EU-VGOS activities in Vienna

Frédéric Jaron[1], Simone Bernhart[2,3,4], Johannes Böhm[1], Javier González García[5], Jakob Gruber[1], Yoon Kyung Choi[2,3,4], Ivan Martí-Vidal[6], Matthias Schartner[7], Benedikt Soja[7], Jan Wagner[4], Eskil Varenius[8], on behalf of the EU-VGOS collaboration

[1]TU Wien, [2]Reichert GmbH, [3]BKG, [4]MPIfR, [5]Yebes Observatory/IGN, [6]University of Valencia, [7]ETH Zürich, [8]Chalmers/OSO

25th EVGA Working Meeting

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TECHNISCHE UNIVERSITÄT WIEN
Vienna|Austria

EU-VGOS

The VIE VLBI Correlator

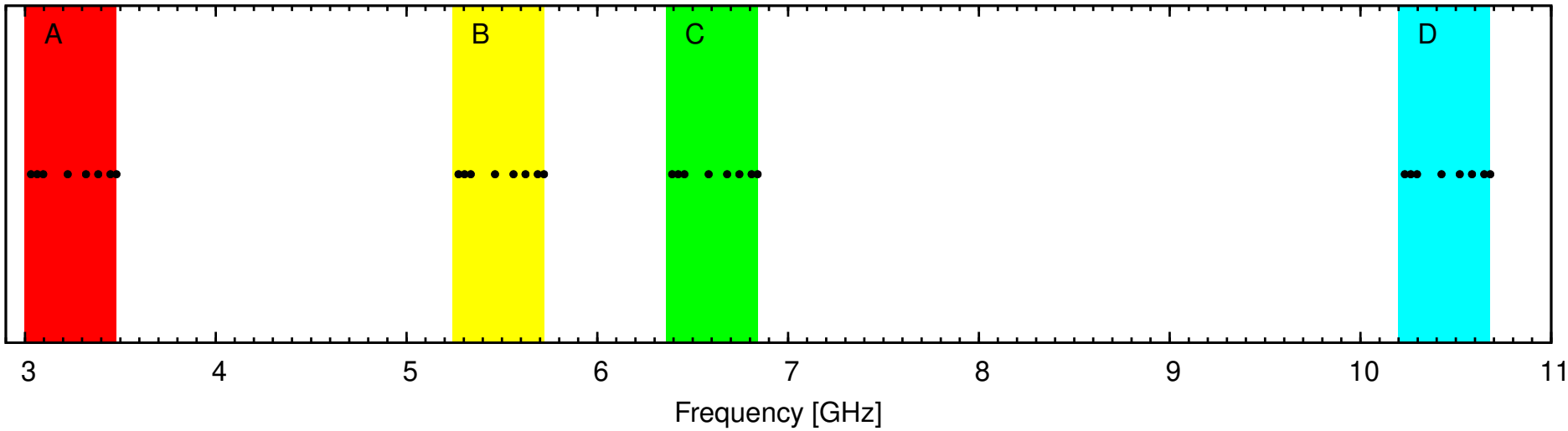
- Operated by the working group of Higher Geodesy at TU Wien
- Operators in charge: Jakob Gruber and Frédéric Jaron
- Vienna Scientific Cluster (VSC4) `http://www.vsc.ac.at`
- 10 compute nodes reserved for VLBI
- 48 CPUs on each core (480 CPUs in total) $\Rightarrow$ 2.7 Pflops/s
- Storage: 1 PB disk space for VLBI
- Connectivity: 10 Gbit/s to GEANT (shared with other services)
- Software correlator: DiFX (various versions)
- Fringe-fitting: HOPS/fourfit (version 3.21), PIMA

Background image: VSC4 (© `http://derknopfdruecker.com`).

- Currently seven EU-VGOS sessions are being correlated in Vienna:
  - ev0021
  - ev0244
  - ev0287
  - ev0303
  - ev0314
  - ev0328
  - ev0345
- Scheduled with VieSched++ by Matthias Schartner.
- Extrapolated flux densities from S/X bands to all four VGOS bands.
- Information about SEFD came directly from the stations.
- Short scans (10, 15, and 20 s) and a few calibrator scans (180 s)
- Network:
  - Onsala-East (ONSA13NE)
  - Onsala-West (ONSA13SW)
  - Wettzell-South (WETTZ13S)
  - Yebes (RAEGYEB)
  - Ishioka (ISHIOKA)

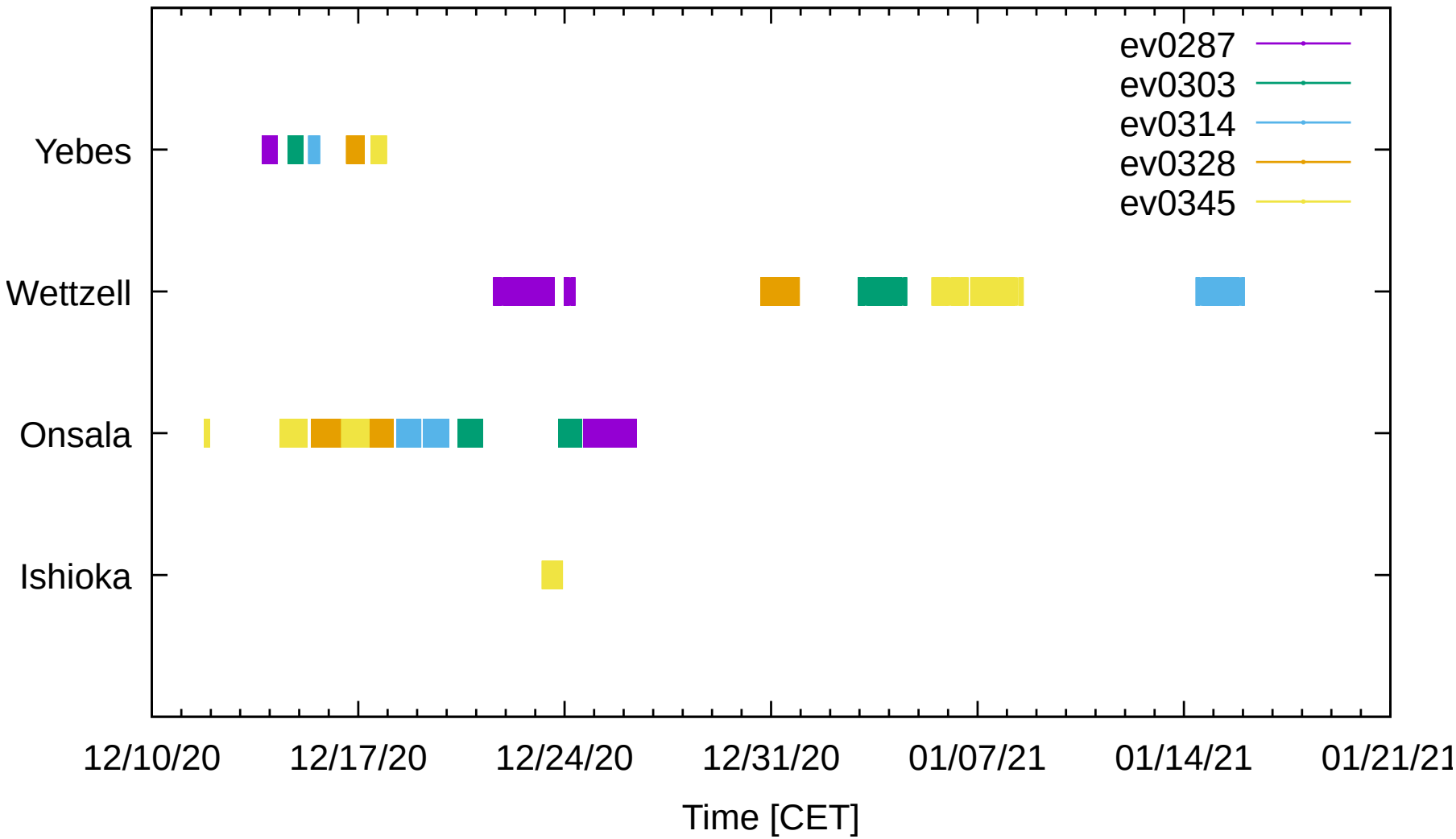
More information about EU-VGOS: Alef et al. 2019, EVGA proceedings

