

STAFF/SC cross-calibration activities

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- 1) Some news about STAFF transfer function
 - Still some worries on S/C #1 transfer function
 - Still some worries on STAFF-FGM differences on S/C # 2,3,4
- 2) The Calibrated Waveforms product
 - Some news...
 - Principle of continuous calibration method
 - Comparison with the old classical method
- 3) Comparison between STAFF-SC CWF & FGM HR waveforms
- 4) Limits of agreement between STAFF-SC & FGM
- 5) STAFF-SC / SA : new studies have to be done
- 6) Conclusions

1) Some new about STAFF transfer function

(see 9th Cross. Cal. Workshop)

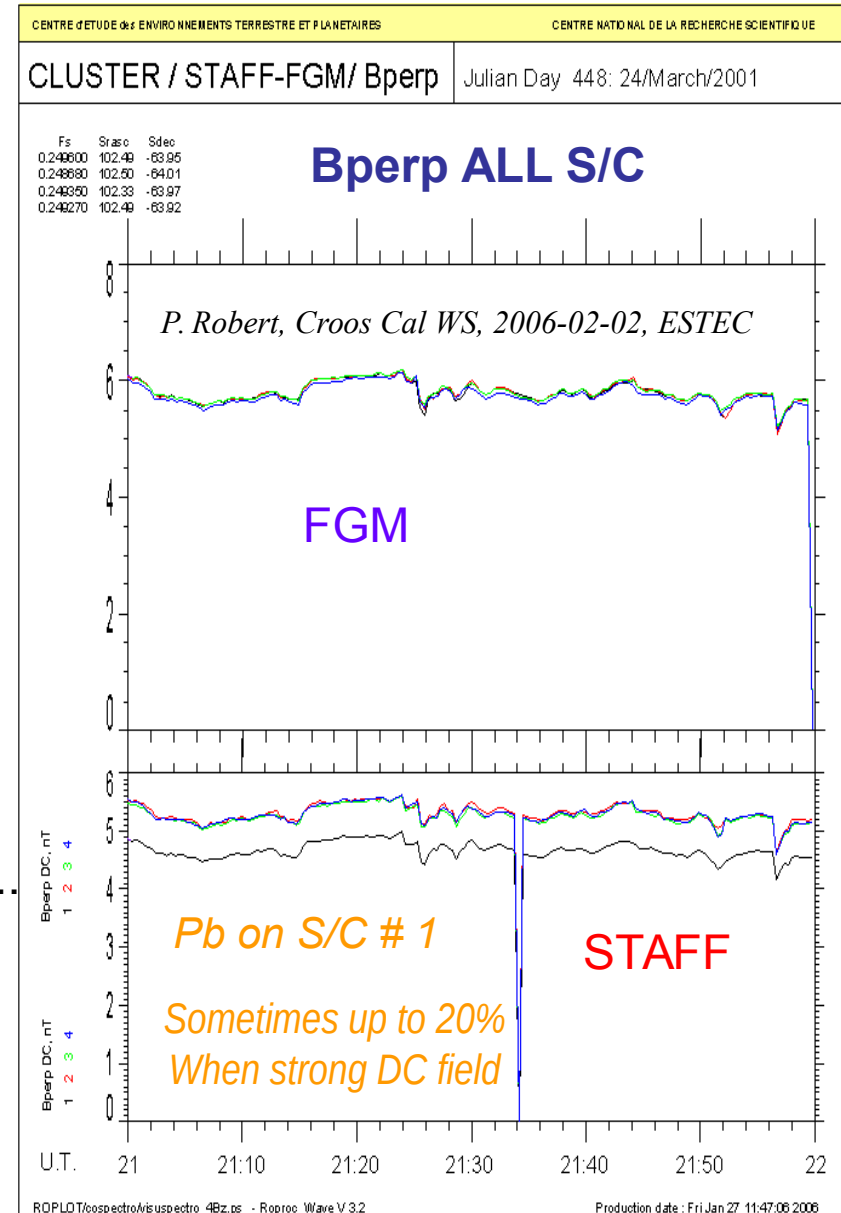
• Problem on S/C #1 transfer function

(20% below FGM)

➡ Error on calibration procedure for computation of S/C#1 transfer function has been identified. 😊

S/C #1 was calibrated in different conditions that S/C #2,3, 4 and using old experiment.

➡ Method to correct it is to find...
Not easy...
But we hope to have good progress soon... 🤖



• Problem on STAFF-FGM difference on S/C # 2,3,4

(10 % below FGM, see talk of 8th & 9th Cross. Cal. Workshops)

➡ No progress... 🙄

(Waiting availability of technical staff)

➡ Needs to see carefully onboard calibration signal.

