Continuum calibration of K-band multi-feed receiver

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Brief outline of the talk

- The K-band multi-feed receiver to perform high sensitivity survey
- Pointing calibration
  - ? Pointing is important
  - Test measurements
- Results
  - New optical alignment
  - New sub reflector unit model & pointing model
  - Antenna characteristic parameters
  - Antenna gain
  - System temperature & spillover temperature

The K-band multi-feed receiver

- High sensitivity continuum observation spectroscopy & polarimetry
- 7-feed hexagon geometry with central feed

- Freq.band,18–26 GHz, BW=2GHz
- 14 output channels (7 LCP + 7 RCP)
- T_{sys} (el =45°) = 75K @ 22GHz (lab)
- Gain(el=45°)$_{central}$=0.12K/Jy, $G_{lateral}$=0.11KJy(Simul.)
- HPBW = 96” (0.026°), Sky distance = 212”(0.059°) @ 22 GHz

Pointing is important

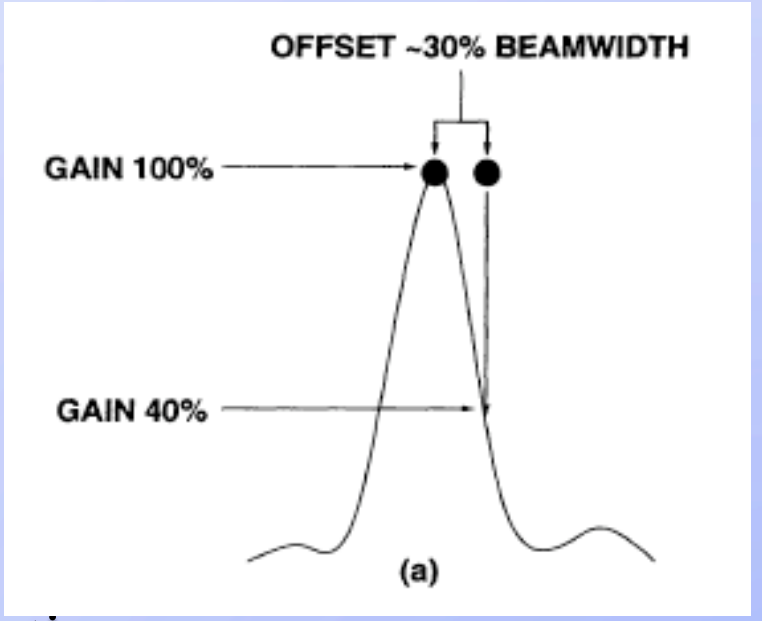
- Antenna pattern Gaussian
- At high freq, HPBW gets narrow
- Pointing offset & poor

