- ***Radio and Plasma Waves***

- ***SCM status***

The SCM team:

Lead Co-I: M. Kretzschmar (V. Krasnoselkikh)

Hardware: G. Jannet

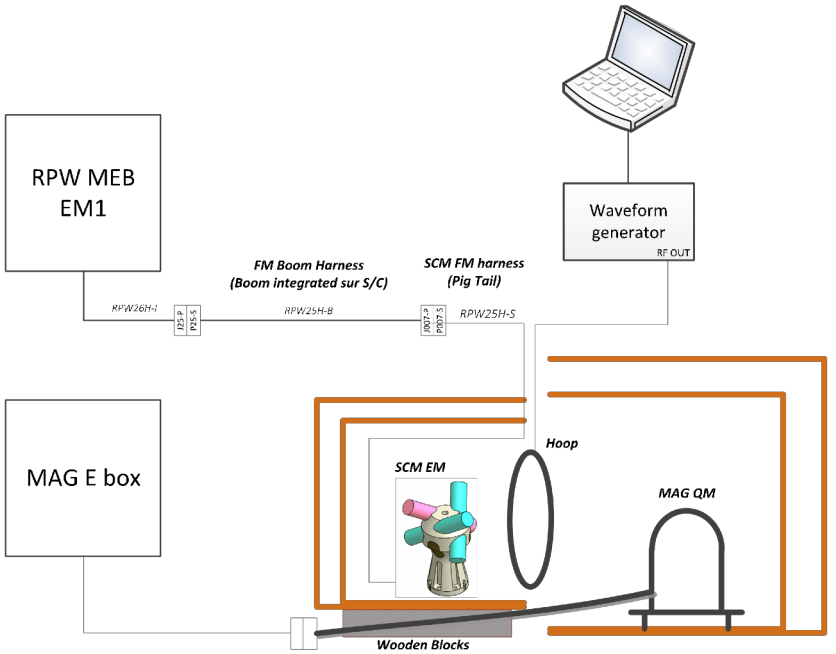
Software: J.Y. Brochot, *Manuel Saunier* (replaces Gamil Cassam Chenai who has left in july 2018)

SCM status

Time synchronization test with MAG

- Purpose : determine the frequency-dependent relative time delay of magnetic field measurements by the Solar Orbiter MAG and RPW instruments to a precision of at least 1ms
- Test planned at Airbus on U-OTB with SCM and MEB EM and MAG EM

- Send a common recognizable stimulus to MAG and SCM and verify/quantify the time delay
- Time synchronization given by S/C to MAG and RPW

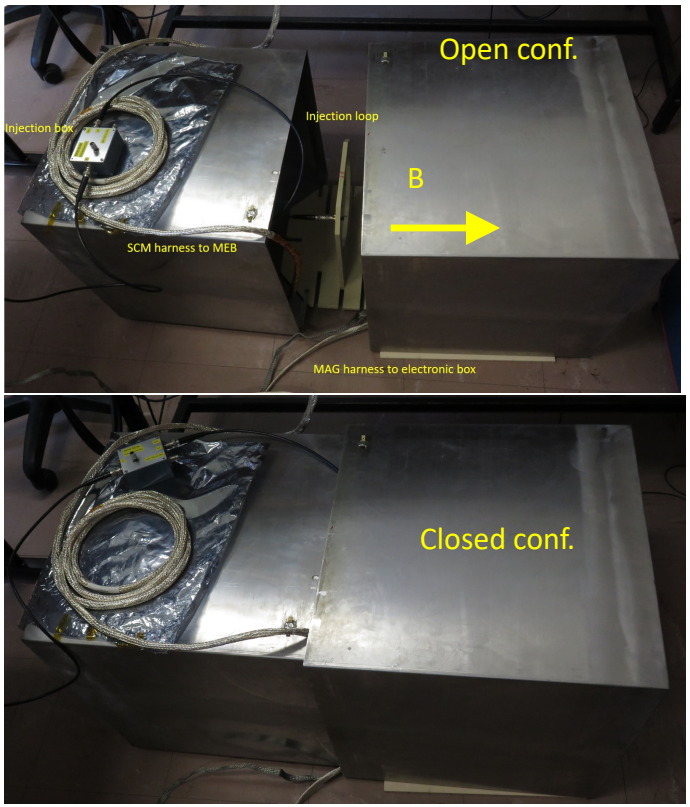


SCM status

Time synchronization test with MAG

- "rehearsal" of the test intended to be performed on the U-OTB in order to validate the feasibility of the measurements done in September at LESIA (because no time synchronization available)

