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The 4 m International Liquid Mirror Telescope: Construction, operation, and science

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ABSTRACT

The International Liquid Mirror Telescope (ILMT) project was motivated by the need for an inexpensive 4 metre diameter optical telescope that could be devoted entirely to astronomical surveys. Its scientific programmes include the detection and study of transients, variable objects, asteroids, comets, space debris and low surface brightness galaxies. To this end, a collaboration was formed between the Institute of Astrophysics and Geophysics (Liège University, Belgium), several Canadian universities (University of British Columbia, Laval University, University of Montreal, University of Toronto, York University, University of Victoria) and the Aryabhatta Research Institute of Observational Sciences (ARIES, India). After several years of design work in Belgium and construction in India on the ARIES Devasthal site, the telescope saw its first light on 29 April 2022. Its commissioning phase lasted from May 2022 until June 2023 (beginning of the monsoon). The ILMT was inaugurated on 21 March 2023 and has been in regular operation since October 2023. The telescope continuously observes the sky passing at the zenith using the SDSS g', r', and i' filters. This paper describes the ILMT, its operation, performance and shows some initial results.

Key words. methods: observational – techniques: photometric – telescopes

1. Introduction

It has been known since Newton that the surface of a liquid in rotation around a vertical axis takes the shape of a paraboloid, ideal for focusing a beam of parallel light rays to a point. However, it was not until the mid-19th century that Capocci (1850), then director of the Naples observatory, revived the idea of using a rotating container filled with mercury as the main mirror of an astronomical telescope. Discussions of the history of liquid mirror telescopes (LMTs) can be found in Gibson (1991) and Surdej et al. (2024b).

Liquid mirrors are an inexpensive alternative to large conventional mirrors, for applications in which conventional pointing and tracking is not required. Compared with a solid glass mirror that has to be cast, ground and polished, a rotating liquid mirror is much cheaper to manufacture. For a 4 m mirror, the difference in cost is more than a factor of 30.

Early liquid mirrors (Wood 1909) suffered from ripples on the surface of the mercury due to the transmission of vibrations and the difficulty of keeping the angular rotation of the mirror constant. The stellar images obtained were of mediocre quality and unstable. In addition, because of the Earth's rotation, the star images could not be kept fixed in the focal plane of the mirror, whose optical axis was strictly vertical. At the time, the technology was not ready to remedy these problems.

The 4 m International Liquid Mirror Telescope (ILMT) presented here has benefited greatly from the technological developments made between 1980 and 2000 by the teams of Borra of Laval University (Borra 1982) and Hickson of the University of British Columbia (UBC, see Hickson et al. 1994a). To

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