MWA Real-Time Subsystem

MWA post-correlation calibration & imaging sys.

Short-term picture

- C-code development / testing in Cambridge
- use simulated data now, and 32T data later

Long-term picture

- parallelized RTC implementation:16 GB s^{-1} thru O(100) pipes
- construct dirty images every 8^s, remove ionospheric distortion
- provide real-time calibration to other subsystems (B<1.5 km)

Greenhill: Harvard-Smithsonian CfA

RTS Manpower & Resources

- Group kept small, geographically proximate
- Overseen by Greenhill, reporting to Sault (RT System)
  - Daniel Mitchell (SAO): full-time
  - Randall Wayth (SAO): full-time
  - Shepherd Doeleman (Haystack): *part-time*
  - Miguel Morales (MIT): *part-time*
  - Justin Kasper (MIT): *part-time*

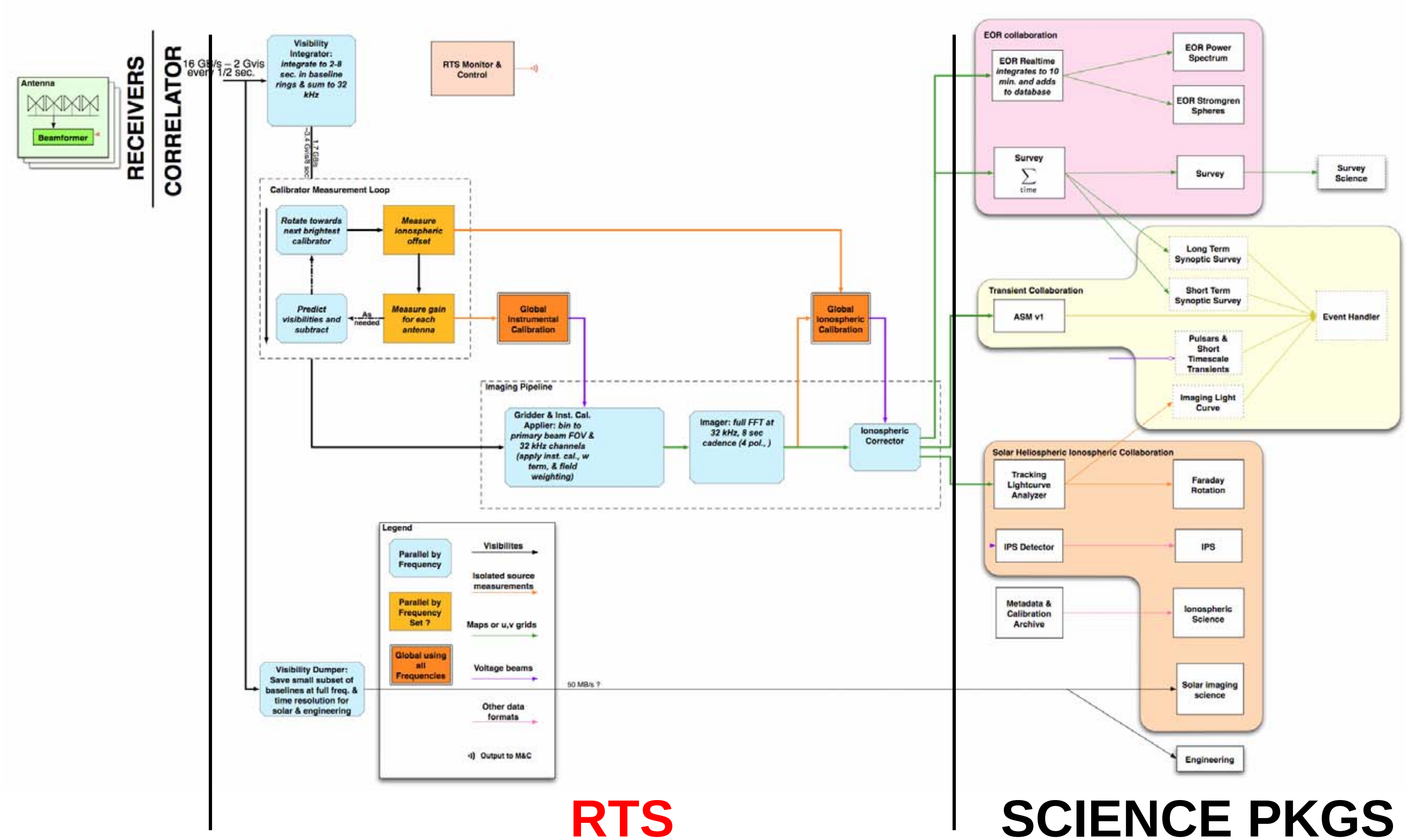
  - Bob Sault on-site with local MWA groups 10/06 - 01/07
  - Steve Ord (SAO): new start Jul. 1, *part-time* on RTS
  - Technical requirements TBD for (1-2) open slots
- Harvard IIC collaboration ⇒ 200^{+}core devel. cluster

