

### Director's Foreword:

Dear Friends, It is indeed a pleasure to see the arrival of the new look News Letter. Congratulations to the editorial team led by Dr. Jaydeb Chakrabarti for giving it a shape. I welcome broad participation by all sections of the centre –faculty, nonacademic staff and students. The news letter is not only a forum to exchange information and inform each other of happenings and the achievements, it is also a platform for expressing views on issues that are of relevance to us as a community. The success of the news letter depends on how much we would like it to succeed. I am sure if it is of relevance to us we would like it to succeed. It will be the constant endeavour of the editorial team to ensure that it has a quality and also it has a relevance. I wish our news letter all the success.

Prof. A.K. Raychaudhuri, Director, SNBNCBS

### 100 years of Helium liquefaction celebrated



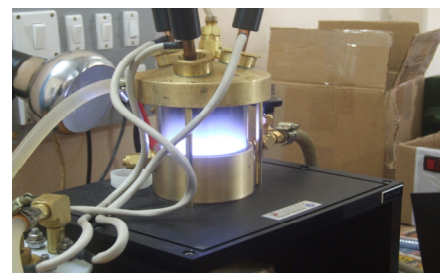
A one-day symposium to commemorate 100 years of helium liquefaction on July 10, 1908 by Kammerlingh Onnes. The talks highlighted the seminal works of Kamerlingh Onnes on the liquefaction of helium in 1908 and the discovery of superconductivity in 1911. The speakers emphasized on the fact that almost all branches of theoretical physics use liquid helium as their testing ground, where fascinating phenomena have been observed all these years. Exotic magnetic phases are often observed at low temperatures and high magnetic fields that are now accessible at a few places in India. Superconducting magnets, an outcome of both helium liquefaction and superconductivity, are used extensively in particle accelerators, MHD, medical applications etc. apart from condensed matter physics experiments. (Prof. A. K. Majumdar, Material Sciences)

### Inside

- Electronic structure..... Pg.2
- Primordial Black holes.... Pg.2
- Heterogeneities ..... Pg.2
- 25<sup>th</sup> Int. Conference..... Pg.2
- Food, art..... Pg.3
- Post-B. Sc..... Pg.3
- Reminiscing Raman..... Pg.3
- Spectrum Seminar..... Pg.3
- BOSSAR..... Pg.3

### A new TRI-ARC melting facility at the Centre

A tri-arc furnace for preparation of metallic alloy samples has been purchased from a DST project. This furnace is of Centorr/Vacuum Industries Model 5TA with tri-arc capabilities. It has been installed for the preparation of alloy samples. It is capable of reaching 3000°C and more for melting of metallic alloys with the three arcs working together with the passage of huge current up to 400 A. (Dr. P. K. Mukhopadhyay, Material Sciences)



### Editorial Message:

The Newsletter is not just an academic chronicle of the Centre. It reflects the life here: as the students, the faculty and every staff members find. We have done good researches during the period as reflected through the highlights. Our strength is not only in researches but also in other creative facets. Nevertheless, I should not highlight the positive aspects alone. There are a number of things we must sort out to make our life in the Centre better and better: The construction of the upcoming building is dragging on too much. The Hostel accommodation inside the campus must come up fast so that the students can spend more time on researches. We hope that such difficulties could be overcome soon by our concerted efforts. We acknowledge the assistance from Ms. Diparwita Das and Indrani Laha in bringing out this issue.

