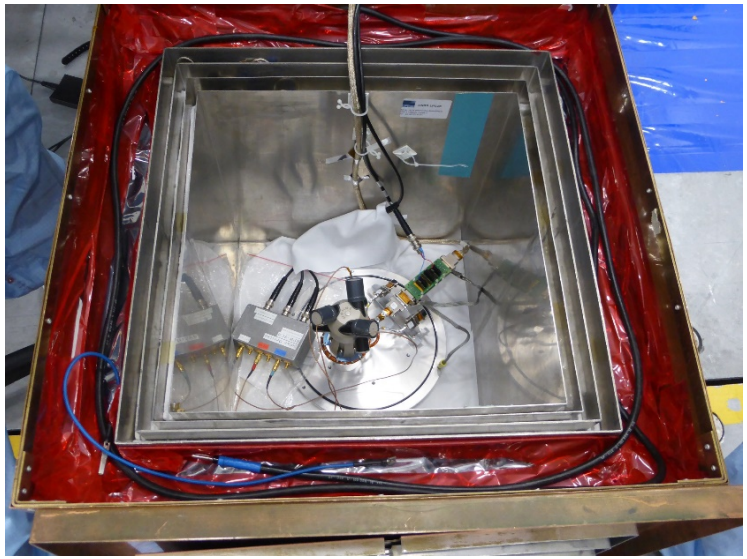
Radio and Plasma Waves

SCM status

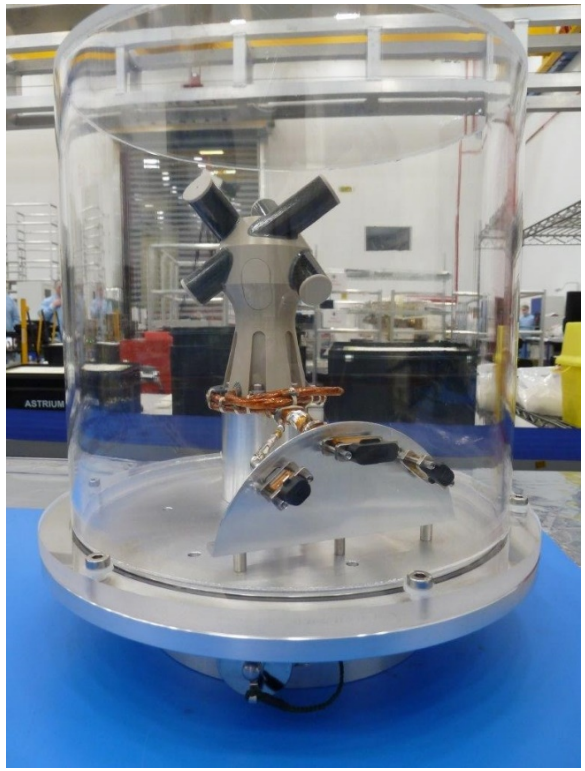
SCM hardware status

FS sensor delivery

- Delivery (handover) done at Airbus in January 2018
- Calibration test with MEB (dismounted from the S/C panel) performed at the same time
- 2 configurations always with SCM connected to MEB:
  - Calibration at the output of SCM using network analyzer
  - Calibration with MEB acquisitions



