Radio and Plasma Waves

SCM status

M. Kretzschmar and SCM team
LPC2E

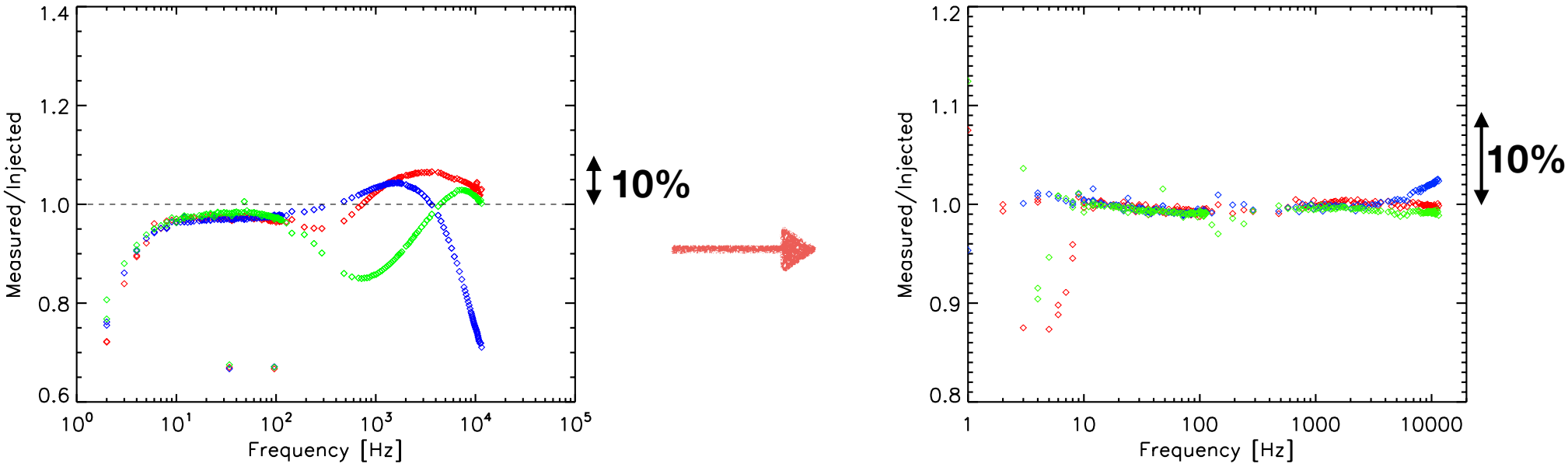
SCM news

- Calibration:
  - Extrapolation in temperature of calibration matrix
  - EMC/FFT
  - Onboard calibration
- Software: see presentation by JYB
- Various:
  - M. Saunier has left us, now recruiting

SCM Calibration

- Cross talk necessitates to calibrate by taking into account all antenna
  - Matrices measurements must be done with MEB
  - Done at Airbus at ambiant temperature.

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



SCM Calibration

- All FS measurements made at T_{amb}
  - but will operate a T_{PA}=-50°C, $T_{Antenna}$=-57.7°C (TBC)
  - Extrapolation in temperature is needed

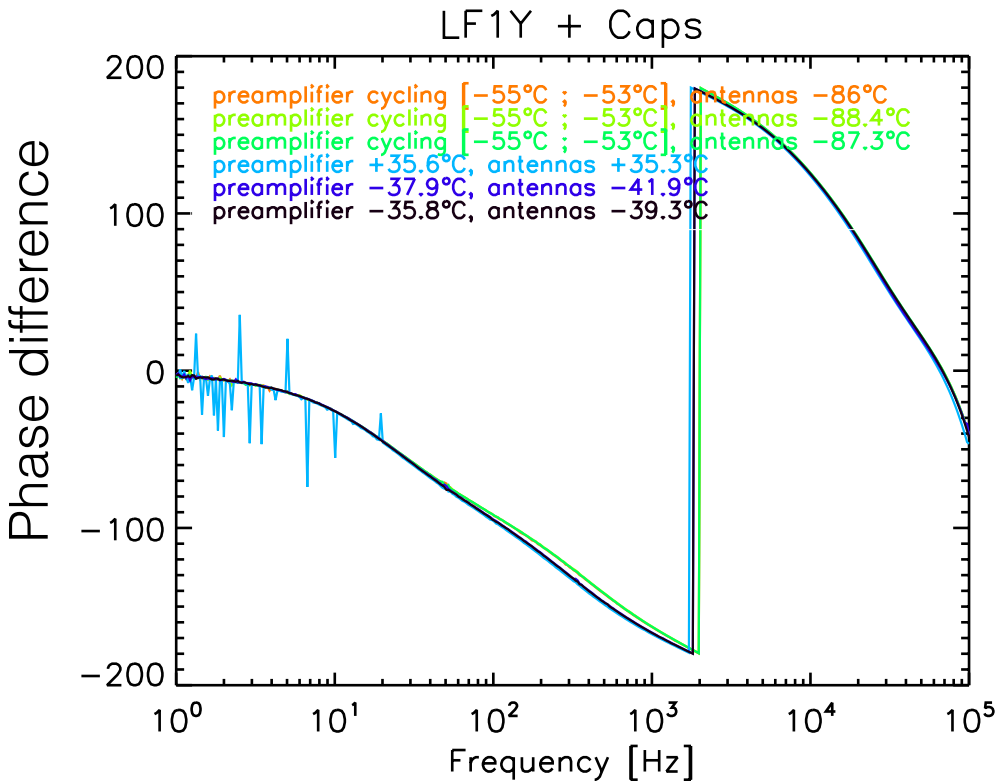
(+20°)

