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A RADIO TELESCOPE FOR IRELAND

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Abstract. Plans are underway for the commissioning of a radio telescope on the island of Ireland at Birr Castle, possibly with a second antenna to be constructed in Northern Ireland. Due to Ireland's location at the northwest corner of Europe, these telescopes will extend the baseline coverages of both the EVN and MERLIN, increasing the imaging fidelity and resolution of these arrays. The island's relatively benign RFI environment will allow observations at bands currently encroached on elsewhere in Europe. We outline the scientific and technological case for this facility, possibilities for funding the project and plans for its future operation.

Key words: instrumentation: radio telescopes, interferometers – techniques: interferometric – radio continuum: general

1. INTRODUCTION

The ARTI (A Radio Telelescope for Ireland) Consortium proposes to build and operate a 32 m dish in Birr, Offaly county in the Irish Republic. The radio telescope will be used in a wide range of single-dish observations, as well as jointly with existing interferometric networks in Europe. Specifically, the telescope will participate in observations with the upgraded e-MERLIN array using data transmission via dedicated fibre-links to the UK. We also aim to become a member of the European VLBI Network and participate regularly in EVN observations, initially using the MkV system, then subsequently with real-time data transmission via GEANT. We hope to eventually build and operate a second antenna in Armagh county, Northern Ireland. The Irish radio telescopes are to be jointly managed by a consortium of Irish Universities and Institutes of Technology across the island of Ireland.

2. WHY BUILD A 30 M CLASS ANTENNA IN IRELAND?

There are a number of factors that make Ireland an attractive location for such a facility. Compared to continental Europe, Ireland offers a very benign RFI environment. Furthermore, the island's location is uniquely positioned to enhance the resolution of both the MERLIN array and the EVN. From a national perspective, we expect the facility to form a clustering point for indigenous science and technology, as has been the case in other countries. The radio telescope will also play a very significant education role in Ireland, both as an instrument for

undergraduate and postgraduate research projects in astronomy and engineering, and as a means to convey the excitement of science and scientific research to second-level students. Our construction and operation of this facility will also make a statement regarding Ireland's commitment to being active in world-class astronomy, and may facilitate future participation in larger consortia, such as the Square Kilometre Array.

3. TECHNICAL SPECIFICATIONS AND SITE

The proposed facility will be a “clone” of an existing 32 m or 34 m antenna design, such as the MERLIN Cambridge node or the 32 m telescope of the Torun Radio Astronomy Observatory. The dish will be fully steerable with an altitude-azimuth mount, and be fully frequency-flexible up to 22 GHz, with the surface shaped for maximum efficiency. Although we do not intend to include receivers operating above 22 GHz initially, we are looking into the possibility of ensuring the dish surface accuracy is high enough to leave open the possibility of adding higher-frequency receivers at a later date. During interferometric observations, the data will be transmitted via dedicated optic fibres to Jodrell Bank Observatory (e-MERLIN) and further over GEANT to JIVE in the Netherlands in the case of EVN observations. The e-MERLIN correlator is being built with an extra slot that can accommodate incoming data from the Irish radio telescope.

The first antenna will be situated on the grounds of Birr Castle, in Offaly county. In 2000, engineers from the Jodrell Bank Observatory surveyed the Midlands and Western region of Ireland, finding all tested sites to be very good to excellent in terms of their RFI. That same year, the 7th Earl of Rosse offered a site for the radio telescope on the grounds of Birr Castle. The proposed site is a benign RFI area, accessible for utilities and likely to be given planning approval. We are in the process of arranging for geological tests of the location proposed for the telescope.

4. SINGLE DISH OPERATIONS

There are a number of areas in which the Irish radio telescope is expected to be utilized in single-dish studies. These include maser surveys in uniquely RFI clear bands and long-term monitoring of transient or variable radio emission from masers, active galactic nuclei and pulsars. There has also been some interest in using the antenna in ionospheric studies, potentially being a participant in the activities of EISCAT.

5. INTERFEROMETRIC OBSERVATIONS

The three main interferometric arrays with which the Irish radio telescope is expected to regularly observe are e-MERLIN, EVN and global VLBI experiments. There is also interest in using the telescope for geodetic VLBI observations. The Birr telescope will provide the longest baselines in e-MERLIN, increasing the resolution of that array by about a factor of three, and especially improving the array's East–West coverage (Figure 1, two left panels). With the use of multi-frequency synthesis over the very broad bands planned for e-MERLIN (and for the Irish radio telescope), the resulting baseline coverage is truly stunning, providing a virtually entirely filled aperture with a diameter of some 1500 km (Figure 1, right central