Test configuration using network analyzer



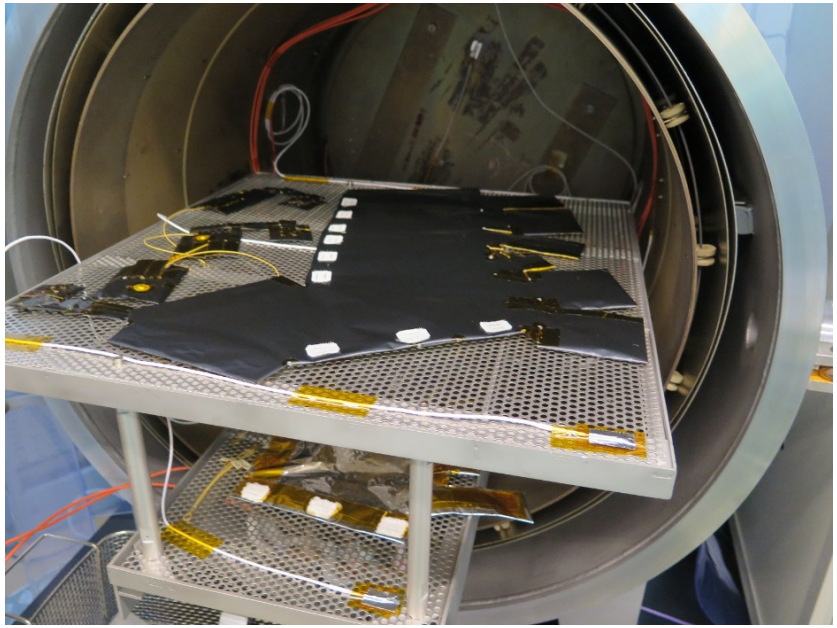
SCM-FS at delivery

SCM hardware status

Remaining tasks

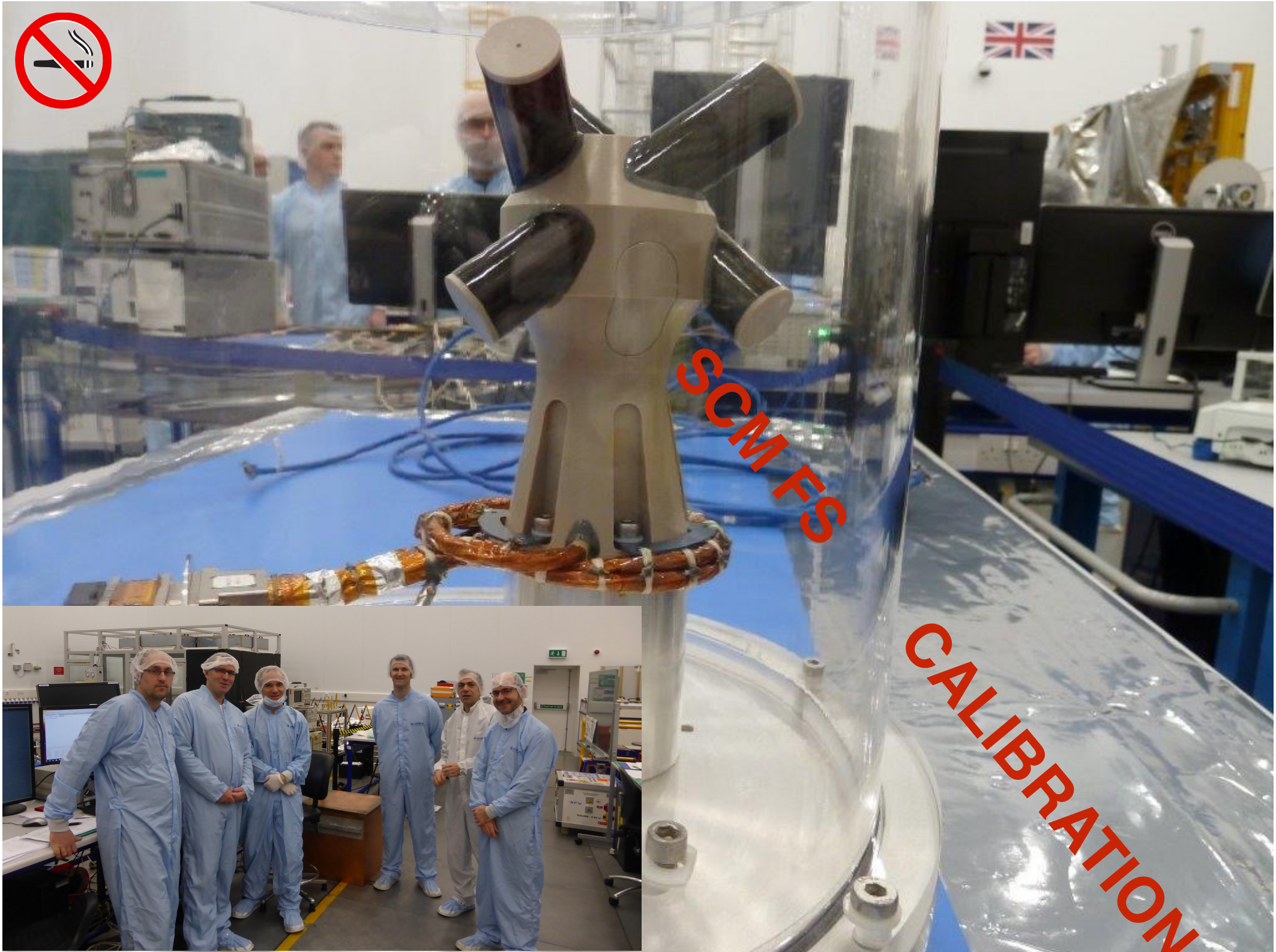
- FM MLI delivery to be used for S/C thermal vacuum test
  - Bake out done in April-May
  - Delivery date to be scheduled