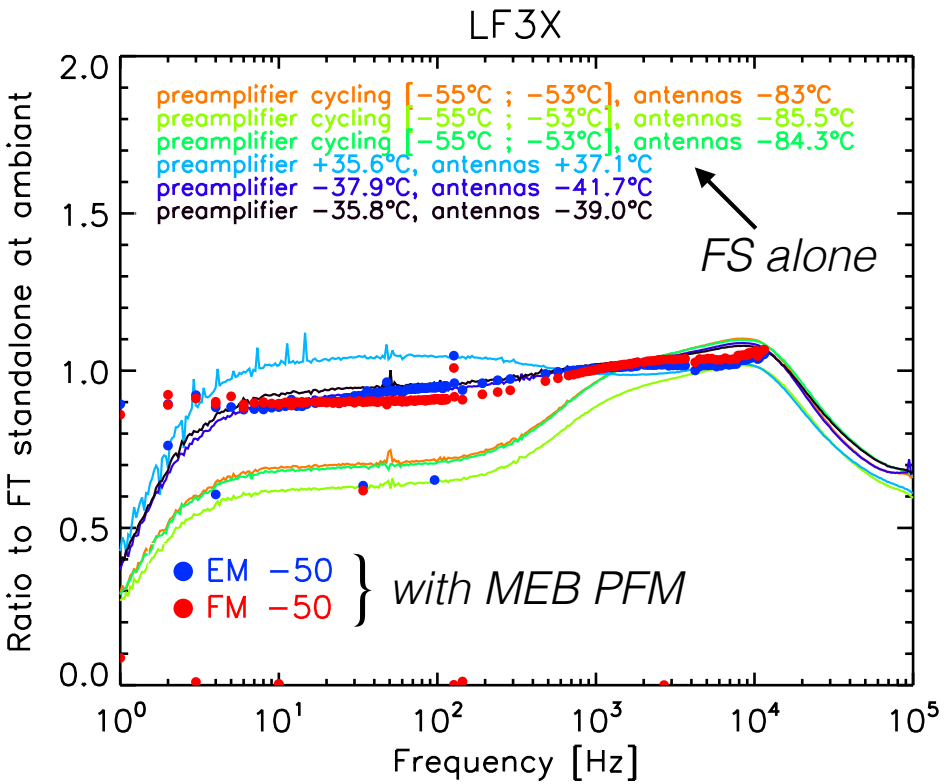
$$\begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix} = \begin{bmatrix} R_{xx} & R_{xy} & R_{xz} \\ R_{yx} & R_{yy} & R_{yz} \\ R_{zx} & R_{zy} & R_{zz} \end{bmatrix} \begin{bmatrix} B_x \\ B_y \\ B_z \end{bmatrix}$$

(-50°)

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

Temperature dependency of transfert function



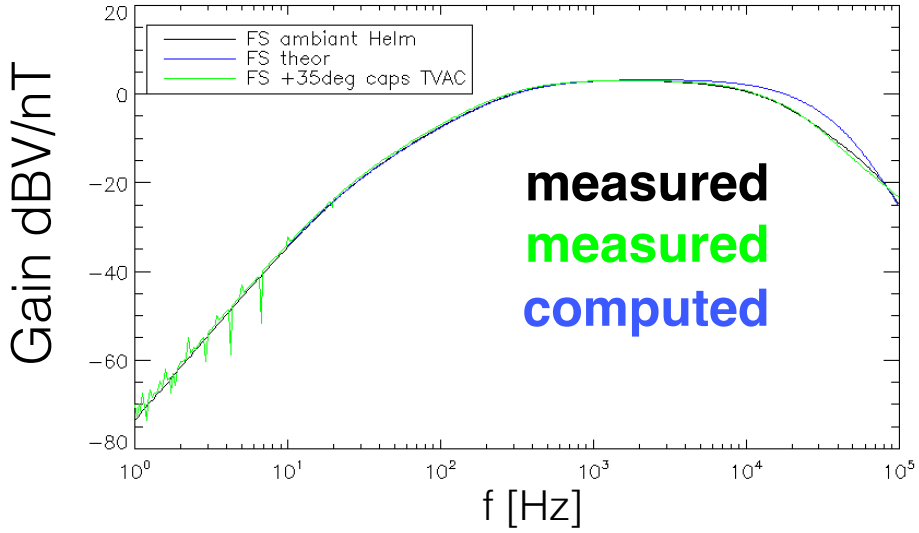


- ➡ Phase is constant
- ➡ Gain is changing, but similarly on different SCM models
- ➡ Temperature sensitivity is on antenna only

