Antenna beam

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aim

- Characterize instrument beam (or response)
- Two mathematically equivalent methods
- Linear combination of antenna response in amplitude or using visibility

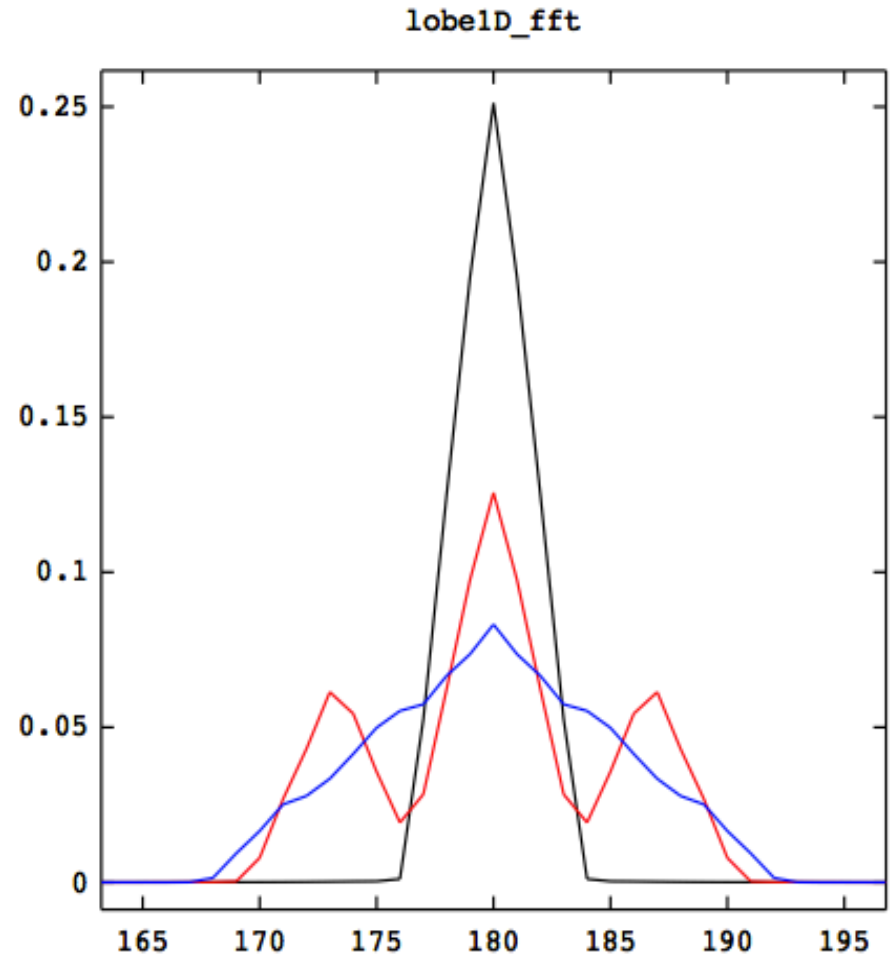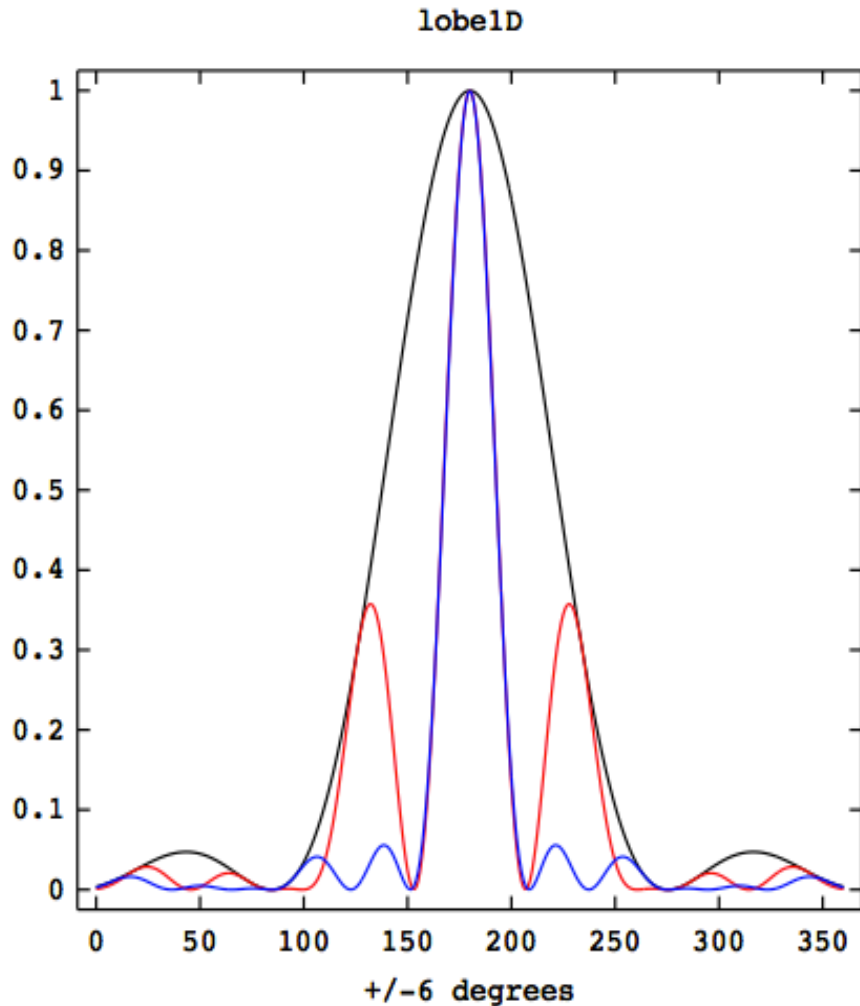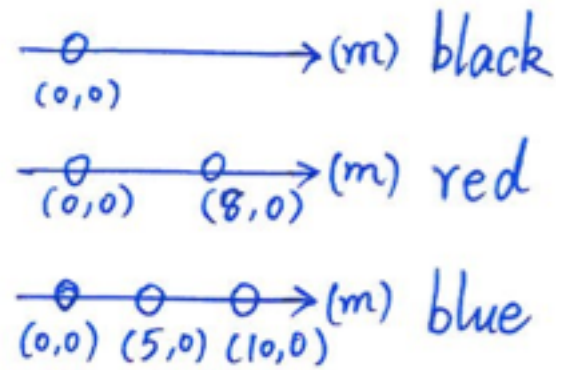$$\iint d\alpha d\beta L_{comb}(\alpha, \beta) I(\alpha, \beta) = \sum c_i c_j V_{ij}$$

