VLA Lowband

Frazer Owen

Atacama Large Millimeter/submillimeter Array
Expanded Very Large Array
Robert C. Byrd Green Bank Telescope
Very Long Baseline Array

NRAO

What is VLA Lowband ?

- 54-86 MHz + 230-470 MHz: Two uncooled receivers at VLA antenna apex in one box. Both use linear polarization.

- Uses two separate feeds but all of both bands can be observed simultaneously using JVLA plus the WIDAR Correlator.

- New Feeds for 54-86 MHz coming online.

- Can observe the entire sky north of -45d with the same primary beam pattern.

Lots of Clever Engineers

Paul Harden

Dan Mertley

Chuck Kutz

Steve Durand

Steve Ellingson

Ravi Subrahmanyan

Brian Hicks

Marion Pospiezalski

Ken Sowinski

Also many Astronomers

Huib Intema
Rick Perley
Susan Neff
Namir Kassim
Tracy Clark
Emil Polisensky
Bryan Butler
Anna Scaife
Minnie Mao
Bill Cotton
Eric Greisen

Old VLA 4band and P-band

- In 1970's 90cm was deferred and planned to be the first new band after VLA's completion.
- 1982: P-band receivers and dipole feeds with NRL funding and designed with help of Bill Erickson, narrow band, perhaps 12MHz, centered near 327 MHz.
- 1991-1998: 4-band narrowband system added to VLA with NRL funding and Erickson design, perhaps 1.5MHz bandwidth centered at 74MHz.

EVLA

- 2004: EVLA electronics forced elimination of 4 and P-band.
- 2010-2013: NRL funding and later NRAO/NSF funding was obtained and Lowband Receiver system installed on VLA.
- P-band now operational for general use.
- However, Erickson 4band feeds found to interfere with other JVLA observing bands.

Old VLA 4band+Pband

MJP 4band feeds

- 2012: New strut-straddling feed location proposed by Steve Ellingson and studied in detail in Va. Tech Mahmud Harum PhD thesis.

- 2013: Modified J-pole feed design (MJP) also proposed by Ellingson.

- 2014-2015: First 6 MJP feeds installed on VLA and tested.

- 2016: Eight more MJP feeds to be added by Feb and tested during the year.

New MJP Dipole Feeds

P-band parameters

- Nominally operates in 230-470 MHz band. Given interference and roll-off in sensitivity of feeds, 270-470 MHz is the practical band for most experiments.

- Near NGP, 1hour integration yields ~150 microJy rms in large configurations. Below 60d Gal Latitude time to reach this noise increases by 1.2-2X and up to 32X at the Galactic Center.

- Confusion, Ionospheric disturbances can increase effective noise.

- Polarization and Spectral Line not commissioned.