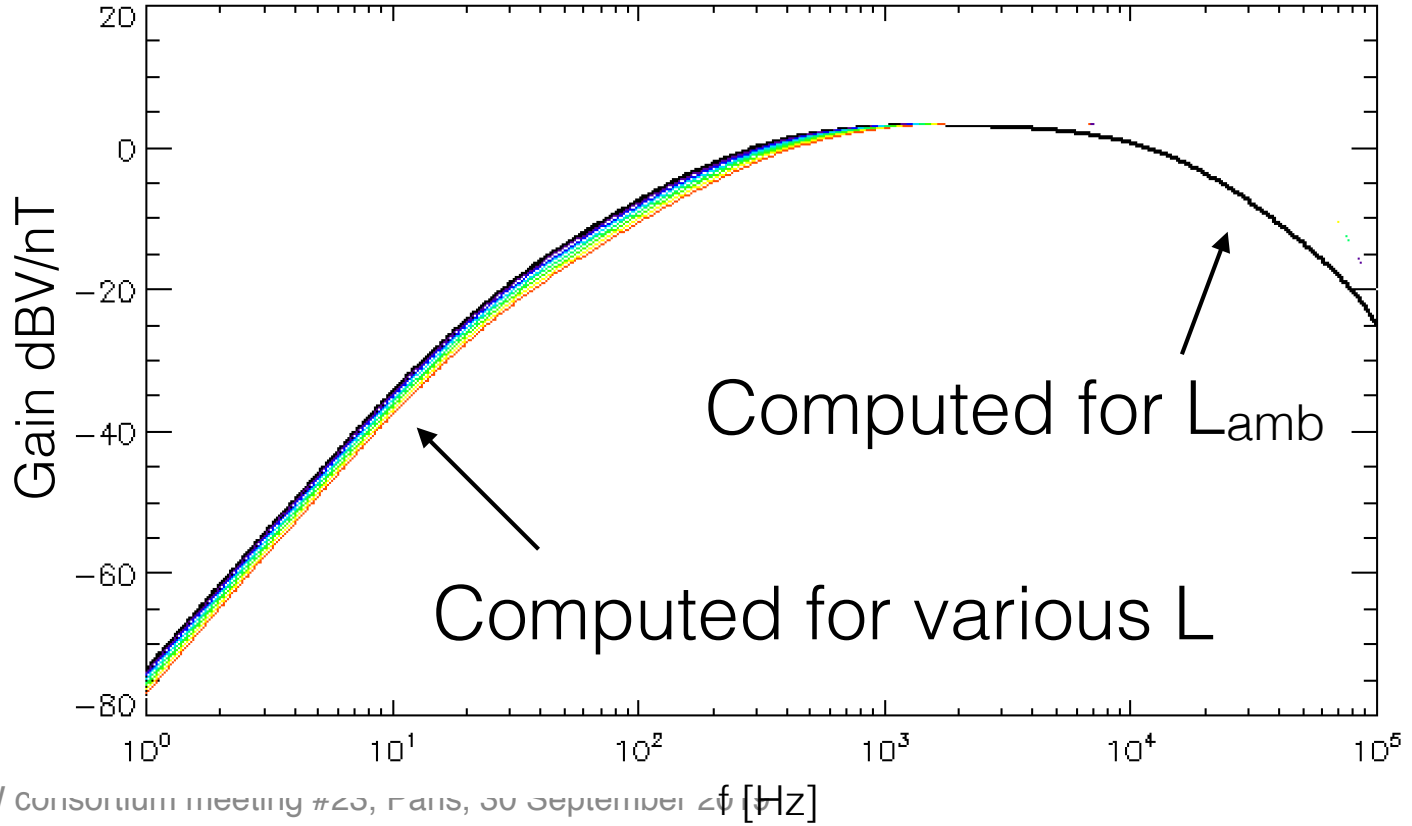
Theoretical Transfert function for SCM

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

- Analytical formulae from equivalent circuit.

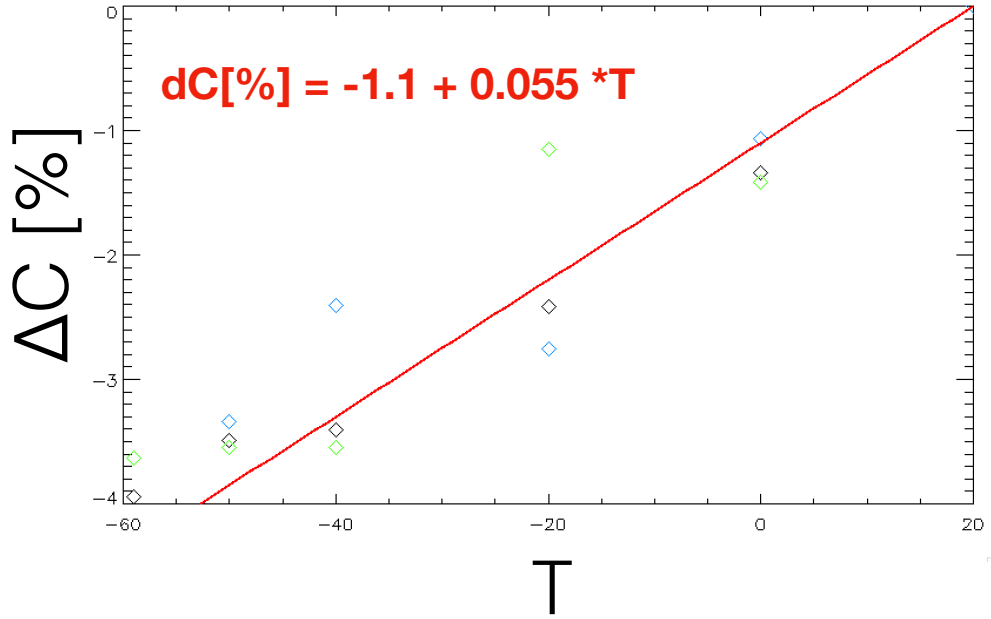


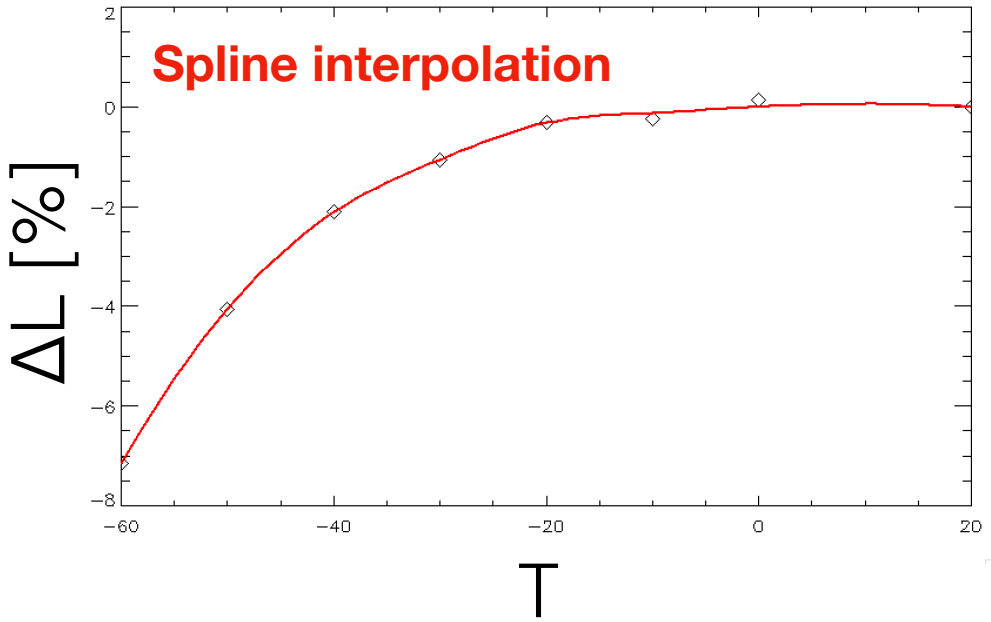
- Low frequency part dominated by the inductance of antenna
  - **M** and **L** depend on **μ_a**