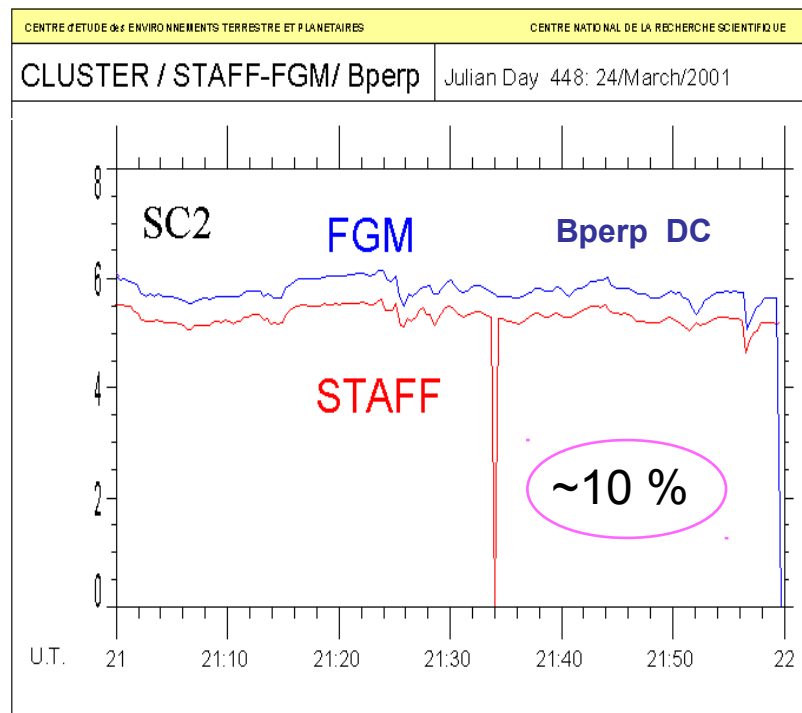
No currently available manpower... 😭

(Priority was on the development of continuous calibration method)

➡ But continuous calibrated waveforms will help us to check if differences are on all frequencies or just on the low frequency part (~ DC)



Note that CWF products will be filtered components (> 0.5 Hz) in GSE system (so without DC)



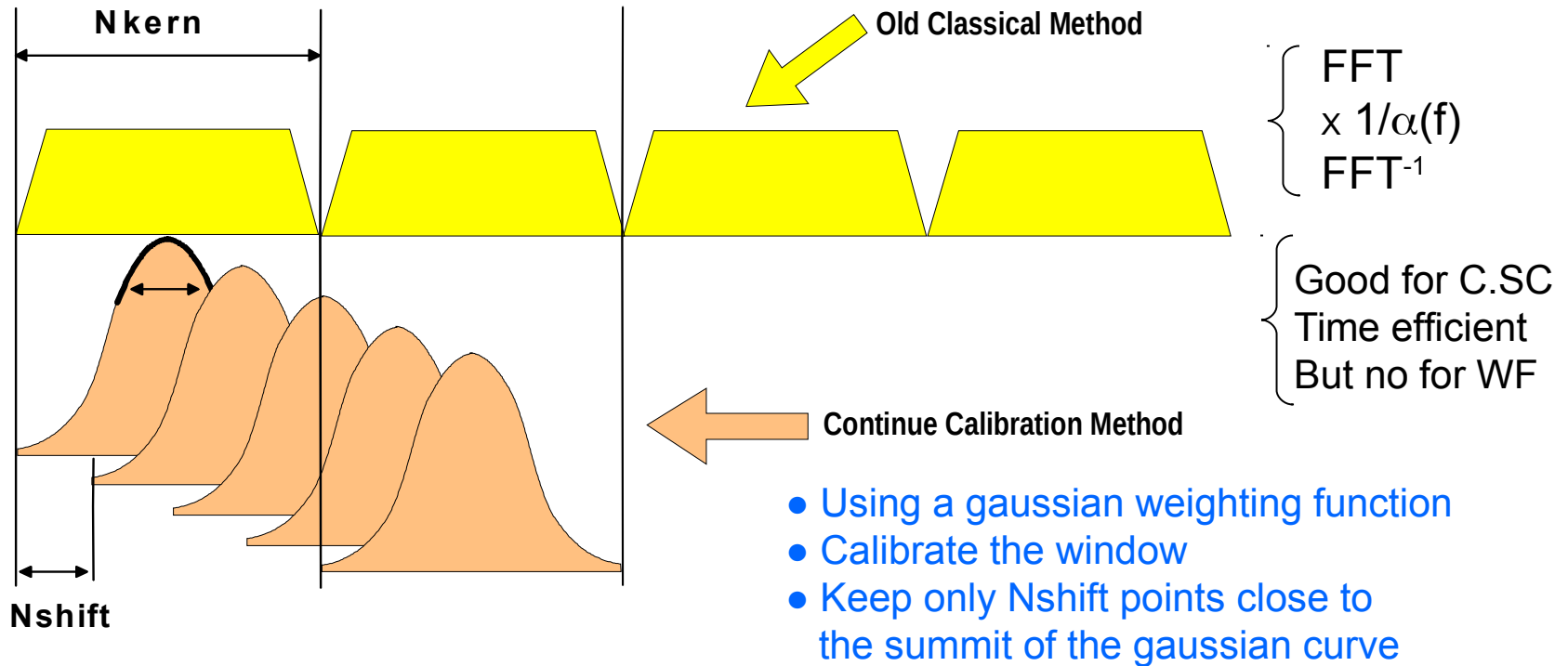
2) The Calibrated Wave Forms product

- Some news...