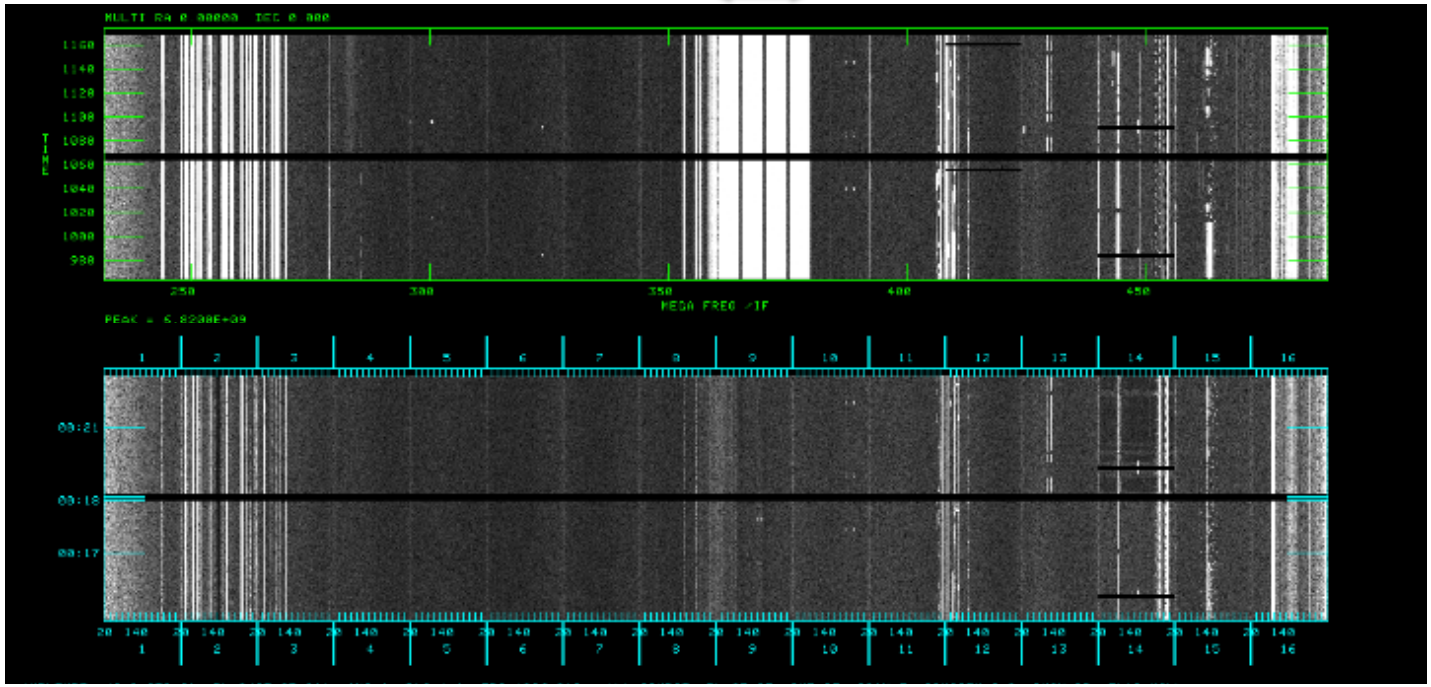
RFI Spectrum – Not bad …

- There will be no surprise to learn that the 230 – 486 MHz range contains RFI. But it is not too bad.
- About 2/3 of the spectrum is useable.
- Two example spectra are shown.

MUOS: Mobile User Objective System.

4 geosynchronous satellites. (USN)