$$L_{comb}(\alpha, \beta) = (lobeAmplitude)^2 = [\sum_{i=1}^{Nantennas} c_i lobeAmp_i(\alpha, \beta)]^2$$

$$V_{ij} = \iint d\alpha d\beta I_{ij}(\alpha, \beta) L_{ij}(\alpha, \beta) exp[i2\pi(\alpha \frac{\Delta x}{\lambda} + \beta \frac{\Delta y}{\lambda})]$$
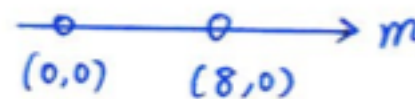
method

- Fourier transform the linear combination of antenna response in intensity to (u, v) plane
- Beam combination

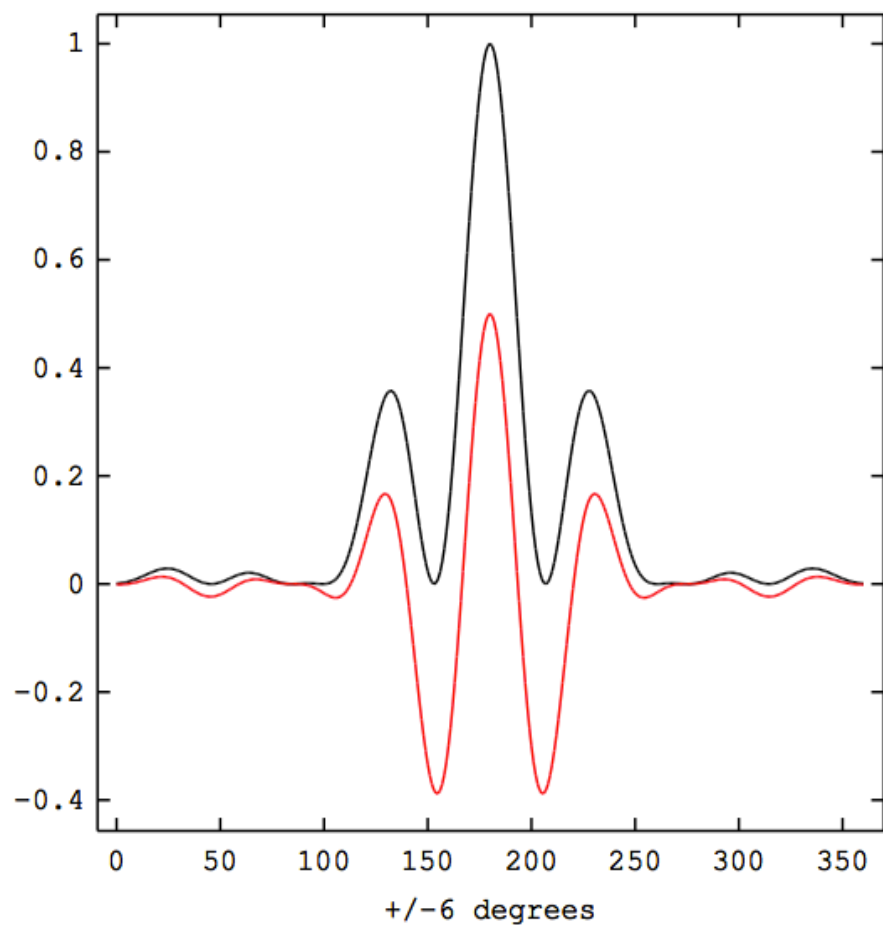# Antenna beam for different number of antennas
Dish-size=4.5m