  (implementation on the TVAC plate scheduled in October)

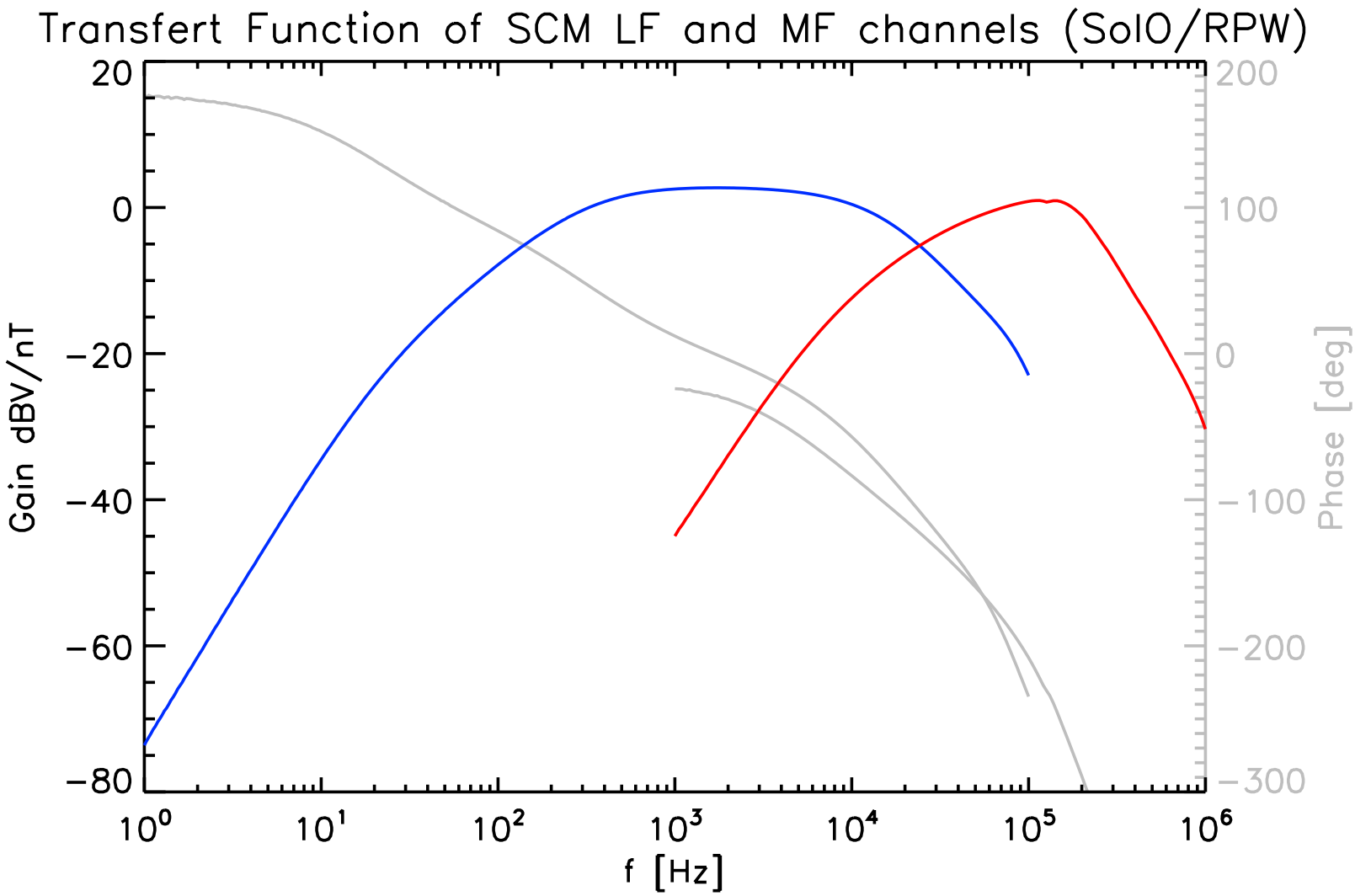


SCM FM MLI in the bake out chamber

- Updated onboard calibration signal (sent by LFR)
  - 5 pairs of frequencies (initial