

Pulsar Busy Week 8: Superterp Single Clock Tests and More...



Jason Hessels

on behalf of

Ben Stappers, Anastasia Alexov, Vlad Kondratiev, Thijs Coenen,
Sander ter Veen, Aris Noutsos, Joeri van Leeuwen, John Romein,
Andre Gunst, Chris Broekema, Michiel Brentjens, etc.

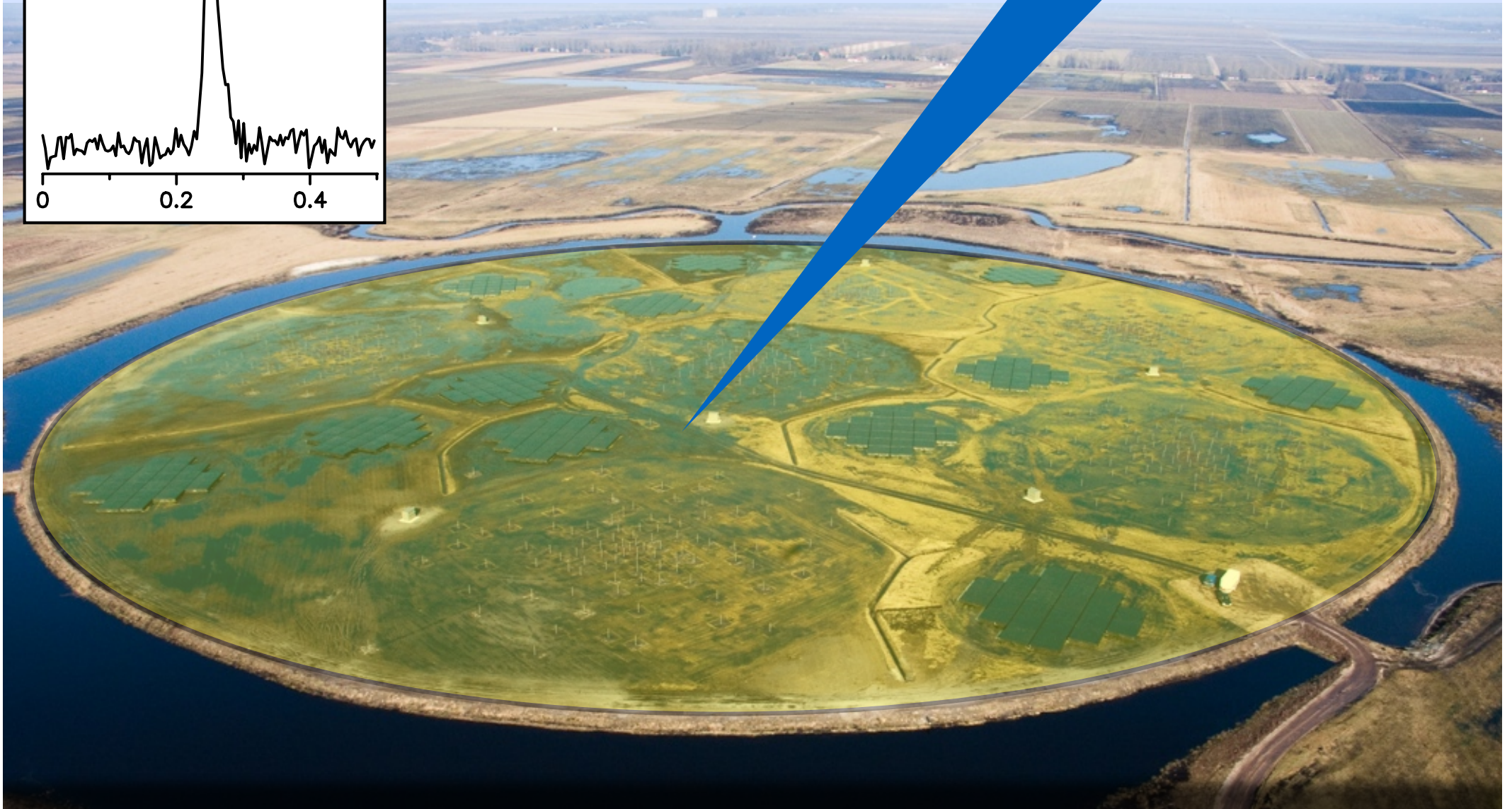
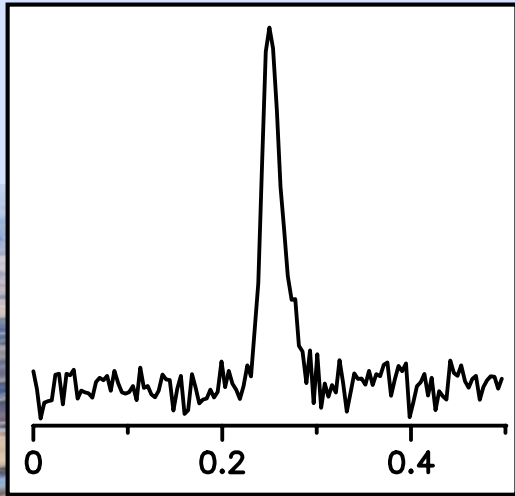
Pulsar Busy Week 8

- Test newly implemented Single Clock (thanks Andre et al.).
- Use Single Clock to make first “tied-array” (i.e. coherent summation) observations.
- Make observations for the LOFAR opening (MSP, Crab Img+PSR, Geminga, Multi-station beams, Anomalously intensive pulses in LBA, thick screen scattering)

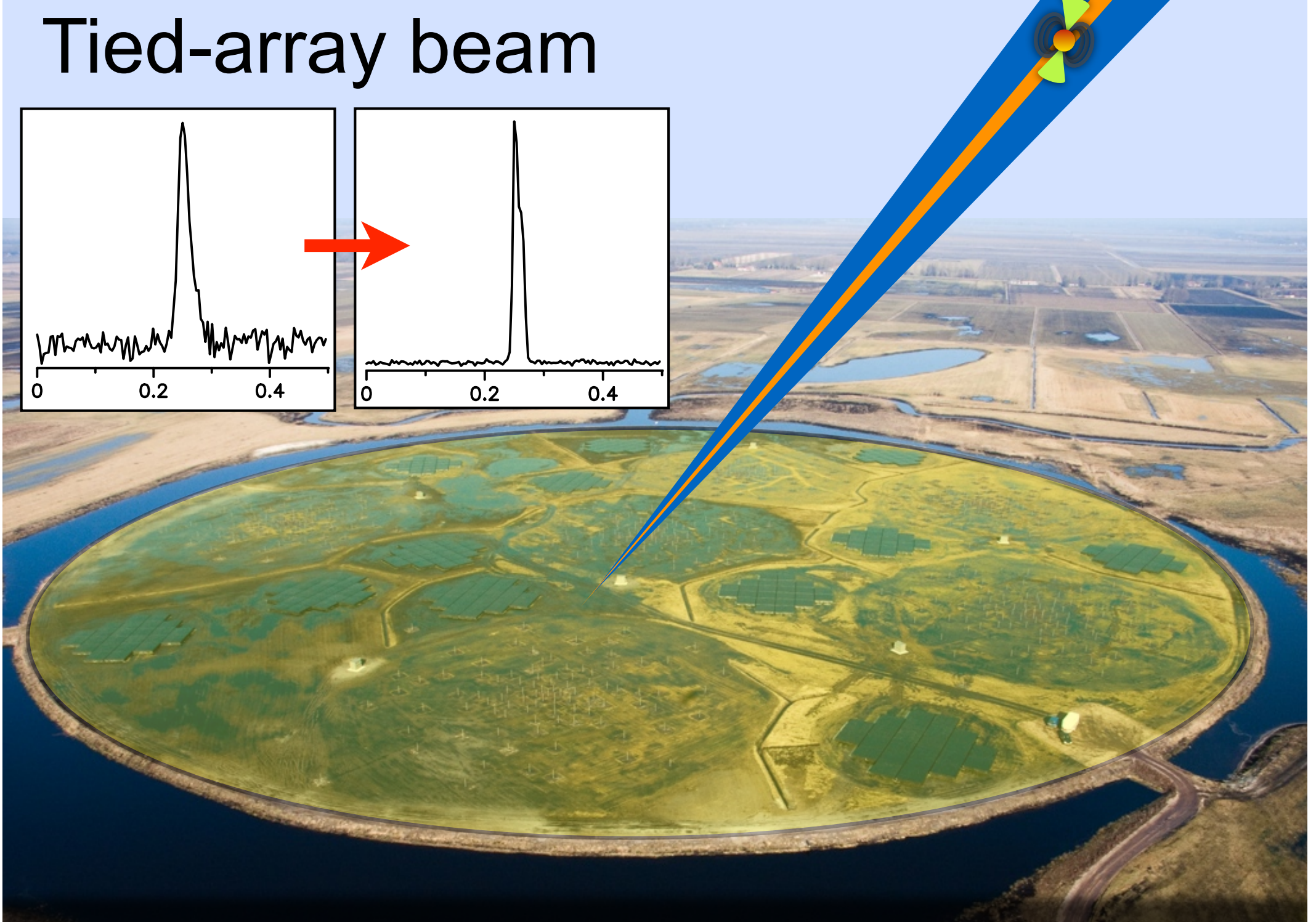
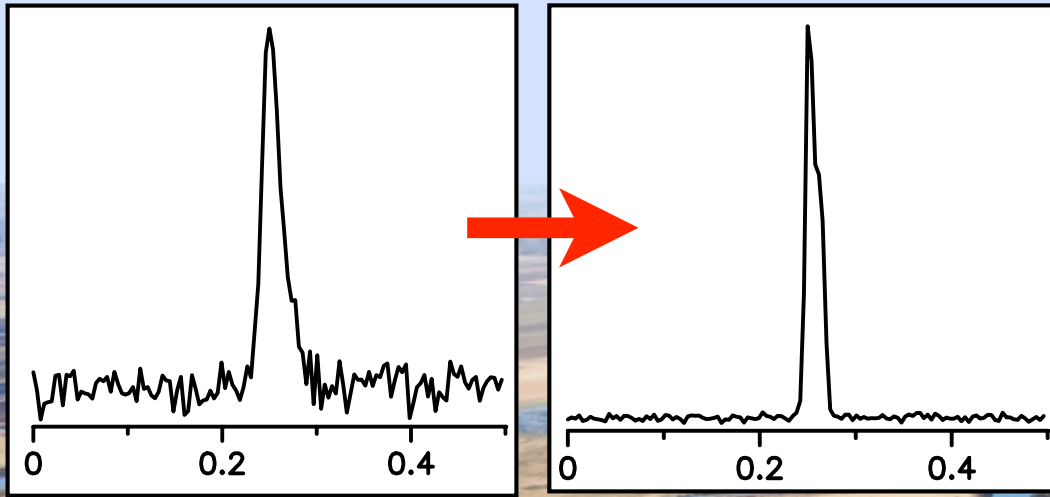
Adding Stations