RTS Development Priorities

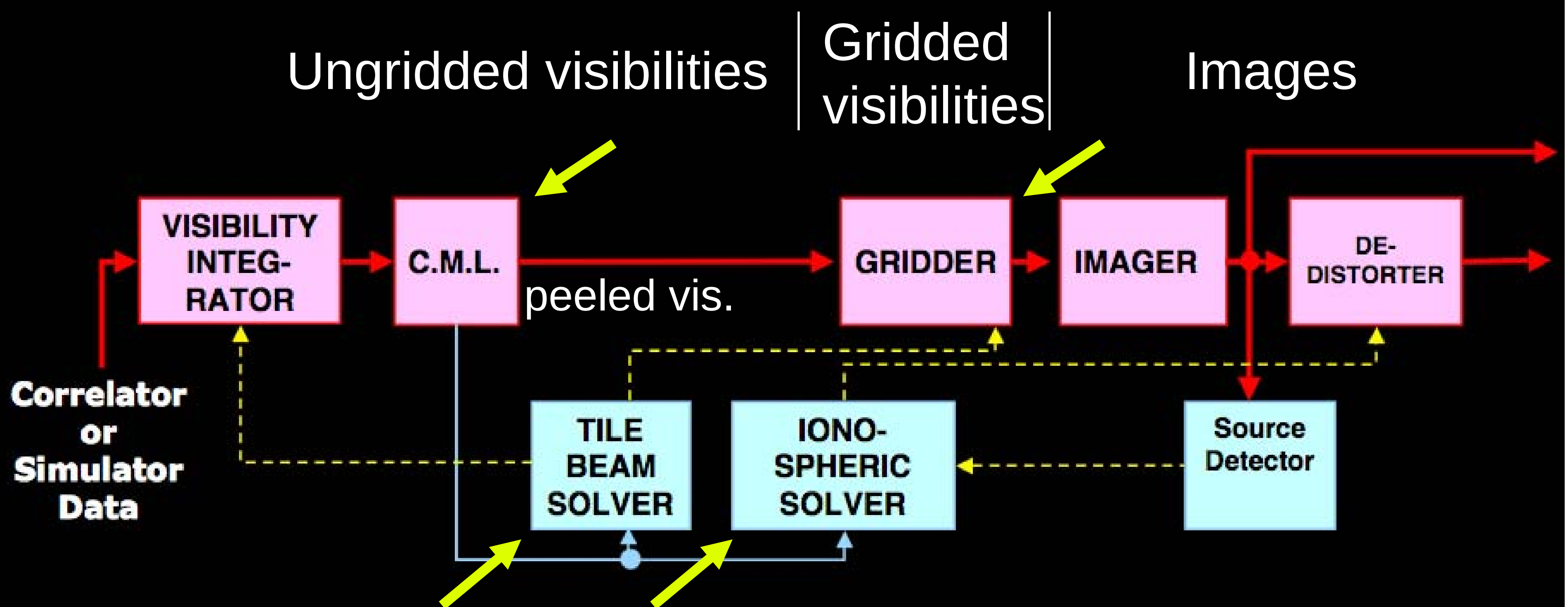
(following 03/07 TAC review)

- Accelerated assembly of formal test harness
  - "right answer" for RTS design cannot be anticipated
    - nuts and bolts testing required; sooner the better
  - sky, ionosphere, and MWA configuration present "challenges"
    - extensive use of simulations for test & evaluation
  - obtain benchmarks; scale; assess performance; rework; repeat
- Drop standalone, individual exploratory codes
  - test-harness to run on desktops and IIC cluster; tight version ctl.
  - built from scratch; C code
  - maintain flexibility in light of uncertain RTC configuration
- Obtain realistic sims via MAPS: dipoles, ionosphere…

