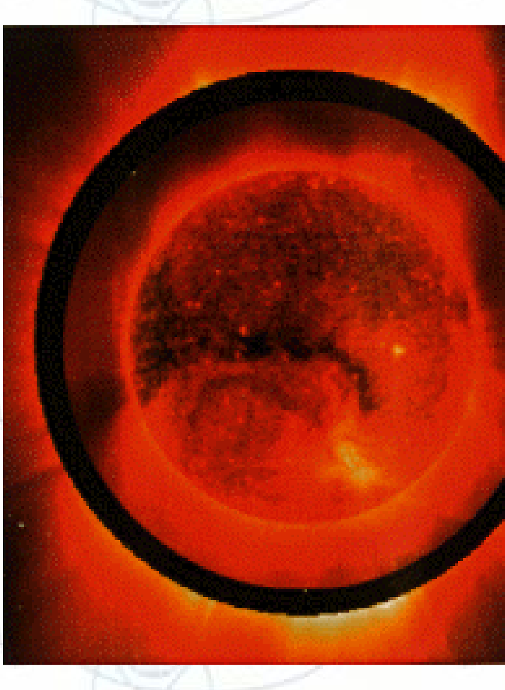
(From "Space Physics", Physics World, Vol. 11, No. 10, October, 1998, p.9)

Scientists have succeeded in turning SOHO around to face the Sun. The Solar and Heliospheric Observatory has been out of action since June when a control error sent the spacecraft spiralling out of control. It spun away from the Sun, losing power and then contact with

Earth. Last month engineers finally managed to make radio contact with SOHO, which enabled them to thaw out its fuel and turn the craft's solar panels sunward. It now remains to be seen if the instruments on board have survived the huge temperature variations, and can continue to observe the Sun.

On 16 September scientists around the world celebrated the result of several days of complex manoeuvring in deep space. "It's a big step forward in our recovery plan for SOHO," says Francis Vandenbussche, head of the SOHO recovery team at the European Space Agency (ESA). "We were never quite sure that we would manage to make the spacecraft point back towards the Sun." Richard Harrison of the Rutherford Appleton Laboratory in the UK, who is principal investigator on SOHO's coronal diagnostics spectrometer (CDS), says that a recovery of this kind had never been achieved before. "To my knowledge this is the first ever real deep-space recovery."

Researchers from 12 teams in Europe and the US still have a number of nervous weeks before they will know which instruments have survived the 100 °C to + 100 °C battering. Harrison says he is optimistic that the CDS, which studies the Sun's atmosphere, will be up and running "Some instruments have a greater chance of working than others", he says. "Some are more robust and were tested to greater extremes before being launched into space. But I do have confidence in the CDS it is a robust instrument which you feel would survive being hit by a sledgehammer."



Stargazer – how SOHO sees the Sun

Launched in December 1995, the $1 billion joint mission between NASA and ESA wasdesigned to study the interior of the Sun, its outer atmosphere, and the origin of the solar wind a stream of highly ionized gas which blows through the Solar System. From a permanent vantage point 1.5 million kilometres from the Earth, SOHO has shown that solar flares produce gigantic seismic quakes in the Sun's interior, and that gyrating storms, like tornadoes, occur near the north and south poles.

If the instruments thaw out as hoped, SOHO should go on observing the Sun until 2003, including a period of maximum sunspot activity around 2000. According to Harrison, the run up to the maximum should reveal many insights into how the Sun changes throughout its cycle of activity.

Although SOHO has already completed its mission as originally envisaged, space scientists are hoping for a lot more. "The mission has been a huge success, and any results from now on arc a bonus. But it required such a large investment that we will milk it for all it's worth," says Harrison.

Miniature Fresnel lenses for EM and X-ray nanofabrication

(From "Literature Highlights", Asia/Pacific Microscopy and Analysis, Issue 5, September, 1998, p17)

In electron microscopes, the electron beam is focused by large magnetic lenses. Electron beams can however also be focused using Fresnel lenses fabricated from thin inorganic films. Ito and colleagues report (Ito, Y et al. Nanofabrication of solid state lenses for electron optics. Nature 394, 49-52, July 1998) that they have made circular pixelated Fresnel lenses only 700nm or less in diameter from 68nm thick AIF3 films which when placed inside a STEM can change the phase of an electron beam. Both convergent and divergent lenses can be made in this manner and they have a numerical aperture of 10-3 which is an order of magnitude less than magnetic lenses. Potential applications for these lenses are in the nanofabrication of electronic devices by electron beam lithography and photonic crystals by X-ray optics.

Dimensional Metrology

(From "Literature Highlights", Asia/Pacific Microscopy and Analysis, Issue 5, September, 1998, p17)

Measurement Science and Technology 9 (7) July 98 is a special issue devoted to Dimensional Metrology. High accuracy measurements are essential in the manufacturing, aerospace, semiconductor and precision engineering industries. This collection of 22 papers includes reviews and original papers on the use of light, laser, and X-ray interferometry, and scanning force microscopy, atomic force microscopy, scanning tunnelling microscopy, scanning electron microscopy and confocal microscopy to provide accurate measurements from the millimetre to nanometre range in a variety of situations.

Israel as New Scientific Associate

(From "Newsletter in Brief", ESRF Newsletter, No. 31, September, 1998, p3)

The Council agreed to, and authorized its Chairman to sign for the ESRF on its behalf, an "Arrangement between the Government of the State of Israel and the European Synchrotron Radiation Facility concerning the long term scientific use of synchrotron radiation for non-proprietary research" very similar to the one concluded last year with Portugal (cf. ESRF Newsletter No. 29, p.3).