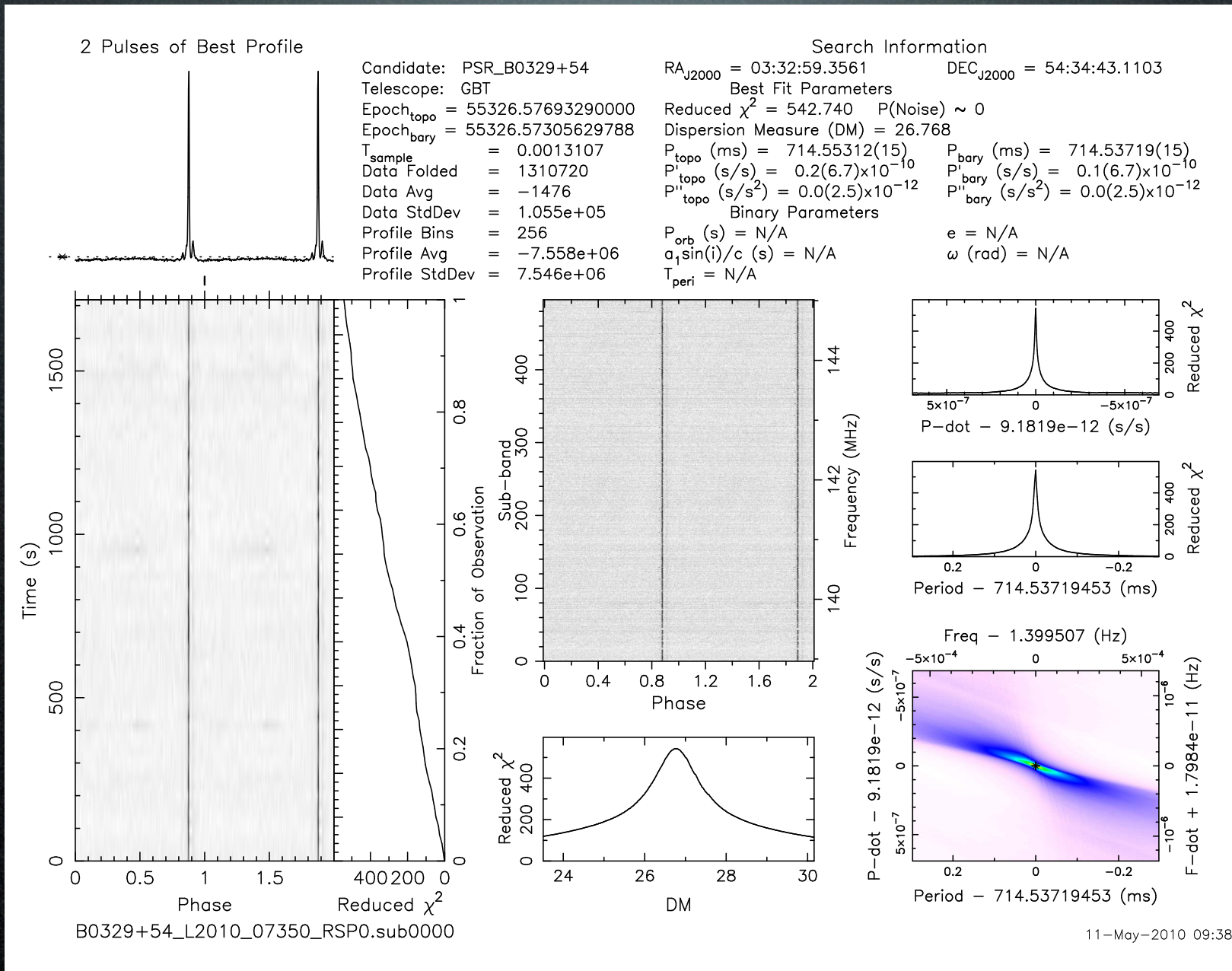
Incoherent sum



Tied-array beam



Incoherent Sum. before Single Clock

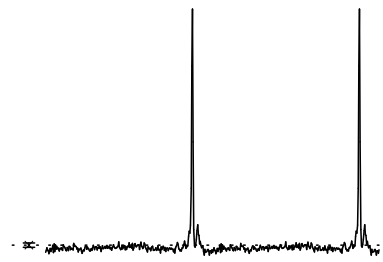


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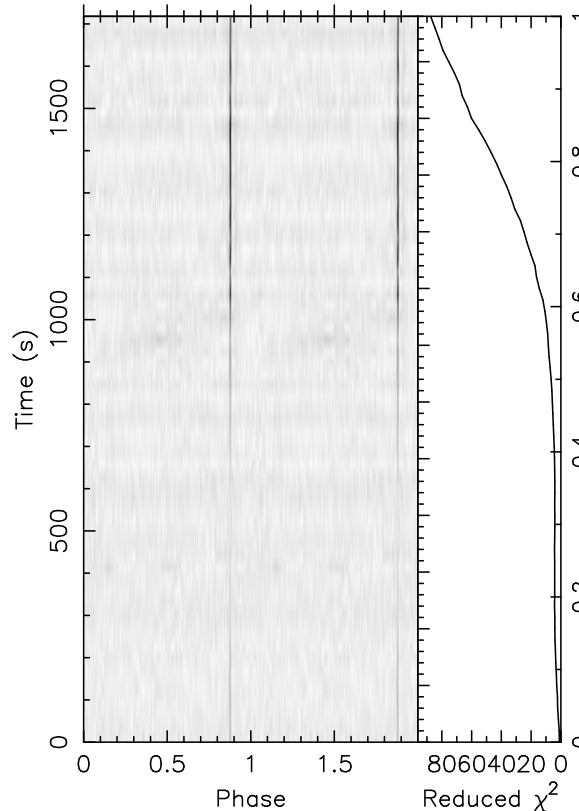
Coherent Sum. before Single Clock