(0,0) →(m) black

(0,0) (8,0) →(m) red

(0,0) (5,0) (10,0) →(m) blue

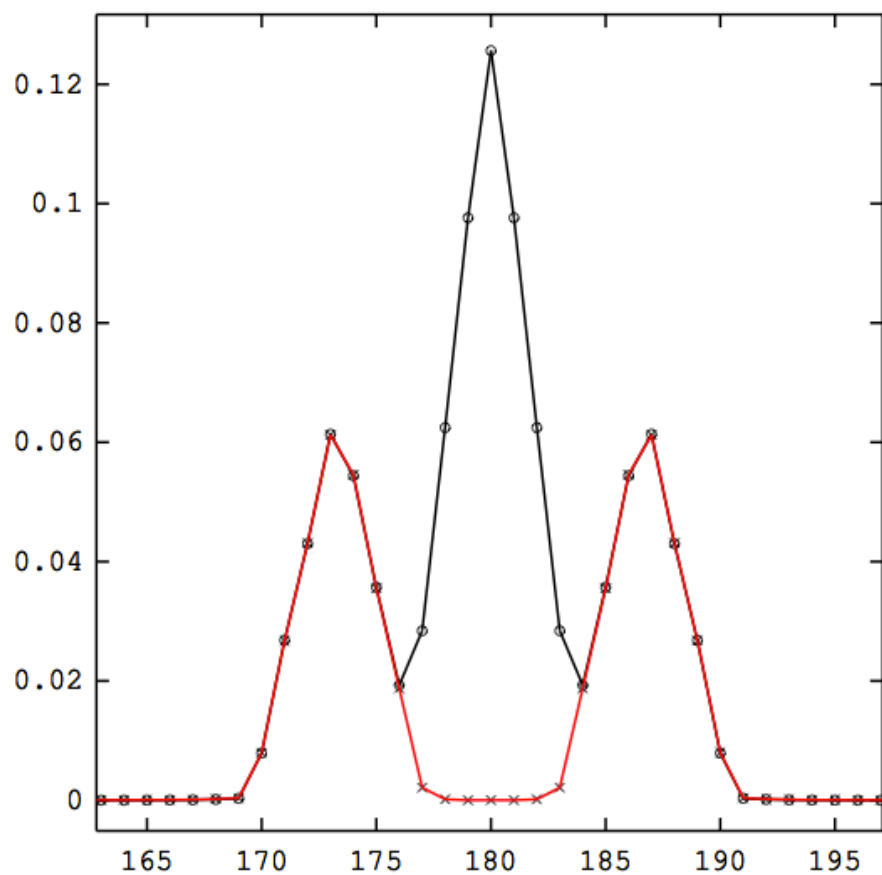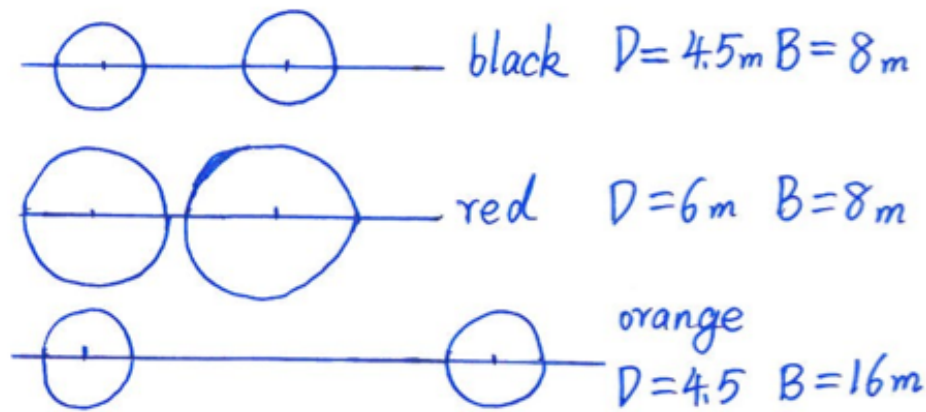**lobe1D**

