

CMB-Bharat project: listening to faintest murmurs of early universe

The proposal has been presented and is being considered by ISRO

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A three-week long programme entitled, 'Cosmology - The next decade', which consisted of a school to train early career researchers and a workshop for active researchers in the field of cosmology came to a close on 25 January. The workshop was held at ICTS-TIFR, Bengaluru. In the workshop, project CMB-Bharat, a project to listen to the faintest murmurs of the universe was mooted. CMB expands into Cosmic Microwave Background. The scientific space project CMB-Bharat has been presented as a proposal to ISRO and is being considered by it, said Tarun Souradeep, from IUCAA, Pune. This was one highlight of the workshop which also saw discussions on the X-ray telescope eROSITA which is to be launched in June 2019.

"Schools of long duration, where there could be detailed courses, taught by the leaders in the field of cosmology are rare in our country. The last such effort was in 2008... Many of those students are now back as cosmology faculty in India and abroad," says Subhabrata Majumdar, who is with the Tata Institute of Fundamental Research, Mumbai (TIFR). "We hope this school will create the much-needed leaders for Indian cosmology in the coming decades," he added, in an email. The programme was organized by Subhabrata Majumdar, Rishi Khatri from TIFR, Mumbai and Aseem Paranjape from IUCAA, Pune.

Tarun Souradeep, who is the lead proposer of CMB-



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Bharat, outlined the scope and plan of the project thus: "CMB-Bharat is a proposal for comprehensive next generation Cosmic Microwave Background (CMB) mission in international collaboration with major Indian contribution. It proposes 'near-ultimate' survey polarisation that would exhaust the primordial information in this 'gold-mine' for cosmology."

Scientific promise

The scientific promise of the project was threefold according to Dr Souradeep. The "ultra-high-goal" according to him was that the project would reveal the first clear signature of quantum gravity and ultra-high-energy-physics in the very early universe. He clarified that this referred to quantum gravitational waves, which are different from what LIGO detectors had observed that were classical in nature. The "high" goals lay in neutrino physics where we could discover more about the neutrino species, their total mass and mass hierarchy; map all dark matter and most ba-

ryons in the observable universe, he said. The problem of knowing the hierarchy of masses of the different species of neutrino is a very deep one and being hotly pursued by many countries. The "legacy," he said, was to improve probe of cosmological model by a factor of over 10 million, and to generate rich galactic and extragalactic astrophysics datasets.

When asked about the timeline he had in mind for this project, he said that it was too early to make any definitive statements and that a more mature study had to be carried out. "Typically, ambitious space missions of this magnitude take over a decade [to] launch. We would like to be observing for 4-6 years and the time to final release of all data and release could extend to [about] 5 years," he said in an email to *The Hindu*.

Comprehensive mission

"There are no active proposals for a comprehensive next generation CMB space mission at this time. CMB-Bharat mission presents an

unique opportunity for India to take the lead on prized quests in fundamental science in a field that has proved to be a spectacular success, while simultaneously gaining valuable expertise in cutting-edge technology for space capability through global cooperation," he added.

The workshop

The workshop was a unique gathering of cosmologists from across the world, and participants could attend invited talks by eminent cosmologists and experimental physicists from across the world, such as Lyman Page (2018 Breakthrough Prize, 2015 Gruber Prize), Rashid Sunyaev (2003 Gruber Prize, 2017 State Prize of Russia for Science and Technology), J. Richard 'Dick' Bond (2008 Gruber Prize, 2018 Gruber Prize as a team member, Officer in the Order of Canada) and others. This programme was a decadal follow-up of a previous 6-weeks long ICTS programme "Cosmology with CMB and LSS" held in 2008.