CROME - antenna response

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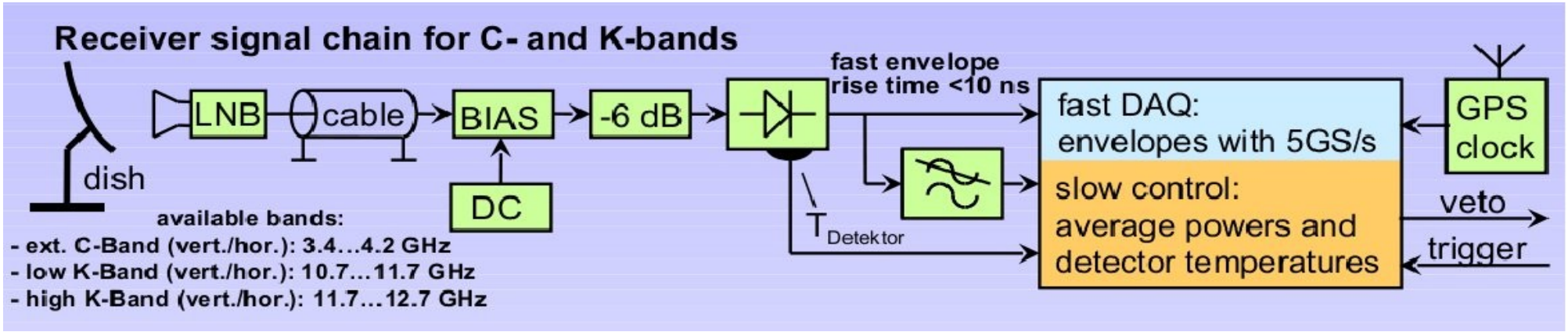
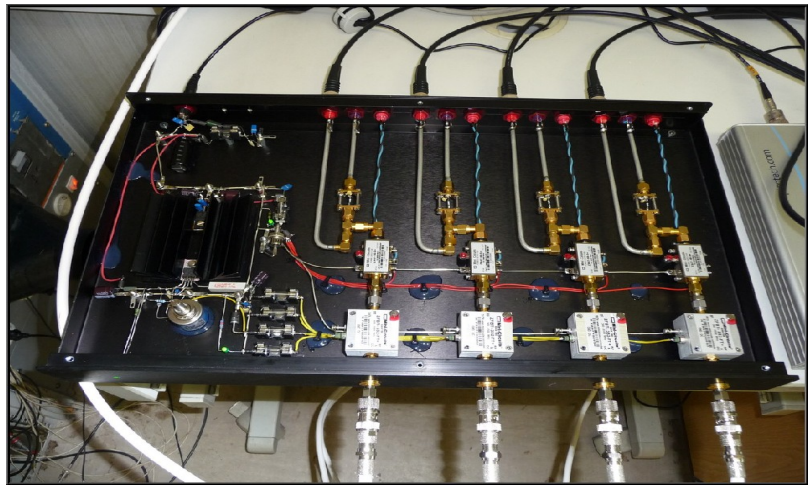
Outline