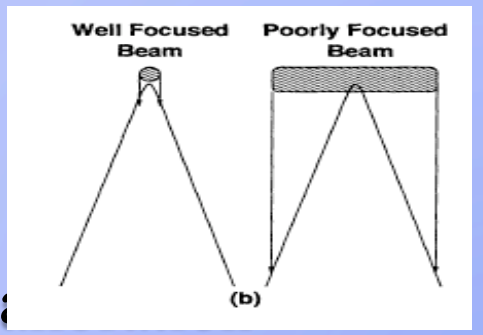
focus degrades SNR

- Observed a point like source,
- W3OH with mechanically deter. optics

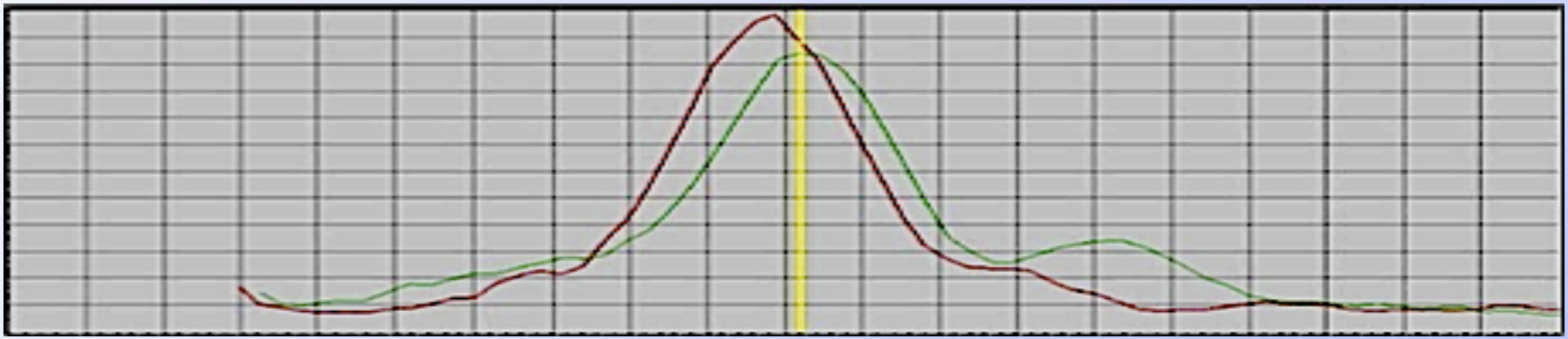
to check pointing of new receiver.

- It's a circumpolar source & bright at 22 GHz
- Used VLBI acquisition system for pointing ca



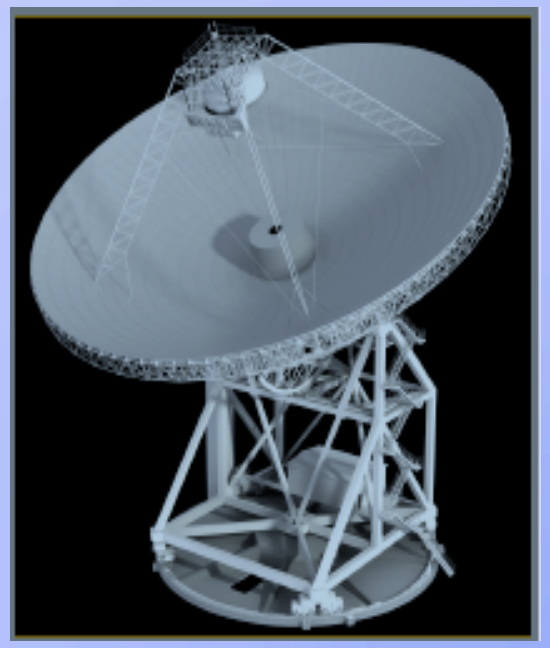


Test Measurements



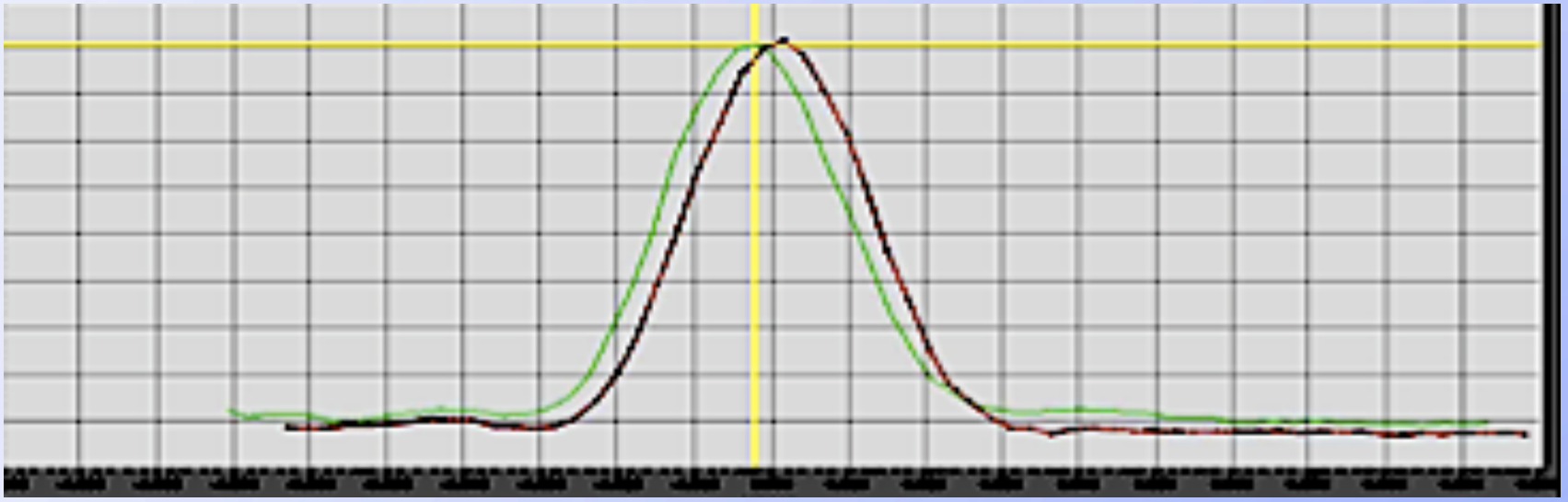
W3OH @ el = 33° with mech. Optical alignment, Tamp = 54K
Optics is not aligned properly