Institute link: <http://www.bose.res.in/>

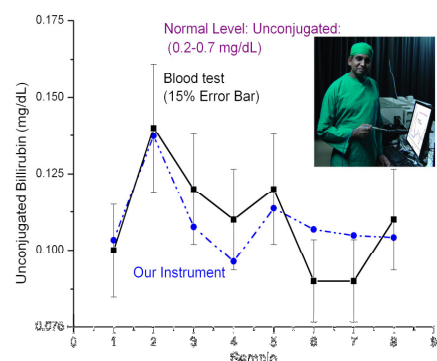
### Anita Mehta awarded a Fellowship of the American Physical Society



Anita Mehta has been awarded fellowship of the APS during April 2008. She was India's second woman Rhodes Scholar to Oxford in 1978, and India's first Radcliffe Fellow to Harvard in 2006-7. She joined as a faculty member in the S. N. Bose Centre in 1995. She is currently a Professor in the Centre. Her current research interests concern Complexity in Natural and Intelligent Systems (highlighted in Page 2).

### Early detection of bilirubin: A direct application of Basic sciences

Sudarson S. Sinha, a graduate student in Dr. Samir K Pal's Group, has developed a simple spectroscopic instrument to estimate the amount of bilirubin in our body. This is a noninvasive detection technique. The detection and analysis time is very little and the cost is affordable. Our preliminary experimental results (hospital trial) on normal patients are also very close (~15%) to the pathological blood test results.



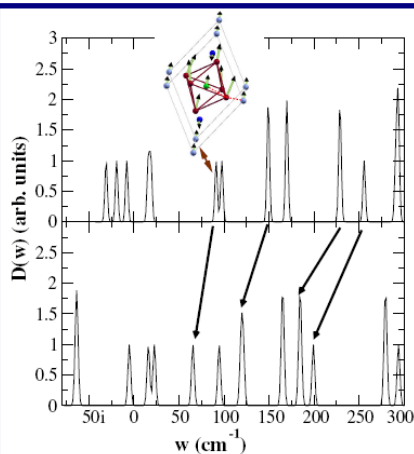


FIG. 3 (color online). Phonon spectra of rhombohedral LNMO in FM (top panel) and FIM (bottom panel) states. The arrows show the shifting of dominant IR-active phonon modes. The inset shows the displacement of atoms corresponding to the lowest frequency IR-active mode. The angle between the dotted lines connecting the Ni—O (at the center of the oxygen-octahedra) and O—Mn (rightmost corner of the cell) is affected by this phonon.

### Electronic Structure, Phonons, and Dielectric Anomaly in Ferromagnetic Insulating Double Perovskite $\text{La}_2\text{NiMnO}_6$

Dr. Tanusri Saha-Dasgupta, Material Sciences

Using first-principles density functional calculations, we study the electronic and magnetic properties of the ferromagnetic insulating double perovskite compound  $\text{La}_2\text{NiMnO}_6$ , which has been reported to exhibit an interesting magnetic field sensitive dielectric anomaly as a function of temperature. Our study reveals the existence of very soft infrared active phonons that couple strongly with spins at the Ni and Mn sites through modification of the super-exchange interaction. We suggest that these modes are the origin for the observed dielectric anomaly in  $\text{La}_2\text{NiMnO}_6$ . *Journal Ref: Phys. Rev. Lett. 100, 186402 (2008)*

### Primordial Black holes in scalar-tensor theories

Dr. A. S. Majumdar, Astrophysics & Cosmology

Scalar-tensor theories (also known as Jordan-Brans-Dicke theories) are one of the best motivated alternatives to the Einstein theory of general relativity. The gravitational constant acquires a time-dependence over the course of evolution of the universe with several exciting cosmological consequences. Black holes in these models could acquire “gravitational memory” due to variation of the gravitational ‘constant’. We have been able to show that primordial black holes (formed during the early evolution of the universe) could survive up to present times in these models, acting as components of cold dark matter in the universe. *Journal Ref: MNRAS, 385, 1467 (2008).*

