

An Update on the Surface Metrology of a Single Piece Carbon Composite Offset Gregorian Radio Reflector

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September 2016

NRC-Herzberg

Astronomy Technology Program - Penticton



National Research
Council Canada

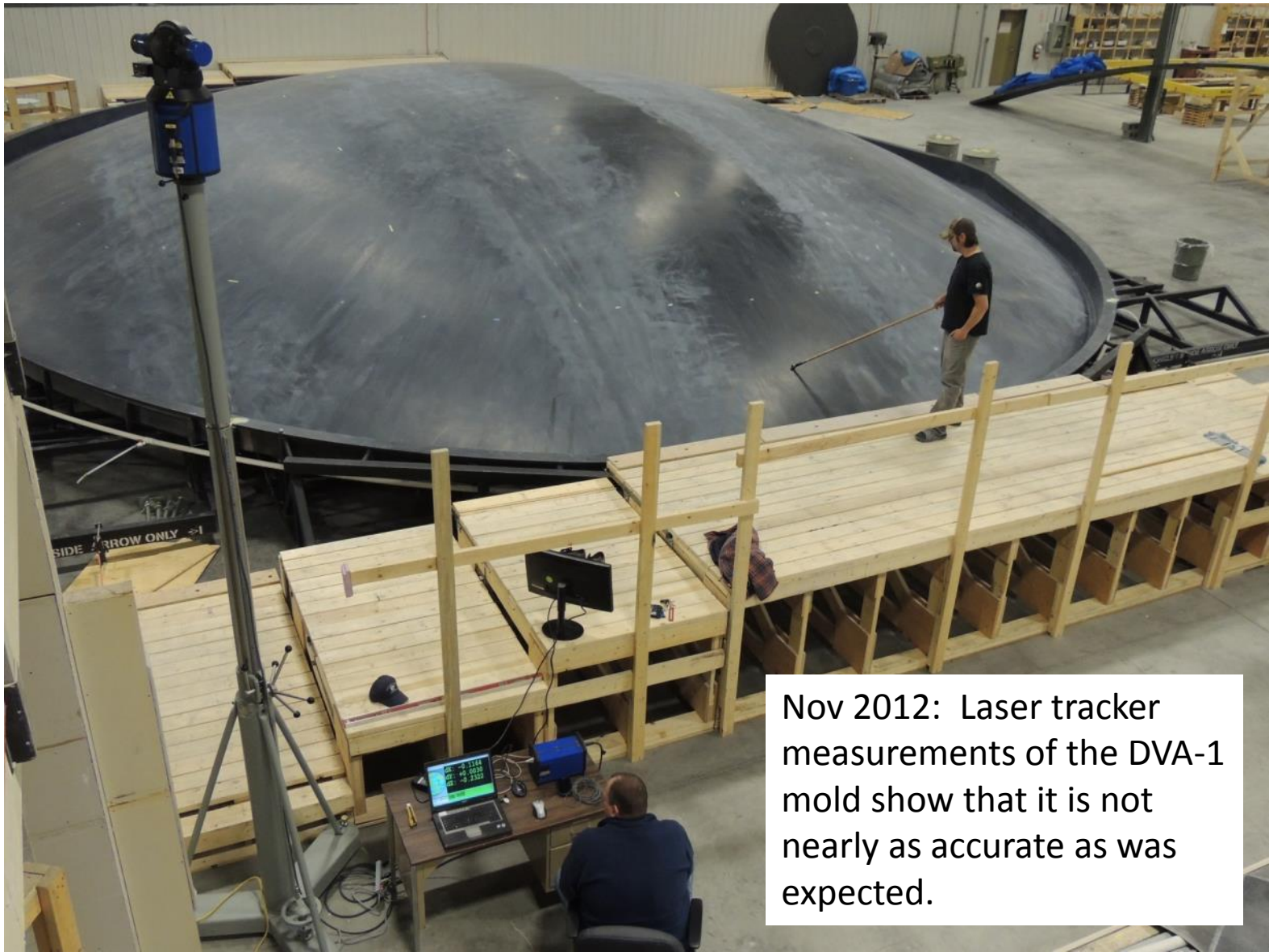
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DVA-1: A 15m Offset Gregorian, Single Piece Carbon-Composite Radio Telescope

- The design is the result of 10 years of composites development at DRAO as well as collaboration between US Technology Development Program (TDP) and NRC.
- 1 to 15GHz design
- Rim supported concept based partially on proven ATA 6m
- Tower and turning head developed by Matt Fleming of Minex Corp (TDP)
- Optics by Lynn Baker, Bill Imbriale, German Cortez (TDP).



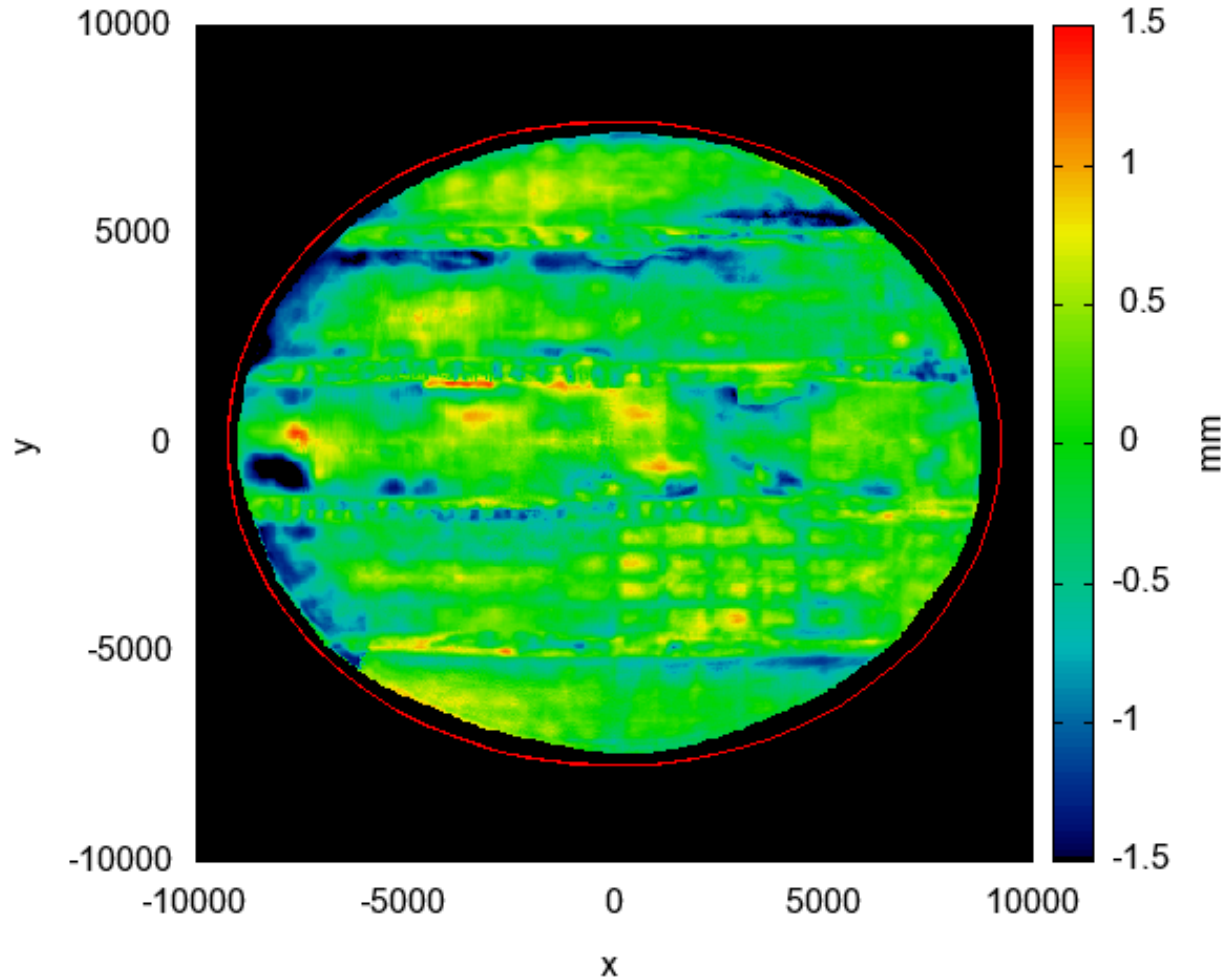


Nov 2012: Laser tracker measurements of the DVA-1 mold show that it is not nearly as accurate as was expected.

Lots of Track-and-Sanding Required!



