

Primary beam status

Aard Keimpema

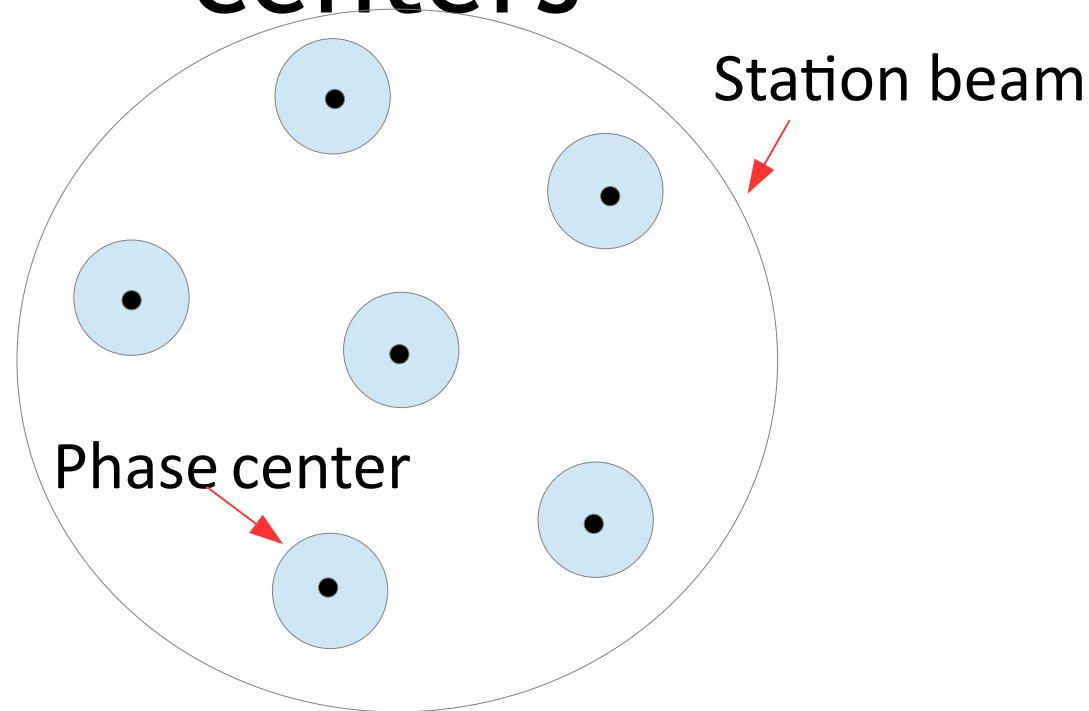
keimpema@jive.eu



JIVE

Joint Institute for VLBI
ERIC

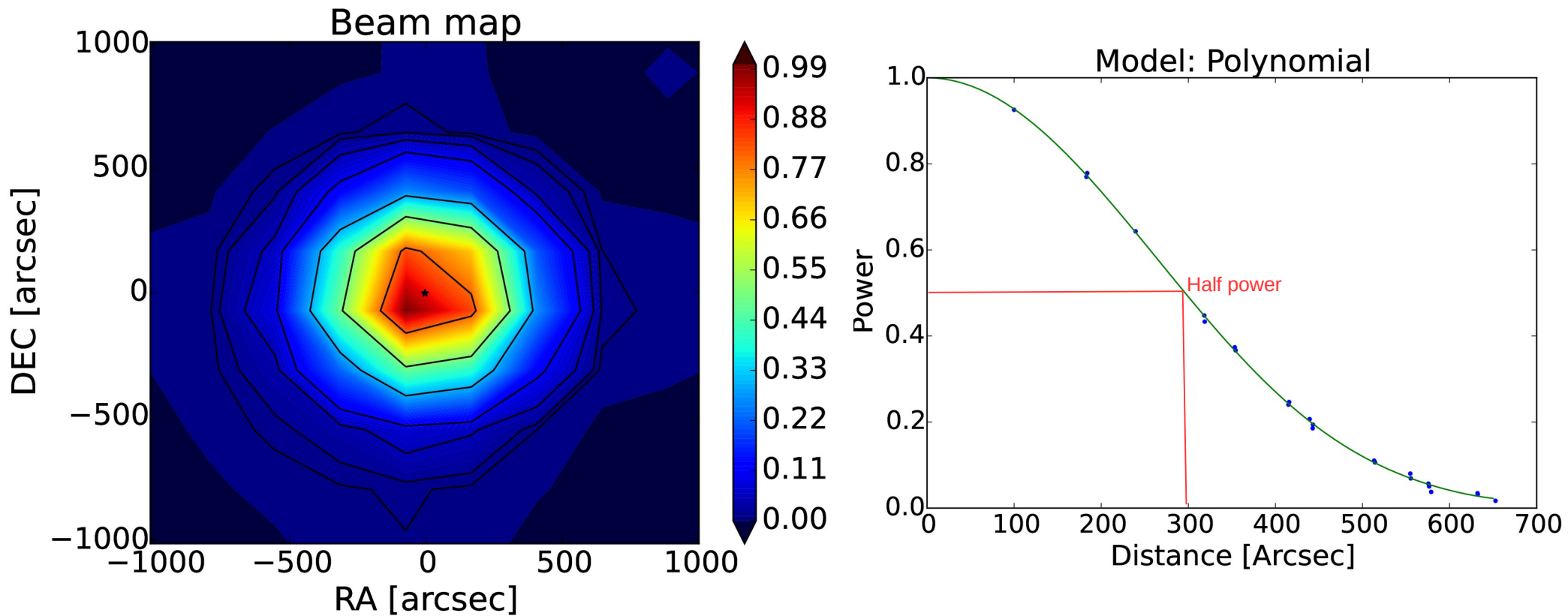
Multiple simultaneous phase centers



- VLBI wide field data sets are huge \gg 1TB
- Solution: create narrow field data sets for all source in the beam
- Largest experiments $>$ 600 sources!
- EVN is heterogeneous: each station's primary beam is different distorting the final image when uncorrected

Beam maps

Effelsberg @21 cm, target 3C286



- Series of deliberate mispointings around a point source
- Beam model is least-squares fitted to this data

Measuring beam maps

- Uwe Bach's instructions and FS scripts
 - <https://github.com/evn-vlbi/BeamMaps>
- EVN Mattermost discussion channel: **#Holog Beammap**
- L Band is most important (but please measure all bands)
- Supported data formats: FITS, ASCII table
- Example ASCII data:

RA offset	DEC offset	LCP	RCP
-0.196584	-0.154995	0.118596	0.147875
-0.171007	-0.155042	0.246834	0.120844
-0.142839	-0.154967	0.039953	0.127841
-0.114712	-0.154985	0.119025	0.097853

- Send data to keimpema@jive.eu