  check the risk of MAG/SCM interferences,
  50HZ disturbances …

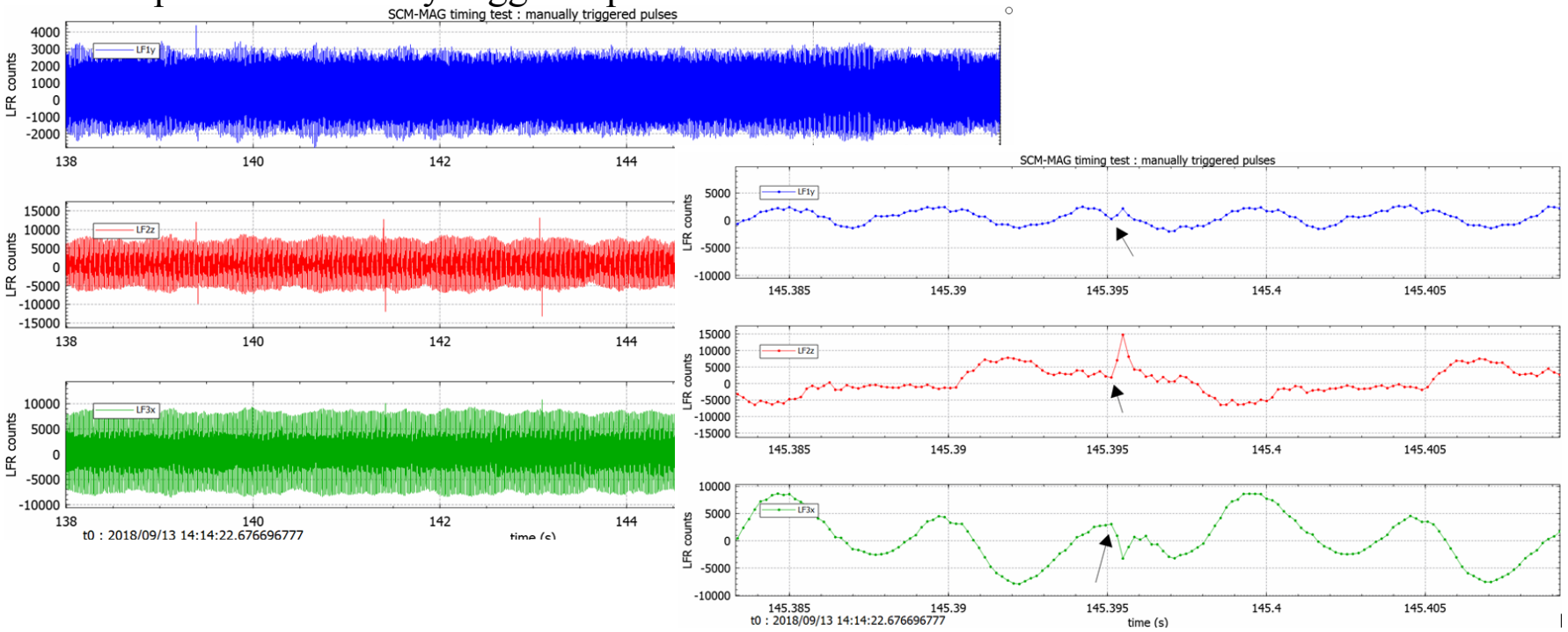


- 2 kinds of stimuli to test
  - Manually triggered pulses
    ⇒ time domain verification
  - Sinus
    ⇒ Fourier domain verification

SCM status

Time synchronization test with MAG

- Example with manually triggered pulse



- Both tests can and will be done (sinus and pulses)

  ⇒ Test procedure sent to Airbus last week

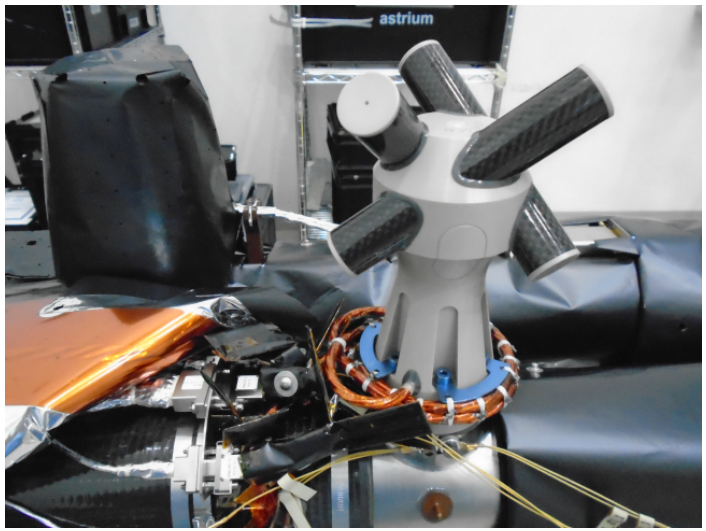
On going work, Date of the test is TBD

SCM status

Integration of SCM fligth model

- Anomaly in December 2018 on MlLI because of contamination due to the velcros
  ⇒ MLI sent back and retrofitted : velcros have been removed and replace by studs
- Delivered at Airbus in January 2019
- January 2019 : Harnesses MLI implemented → SCM mounted on the boom

