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Expanding New Zealand VLBI Capability And The 30m Dish

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(Lewis Woodburn, Tim Natusch, Peter Thomasson, Mark Godwin, Christophe Granet and Sergei Gulyaev)

Institute for Radio Astronomy & Space Research
Auckland University of Technology

Third International VLBI Technology Workshop
10th - 13th November 2014, Groningen/Dwingeloo, the Netherlands

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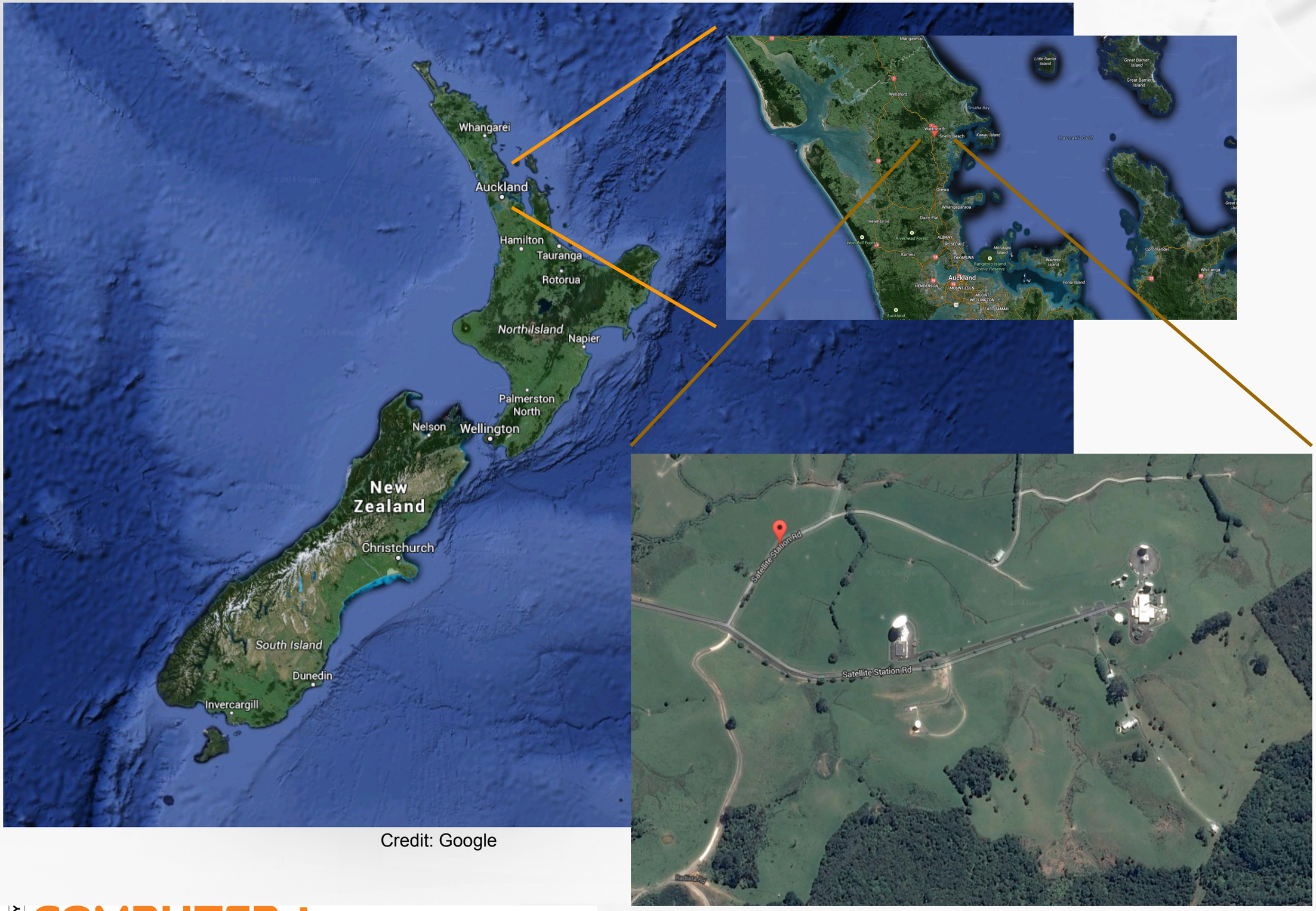
Where are we ?



Credit: Google

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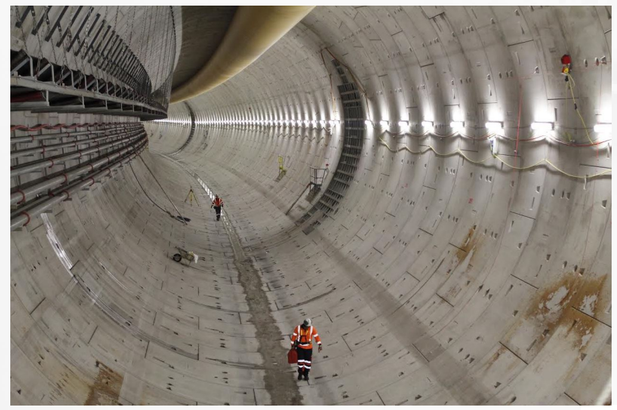
Warkworth Infrastucture

Network



10Gb connectivty to REANNZ in 2014
40Gbps NZ to USA and Australia

Digital Backend

New DBBC received and connected to 12m in April 2014

SEFD now comparable to AuScope antennas, 3547 for CONT14
(it was 5340 for AUST13)

The old DBBC for repair and then to be used on 30m

We have decided to purchase a 3rd DBBC

Recorders

Started upgrading Mk5 diskpacks from 16TB to 32TB

Will “downgrade” a Mk5C to a Mk5B+ for 30m

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12m VLBI Activities

DBBC Issues since new
Maser Issues in 2013
Elevation Bearing 2013

IVS

- AUST13
- CONT14
- AUST14

LBA

- Active in 2013
- 2014 reduced inclusion

Other

- 2014 Jive - MEX

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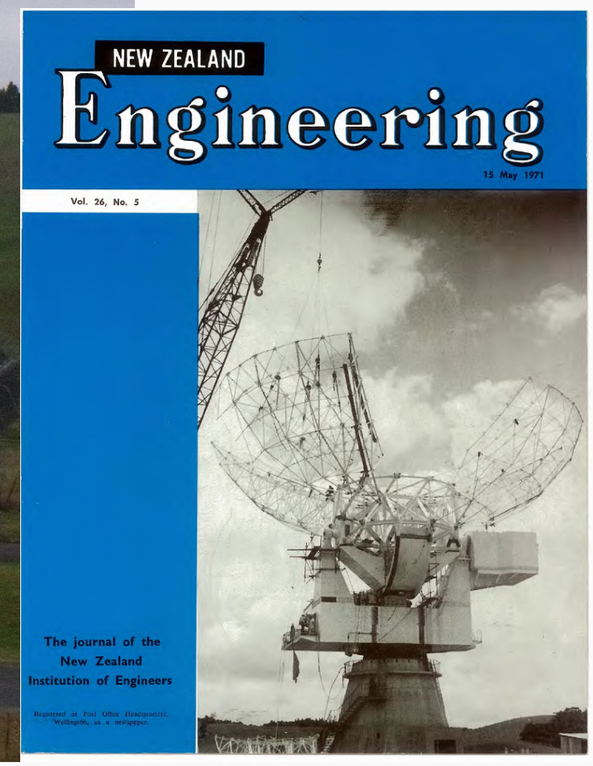
2010 New Zealand Capability Improves