Current status

Beam maps - MPIFR Deki

deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Beam_maps

Beam maps

Modified 12:20, 8 Jan 2021 by aorlati | Page History

Current status with the availability of beam maps from stations. These maps, when available, should be provided to JIVE.

Current status of the availability of beam maps at the stations

	L Band	C band	M band	X band	K band	Q band	Last updated
Ar							
Bd	in progress	1406 1610 sent to JIVE	NA	1710 sent to JIVE	In progress	NA	23-11-2017
Ef	at JIVE	at JIVE	?	available	available	?	19-06-2015
Hh	In progress	In progress					18-06-2015
Jb							
KVN	-	-	-	-	available	available	10-06-2015
Mc	at JIVE @1413MHz @1397MHz	Work in progress.	Work In progress	Work in progress	Work in progress	-	08-01-2021
Mh	-	-	-	no	no	no	09-06-2015
Nt							
On	at JIVE	at JIVE	at JIVE				
Sr	Maps sent to JIVE (elevation ranges 22-35; 53-73 degrees) @1550 MHz	-	Maps sent to JIVE (elevation ranges 12-17; 17-22; 26-32; 34-40; 42-48; 50-56; 58-64; 66-72; 76-84 degrees) @6900 MHz	-	Maps sent to JIVE (elevation ranges 20-40; 40-60; 60-80 degrees) @21975 MHz	-	24-11-2020
Tg							

