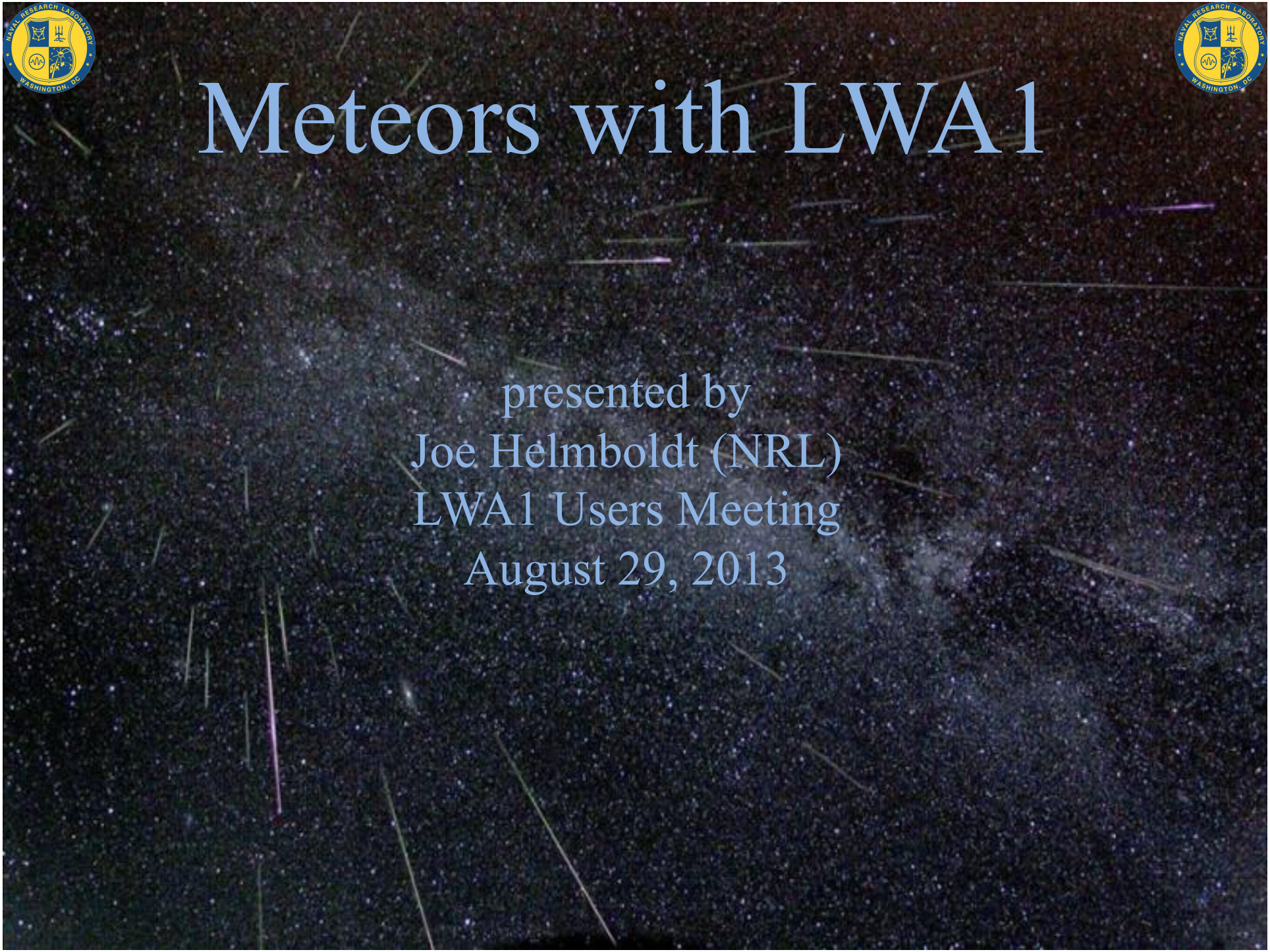

Meteors with LWA1

presented by
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LWA1 Users Meeting
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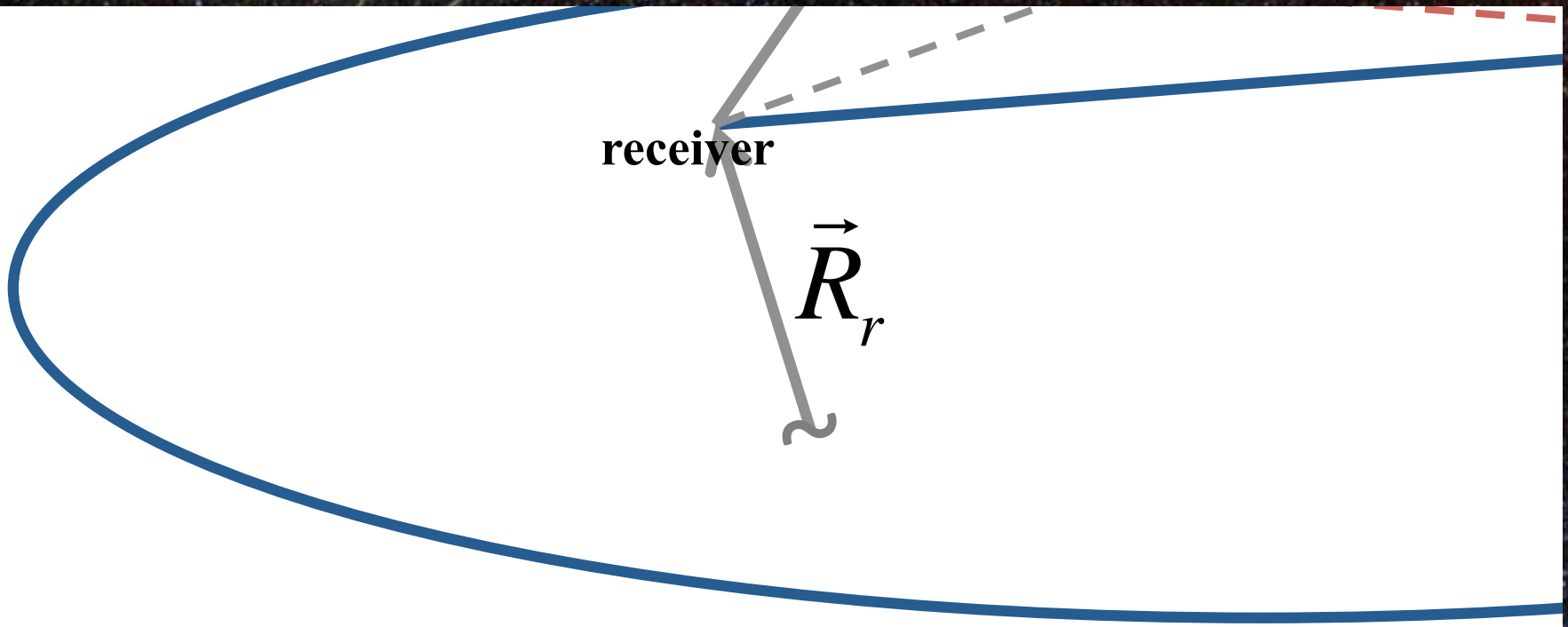
Introduction

- When meteors pass through lower ionosphere, create dense, transient ion trail
- Dense enough to reflect VHF signals up to FM band
- Consequently, rich field of VHF radar-based studies of meteor trails
- These tell us something about meteor sizes/masses and condition of the upper atmosphere (mesosphere/ lower thermosphere [MLT] region)

Schematic



Meteor Radars

- Meteor radars typically one of two types:

Single-dish: high-sensitivity, small field of view

Antenna array: small-N – low sensitivity, large field of view; large-N – operated like single dish