NZ Telecom grant AUT the use of one of the Warkworth 30m satellite earth station dishes for Radio Astronomy and Science Research. The older dish got demolished.

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Conversion Plan

Change the Azimuth limits ± 270 (previously ±170)

Change motors, cables and cable wrap system

Change the control system

Clean and maintain the structure (rusty bolts, hatches etc)

Change the antenna RF system from Satellite C-Band to astronomical bands

Woodburn et al, in prep
(http://arxiv.org/abs/1407.3346)

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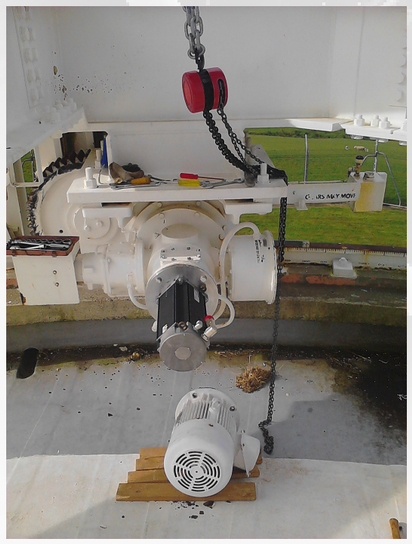
Warkworth 30m Conversion



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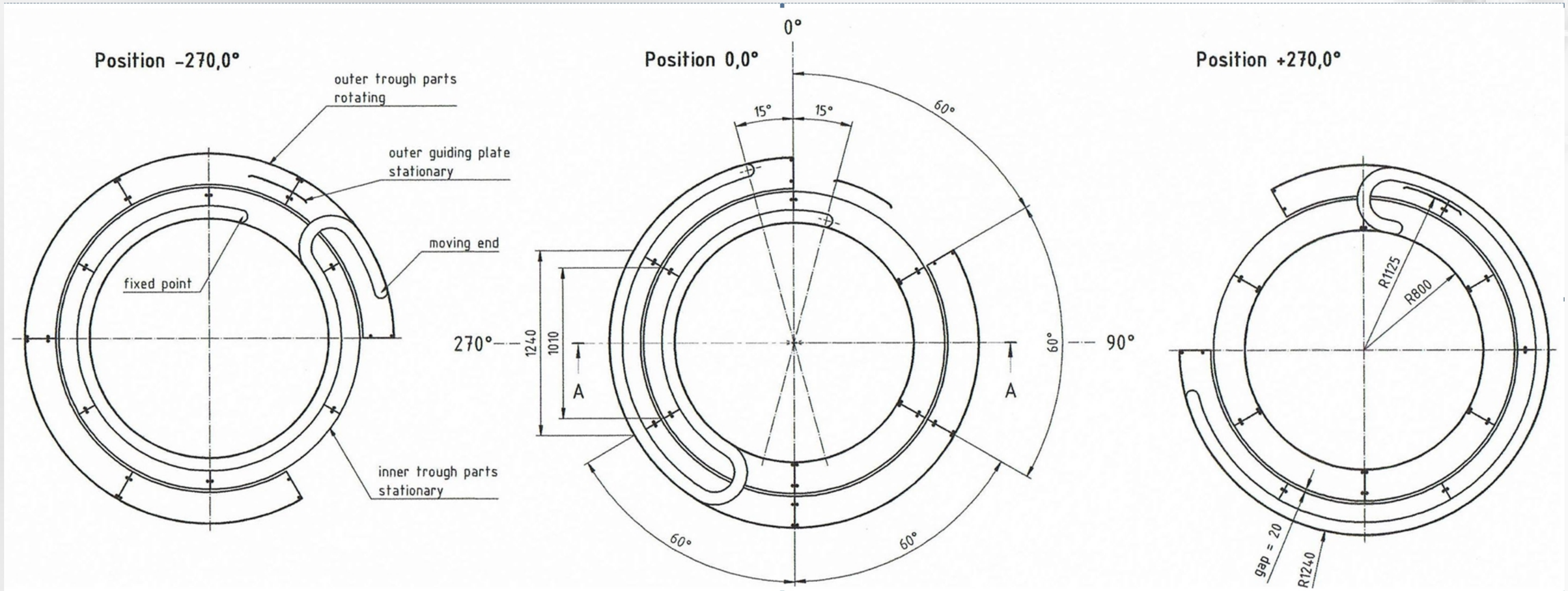
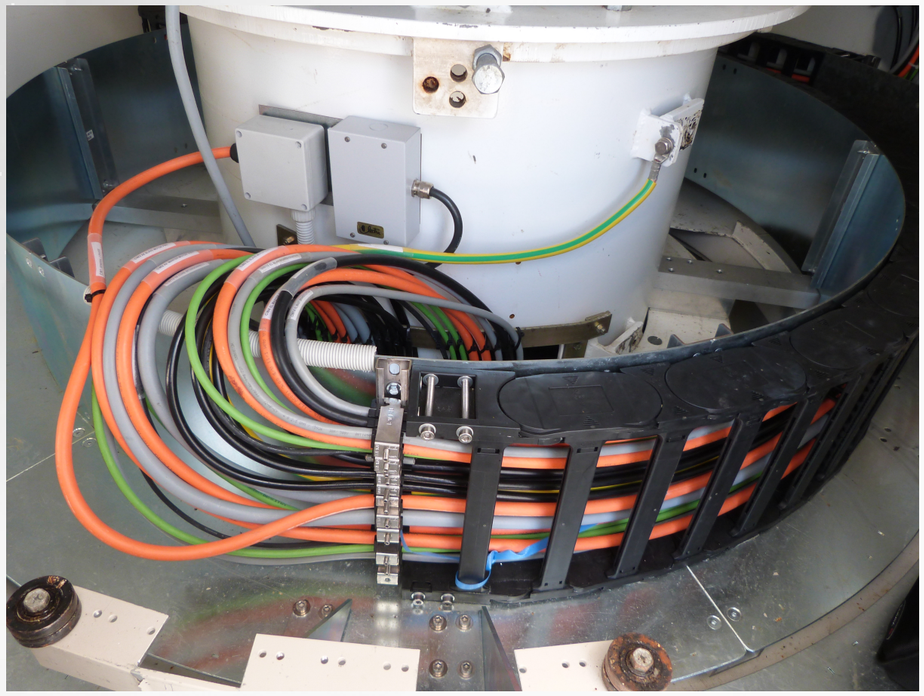
Cable Wrap – IGUS Energy Chain System