~60% of L-Band maps done

https://deki.mpifr-bonn.mpg.de/Working_Groups/EVN_TOG/Beam_maps

Airy Disk Beam Model

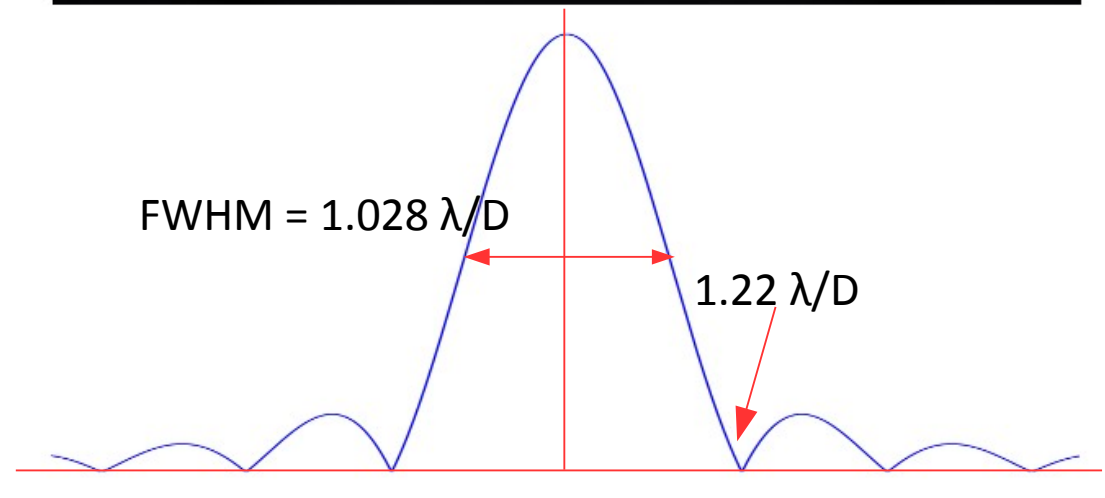
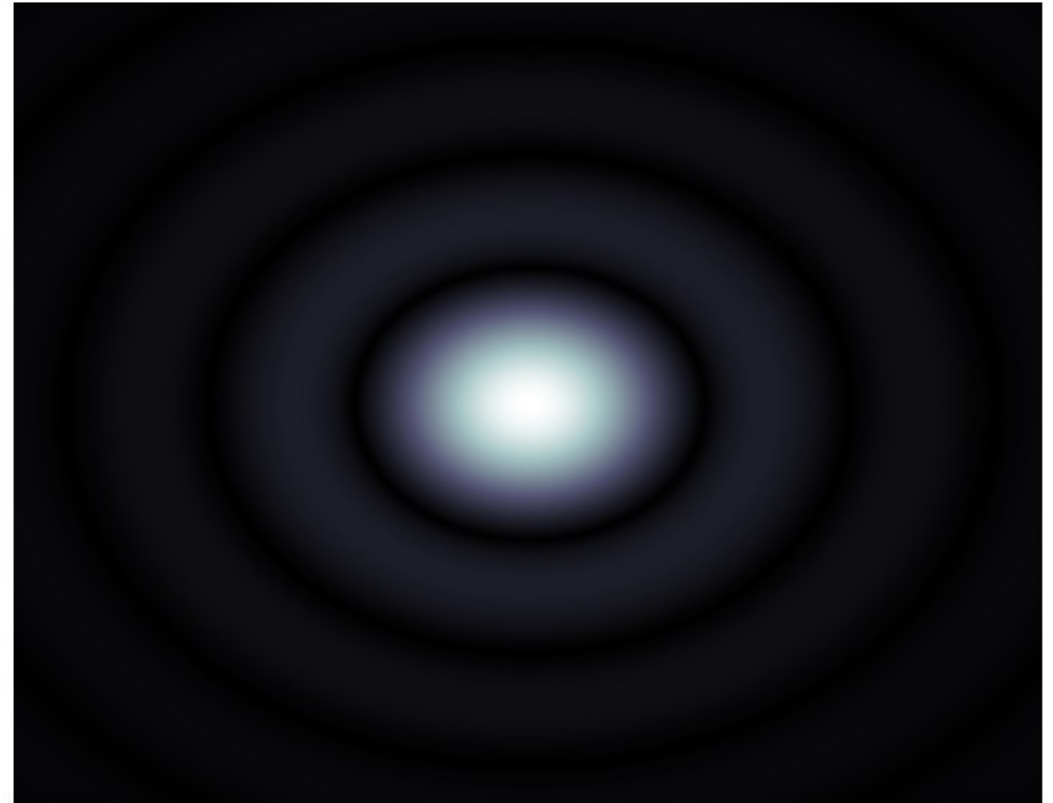
First order model : Uniformly illuminated circular aperture (Airy Disk)

$$I(\theta) = \left| \frac{2 J_1(z)}{z} \right|^2, \quad z = \frac{\pi D}{\lambda} \sin(\theta)$$