lobe1D_fft

Autocorrelation and Crosscorrelation

lobe1D - 2 dishes with/without autocorrelation

FFT lobe1D - 2 dishes with/without autocorrelation

+/-6 degrees
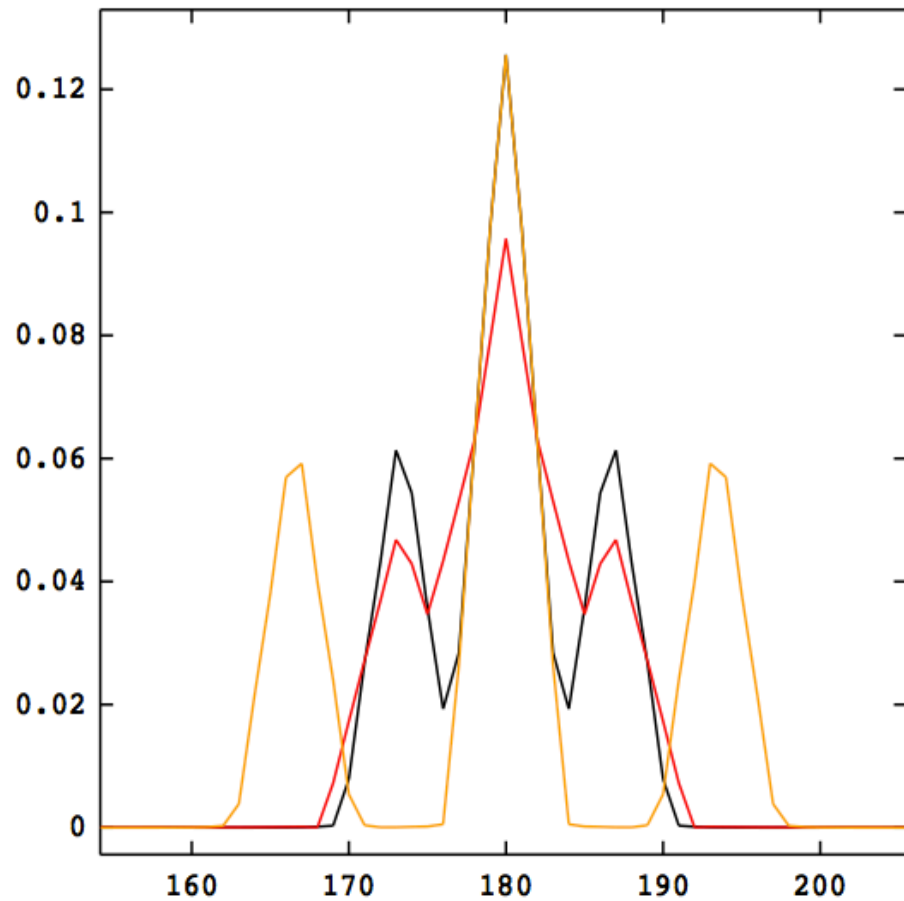
Dish-sizes and Baselines

black D=4.5m B=8m
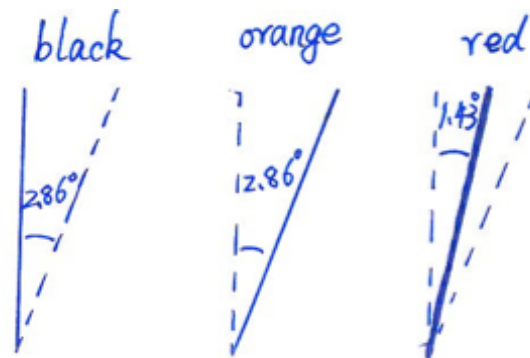
red D=6m B=8m

orange D=4.5 B=16m

lobe1D - 2 paraboles

+/-6 degrees
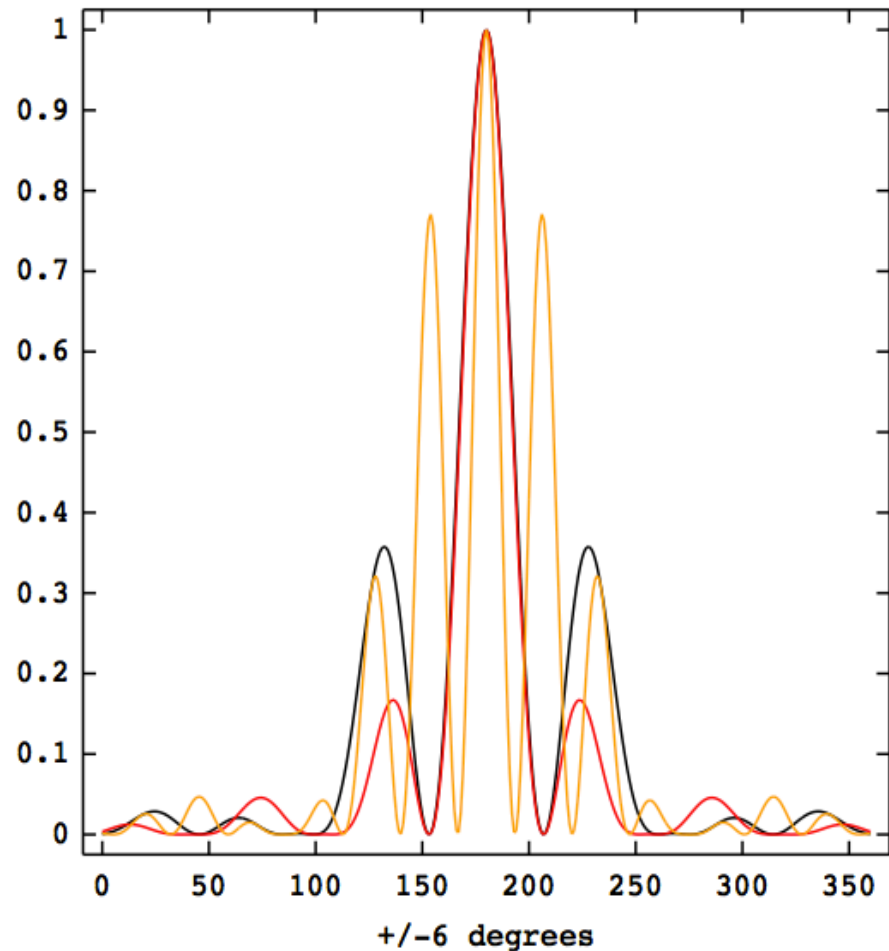
FFT lobe1D - 2 paraboles

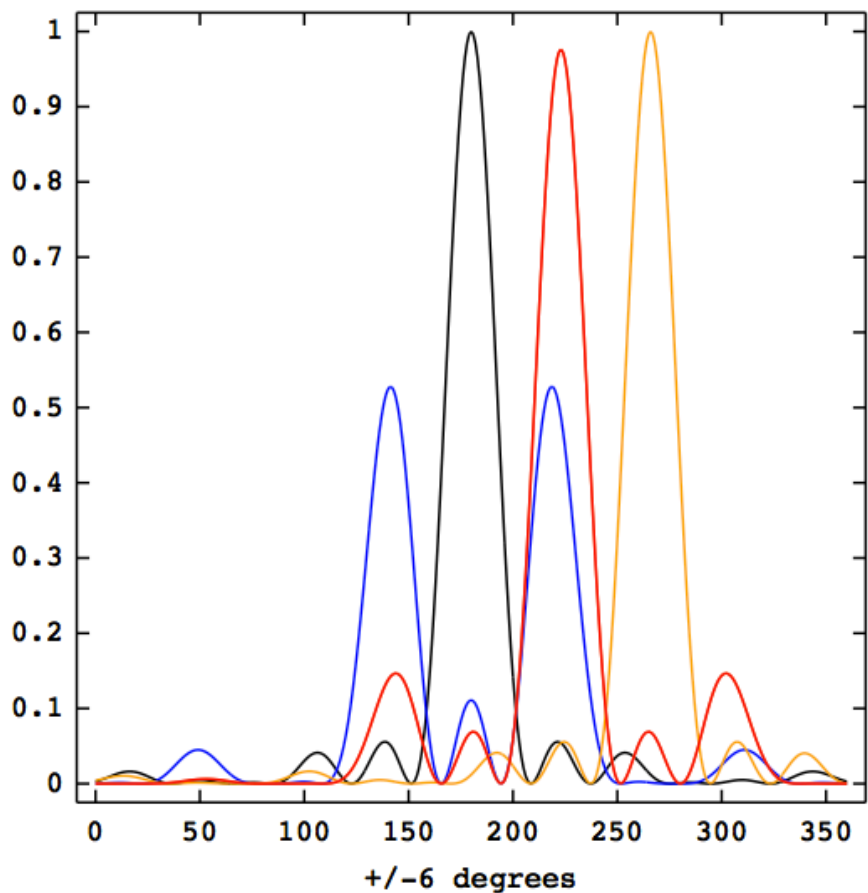# Combination of 2 pointings
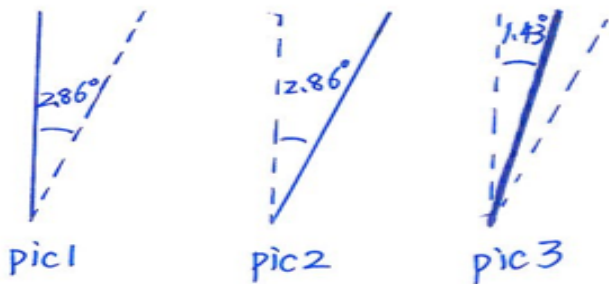