Problem: chain pulls away from walls due to stiffness of cables

Solution: Gluing magnetic strips along the outside of the chain



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Control System

Designed and commissioned:

Mark Godwin – MP Godwin Ltd, UK

Supplied by:

Control Technologies, UK

- **Internal clock, linked via ntp to station clock**
- **Fibre network connectivity using Modbus**

Accuracy:

1 milli degree, under light wind conditions

Cleaning and Maintenance

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AUT 30m Antenna Specification

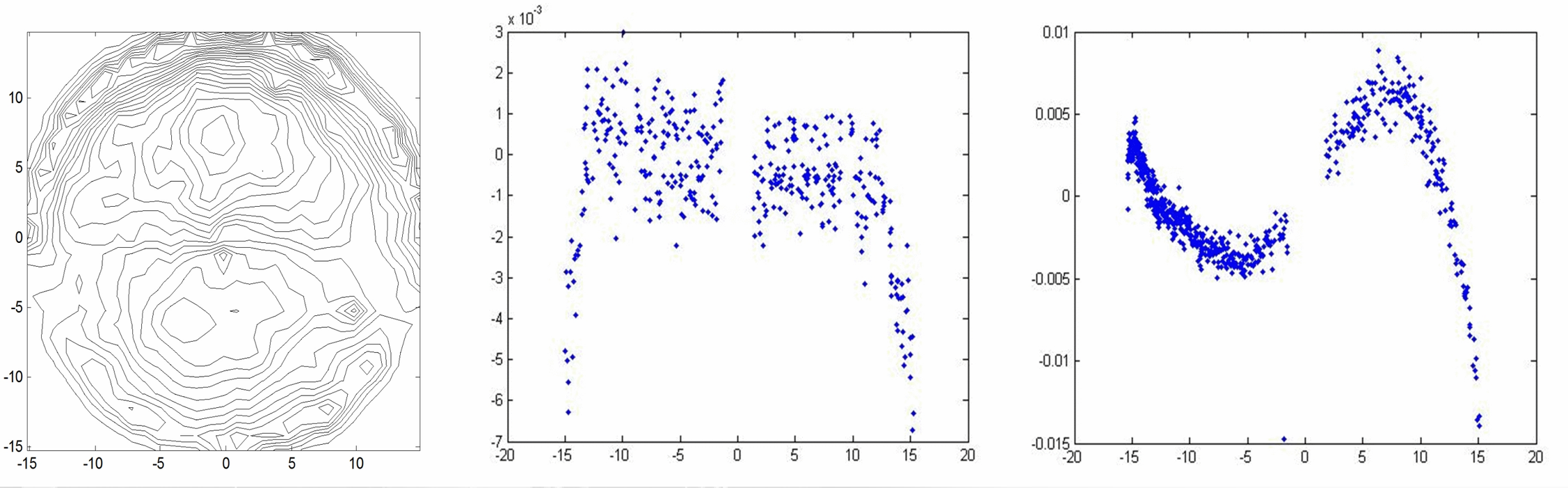
Table 1 Specifications of the Earth Station according to the manufacturer‘s (NEC) handbook.

Description	Detail
System	Alt-azimuth, wheel-and-track, Cassegrain, beam-waveguide antenna
Drive system	Electric-servo, dual train for antibacklash
Transmission frequency band	C-Band
Reception frequency band	C-Band
Primary mirror diameter	30.48 m
Subreflector diameter	2.715 m
Azimuth Maximum Velocity in Slew Mode (Open Loop)	0.3 deg/sec or 18.0 deg/min
Elevation Maximum Velocity in Slew Mode (Open Loop)	0.3 deg/sec or 18.0 deg/min
Max Acceleration/Deceleration in both axes	0.2 deg/sec/sec
Max Tracking Velocity (Closed Loop)	0.03 deg/sec or 1.8 deg/min (estimated as no data in the NEC documentation)
Azimuth Working Range (as defined by soft limits)	-170 to 170 deg
Elevation Working Range (as defined by soft limits)	0 to 90 deg
Surface accuracy (rms)	0.4 mm
Track diameter	16.97 m
Total weight on track	268 tons
Wind speed in tracking operation	up to 40 m/s
Survive wind speed in stow position	up to 70 m/s

Table 2 New parameters after control system replacement.

Description	Detail
Azimuth Maximum (Tracking and Slewing) Velocity	0.37 deg/sec or 22.2 deg/min
Elevation Maximum (Tracking and Slewing) Velocity	0.36 deg/sec or 21.6 deg/min
Azimuth Acceleration/Deceleration	0.2 deg/sec/sec
Elevation Acceleration/Deceleration	0.25 deg/sec/sec
Azimuth Working Range (as defined by soft limits)	-179 to 354 deg
Elevation Working Range (as defined by soft limits)	6.0 to 90.1 deg

Survey of Surfaces



Laser Scan - by a local company: Synergy Positioning Systems Ltd
antenna at 6 degrees elevation to allow scan

Processing – Prof Gulyaev AUT and Dr Granet BAE Systems

RMS of surface residuals (El 6 degrees) 3.5mm (left image)
RMS along horizontal cross section ≈1mm (middle
RMS along the vertical cross section 5mm (right image)
{will have gravitational deformation}