- ➡ Program in version 1.0 has been written (october 15) 🤖!!!
- ➡ Program is currently under tests (P.R./C.B.).
- ➡ Preliminary tests are good... 😊
- ➡ and preliminary results seem to fit well with FGM HR waveforms . 😊

• Principle of the Continuous Calibration Method (CCM)

➡ Principle of a slipping calibration window



➡ Definition of Kernel size and Shift size

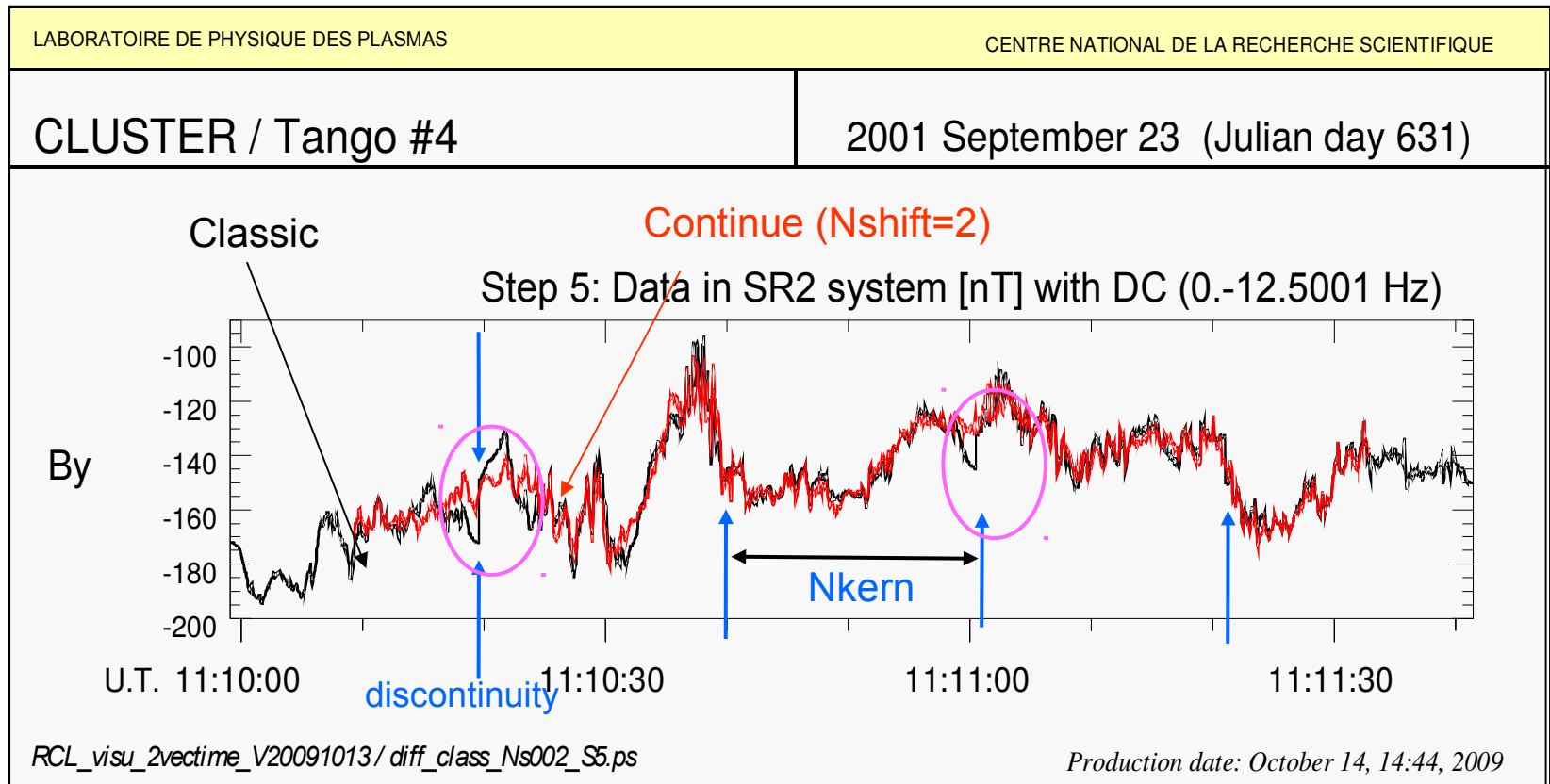
- **N_{kern}** must be chosen to
 - do a correct despun ($> 2T_s$, but not too long, ex: 512)
 - have a high enough frequency resolution (not too short)
- **N_{shift}** should be
 - the shortest possible (ex : 2 pts)
 - but could be extended to reduce CPU time without damage for the calibration quality (tests in progress, could be 6-8 pts)

• Comparison with the Old Classical Method (OCM)