black   orange   red
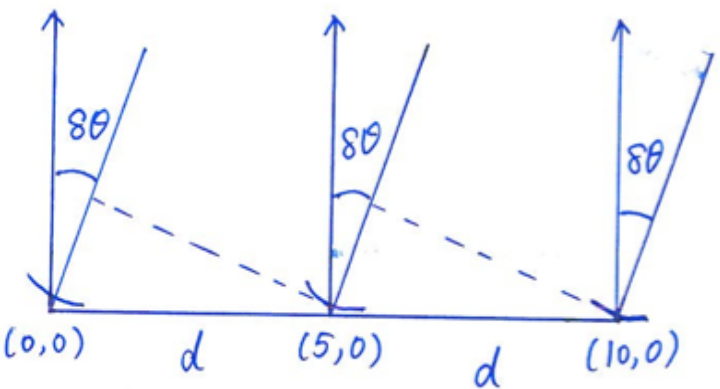
lobe1D – 3 paraboles combination 2 pointings
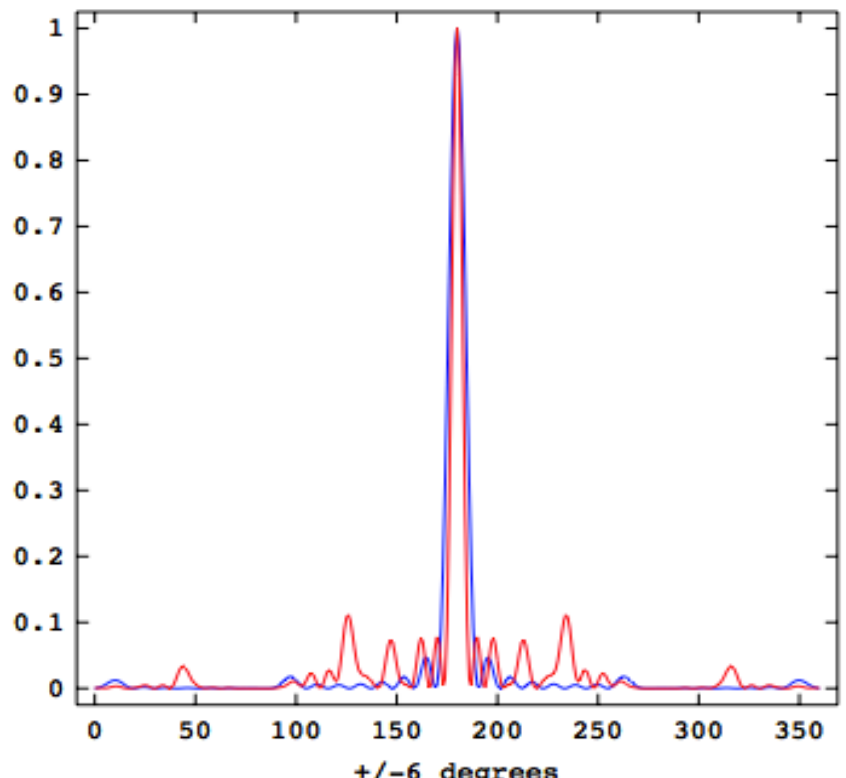
FFT lobe1D – 3 paraboles combination 2 pointings
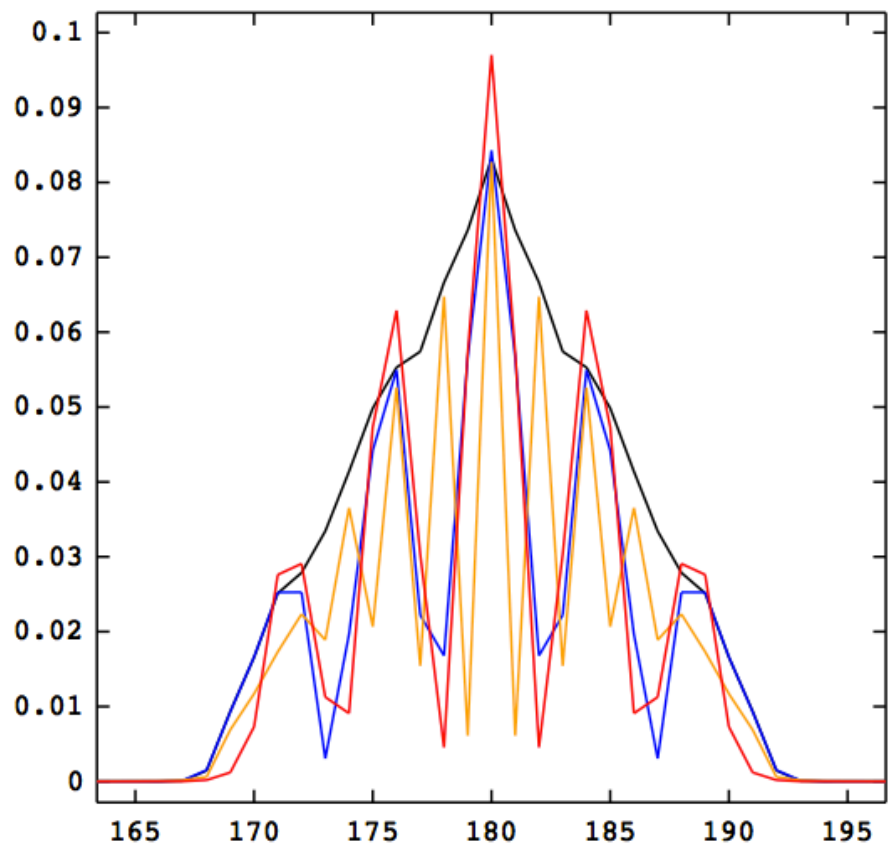
+/-6 degrees