Also the laser scan provided 3D models of the total structure

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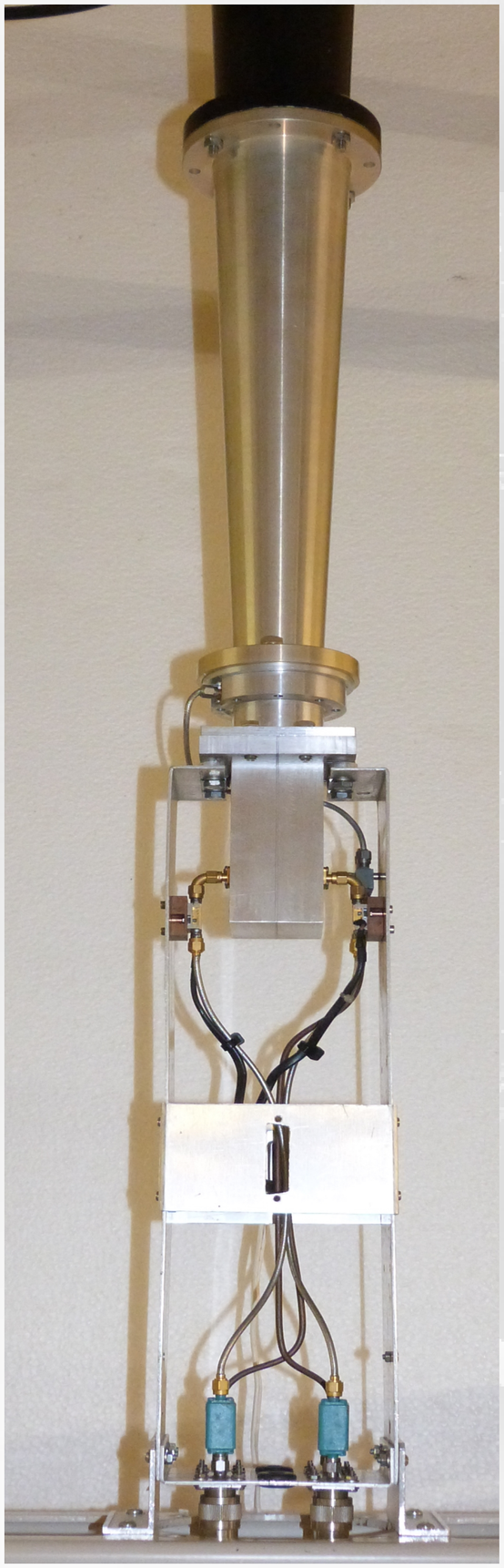
Instruments - Systems