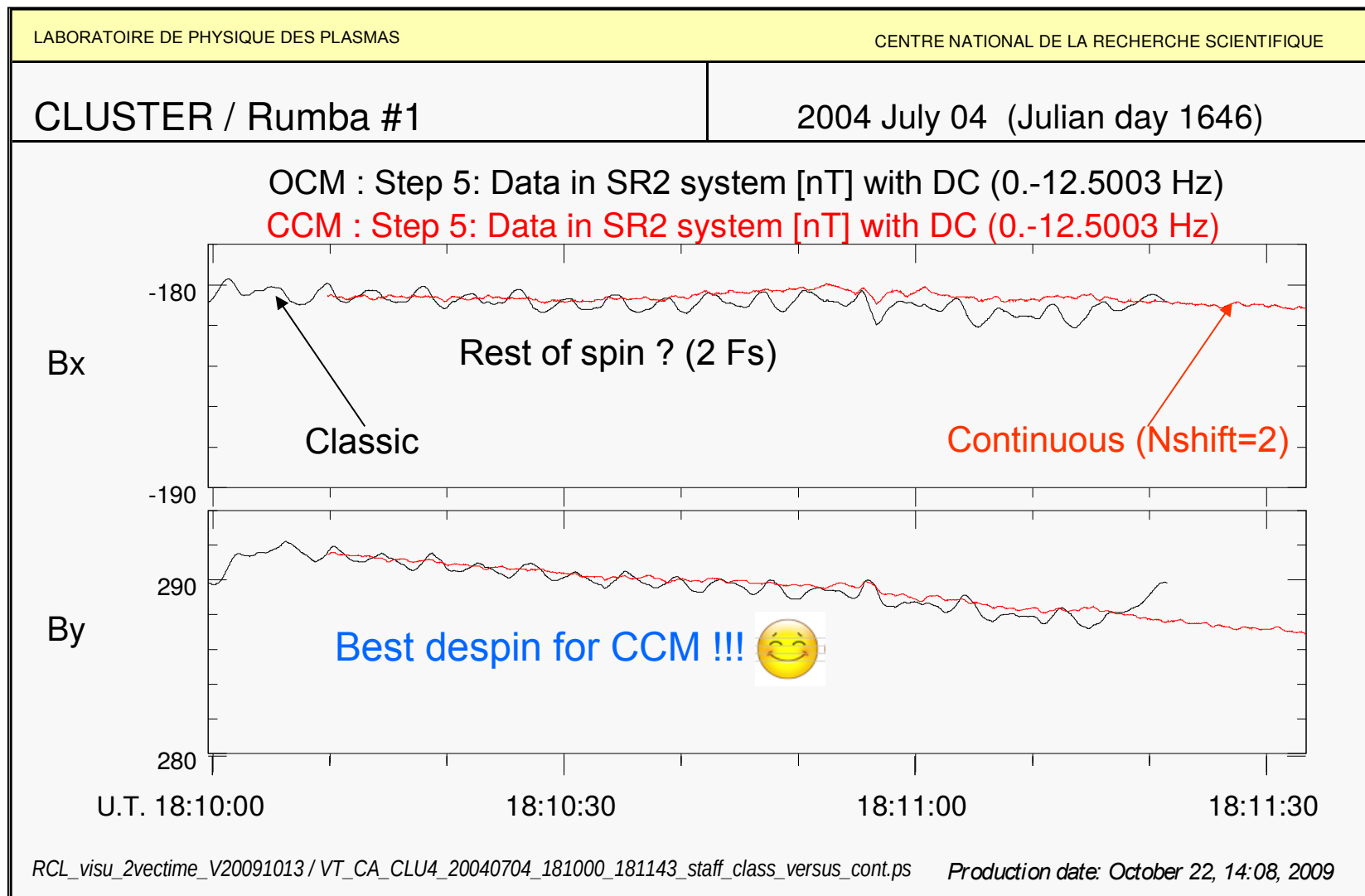
➡ The CCM as a generalization of the OCM

- If we choose the same N_{kern} and $N_{\text{shift}}=N_{\text{kern}}$, and keep trapezium weighting function the CCM gives the same result that the OCM (has been checked).
- So, the OCM is now obsolete, since the CCM includes the OCM.