8 dishes with equal spaces or random spaces

lobe1D – 8 dishes angle=2.86 degrees;

lobe1D – 8 dishes blue-equal spaces; red-random spaces

lobe1D – 8 dishes combination 2 pointings;
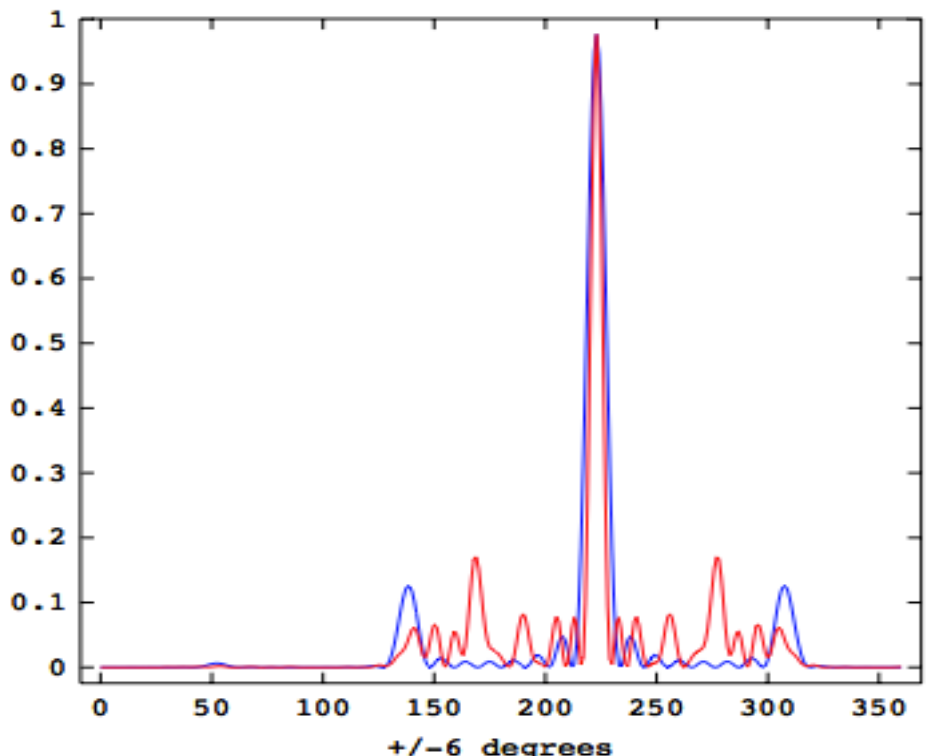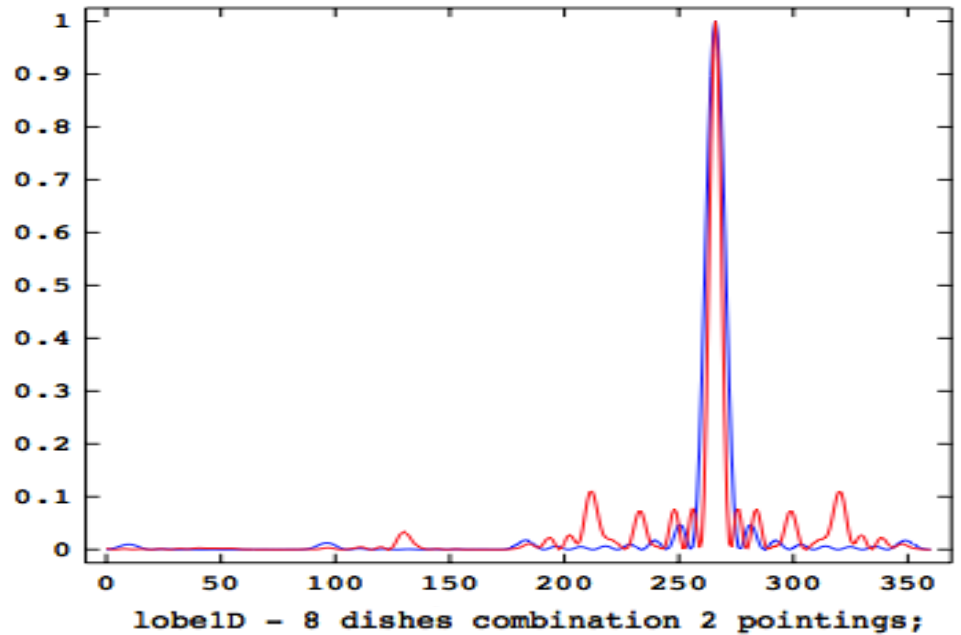
+/−6 degrees