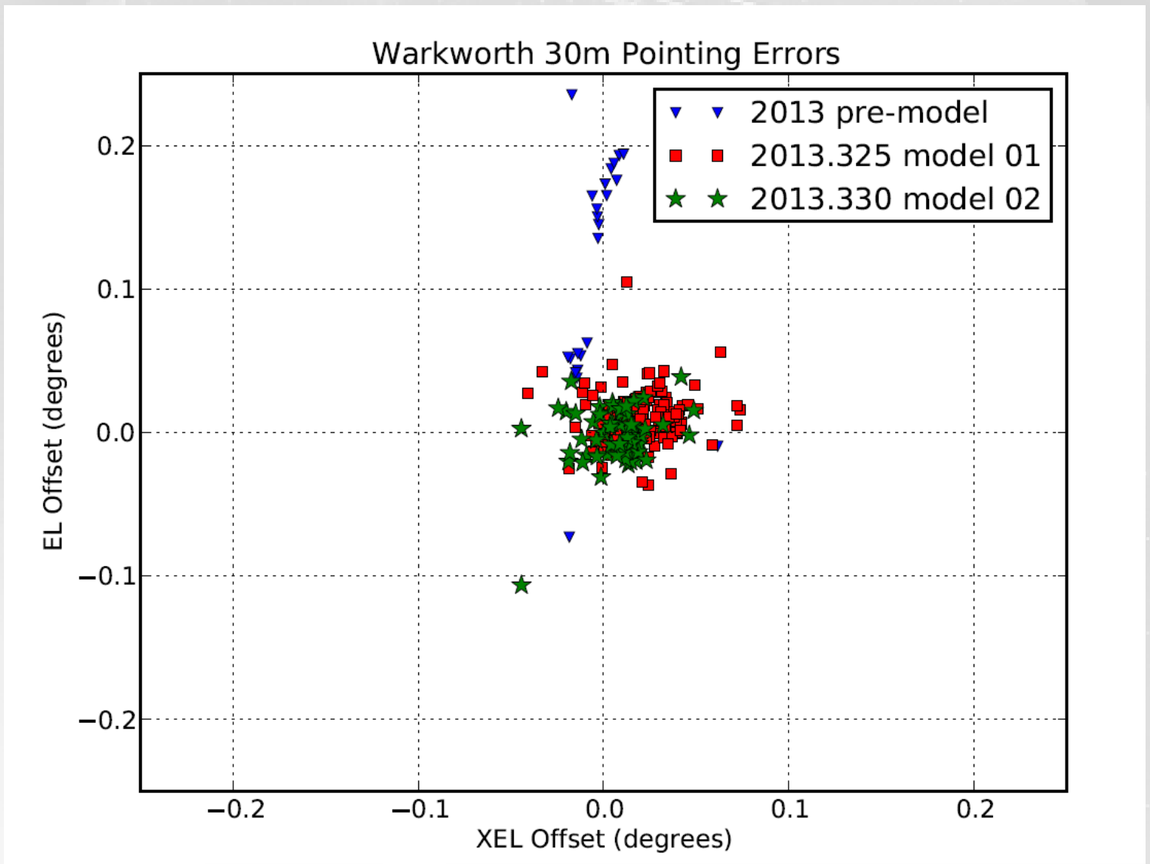
Waveguide transition – BAE Systems

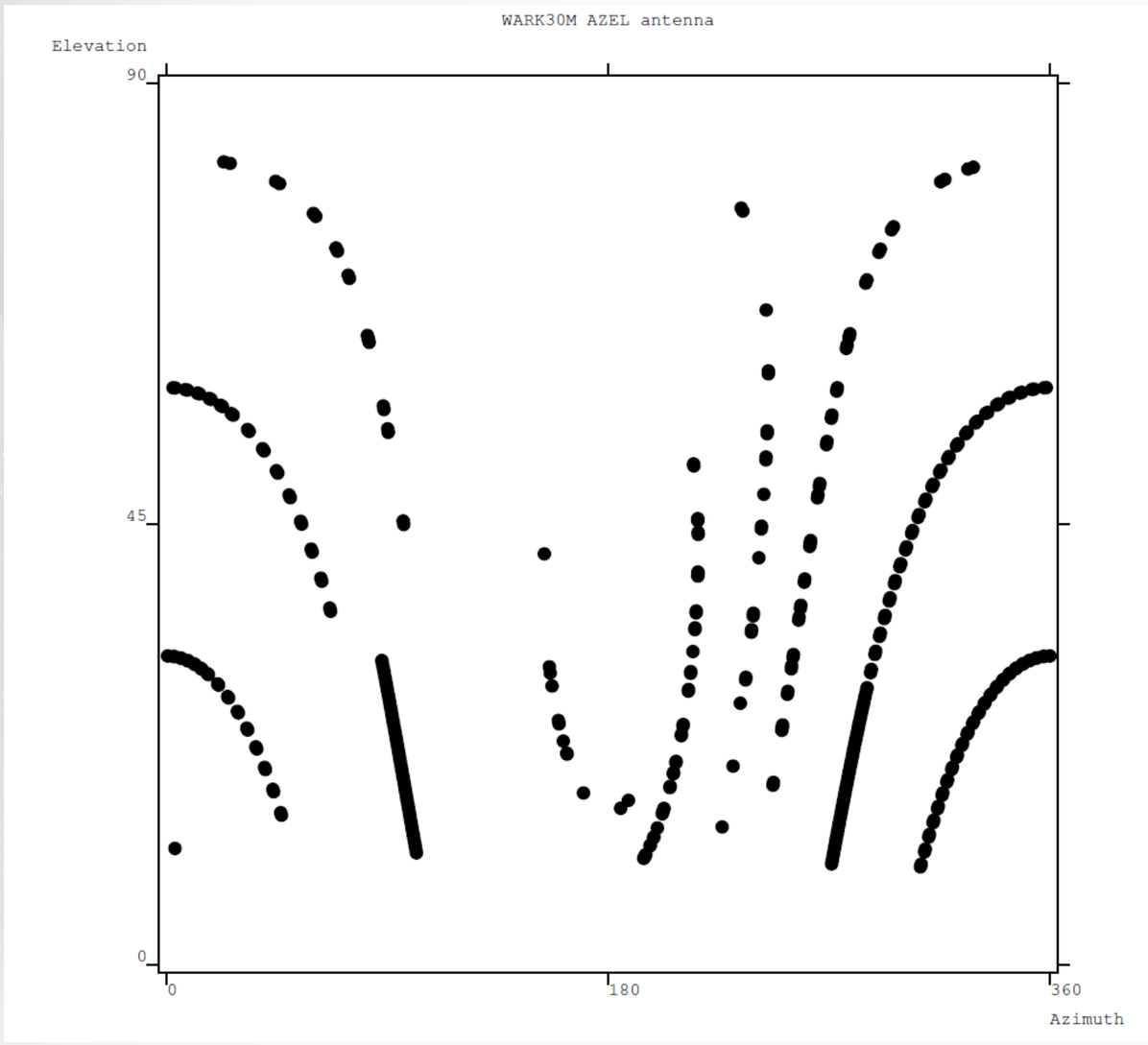
Uncooled C-Band receiver
(ex Jodrell Bank MKII)

- Center freq 6.7 GHz, 300 MHz bandwidth
- Mixed with 5.8 GHz LO
- Output freq 750-1050 GHz
- Receiver system temp ≈ 85 K

Warkworth DBBC #1

First Pointing 4200 MHz





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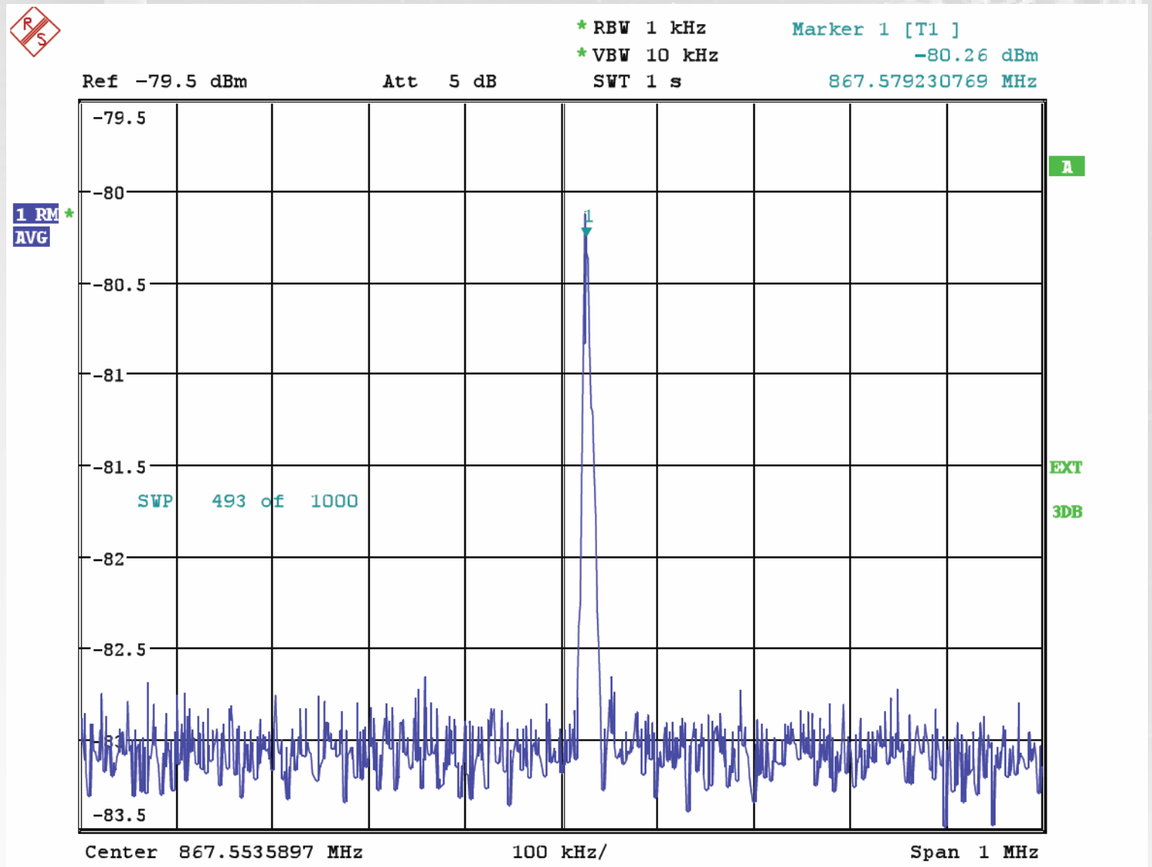
Warkworth 30m First Light