2 Pulses of Best Profile

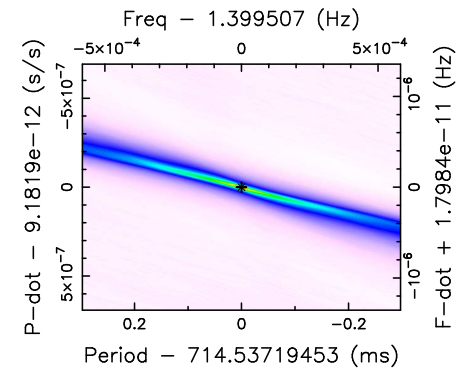
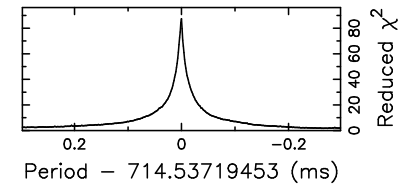
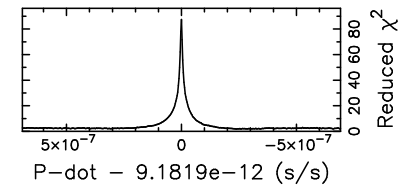
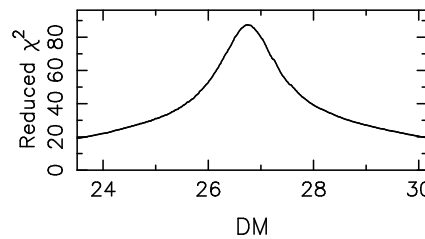
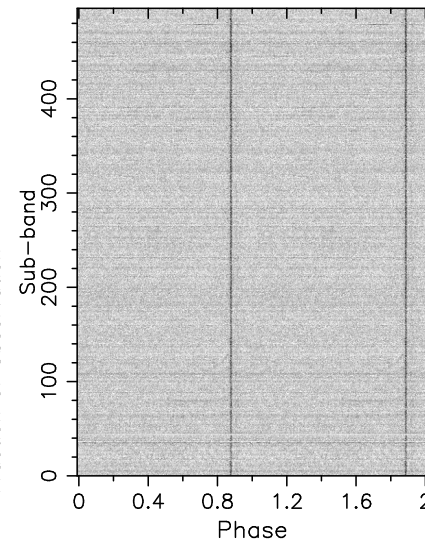


Candidate: PSR_B0329+54
 Telescope: GBT
 Epoch_{topo} = 55326.57693290000
 Epoch_{bary} = 55326.57305629788
 T_{sample} = 0.0013107
 Data Folded = 1310720
 Data Avg = 3672
 Data StdDev = 1.068e+05
 Profile Bins = 256
 Profile Avg = 1.88e+07
 Profile StdDev = 7.642e+06

Search Information
 RA_{J2000} = 03:32:59.3561 DEC_{J2000} = 54:34:43.1103
 Best Fit Parameters
 Reduced χ^2 = 87.452 P(Noise) \sim 0
 Dispersion Measure (DM) = 26.742
 P_{topo} (ms) = 714.55312(36) P_{bary} (ms) = 714.53719(36)
 P_{topo} (s/s) = 0.0(1.6) $\times 10^{-9}$ P_{bary} (s/s) = 0.0(1.6) $\times 10^{-9}$
 P_{topo}'' (s/s²) = 0.0(6.2) $\times 10^{-12}$ P_{bary}'' (s/s²) = 0.0(6.2) $\times 10^{-12}$
 Binary Parameters
 P_{orb} (s) = N/A e = N/A
 a₁sin(i)/c (s) = N/A ω (rad) = N/A
 T_{peri} = N/A



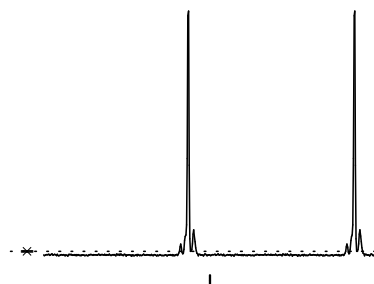
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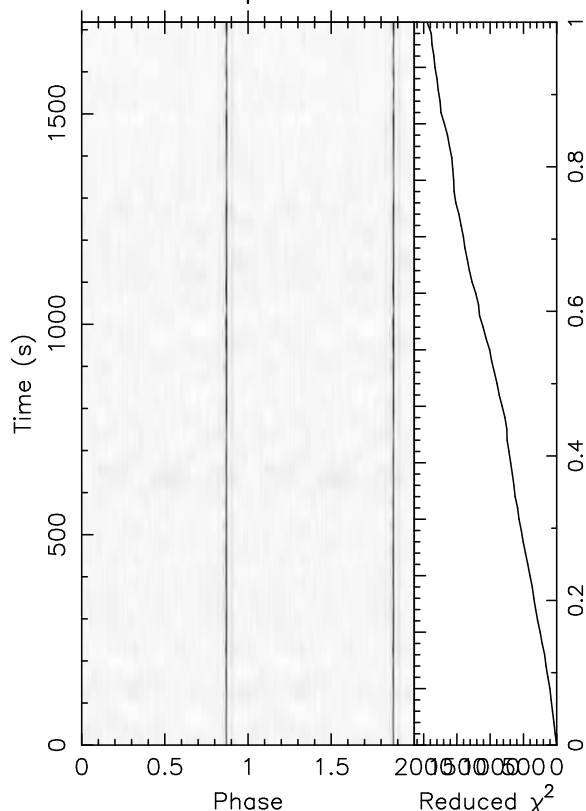
Incoherent Sum. after Single Clock

2 Pulses of Best Profile

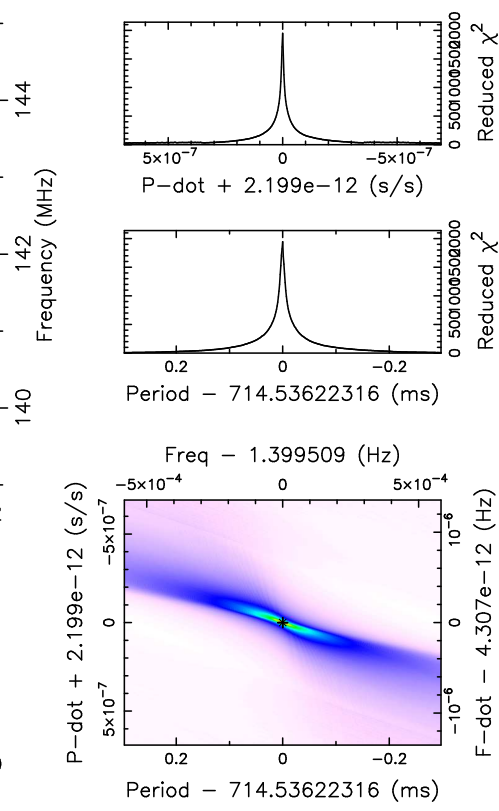
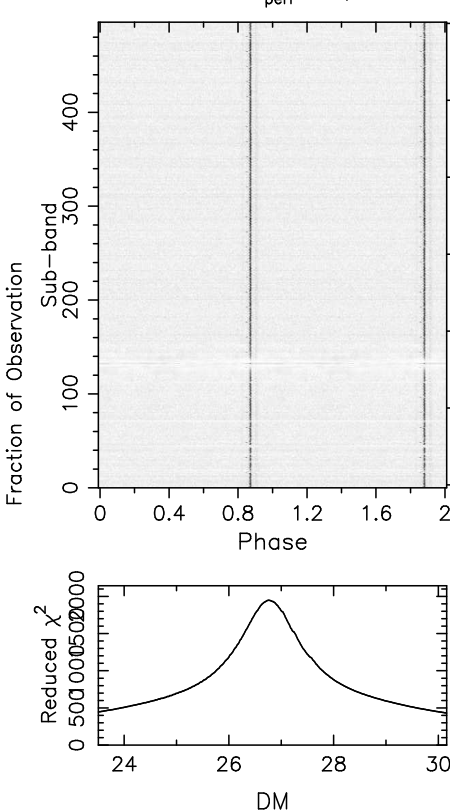


Candidate: PSR_B0329+54
 Telescope: GBT
 Epoch_{topo} = 55327.53528940000
 Epoch_{bary} = 55327.53139145765
 T_{sample} = 0.0013107
 Data Folded = 1310720
 Data Avg = -5486
 Data StdDev = 1.059e+05
 Profile Bins = 256
 Profile Avg = -2.813e+07
 Profile StdDev = 7.577e+06

Search Information
 RA_{J2000} = 03:32:59.3561
 DEC_{J2000} = 54:34:43.1103
 Best Fit Parameters
 Reduced χ^2 = 1947.427 P(Noise) \sim 0
 Dispersion Measure (DM) = 26.768
 P_{topo} (ms) = 714.551180(79) P_{bary} (ms) = 714.536223(79)
 P'_{topo} (s/s) = 0.0(3.6) $\times 10^{-10}$ P'_{bary} (s/s) = 0.0(3.6) $\times 10^{-10}$
 P''_{topo} (s/s²) = 0.0(1.3) $\times 10^{-12}$ P''_{bary} (s/s²) = 0.0(1.3) $\times 10^{-12}$
 Binary Parameters
 P_{orb} (s) = N/A e = N/A
 a₁sin(i)/c (s) = N/A ω (rad) = N/A
 T_{peri} = N/A



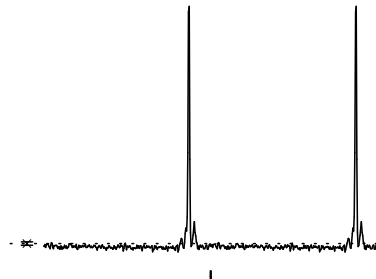
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Coherent Sum. after Single Clock