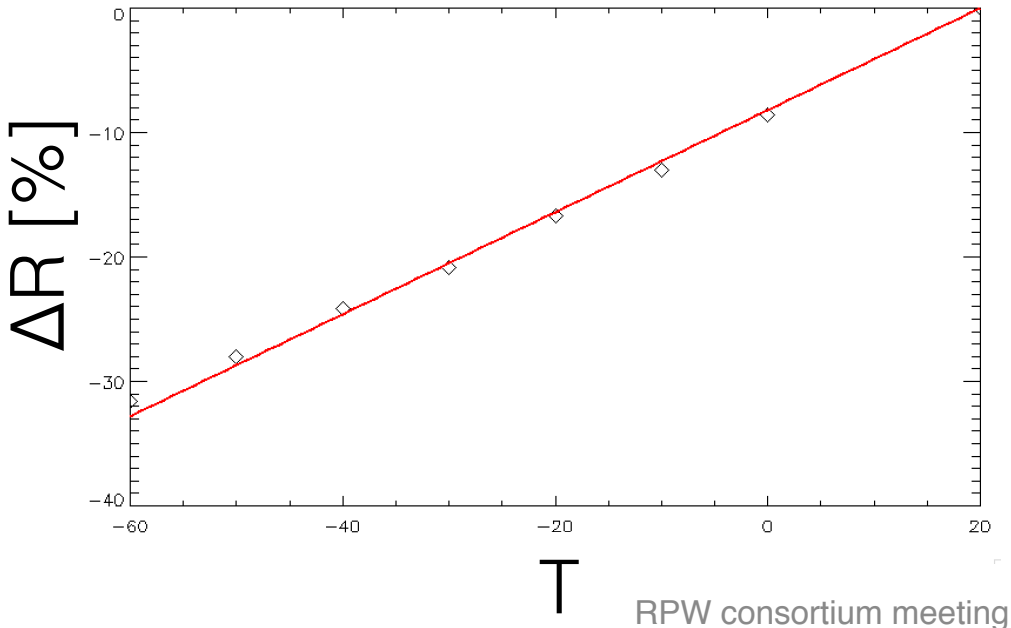


- R_{SC} and C can also depend on temperature

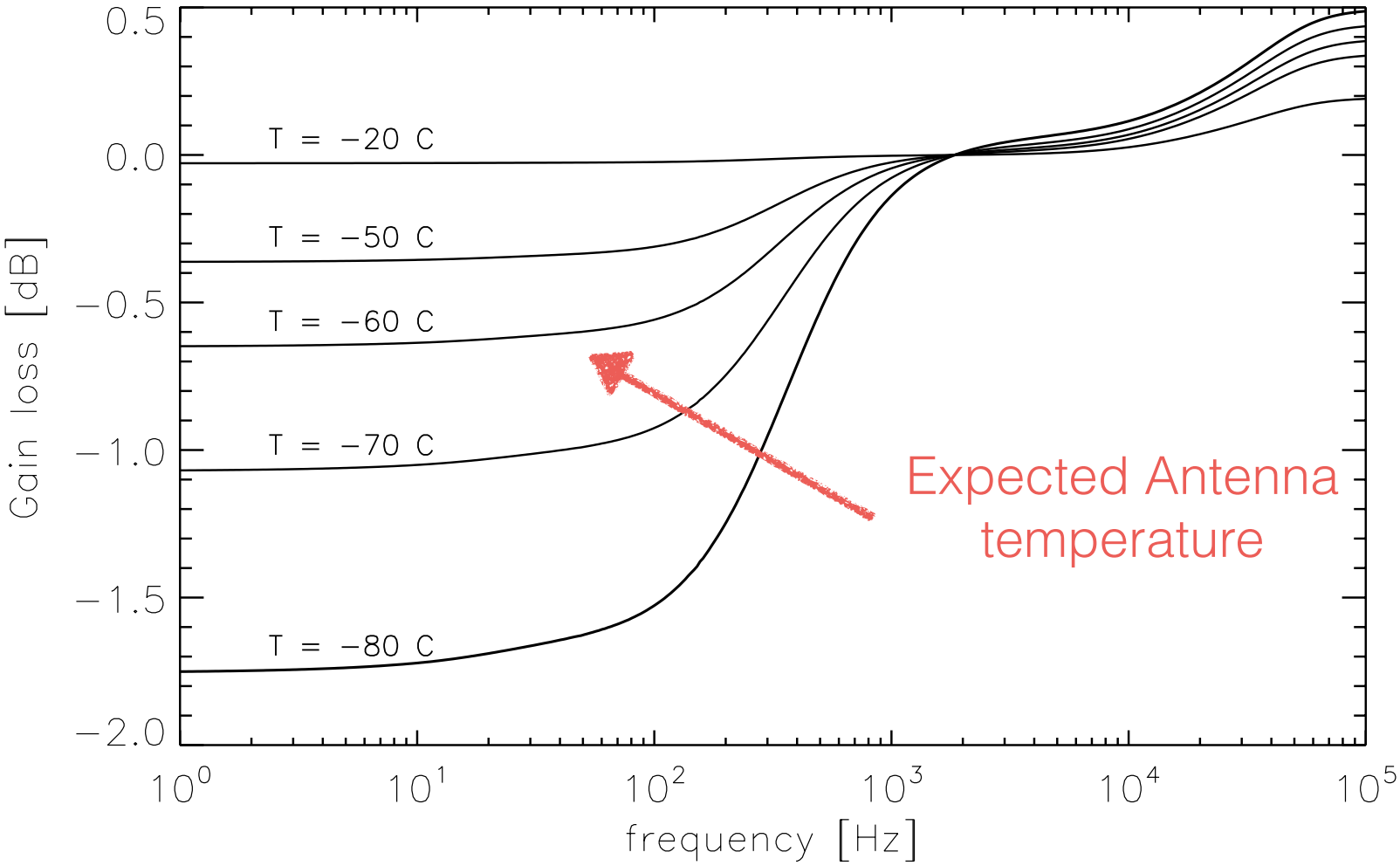
Variation of Antenna parameters



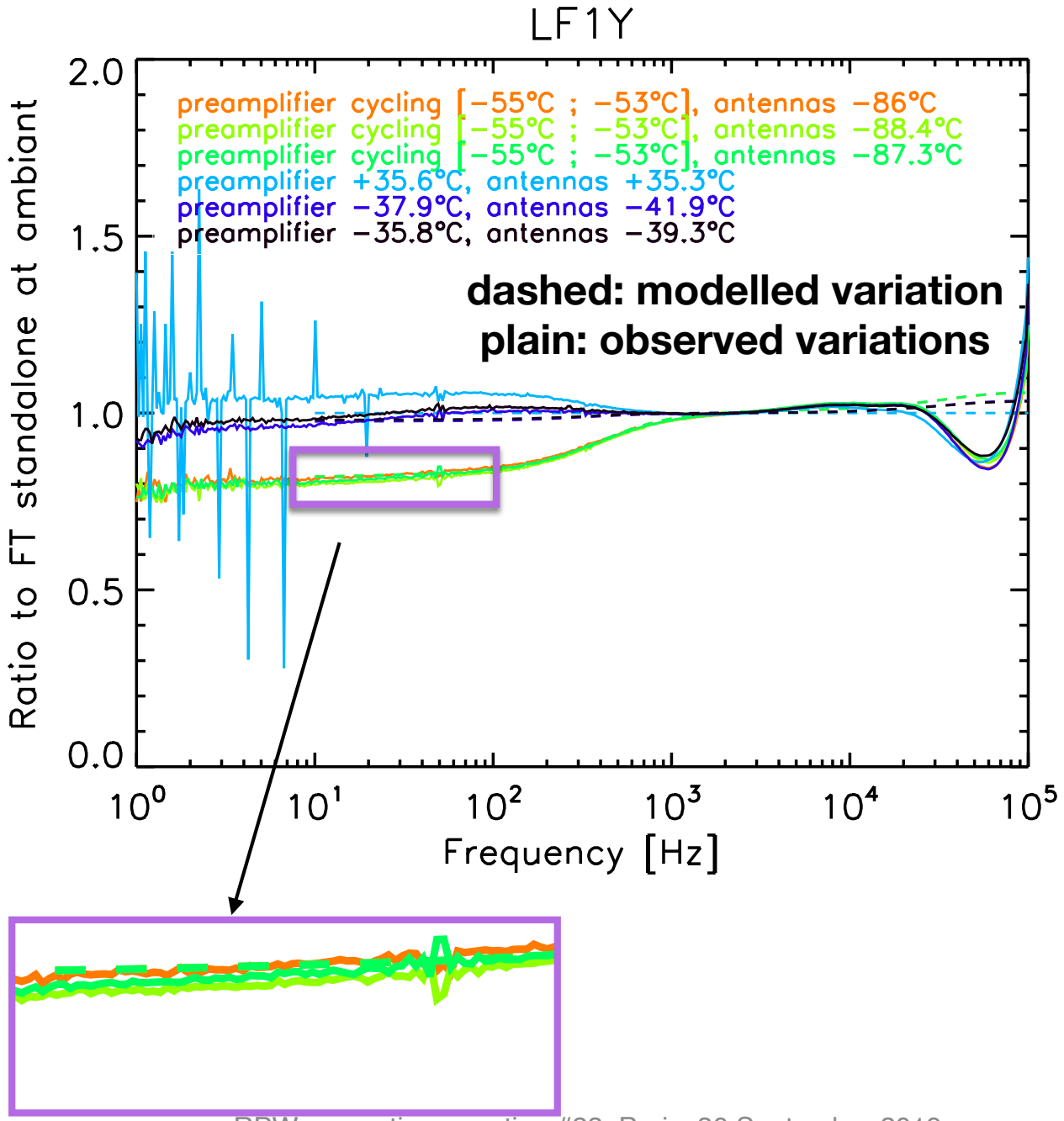




Variation of Antenna gain



Comparison


LF1Y
preamplifier cycling [−55°C ; −53°C], antennas −86°C
preamplifier cycling [−55°C ; −53°C], antennas −88.4°C
preamplifier cycling [−55°C ; −53°C], antennas −87.3°C
preamplifier +35.6°C, antennas +35.3°C
preamplifier −37.9°C, antennas −41.9°C
preamplifier −35.8°C, antennas −39.3°C
dashed: modelled variation
plain: observed variations
Ratio to FT standalone at ambiant
2.0
1.5
1.0
0.5
0.0
10^0
10^1
10^2
10^3
10^4
10^5
Frequency [Hz]