### Heterogeneities in granular dynamics

Prof. Anita Mehta, Theoretical Sciences

The absence of Brownian motion in granular media is a source of much complexity, including the prevalence of heterogeneity, whether static or dynamic, within a given system. Such strong heterogeneities can exist as a function of depth in a box of grains; this is the system we study here. First, we present results from three-dimensional, cooperative and stochastic Monte Carlo shaking simulations of spheres on heterogeneous density fluctuations. Next, we juxtapose these with results obtained from a theoretical model of a column of grains under gravity; frustration via competing local fields is included in our model, whereas the effect of gravity is to slow down the dynamics of successively deeper layers. The combined conclusions suggest that the dynamics of a real granular column can be divided into different phases—ballistic, logarithmic, activated, and glassy—as a function of depth. The nature of the ground states and their retrieval (under zero-temperature dynamics) is analyzed; the glassy phase shows clear evidence of its intrinsic (“crystalline”) states, which lie below a band of approximately degenerate ground states. In the other three phases, by contrast, the system jams into a state chosen randomly from this upper band of metastable states.

*Journal Ref: Proceedings of the National Academy of Science, 105, 24, 8244–8249 (2008) ; <http://www.pnas.org/content/early/2008/06/06/0711733105.abstract>*

### IN BRIEF

**EVLP Programme:** Our Extended Visitor's Program (EVLP) is running with success. A number of renowned Scientists all over the Country spend time here and gave talks and lectures.

**Bose Colloquium:** The newly launched Bose Colloquium has attracted a good audience. The speakers are distinguished personalities in the National Science scenario, like Dr. Anil Kakodkar, The Chairman, AEC and Secretary DAE, Prof. T. V. Ramakrishnan, Prof. Amitava Raychaudhuri and others. The Bose Colloquium speaker list includes faculty members of the S. N. Bose Centre also: Prof. Abhijit Mookerjee and Prof. N. Nayak.

**Placement Awareness Cell:** The Centre has started its Placement Awareness Cell (PAC) from May 2008 to make the students and researchers aware about the employment opportunities.

**Ph D thesis:** Thesis has been submitted by six students so far this year. The students who obtained the Phd degree are:

- Subarna Mitra,
- Soumen Mandal,
- Sunandan Gangopadhyay,
- Biplab Ghosh and
- Kuldeep Kumar.

**New students:** New students joined the Centre in both the Post-BSc and Post-MSc regular Phd curricula. The classes have started around the first week of August.

### 25<sup>th</sup> International Conference on Low Temperature Physics (LT 25)

Dr. Ranjan Chaudhury, Material Sciences

The 25<sup>th</sup> International Conference on Low Temperature Physics (LT 25) was held in Amsterdam (Netherlands) during August 6- 13, 2008. This conference was very special, as it commemorated the centennial of the liquefaction of Helium by Kamerlingh Onnes, carried out in the neighbouring city of Leiden. The conference covered diverse fields, ranging from the different areas in condensed matter physics and materials sciences to the problems of quantum computation and cryotechnology. On the inaugural day two award lectures were delivered by I. Fomin and Y. Bunkov on “Spin Superfluidity and Coherent Spin Precession” (London Prize) and J.S. Tsai on “In Quest of Quantum Coherent Behaviour in Macroscopic Objects via Superconducting Devices” (Simon Prize). Some of the speakers in different areas were: L. Taillefer, A. Yazdani, H. Hosono, C.M. Varma, S. Sachdev, F. Levy, G. Aeppli, and E. Fradkin. The concluding scientific lecture of this conference was delivered by W. Ketterle on “Superfluidity in a gas of strongly interacting fermions”.





The International Conference on Martensitic Transformations (ICOMAT) is held once every four years since 1976. This year, the 12<sup>th</sup> ICOMAT conference was held in Santa Fe, in New Mexico, U.S.A. from 29<sup>th</sup> to the 5<sup>th</sup> of July. The work carried out in the Centre by Prof. Surajit Sengupta and graduate students Jayee Bhattacharya and Arya Paul in collaboration with Prof. Madan Rao (Raman Research Institute, Bangalore) was presented to a discerning and critical international audience. Martensitic transformations are structural transitions which occur in solids without atoms undergoing any diffusive motion, and produce characteristic micro-structural patterning which has many important technological applications such as, strengthening of alloys, shape memory, super-elasticity etc.