- Parameters of CROME antennas
- Gain pattern
- Conversion to Watts
- ToDo

Chain of detector



- Dish – feeds – LNBs – power supply and detector – scope – gps clock - pc

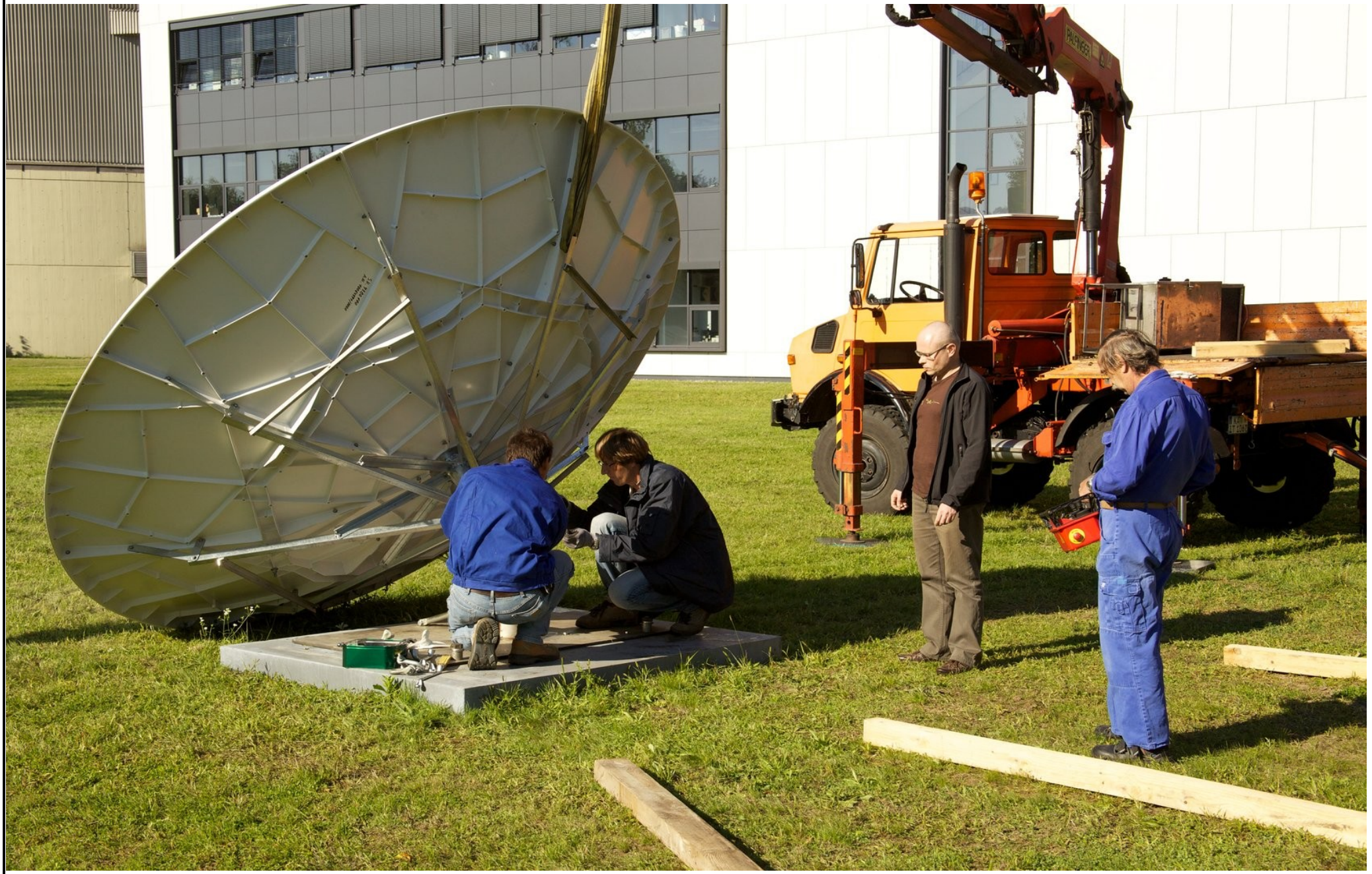


Initial setup

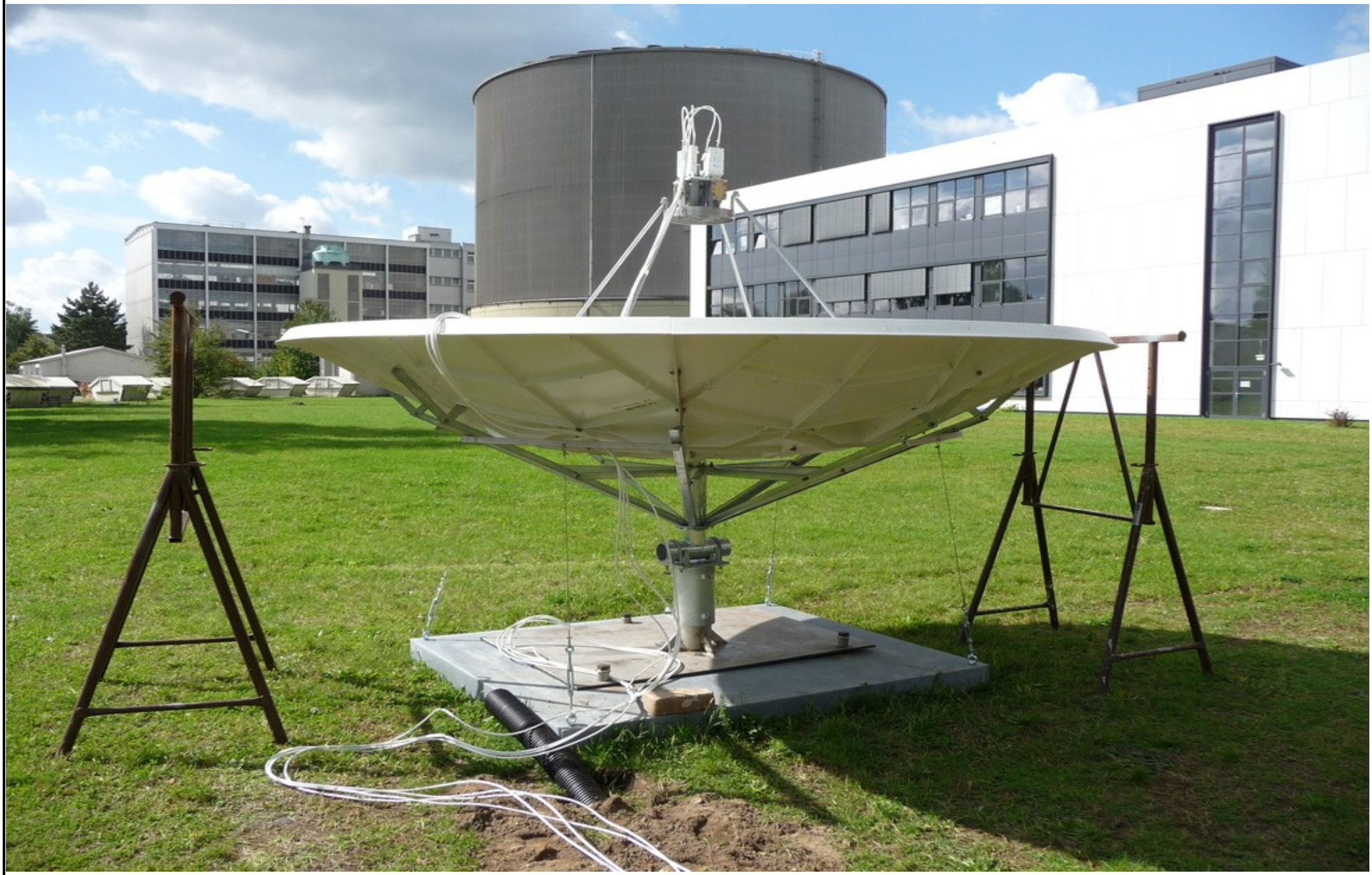
- 90 and 150 cm parabolic offset dishes
- Ku-band (10.7 – 11.7 GHz) receivers
- Extended C-band (3.4 – 4.2 GHz)
- 13 K noise temperature
- 2 months of measurement (now for testing)

Transportation

Installation



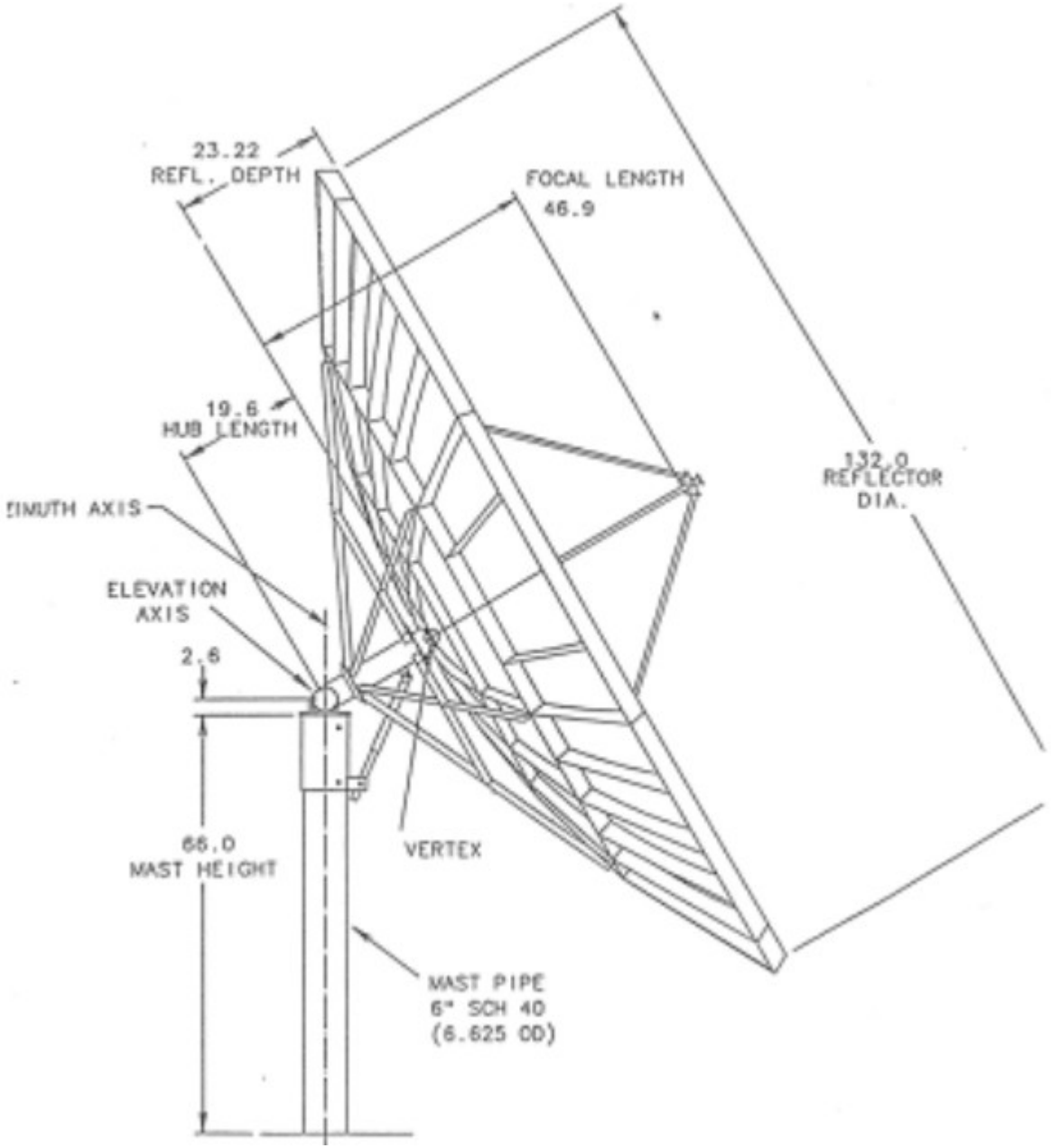
Final adjustment



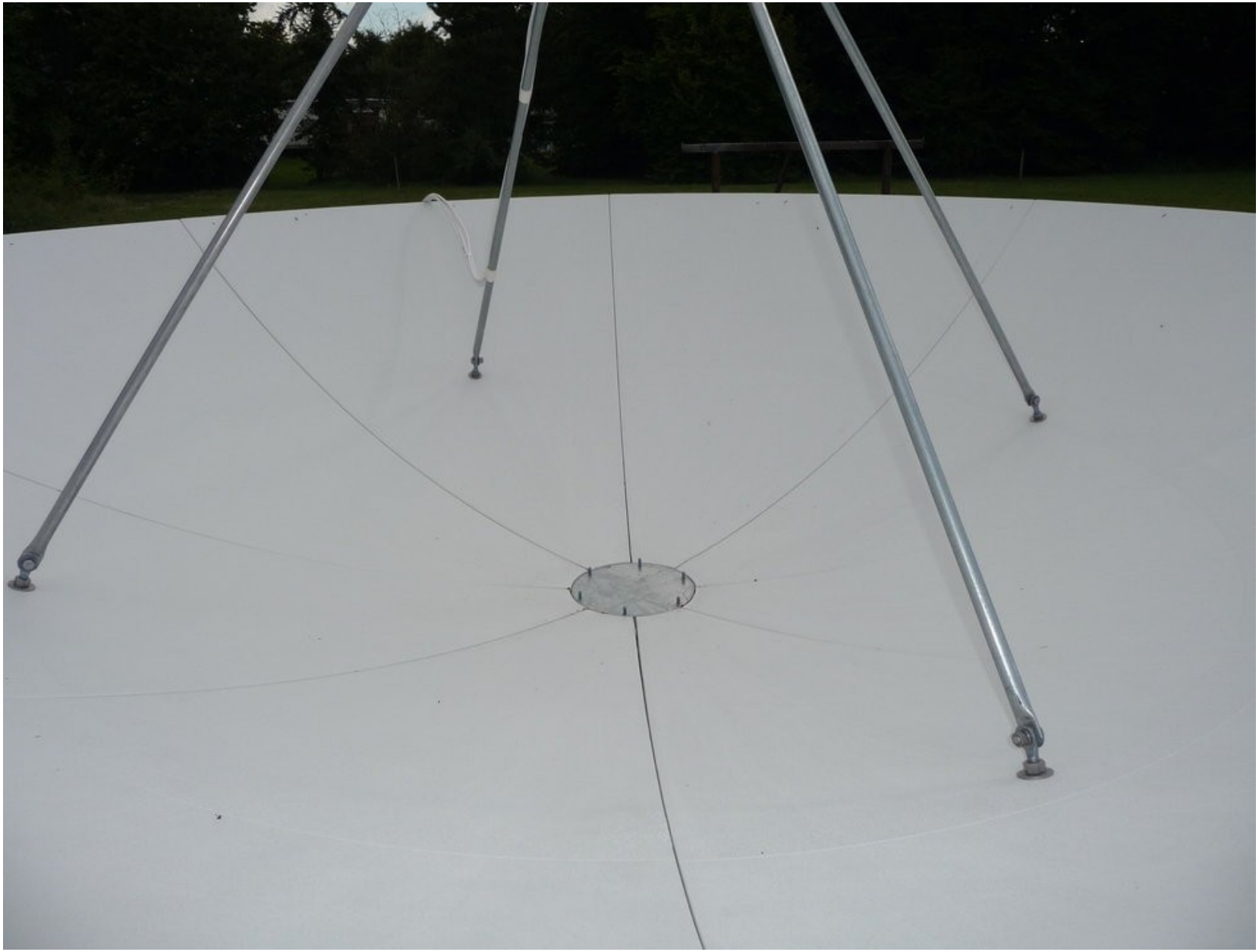
New antenna

- Segmented dish
- Diameter: 335.3 cm, focal length: 119.1 cm
- Prime focus with 4 receivers