SCM MLI not implemented because of the risk of damage during vibrations



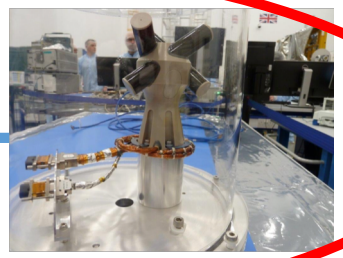
SCM status

Integration of SCM fligth model

- Pending task : cleaning of SCM and implementation of the instrument MLI

SCM Calibration status

LFR, TDS, HFR



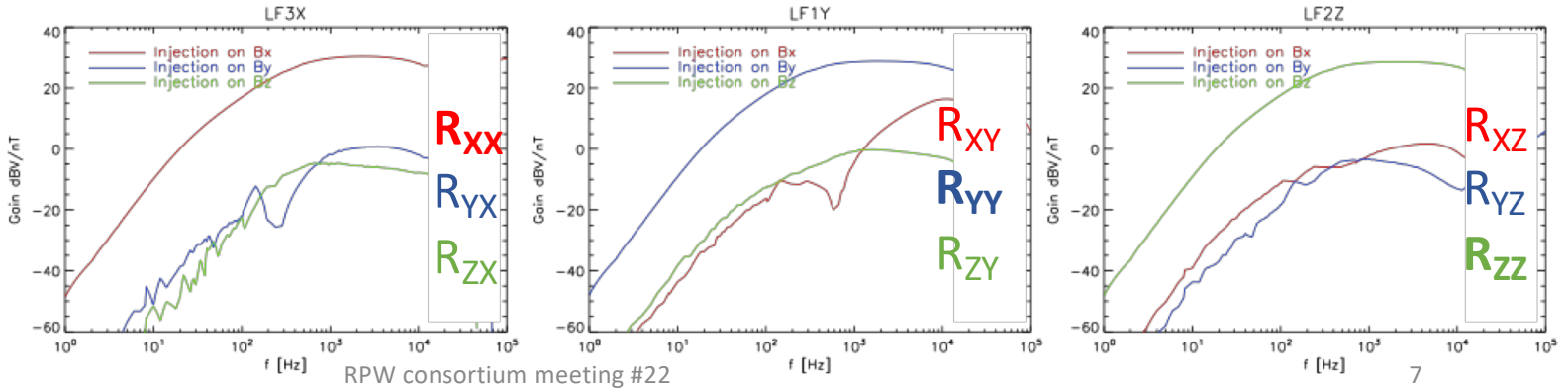
Reminder:

1) Cross talk

2) (SCM+MEB) ≠ SCM +MEB

Matrix calibration grossly validated for SCM FM ans FS at ambiant temperature

$$\begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix} = \begin{bmatrix} R_{xx} & R_{xy} & R_{xz} \\ R_{yx} & R_{yy} & R_{yz} \\ R_{zx} & R_{zy} & R_{zz} \end{bmatrix} \begin{bmatrix} B_x \\ B_y \\ B_z \end{bmatrix}$$