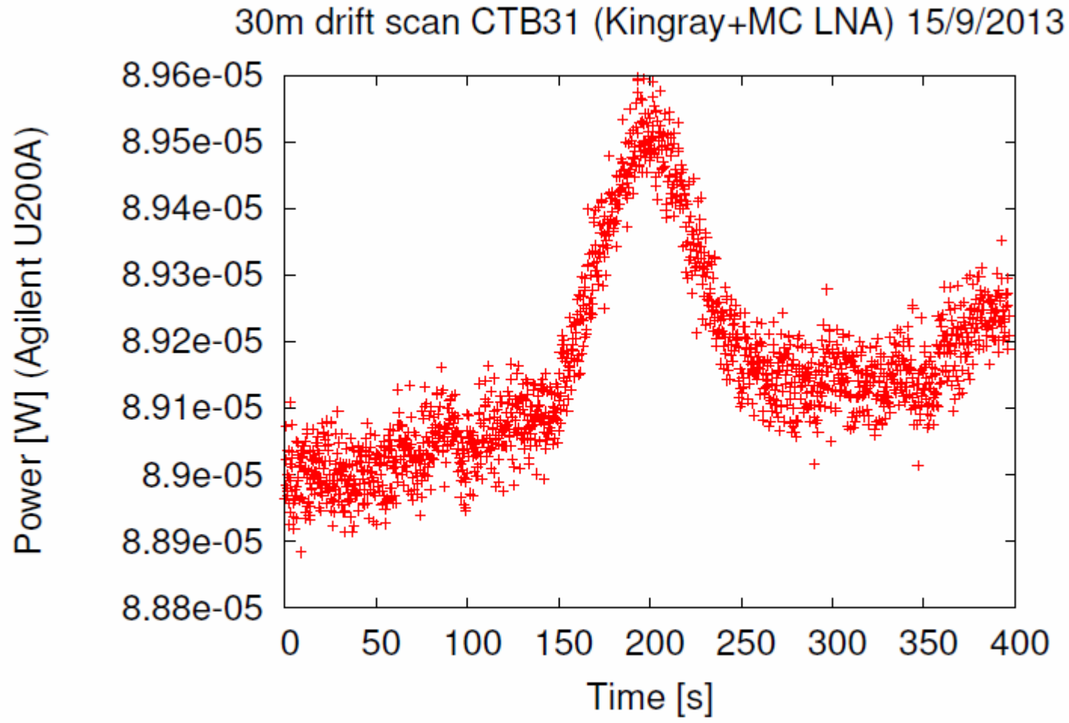


FIGURE 9. CTB31 drift scan

Credit: Tim Natusch, AUT

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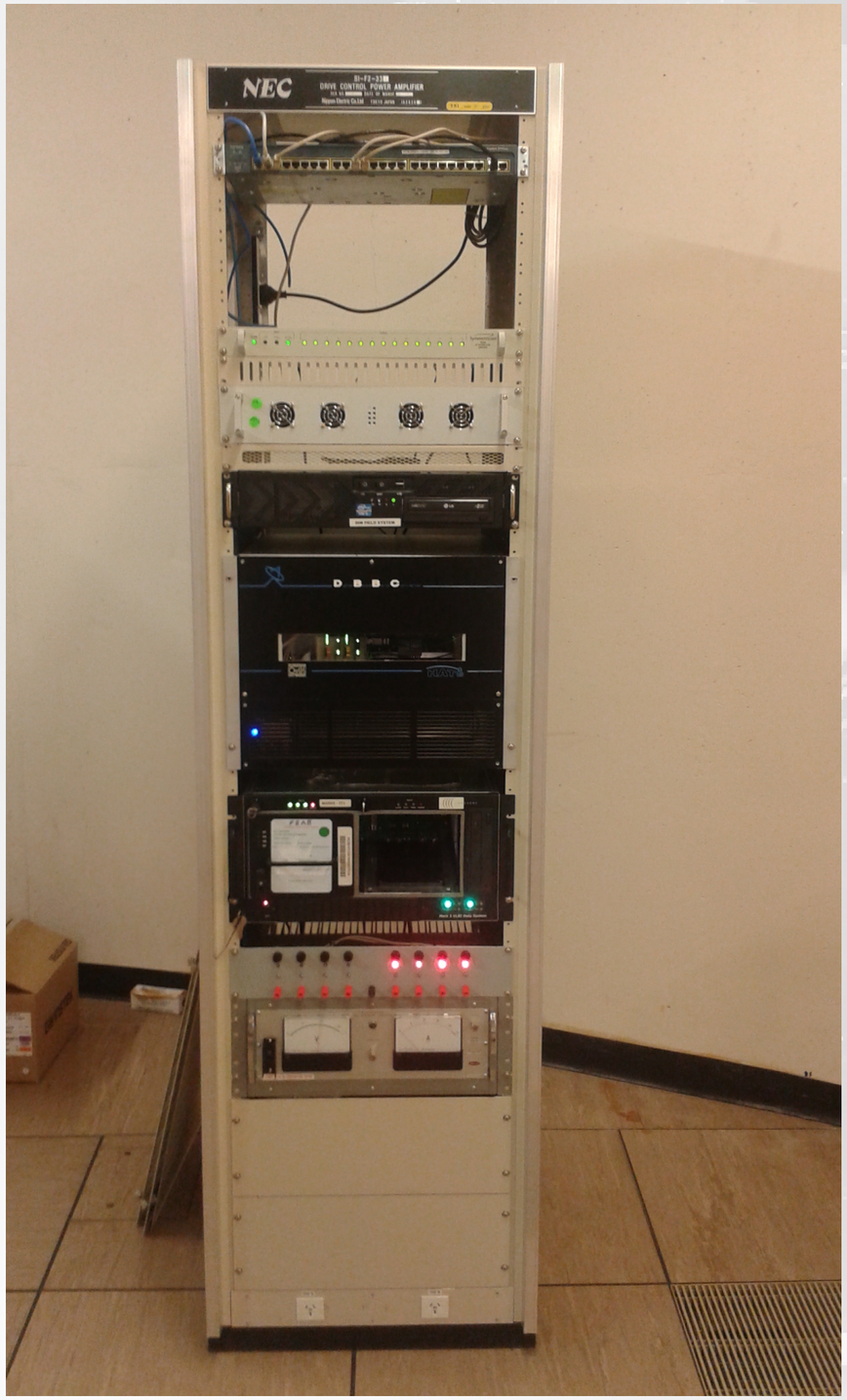
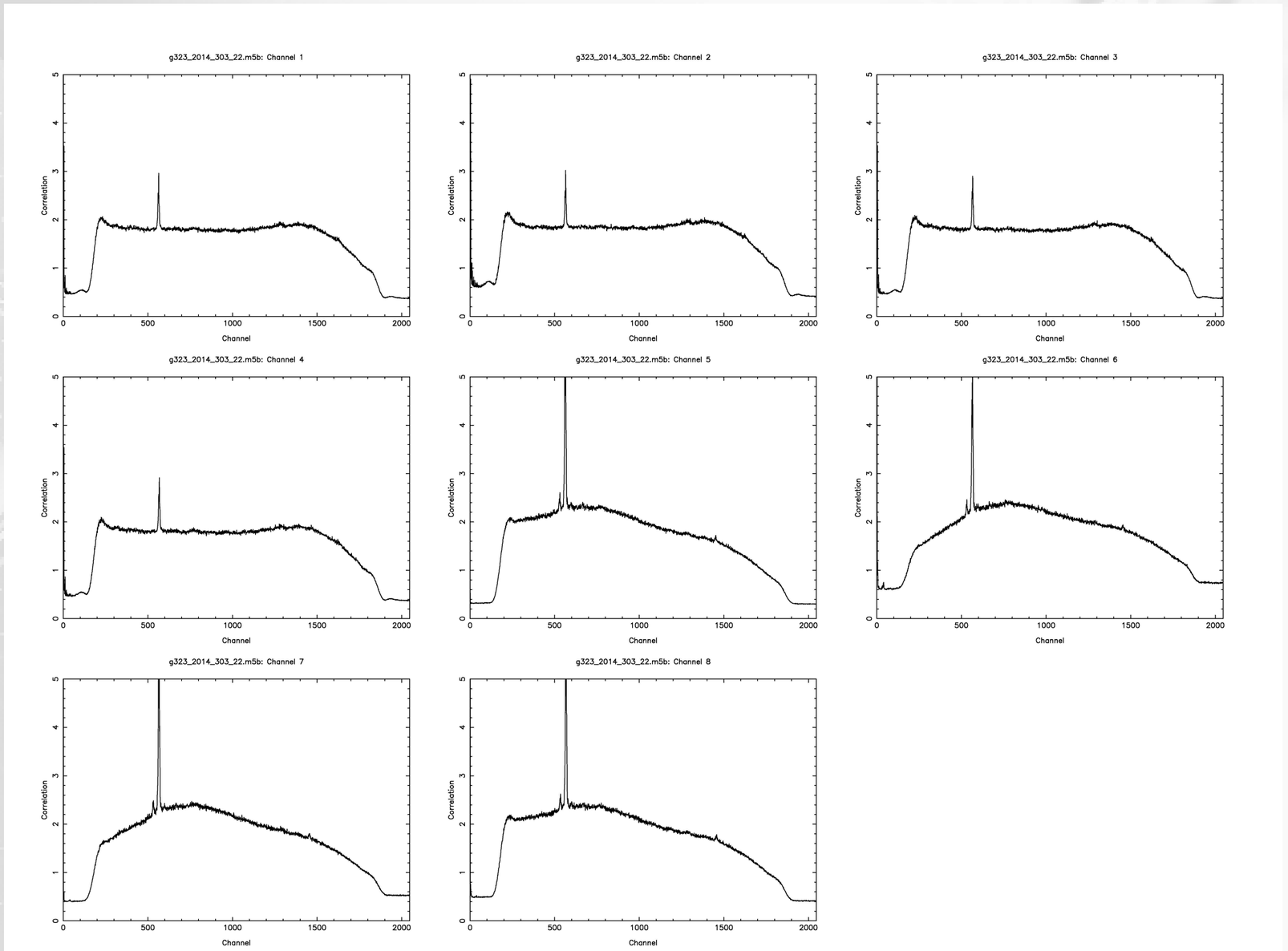
30-10-2014 : Digital VLBI Backend Working





