

# CASA Polarization Status & Plans

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2013 June 28

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# CASA Polarization Calibration Model

- Calibration Model:

$$\mathbf{V}^{obs} = \mathbf{K}^{crs} \mathbf{B}^r \mathbf{G}^r \mathbf{D}^r \mathbf{X}^r \mathbf{P} \mathbf{V}^{mod}$$

- Basic Solve sequence:

- Normal  $\mathbf{B}^r$  and  $\mathbf{G}^r$  (parallel-hands):

$$\begin{aligned} \mathbf{V}^{obs} &= \underline{\mathbf{B}^r} \mathbf{V}^{\mathcal{I}} \\ (\mathbf{B}^{r-1} \mathbf{V}^{obs}) &= \underline{\mathbf{G}^r} \mathbf{V}^{\mathcal{I}} \quad (+\text{estimate } \mathcal{QU}) \end{aligned}$$

- $\mathbf{K}^{crs}$ ,  $\mathbf{X}^r$ ,  $\mathcal{Q}$ ,  $\mathcal{U}$ ,  $\mathcal{V}$  (cross-hands):

$$\begin{aligned} \mathbf{V}^{obs} &= \underline{\mathbf{K}^{crs}} (\mathbf{B} \mathbf{G} \mathbf{P} \mathbf{V}^{101}) \\ (\mathbf{G}^{r-1} \mathbf{B}^{r-1} \mathbf{K}^{crs-1} \mathbf{V}^{obs}) &= \underline{\mathbf{X}^r} \mathbf{P} \underline{\mathbf{V}^{\mathcal{QUV}}} \quad (+\text{resolve amb}) \end{aligned}$$

- Revise  $\mathbf{G}^r$ , using IQU (parallel-hands):

$$(\mathbf{B}^{r-1} \mathbf{K}^{crs-1} \mathbf{V}^{obs}) = \underline{\mathbf{G}^r} (\mathbf{P} \mathbf{V}^{1QU})$$

- $\mathbf{D}^r$ , using IQU (cross-hands):

$$(\mathbf{X}^{r-1} \mathbf{G}^{r-1} \mathbf{B}^{r-1} \mathbf{K}^{crs-1} \mathbf{V}^{obs}) = \underline{\mathbf{D}^r} (\mathbf{X}^r \mathbf{P} \mathbf{V}^{1QU})$$

- (Iteration?)

- Correction:

$$\mathbf{V}^{corr} = (\mathbf{P}^{-1} \mathbf{D}^{r-1} \mathbf{X}^{r-1} \mathbf{G}^{r-1} \mathbf{B}^{r-1} \mathbf{K}^{crs-1} \mathbf{V}^{obs})$$

# Status

- Essential linear feed basis instrumental polarization calibration treatment supported and working
  - Cross-hand phase spectrum estimation
  - Calibrator  $Q, U$  estimation
  - Linearized instrumental polarization solution
  - General matrix correction
- Observational requirements (expectations):
  - Strongly (> few %) linearly polarized calibrator
  - Parallactic angle coverage sufficient for  $Q, U$  estimation (and therefore also for other polarization-specific steps)
- Simplified and degenerate approaches also supported at user's own risk

# CASA Planning

- NB: All polarization development plans must be evaluated and prioritized alongside general CASA development cycle (6 month) planning
  - v4.2 development underway; release: ~Nov 2013
  - v4.3 planning beginning now; release ~May 2014

# CASA Todo List - I

- Stokes options in plotms
- Algorithm/Robustness Improvements
  - \*\*  $\mathcal{V}$  estimation
  - qufromgain: option to remove source polarization signal from gains
  - qufromgain: reduce sensitivity to antennas with outlying gain ratios; antenna (de-)selection
  - \*\*xyamb: channelized XY-phase ambiguity resolution (cross-hand delay)
  - “Sky-frame” expression of instrumental polarization (rather than gain refant frame)
  - Iteration (has been deliberately ‘naked’, for now)
- Modularization
  - Decouple XY-phase and QU estimation (currently ‘Xyf+QU’), XY-phase ambiguity switch (gencal)
- Interface
  - Migrate almapolhelpers methods to general CASA tasks
  - Migrate (modularized) ‘Xyf+QU’ from gaincal to polcal
  - smodel improvements (removal?)

\*\*Items arising or especially contemplated at Bologna School/Workshop

# CASA Todo List - II

- \*\*Simulation
  - Corruption by full magnitude instrumental polarization
  - Corruption by plausible residual instrumental polarization (so as to yield realistically 'poor' result)
- Documentation
- Analysis
  - \*\*RM synthesis
  - \*\*Viewer enhancements (e.g., simplified vector plotting)
  - \*\*Polarization-related UV statistics
- General CASA development relevant to polarization
  - Cal Library (better organized calibration apply semantics)
  - Full polarization setjy (standard calibrators)
  - CalTable plotting in plotms, \*\*including overlays of calibration on data

\*\*Items arising or especially contemplated at Bologna School/Workshop