Since the Foundation Phase of the ESRF, contacts have been made with the Israel Academy of Sciences and Humanities concerning an involvement of Israel in the ESRF. In February 1987, the then Israeli Minister of Science and Development, Gideon Patt, considered in a letter to the Chairman of the provisional ESRF Council, Pierre Agrain, an application for Israel to become a full Member of the ESRF. In the outcome, however, Israel was not among the founding Members of the ESRF. Nevertheless, regular visits by Israeli scientists over the last ten years have marked the continuous interest of the Israeli Scientific community. However, it was obvious that its size would not match the 4% threshold required for full ESRF Membership.

Discussions with the Israeli partners intensified after the Council had clarified the conditions for long-term arrangements in accordance with Article 8 of the ESRF Convention. The arrangement agreed by the Council is due to be signed in November in Jerusalem and will make Israel the second Scientific Associate of the ESRF. Thus scientists from Israel will have the same rights of access to the ESRF beamlines as those from the twelve Contracting Party countries. For the time being, the level of the Israeli contribution to the ESRF operating costs has been set at 1% of the contributions of the Members.

Soft Matter under Flow as Probed by Small-Angle Scattering – SASFLOW'98

O Diat

(From "Newsletter in Brief", ESRF NEwsletter, No. 31, September 1998, p7)

In the last five years a major challenge among the soft-matter community is to elucidate the relationship between rheological properties of complex fluids and their mesoscopic structure as revealed by small-angle scattering (SAS) experiments. On 28-29 May 1998, a common ESRF/ILL workshop was held at the ESRF, organized by O. Diat (ESRF), P. Lindner and J. Zipfel (ILL).

The main objectives of this common workshop were:

- to advance the new opportunities of experiments under shear on large instruments and especially at the ESRF and ILL.
- to provide a summary of recent experiments or projects using SAS techniques.
- to explore users' interest in order to plan long-term projects and to optimize technical developments and analysis.

This workshop was divided into six sub-sessions, on surfactants, polymer solutions, block-copolymers, polymer blends, suspensions under shear and a session on instrumentation plus a visit to the experimental facilities on the site (ILL and ESRF). A poster session was also organized in order to complement the overview of some recent experiments in this field.

As D. Roux recalled in the first contribution, scattering techniques (light, x-ray and neutron) give the most interesting structural information to understand the phenomenological and mechanical results obtained by rheology. Several examples of shear transitions i.e. transitions to metastable phases or orientation not observable at equilibrium were presented (shear stripping of charged vesicles - Gradzielsky et al; "onion phases" - Roux et al; shear ordering of surfactant system - Penfold et al. Richtering et al; shear ordering or shear melting in block-copolymer system either in melt or solution K. Mortensen et al, I. Hamley et al, Porte et al; shear thickening in polymer-clays mixed system, S. Cocard et al). On the other hand, phase transitions under shear or shift of the transition line have also been observed as in vesicle to micelle transition in surfactant mixtures (E. Mendes et al), in shear-induced aggregation in polymer solution (1. Morfin et al, T. Hashimoto), in shear effects in liquid crystal polymers (L. Noirez et al), or in critical polymer mixtures under shear flow (C. Han et al), on weakly flocculated dispersions (J. Vermand et al) and on diblock copolymer systems with re-entrant phenomenon (H. Leist et al). Although we can always present these shear effects as enhancement or decrease of fluctuations along the flow, it is still very difficult to predict them. All these examples are the signature of a large and rich variety of flow behaviour completely open to theory[1].

All these groups presented some results using their specific techniques (light or neutron or x-rays). The aim of this common workshop was to find out ways of optimizing the use of the new third generation synchrotron sources (high spatial resolution and time-resolved experiments) as well as high-flux neutron beams (contrast variation) tor pertinent experiments. Kinetics studies under continuous or oscillatory shear to describe the out-of-equilibrium transitions have been stressed (Porte et al. O. Pelletier et al. Mortensen et al C. Han et al). Mvoreoxer. the development of shear cells with an access to the vorticity -gradient plane seems very important due to the effect of phase separation in the Couette cell gap (stress effect instead of shear effect). This also requires the on-line set-up of a rheometer to correlate directly stress measurement and scattering techniques.

The last point but not the least which has been emphasized, is the development of elongational flow systems (spinning system, stagnation point and stretching devices) which are very relevant in areas like materials processing, development of composites as well as in investigations of polymer dynamics in complex geometries (M. Cloitre et al).

Some new contacts have already been established and. in common with the ILL, we shall be able to judge the effectiveness of our development only in a few years' time when we look at what will be achieved. A common WEB page will be implemented in order to inform other large instrument beamlines and users about new instrumental development at the ESRF and the ILL.

P. Lindner, J. Ziptel and myself would like to thank all the people who have made this workshop successful.

[1] T. McLeish: Theoretical Challenges in the Dynamics of Complex Fluids, edited by T. McLeish,
Kluwer Academic Publishers, Netherlands (1997).

NEW MEMBERS, ADDRESS CHANGES

Contact details for Members (access from Welcome page) are updated regularly between issues, including the information for the members listed below

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Corrections to Members' contact information:

These have been made for the following members in the Membership Contact List accessed from the Welcome page

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