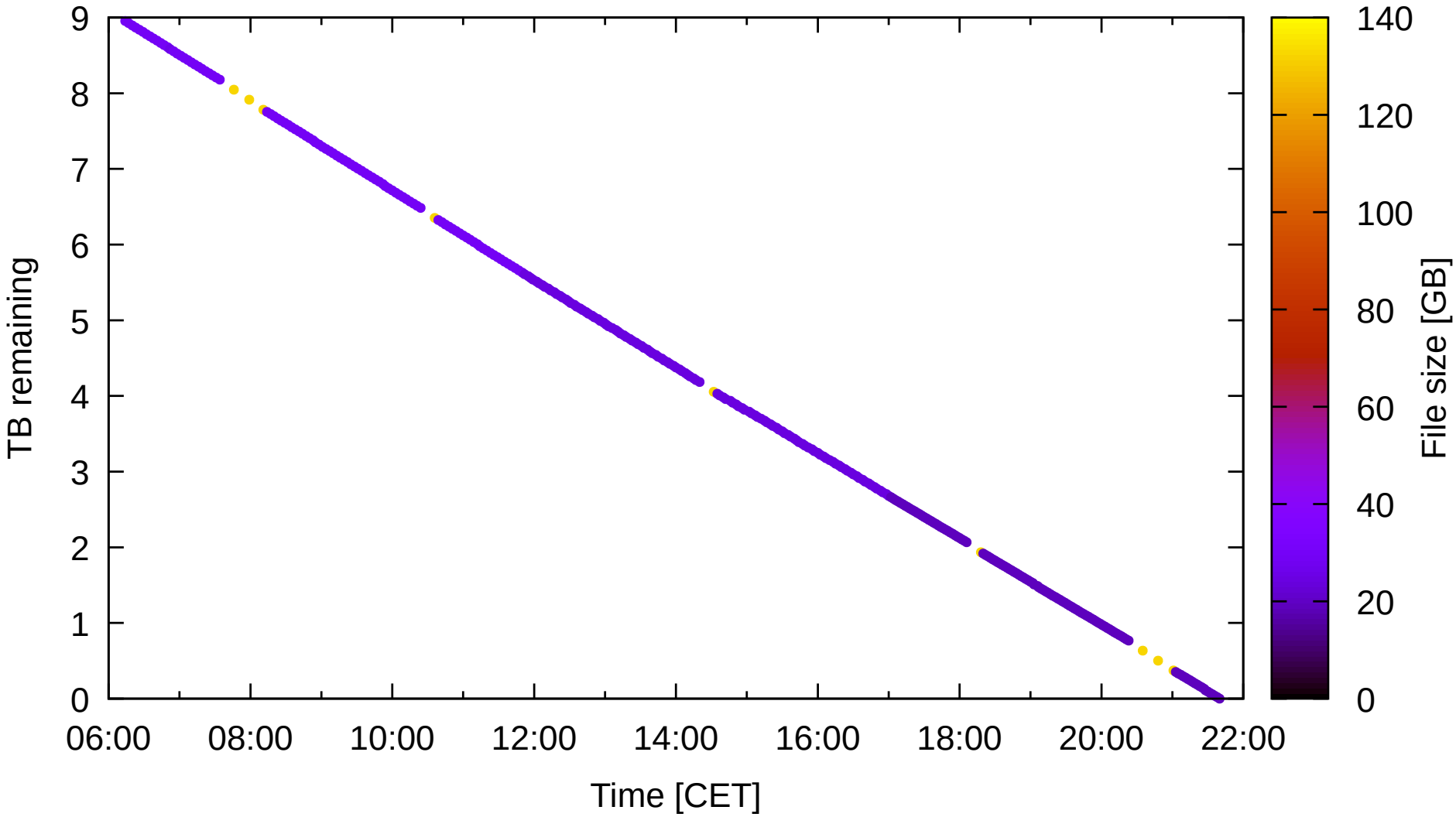
Frequency setup



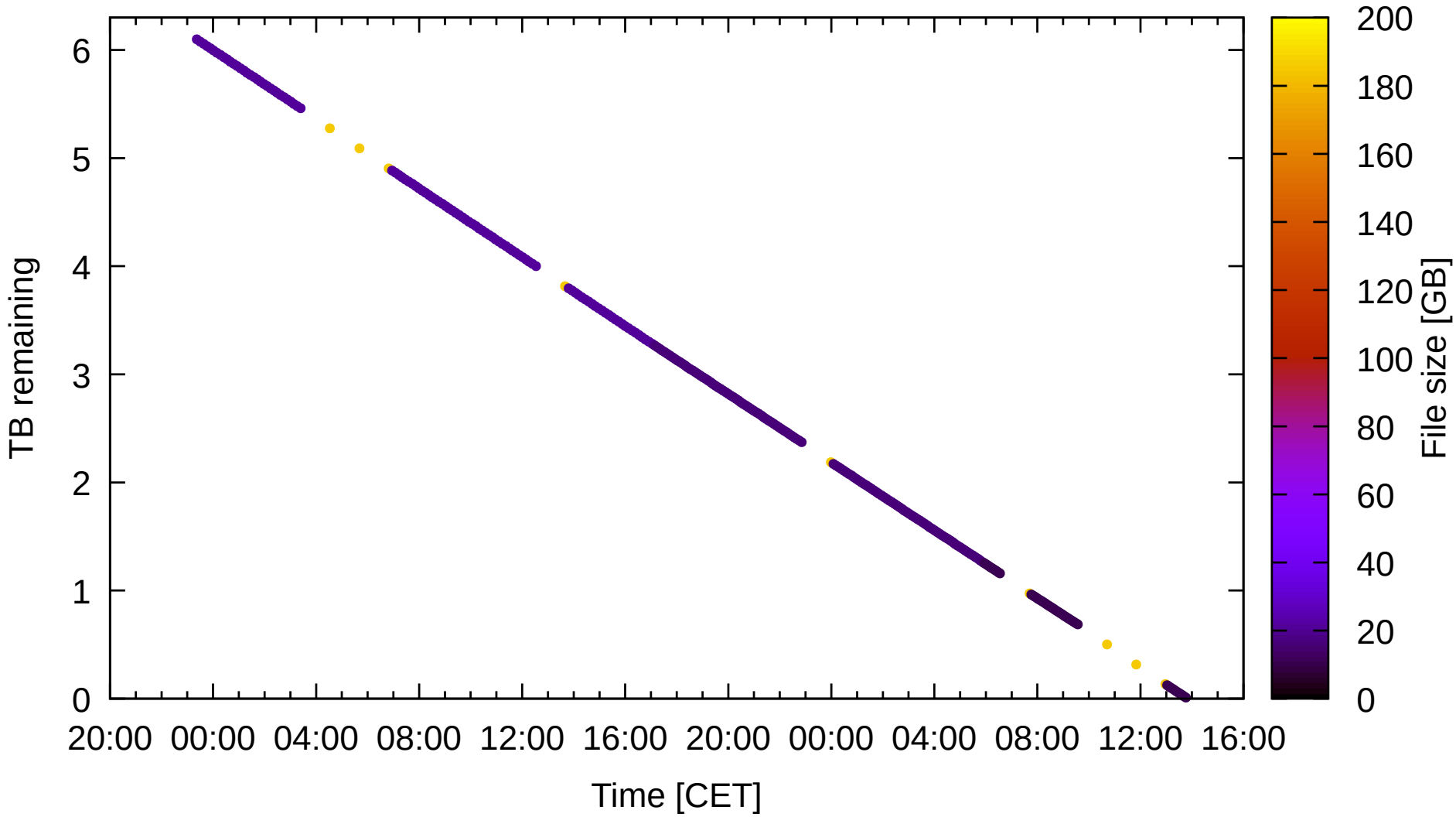
- Four bands 480 MHz wide, each containing 8 channels 32 MHz wide.
- Dual linear polarization: called “X” and “Y” (better: H and V?)
- Sample rate 64 Ms/s
- 2 bit sampling
- Phase-cal: every 5 MHz (Yebes: every 10 MHz)
- Real data (Yebes: complex)

