The Little Kiwi Dish that Could

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Can we do single dish science ?

With a 12m antenna can we do any science apart from just VLBI as the last remote element on the end of a long baseline array.

Abstract

We report on the first single dish experiments using the Warkworth 12m antenna with a digital baseband converter (DBBC) and Mark5B recorder operated by AUT University. The radio recombination lines of hydrogen H90α, H91α, H92α, helium He91α and carbon C91α were detected from OrionA, and H90α, H91α, H92α from M17 and NGC3603 at 8GHz. Ratios of integrated line intensities agree with published helium abundances.

Background

The Warkworth Radio Astronomical Observatory (WRAO) is located some 60 km north of the city of Auckland, near the township of Warkworth. The observatory is operated by the Institute for Radio Astronomy and Space Research (IRASR) of AUT University. The observatory's 12m radio telescope operates in three frequency bands centred on 1.4, 2.3 and 8.6 GHz [1]. We regularly participate in Australian Long Baseline array observations and also have an active schedule observing for the International VLBI Service for Geodesy & Astrometry.

So what's our advantage ?

In between IVS and LBA observations we have a lot of time to integrate and integrate and integrate ....zzzzzzz

So what equipment do we have that's different ?

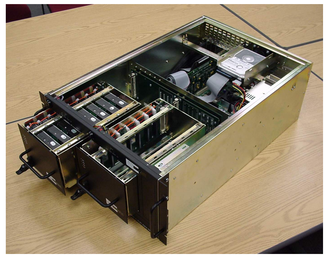
The Digital Baseband Converter (DBBC) replaces the VLBI terminal previously used with a complete and compact system that can be used with any VSI compliant recorder or data transport.

DBBC

The radio telescope at Warkworth is equipped with a DBBC [2] which replaces the VLBI terminal used elsewhere with a complete and compact system that can be used with any VSI compliant recorder or data transport. It consists of four modules each with four RF inputs. These can receive input in the ranges 0.01-512, 512-1024, 1024-1536, 1536-2048 MHz and 2048-2100 MHz.

Mk5

The other piece of important equipment is a Mark5B VLBI VSI-H compliant data recorder. This is used to record the data received from the DBBC at 2 bit resolution.



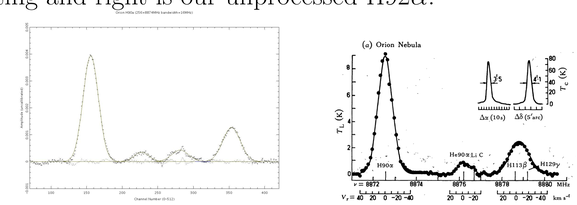
Did we see anything ?

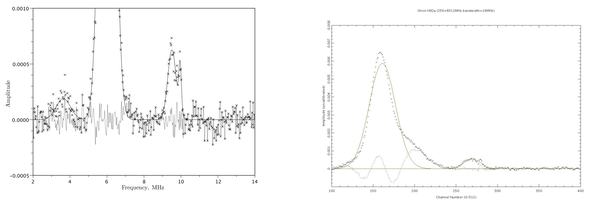
Judge for yourself

Let's also compare with published results.

Orion A

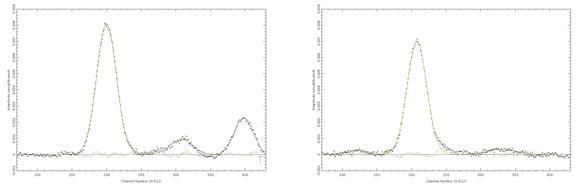
The plots show the integrated line profile for the recombination lines within X-band for a 16MHz band with gaussian fit (*solid line*), data (*crosses*), and the residual (*dashed line*). The recombination lines from left to right are our unprocessed H90α and for comparison on the right we include H90α from McGee [3]. The second line is left H154ϵ, H91α, He91α and C91α after processing and baseline fitting and right is our unprocessed H92α.





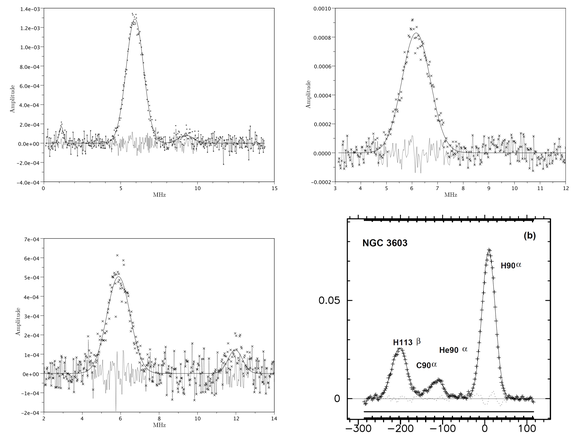
M17

We also observed M17 and again found the strong Hydrogen Alpha line. We haven't yet integrated longer for any additional weaker lines. The recombination lines from left to right are H90α and H91α.



NGC3603

Pree et al [5] detected H90α within this HII region using the ATCA. We present data for the additional lines after processing and baseline fitting H91α, H92α within this HII region. Integrated line profiles for H90α (top left), H91α (top right) and H92α (bottom left) are all 16MHz bands with a resolution of 512. Bottom right is H90α from Pree et al for comparison:



Conclusion

Scepticism has existed that a 12m dish with an un-cooled receiver designed for IVS would be able to detect radio recombination lines. We believe that it has been demonstrated that RRLs in X-band have been detected, with some unpublished. Thus from this work our 12m dish is capable of doing some single dish science which we hope to continue and expand.

References

[1] S. Gulyaev,T. Natusch, 2009, International VLBI Service for Geodesy and Astrometry 2009 Annual Report,D. Behrend & K. D. Baver, 138

[2] Gino et al, 2010, DBBC VLBI2010, IVS 2010 General Meeting Proceedings, D. Behrend, D. Baver, 'http://ivscc.gsfc.nasa.gov/publications/gm2010/tuccari1.pdf'

[3] R. X. McGee, L. M. NewtonR. A. Batchelor, Recombination lines near 8.9 GHz of strong sources in the southern Milky Way, Australian Journal of Physics, vol. 28, Apr. 1975, p. 185-207

[4] V. Pankonin, P. Thomasson, J. Barsuhn,1977, A Survey of Radio Recombination Lines from HI Ragions and Associated HII Regions, A&A, 54, 335-344

[5] C. G. Pree, M. C. Nysewander, W. M. Goss, NGC 3576 AND NGC 3603: TWO LUMINOUS SOUTHERN H II REGIONS OBSERVED AT HIGH RESOLUTION WITH THE AUSTRALIA TELESCOPE COMPACT ARRAY, 1999, ApJ, 117, 2902

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