

## N.12: RRCAT Seminars during January-June 2018

**Neutron scattering with pulsed neutrons: Modern developments and opportunities:** *Dr. J. Ross Stewart, Group Leader, Excitations and Polarized Neutron Activity, ISIS, RAL, UK, Jan 24, 2018.*

Modern neutron sources, such as the SNS at Oak Ridge USA, J-Parc at Tokai, Japan and the upcoming ESS at Lund Sweden tend to be based on pulsed proton accelerators (“Spallation Neutron Sources”). Much of the technology and instrumentation in use at these neutron sources was developed and implemented first at the ISIS spallation source in the UK. In fact, before operation of the SNS, US and J-Parc, Japan, for many years, ISIS, UK was most intense pulsed neutron source. An overview of pulsed neutron scattering sources and instrumentation was given in the talk. New instrumental developments at ISIS and especially those using polarized neutrons were also presented.



**Design and applications of flywheel energy storage system:** *Dr. S. R. Gurumurthy, Deputy Project Manager (R & D), BARC, Mumbai, March 13, 2018.*

Concern of increasing energy demand, exhausting fossil fuel reserves and consequences of climate change, urges us to design energy efficient systems to conserve the existing energy resources. Energy storage is one of the areas where there is a scope to improve the efficiency. One of the devices which can store energy is flywheel which has the merits of less maintenance, higher energy density, environmental friendly, longer life and unlimited charge and discharge cycles. Flywheel energy storage is now considered a viable technology for stationary applications like UPS, solar and wind power systems particularly when short time back up is required. This talk covers the discussion on the methodology of design of an efficient Flywheel Energy Storage (FES) system which includes Bidirectional power Converter (BDC), Brushless DC (BLDC) and a flywheel. The energy extracted from an FESS is limited by various factors like gain of the boost converter, source resistance of the generator and losses in the system. A brief discussion on these factors including a method for apportioning of the sources of various losses, techniques



for reducing these losses, factors which influence the extractions of energy harvested was covered in the talk. A patented novel scheme using a combination of multi-armature winding permanent magnet brushless dc generator and a buck converter for the enhancement of the harvested energy was discussed. The presentation also covered the applications of FESS in the battery less UPS, regenerating braking system in transportation and pulse power supplies.

**Black holes or black hole mimickers? (RRCAT Colloquium):** *Dr. Abhas Mitra, Former Head, Theoretical Astrophysics Section, BARC, Mumbai, June 22, 2018.*

The simplest mathematical Black Hole (BH) is just a point mass (singularity) surrounded by an imaginary sphere of radius  $R=2M$  ( $G=c=1$ ). On the other hand, a BH mimicker has almost the same radius, but it is full of matter and has no singularity. In fact the recent LIGO detection of Gravitational Waves may have already suggested that the so-called BHs are BH Mimickers. Historically many physics stalwarts like Einstein and Dirac rejected the idea of exact BHs because of its unphysical properties. But nobody could resolve the paradox why BHs cannot exist when there are exact solutions for the same. This conundrum was discussed by the speaker who showed that the “exact solutions” may be illusive because they correspond to a gravitational mass  $M=0$ , which in turn is agreement with the idea that BHs represent absolute ground states having  $E=Mc^2=0$ . Thus, the so-called BHs having  $M>0$  must be BH mimickers. Series of peer reviewed papers have shown that when a massive star would contract close to the limit  $R>2M$ , it would almost completely trap its heat and radiation due to intense gravitation. And instead of becoming a true BH, it turns into an ultra-magnetized radiation pressure supported star which is now known as Magnetospheric Eternally Collapsing Object (MECO). The present speaker and his American collaborators, Stanley Robertson and Darryl Leiter, accordingly, predicted that the so-called BHs should be ultra-magnetized MECOs. This prediction has been observationally verified and there was a Harvard Press Release on this research in 2006. Now there are more direct evidences that there are unusually strong magnetic fields around most of the BHs, a result best explained in terms of MECO because real astrophysical BHs have no intrinsic magnetic field.



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