Data e-transfer to Vienna

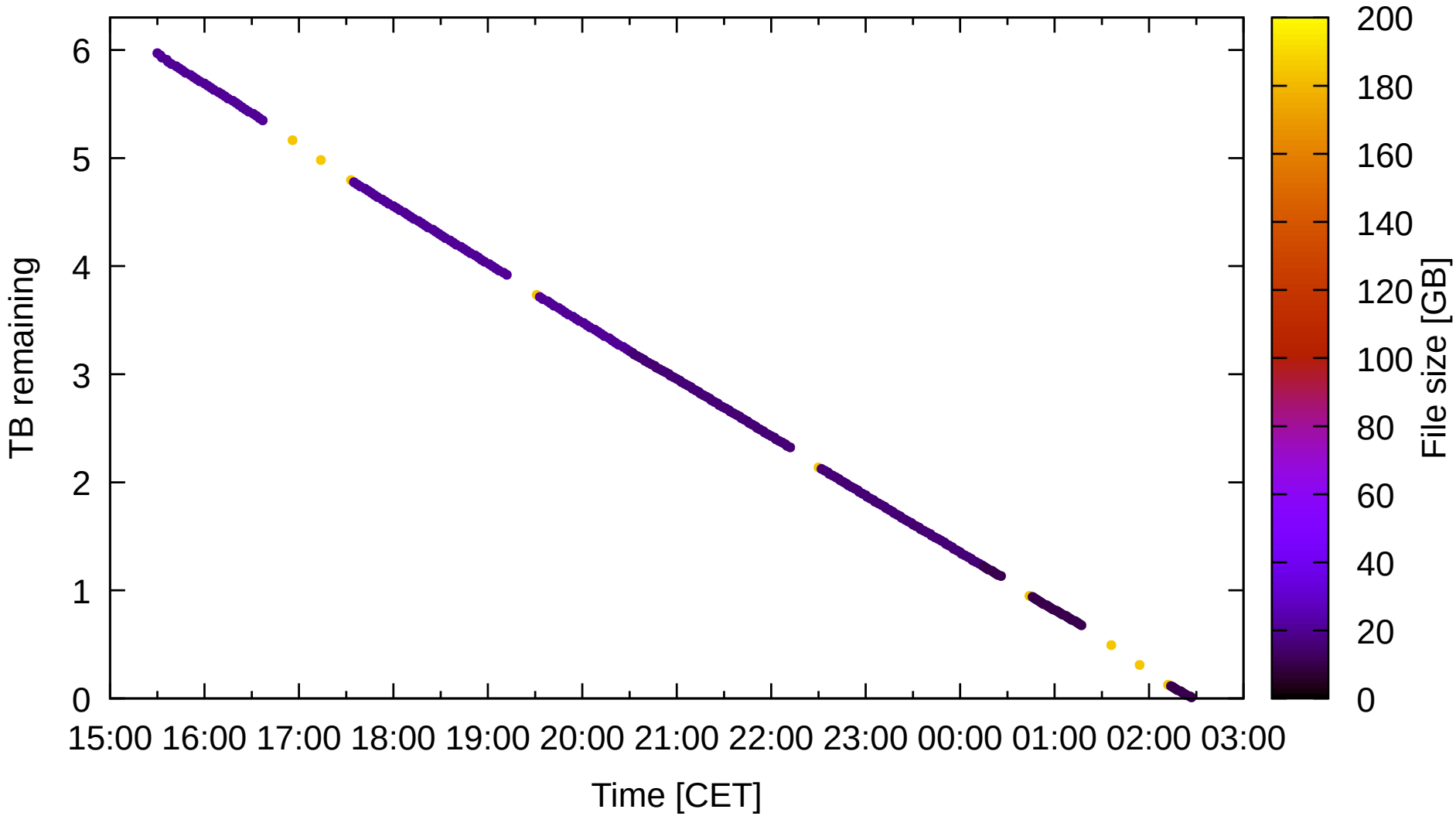




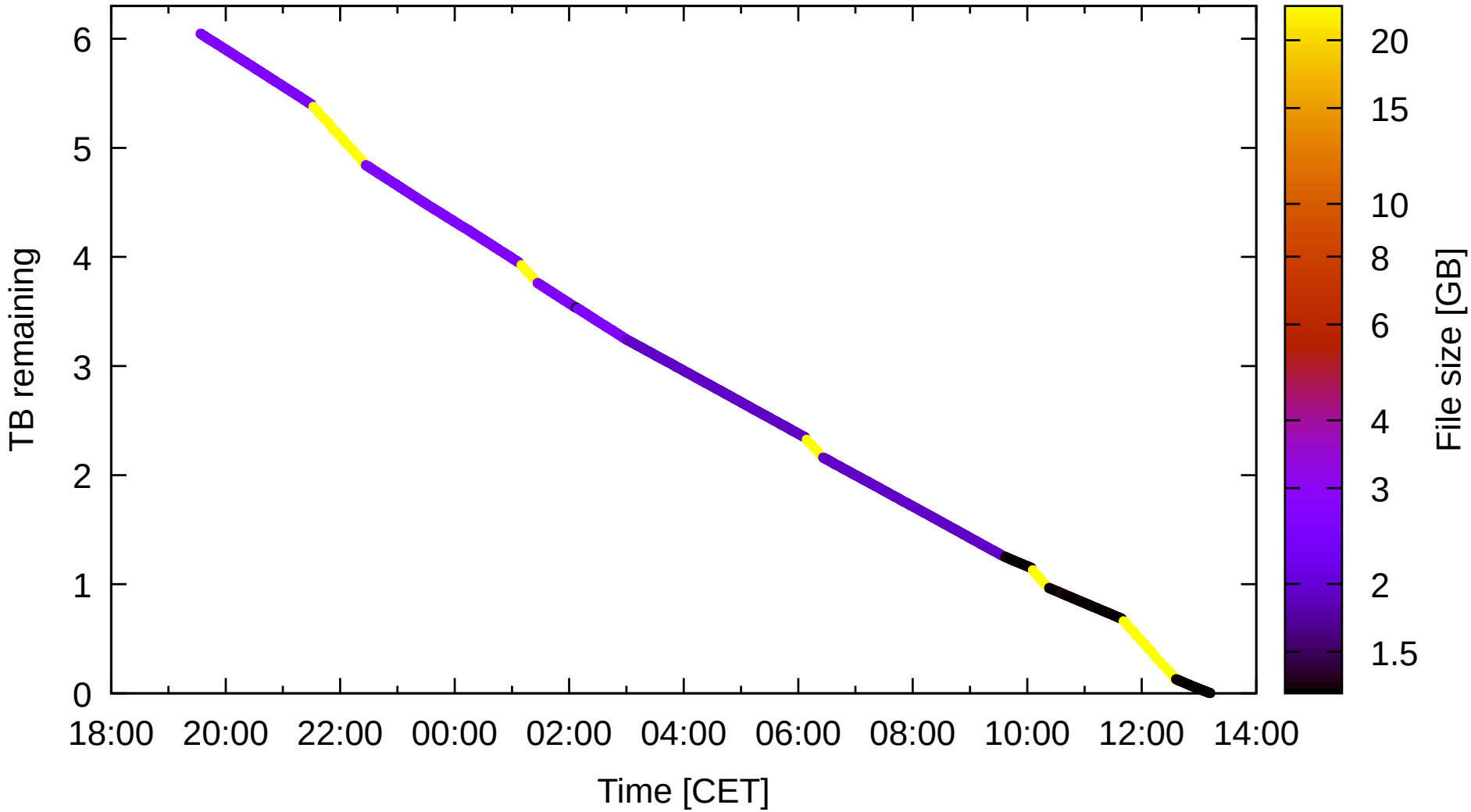
Transfer started: Dec 23, 2020, 06:14 CET, Finished: Dec 23, 21:40 CET
Duration: 15:54 h, Data volume: 8.98 TB, Average speed: 1.3 Gbit/s



Transfer started: Jan 2, 2021, 23:22 CET, Finished: Jan 4, 13:50 CET
Duration: 28:12 h, Data volume: 6.12 TB, Average speed: 482 Mbit/s