➡ CCM – OCM comparison 1) High DC, High ULF fluctuations



➡ CCM – OCM comparison (suite) 2) High DC, No fluctuations



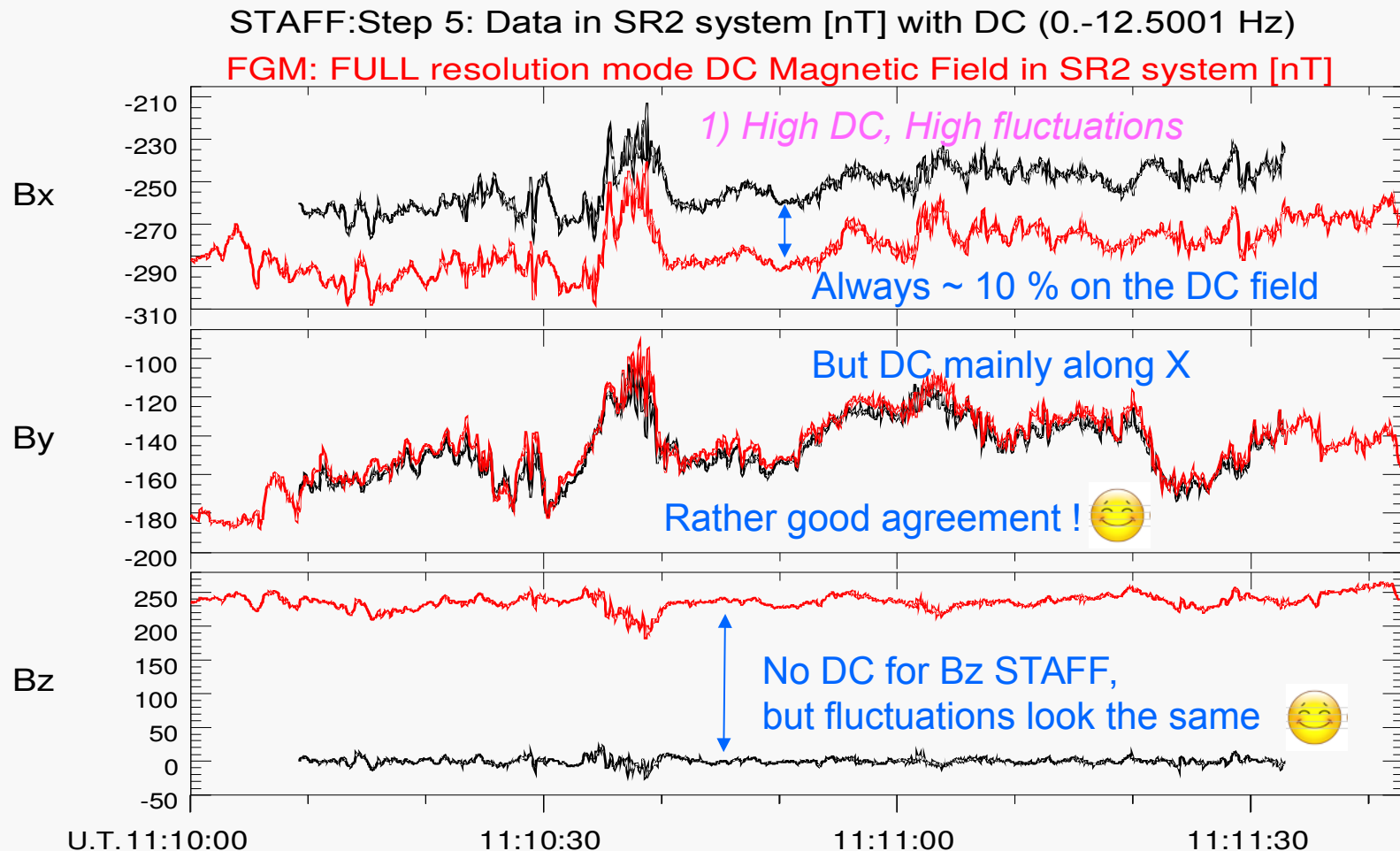
3) Comparison between STAFF-SC CWF & FGM HR waveforms

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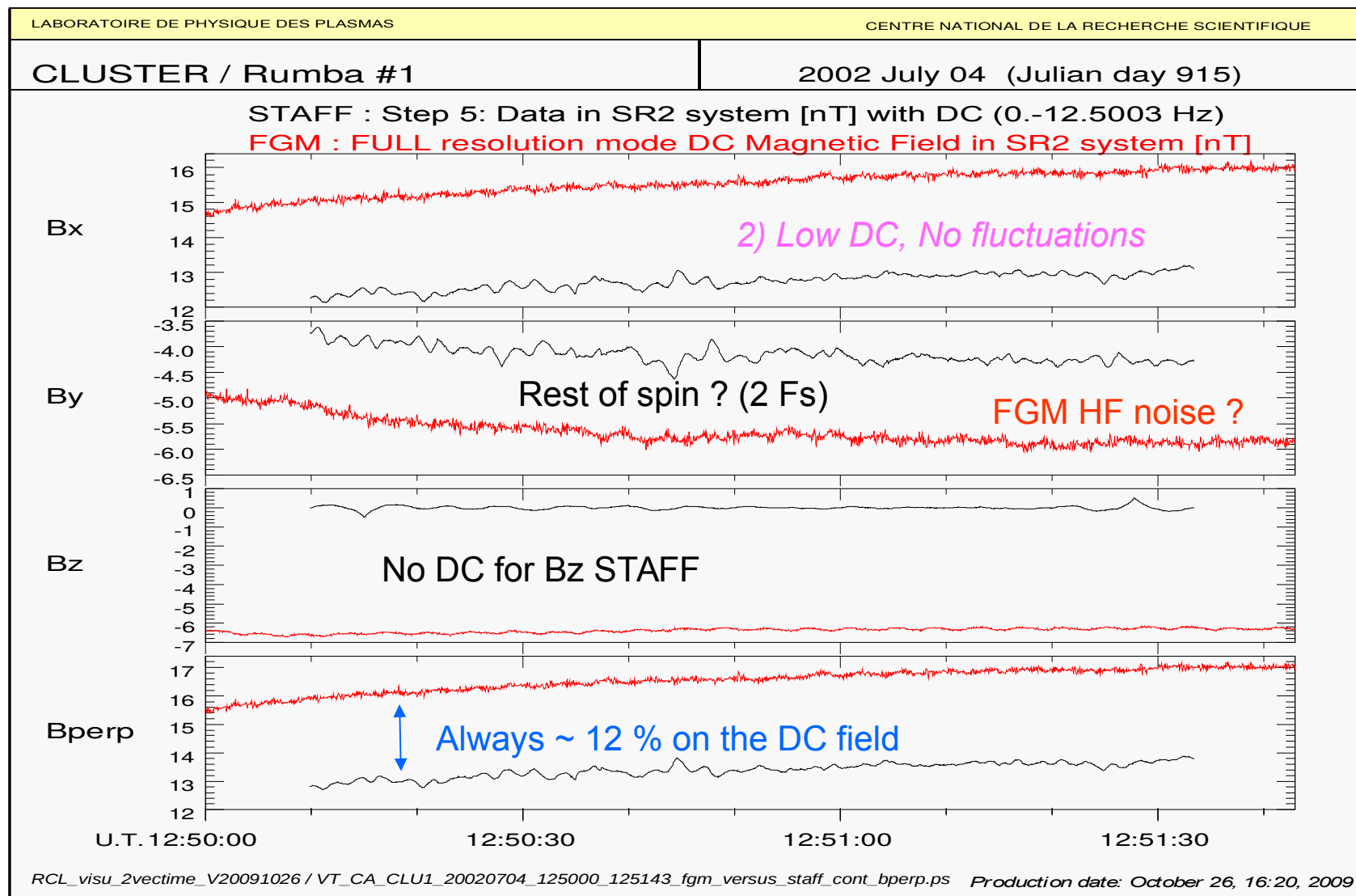
CLUSTER / Tango #4