DVA – 1 Mold Measurement, April 2013



- RMS 0.476mm unweighted
- Clearly there are still errors along the mold joints
- Mold sub structure visible in lower right hand quadrant
- This accuracy sufficient for project requirements

Primary Reflector Construction, June 2013



Oct 17 2013: Flight Day



Sept 2016





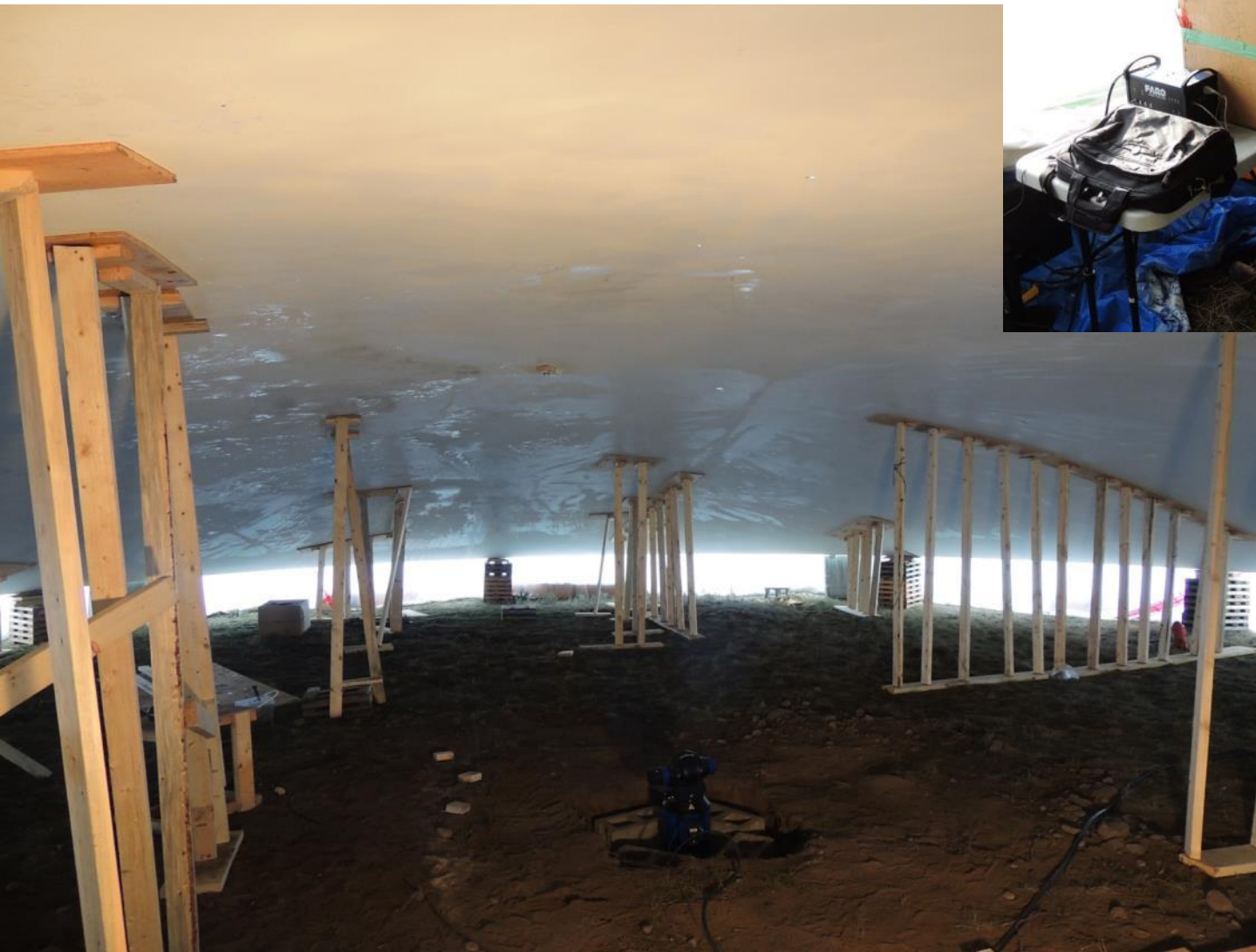
Sept 2016





Sept 2016





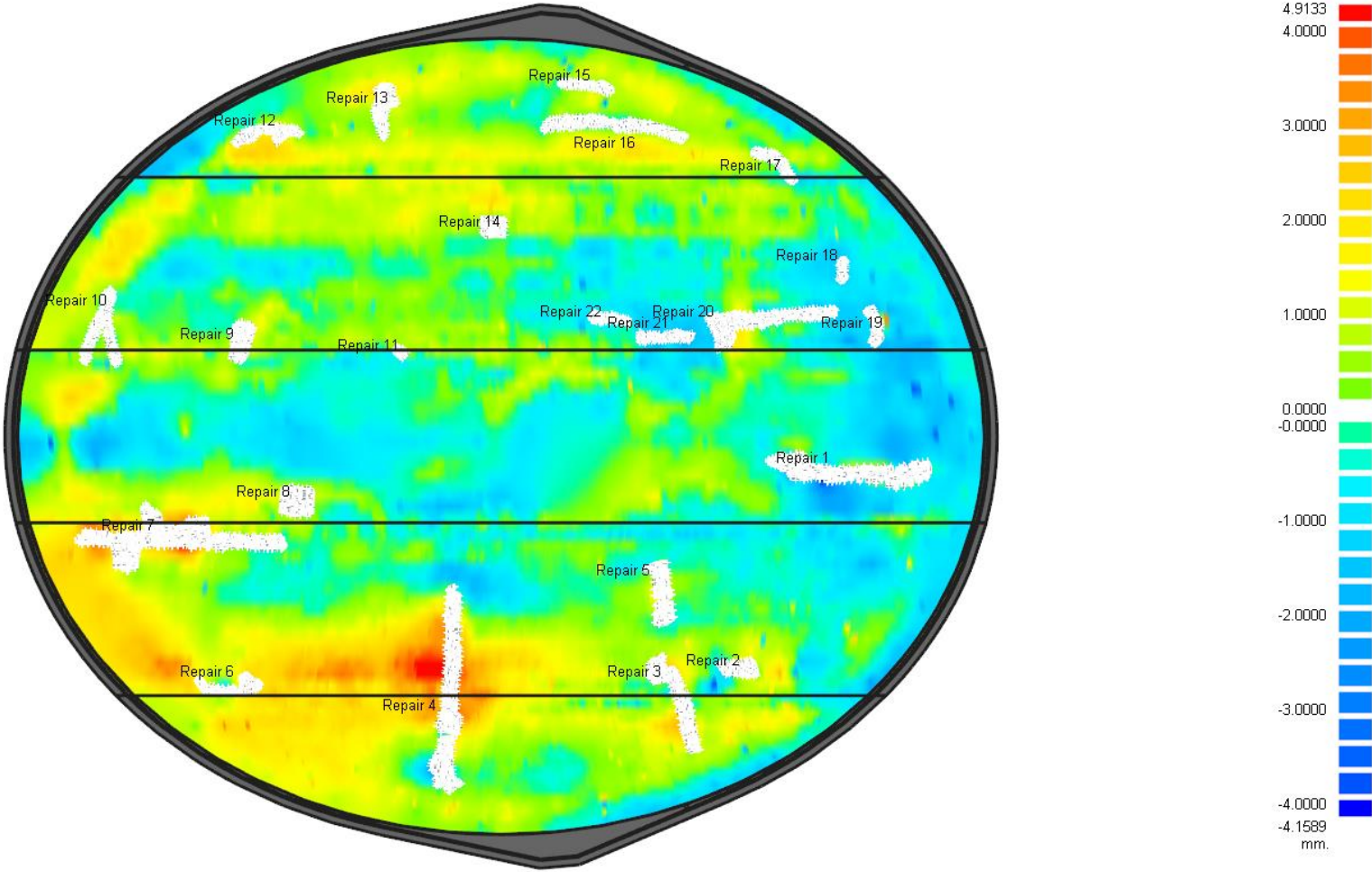
Sept 2016



Crack Repair, Nov 2013



DVA-1 First Scan After Repairs Dec 2013