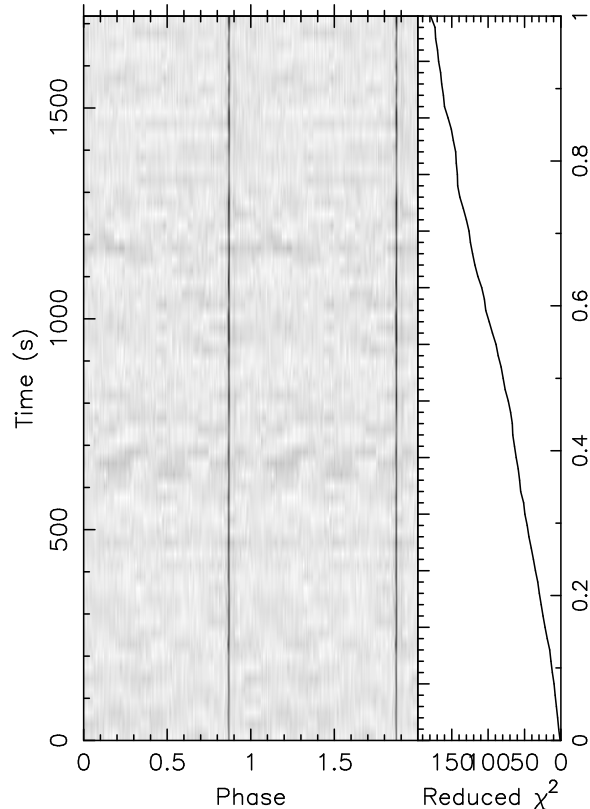
2 Pulses of Best Profile



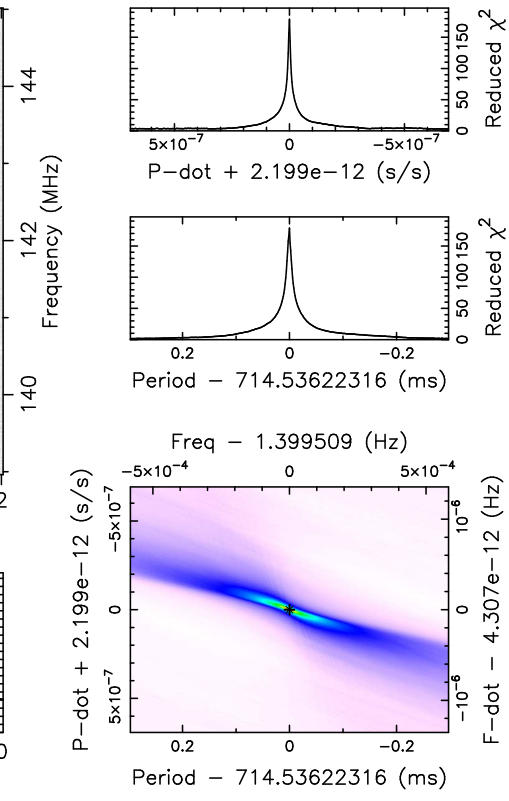
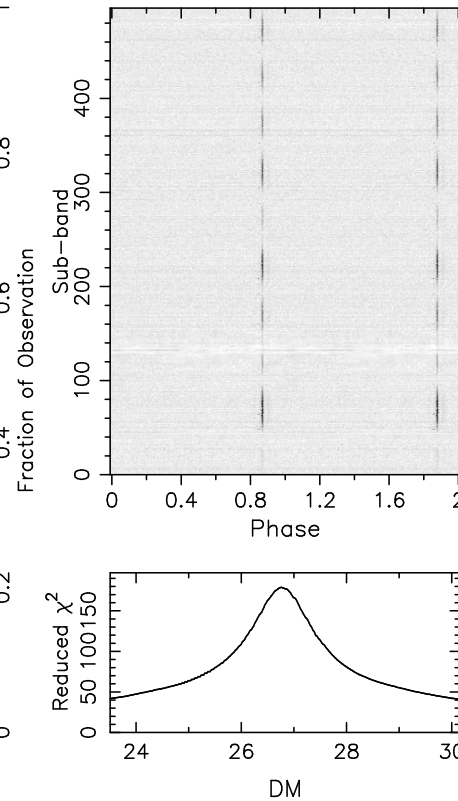
Candidate: PSR_B0329+54
 Telescope: GBT
 Epoch_{topo} = 55327.53528940000
 Epoch_{bary} = 55327.53139145765
 T_{sample} = 0.0013107
 Data Folded = 1310720
 Data Avg = 2890
 Data StdDev = 1.074e+05
 Profile Bins = 256
 Profile Avg = 1.477e+07
 Profile StdDev = 7.683e+06

Search Information
 RA_{J2000} = 03:32:59.3561
 DEC_{J2000} = 54:34:43.1103
 Best Fit Parameters
 Reduced χ^2 = 178.918 P(Noise) \sim 0
 Dispersion Measure (DM) = 26.768
 P_{topo} (ms) = 714.55118(25)
 P_{topo} (s/s) = 0.0(1.1)x10⁻⁹
 P^{''}_{topo} (s/s²) = 0.0(4.3)x10⁻¹²
 Binary Parameters
 P_{orb} (s) = N/A
 a₁sin(i)/c (s) = N/A
 T_{peri} = N/A

P_{bary} (ms) = 714.53622(25)
 P_{bary} (s/s) = 0.0(1.1)x10⁻⁹
 P^{''}_{bary} (s/s²) = 0.0(4.3)x10⁻¹²
 e = N/A
 ω (rad) = N/A