Prodelin dish

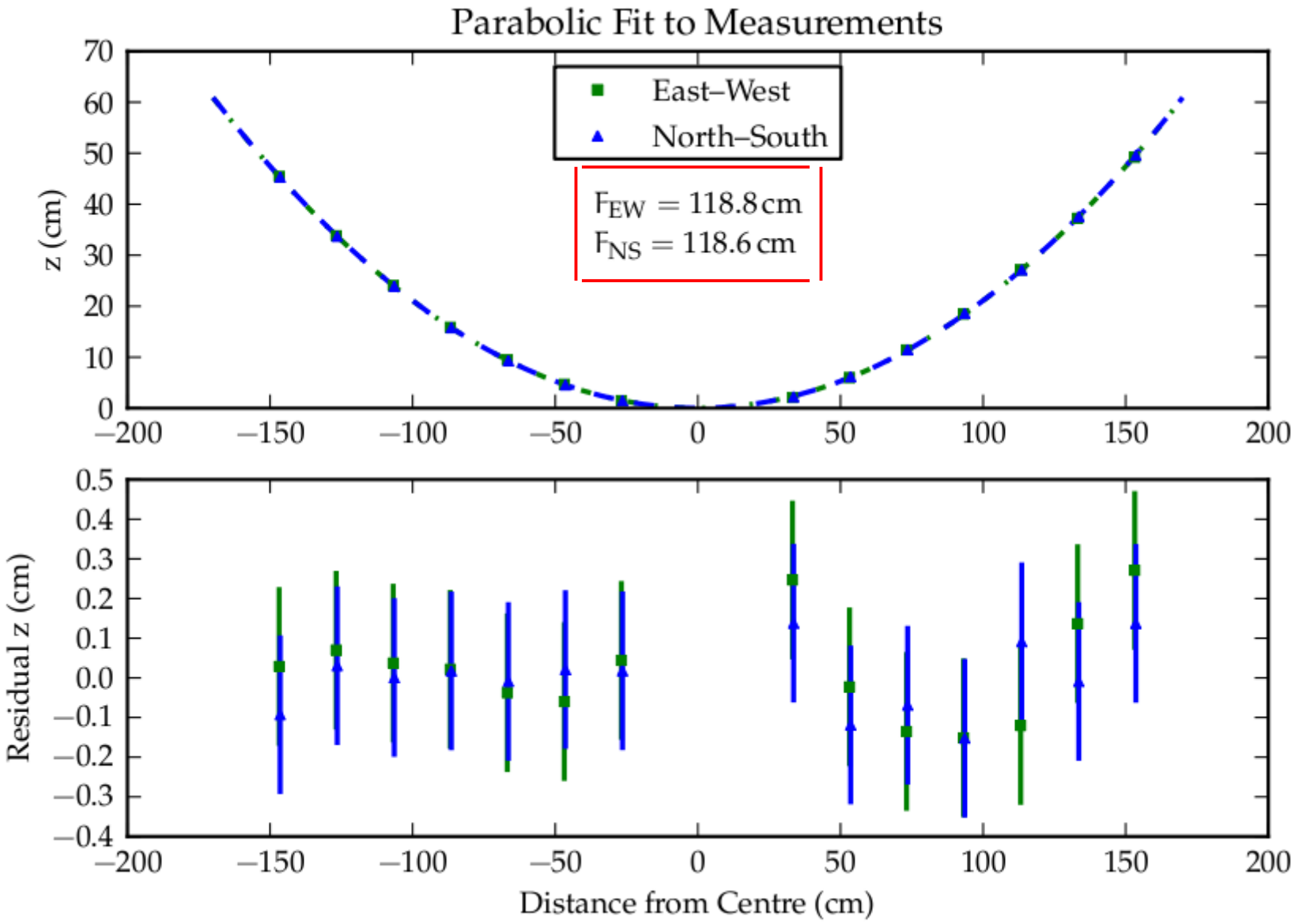


Paraboloid



Measurement

Fit for data


Parabolic Fit to Measurements
East–West
North–South
$F_{EW} = 118.8\,cm$
$F_{NS} = 118.6\,cm$
z (cm)
Residual z (cm)
Distance from Centre (cm)

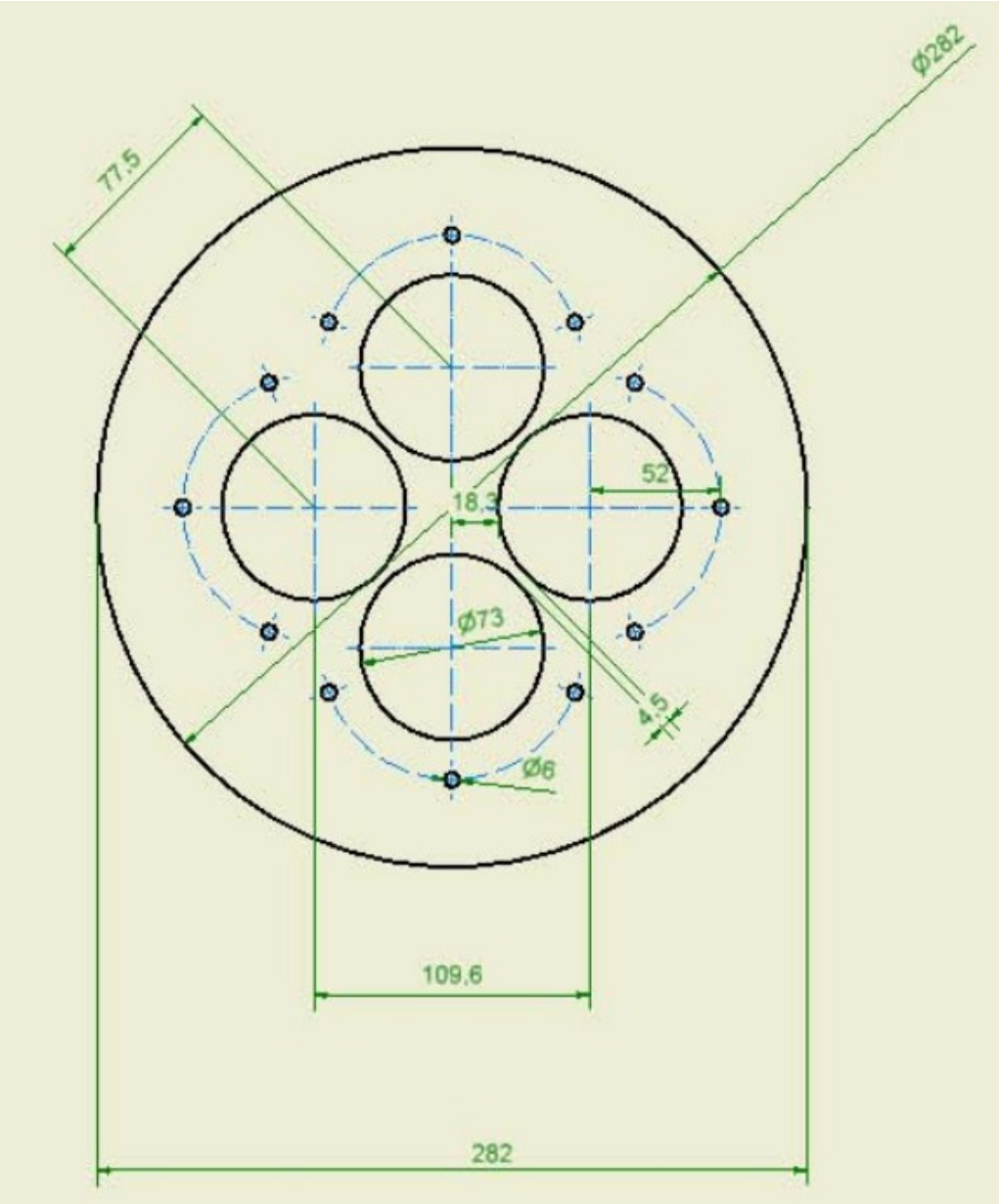
Receivers

- Feeds:
  Linear dual polarity feeds
  5 feeds also with circular polarizer
  Diameter of entrance window: 67 mm