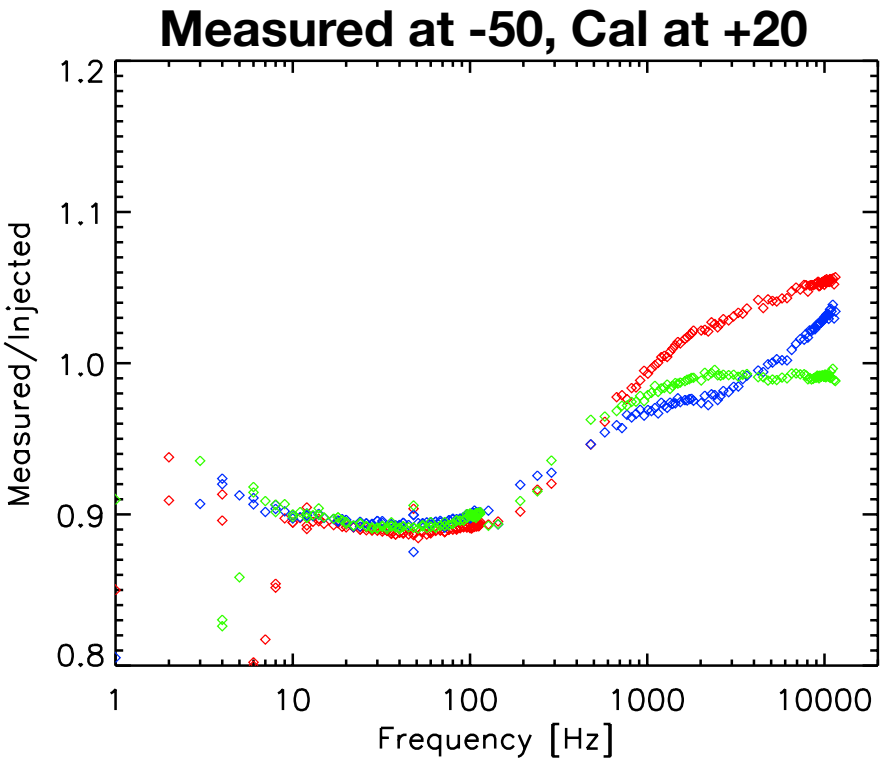
SCM waveform Calibration

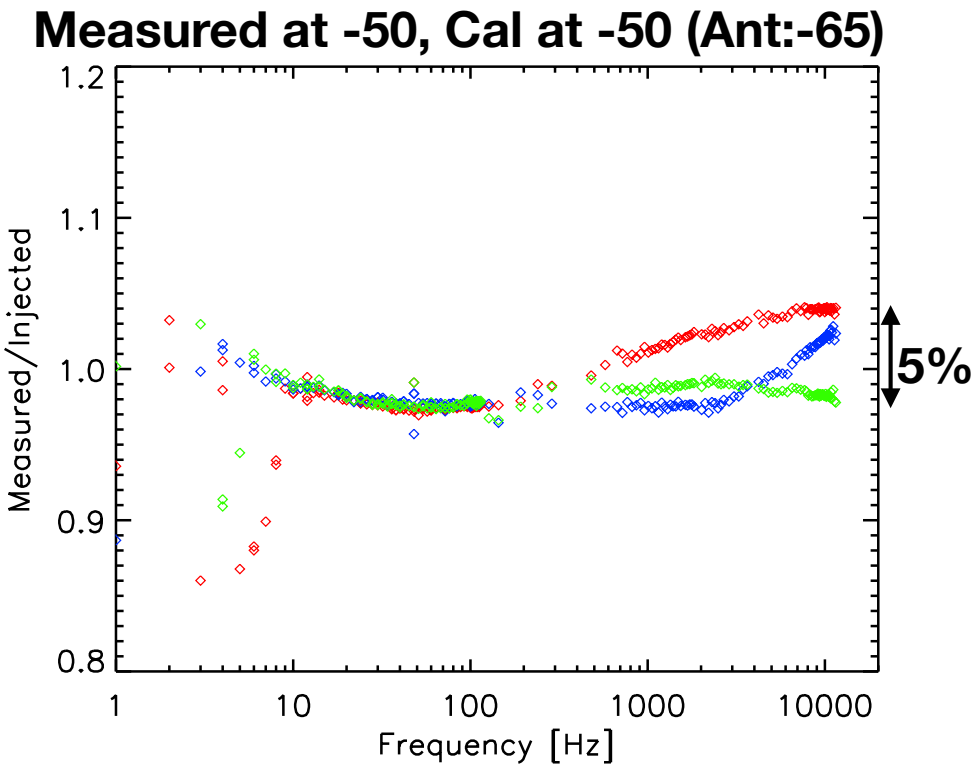
(+20°)

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

(-50°)