- Mfeed is mounted at secondary focus on Medicina 32 dish
- Used sub-reflector to align optics
- Sub-reflector 5 degree of freedom, 3tr+2tilt



New optical alignment

- Test observation with different sub-reflector positions
- The new optical alignment has increased the power () in the main lobe & reduced side lobes

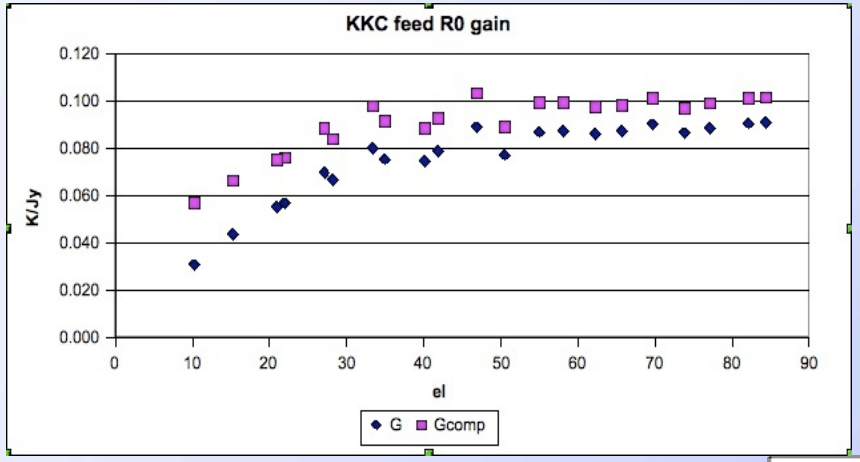


W3OH @ el = 36° with new alignment, Tamp = 81K

Sub-reflector and pointing model

- New SCU model in the operating system for the new optical alignment
- Observed a number of sources to establish the pointing model
- After the new pointing model we have characterize central and lateral horns, measured Tsys and Antenna gain

