

# Why is the MWA excellent for studying transients?

- RFI – location, location, location!
- Large solid angles
- Continuous operation
- Sensitivity
- Wide frequency coverage
- Relatively unexplored frequency range
- High time resolution (in some modes)
- System infrastructure that facilitates multiple software analyses

# Transient Science Relevant Specifications

- Key metric is **discovery phase space coverage**; anticipated sources include GRB afterglows, micro-quasars, AGN flares, scintillation events, and pulsar giant pulses; unanticipated sources include ...
- FOV: 0.07-1.0 SR tile beam ( $\leq 2\pi$  steradians)
- Angular resolution: 3' at 200 MHz
- Frequency resolution: 32 KHz (8 KHz)
- Processed BW: 32 MHz
- **200 kilopixel snapshot with 8 mJy rms in each 8 second cycle!**
- Polarization: Intensity only (full Stokes)
- Time resolution: 8 sec (0.5 s)

# Techniques

- 5 different software analysis methods, or “transient camera backends”
  - All Sky Monitor
  - Beamformer Light Curve
  - Imager Light Curve
  - Short Term Synoptic Survey
  - Long Term Synoptic Survey
- Each analysis method comprised of
  - algorithms
  - code
  - observing strategies

# All Sky Monitor

- Application running on RTC, continually monitoring all image data flowing from the correlator
- Runs in tag-along mode, looking in direction of of tile beams (v.1), and at the current freq. channels
- Images of primary tile beam field compared to Reference Sky Model (corrected for interferometer beam) for statistically significant changes
- Later, full sky will be examined, albeit at reduced sensitivity, and integration period will shorten from 8s to 0.5 s.
- Performing as many as 7-dimensional search {RA, Dec, start time, duration, dispersion, center frequency, bandwidth} by comparison to reference sky
- Logarithmic binning chains in duration and dispersion
- **Data source:** images within beam, visibilities for regions outside tile beam; frequency and pointing direction *not* under ASM control.

# Beamformer Light Curve

- High resolution time series formed at selected locations on the sky, using the voltage beamformer.
- Limited online analysis - mostly offline
- **Data source:** program sources chosen by investigators, with user-specified direction, frequency band, and duration.

# Imager Light Curver

- Light curves to be formed and analyzed on data coming from the imager
- Finite set of selected targets
- Frequency integration span TBD
- Different analyses from ASM, e.g. search for periodicity; also statistics differ for a targeted search
- **Data source:** Program sources or fields toward which the array is pointed, at specified frequency

# Short Term Synoptic Survey

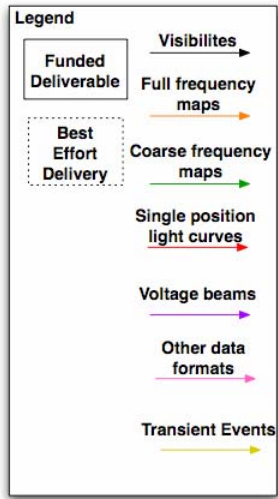
- Program of periodic observations a la LSST
- Whole (accessible) sky
- Full frequency range (80-300 MHz)
- ~500 pointing - frequency range combinations
- Observing interval TBD (but of order days)
- Integration time TBD, but short (~secs)
- Limited cleaning of images
- **Data source:** Programmed scan of whole sky, for  $\delta < 30^\circ$  in 7 frequency bands