MUOS



1 Km baseline

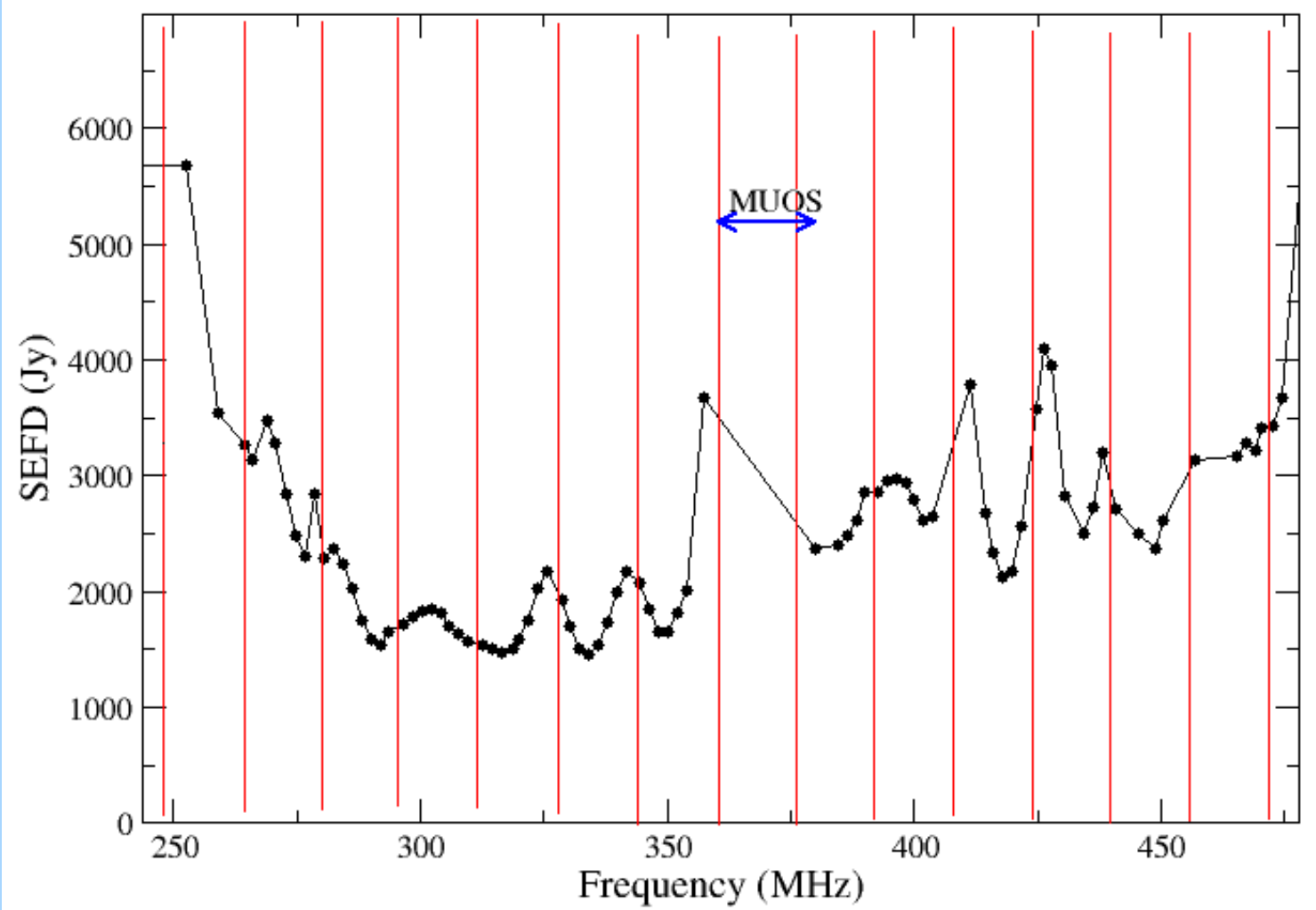
35 Km baseline

232 MHz

350 MHz

488 MHz

P-band Sensitivity



4Band parameters

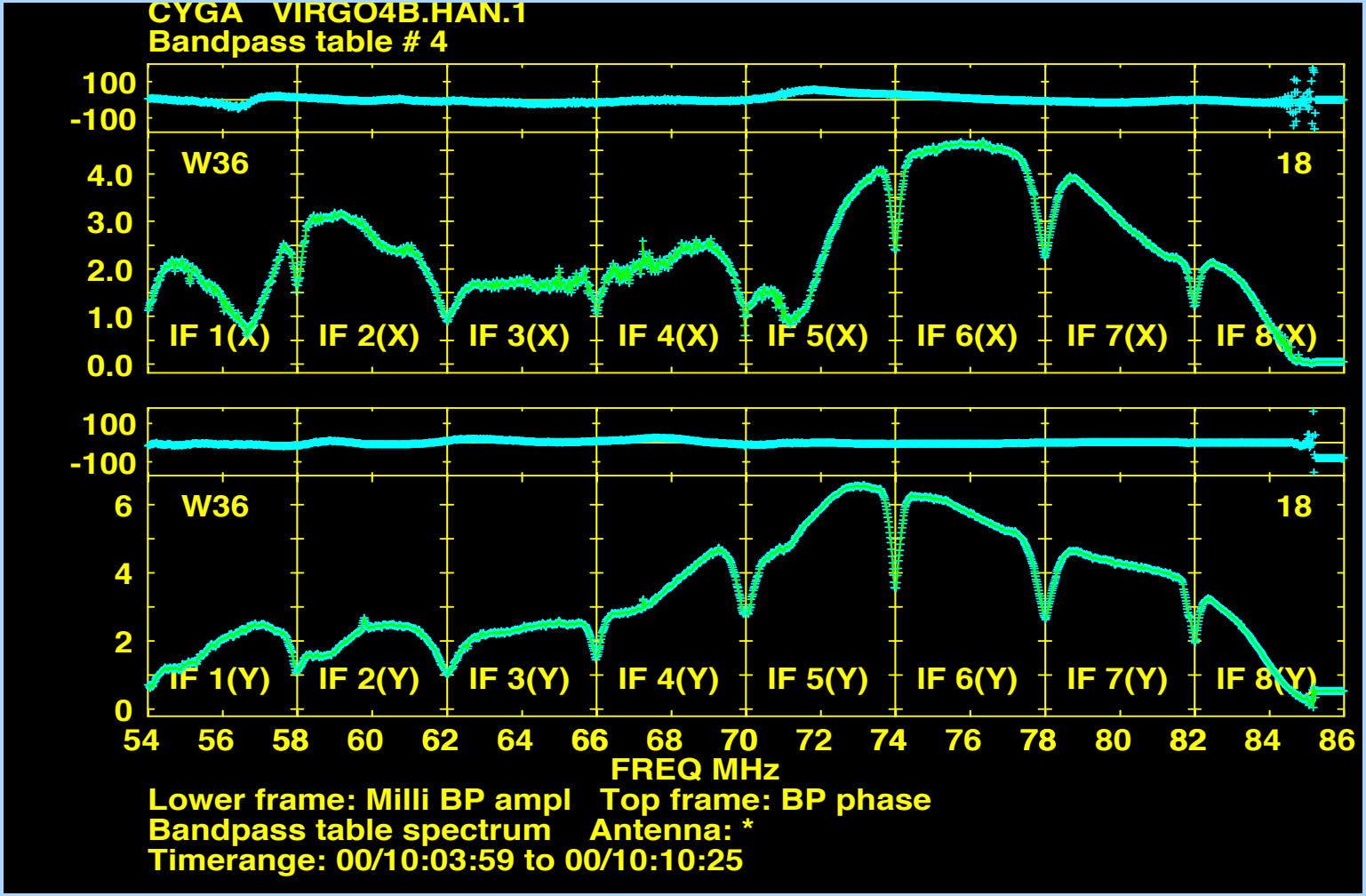
- Imaging commissioned with 6 MJP feeds, currently 11 on antennas, should be 14 by Feb 2016. A little more funding needed to complete array.

- Nominally 54-86 MHz. For most experiments based on 6 MJP imaging 72-84 MHz is the useful band.

- Linear Polarization, Tsys~2000K, efficiency~10%

- Now very little interference due to shutdown of US TV channels in 4band.