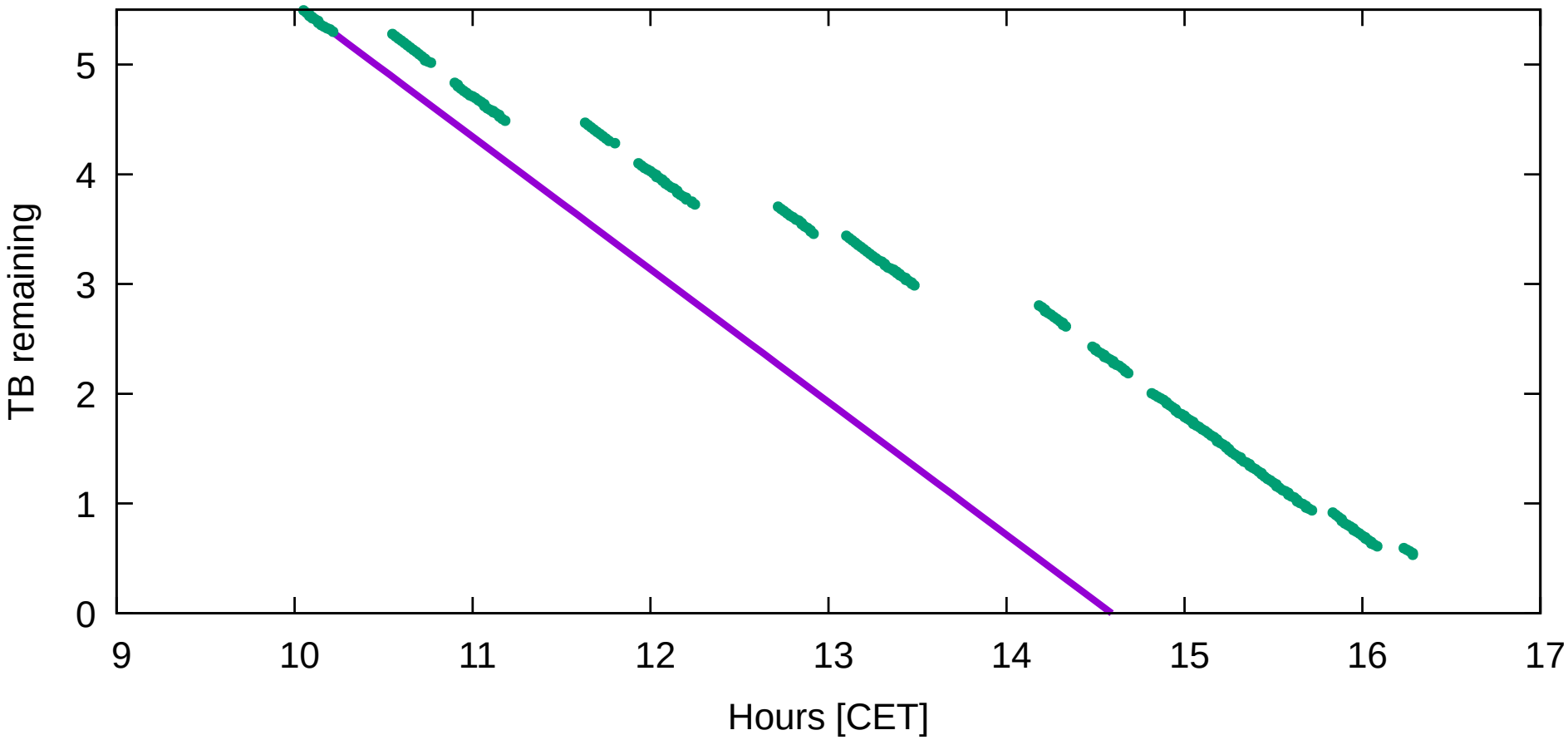


Transfer started: Dec 14, 2020, 15:30 CET, Finished: Dec 15, 02:28 CET
Duration: 10:58 h, Data volume: 5.99 TB, Average speed: 1.2 Gbit/s



Transfer started: Dec 23, 2020, 19:34 CET, Finished: Dec 24, 13:12 CET
Duration: 17:38 h, Data volume: 6.05 TB, Average speed: 762 Mbit/s
Large files only: 1.3 Gbit/s, Small files only: 657 Mbit/s

Data from Wettzell came in multi-thread format, had to convert...



- Total duration: 6:15 h (1:30 h overhead)
- Error messages: desync, frame delta 15796, fps 31250
- Error frequency seems to depend on vmux (i.e., DiFX) version, most stable: 2.6.1
- 275 out of 281 scans converted. 2% scan loss, 13% data loss, $4/9 = 44\%$ long scans lost!
- Later: Could convert 95% of the data by revisiting lost scans.

Which DiFX version should I use to correlate these data?

- There hasn't been any version of DiFX which works for VGOS data without problems.
- Discussion in the EU-VGOS Correlation Meetings
- Friday, March 6, 2021: DiFX-2.5.0 made available as release candidate for DiFX-2.5.4. (Credit: Jan Wagner)

For details and instructions visit

`https://deki.mpifr-bonn.mpg.de/Cooperations/EU-VGOS_P-o-C/VGOS_DiFX_Versions`

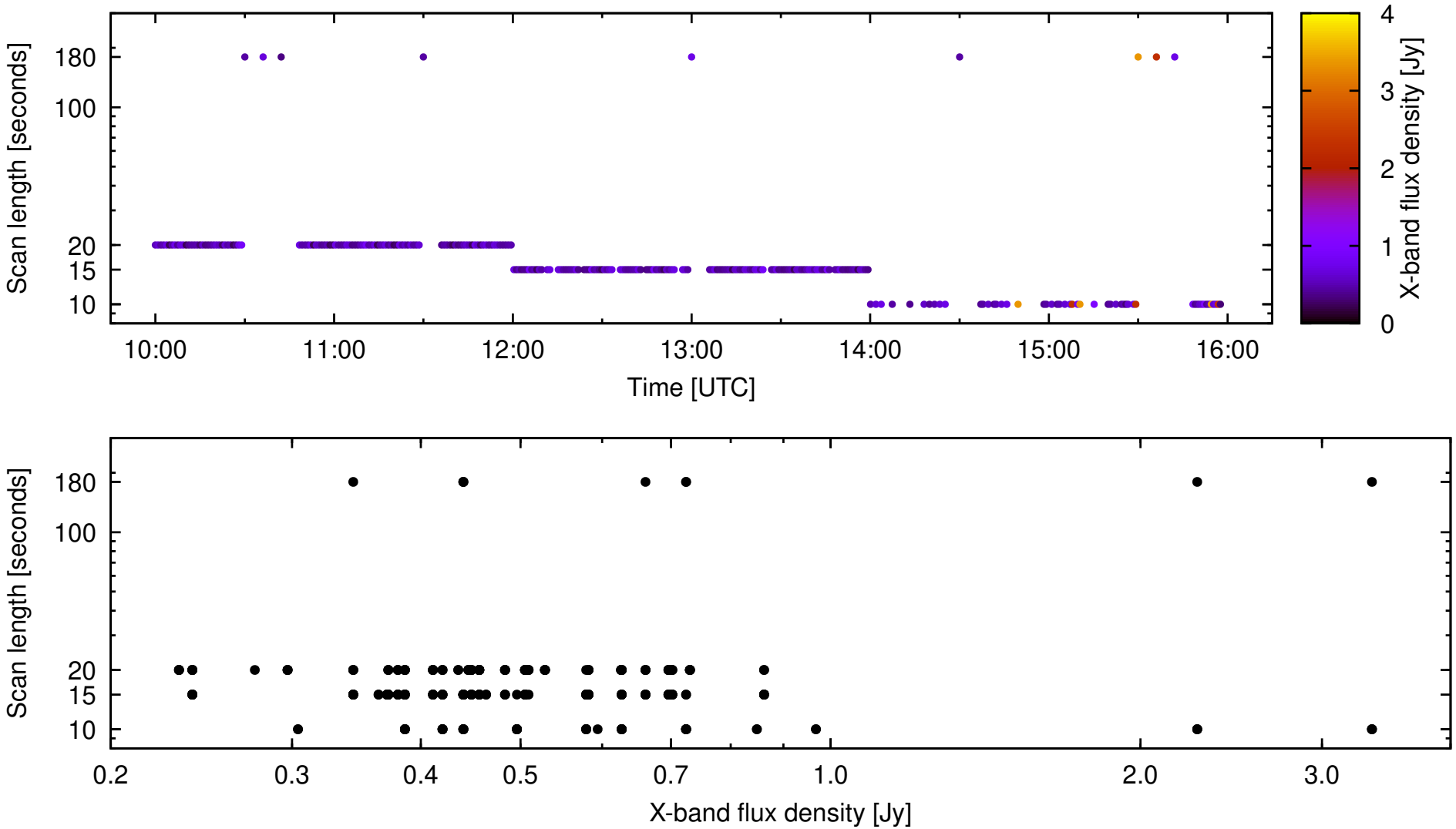
$\rightarrow$ I used this version DiFX-2.5.0 to correlate ev0303.