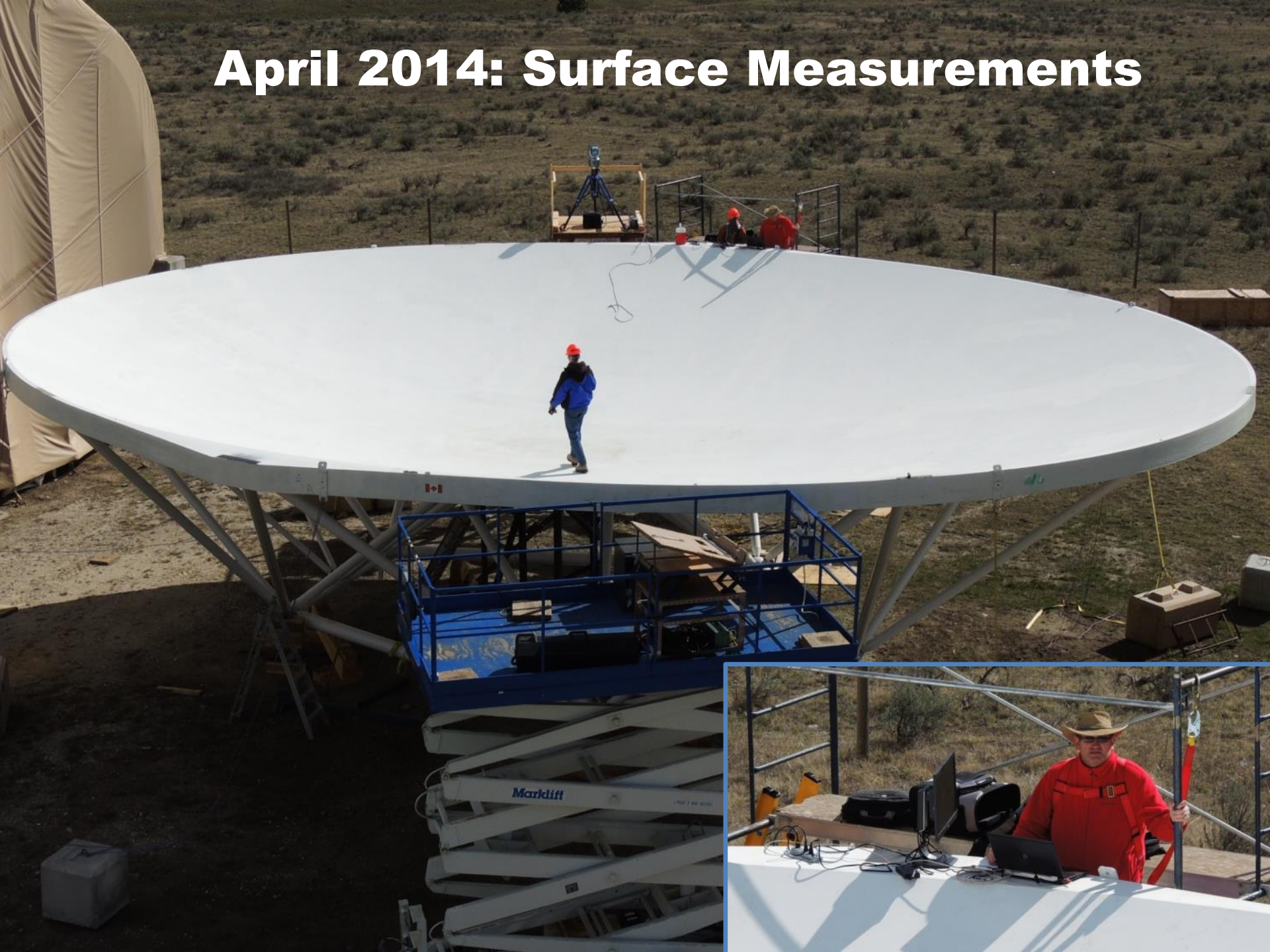
Lift #4: Installing the Backup Structure



The work was accomplished in about 6 hours on Dec 18 2013.



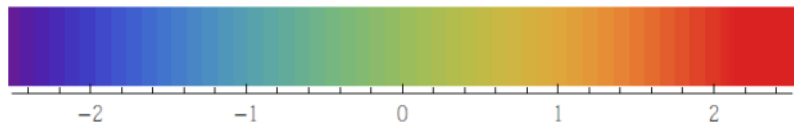
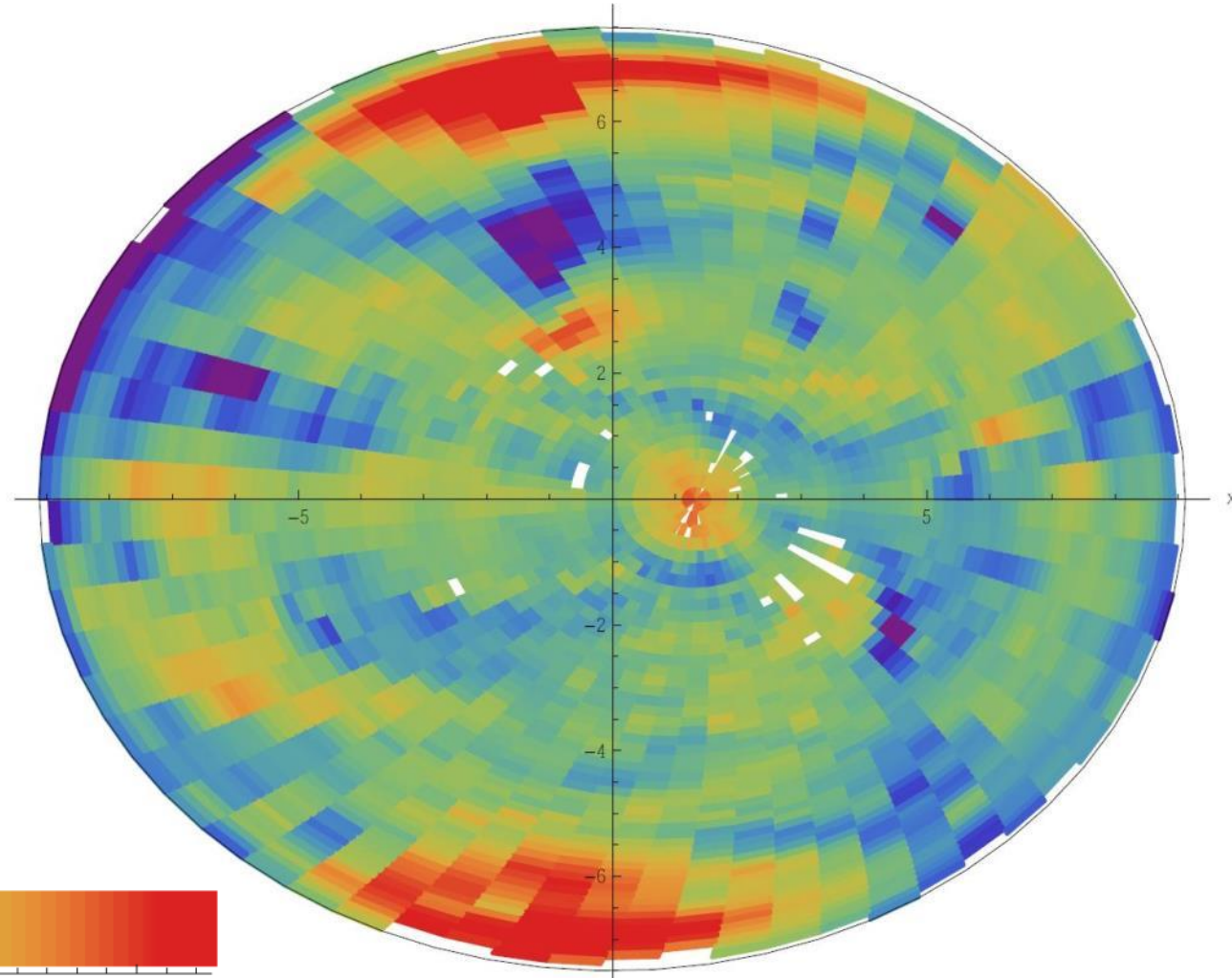
April 2014: Surface Measurements



DVA-1 Reflector Accuracy After Repairs, Mounted on Back Structure, April 2014

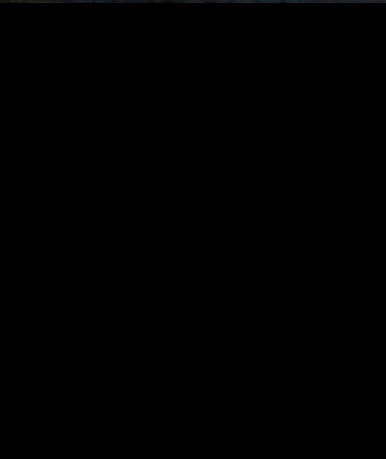
- Primary reflector RMS after repairs RMS 0.89mm,
- RMS with feed illumination function 0.71mm
- RMS with repaired areas removed 0.71mm