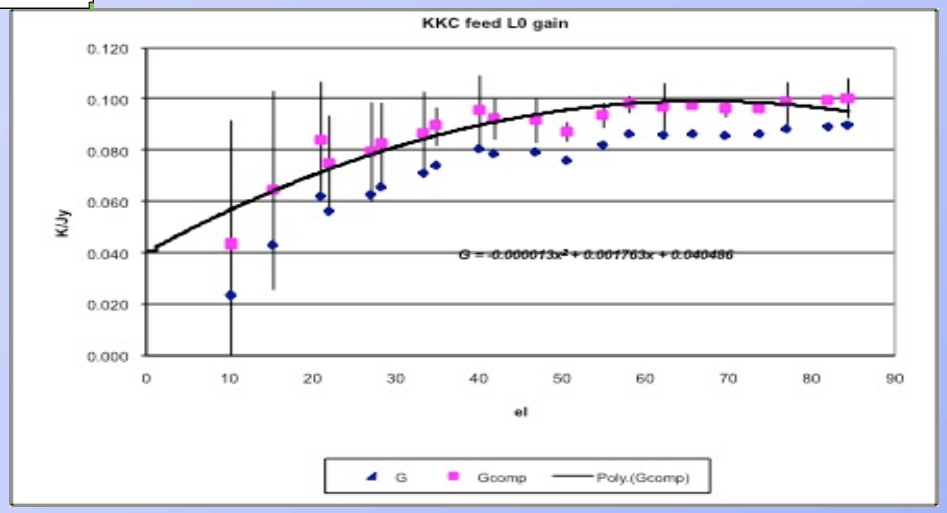
Multi-feed Antenna gain



Right circular polarization

Central feed , gain = 0.1 K/Jy

Lateral feed gain = 98% of Central feed



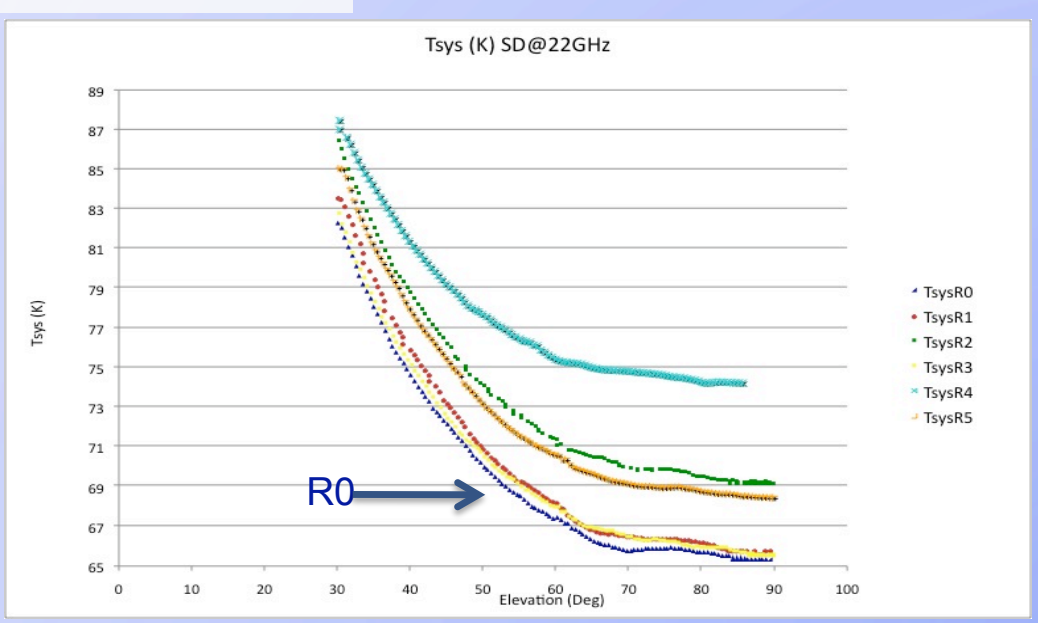
Left circular polarization

M-feed system temperature