Details about DiFX 2: Deller et al. 2011, PASP, 123, 901

Two ways of fringe-fitting

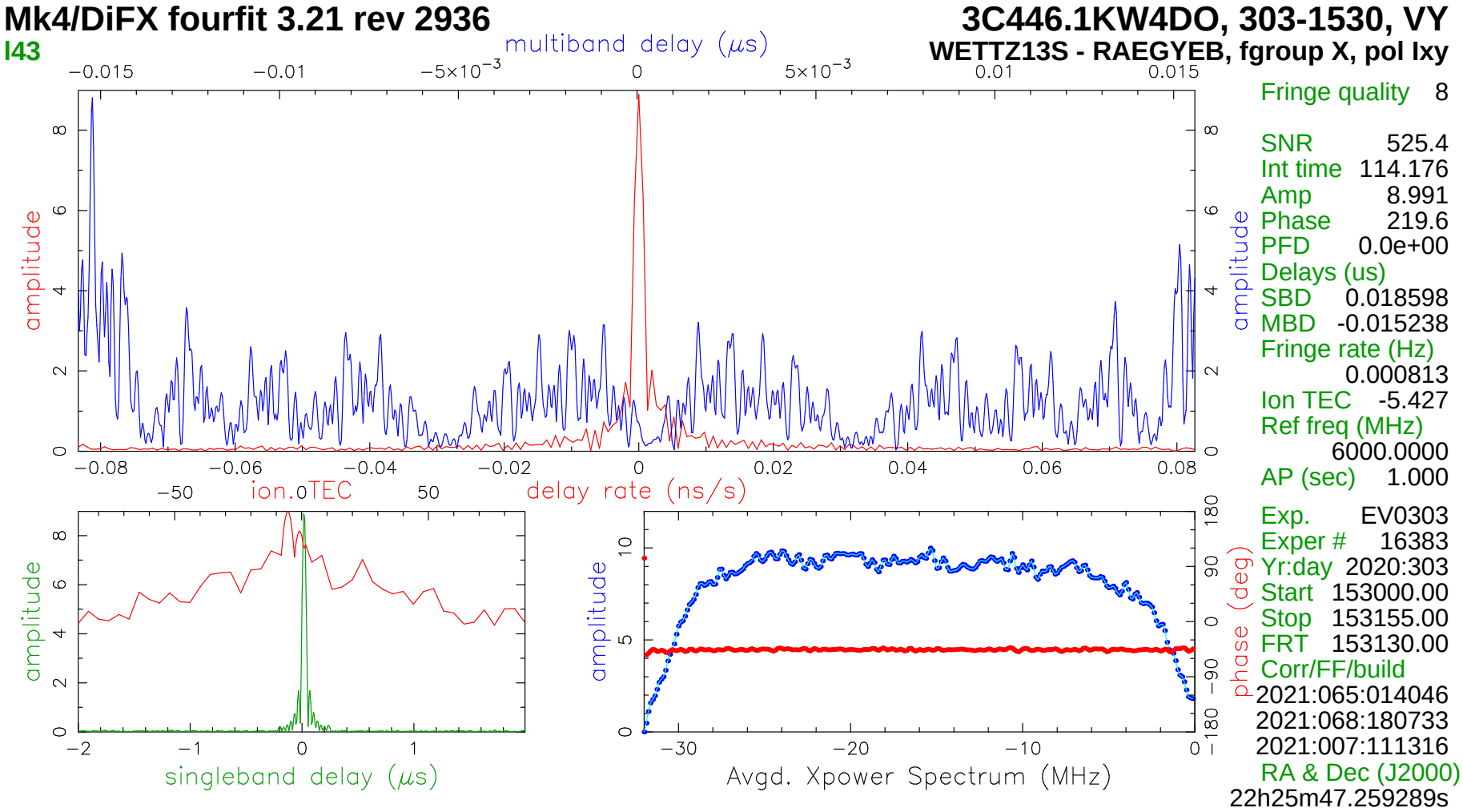
1. Pseudo Stokes *I*, following the instruction in the MIT Haystack VGOS manual:
   `https://www.haystack.mit.edu/wp-content/uploads/2020/07/docs_hops_000_vgos-data-processing.pdf`
   by John Barrett et al.
   `> fourfit -P I ...`
2. PolConvert: Convert the visibilites from linear to circular polarization basis and do additional calibration.
   Polconversion was done by Javier González using a preliminary version of PolConvert for VGOS. Official version to be released soon.
   Martí-Vidal et al., 2016, A&A, 587, A143
   `> fourfit -P RR+LL ...`