MWA Geography

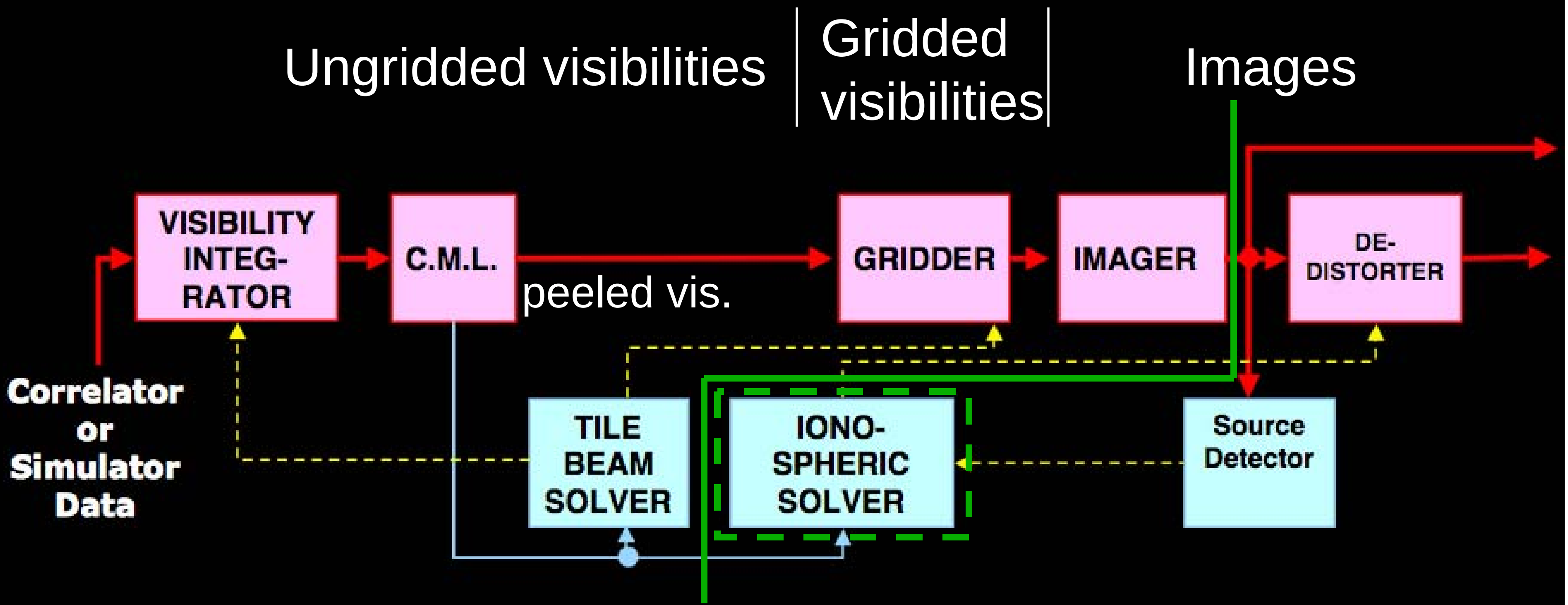


RTS Processing Flow



- Parallel-by-frequency processing steps; data sedentary w/in nodes
- Distribution of measurements (low-BW)
- Distribution of calibration (low-BW)

RTS Processing Flow



Parallel-by-frequency processing steps; data sedentary w/in nodes

Distribution of measurements (low-BW)

Distribution of calibration (low-BW)