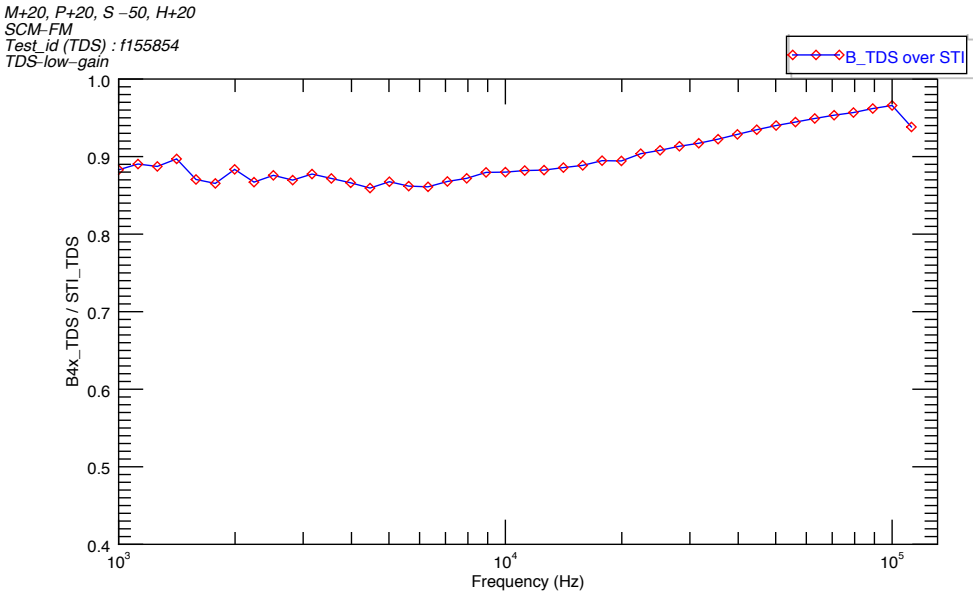
SCM Calibration status

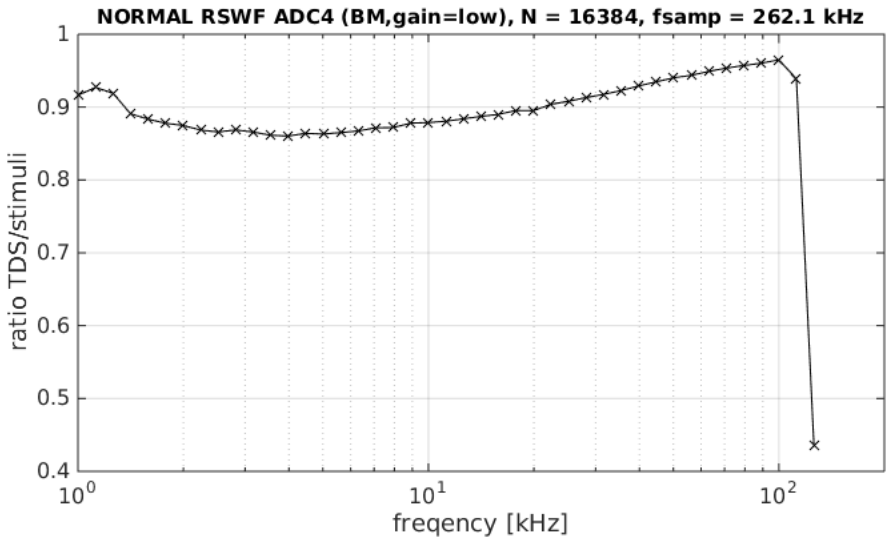
- FS LF matrix calibration has been measured at ambiant, with the MEB connected in the following configuration:
  - LFR ON and TDS HF
  - LFR OFF and TDS LFM
- FS MF transfert function has been measured at ambiant, with the MEB connected in the following configuration:
  - LFR ON and TDS HF

- The value contained in the SCM RCT file are not definitive !
- In particular, they need to be extrapolated at operating temperature of -50°C