ev0303: Scan lengths and source fluxes

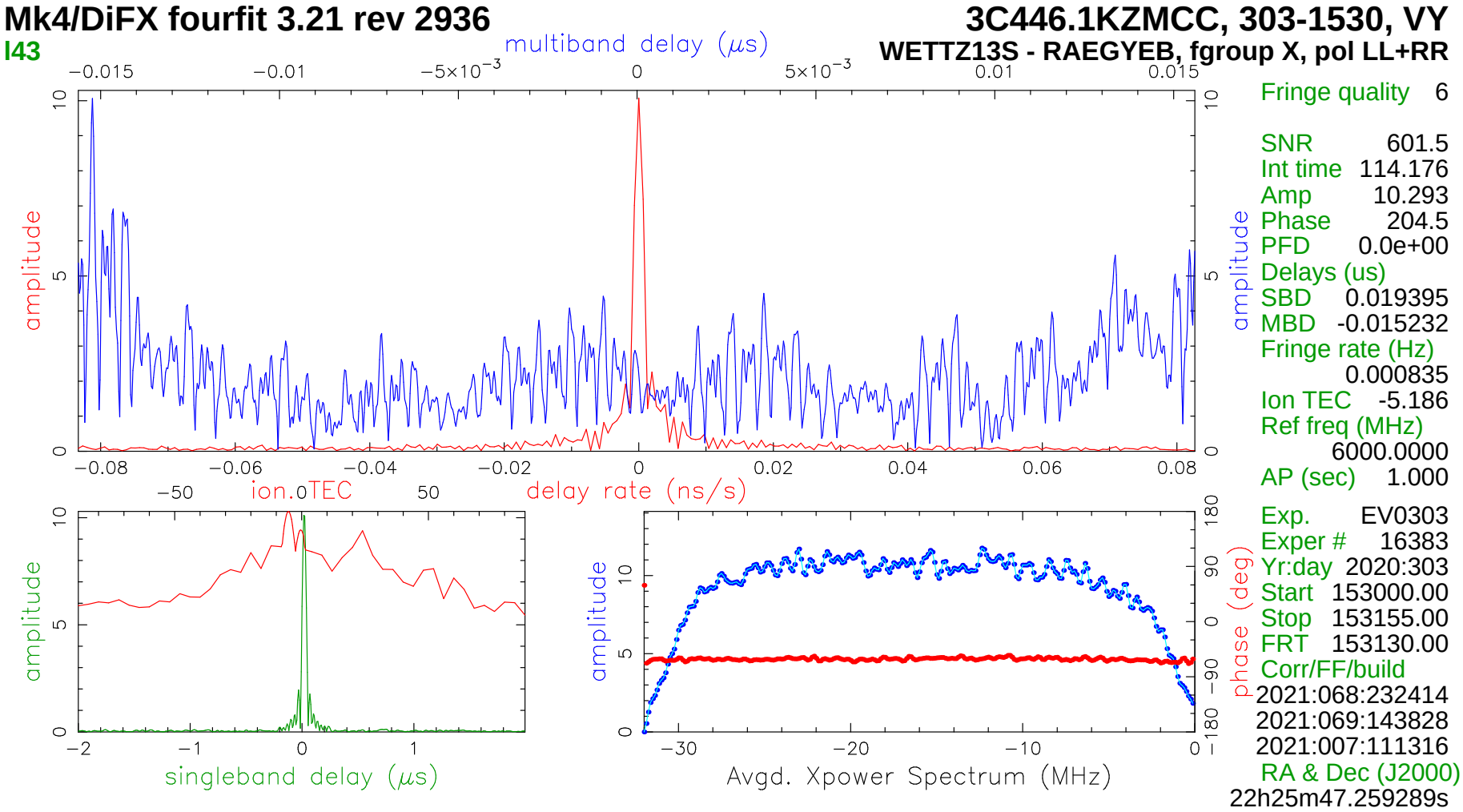


Source fluxes taken from RFC (L. Petrov): `http://astrogeo.org/rfc/`

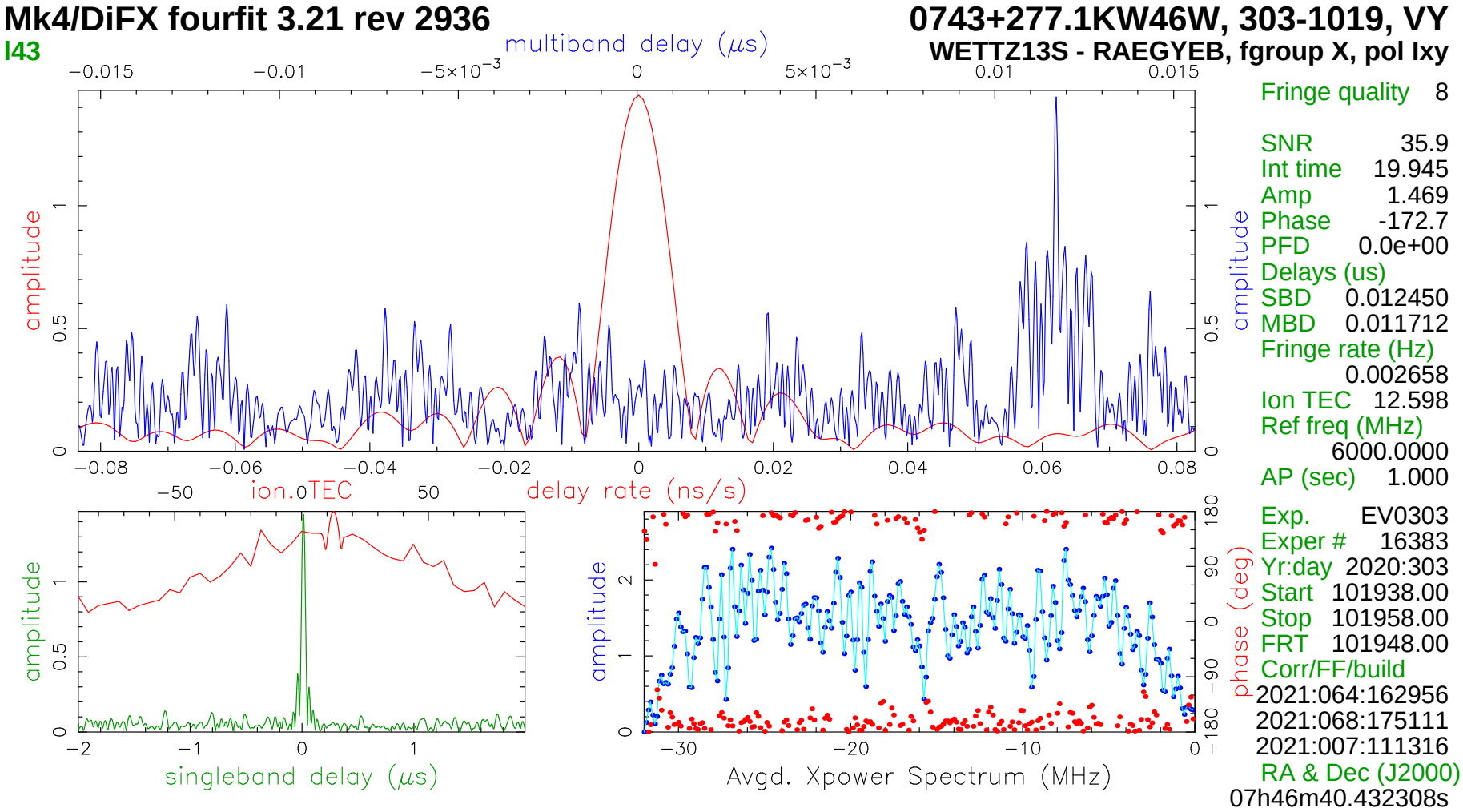
Bright calibrator scan (pseudo Stokes *I*)



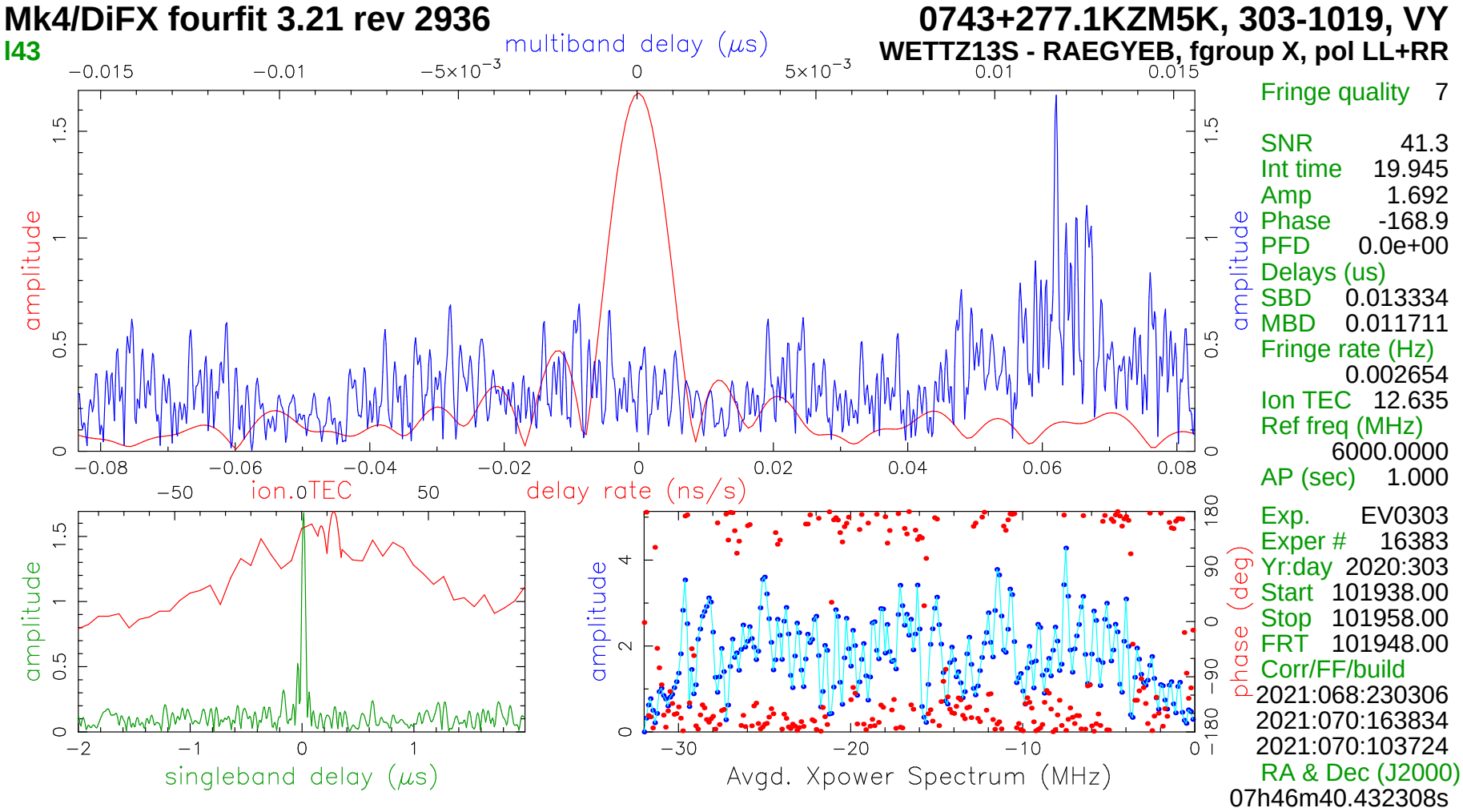
Bright calibrator scan (polconverted)