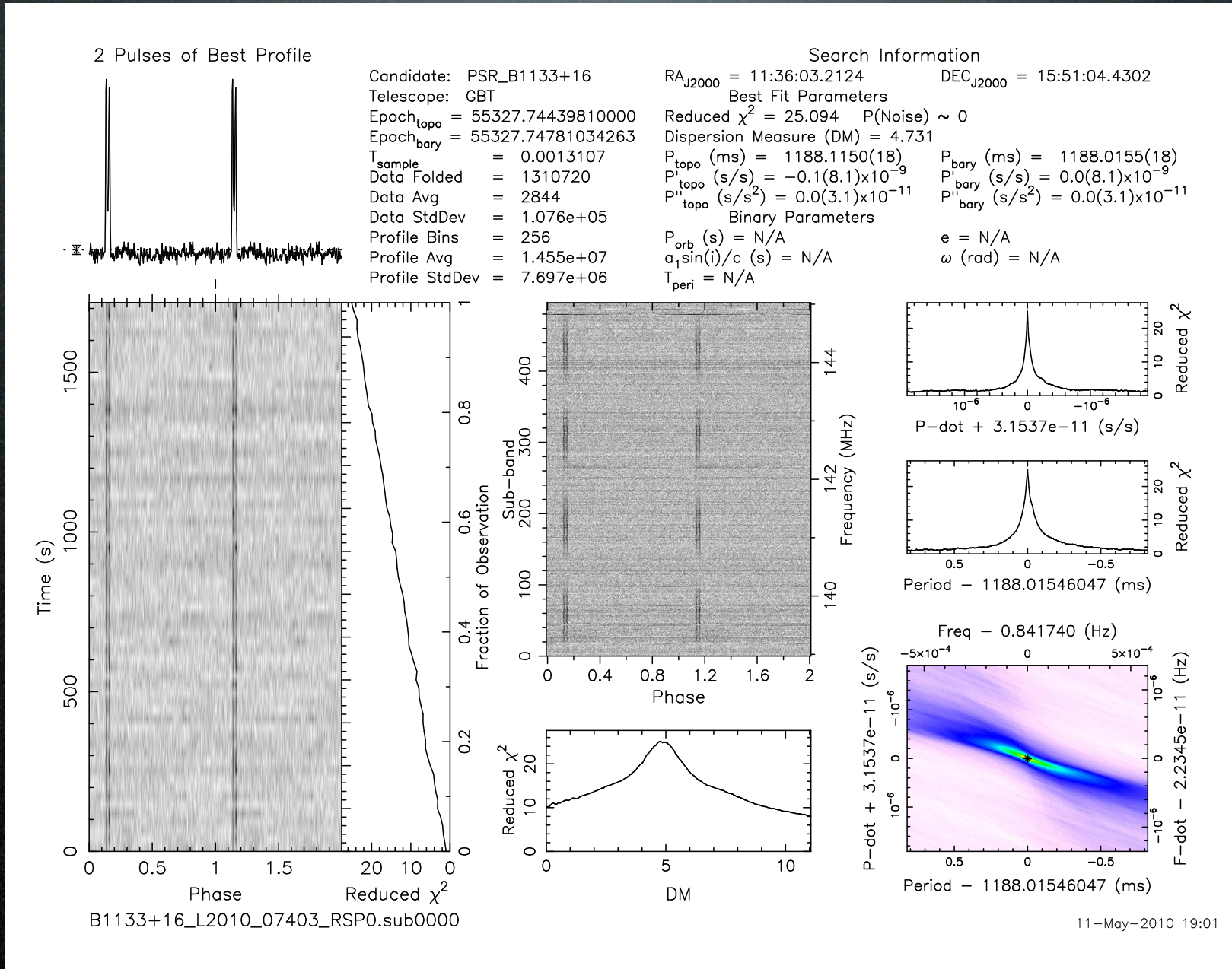


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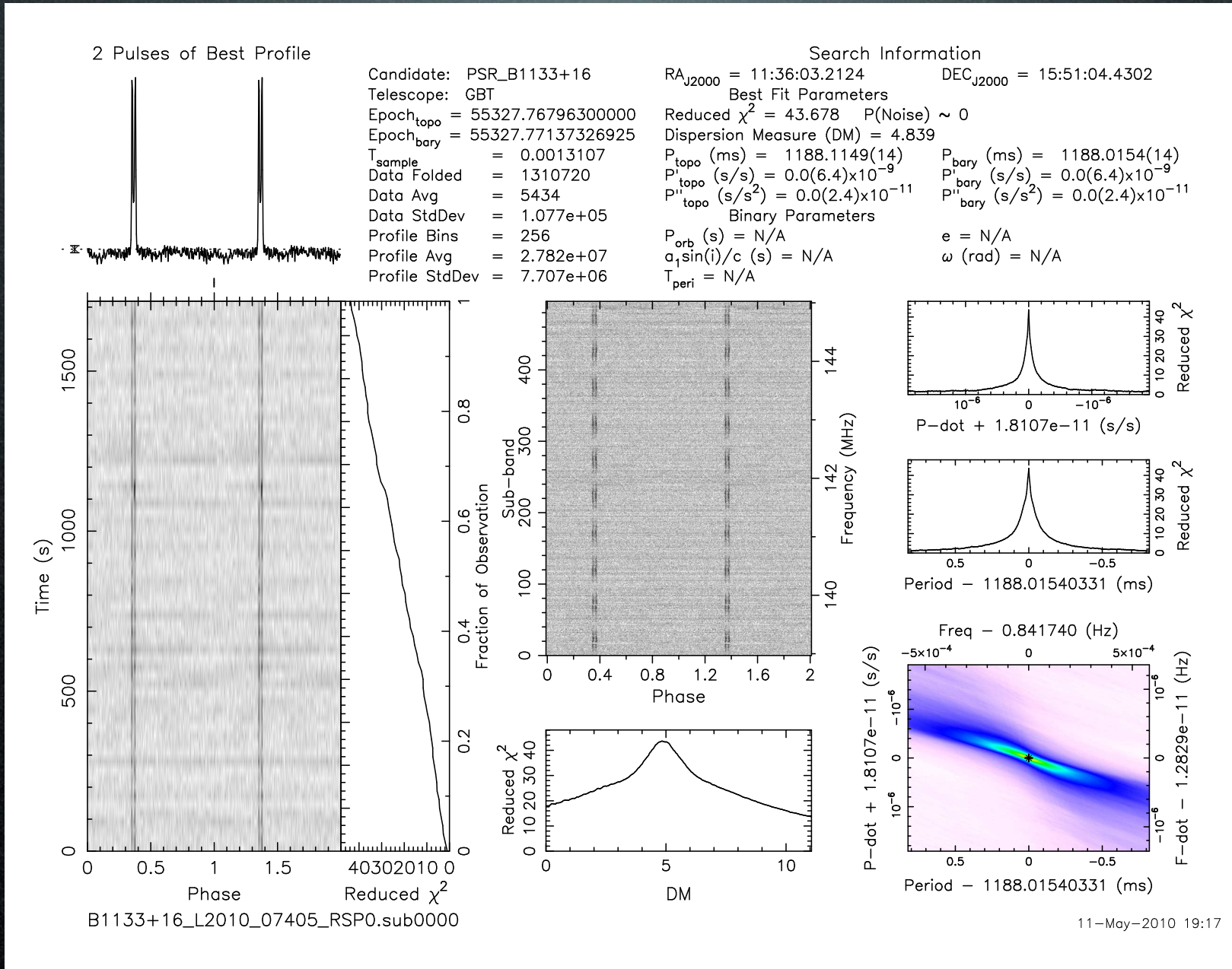
11-May-2010 13:40

Coherent Sum. after Single Clock (CS005-6)



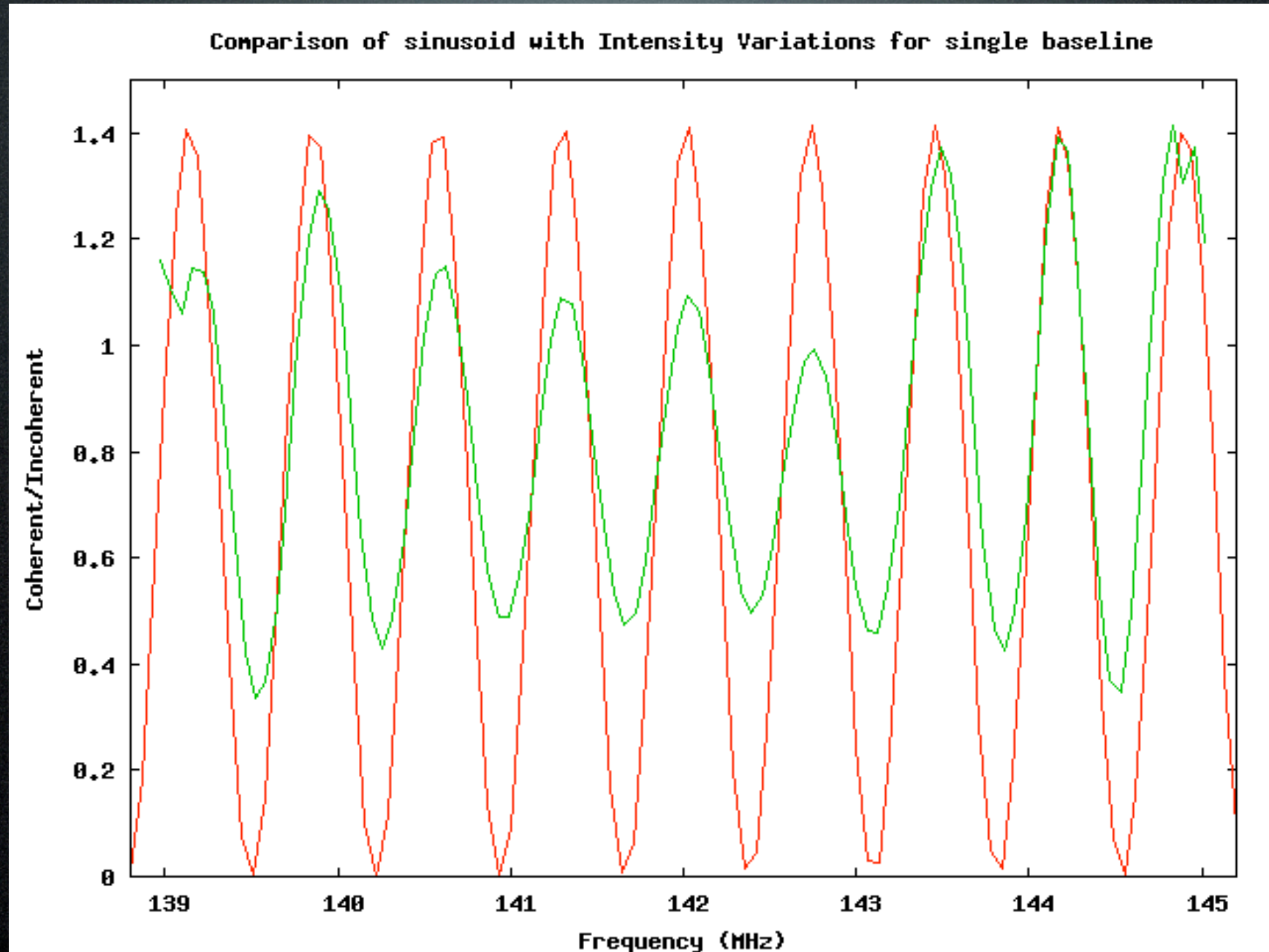
11-May-2010 19:01

Coherent Sum. after Single Clock (CS003-5)