2001 September 23 (Julian day 631)



RCL_visu_2vectime_V20091026 / VT_CA_CLU4_20010923_111000_111143_fgm_versus_staff_cont_bperp.ps Production date: October 26, 16:20, 2009

Comparison between STAFF-SC CWF & FGM HR waveforms (suite)



Comparison between STAFF-SC CWF & FGM HR waveforms (suite)

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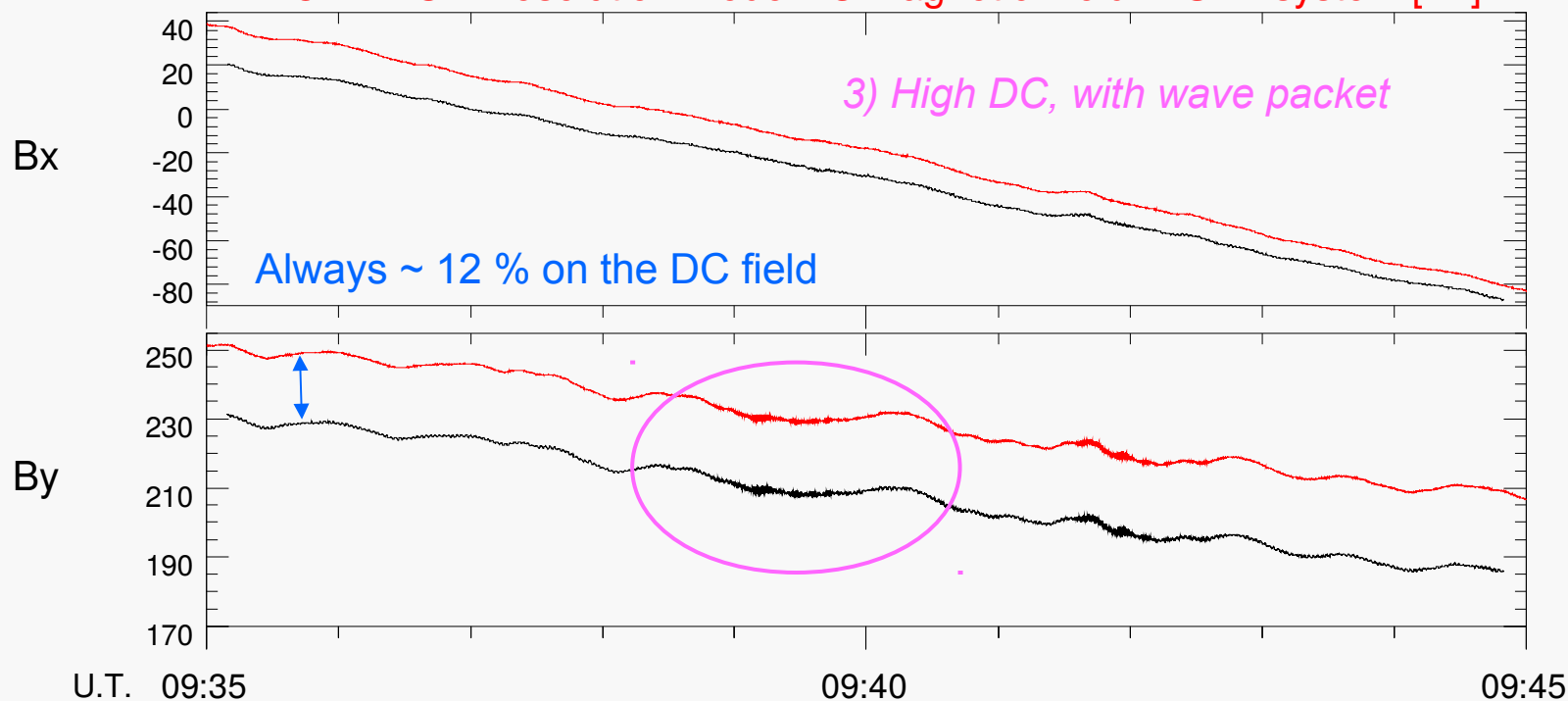
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CLUSTER / Tango #4