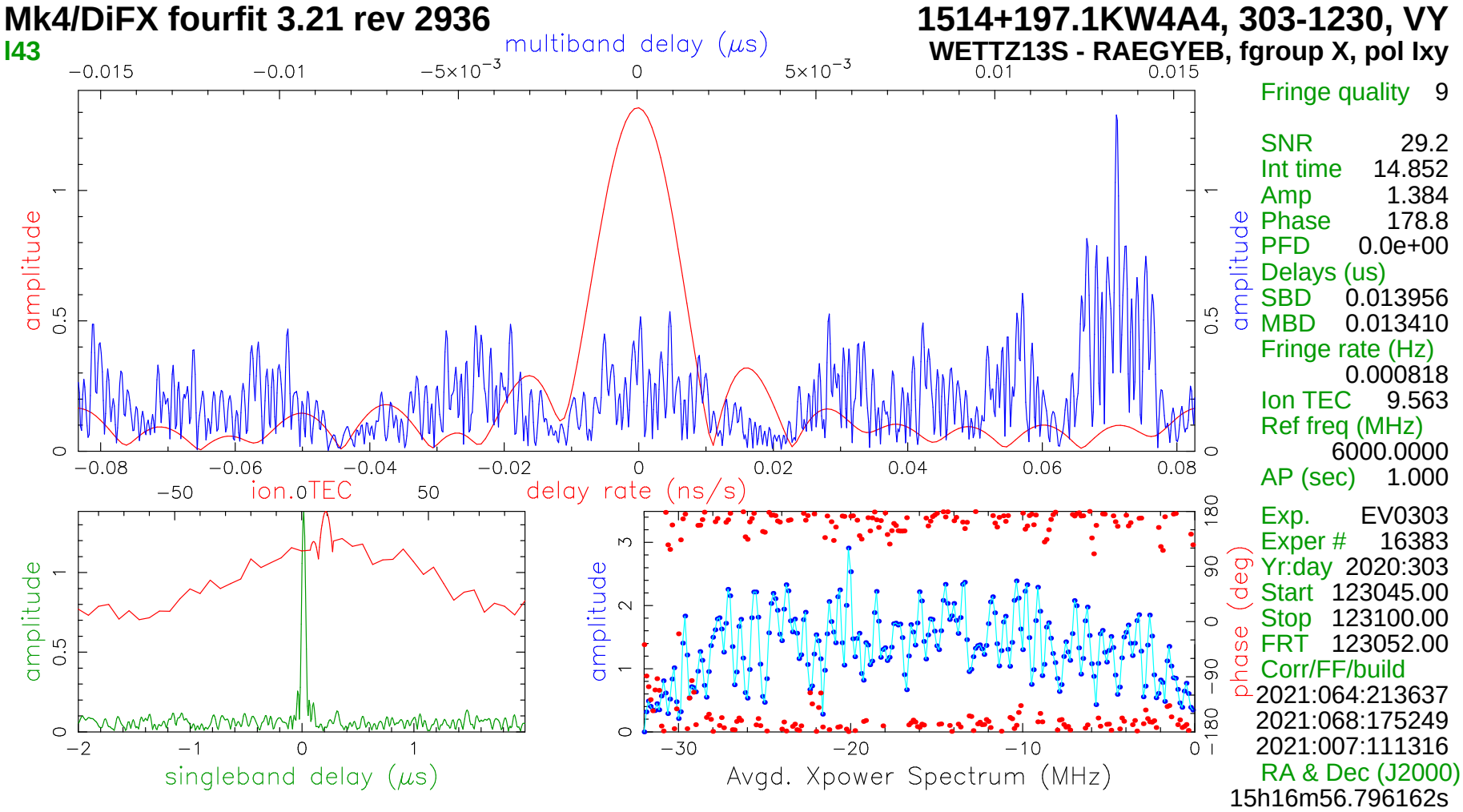
Short scan (pseudo Stokes *I*)



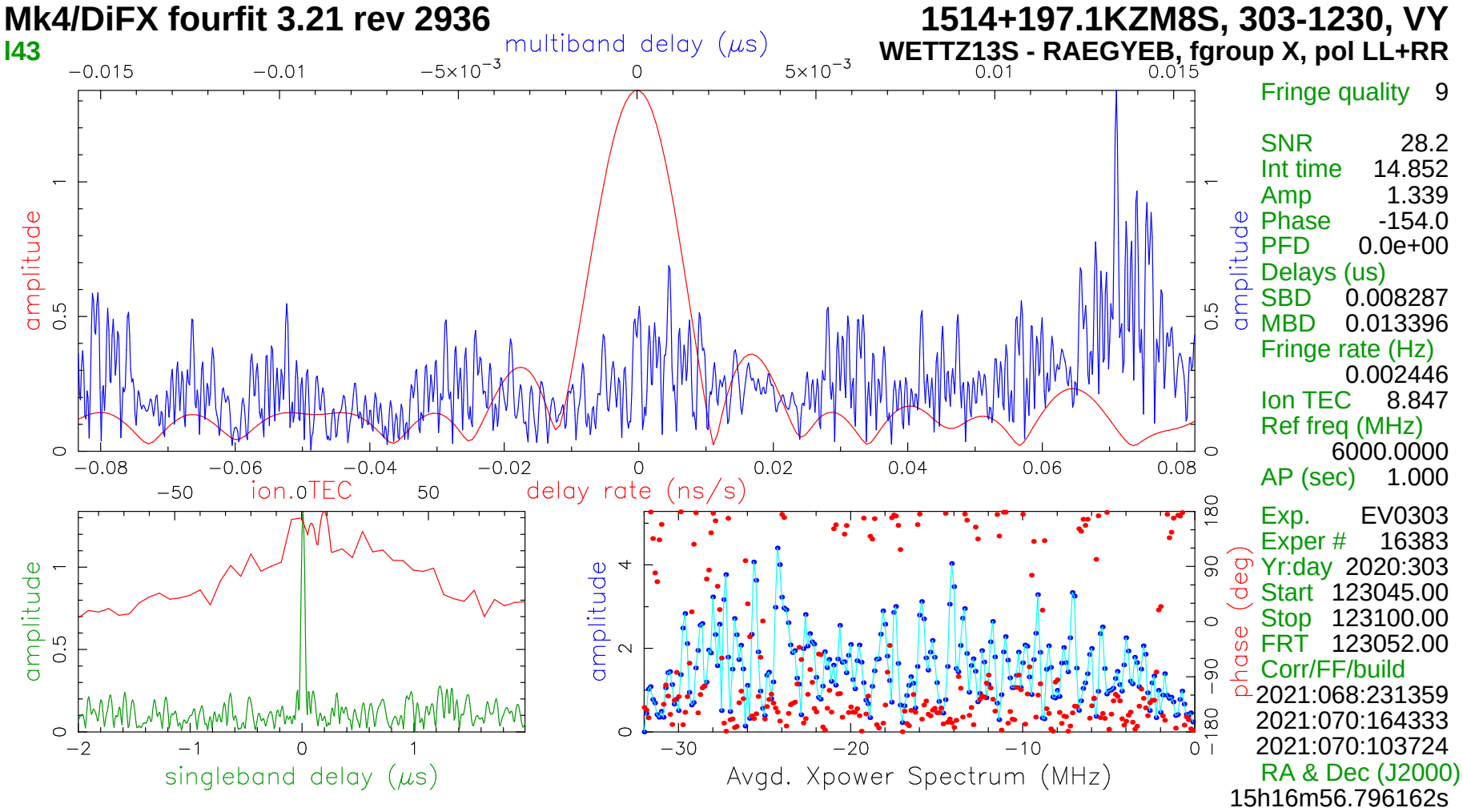
Short scan (polconverted)