# Long Term Synoptic Survey

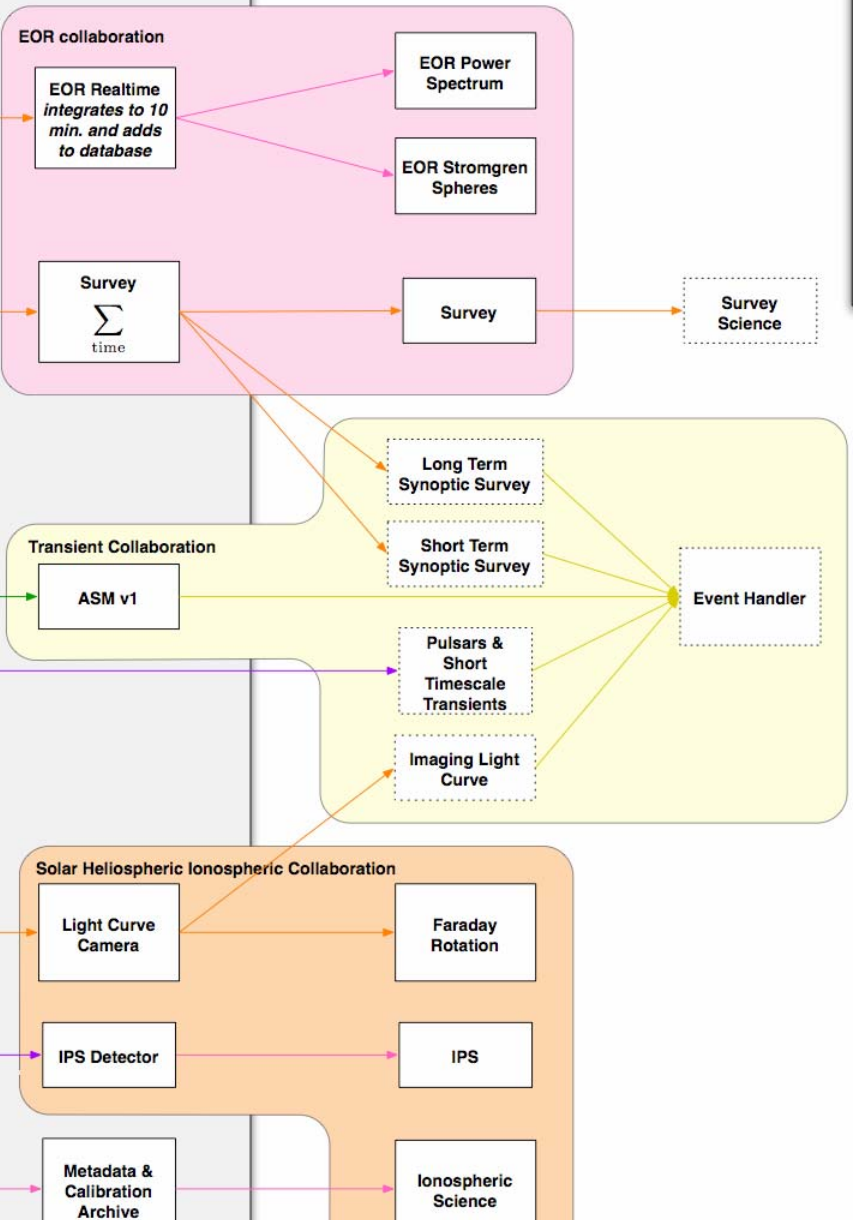
- Similar to STSS, but less frequent with deeper integrations
- Images well-calibrated and cleaned
- Timescale TBD (~ months)
- Integration time TBD (~minutes)
- **Data source:** Programmed scan of whole sky for  $\delta < 30^\circ$  in 7 frequency bands

<b>Science Topics</b>	<b>A</b>	<b>B</b>	<b>I</b>	<b>S1</b>	<b>S2</b>
Blind Transient Search	X				
Periodic Survey				X	X
Pulsars		X			
Radio supernovae	X			X	X
LIGO events	X				
GRB prompt emission	X				
GRB afterglows	X			X	X
X-ray binaries	X		X		
Pulsar giant pulses	X	X			
Local gas giants	X	X	X		
Extrasolar planets	X	X	X		
Flare stars		X	X		
Scintillation events	X	X	X		
Microlensing events		X		X	X
Burpers	X	X			
RRAT's		X			

# Science Packages



Online within the RTC



# Analysis Flow

1. Analysis packages (A, B, I, S1, S2)
2. Event Handler -- clearing house for detected events. Decides which collaborations to notify (after preliminary classification based upon analysis package parameters)
3. Science Collaborations -- teams and software, organized around groupings of science topics