+/−6 degrees

2 dimensional beam

NS ↑
DishD=4.5m
→EW
(0,0)
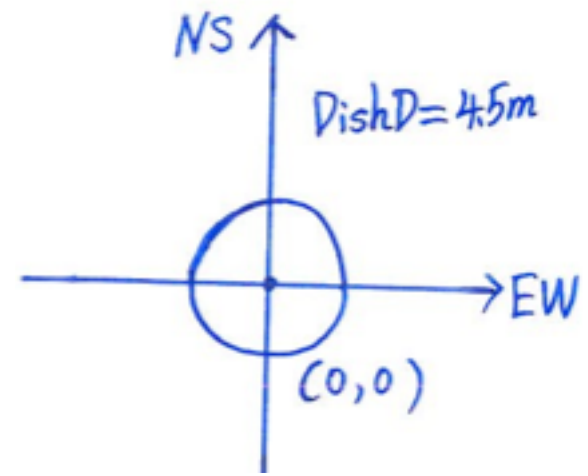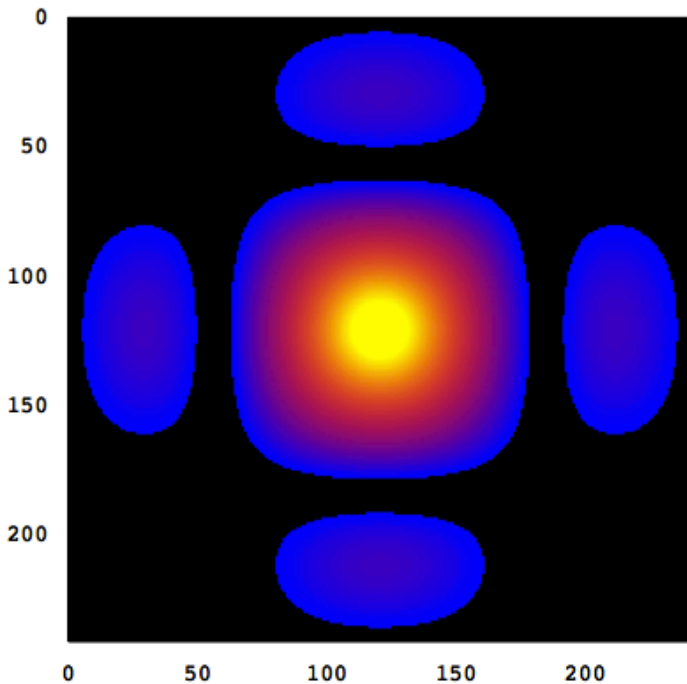
lobe2D - 1 dish

+/- 6 degrees
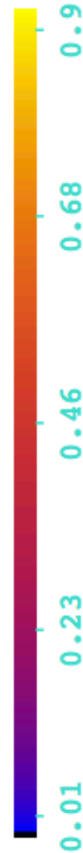
FFT lobe2D - 1 dish
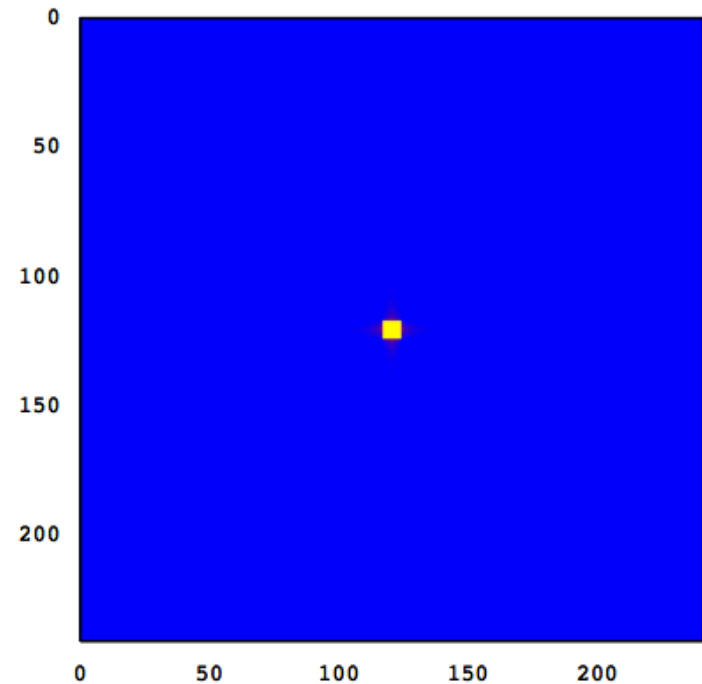
u(rad^-1) u=0->28arcmin

PAON-4

NS

(8,5)

(8,0)

EW

(0,0)

(8,-5)

DishD=4.5
(m)
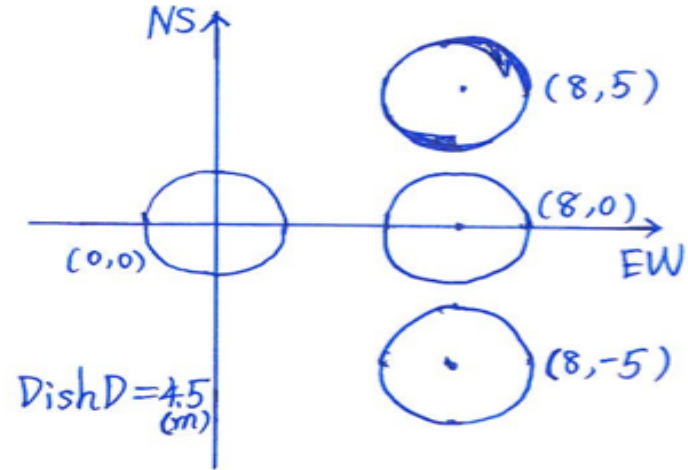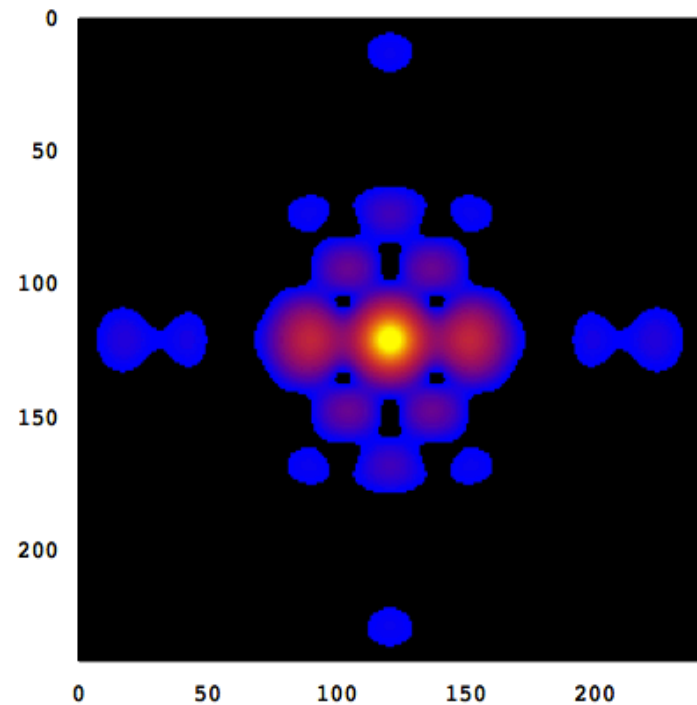
lobe2D - 4 dishes