MF4X

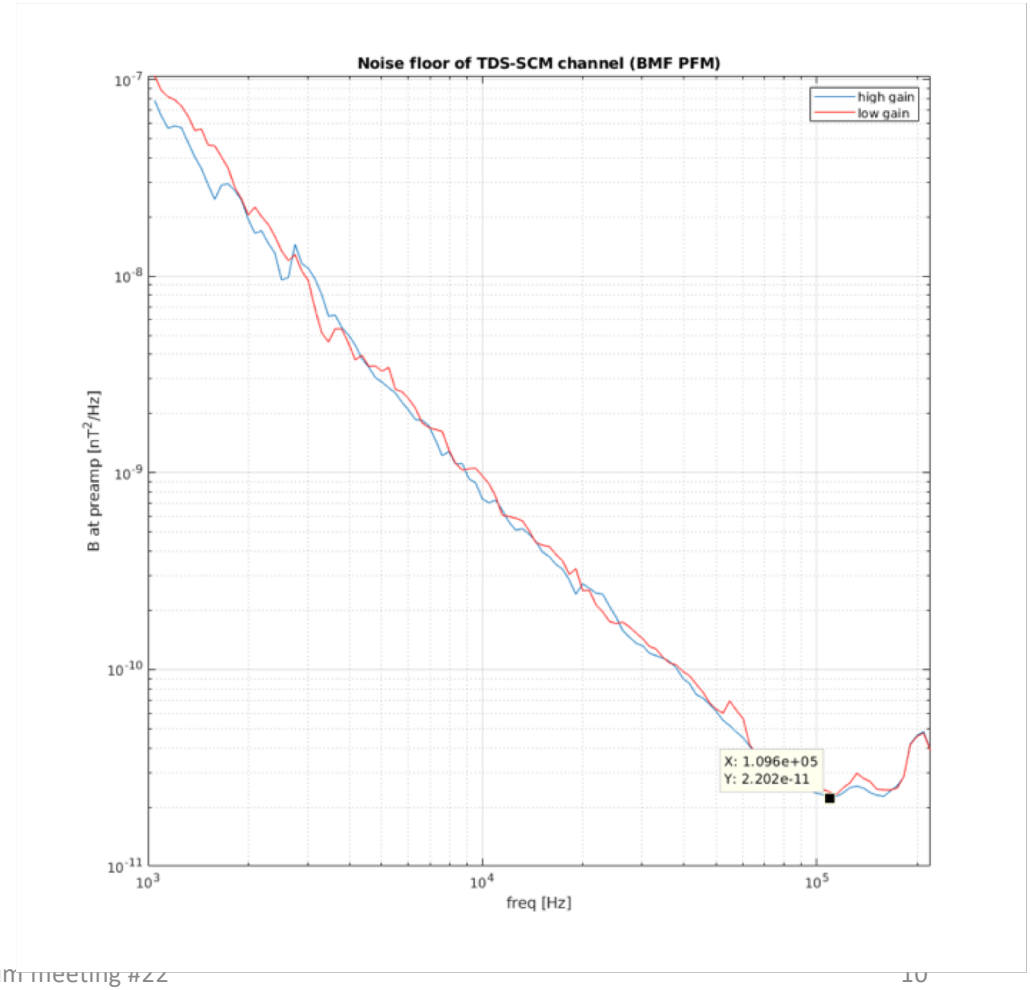
- The influence of Y and Z antennas on the bi band X antenna has been measured.
- Extrapolation in temperature to be made if necessary (to be checked)
- **(SCM+MEB) ≠ SCM +MEB**