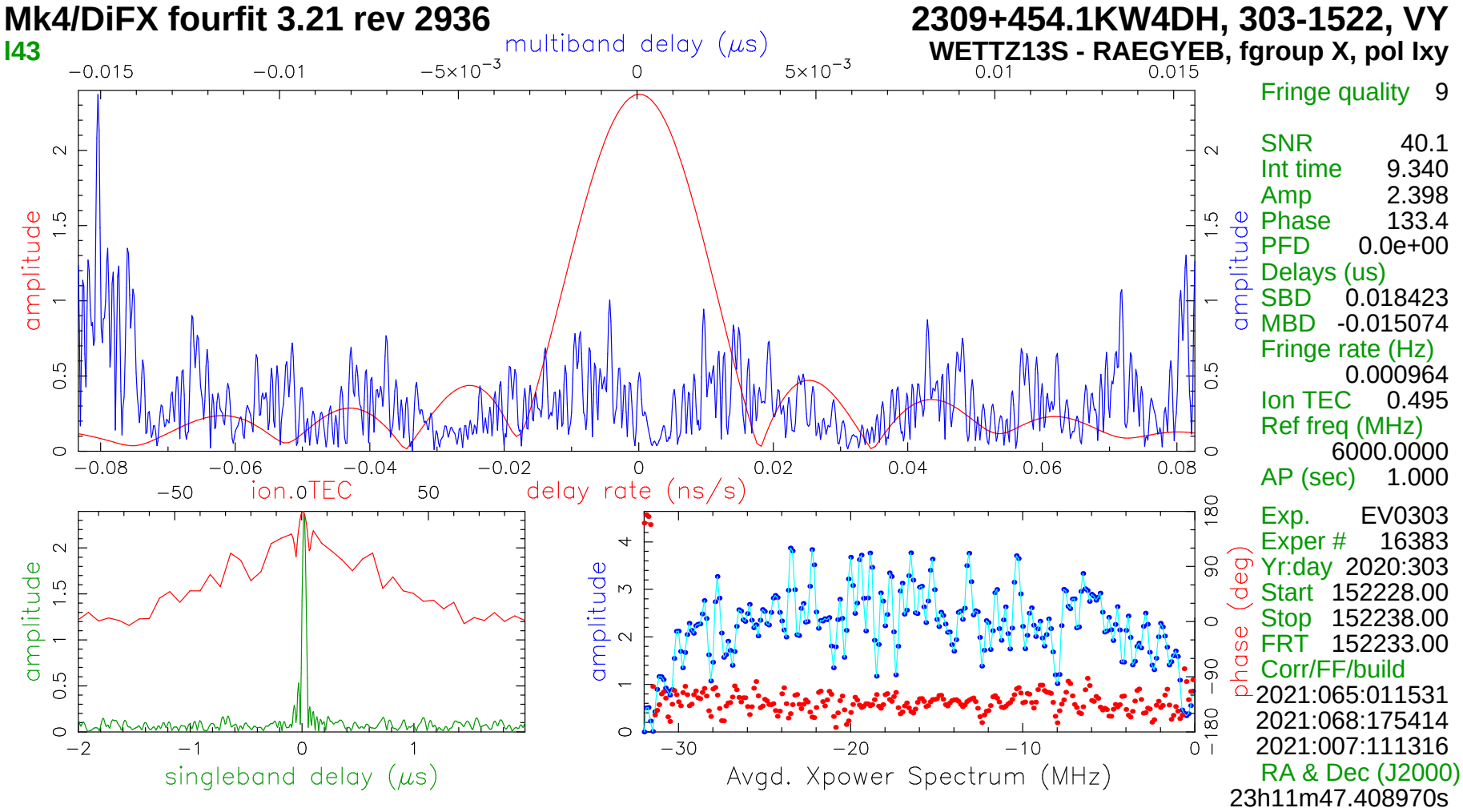
...shorter... (pseudo Stokes *I*)



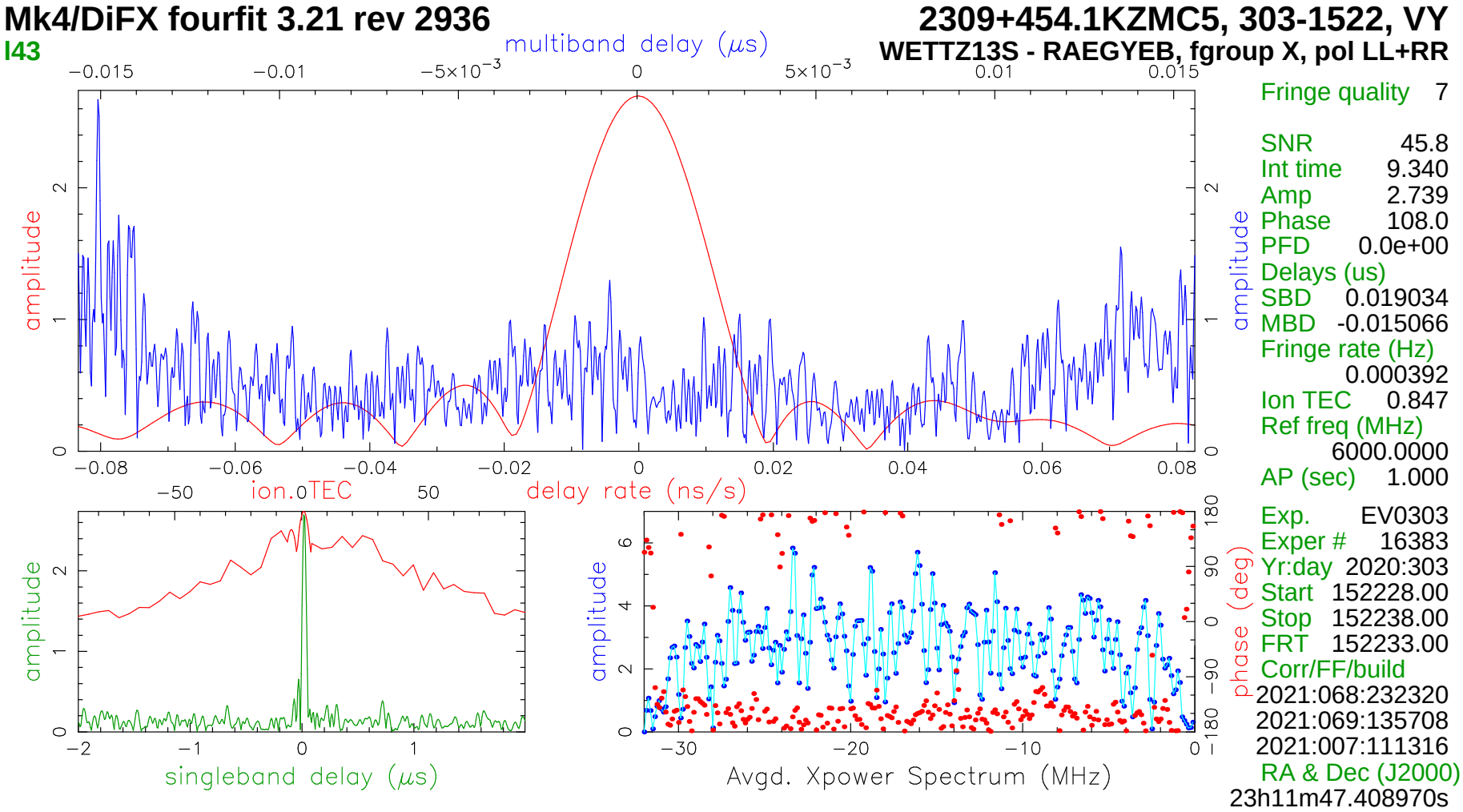
...shorter... (polconverted)



...the shortest (pseudo Stokes *I*)



...the shortest (polconverted)



Conclusions

1. E-transfer to Vienna works smoothly, but rate seems to depend on file size.
2. Converting data from multi-thread to single-thread (vmux) takes very long and is prone to errors.
3. DiFX-2.5.4 for VGOS is on its way. Please test it!
4. Results of fringe-fitting polconverted data look promising.
5. VGOS scans down to 10 seconds can still give good SNR.
6. Outlook: Investigate fringe-fitting with PIMA.