2001 September 23 (Julian day 631)

STAFF / Step 5: Data in SR2 system [nT] with DC (0.-12.5001 Hz)

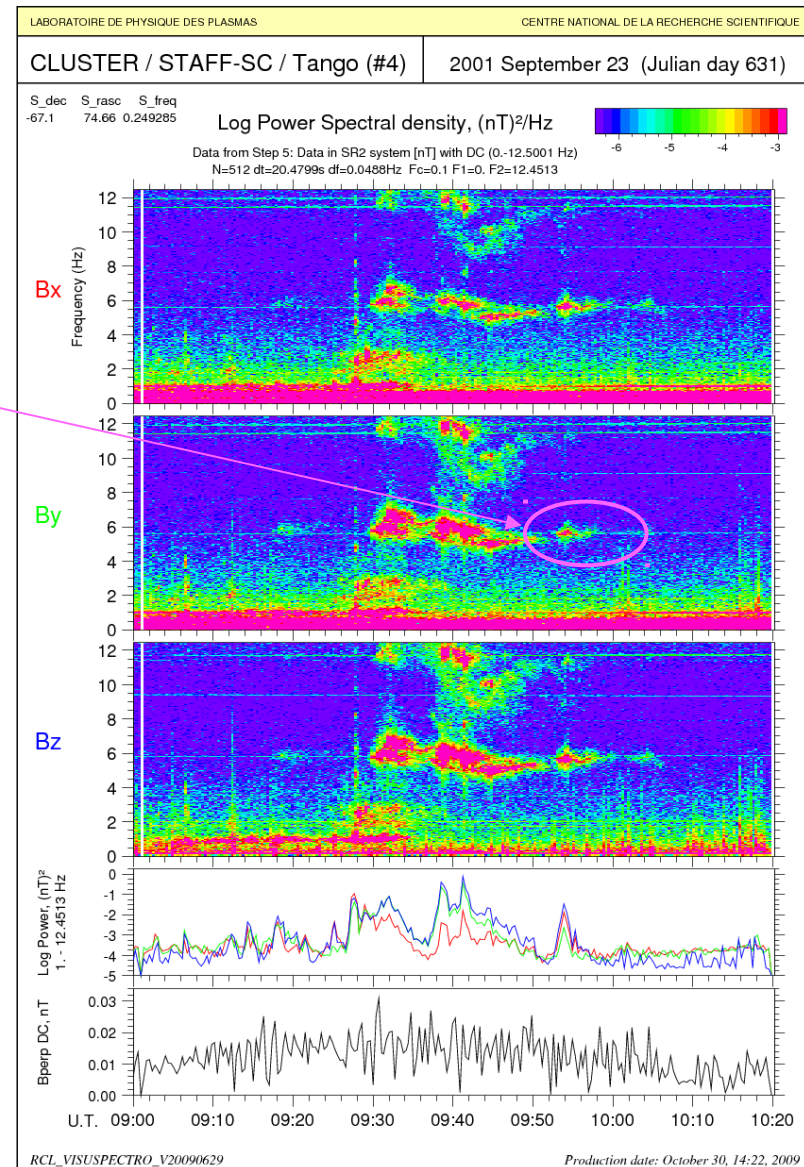
FGM : FULL resolution mode DC Magnetic Field in SR2 system [nT]



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Comparison between STAFF-SC CWF & FGM HR waveforms (suite)

Monochromatic wave at ~ 6 Hz



Comparison between STAFF-SC CWF & FGM HR waveforms (suite)