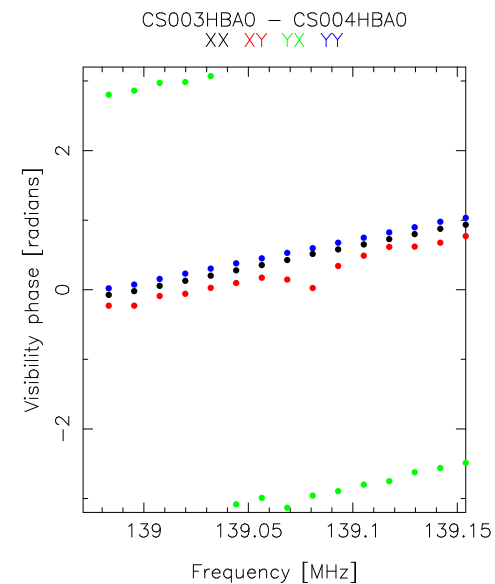
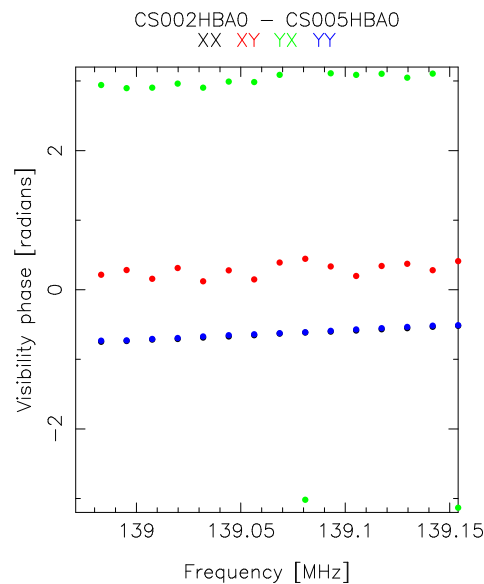
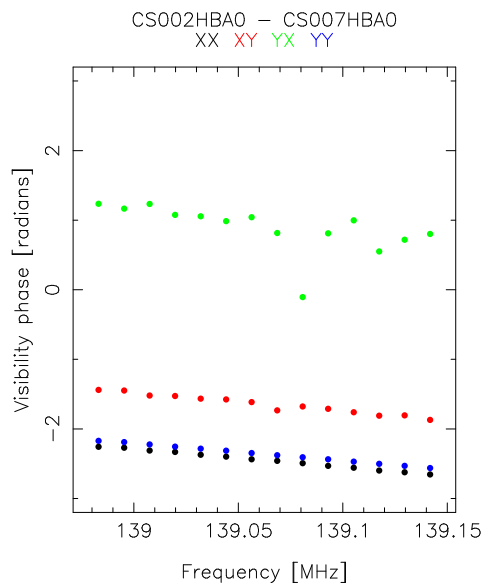
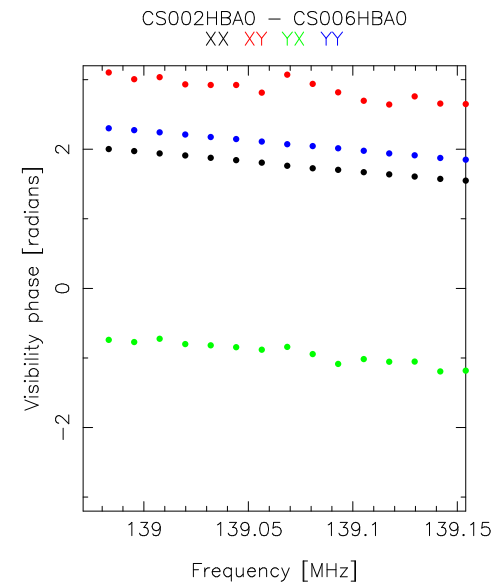
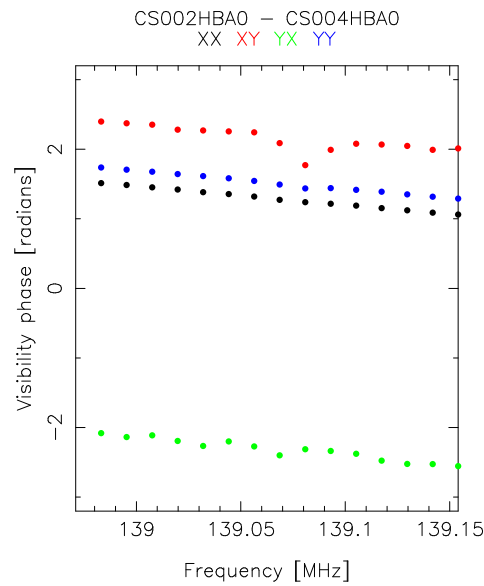
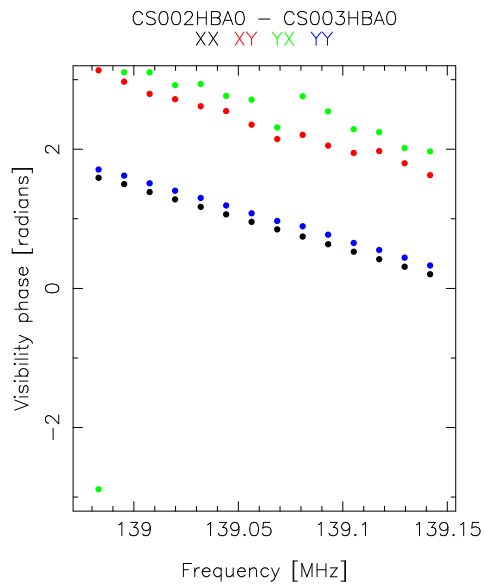


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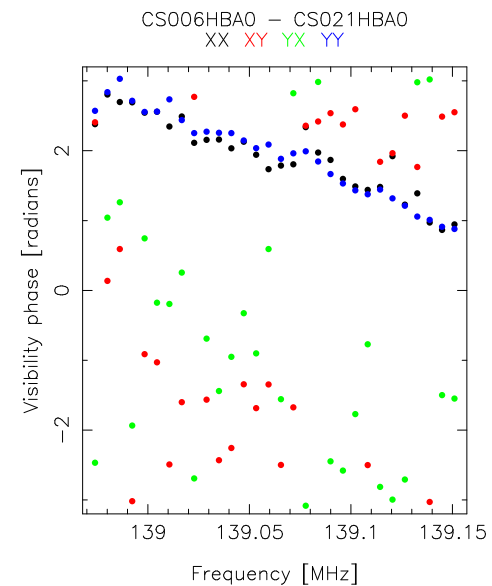
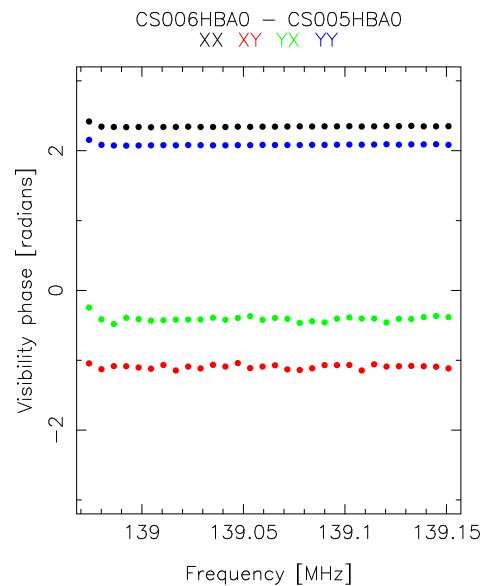
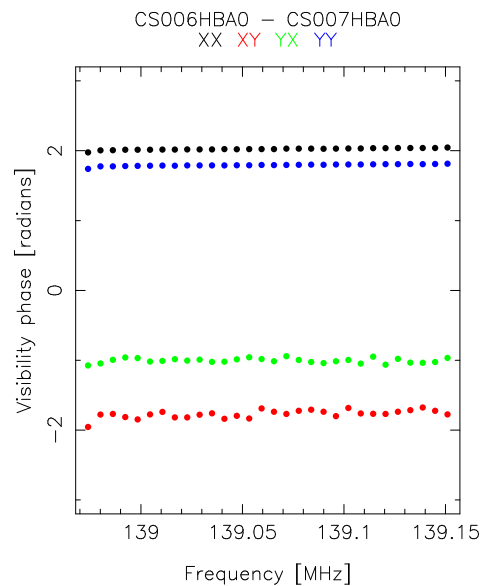
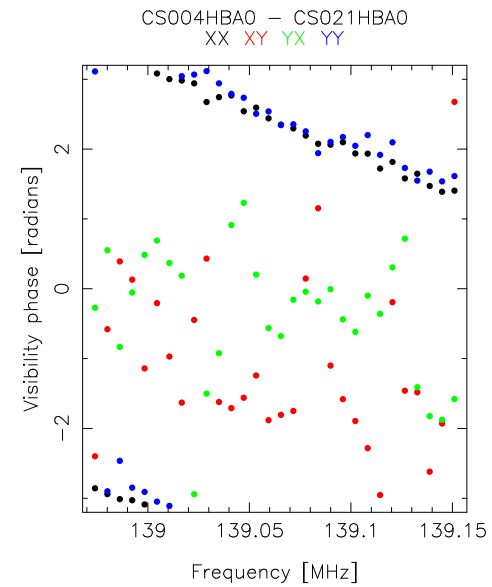
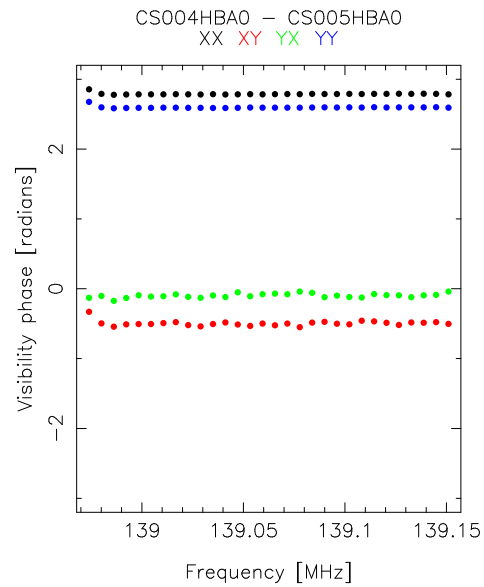
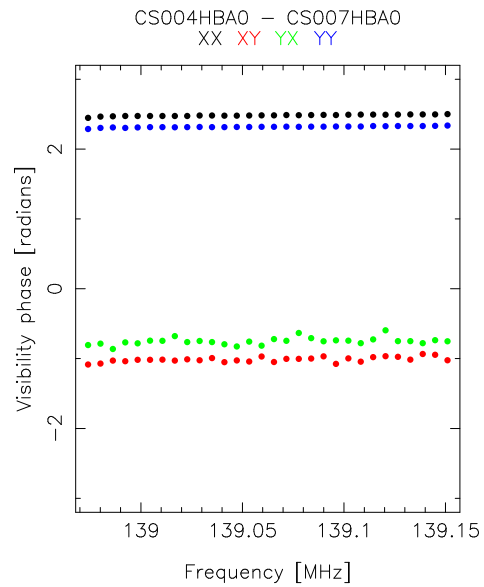
Coherent Sum. after Single Clock (CS003-5)