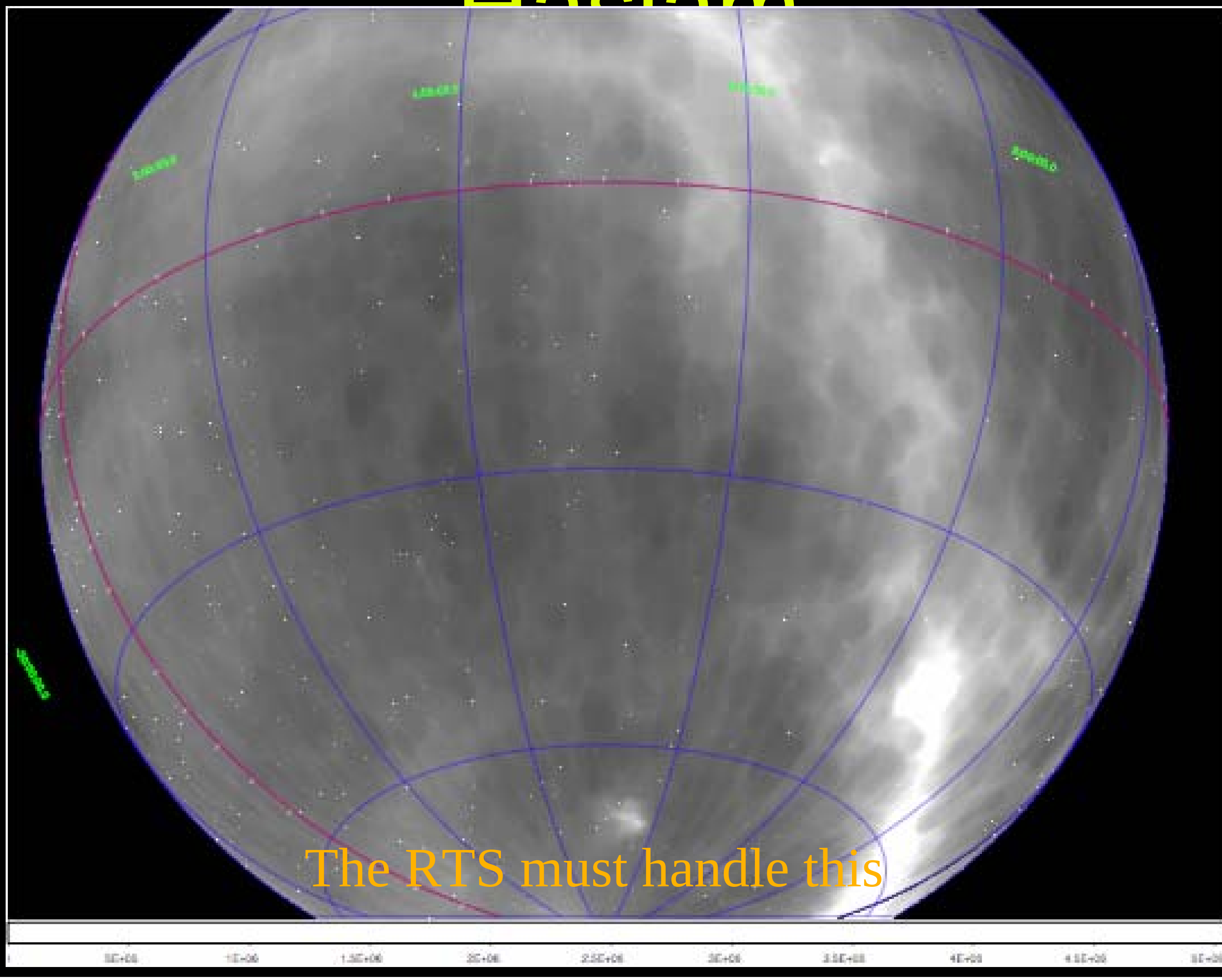
RTS v.0 Elements in Harness

Element	TBD (examples)
• Raw vis. integrator	• σ^2-weighting
• Cal Msrm't Loop	• ν-chan avg'g; polarized sky; tolerance testing
• Tile-beam solver	• full beam response; tolerance testing;
• Gridder	• kernel (w-corr; fully integrate beam response; optimal anti-alias)
• Imager	

RTS v.0 Elements to be Integrated

Element	TBD (examples)
• Source Detector	• planning
• Ionospheric solver:	• trial integration
• De-distorter:	• planning
• Simulations (ongoing)	• clean Stokes-I diffuse sky model; polarized sky model; translating turbulent ionophere

Simple Sky Model: Pks + Haslam*



Simple Tile Beam: 10%, 5° noise

QuickTime™ and a
GIF decompressor
are needed to see this picture.

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CML Peel Demonstration

QuickTime™ and a
GIF decompressor
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- XX polarization
- 140 MHz
- Compact sky only
- 10^3 brightest sources
- LST=1.5^h Boolardy
- Flat sky projection