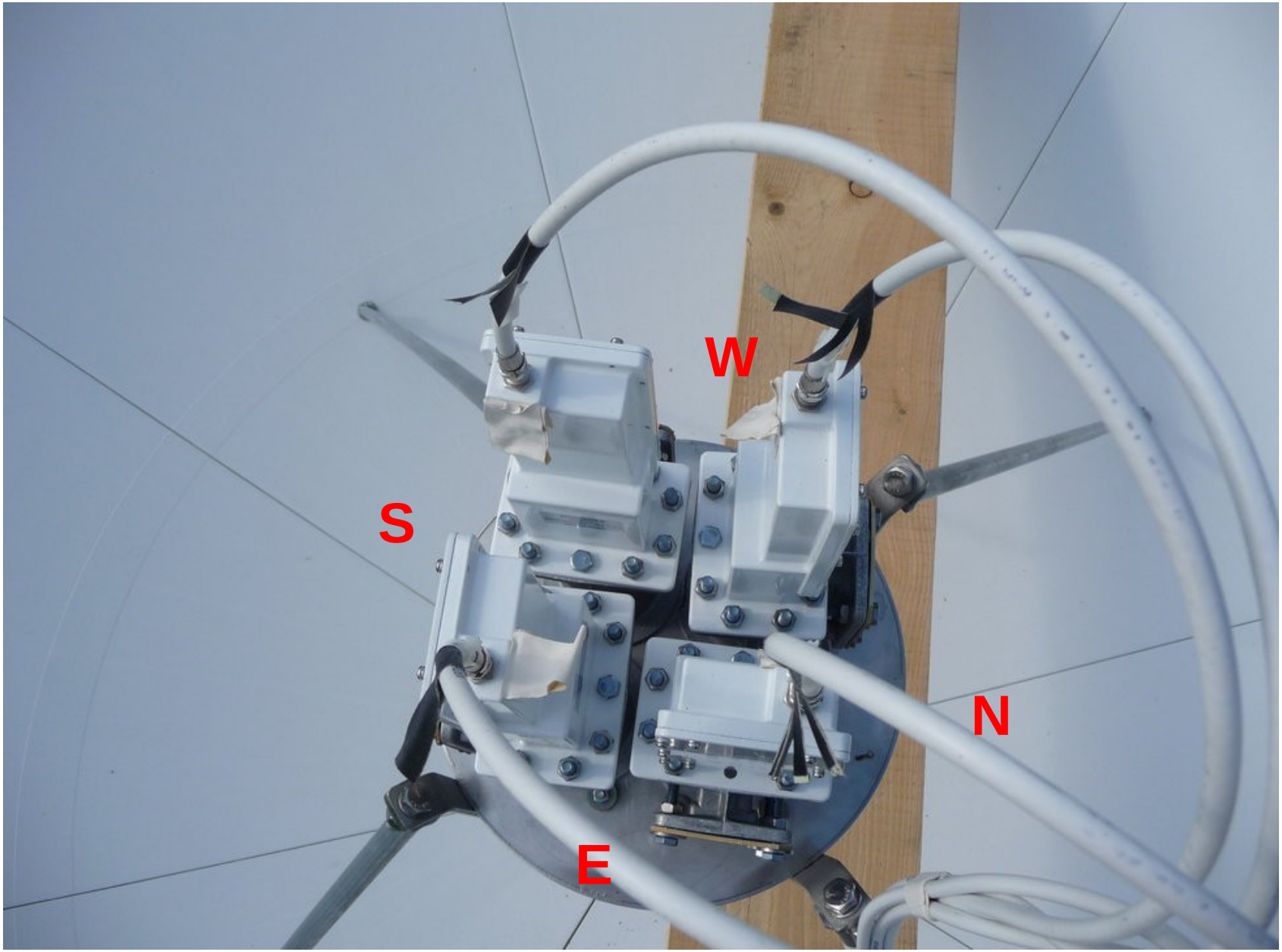
- LNBs:
  Extended C-band: 3.4 – 4.2 GHz
  Local oscillator frequency stability +-250 kHz
  Noise temperature 13 K

Receivers in the dish

Feeds' holder



Vertical linear polarization



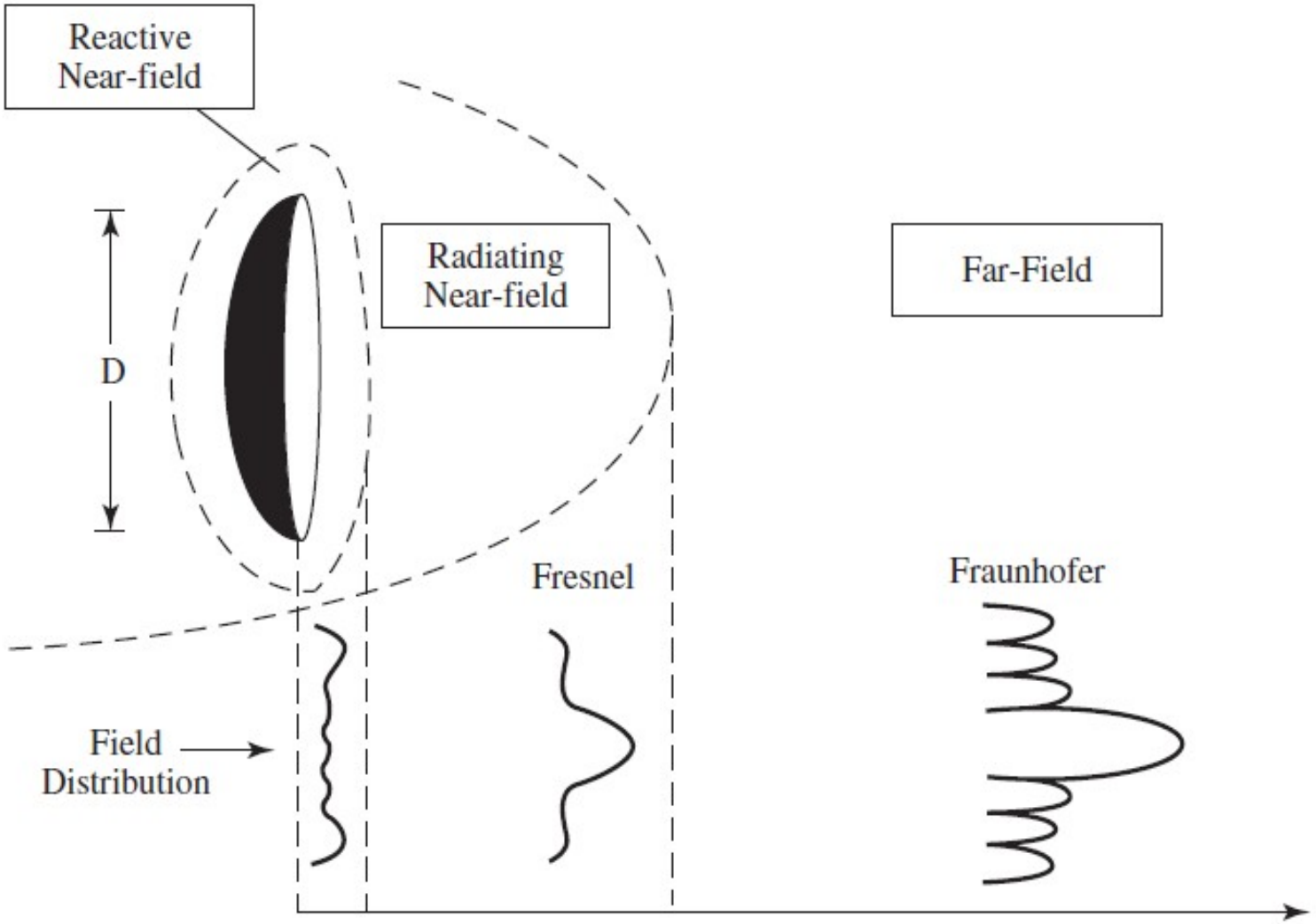
Gain pattern

- How does look a gain pattern?
- What is a beam width?