LWA1

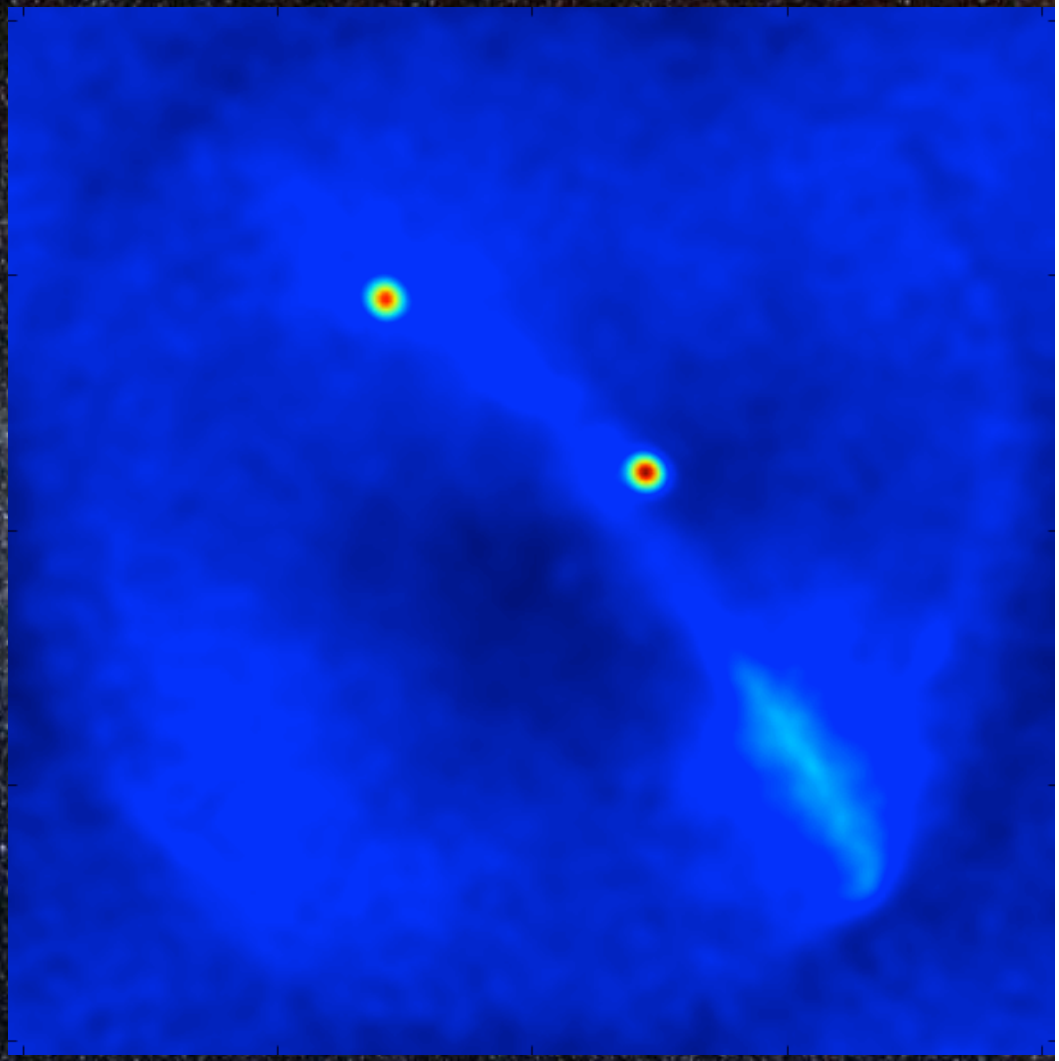
- LWA1 transient buffer mode offers "best of both worlds"
- All-sky field-of view with collecting area of dish with >30m diameter

Meteor Observations

- As demonstration, used LWA1 to observe meteor reflections of analog TV signals, specifically, video carrier for channel 2 at 55.25 MHz
- Video carrier very narrow-band (~30 Hz); increases number of detections using Doppler discrimination
- Also detect airplanes and occasionally (LEO) satellites; ground wave from XEPM in Juarez as well