Channels 1-4 : RCP 6.7GHz
Channels 5-8 : LCP 6.7GHz

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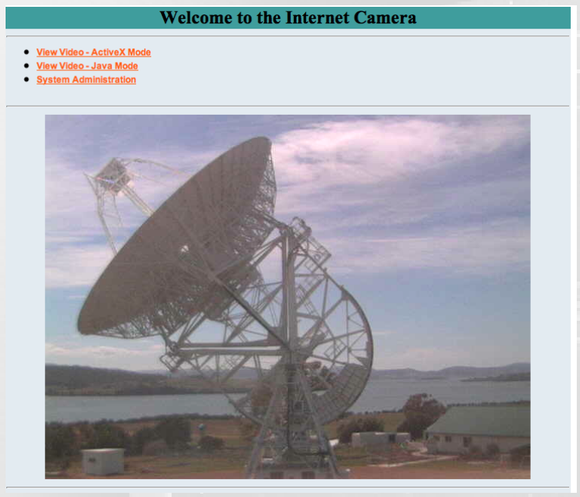
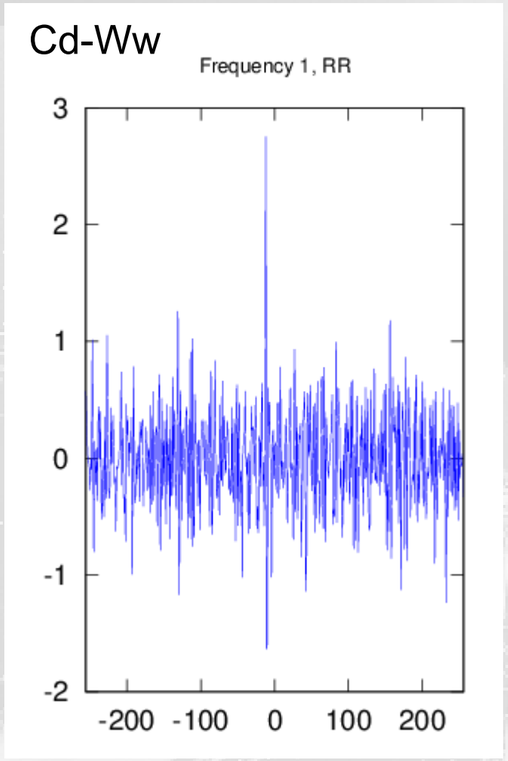
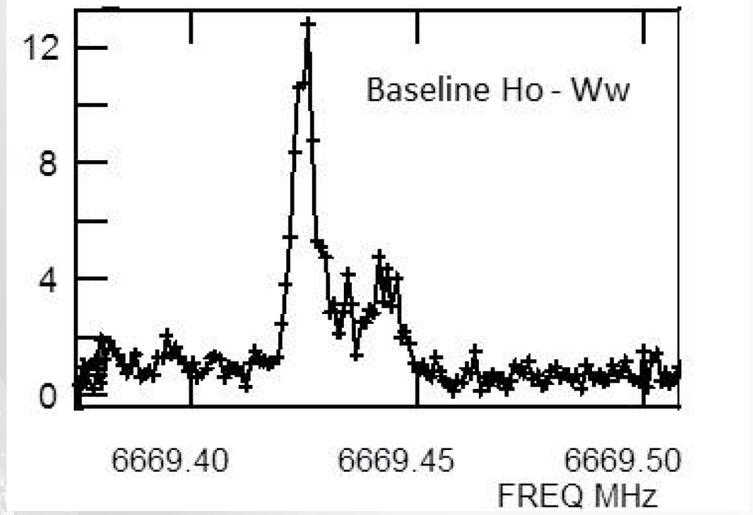
6-11-2014 : First Fringes