- 1) Measurement by calibrated GHz source
- 2) Simulations

Measurement by a source

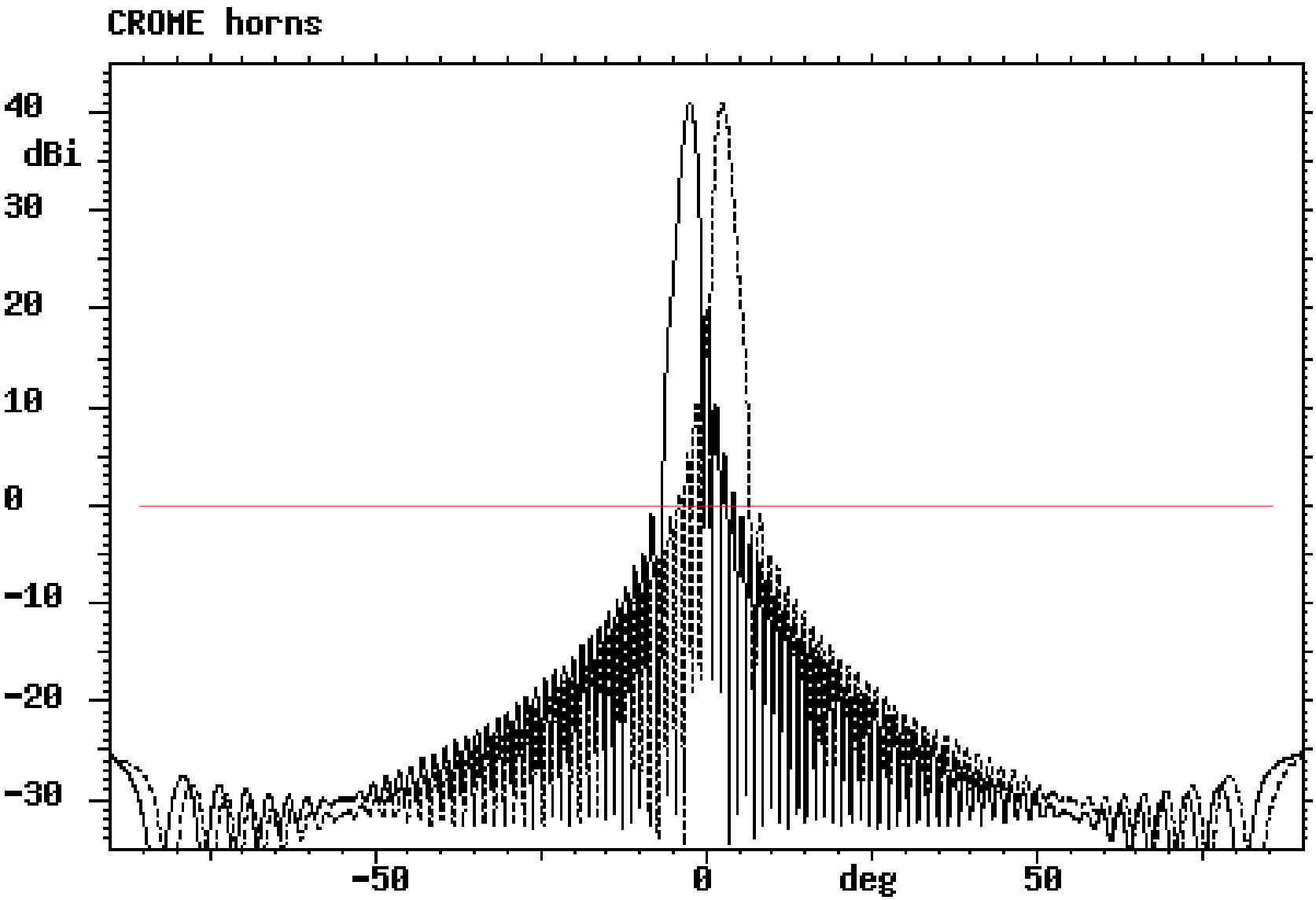
- Far-field region at distance ≥ $2*D^2/\lambda$ = 300 m (!)



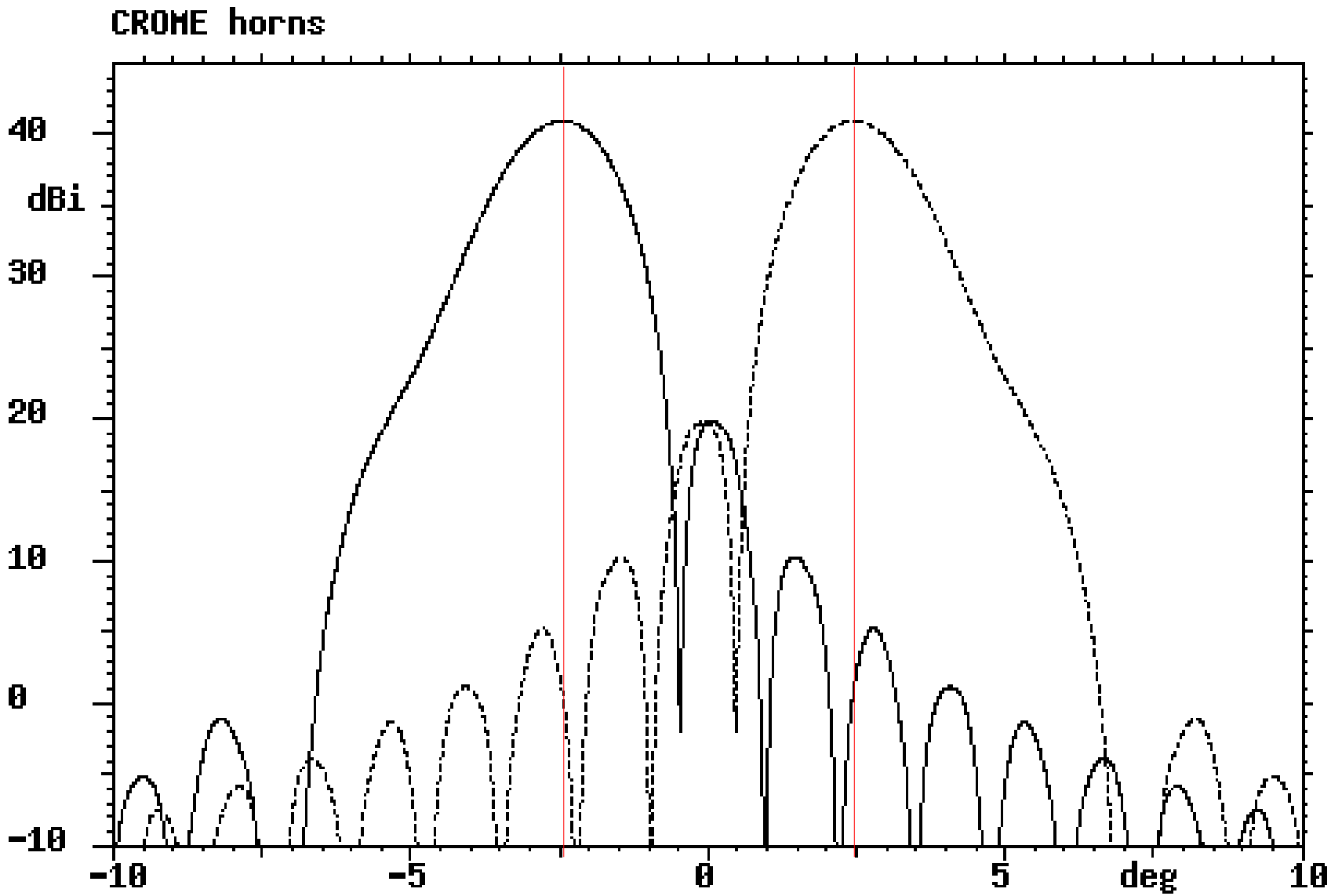
Calculation of gain pattern

- GRASP (www.ticra.com)
- Parabolic dish
- Horn receivers with a diameter of 67 mm
- Polar angle: -180^{o} to +180^{o}
- Zenith angle: -90^{o} to +90^{o}
- Step should be ≤ 0.5^{o} (!)