Meteor Pipeline

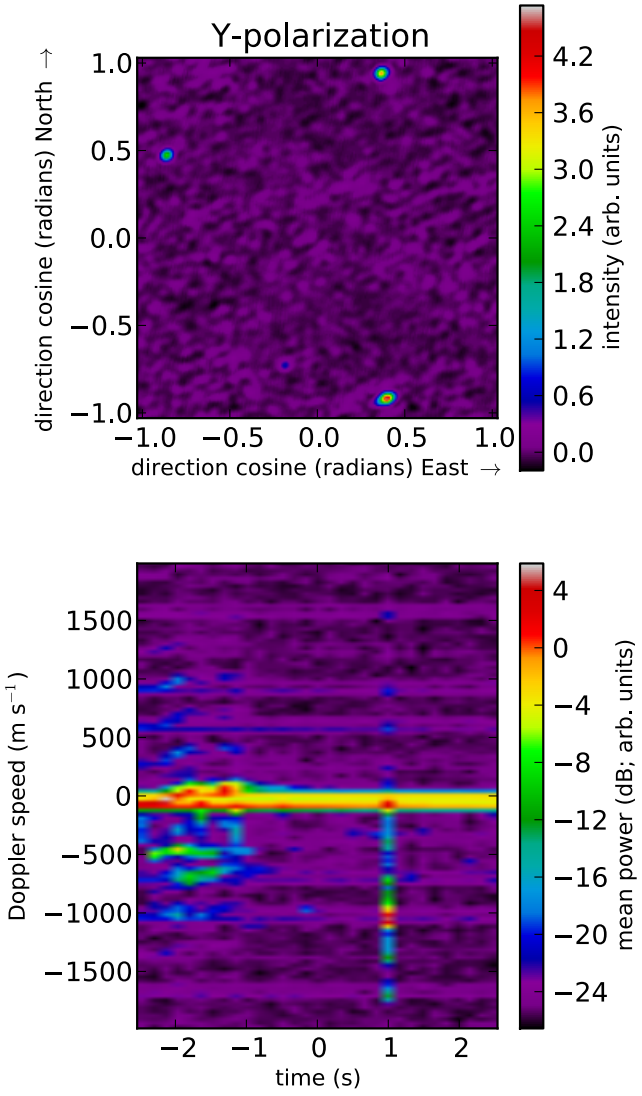
- Developed a python class, LSLmap, that correlates and images TBN data; uses NumPy and LSL; includes image-only CLEAN and self-calibration

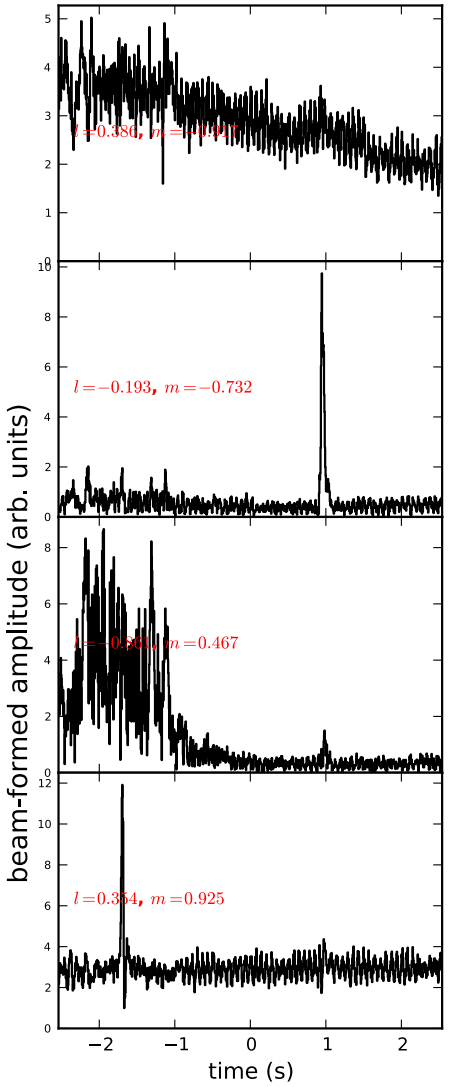


55.25 MHz all-sky image: 5m of data, ~5s integrations, 60kHz BW, median combined in time and frequency

Meteor Pipeline (cont.)