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CML Peel Demonstration

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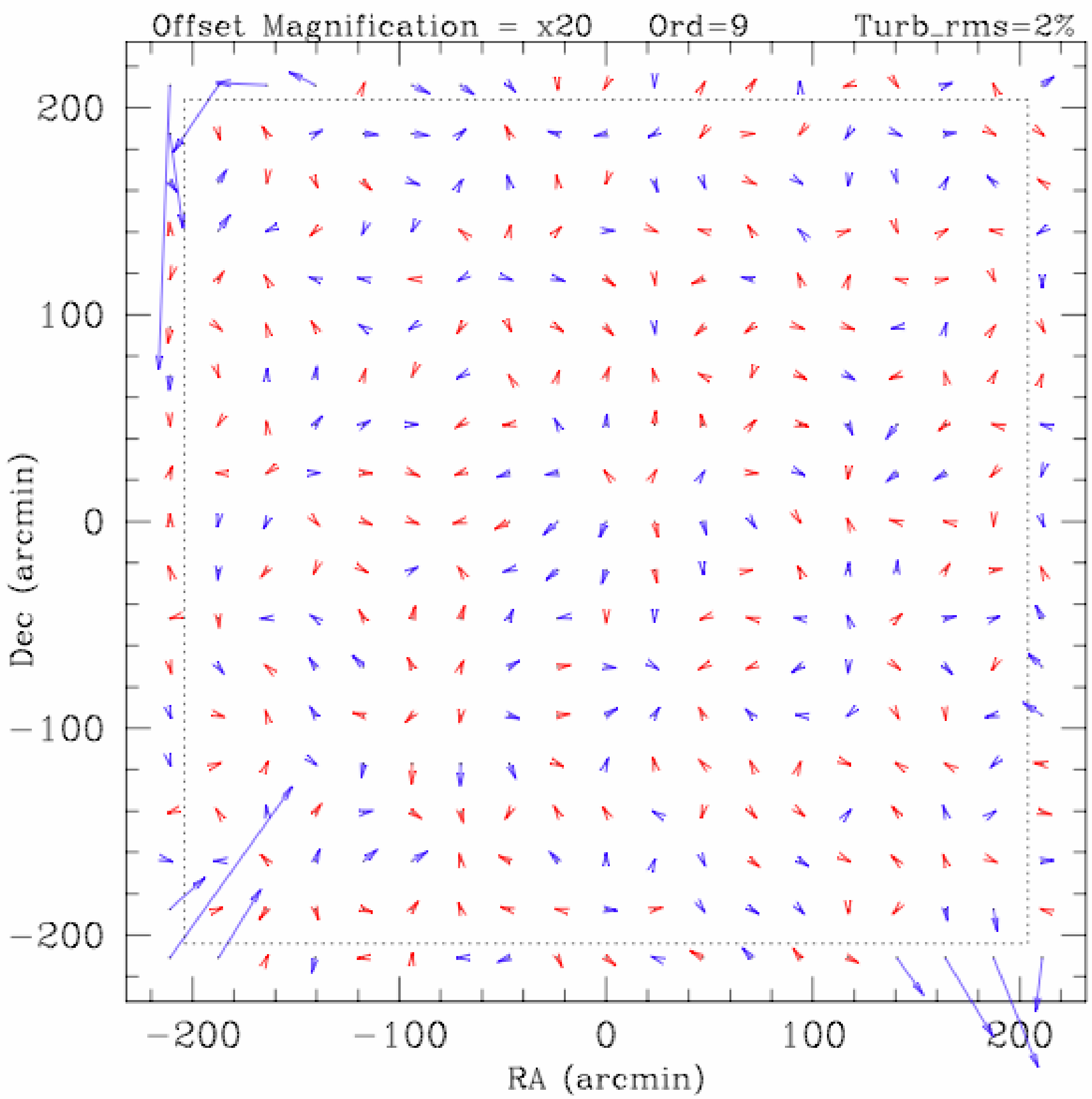
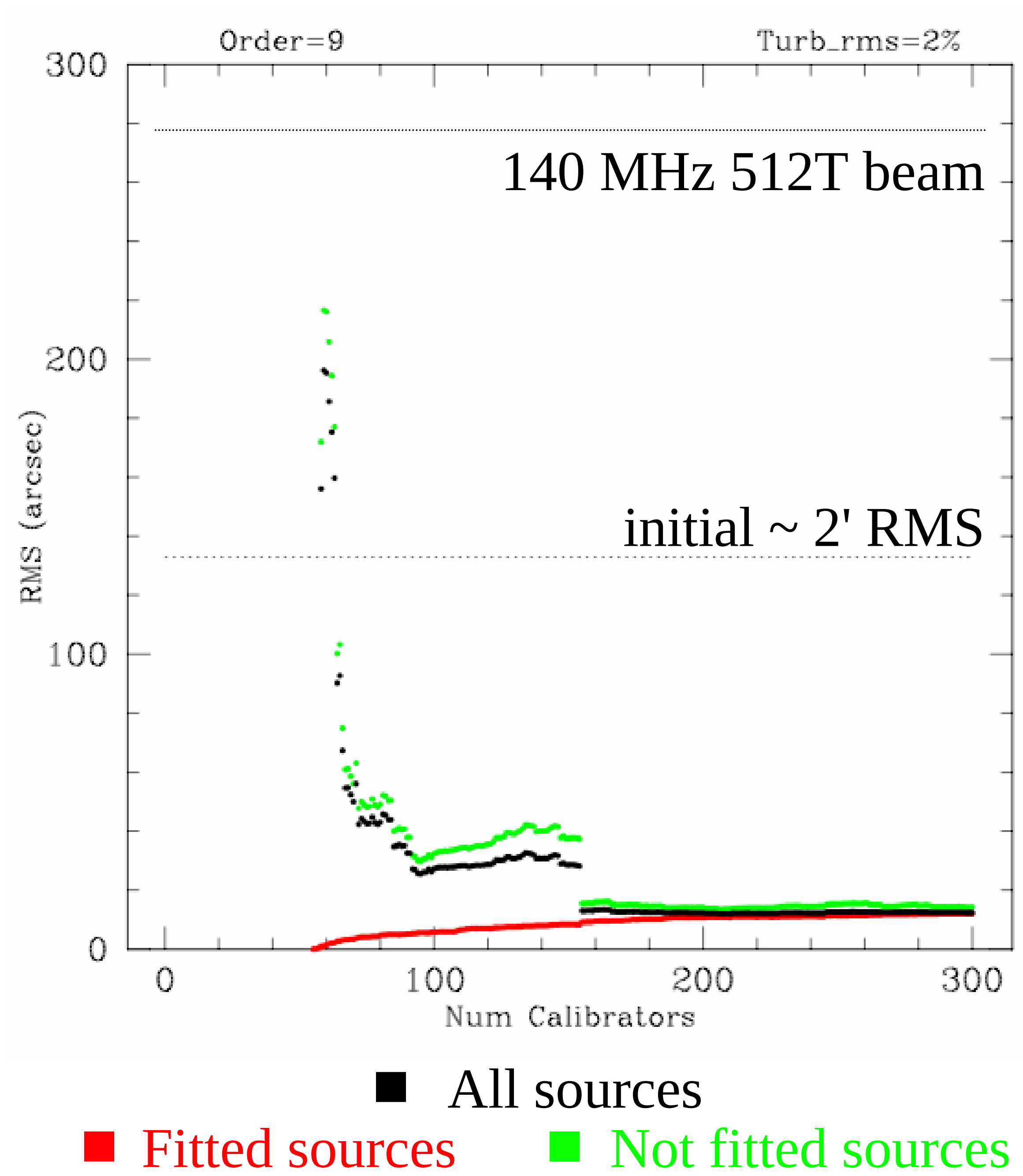
Ionospheric Correction Demo.