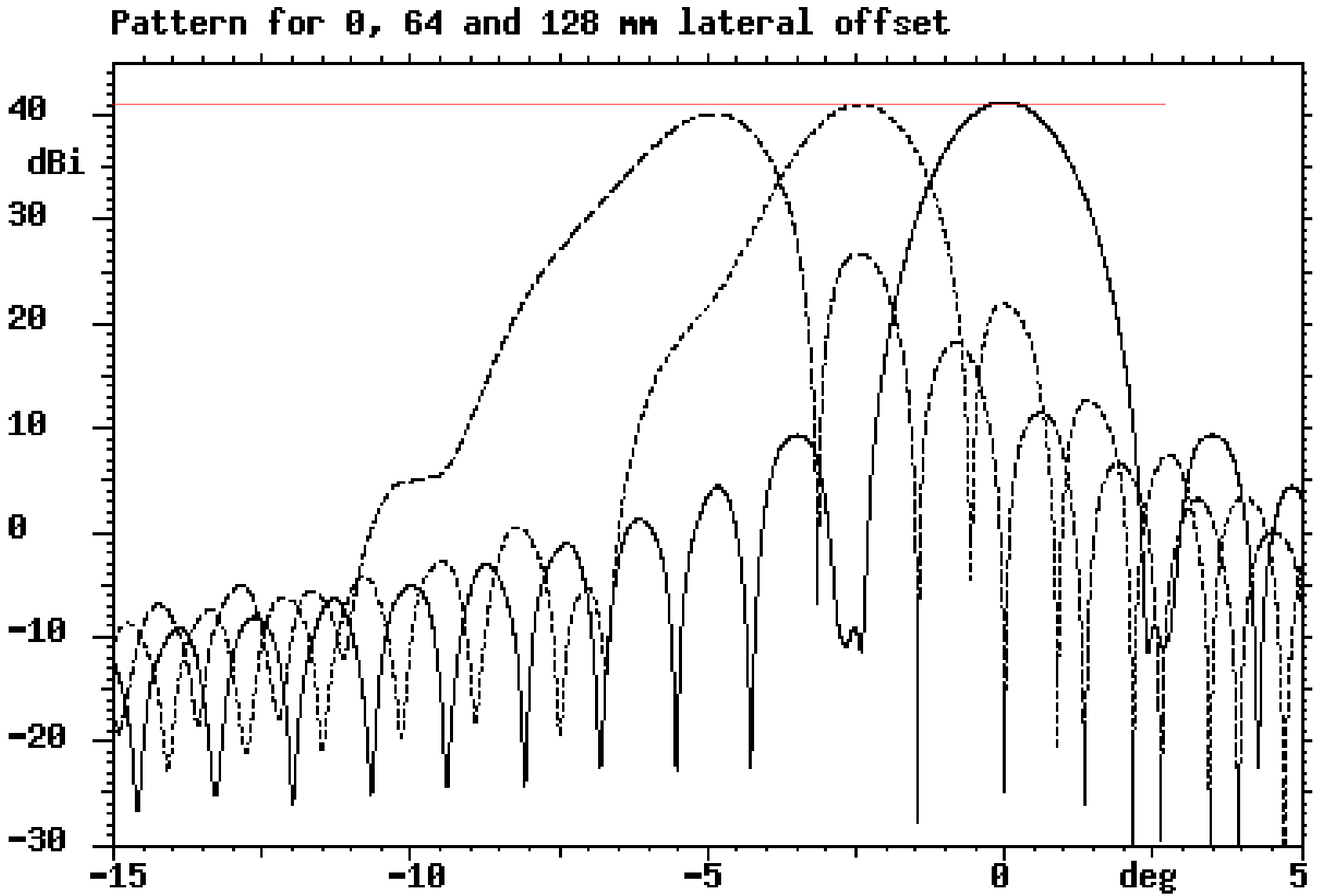
Calculated gain pattern



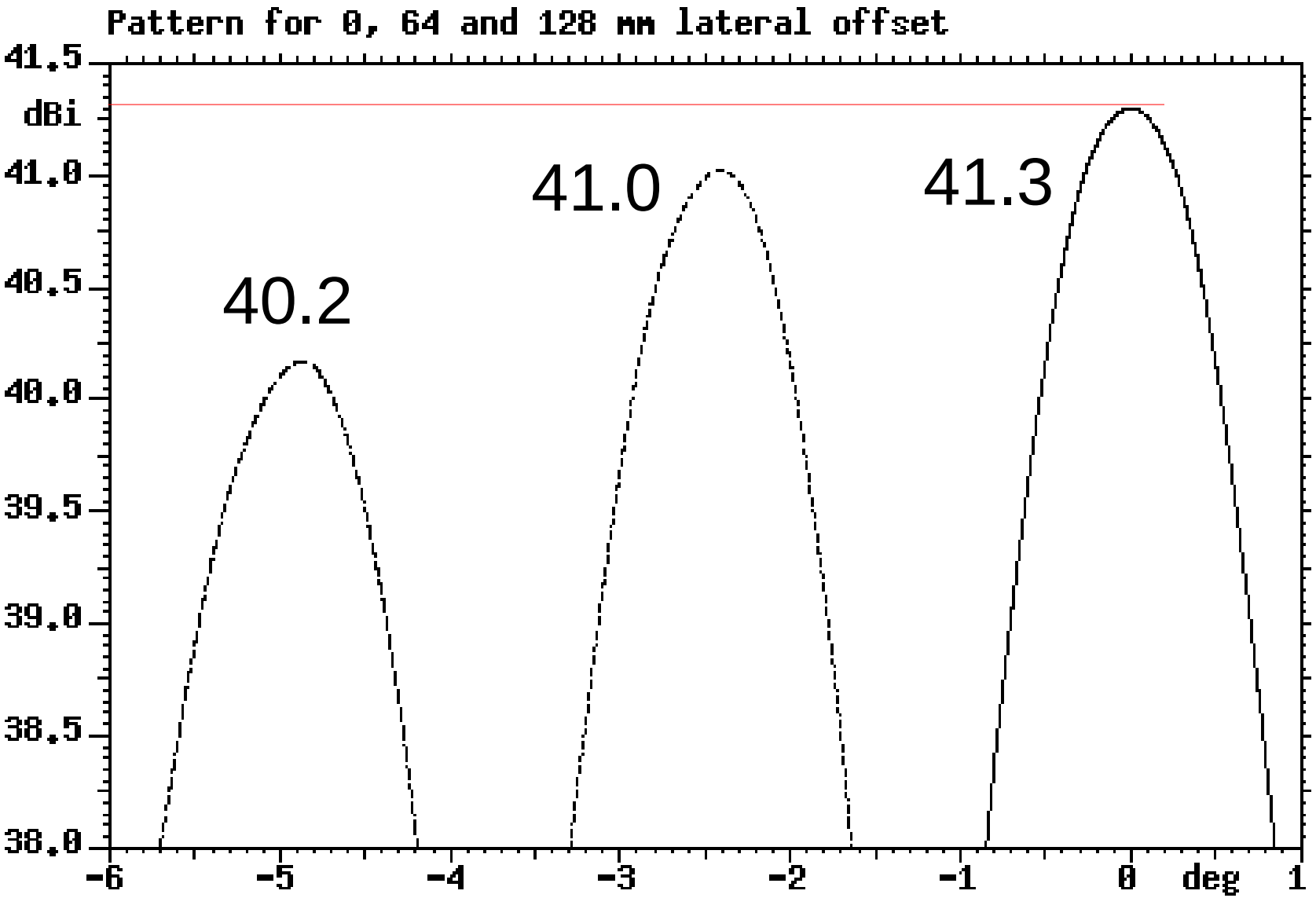
Zoomed gain pattern



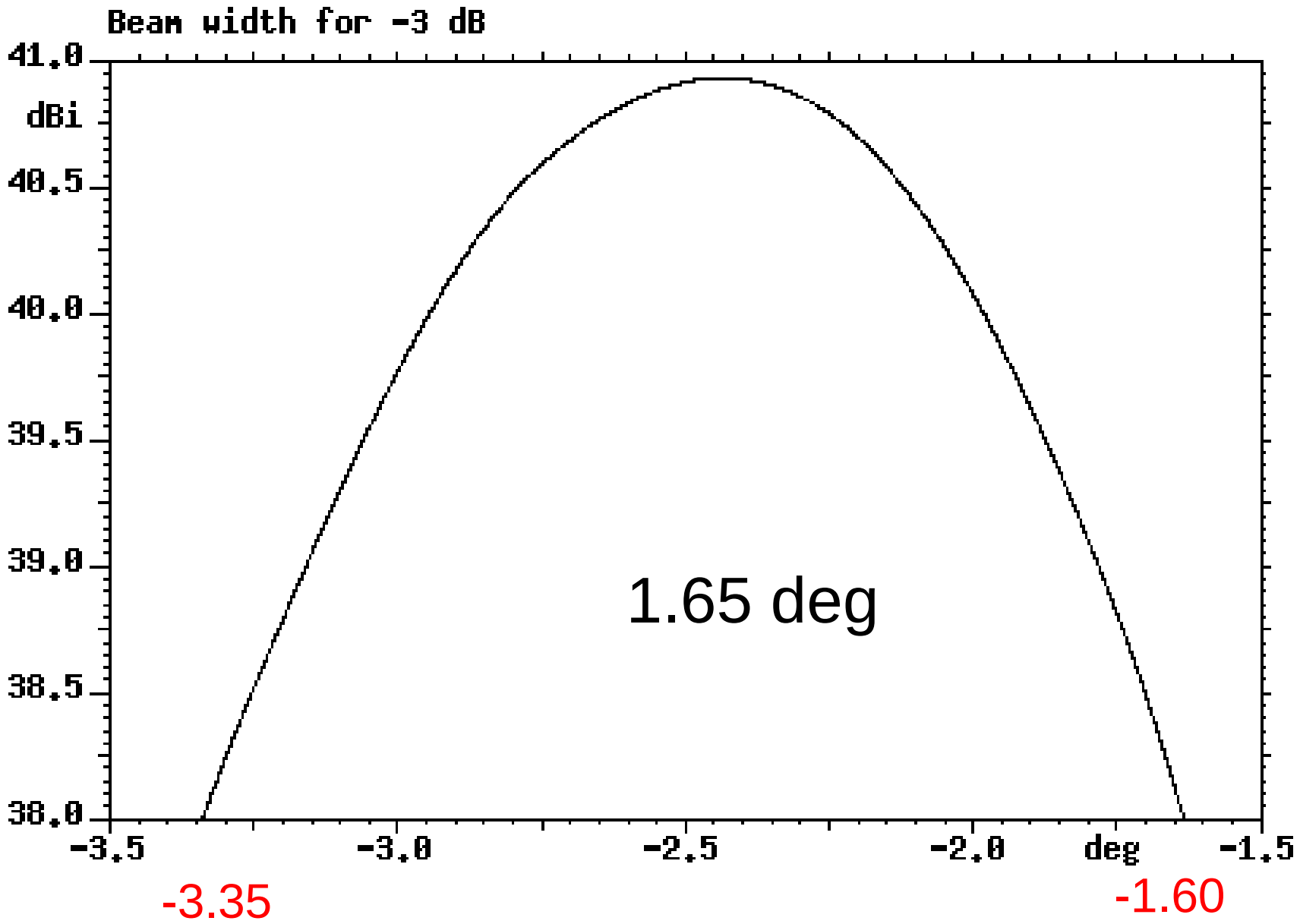
Comparison with focal point



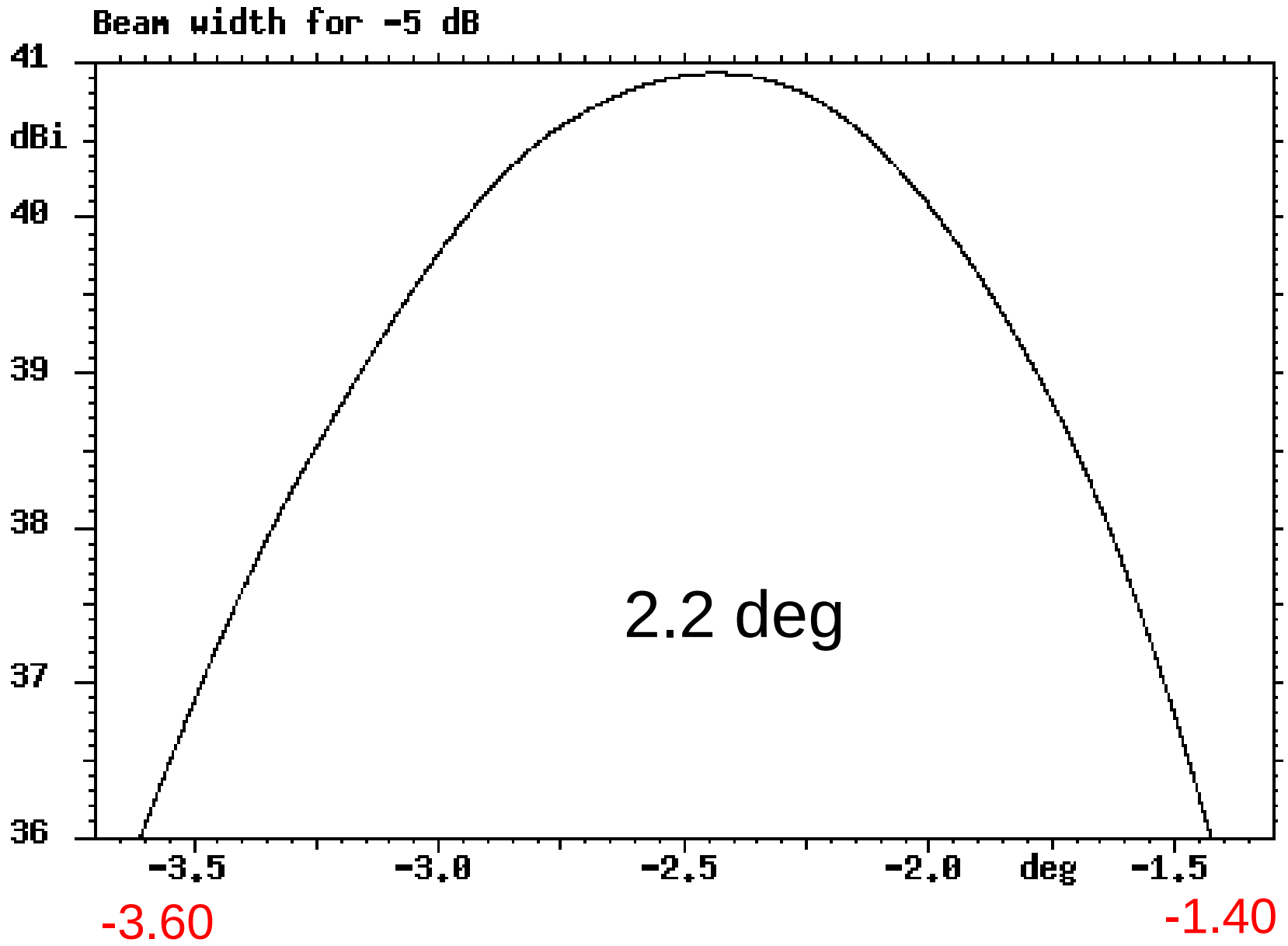
Comparison with focal point



Beam width for -3 dB



Beam width for -5 dB



Conversion to Watts

- Power P = kB * Bandwidth * Tsys
- Boltzman constant kB
- Bandwidth B = 0.8 GHz
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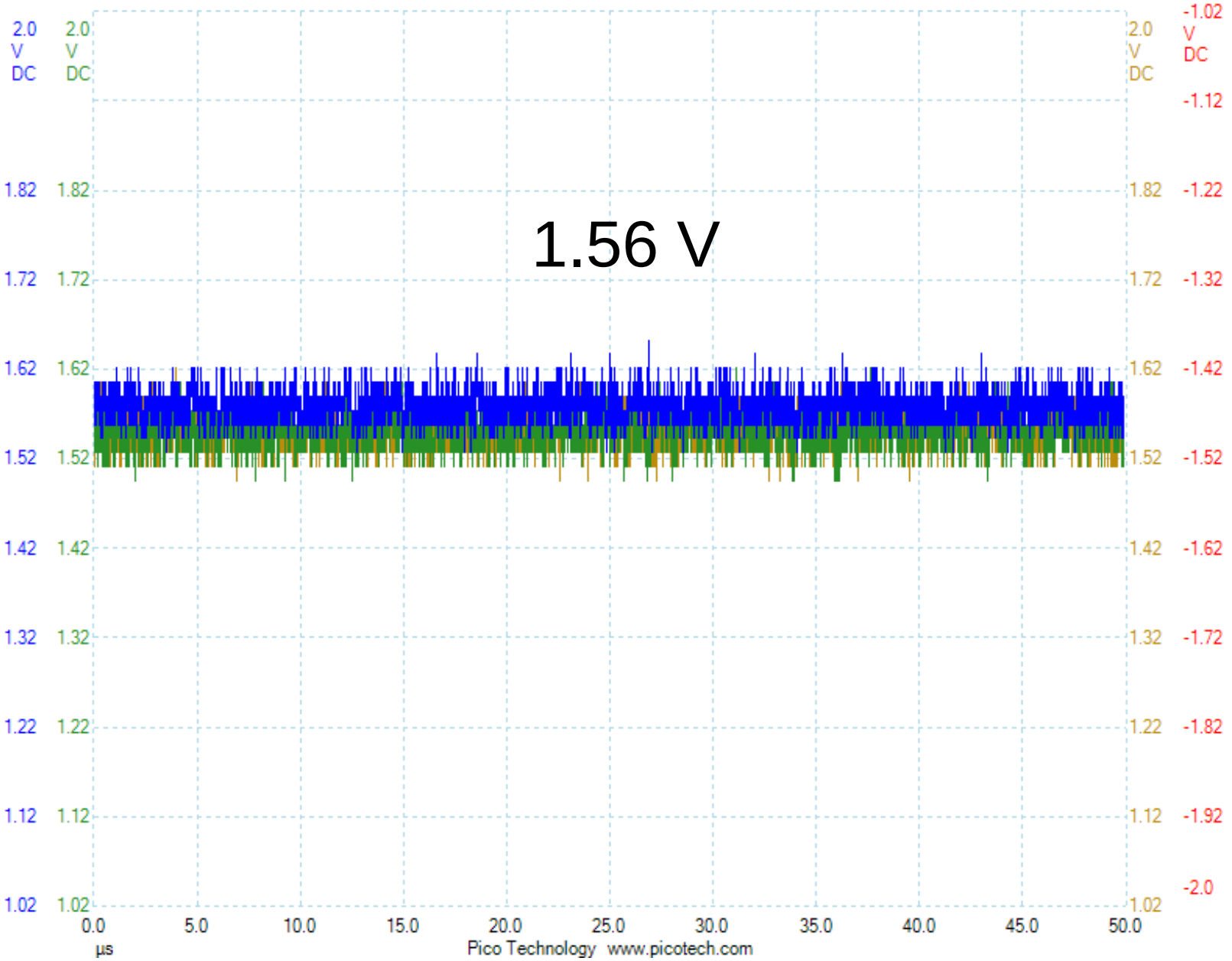