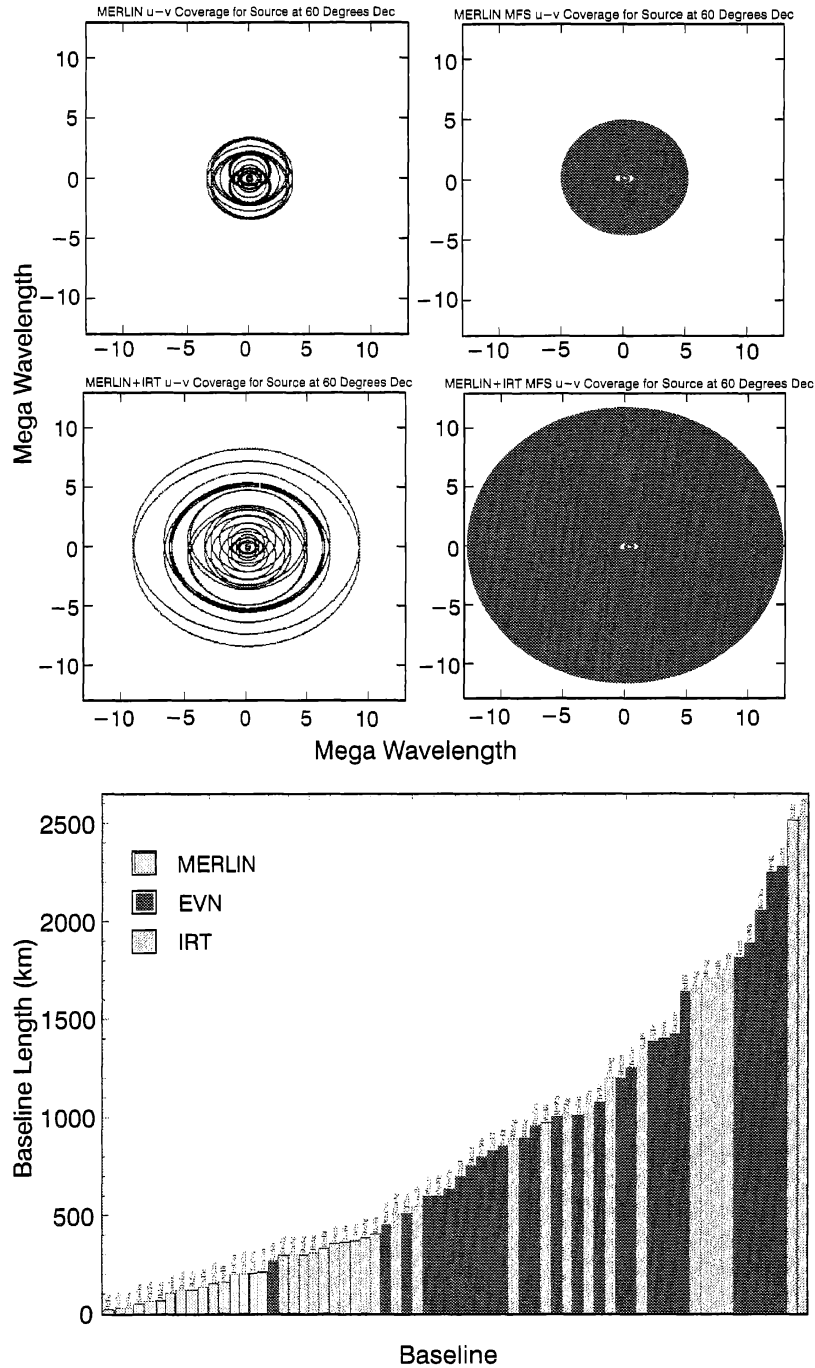


Fig. 1. The two top panels: baseline coverage for MERLIN without and with a 32 m antenna at Birr. The two central panels: effect of the expanded bandwidth of e-MERLIN on these baseline coverages. Bottom panel shows how the proposed Irish radio telescope (IRT) would complement e-MERLIN and the EVN by providing additional short, intermediate and long baselines.

panel. The Irish radio telescope will form the longest baseline in the continental EVN, to the Noto radio telescope on Sicily. The increase in resolution will be about 10%, while the baselines to the Irish radio telescope will increase the volume of data obtained in a given observation by some 30–40%.

The addition of the Irish radio telescope should greatly enhance the reliability of EVN+MERLIN observations by increasing the number of baselines common to the two arrays from one (Jodrell–Cambridge) to three (Jodrell–Cambridge–Birr), as well as by providing a number of baselines on scales intermediate to those sampled by MERLIN and the continental EVN (Figure 1, lower panel). Similarly, the Irish radio telescope can play a special role in global VLBI observations by helping to bridge the “Atlantic gap” between the European and American arrays.

6. ESTIMATED COSTS AND FUNDING ISSUES

The complete cost of the construction and outfitting of one 32 m antenna is estimated to be 10 million Euro, while the estimated running costs are 300 000 Euro/yr. We are pursuing funding from a number of sources, which include EU Funding via the European Regional Development Fund, national funding via Science Foundation Ireland, Cross-Border Funding between the Irish Republic and Northern Ireland and other sources such as corporate and private donors.

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