Crab Phases vs. Freq.: Pre delay corr.

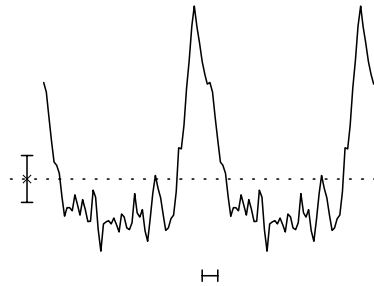


Crab Phases vs. Freq.: Post delay corr.



“Planet Pulsar” B1257+12

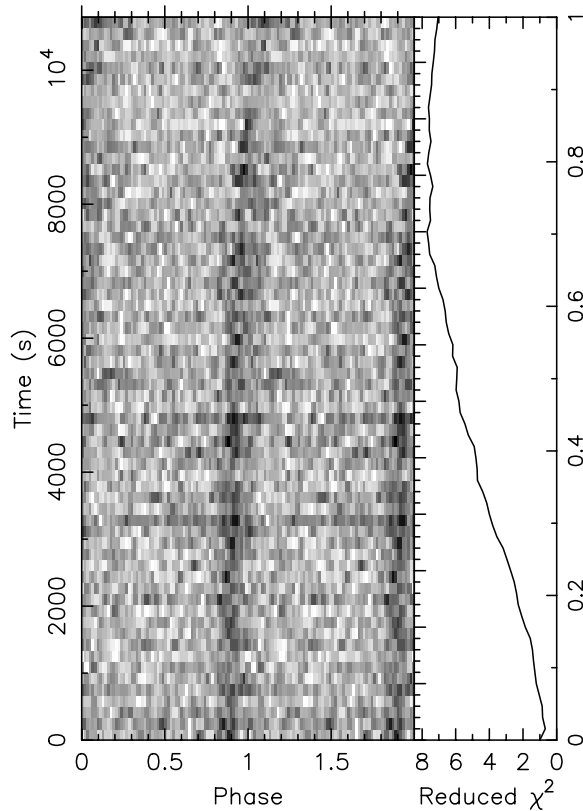
2 Pulses of Best Profile



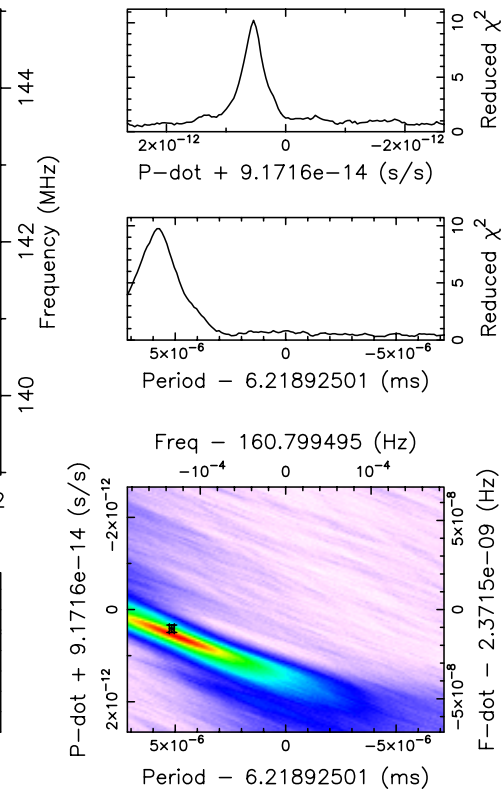
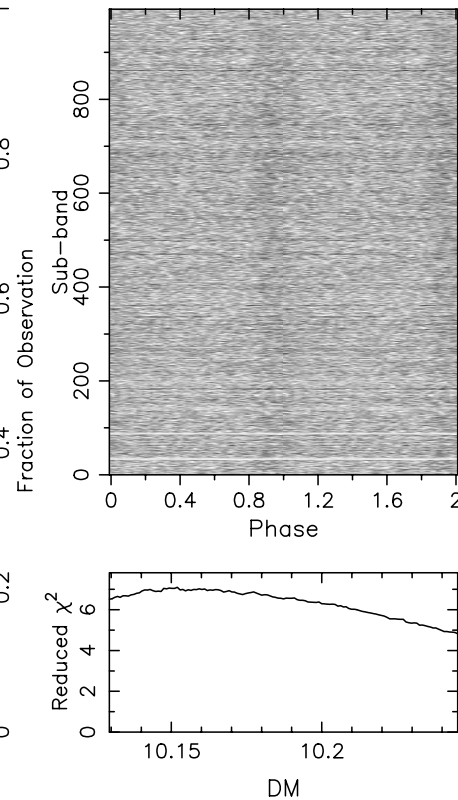
Candidate: PSR_B1257+12
 Telescope: GBT
 Epoch_{topo} = 55329.81872690000
 Epoch_{bary} = 55329.82351096013
 T_{sample} = 0.00016384
 Data Folded = 65863680
 Data Avg = 1.502e+04
 Data StdDev = 1.492e+05
 Profile Bins = 64
 Profile Avg = 1.546e+10
 Profile StdDev = 1.513e+08

Search Information

RA_{J2000} = 13:00:03.5747 DEC_{J2000} = 12:40:56.4467
 Best Fit Parameters
 Reduced χ^2 = 7.052 P(Noise) < 9.92e-59 ($\approx 16.1\sigma$)
 Dispersion Measure (DM) = 10.150
 P_{topo} (ms) = 6.21932320(11) P_{bary} (ms) = 6.21893016(11)
 P'_{topo} (s/s) = 2.32(81)x10⁻¹³ P'_{bary} (s/s) = 3.23(81)x10⁻¹³
 P''_{topo} (s/s²) = 3.9(4.8)x10⁻¹⁷ P''_{bary} (s/s²) = 0.0(4.8)x10⁻¹⁷
 Binary Parameters
 P_{orb} (s) = 5748641.280000 e = 0.018300
 a₁sin(i)/c (s) = 0.001311 ω (rad) = 4.358052
 T_{peri} = 55290.34070000000