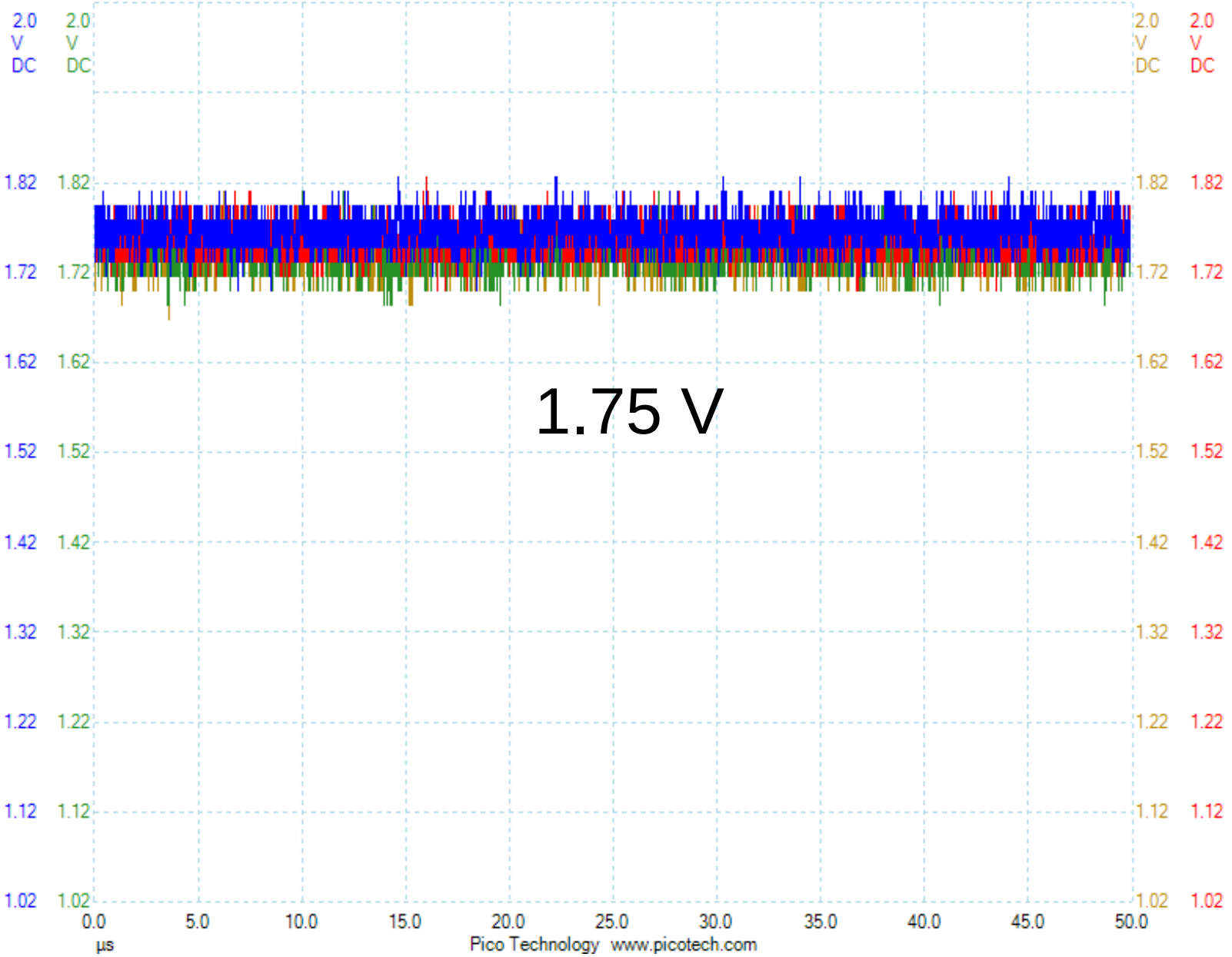
- System temperature = sum of antenna (dish, sky,..) and electronics temperature
- Power detector characteristics
- Measurements in DC voltage

MW absorber

DC for mw absorber



DC for clear sky

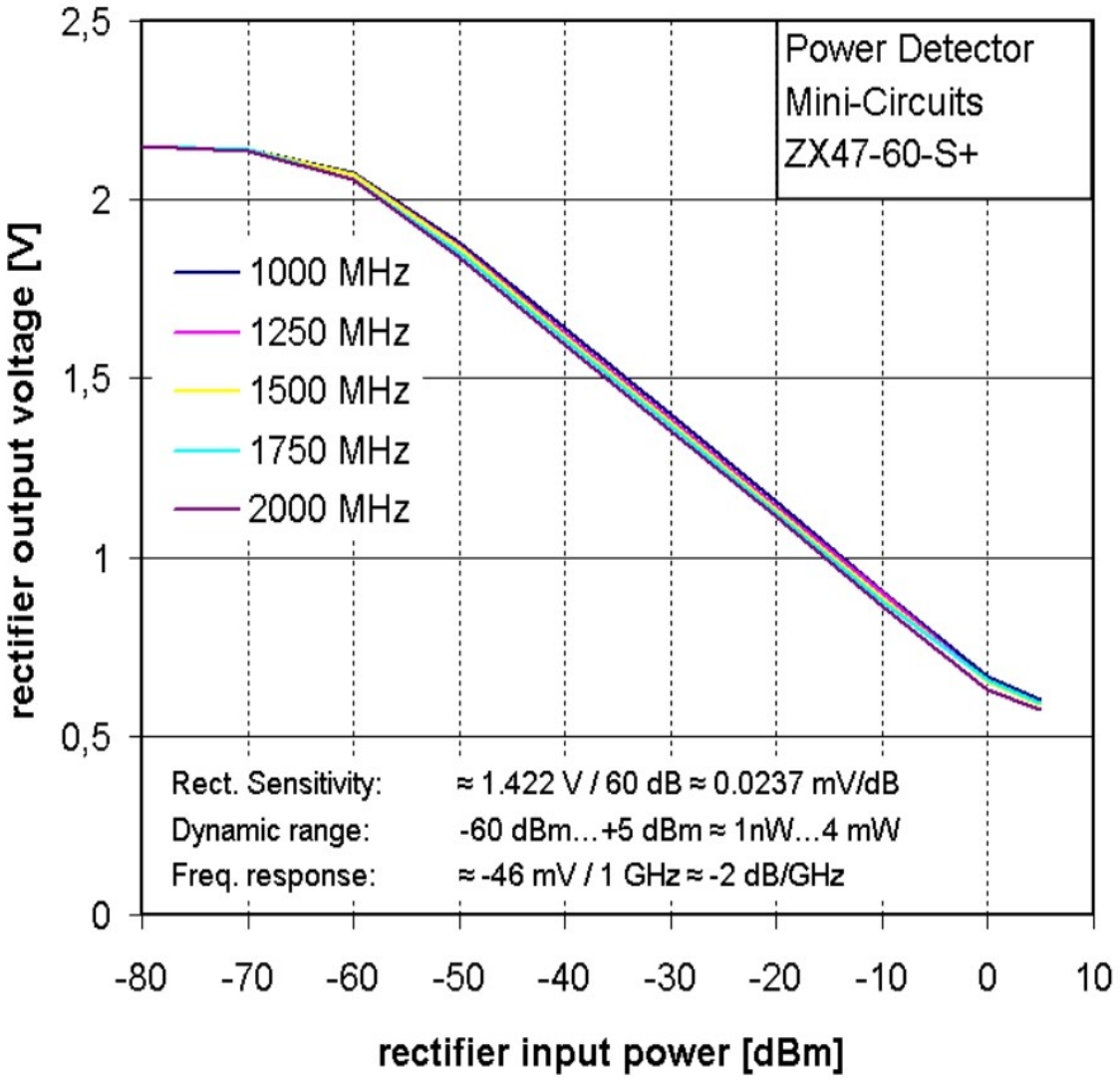


1.75 V

DC values

- Electronic noise (unplugged cables): ~2.2 V
- Clear sky: 1.75 V
- Cloudy sky: 1.73 V
- MW absorber: 1.56 V
- Difference between channels is ~0.25 mV

Power detector characteristic



- Sensitivity:
  23.7 mV / dBm
- Negative amplifier (i.e. lower voltage, higher signal)

Conversion to dBm

- Ratio of voltages:
  (1.75-1.56) V / 24 mV = 7.9 dBm

- Ratio of powers calculated for mw absorber and clear sky:
  $10*\log_{10}(P(350\ K)/P(70\ K)) = 7.6$ dBm

- We can approximately convert measured voltages into Watts.

Plans for future

- More detailed background and calibration measurements
- Include -6 dB attenuator
- Short circuit to allow DC measurement
- Calculation of the best pattern (to have large beam width and also high sensitivity):
  More feeds or defocusing?
  Ideal surface?