Beam shapes for calibrating off-axis detections

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SFXC

- Has its origins in the Casini-Huygens mission.
- Has replaced the old hardware correlator (the EVN MkIV data processor) for nearly all observations.
- Features :
 - Pulsar binning / gating
 - Supports Mark4, Mark5B, and VDIF formats.
 - Arbitrary spectral resolution
 - Multiple simultanious phase centers
- GPL licensed, available from JIVE wiki : http://www.jive.nl/nexpres/doku.php?id=nexpres:nexpres_wp7

Wide-field VLBI

- Wide-field techniques make it possible to map the entire station beams at VLBI resolutions : VLBI as a survey instrument.
- Problem : Prohibitively large datasets.
- Mapping the entire primary beam of a 100m dish (9.5 arcmin) to 10% accuracy with 10 stations requires an output data rate of 400 GB/hour

Multiple simultaneous phase centers

- Produce a single narrow field data set for each source in the beam.
- Internally the data is correlated at the required high spectral and temporal resolution.
- Results averaged down in time and frequency before writing to disk.



Narrow "Pencil beam"

Multiple simultaneous phase centers



• Going from 1 to 100 sources (5% accuracy) requires only 30% more correlation time!

Primary beam correction

- Fringe amplitude is modulated by primary beam pattern
- Simple model : Uniformly illuminated circular aperture (Airy Disk)

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$$I = \left| \frac{j_1(kD\sin(\theta)/2)}{kD\sin(\theta)} \right|$$





Effelsberg illumination pattern @11.7 Ghz



The Effelsberg Holography Campaign - 2001

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

Primary beam correction

- Corrections are applied using a parseltongue script.
- Airy disk model is used, but with effective aperture sizes fitted from published FWHM.
- Primary beam does not vary significantly over pencil beams. Correction factor is constant.
- Simple model ignores dish deformations due to elevation and temperature.

N11L4 (18 cm)

- Test experiment to probe primary beam shapes
- A series of deliberate mis-pointings around 3C66A



Before :

N11L4 (18 cm)

- Test experiment to probe primary beam shapes
- A series of deliberate mis-pointings around 3C66A

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After :

N11L4 (18 cm)

- Test experiment to probe primary beam shapes
- A series of deliberate mis-pointings around 3C66A



All 3 Hours :



Questions

- Beam parameters for all EVN stations (FWHM, Axis offsets).
- Beams shapes as function of frequency : How well does the λ/D scaling relation hold?
- Are beam shapes as function of elevations available?
- At which elevations should we flag our data?