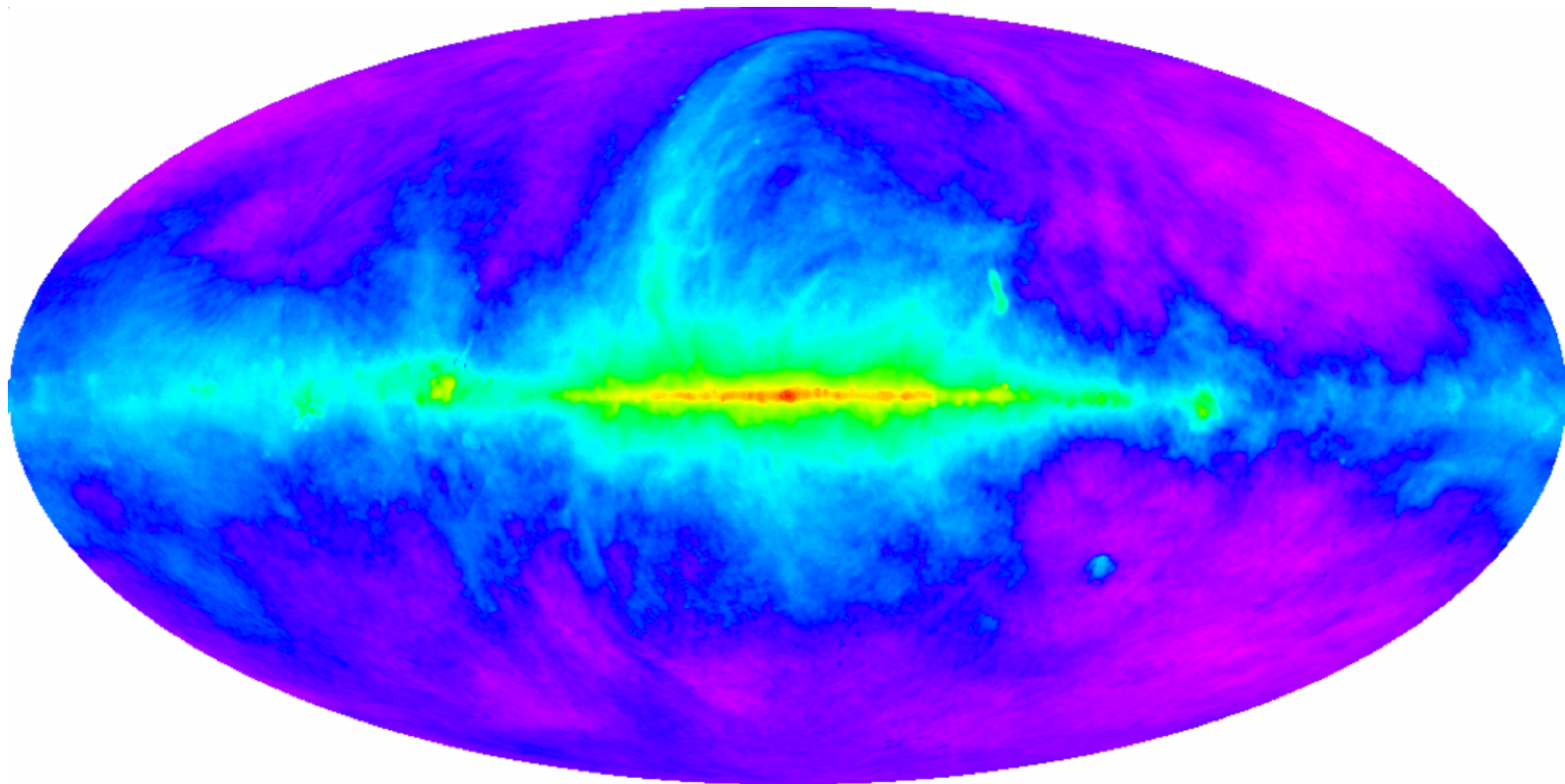




Sky Surveys with LWA1

Emil Polisensky (NRL)

LWA Current and Future Users Meeting 13 May 2011





Why Survey?