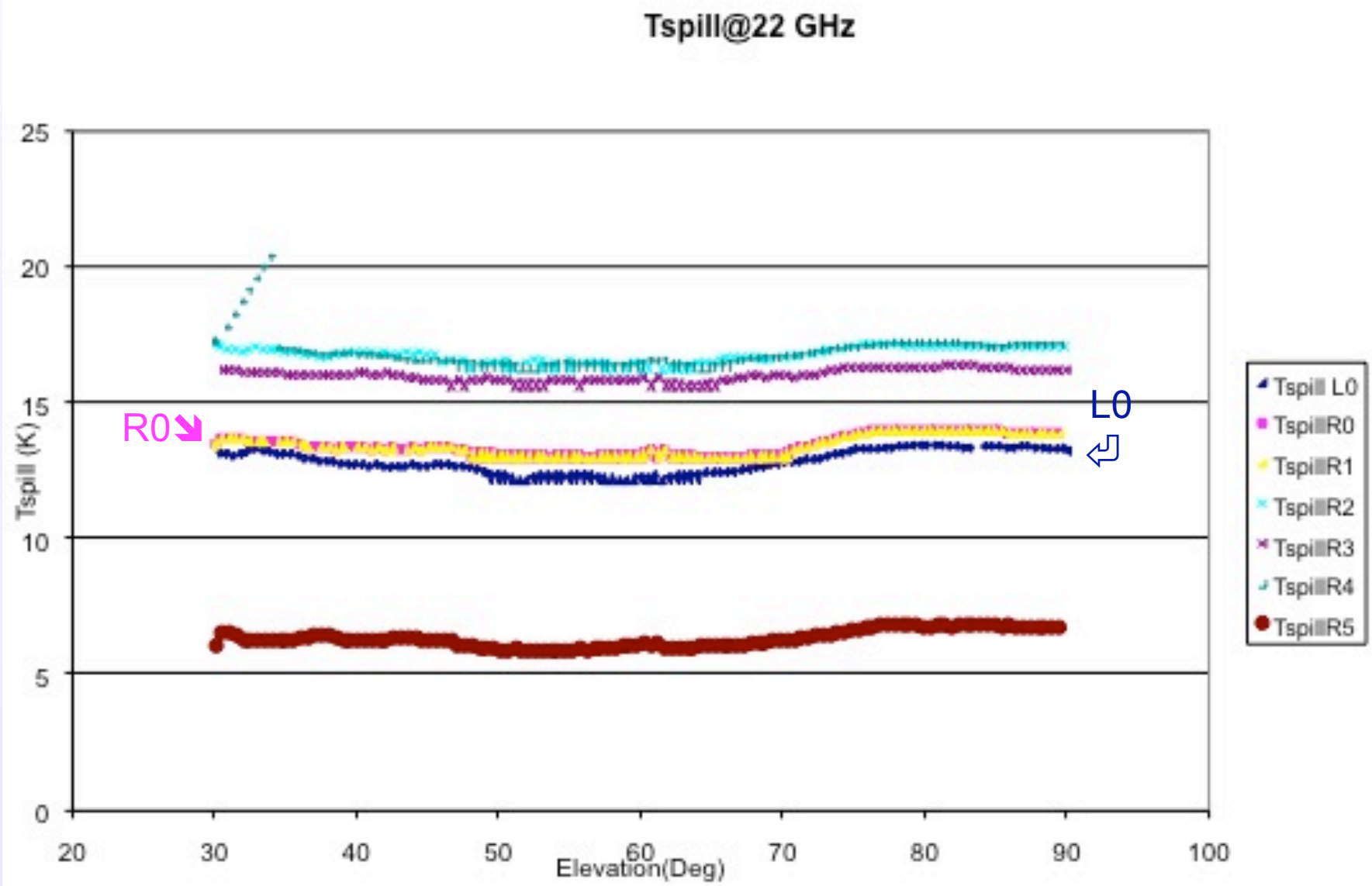
$$T_{sys} = T_{sky} + T_{spill} + T_{receiver}$$

T_{sky} is the contribution of the background sky brightness.
$T_{receiver}$ is the noise temperature of the receiver.
T_{spill} is the rear and background spillover.

Tsys (el = 45) = 75 K
opacity 0.1(lab)