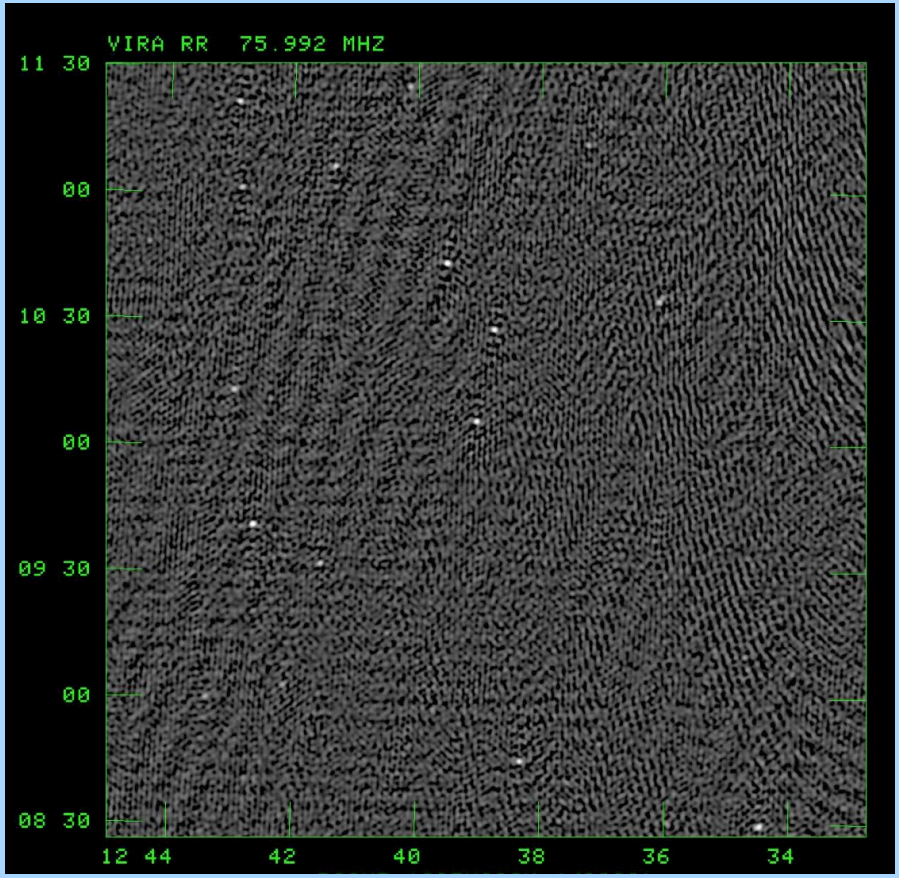
4Band bandpass

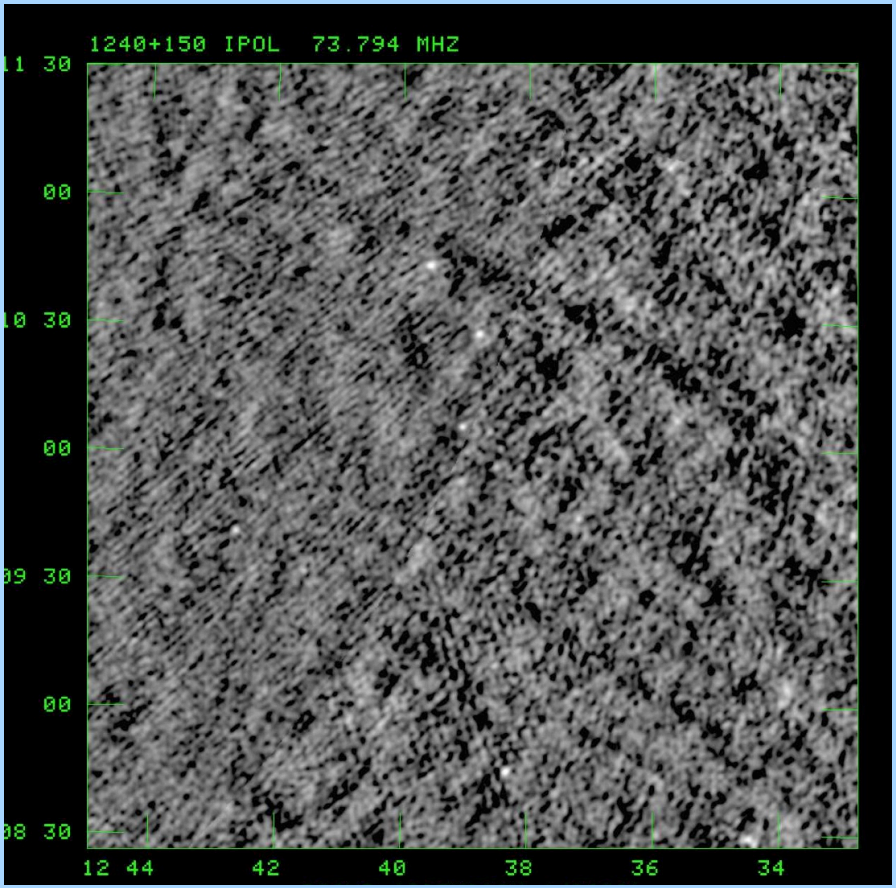


Imaging with Lowband

- Imaging generally requires new wideband algorithms, such as those in CASA or OBIT in order to get full sensitivity and spectral information.
- MSMFS Imaging: Multi-Scale, Multi-Frequency Synthesis in CASA clean works well.
- At 4 and even P the ionospheric phase distortions across the primary beam can be a problem.
- Ultimately new wideband algorithms, like SPAM, are needed.