Santa Fe is a quaint historic town in an area distinguished by a unique fusion of several cultures viz. Spanish, Native American and Wild West which naturally fosters a spirit of creative innovation. There are several interesting artists' communities and art galleries. The multi-cultural ambience also expresses itself in the region's distinctive food, ranging from "blue" corn tortillas, to the spicy "Carne Adobado" -- all accompanied by drafts of cool and refreshing Margaritas.

*Post B. Sc. program: Right or Wrong?*

*Prof. Jayanta K Bhattacharjee, Theoretical Sciences*

It is a sad truth that constructive thinking about the education policy of the nation was limited to the first euphoric decade after independence. Three giant steps were taken in the Nehruvian period:

A) Setting up of IITs- the major success story of our country over the years; B) Setting up of research only laboratories, thereby violating a centuries old tradition ; and C) Introduction of the eleven year school curriculum, the undoing of which in the seventies is the primary reason behind the poor shape of education at present.

No steps were taken to ensure the vitality of universities. When in the course of time the inability of states to differentiate between running a political machinery and a university took its toll, it was realized that research institutes require universities for their existence. To remedy the situation, the research institutes decided to catch them young and introduced a masters program in their schedule. Our centre joined the bandwagon in 2001.

Has the program been a success? Even more importantly, should it have been a success? The answer to the second question is an emphatic "no". There should be no substitute for universities. Universities with their vastness, their varied programs, their ability to cater to all kinds of students, offer an intellectual environment that cannot be matched. What about the picture from the point of view of the institute? The younger students with their unbiased attitudes, their freshness of thought and irreverence provide a vibrancy in a generally sterile atmosphere. The institutes cannot afford to let this program go. A dynamic equilibrium between the head and the heart is what we can hope for.

*Reminiscing Raman: On my first visit to RRI, Bangalore*

*Sunish Kumar Deb, Academic & Students' Programme*

There lies that Tall Man  
Cremated  
Under the Prima Vera Tree  
It rises high to paint the sky  
With glowing yellow flowers  
With many maturing colours  
And the sky beckoning them  
With motherly care.

At dawn or at dusk  
Amid the chirping percussions  
Under the leafy pathways  
His unseen presence hovers in the air  
Instilling spirit to myriad minds  
To brood and rear ideas rare  
To flow more colours to life.

There stands the pyramidal Prima Vera  
Reminiscing Raman  
And his cheering colours.

It's a bliss for the blessed.



*BOSSAR (Bosonic Students' Society for Academics and Recreation) activity*

*Kapil Gupta, Material Sciences*

Movies are screened from time to time, named as "Symmetry Breaking". There is absolutely no symmetry in subject of movies. A variety of cinemas as well as feature films are screened. They range from thriller to comedy to serious art films, some are master piece of directorial work or some are one of the best in acting. "Symmetry Breaking" in many senses breaks the symmetry.

*Editorial Board :*

*Jaydeb Chakrabarti, Manu Mathur, Ranjit Biswas, Kinsuk Acharyya, Chhayabrita Biswas, Kapil Gupta, Mahua Mitra and Mitali Nanyasi.*

*Spectrum Seminar: What Is Turbulence?*

*Sagar Chakraborty, Theoretical Sciences*

Turbulence, a million dollar problem, still remains unsolved. It has been termed, by the legendary physicist Richard Feynman, as "the last great unsolved problem of classical mechanics". We went through the layman's description of turbulence through some pictures and then tried to sophisticate the issue by realizing that it is the sensitivity to the initial conditions that's important for turbulence. Of course, then we elaborated what is exactly meant by "the sensitivity to the initial conditions" by means of a simple one dimensional discrete dynamical system (or map). The discussion was concluded with a short account of the present state of research on turbulence from physicists' viewpoint.