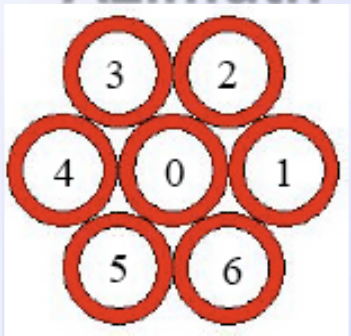


M-feed spillover temperature



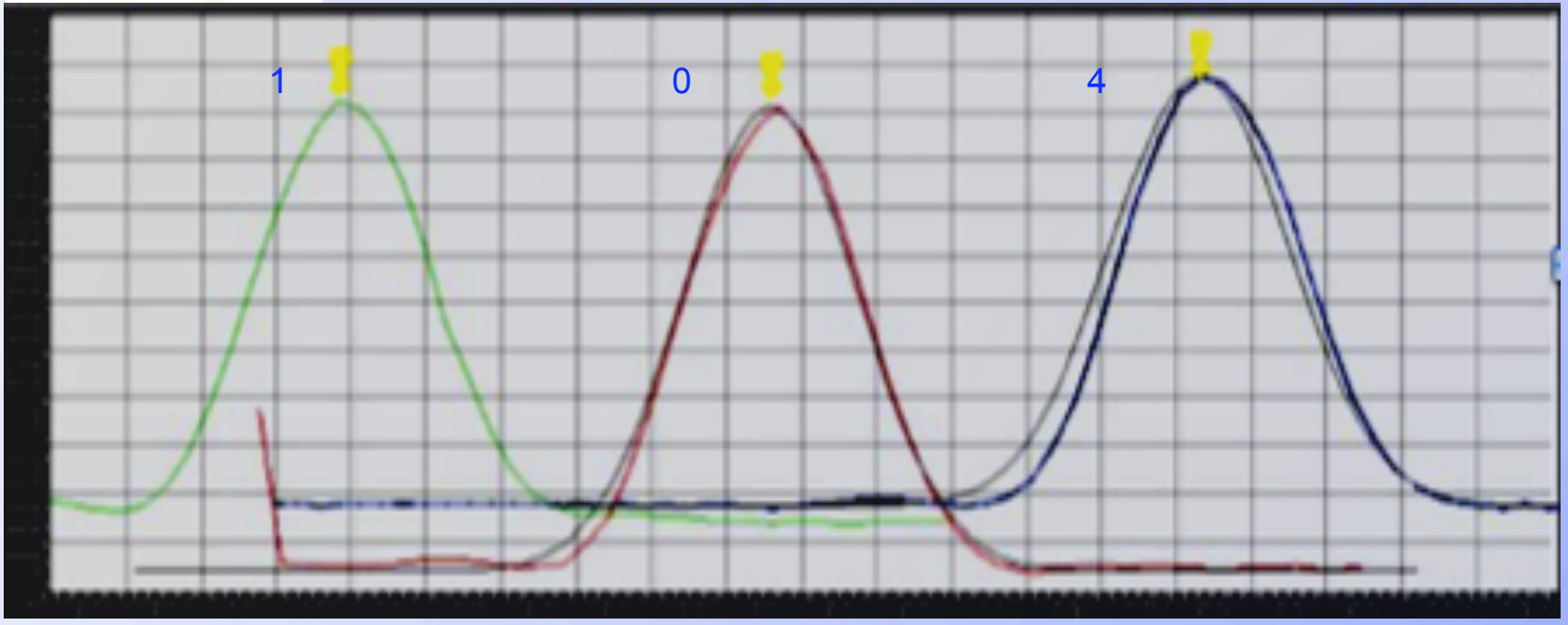
Lateral feeds – 4 0 1

Azimuth scan on W3OH with feed 4 0 1



Beam separation = 0.060°

HPBW = 0.026°



Pilot survey

- After characterizing the antenna @ 22 GHz with VLBI acquisition system with a bandwidth of 400MHz
- Conducted a Pilot survey in Feb 2009 using new Total power backend for mfeed, instantaneous bandwidth upto 2 GHz
- Using On the fly mapping technique to map a patch of sky at an elevation of 45° (Refer to Simona Righini)
- Antenna gain with TP acquisition system has been measured at an el of 45°

Comparison table

Antenna	Freq.	Elements	Configuration	Sky Distance	FWHM
Medicina 30 m	18 -26 GHz	7	Hexagonal + central horm	212”	92”
Pico Valeta 30 m	230 GHz	2 X 9	2 square 3X3	24”	11.7”
Nobeyama 45 m	43 GHz	6	Rectangular 2X3	80”	39”
Aricibo 305 m	1.5 GHz	7	Hexagon +central horn	26 cm b/w the horns	3.3’
Parkes 64 m	1.5 GHz	13	2 concentric hexagon + central horn	28’	14.4’