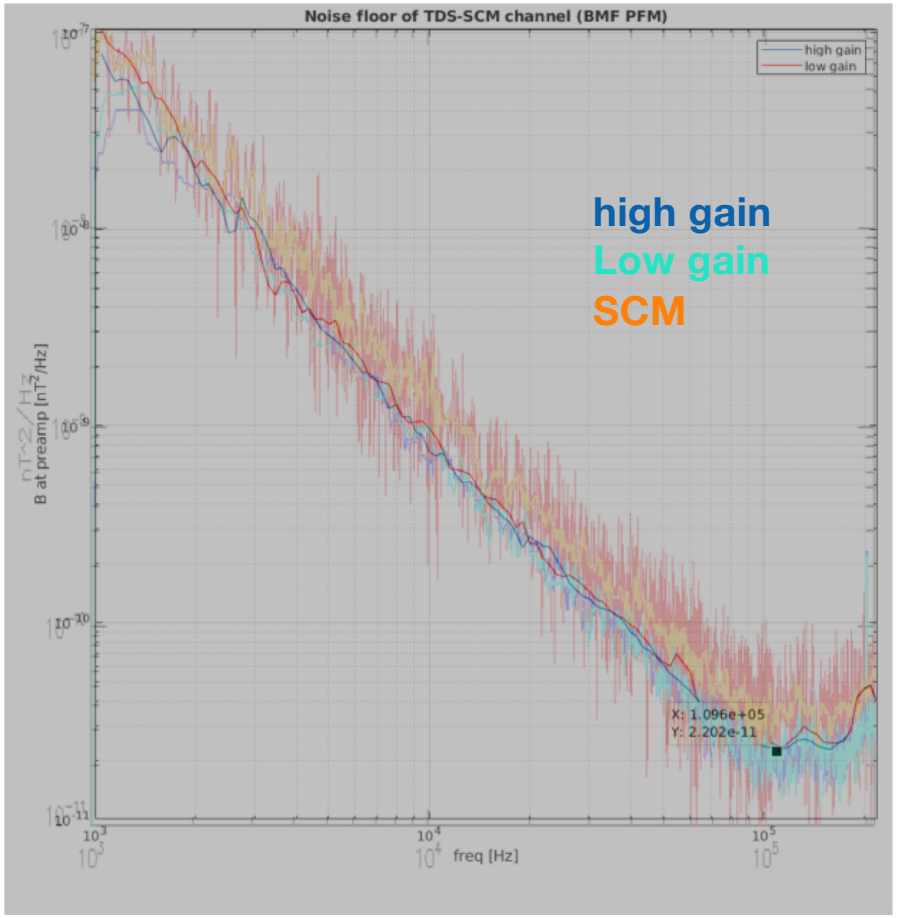
MF4X

- Agreement on MF noise between TDS and SCM team
-



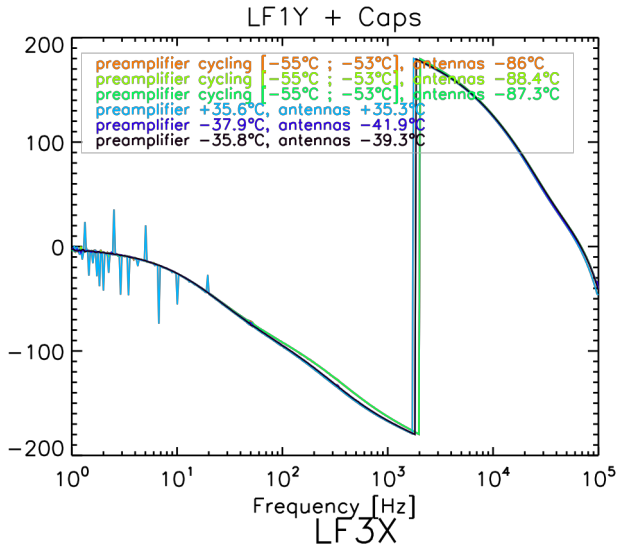
MF4X

- Agreement on MF noise between TDS and SCM team
- But the values are wrong because of the calibration
- Current SCM MF RCT do not take into account this
- To do: Update transfert function, compare WF and HFR measurements

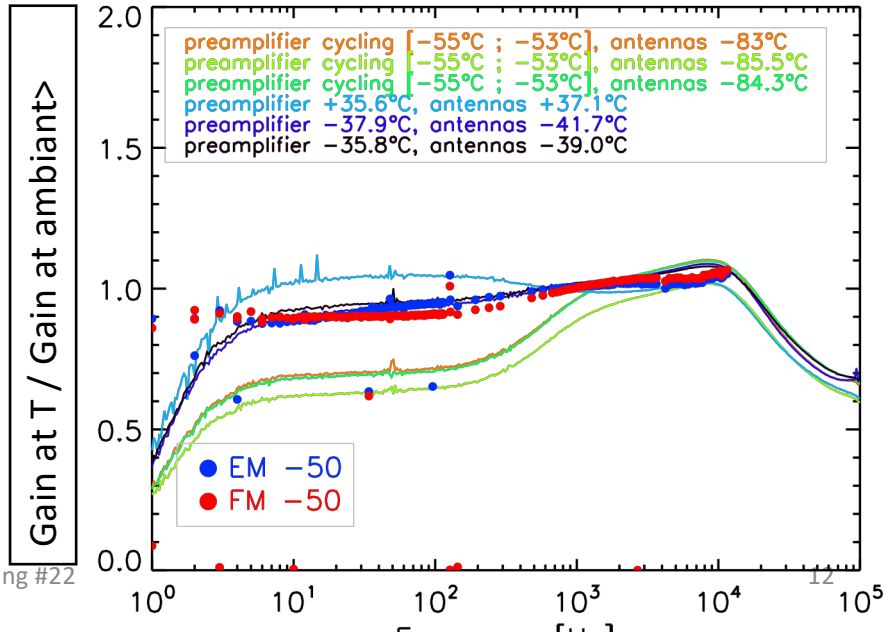


Temperature extrapolation (LF case)