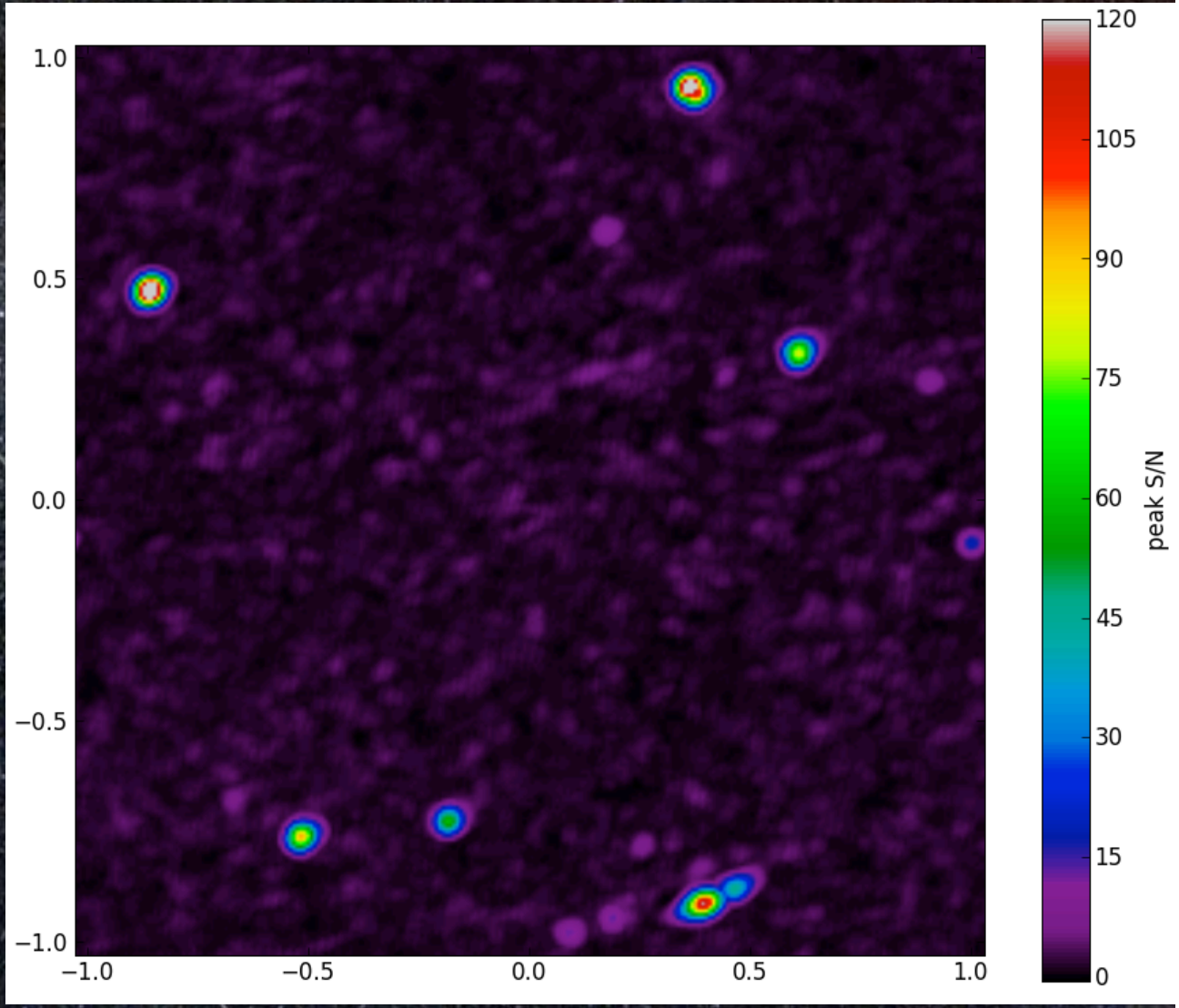
- Meteor pipeline uses LSLmap; identifies bright echoes within 5.079s image that can be used to make high-resolution time series (5.12ms sampling) via beam-forming
- Runs separately on each pol.