Color scale clipped at $\pm 2.4\text{mm}$

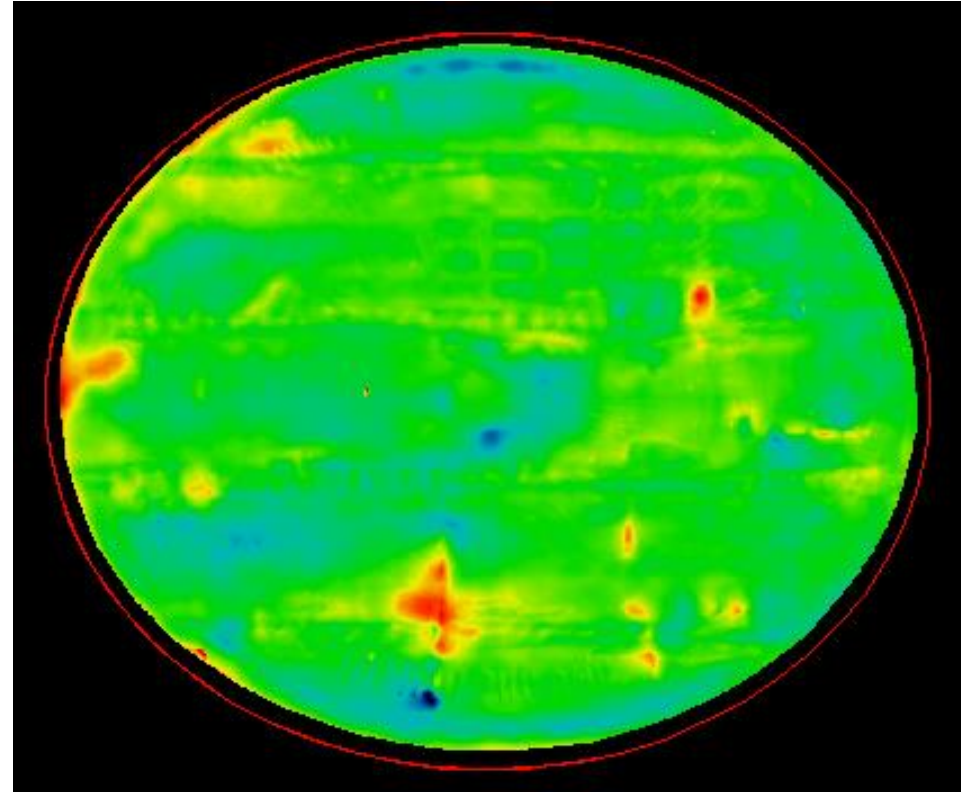
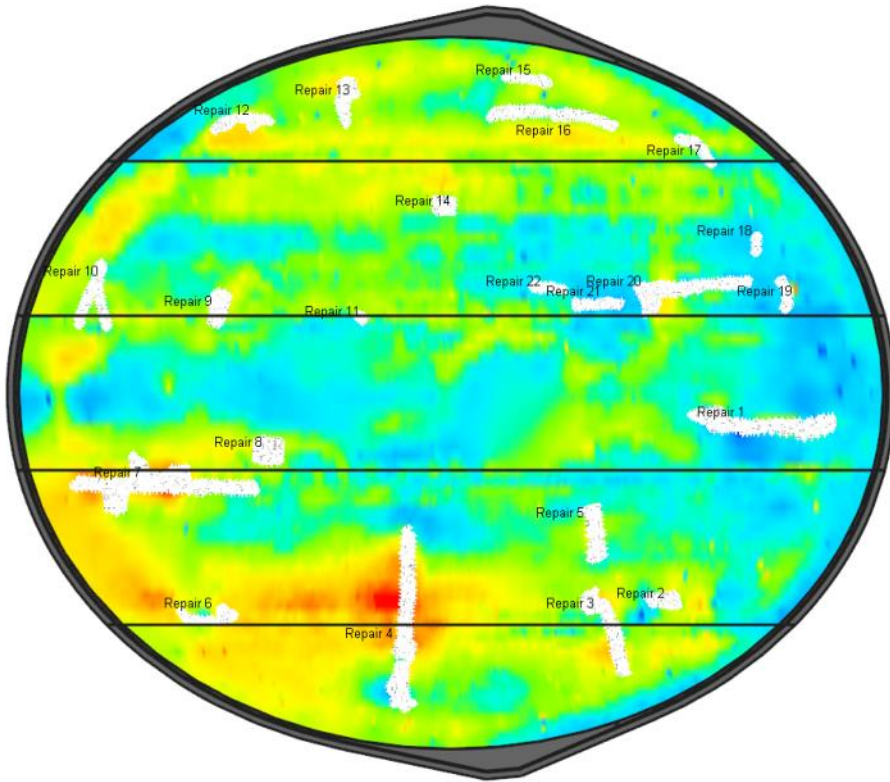




Primary Scan
September 2014.
We start
scanning at night
to improve
accuracy.

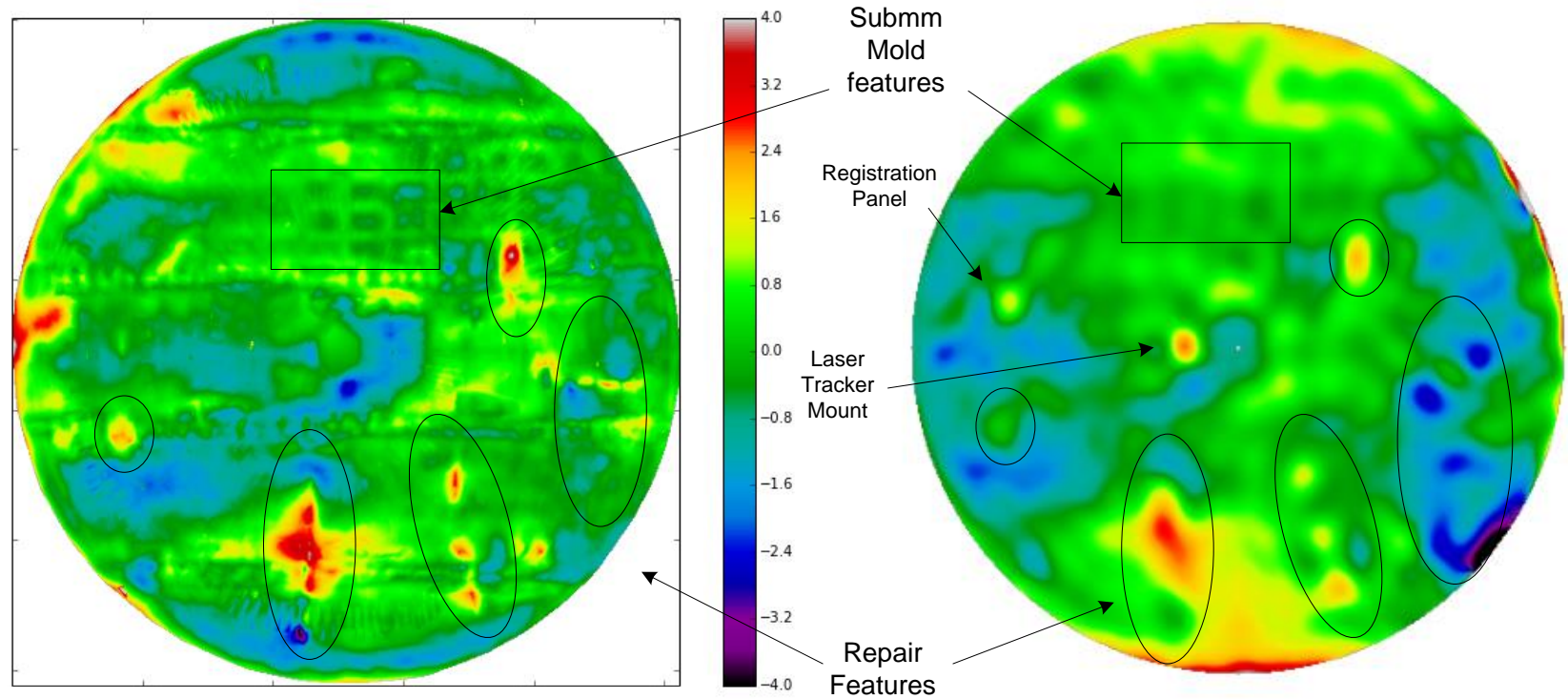


Primary Dish Surface Scan Sept 2014, Compared to Bare Dish Scan Nov 2013

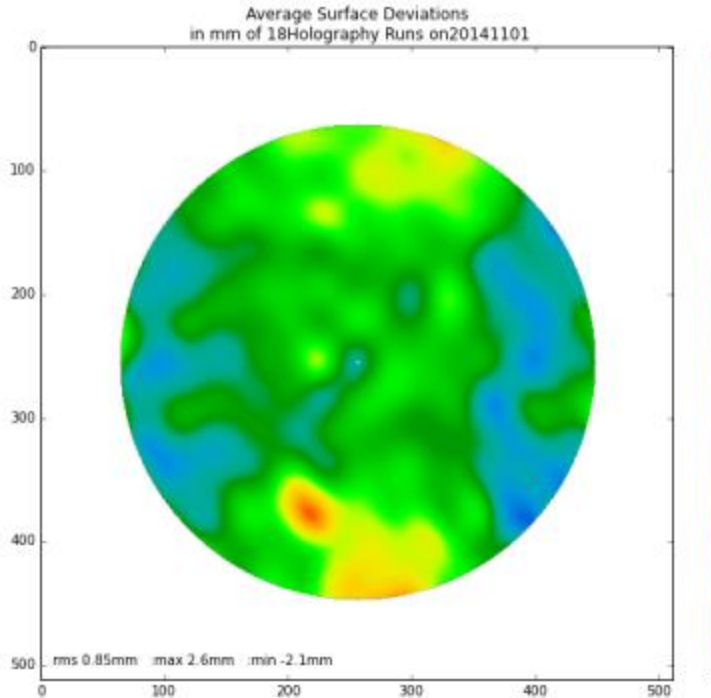


Primary reflector surface deviations. RMS error, uncorrected for aperture weighting 0.89mm, with aperture weighting, 0.77mm.