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

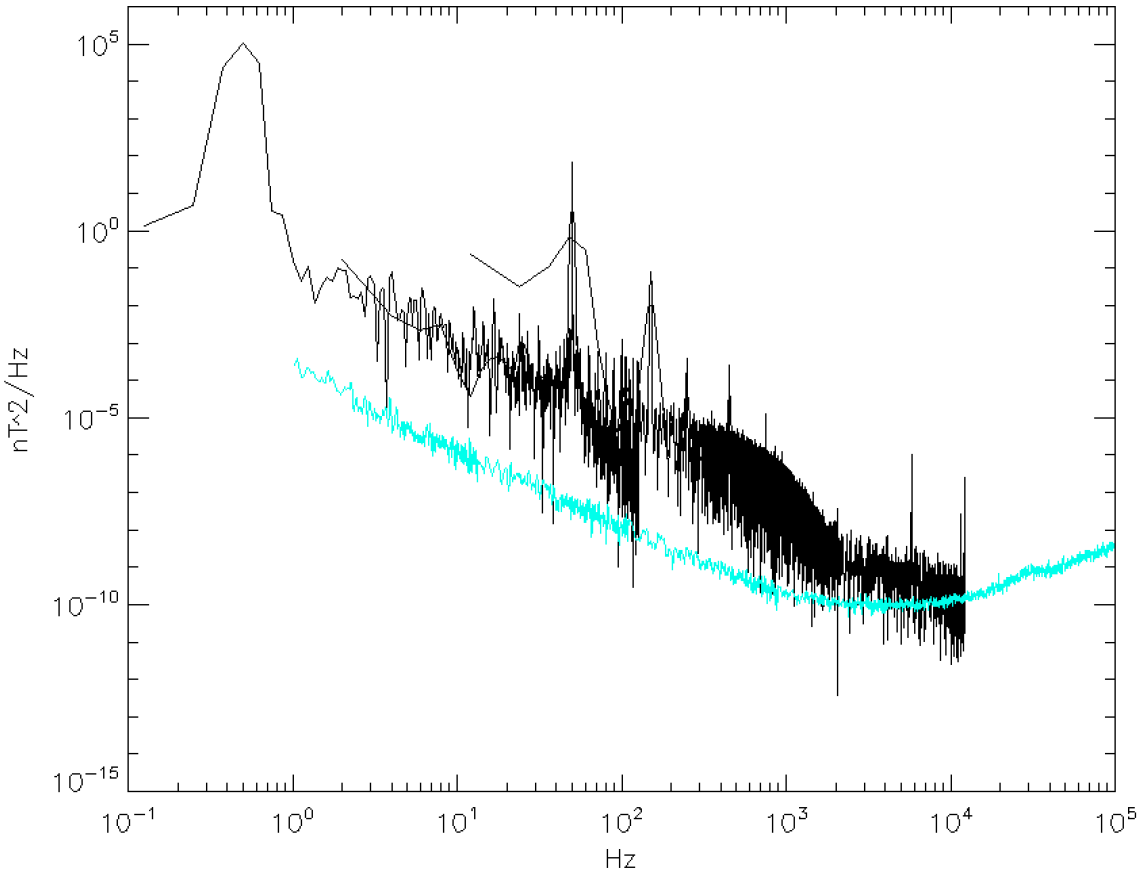




FFT

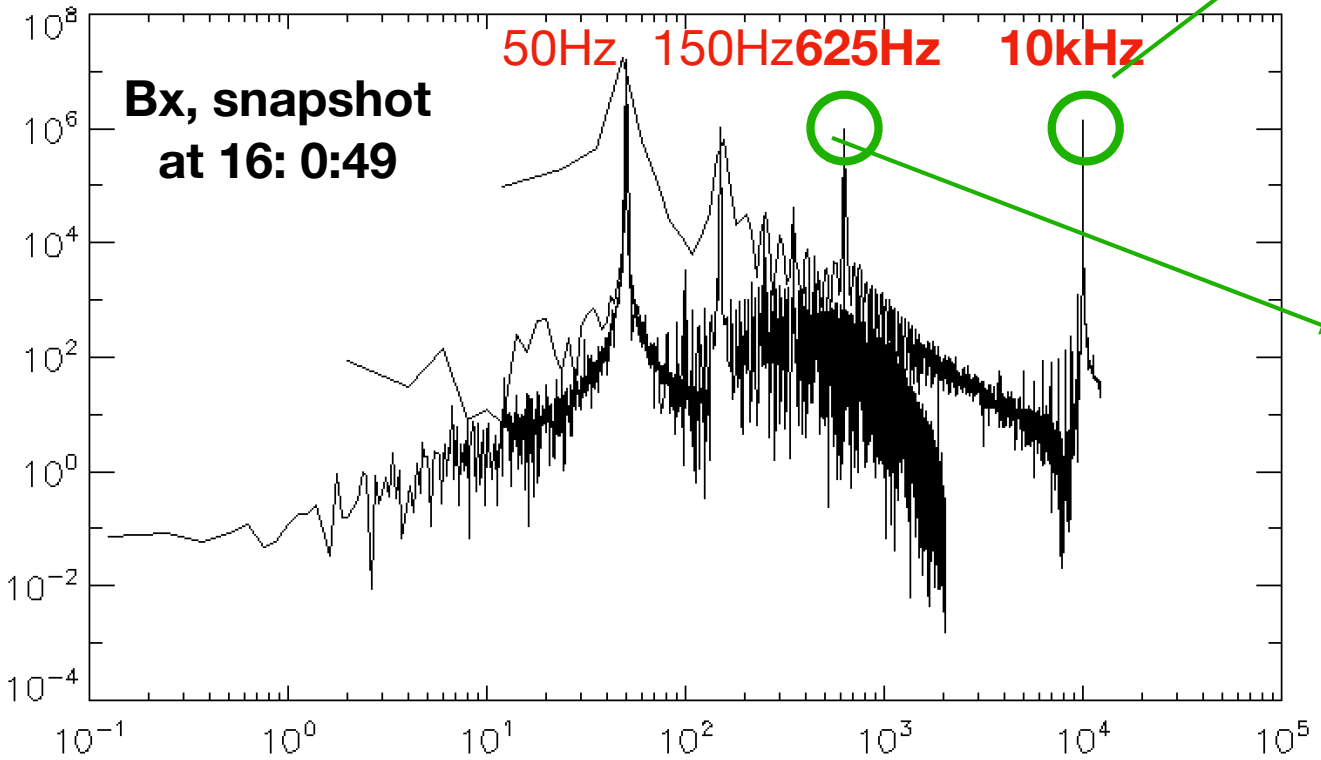
- General background above SCM noise floor.
- 50 Hz and harmonics
- Some spurious whose origin is unclear
- No reaction wheels
- FFT sweeps detected

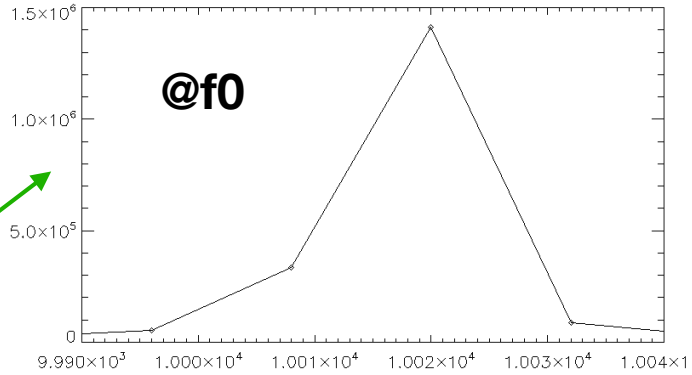
One casual FFT spectrum vs SCM noise floor

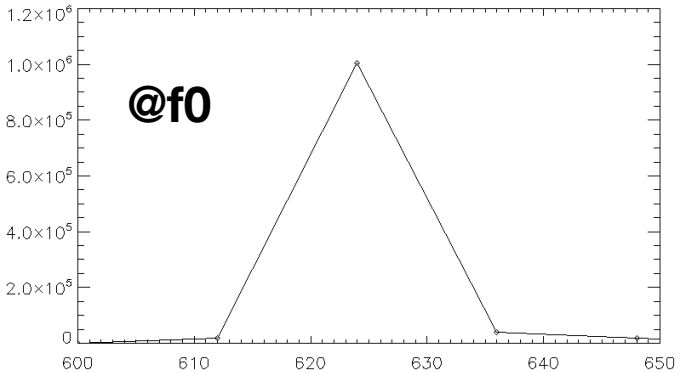


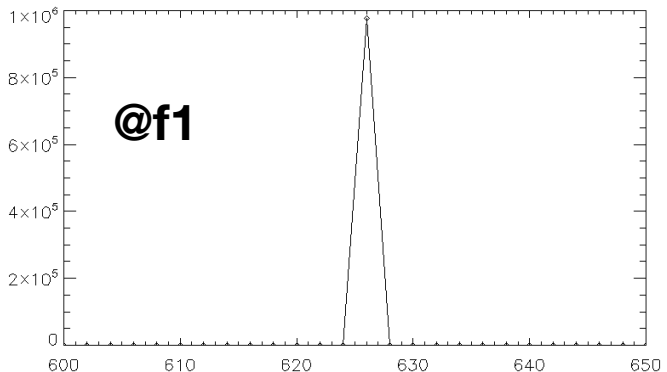
SCM Onboard calibration

- LFR send 5 snapshots with 2 frequencies each.
- Never tested on MEB PFM
- Played during FFT but only 2 snapshots (too short recording)