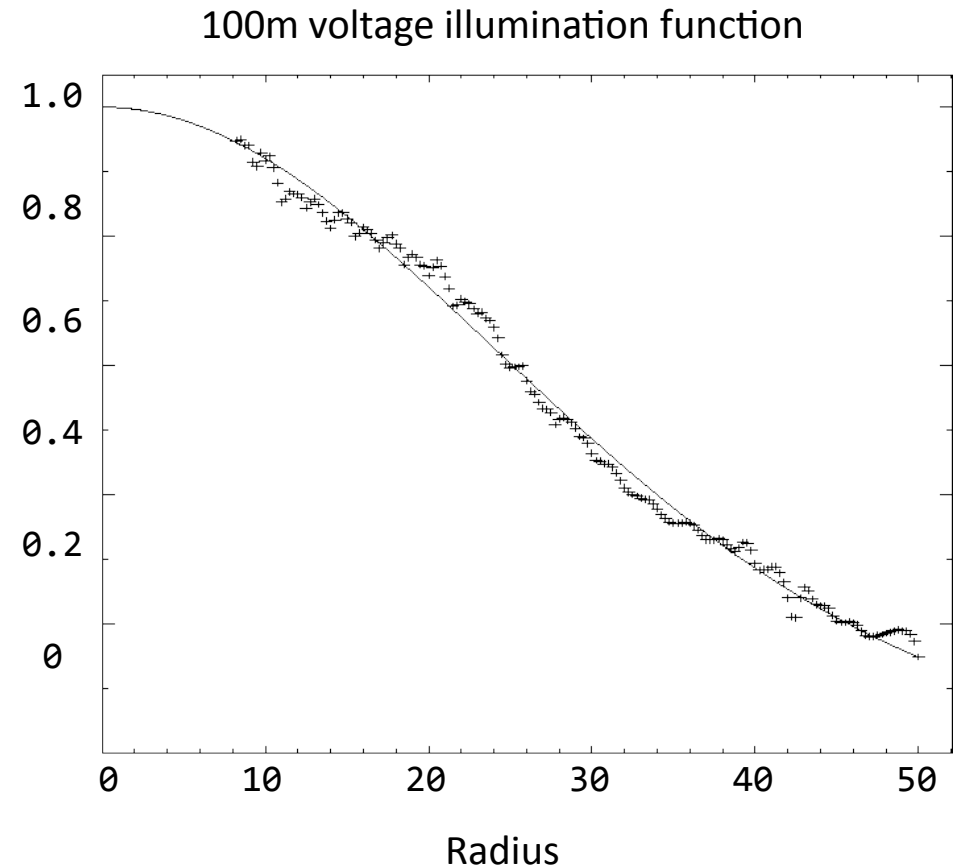
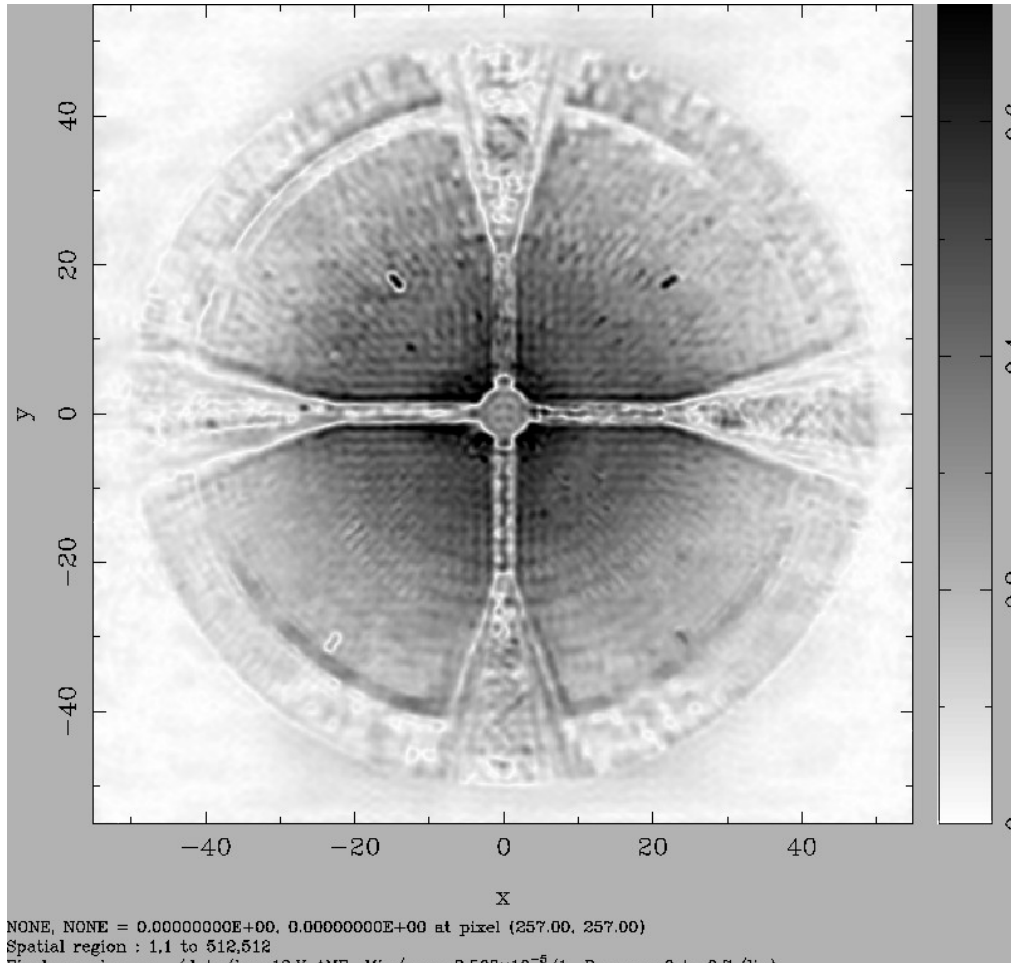
D = Dish diameter,

