Pointing correction

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Image plane corrections

$$V_{ij}^{Obs}(u,v,w) = \int\int X_{ij}(l,m,w)\, I^{M}(l,m)\, e^{2\pi\iota(lu_{ij}+mv_{ij})}\, dl\, dm$$

$$V_{ij}^{Obs}(u,v,w) = \boldsymbol{FT}[X] * V^{M}(u,v)$$

The transform is more complicated (not a *FT* operator)

General approach:

- Major cycle involves: $V - AI^{M}$ and $A^{T}(V - AI^{M})$
  - Use $FT[X_{ij}]$ to predict the model data (AI^{M})
  - Compute V^{R} at high accuracy.
  - Use an approximation for A^{T}: $B^{T}(V\text{-}AI^{M})$

Primary Beam Effects

- $FT[X_{ij}]$ as a function of direction is measured a priori

  $$V_{ij}^{Obs} = G_{ij} . \left[E_{ij} * V^{M} \right] \quad where \quad E_{ij}(l_i, l_j, u_{ij}; p_i, p_j)$$

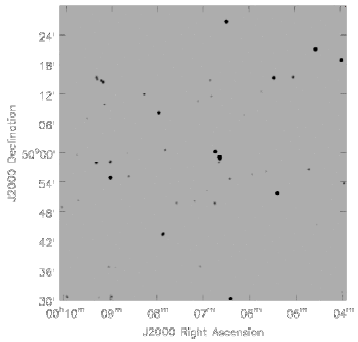
- Primary beam effects

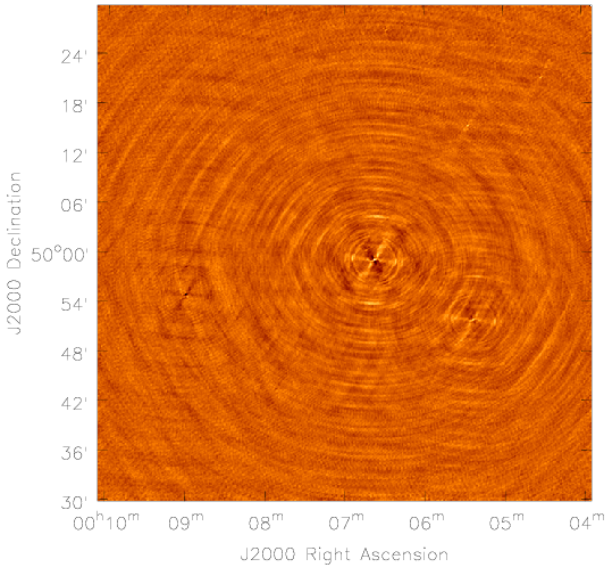
  $$E_{ij} = E_i^o * E_j^o \quad where \quad E_i^o = \boldsymbol{FT} \left[Measured\ PB_i \right]$$

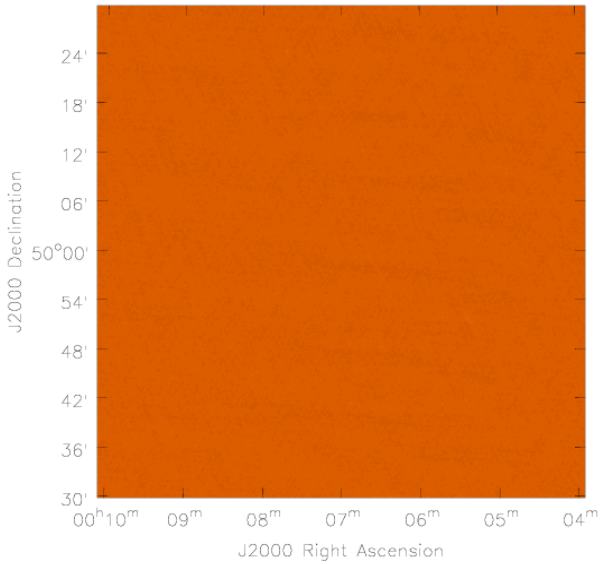
- Polarized primary beam: Beam squint
  - For full beam polarimetry (EVLA)
- Pointing offset calibration
  - For mosaicking (EVLA, ALMA)

Example

Residual image before and after pointing correction.

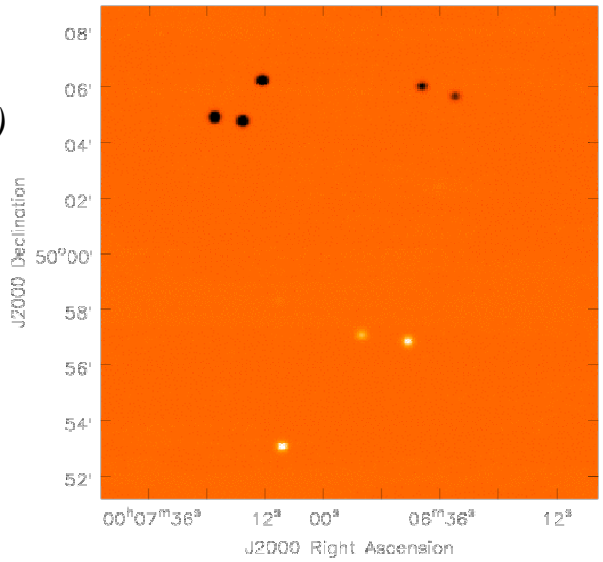


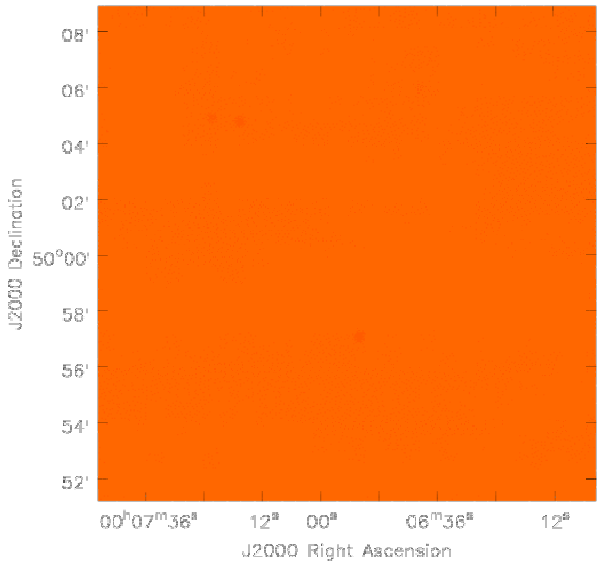




$I^V = PB(I^{RR} - I^{LL})$

Peak ~4%





$I^V = PB^R I^{RR} - PB^L I^{LL}$

Peak ~0.2%

Pointing solver

- Minimize: $\left[V^{Obs} - AI^{M}\right]^{T} W \left[V^{Obs} - AI^{M}\right]$ w.r.t. $A \equiv A\left(l_i, l_j\right)$

- $GCF \equiv GCF^{o} \Delta GCF$ to compute $\boldsymbol{A}$