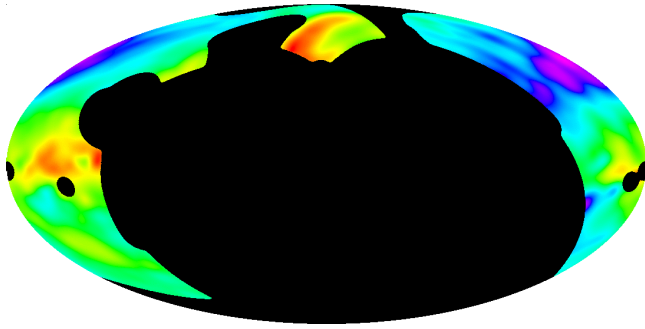


- Necessary for studying and modeling sources of Galactic and extragalactic emission
- Foreground subtraction for high- z 21 cm line mapping of early Universe ($z > 15$)
- Anchor for models of background emission for higher frequency EOR studies
- Measurement of Galactic HII absorption regions

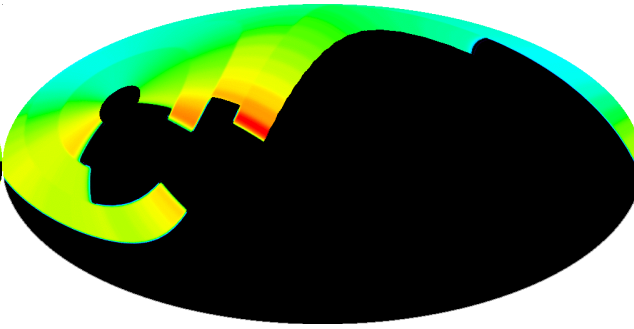


Why LWA1?

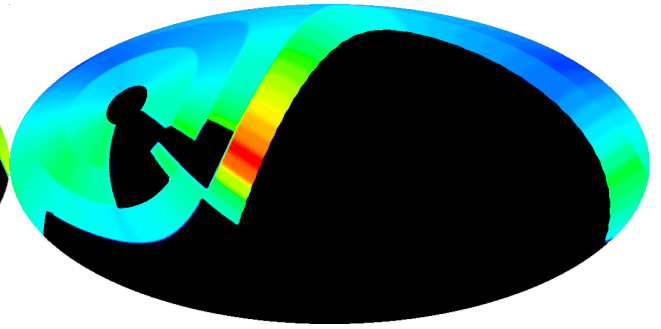
- Previous survey instruments usually single frequency, poor resolution, poor sky coverage, most maps not available in electronic form
- Making spectral index maps complicated by using multi-instrument data



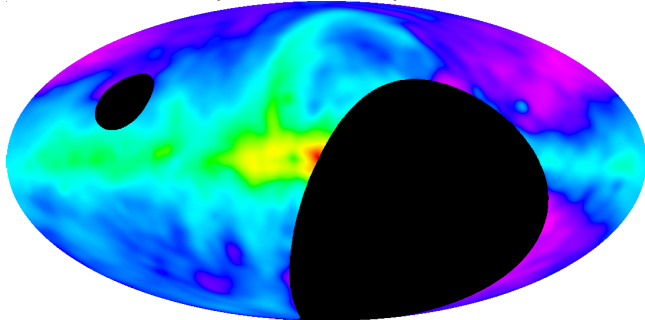
10 MHz (Caswell 1976)



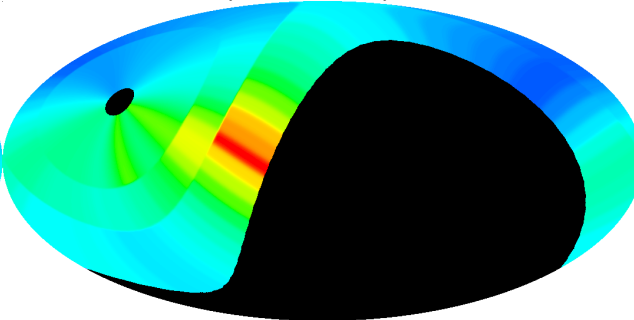
13 MHz (Bridle 1967)



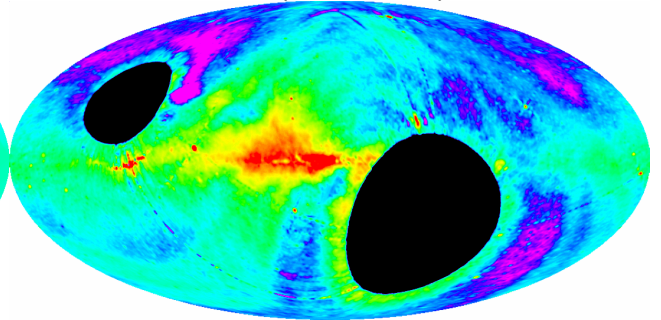
17 MHz (Bridle 1967)