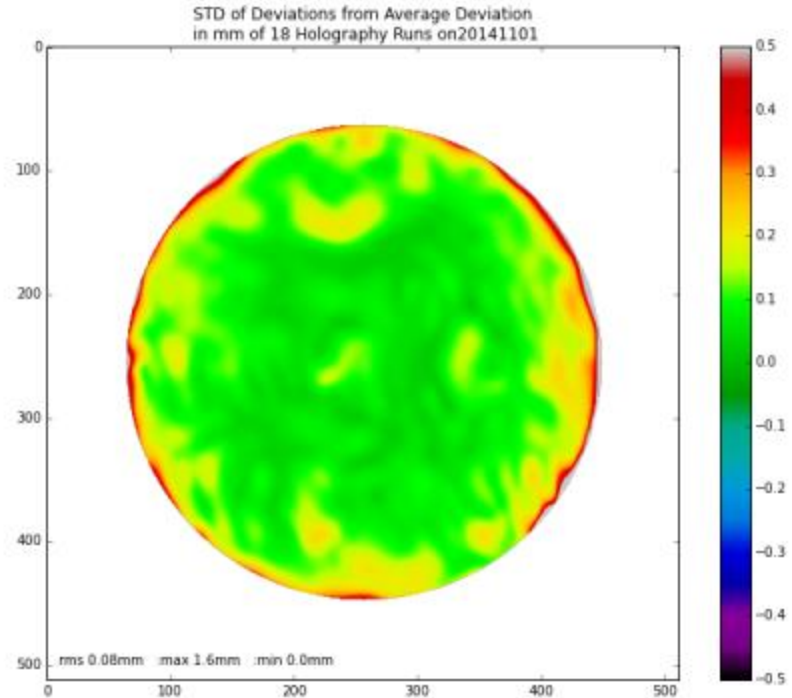
Laser Tracker vs Holography of Primary



Average Surface Error of 18 Holography Maps (28 Hrs)



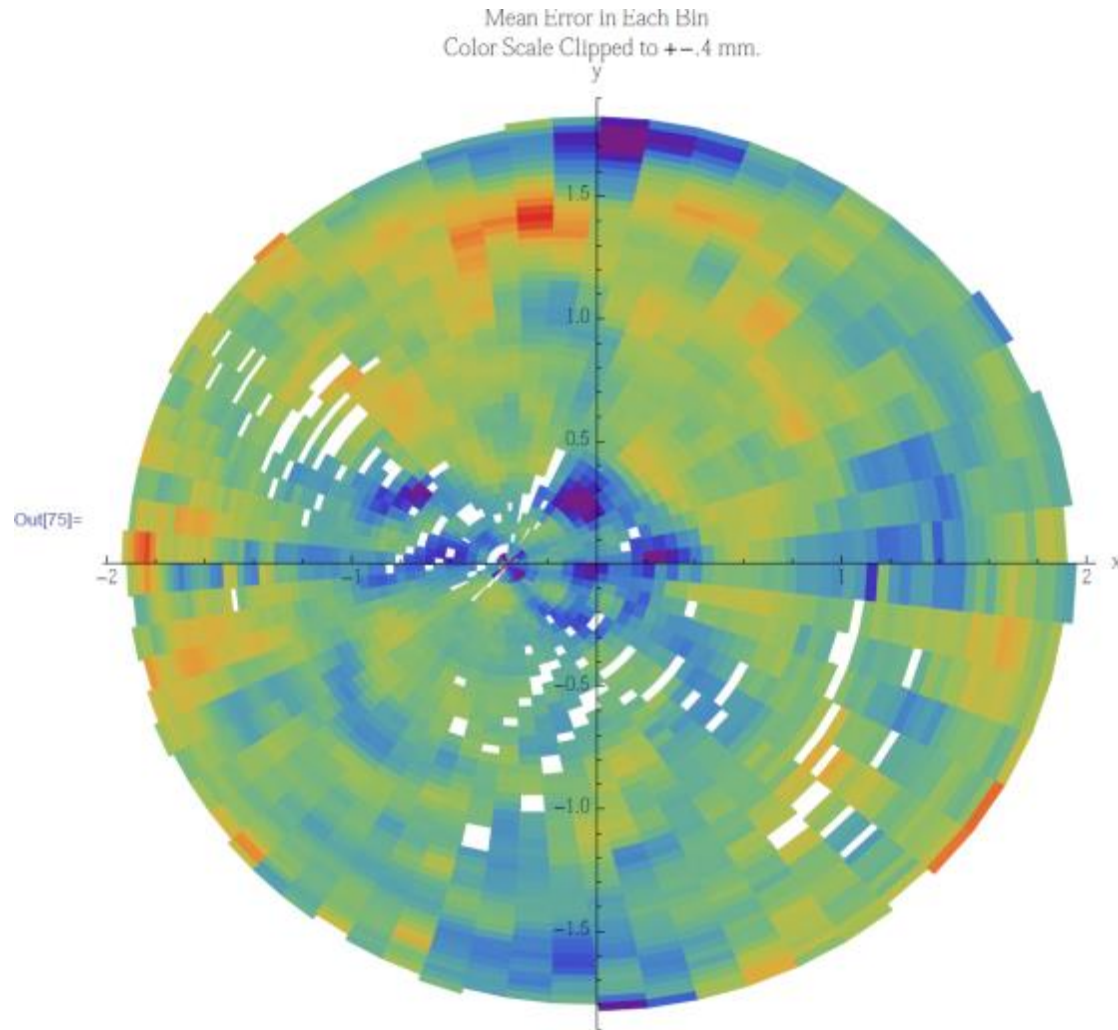
RMS .85mm



- Deviations from average .08mm RMS

Secondary Reflector Scan

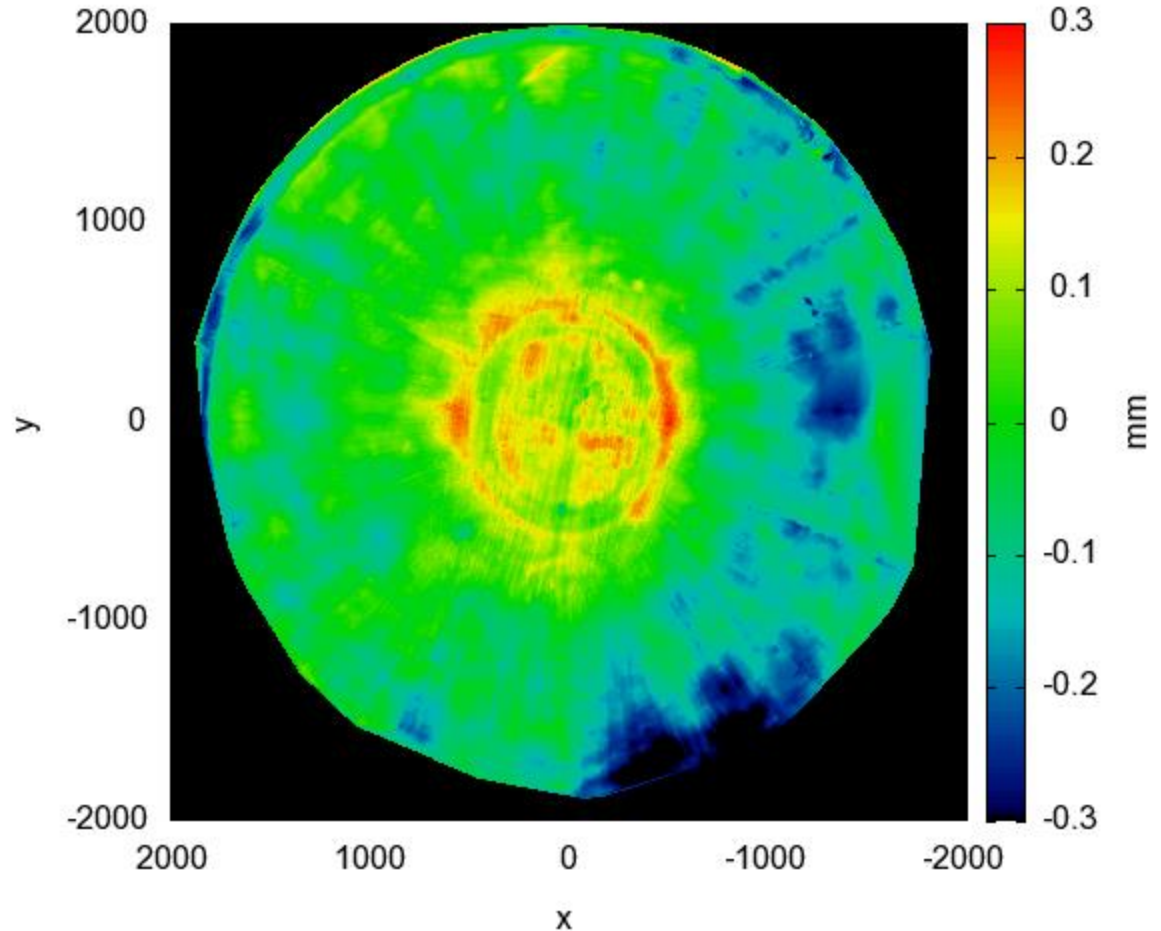
Secondary Part RMS
without antenna
weighting 0.2mm,
With antenna weighting,
0.11mm