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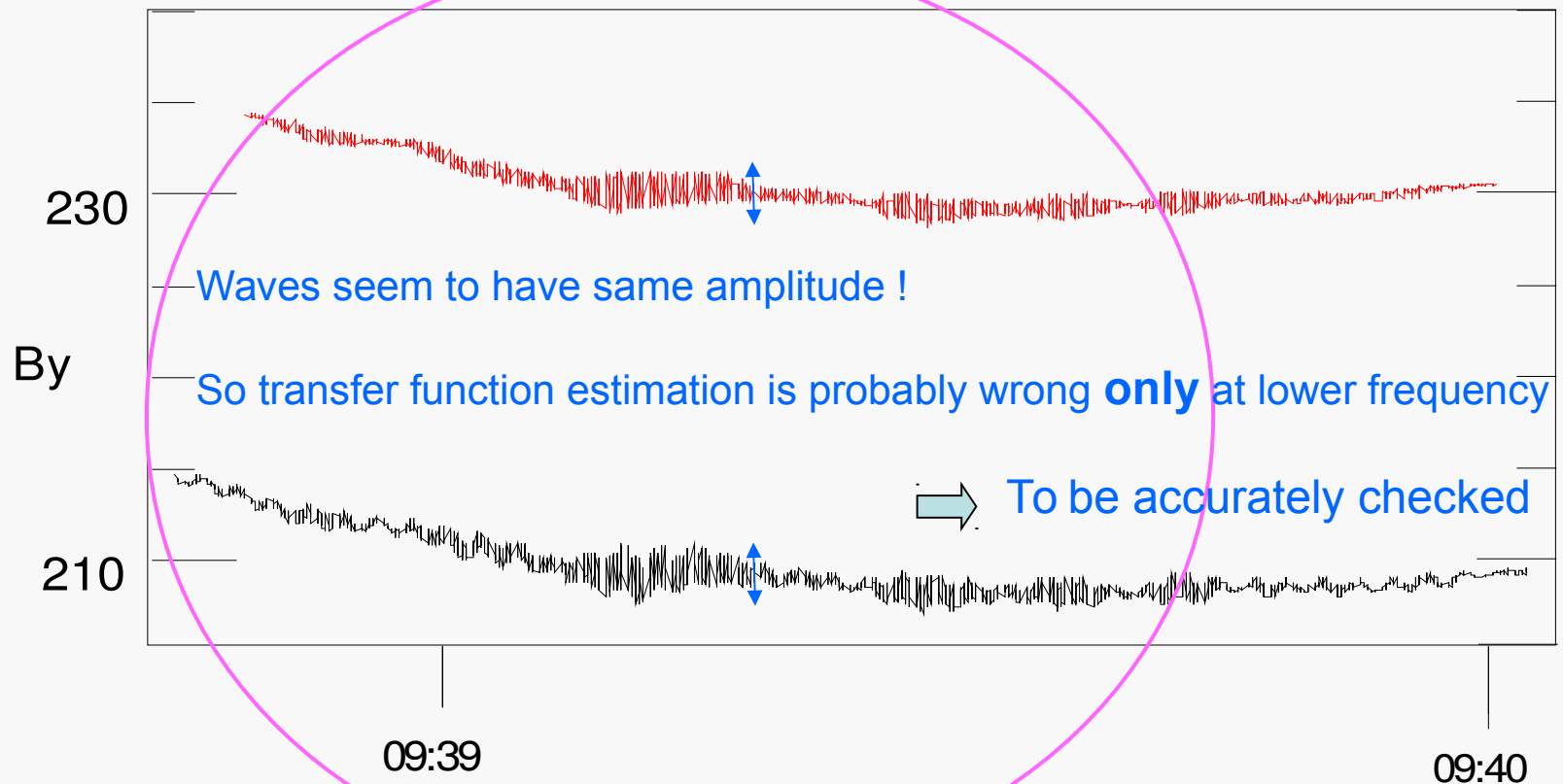
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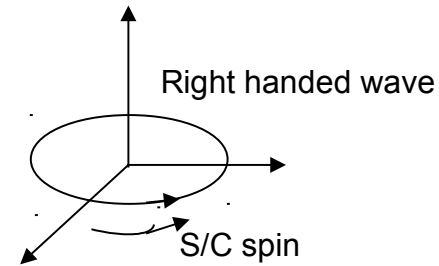
2001 September 23 (Julian day 631)

STAFF / Step 5: Data in SR2 system [nT] with DC (0.-12.5001 Hz)

FGM : FULL resolution mode DC Magnetic Field in SR2 system [nT]



4) Limits of agreement between STAFF-SC & FGM



- STAFF transfer function is equal to zero at $f=0$
- So, a **right**-handed polarized wave at spin frequency **cannot be recorded** by the STAFF sensor. It is seen at $f=0$ by the spinning sensor coordinate system :

$$F_{SR2} = F - F_{spin}$$

- But a **left**-handed polarized wave at any frequency, including DC, **is recorded** by the STAFF sensor :

$$F_{SR2} = F + F_{spin}$$



So, at low frequency, we **cannot** have a full agreement between STAFF and FGM (except for left-handed polarized wave) 🙄



But for frequencies $\gg F_{spin}$, we can expect good agreement ! 😊

To be at ease, remember that CWF product will be filtered components (> 0.5 Hz) in GSE system (so without DC) so we hope that STAFF-SC CWF will be consistent with FGM data 🙏

(From preliminary results, we are not too anxious...)

5) STAFF-SC / SA : new studies have to be done

- Correction of STAFF-SC transfer function (NBR & HBR) remains to be done.
- Sensitivity, noise instrument, minimum signal recordable versus frequency etc... have to be defined accurately (already planned action).
- Cross calibration between STAFF-SC/HBR and STAFF-SA must be refreshed after STAFF-SC transfer function correction.
- Continuity of sensitivity, noise instrument etc... must be checked between STAFF-SC and STAFF-SA.

5) Conclusions

- CCM seems to work well. 😊
- Preliminary tests give encouraging results. 😊
- Only fluctuations above ~ 0.5 Hz should be compared with FGM data, and in GSE system (coordinate system used for CAA CWF) ; results expected soon.
- Up to now, the CCM is high CPU time consuming:
Ex.: For Nshift=2 (best quality) $\Rightarrow$ 20 mn for 3h in NBR, $\sim$ 3h/days.
Possible optimization of the code, and using Nshift $\sim$ 4-8 (tests to be done).
- LPP velizy moves to “Ecole Polytechnique”, in Palaiseau, at the beginning of January 2010 : some delays and technical problems are expected...