Hobart 26m Credit: UTas

Ceduna 30m Credit: UTas





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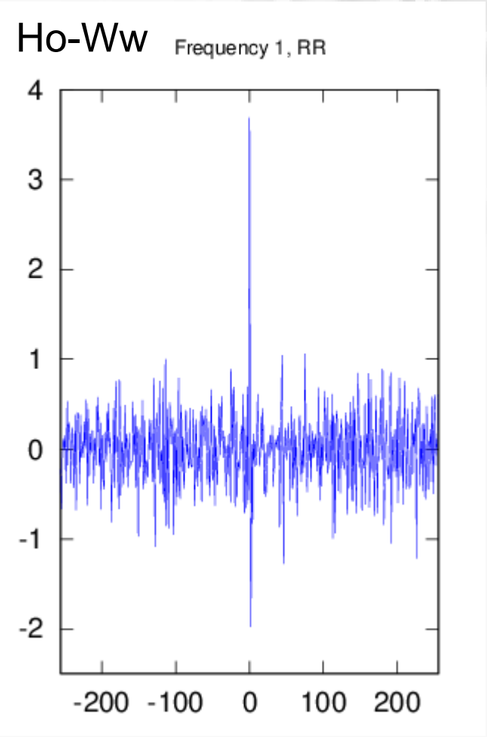

Thanks to our colleagues from the University of Tasmania:

Simon Ellingson and Jamie McCallum

AUT University:

Tim Natusch, Stuart Weston and Lewis Woodburn

We have first VLBI fringes with the Warkworth 30m, Ceduna 30m and Hobart 26m at 6.7 GHz.

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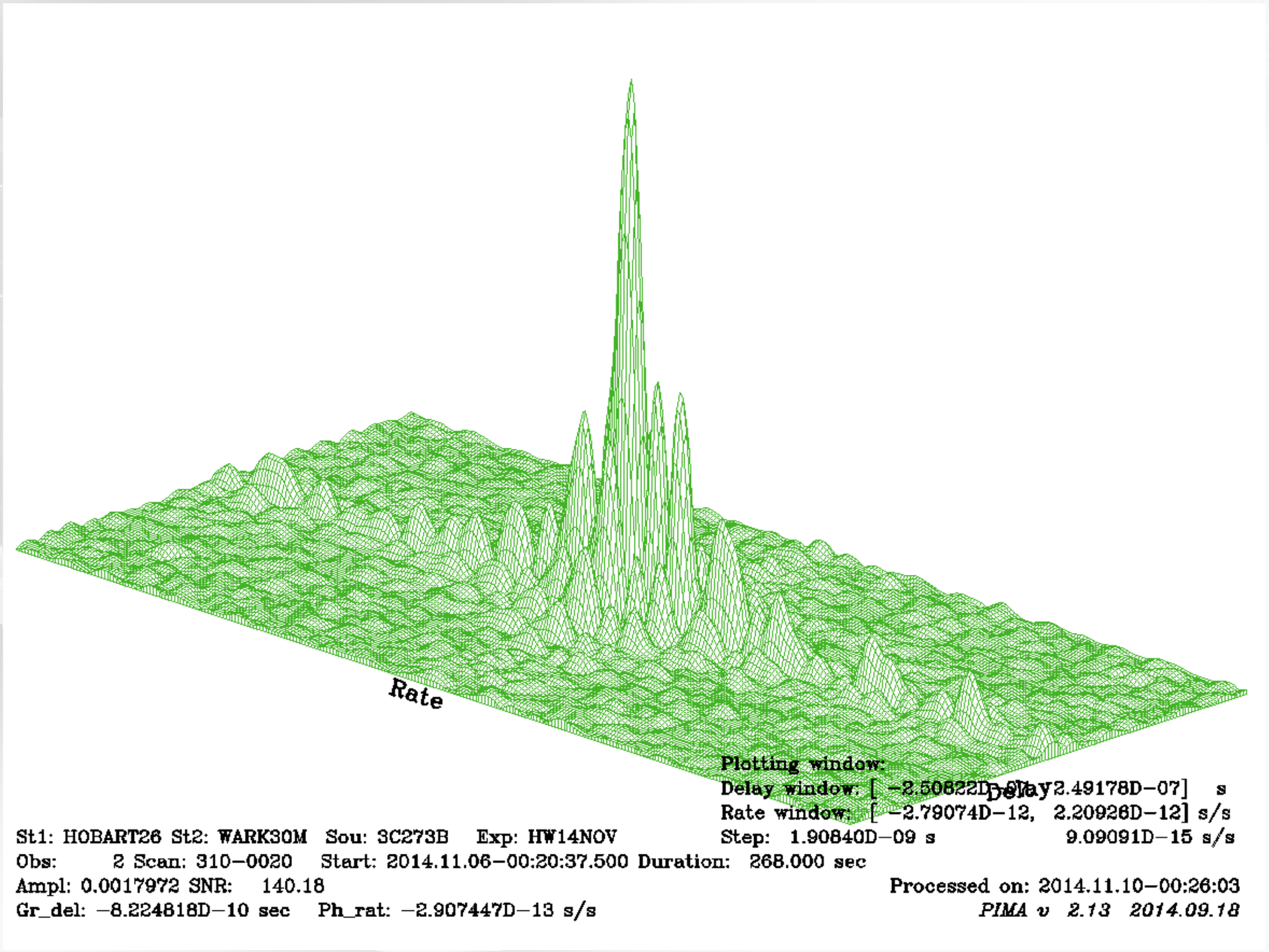
6-11-2014 : First Fringes



Credit : Leonid Petrov

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Warkworth 30m : BIG Issue our neighbour

Future Development

C-band : Cooled receiver

L-Band : possibly at secondary focus

S/X : Would be nice

K : ……

Thank You

Image Credit: S Weston

sweston@aut.ac.nz

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