Near Virgo A: 4band

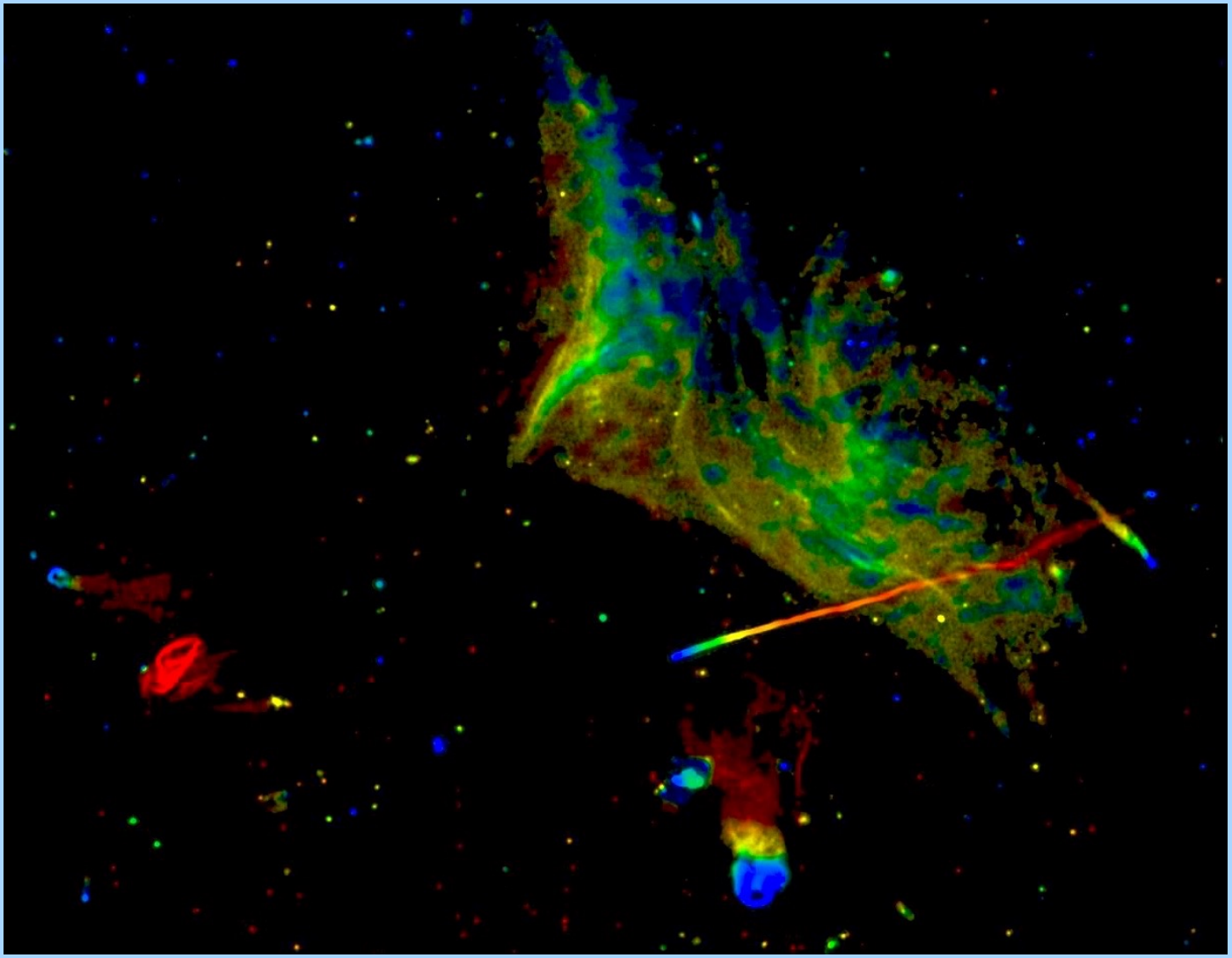




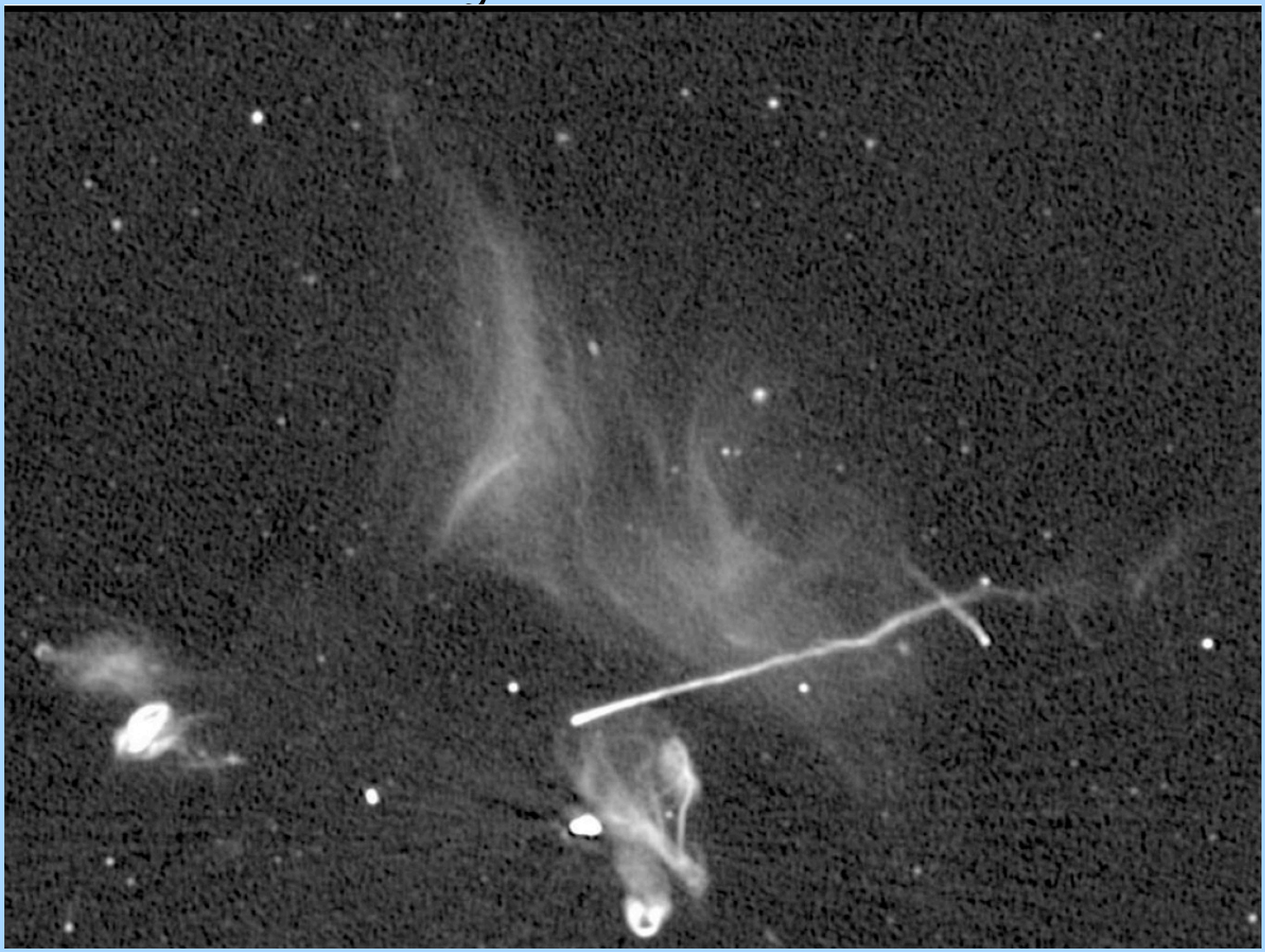
6 MJP Dipoles

VLASS

A2256 JVLA L-band



Preliminary A2256 P-band



Conclusions

- Wideband P-band on VLA now routinely producing results.
- 4Band coming back with new MJP Feeds
- Other ways to use Lowband discussed in talks to come.