# Transient Science Collaboration

- Formation meeting in Melbourne, December 2006
- **Open to any interested community members**
- Identified ~15 science topics for which we formed 10 teams
- Also formed teams willing to develop the 6 backend software packages
- RJC as first TSC Coordinator

# TSC Membership as of 2007.6.26

- Fred Baganoff
- David Barnes
- Ramesh Bhat
- Judd Bowman
- Frank Briggs
- Adam Burgasser
- Roger Cappallo
- Deepto Chakrabarty
- Brian Corey
- A. A. Deshpande
- John Dickey
- Shep Doleman
- Bryan Gaensler
- Duncan Galloway
- Lincoln Greenhill
- Gregg Hallinan
- Jackie Hewitt
- Simon Johnston
- Justin Kasper
- Eric Katsavounidis
- Colin Lonsdale
- Mervyn Lynch
- Yogesh Maan
- Andrew Melatos?
- Daniel Mitchell
- Miguel Morales
- Divya Oberoi
- Rachel Osten
- Nirvikar Prasad
- Anish Roshi
- Brian Schmidt
- Uday Shankar
- Lister Staveley-Smith
- Randall Wayth
- Rachel Webster
- Matthew Whiting

# Software Teams

- **ASM** Judd Bowman, Roger Cappallo, Deepto Chakrabarti, Brian Corey, A. A. Deshpande, Miguel Morales, Anish Roshi
- **Beamformer Light Curve** A. A. Deshpande, Duncan Galloway, Lincoln Greenhill, Yogesh Maan, Daniel Mitchell, Divya Oberoi
- **Imager Lightcurve** David Barnes, A. A. Deshpande, Justin Kasper, Brian Schmidt, Matthew Whiting,
- **Short-term Synoptic Survey** Frank Briggs, Bryan Gaensler, Lincoln Greenhill, Daniel Mitchell, Randall Wayth
- **Long-term Synoptic Survey** Frank Briggs, Shep Doeleman, Bryan Gaensler, Lincoln Greenhill, Daniel Mitchell, Randall Wayth
- **Event Handler** Frank Briggs, Roger Cappallo, A. A. Deshpande, Shep Doeleman, Miguel Morales

# Science Teams

- **Blind Transient Search** David Barnes, Judd Bowman, Frank Briggs, Roger Cappallo, Deepto Chakrabarty, Brian Corey, A. A. Deshpande, Shep Doeleman, Lincoln Greenhill, Jackie Hewitt, Colin Lonsdale, Mervyn Lynch, Miguel Morales, Divya Oberoi, Anish Roshi, Brian Schmidt, Lister Staveley-Smith, Matthew Whiting
- **Periodic Survey** David Barnes, Frank Briggs, Shep Doeleman, Lincoln Greenhill, Justin Kasper, Daniel Mitchell, Uday Shankar, Lister Staveley-Smith, Randall Wayth, Matthew Whiting
- **Pulsars/Giant Pulses/RRATs/Magnetars** David Barnes, Ramesh Bhat, A. A. Deshpande, John Dickey, Simon Johnston, Yogesh Maan, Daniell Mitchell, Divya Oberoi, Nirvikar Prasad, Randall Wayth

# Science Teams (cont'd)

- **GRB Prompt Emission & Afterglows** Fred Baganoff , Frank Briggs, Bryan Gaensler, Jackie Hewitt, Justin Kasper, Miguel Morales, Brian Schmidt
- **X-Ray Binaries** Deepto Chakrabarty, Duncan Galloway, Bryan Gaensler, Justin Kasper, Nirvikar Prasad, Matthew Whiting
- **Planets - Jovian & Extrasolar** Roger Cappallo, Shep Doeleman, Lincoln Greenhill, Colin Lonsdale
- **Flare Stars** Adam Burgasser, Bryan Gaensler, Justin Kasper
- **Scintillation Events** A. Deshpande, Bryan Gaensler, Divya Oberoi
- **LIGO** Eric Katsavounidis, (Andrew Melatos?)
- **Burpers** A. A. Deshpande , Bryan Gaensler, Duncan Galloway, Colin Lonsdale, Miguel Morales, Anish Roshi, Matthew Whiting