λ = wavelength

$J_1(z)$ = Bessel function of the first kind



Effelsberg illumination pattern @11.7 Ghz



The Effelsberg Holography Campaign - 2001

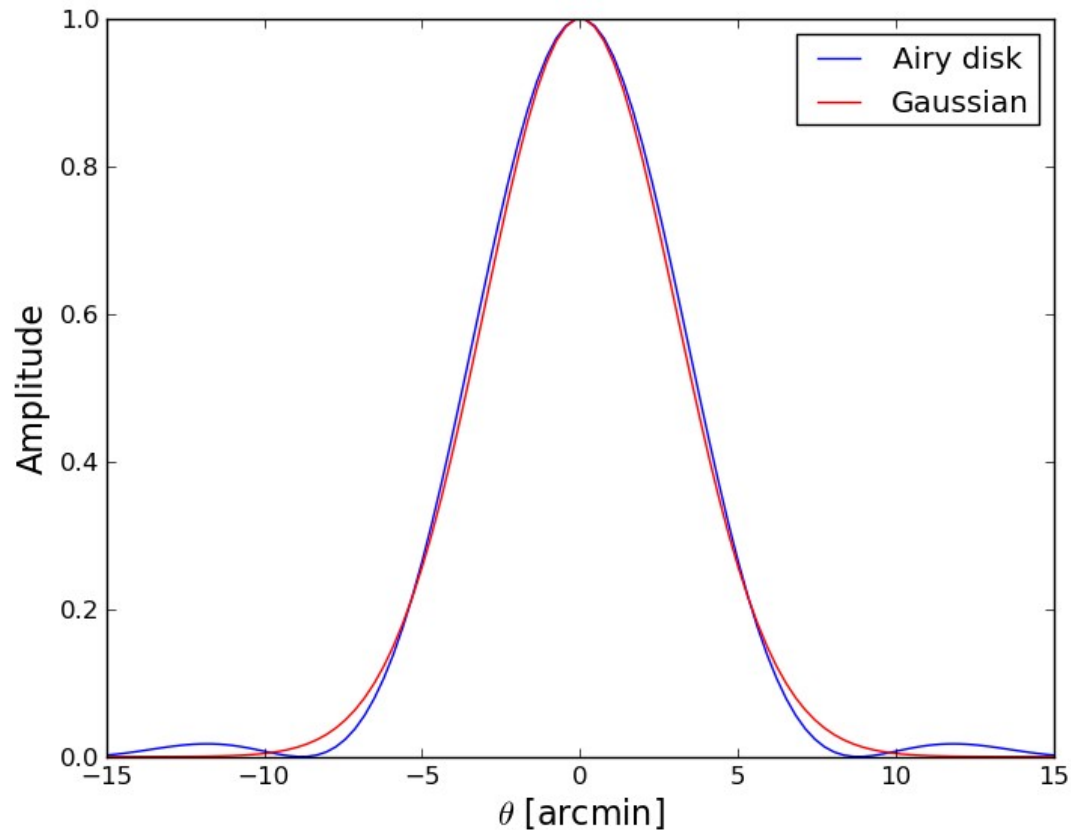
M.Kesteven, D.Graham, E.Fürst, O.Lochner & J.Neidhöfer

