



Primary Beam and Mosaic Imaging



What are we trying to do?

- **Accurate correction for the primary beam in all Stokes parameters for heterogeneous arrays (ALMA 12m + ACA; e-MERLIN; EVN)**
- **Mosaic imaging over large field of view: critical for ALMA**
- **Wide-band imaging (large $\Delta\nu/\nu$) requires use of frequency-dependent primary beams**



Technical issues

- **Subset of full wide-field, wide-band imaging problem.**
- **w term important for lower frequencies; not for ALMA**
- **Closely related to correction of dynamic direction-dependent effects (e.g. ionosphere, pointing), but should be possible to use a priori models.**
- **Intermediate timescales: variation of primary beam with elevation.**
- **Current primary beam models are often crude (circularly symmetric). EM simulations available for ALMA: others?**
- **Use on-sky measurements (holography) to validate.**



Existing methods



- **AIPS primary beam model is crude and assumes all antennas identical – must do better**
- **CASA machinery currently allows different primary beams, indexed by antenna diameter.**
- **Various mosaic imaging algorithms in AIPS, CASA, GILDAS, Miriad, Obit (CLEAN and MEM based)**
- **Use of realistic primary beams for CARMA (Wright, SKA Memo 102)**
- **Related work on optimal single-dish data combination CASA feather task; also in Obit. IRAM work (part of ALMA FP6 Enhancement Programme) will be ported to CASA**



Technical Issues



- **Want to extend to all Stokes parameters (although this is less urgent, at least for ALMA); possible within the same framework**
- **How does this application relate to the work on LOFAR (and SKA?) planned for task 6.2.4?**
- **It may be hard to separate the primary beam problem from other aspects of wide-field imaging.**
- **In particular, what is the division between time-variable and a priori corrections (both use the same correction machinery)?**



Deliverables



- Use cases:
 - e-MERLIN (test data available 2010?)
 - ALMA (test data as available; 2011)
 - CARMA (existing data)
- Report on existing and proposed mosaic algorithms, especially those already implemented in CASA, with recommendations for development.
- Algorithm development → **CASA task(s)**
- Reports on tests with e-MERLIN, CARMA and ALMA



Effort



- ARC scientist position at ESO; interviews in progress; anticipate in post by August.
- Shared between interoperability and mosaic imaging tasks (also some duties for EU ARC)
- RAL provides technical direction; PA manages ARC; Hans Rykaczewski provides administrative support.
- Collaboration with JBCA (to be agreed)
- Anticipate close interaction with CASA group: the aim is to enhance their work, not to duplicate or compete



Proposed milestones



	Month	mm (ESO)
Report on existing algorithms and software and recommendations for development	12	3 (1)
Beta release	26	12 (6)
Report on tests with CARMA data	28	1 (1)
Report on tests with e-MERLIN data	30	1 (0)
Delivery of documented mosaic imaging software	32	6 (3)
Report on tests with real ALMA data	36	1 (1)



Management Issues



- Strategic choice to implement in CASA
- Division of responsibility with JBCA and NRAO
- Delay in recruitment (to ~August 2009)
- Intermediate milestones for main release