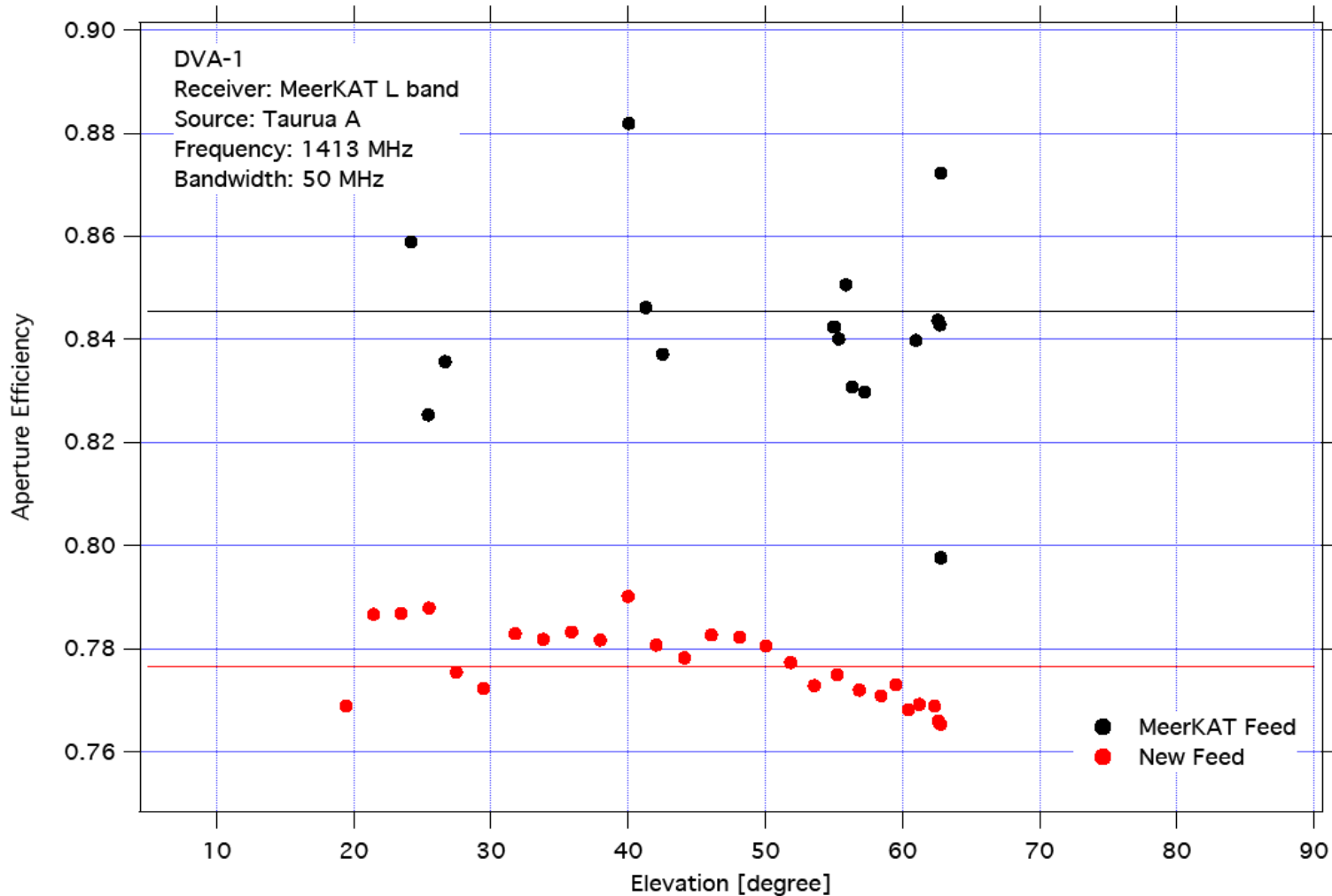
GDSatcom 4m Secondary

GDSatcom Secondary

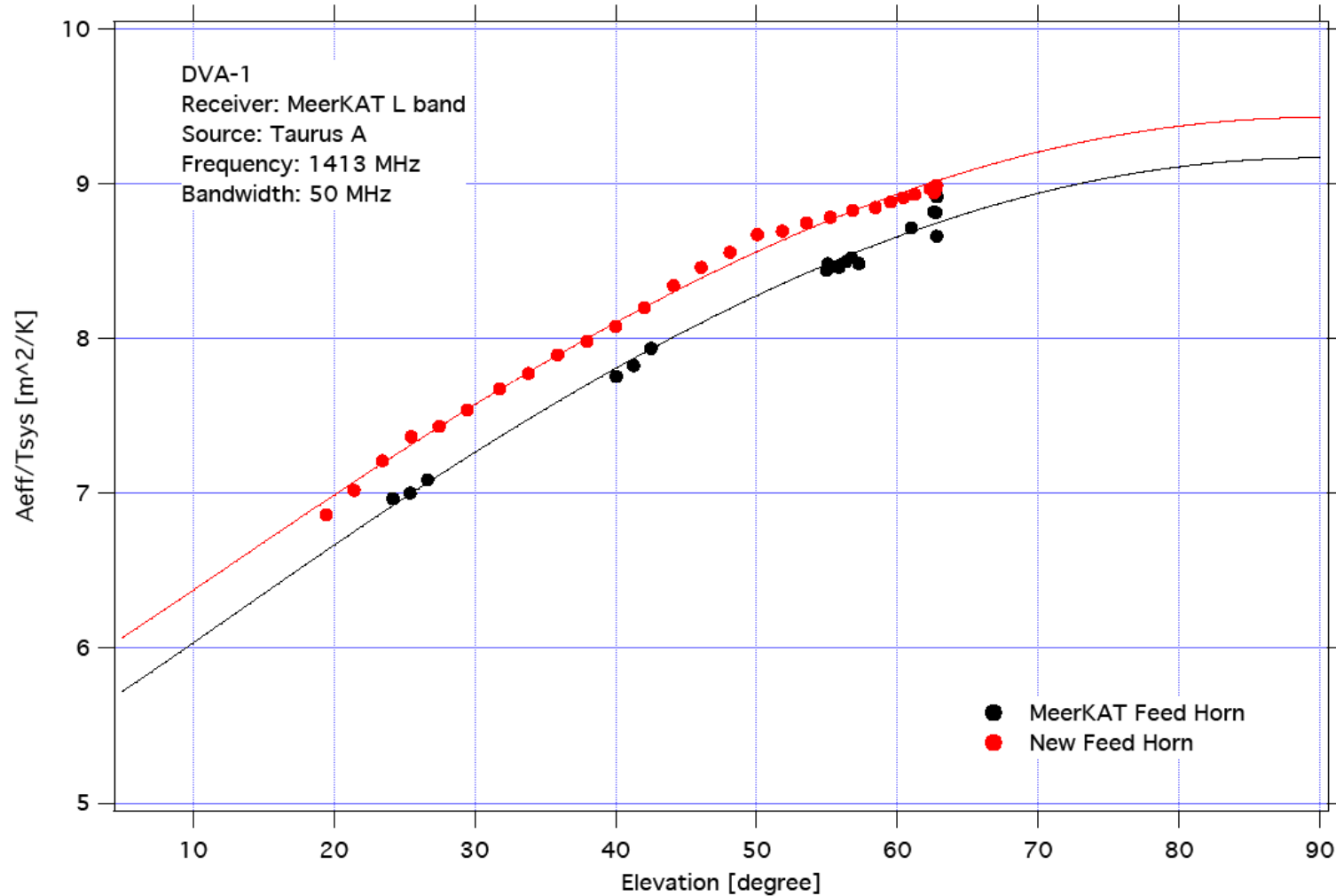
- Part2 RMS 0.101mm
- Part1 RMS 0.098mm
- Mold RMS 0.063mm
- Part/mold 1.6