+/- 6 degrees

FFT lobe2D - 4 dishes
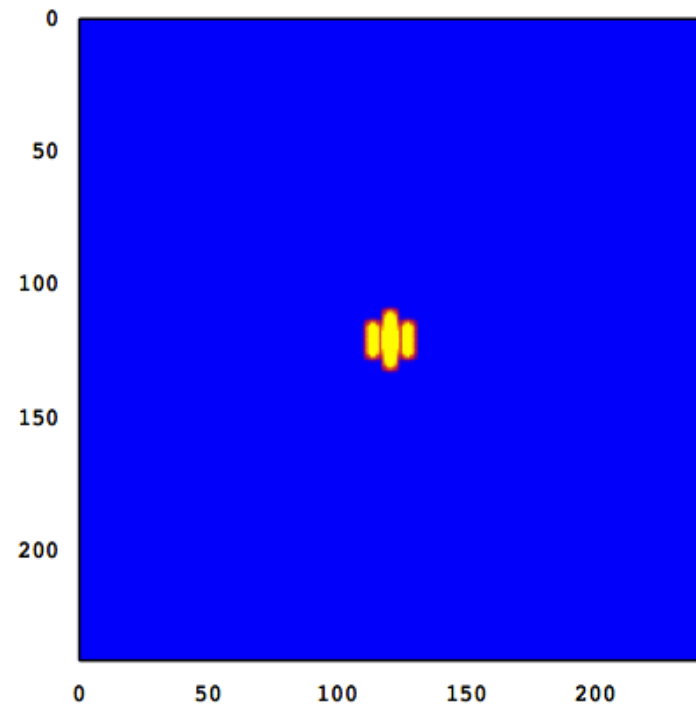
u(rad^-1) u=0->28arcmin

Combination of 2 pointings

NS ↑

(8,5)

(8,0)

(0,0)   EW

(8,-5)

DishD=4.5 (m)

lobe2D - 4 dishes combination 2 pointings

+/- 6 degrees
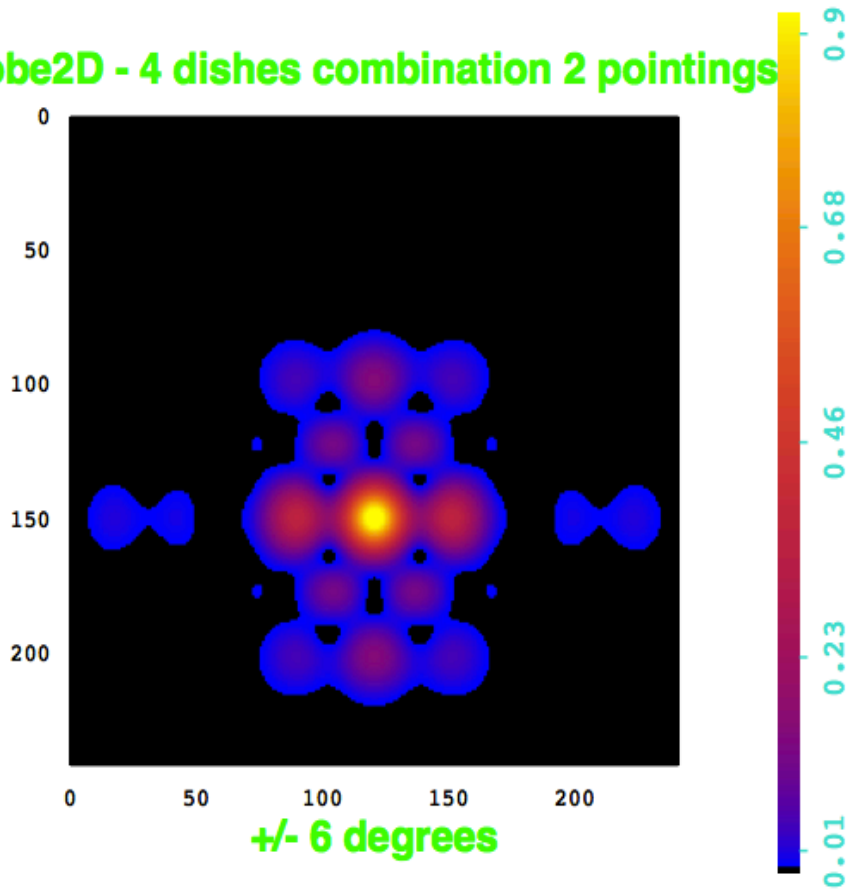
FFT lobe2D - 4 dishes combination 2 pointings

u(rad^-1) u=0->28arcmin

Conclusions

- Study response as a function of dish-sizes and baselines

- Study and optimize PAON4 configuration (4 x D=5 m dishes)

- Compute antenna response for Tianlai instrument configuration

- Compute sky map as observed by an instrument (PAON4 & Tianlai), including instrument noise (system temperature)