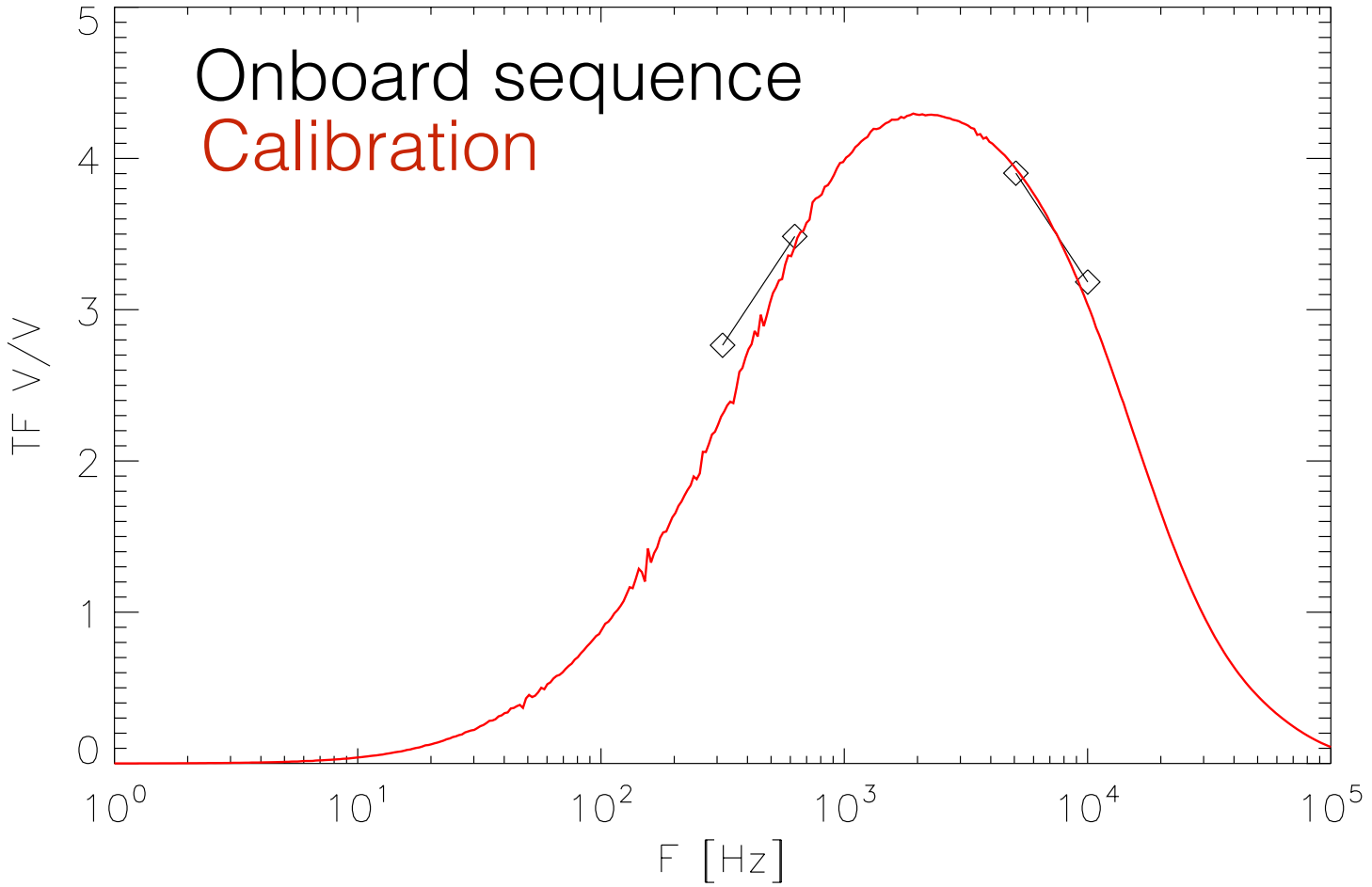






SCM Onboard calibration

- LFR send 5 snapshots with 2 frequencies each.
- Never tested on MEB PFM
- Played during FFT but only 2 snapshots



SCMCAL information

SCMCAL deliveries

- V0.8.0 (22/05/2019)
  - Unification L2S and L2
  - Suppression of the variables ACQUISITION_TIME, TIME_SYNCHRO_FLAG
  - Calibration dealing with FILLVALUES
- V0.9.0 (10/07/2019)
  - Support of master CDF V04
  - New format line in the log files (with the date as prefix)
  - New log files are lighter when using the verbose option INFO (witch is the option in this delivery)
  - The existence of the global attributes is systematically tested before use (for input and output files)
    This helps SCMCAL to work with older versions of L1R data files
  - Integrate the corrections of "descriptor.json" made during the integration of SCMCAL V0.8.0 in the ROC

SCMCAL was successfully integrated in the ROC

Computing transfer matrix for SCM FM2 at 20°

- We computed a good transfer matrix using RPW data tests (measurement at Airbus) and SCM stand alone calibrations for SCM-FM2 and MEB PFM

Team composition changes

- Manuel Saunier did not renew his contract at the end of June 2019
- We are looking for a new software engineer

SCMCAL V0.9.0 Processed Datasets

from L1R	Dataset L2S	Dataset L2	Transfer Functions
LFR			RCT LFR & RCT TDS (given in L1R files); RCT SCM (given in config file)
	ROC-SGSE_L2S_RPW-LFR-SBM1-CWF-B_V03	SOLO_L2_RPW-LFR-SBM1-CWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-LFR-SBM2-CWF-B_V03	SOLO_L2_RPW-LFR-SBM2-CWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-LFR-SURV-CWF-B_V03	SOLO_L2_RPW-LFR-SURV-CWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-LFR-SURV-SWF-B_V03	SOLO_L2_RPW-LFR-SURV-SWF-B_V04 ✓	
TDS			
	ROC-SGSE_L2S_RPW-TDS-LFM-CWF-B_V03	SOLO_L2_RPW-TDS-LFM-CWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-TDS-LFM-RSWF-B_V03	SOLO_L2_RPW-TDS-LFM-RSWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-TDS-SBM1-RSWF-B_V03	SOLO_L2_RPW-TDS-SBM1-RSWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-TDS-SBM2-TSWF-B_V03	SOLO_L2_RPW-TDS-SBM2-TSWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-TDS-SURV-RSWF-B_V03	SOLO_L2_RPW-TDS-SURV-RSWF-B_V04 ✓	
	ROC-SGSE_L2S_RPW-TDS-SURV-TSWF-B_V03	SOLO_L2_RPW-TDS-SURV-TSWF-B_V04 ✓	

Activities in the near future

Validation of the ROC infrastructure at October 21st-25th

- SCMCAL V0.9.0 is operational
- The contact for SCM : Jean-Yves Brochot
- How can we access to pipeline data (sftp, …) ?

Evolutions of SCMCAL

- Consequences of upgrading libcdf V3.6.2 to V3.7.1 not evaluated yet
- New mechanism to choose the relevant RCT for a time range (RPW_CAL_SCM.xml)
  - actually the RCT filename is given into the configuration file of the RCS and is **constant**.
  - the path to find the RCT is given by environment variable ROC_RCS_CAL_PATH

  → ROC needs to define the mechanism to pass the name of the RCT to the RCS

Computing the SCM component into S/C to RTN frame

- Add new variables into L2 skeletons (paying attention of the size of the L2 files)
- Need the ROC to setup and provide access to SPICE kernels to compute transformation frames.

Computing the SCM transfer matrices at different temperatures