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Study of core-collapse supernovae with the upcoming 4m international liquid mirror telescope at Devasthal, Nainital

Brajesh Kumar[1,2,3*], Jean Surdej[3], Paul Hickson[4], E. F. Borra[5], François Finet[6], J. P. Swings[3], Serge Habraken[3] and S. B. Pandey[2]

[1]*Indian Institute of Astrophysics, Koramangala, Bangalore 560 034, India*
[2]*Aryabhatta Research Institute of Observational Sciences, Manora Peak, Nainital 263 002, India*
[3]*Institut d'Astrophysique et de Géophysique, Université de Liège, Allée du 6 Août 17, Bât B5C, 4000 Liège, Belgium*
[4] *Department of Physics and Astronomy, University of British Columbia, 6224 Agricultural Road, Vancouver, BC V6T 1Z1, Canada*
[5] *Centre d'Optique, Photonique et Lasers Département de Physique, Université Laval, Canada*
[6] *National Astronomical Observatory of Japan (NAOJ), 650 N. A'ohoku Place, Hilo, 96720 HI, USA*

Abstract. We present an overview and status of the upcoming 4m International Liquid Mirror Telescope facility at Devasthal, Nainital and its uses for the study of core-collapse supernovae (CCSNe).

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1. Overview of the project

The International Liquid Mirror Telescope (ILMT[1]) project is a scientific collaboration between four countries: Belgium, India, Canada and Poland. It will be set-up at the newly developed Devasthal observatory in Nainital (79° 41′ 04″ E, +29° 21′ 40″, altitude ∼2450m) which is operated by Aryabhatta Research Institute of Observational Sciences (ARIES), India. Taking advantage of best seeing conditions towards the zenith, the ILMT will be able to image a strip of sky in the g', r' and i' (central wavelength: 475, 625 and 763 *nm*, respectively) spectral bands, having an approximate width of 27′ in declination and length of 24 hours in right ascension. With a very simple structure, combined with a 4k × 4k CCD camera and a specific optical corrector, this telescope will work in the time delay integration mode (c.f. Hickson

*email: brajesh.kumar@iiap.res.in
[1]More details about this project can be found at http://www.aeos.ulg.ac.be/LMT

and Richardson 1998; Vangeyte et al. 2002). The ILMT will perform a deep survey of a long and narrow strip of sky (stars, galaxies, active galactic nuclei, supernovae, asteroids, space debris, etc.) that is crossing its field-of-view (FOV). The survey with the ILMT will be mainly dedicated to photometric and astrometric variability studies. A detailed account for the science cases based upon the ILMT is given in Surdej et al. (2006). Presently, the ILMT enclosure construction is in advanced stage and installation will start after completion of the enclosure.

2. ILMT and CCSNe study

Pointing towards zenith, the ILMT FOV is centered at the declination corresponding to the Devasthal observatory latitude (29.3611° N). As the Earth rotates, with a FOV of 27′ by 27′, the ILMT will access ∼141.2 sq. deg. strip of sky, out of which ∼72 sq. deg. will belong to high galactic latitude (|b| > 30°, see Finet 2013; Kumar 2014, for details). The ILMT limiting magnitudes for i', r' and g' filters have been estimated to be ∼21.4, ∼22.2 and ∼22.8, respectively (see Kumar 2014). Successive night images can be co-added to obtain longer integration times and consequently, we may reach still fainter magnitude levels. To discover transients (such as CCSNe) previous night images or a good reference image will be subtracted from the search night images using the image subtraction techniques (e.g. Optimal Image Subtraction, Alard 2000). The 3.6m Devasthal Optical Telescope (Sagar et al. 2012), situated near the ILMT will be triggered for spectroscopic confirmation of newly discovered transients and once confirmed, further follow-up observations of CCSNe can be performed with the 0.5m, 1.04m and 1.3m ARIES telescopes. Collaboration with other existing facilities world wide is also foreseen. Taking advantage of continuous and unbiased imaging with the ILMT, we expect to discover hundreds of CCSNe each year with the inexpensive liquid mirror technology (Borra 2003; Kumar 2014). Study of these cosmic explosions may shed more light on supernovae physics.

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