- Phase do not change with temperature



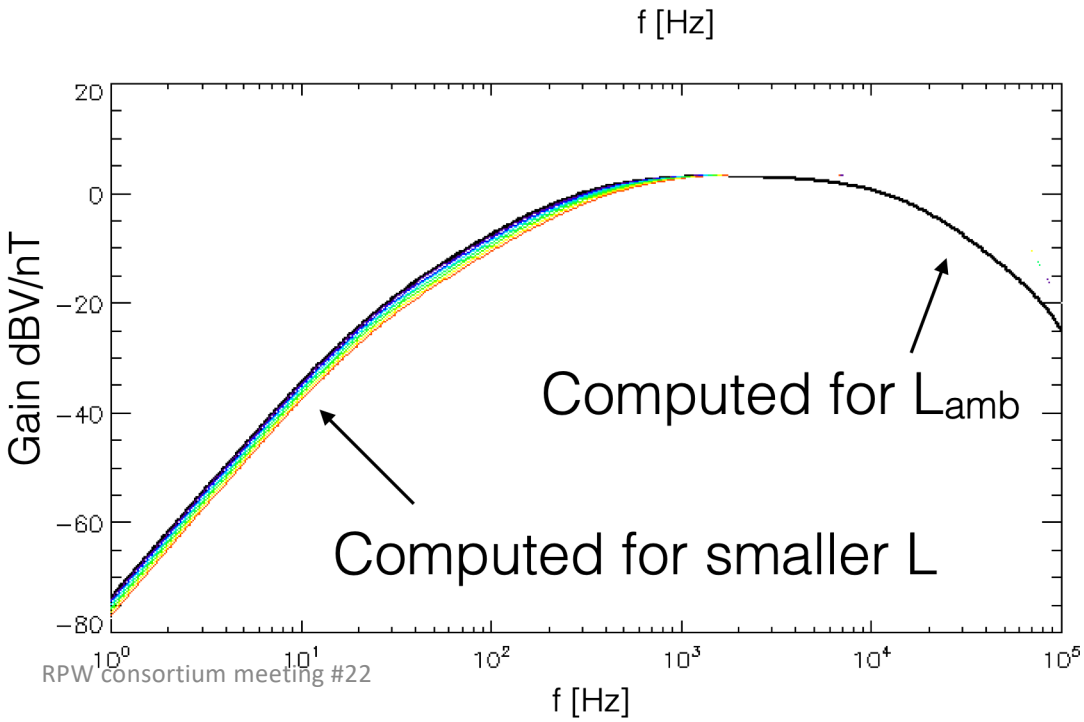
- SCM Gains do change with temperature



Modeling temperature dependence (1)

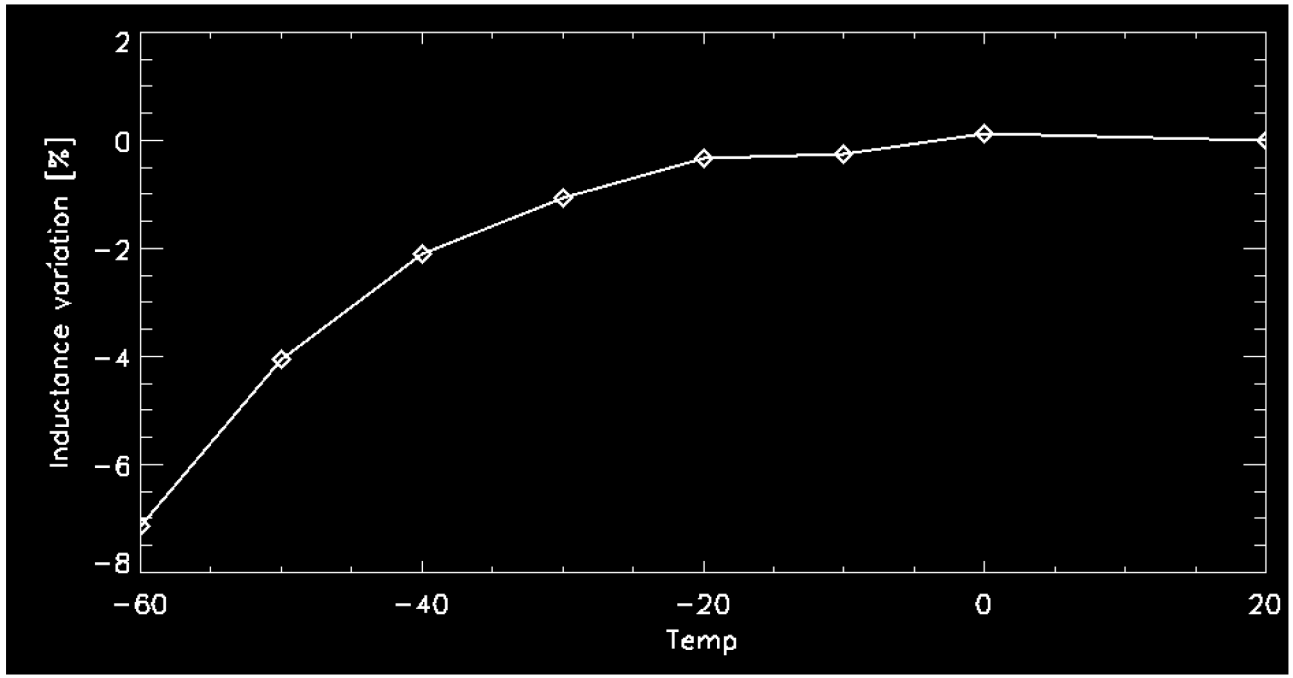
$$\frac{V_o}{B}(\omega) = \frac{-j\omega\mu_a NSG}{1 - L_p C\omega^2 + j\omega(R_{sc}C + GM/R_{fb})}$$