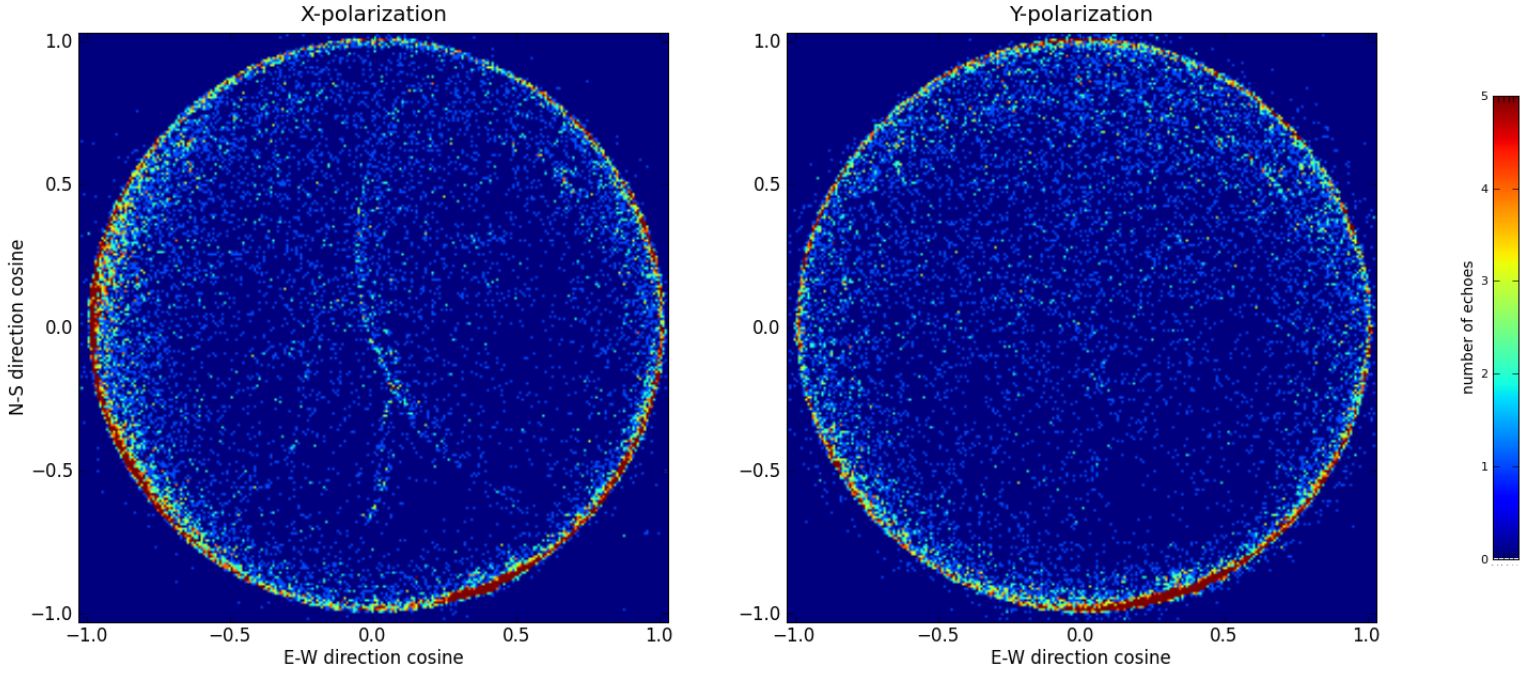


Meteor Pipeline (cont.)

- Applies self-cal sol'n from full-BW image to all channels (~6 Hz wide each) and images them using deeper CLEAN
- Allows for much larger number of detections via Doppler discrimination



Results



- All-sky detections within 1.9 hour observing run ~4 days after the peak of the perseid shower
- Long features are specular reflections from stream(s) “viewed” by different transmitters; too faint to see with smaller array

Conclusions

- LWA1, in TBN mode, offers unique, high-sensitivity, all-sky meteor trail detection/tracking capability
- Can be done with existing transmitters, reducing operation cost for long observing runs
- Offers possibility of detecting relatively faint streams/ showers not observable with other instruments
- Can also map ambipolar diffusion coefficient (~T/ρ) in MLT region over large area and short time interval
- Will have height discrimination capability via parallax with the addition of new stations (e.g., LWA-SV)