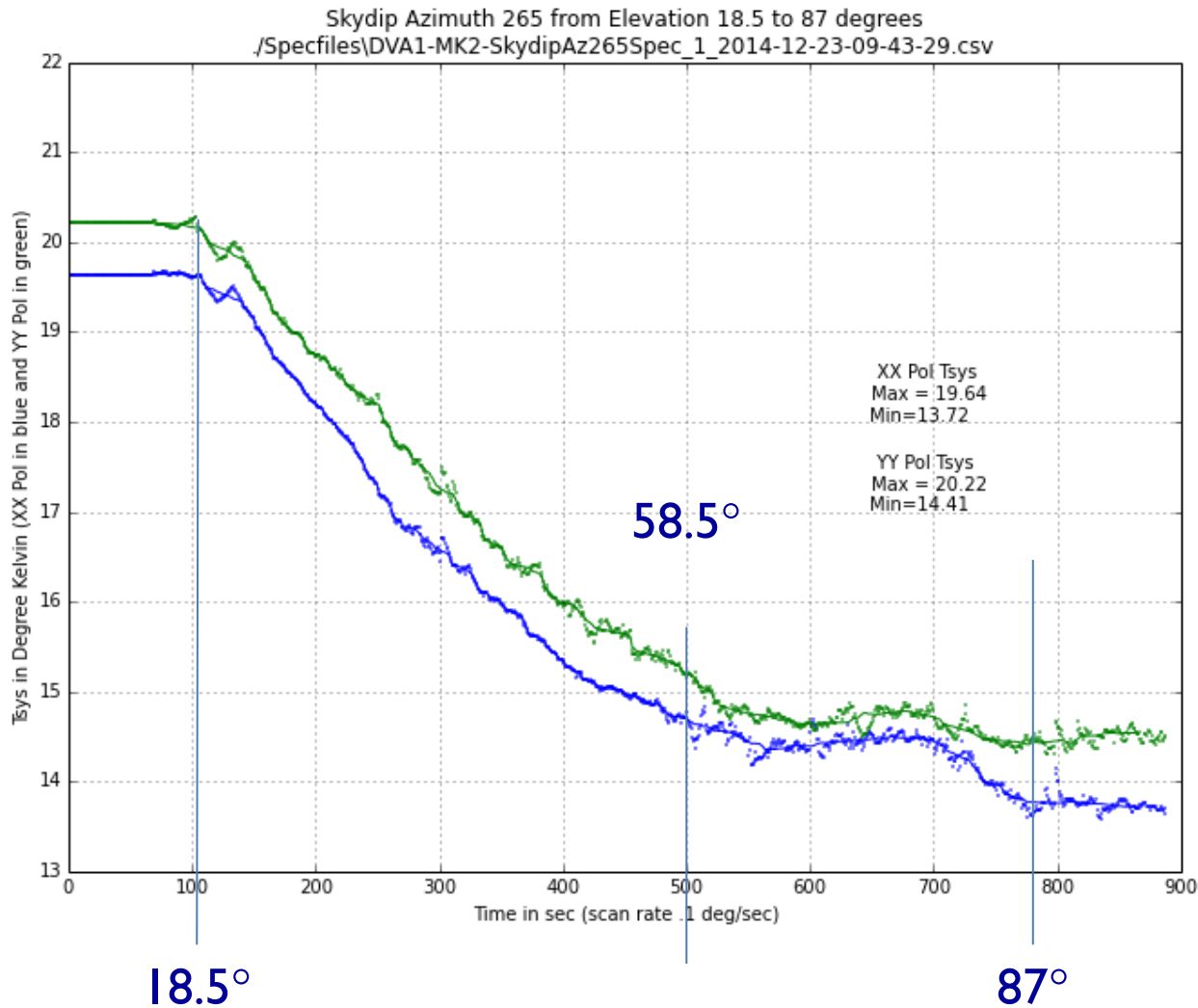
Aperture Efficiency with MeerKat and New (LB) Horn



Aeff/Tsys with MeerKat and New (LB) Horn

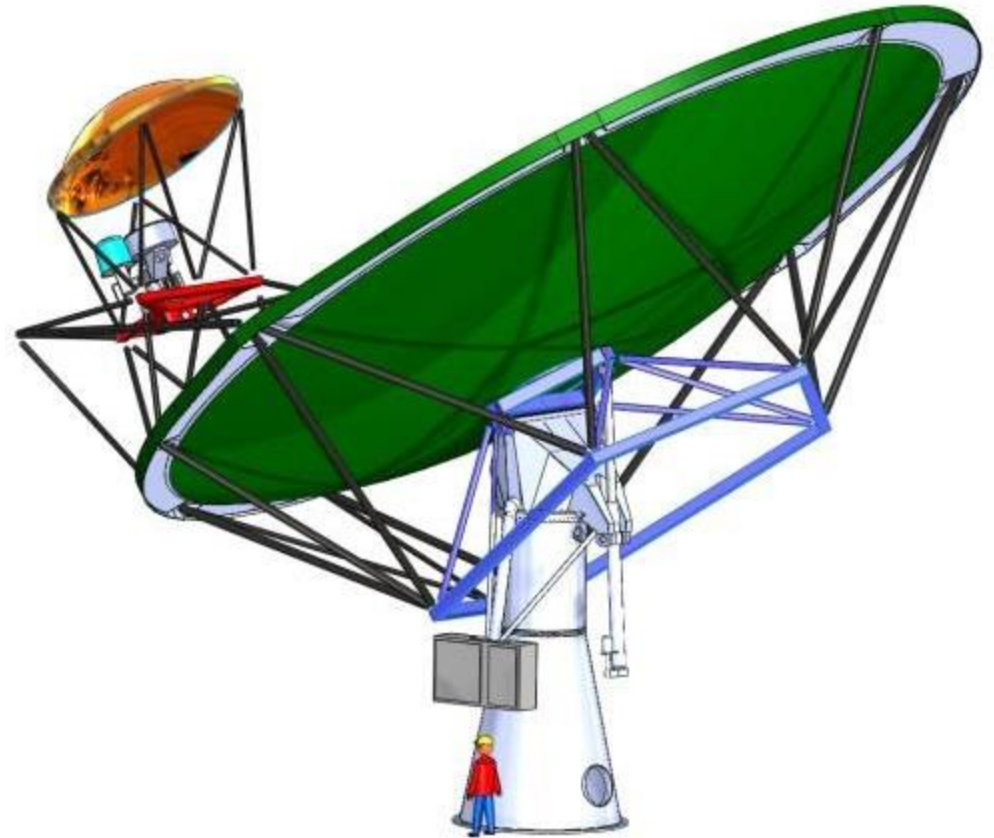


Preliminary Tipping Curves Results

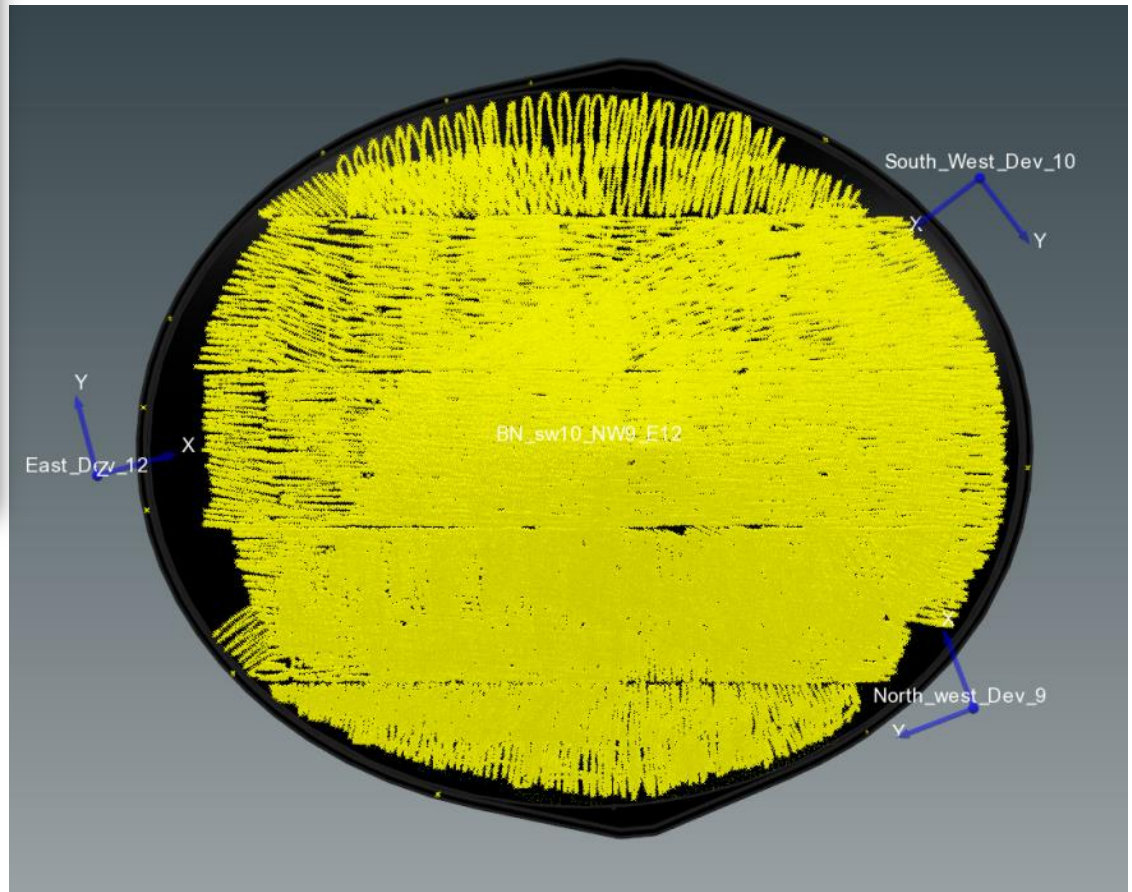


DVA-3 Project: Upgrade to 50GHz

- Same optics by Lynn Baker, Bill Imbriale, German Cortez (TDP).
- Same rim supported single piece carbon composite primary and secondary but:
 - Surface accuracy for 50GHz
 - Surface reflectivity for 50GHz
 - Pointing for 50GHz: new tower, new back structure (new everything!)