Gaussian model

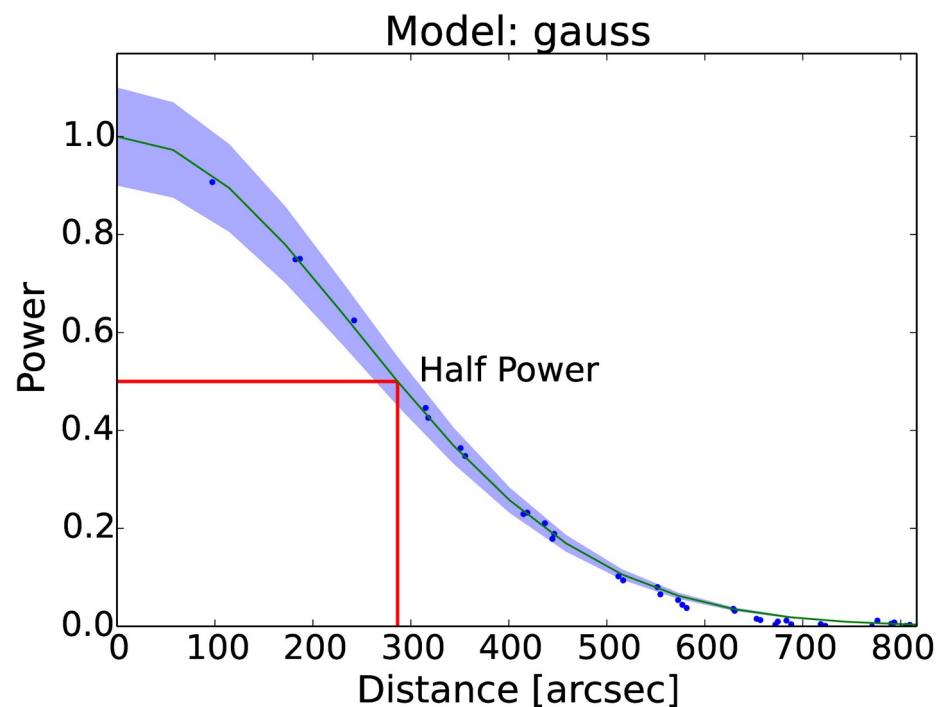
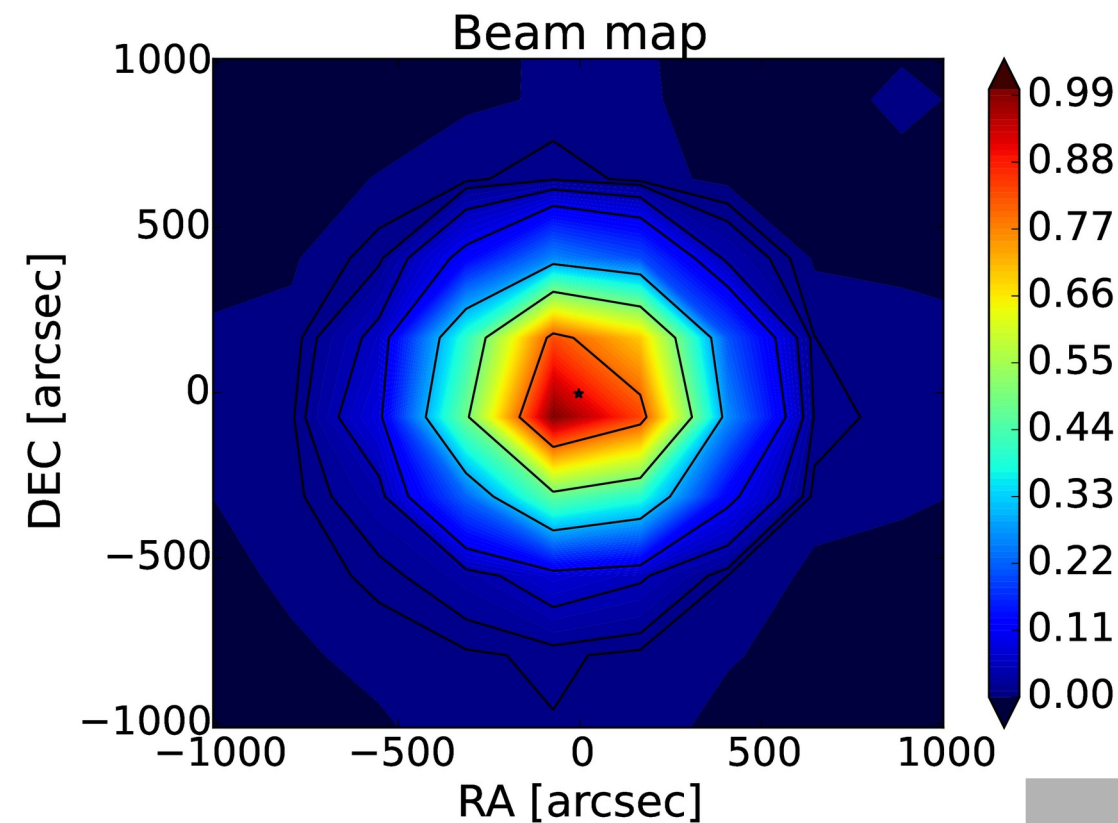
- The Airy disk model can very closely be approximated by a Gaussian model