- Chapman profile
- 2% turbulence
  - ~ 4x VLA night
  - ~ 2x VLA day
- 9th order poly.
- 361 sources
- 8°x8° field; 140 MHz

Fitted sources Sample for RMS est.



Ionospheric Correction Demo.

- Chapman profile
- 2% turbulence
  - ~ 4x VLA night
  - ~ 2x VLA day
- 9th order poly.
- 361 sources
- 8°x8° field; 140 MHz
- 30°x30° field will be a challenge.
  - Source Detector
  - >1000 sources req.

End-to-end Processing

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

36° square

- Sky to MAPS sim
  MAPS to RTS
  RTS to display
- Demo CML
- Demo Gridder
- Demo data path
  - Compact/diff. sky
  - 10^3 brightest srcs
  - 20 sources peeled
  - XX @ 140 MHz
  - LST=6^h Boolardy

Relevance to 32T

- 32T enables RTS real-world testing & guides development
  - benchmarks inform scaling of computation to 512T
- RTS enables 32T data processing off-site
  - Assessment of dipole/tile performance
  - Construction of initial un/polarized sky survey
- RTS testing transitions to site with h/w transition to 512T
  - regulated by RTC/infrastructure development

QuickTime™ and a
GIF decompressor
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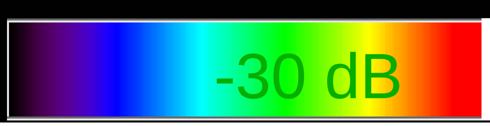
end

Analytic Tile Beam: no noise

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

QuickTime™ and a
Photo - JPEG decompressor
are needed to see this picture.

-30 dB  0 dB