- Analytical formulae from equivalent circuit.
- Low frequency part dominated by the inductance of antenna
  - **M** and **L** depend on μ_a



Modelling temperature dependence (2)

- The decreasing gain at low temperature and low frequency is caused by lower μ_A, and can be traced by the inductance
- To do:
  - Uses observed L(T) to deduce V/B(T) and apply it to the measured calibration matrix
  - Validate with FM measurements



Antenna inductance decreases with low temperature

Remaining work

- LF Antenna:
  - Extrapolate FM matrix calibration at -50 °
  - Validate matrix calibration on FM measurements made at LESIA at -50°
  - Extrapolate FS matrix calibration
- MF Antenna:
  - Fix calibration at ambiant
  - Extrapolate in temperature if necessary
- RPW B calibration validation (LFR, HFR):
  - Select various tests with contemporary WF and spectral products, calibrate and compare (**Compulsory**)

Proposals for LFR and HFR teams

- Select various tests with contemporary WF and spectral products, calibrate and compare
- Compulsory tests

SOFTWARE: SCMCAL information

SCMCAL deliveries

- V0.6.0 (14/12/2017)
  - Presented in Consortium Meeting RPW #21
- V0.7.0 (19/11/2018)
  - The entry files are L1R (no longer support of L1)
  - Make use of RCT from LFR and TDS
  - Make use of different transfer matrix when using LFR or TDS
  - Make use of SCM temperature (HK_RPW-LFR is mandatory)
  - Parameters (temperature, CALIBRATION_TABLE_INDEX, …) may vary inside one L1R file
  - Not compliant with the last version of the ICD (Iss.01, Rev.02 draft)

Computing transfer matrix for SCM FM2 at -50°

- Using RPW data tests, SCM stand alone calibrations and modeling of SCM to deal with temperature influence

Team composition changes

- Gamil Gassam Chenaï's contract ended in june 2018
- Manuel Saunier joined us in february 2019

SCMCAL V0.7.0 Processed Datasets

from L1R	Dataset L2S	Dataset L2	Transfer Functions
LFR			
	ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B_V03 ✓	SOLO_L2_RPW-LFR-SBM1-CWF-B_V01	
	ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B_V03 ✓	SOLO_L2_RPW-LFR-SBM2-CWF-B_V01	
	ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B_V03 ✓	SOLO_L2_RPW-LFR-SURV-CWF-B_V01	
	ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B_V03 ✓	SOLO_L2_RPW-LFR-SURV-SWF-B_V01 ✓	RCT LFR
TDS			RCT TDS
	ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B_V03 ✓	SOLO_L2_RPW-TDS-LFM-CWF-B_V01	
	ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B_V03 ✓	SOLO_L2_RPW-TDS-LFM-RSWF-B_V01	RCT SCM
	ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B_V03 ✓	SOLO_L2_RPW-TDS-SBM1-RSWF-B_V01	
	ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B_V03 ✓	SOLO_L2_RPW-TDS-SBM2-TSWF-B_V01	
	ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B_V03 ✓	SOLO_L2_RPW-TDS-SURV-RSWF-B_V01	
	ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B_V03 ✓	SOLO_L2_RPW-TDS-SURV-TSWF-B_V01	

Consequences of Interface changes

Unification of L2S and L2 into L2

- only 10 skeleton files to maintain rather than 20,
- only some small changes to do inside our L2S skeletons (some GlobalAttr)
  What is the data version since ROC-SGSE data L2S were V03 while L2 data were V01 ?
  Same question for L1R data.

Only 1 descriptor for the the 2 pipelines

- only 1 default configuration file (that permit SCMCAL to chose the RCT to use)
  No problem until it is possible to pass a specific configuration file to the CLI.

➔We agree with the changes proposed as long as the analyzers teams also do the changes

➔ We will be ready for integration of SCMCAL into the ROC mid of April 2019

Since LFR_HK is now an entry of SCMCAL (to obtain SCM temperature),

- How to process tests where HK_LFR is missing ? (ICD document indicates that RCS is not launched when an entry is missing)
  Is it possible to have optional argument ?
  In this case we could guess that the temperature is the default one –50° and raise a bit of the QUALITY_FLAG.

TO DO

- Make changes to be compliant with the latest version of the RCS ICD
- Decide of the relevant bits of QUALITY_BITMASK for SCM
- Decide the rules to raise these bits
- Code this into SCMCAL (for every 10 functions)
- Add variables for B in the chosen frames in the skeletons
- Compute B in the chosen frames
- When all RCS will be integrated and the ROC has produced L2 data, special comparisons must be made between spectrum computed from calibrated waveforms and calibrated spectrum to ensure calibration is correct.