$$I(\theta) = A_0 e^{-\frac{\theta^2}{2\sigma^2}}$$

- The optimum fit is $\sigma = 0.42\lambda/D$, for apperture of width D



Effelsberg @21CM, RCP

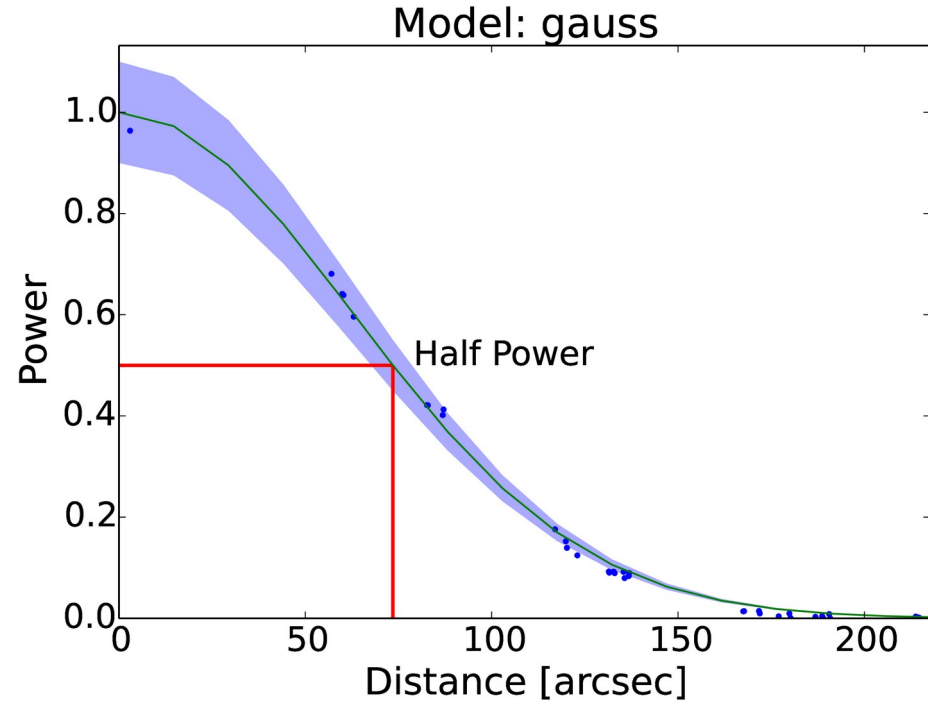
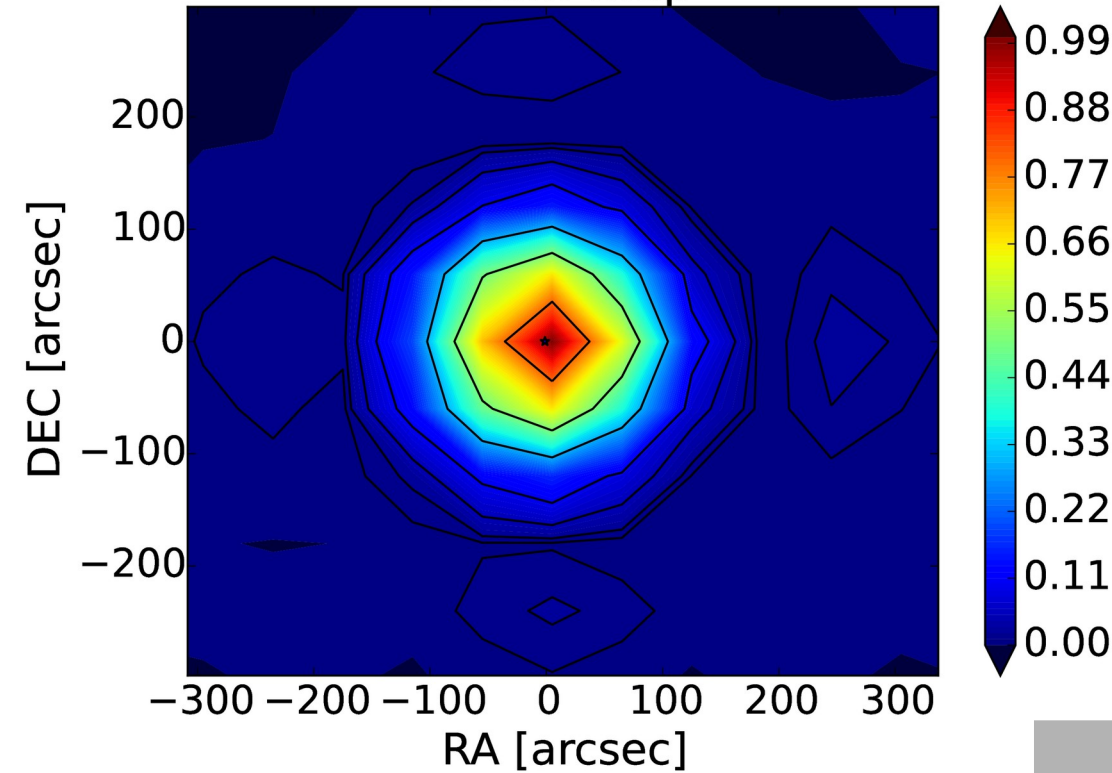