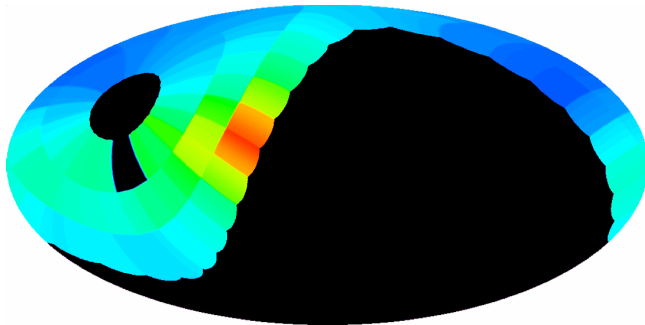
22 MHz (Roger et al. 1999)



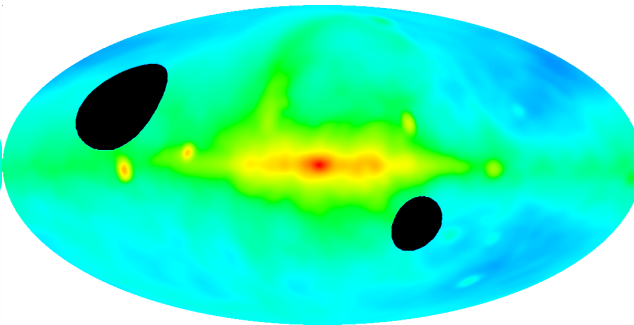
26 MHz (Turtle et al. 1962)



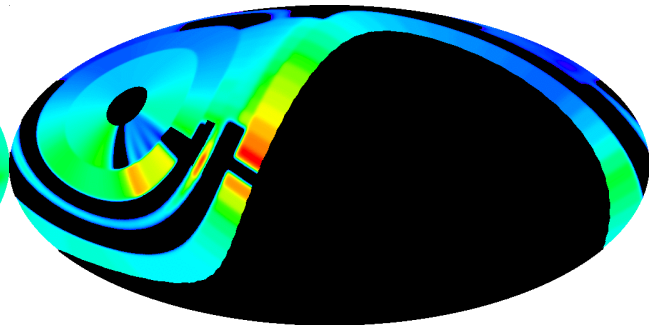
35 MHz (Dwarakanath et al. 1990)



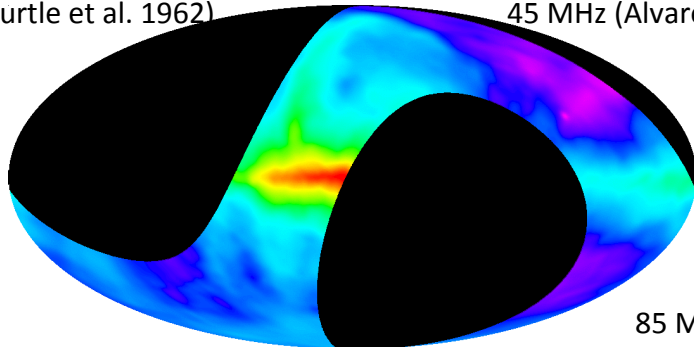
38 MHz (Turtle et al. 1962)



45 MHz (Alvarez et al. 1997, Maeda et al. 1999)



81 MHz (Bridle 1967)



85 MHz (Landecker & Wielebinski 1970)

Credit: GSM website
(A. de Oliveira-Costa)



Why LWA1?

- Large bandwidth: LWA1 can map 10-88 MHz including protected astronomy bands at 13.4, 25.6, 38, 74 MHz
- Good sky coverage: Dec $> -40^\circ$ includes Galactic Center and HII absorption regions
- Resolution $8^\circ(20\text{MHz}/v)$, comparable to 45 MHz (Alvarez et al., 4°) and 22 MHz (Roger et al., 2°) maps
- Mitigates error sources for spectral index maps (matching sky coverage, systematics)



Observing Strategy

- LWA1 best resolution at meridian – observe sky as it passes overhead
- One beam, total power mode (DRX): 19.6 MHz bandwidth. Require 4 all sky scans with 1 beam to cover 10-88 MHz.
- Sensitivity: $\Delta T = T / \sqrt{\Delta\nu\Delta t}$
 $\Delta\nu = 2.4 \text{ kHz}, \Delta t = 1 \text{ sec} \rightarrow \Delta T = 10 \text{ mK}$
- Sky rotates 1° in 240 sec, can easily sample RA, Dec in 1° steps

Observing Strategy

- 4 days of observing time w/ 1 beam to map 10-88 MHz (ignoring RFI)
- 2 observing epochs separated by 6 months beneficial since Sun in different location w.r.t. Galactic background
- Additional observing epoch to make 2 frequency spectral index map with matching beam size at higher frequency (tapering element weights)





Commissioning value

- Comparison between predicted and measured antenna and station beam patterns, calibration stability, RFI mitigation, establishment of an absolute flux density scale, software development, ...

Fin.