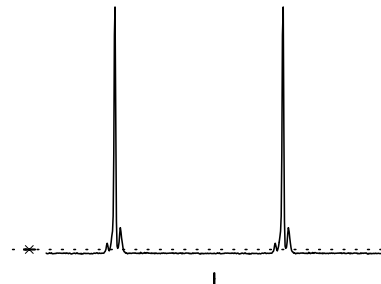
B1257+12_L2010_07462_RSP0.sub0000



18-May-2010 11:32

Using two station beams: beam 1

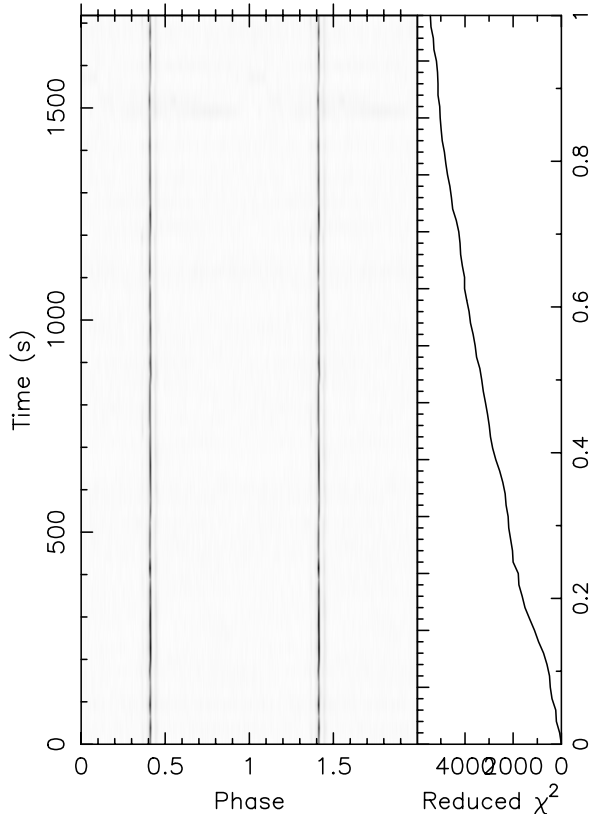
2 Pulses of Best Profile



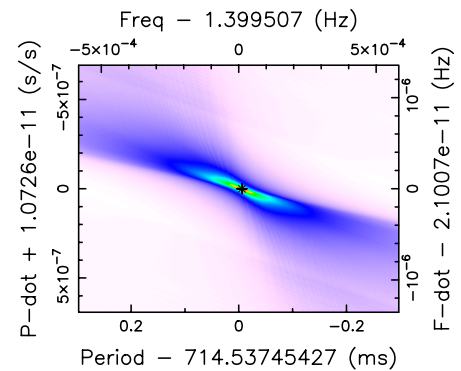
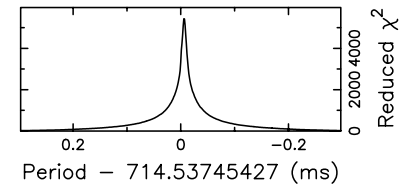
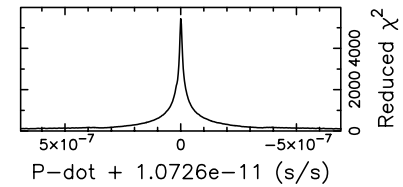
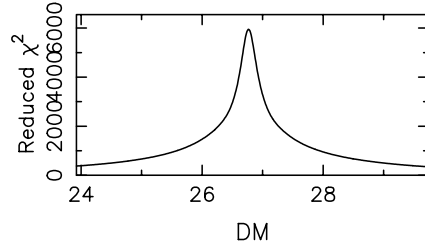
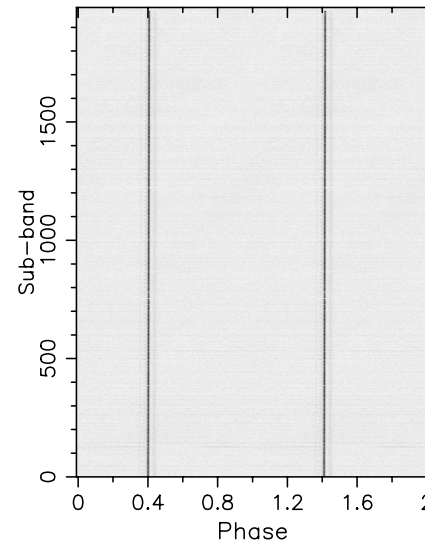
Candidate: PSR_B0329+54
 Telescope: GBT
 Epoch_{topo} = 55333.49732640000
 Epoch_{bary} = 55333.49340215600
 T_{sample} = 0.0013107
 Data Folded = 1310720
 Data Avg = -2064
 Data StdDev = 2.169e+05
 Profile Bins = 256
 Profile Avg = -1.063e+07
 Profile StdDev = 1.552e+07

Search Information

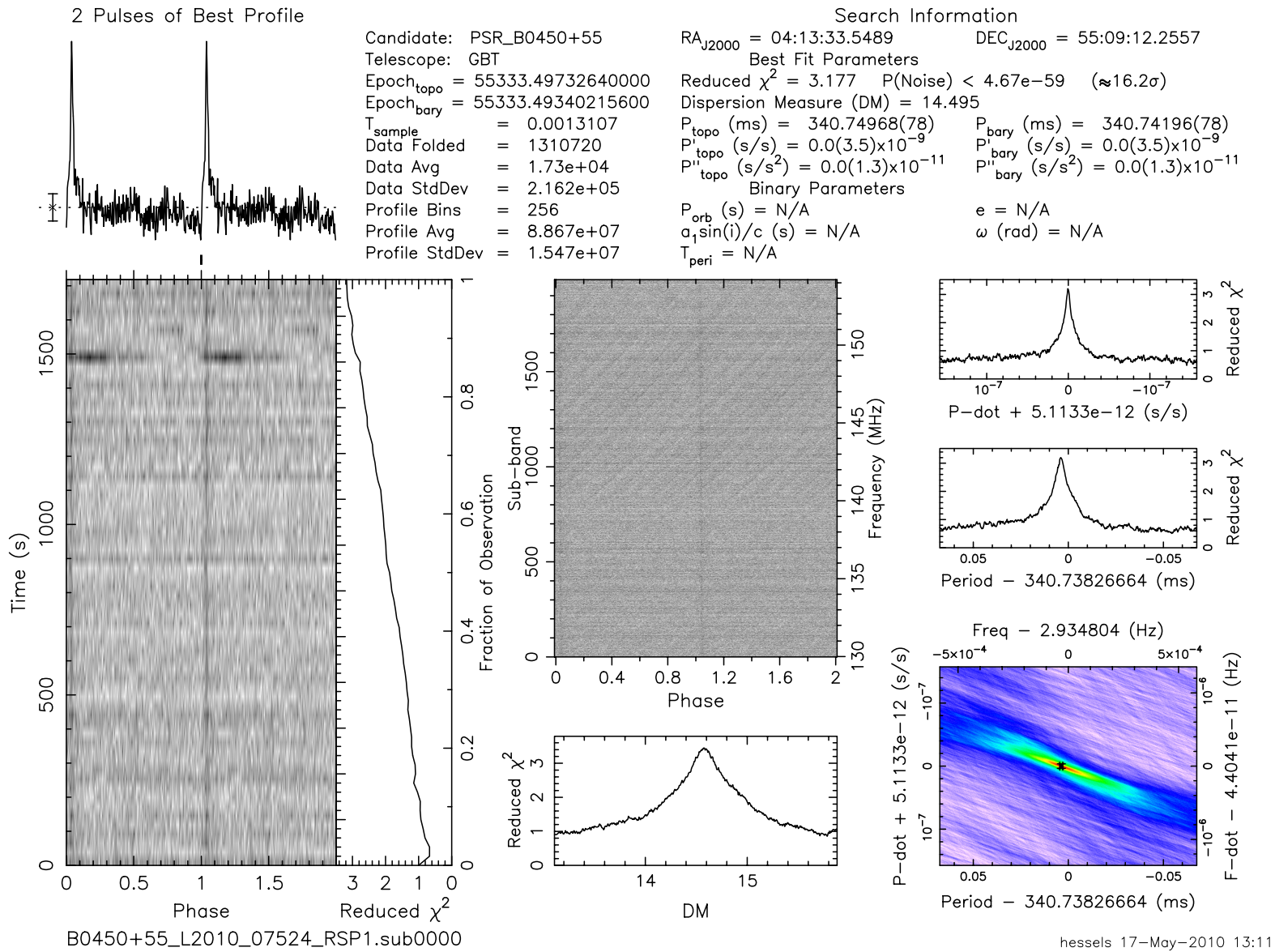
RA_{J2000} = 04:13:33.5489 DEC_{J2000} = 55:09:12.2557
 Best Fit Parameters
 Reduced χ^2 = 5435.030 P(Noise) \sim 0
 Dispersion Measure (DM) = 26.833
 P_{topo} (ms) = 714.547837(51) P_{bary} (ms) = 714.531650(51)
 P_{topo}¹ (s/s) = $-0.2(2.3) \times 10^{-10}$ P_{bary}¹ (s/s) = $-0.1(2.3) \times 10^{-10}$
 P_{topo}¹¹ (s/s²) = $0.0(8.6) \times 10^{-13}$ P_{bary}¹¹ (s/s²) = $0.0(8.6) \times 10^{-13}$
 Binary Parameters
 P_{orb} (s) = N/A e = N/A
 a₁sin(i)/c (s) = N/A ω (rad) = N/A
 T_{peri} = N/A



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Using two station beams: beam 2



Suggestions/Issues

- Webpage with SAS/MAC schedule available (avoid processing conflicts)
- Issues with the scheduler --> how do we make our lives easier?
- Moving data around --> need to be systematized!
- Moving data to the archive --> Joeri to look into this more

Summary

- Now seem very close to being able to form LOFAR's first multi-station tied-array beam.
- Michiel B. has created software to “tune” the system by fitting for delays to all stations.
- Coherently combined Superterp will be more sensitive than entire array combined incoherently.
- Lots of observations done in preparation for opening and science meeting. Results coming in!