Model:
$$I(x, y) = e^{-\frac{(x-x_0)^2 + (y-y_0)^2}{2(z\lambda)^2}}$$

	RCP	LCP
X0	-6.88441"	-3.68020"
Y0	-3.42791"	-2.98701"
Z	1151.51	1151.6
FWHM	572.9"	574.9"
D _{eff}	75.2 M	75.0 M

Effelsberg @6CM, RCP

Beam map

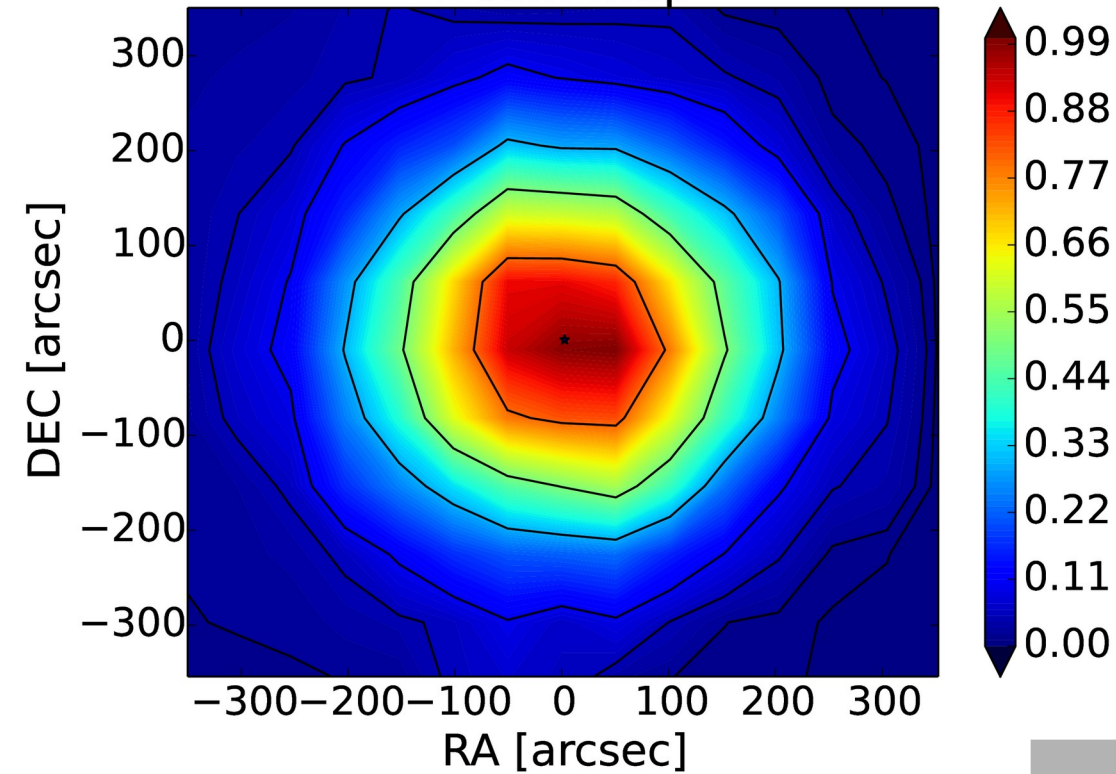


$$\text{Model: } I(x, y) = e^{-\frac{(x-x_0)^2 + (y-y_0)^2}{2(z\lambda)^2}}$$

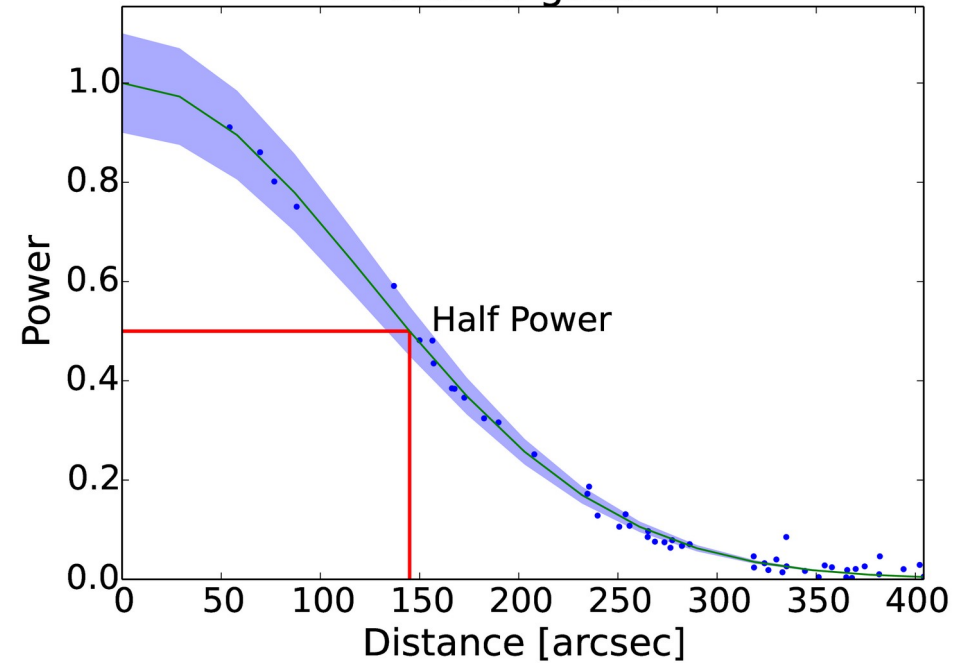
	RCP	LCP
X0	7.985279"	-1.191061"
Y0	-0.154405"	0.081825"
Z	1009.2	1017.3
FWHM	147.0"	148.2"
D _{eff}	85.8 M	85.1 M

Yebes @6CM, RCP

Beam map



Model: gauss



$$\text{Model: } I(x, y) = e^{-\frac{(x-x_0)^2 + (y-y_0)^2}{2(z\lambda)^2}}$$

	RCP	LCP
X0	2.807198"	-0.363737"
Y0	0.695973"	-4.880469"
Z	2052.1	2060.1
FWHM	289.9"	290.5"
D _{eff}	42.2 M	42.1 M

EVN Pipeline application

- Primary beam corrections are applied in the EVN pipeline
- Currently corrections are only available in AIPS
- Corrections are stored in SN table containing all sources

Before :