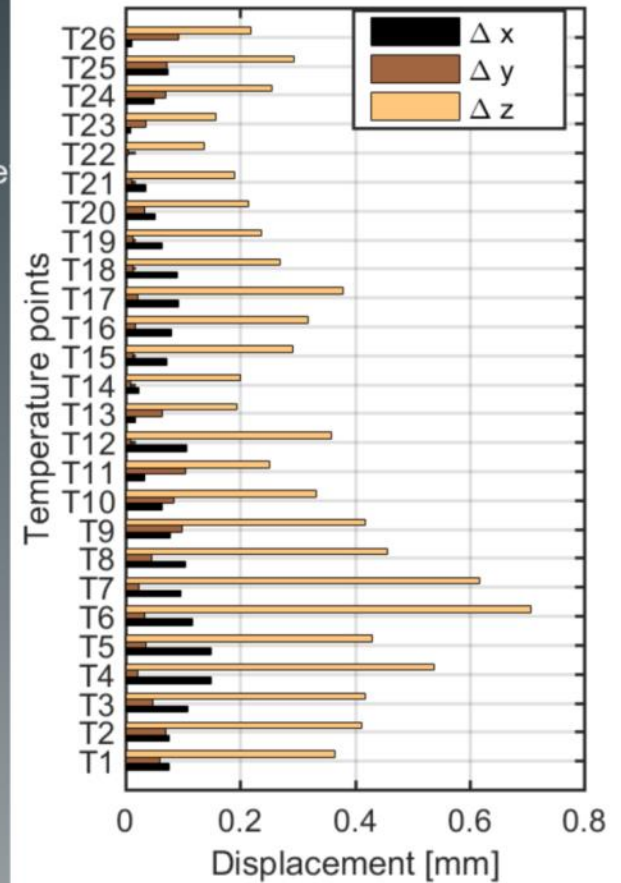
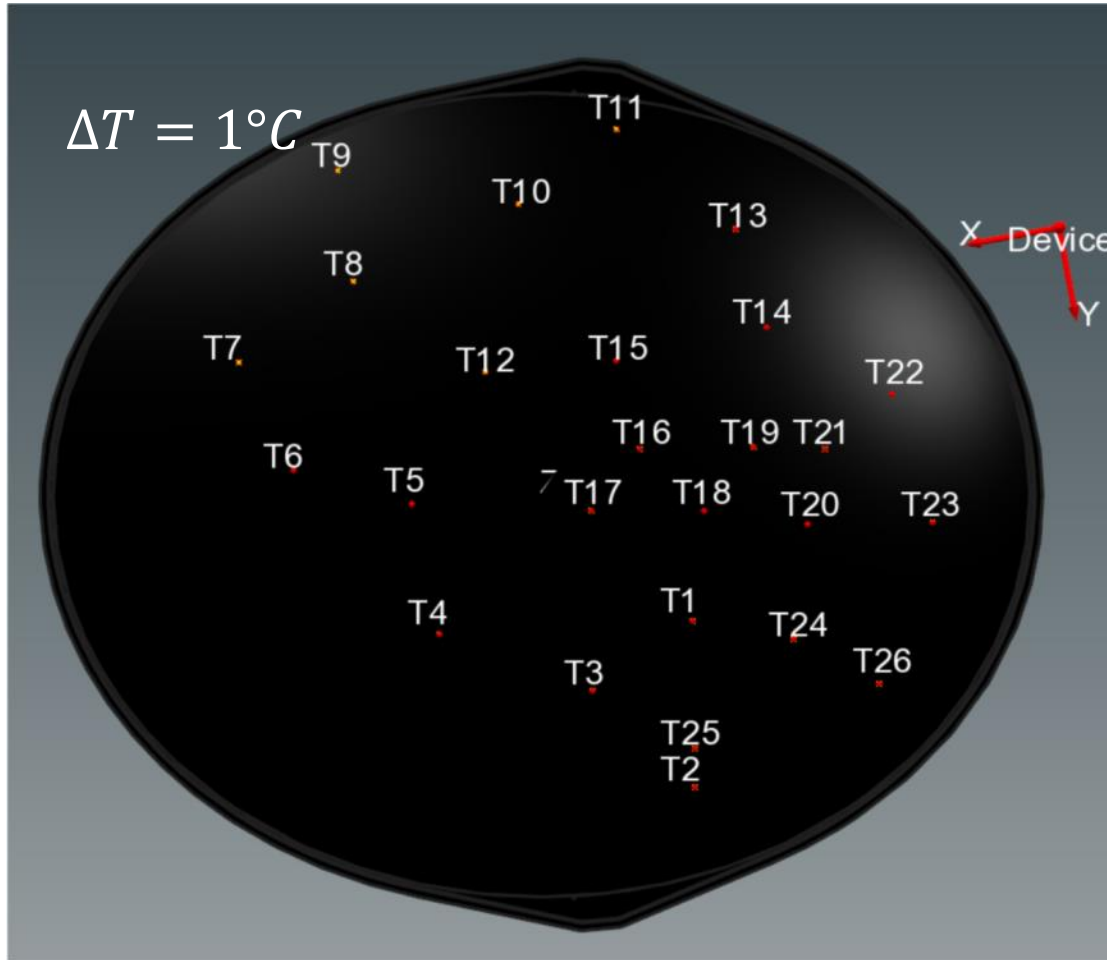


First Step: Improve Mold Accuracy, Summer 2016



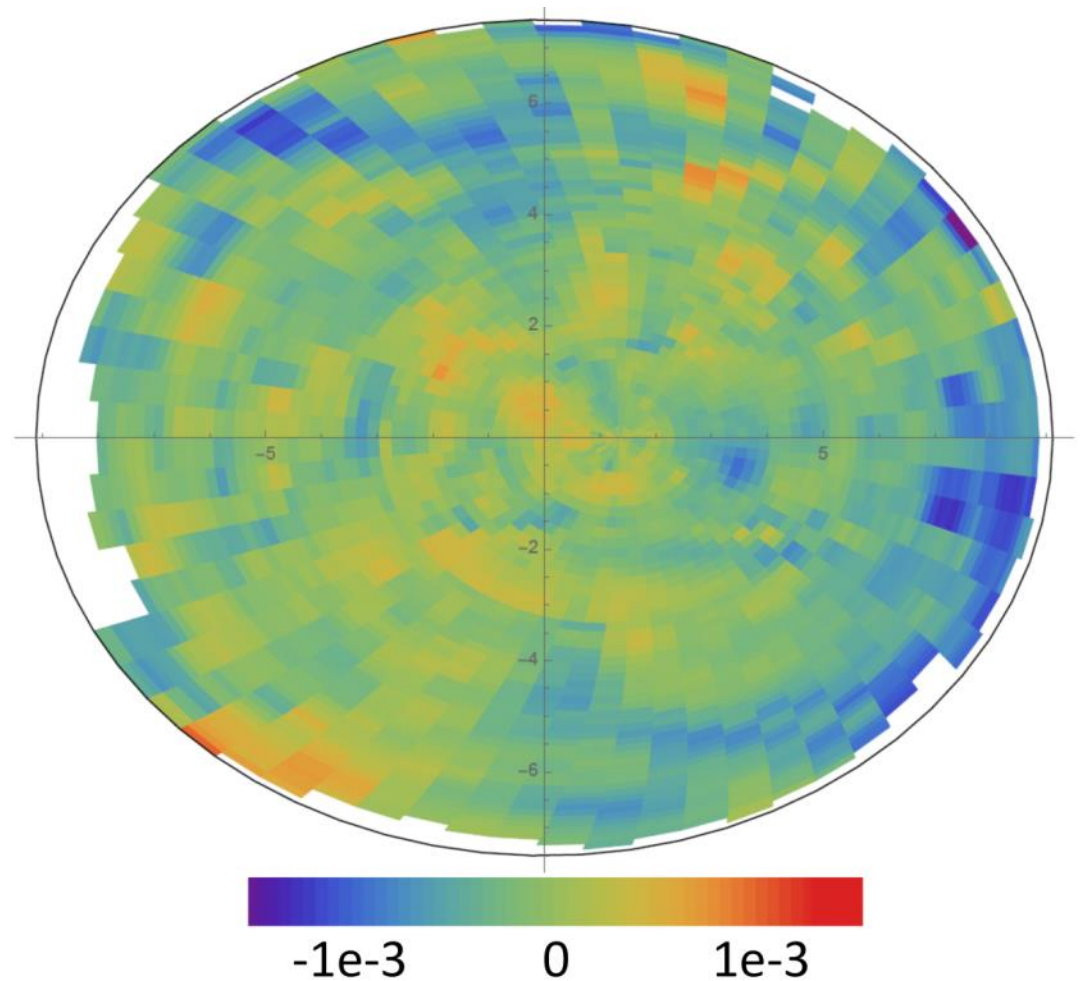
- Measuring to 15 microns over 10s of meters is challenging!
- Quickly learned that a very stable room temperature is required.

Thermal expansion of the mold



DVA – 3 Mold Measurement Results

- Mold RMS error = 0.21 mm (unweighted)
- Mold RMS error = 0.18 mm (weighted)



Questions?