one + 4 others), working with LFR snapshots
  - Updated LFR software is ready
  - A test on EM (SCM + LFR) shall be performed before the implementation on PFM

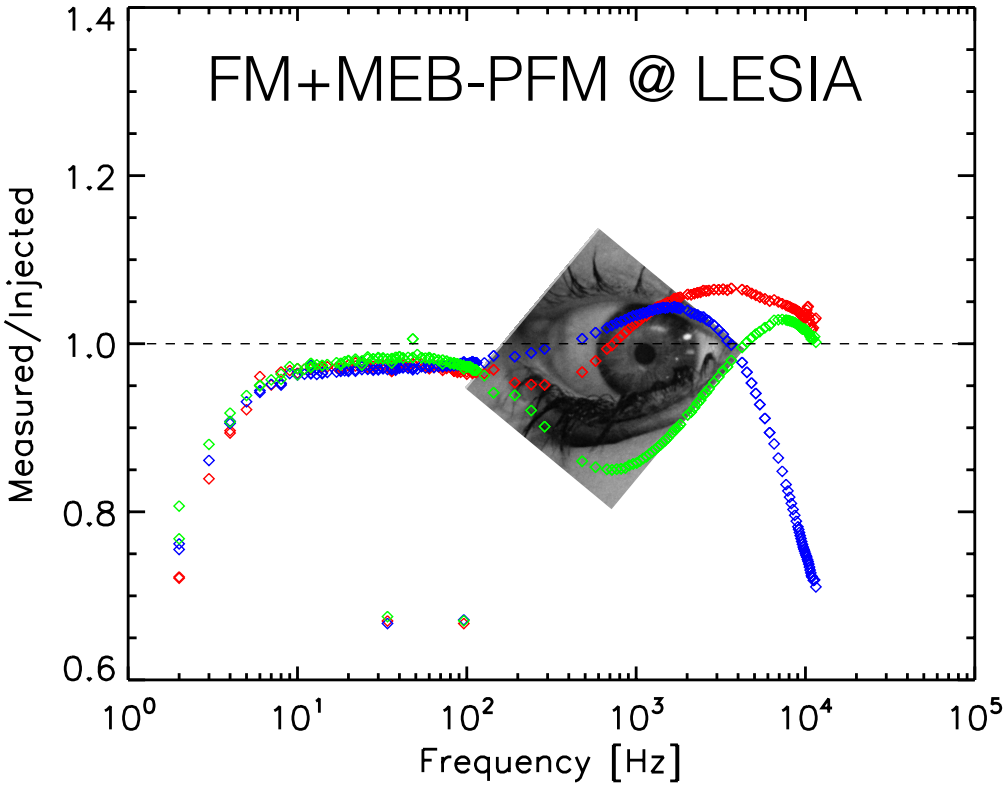

SCM FS
CALIBRATION

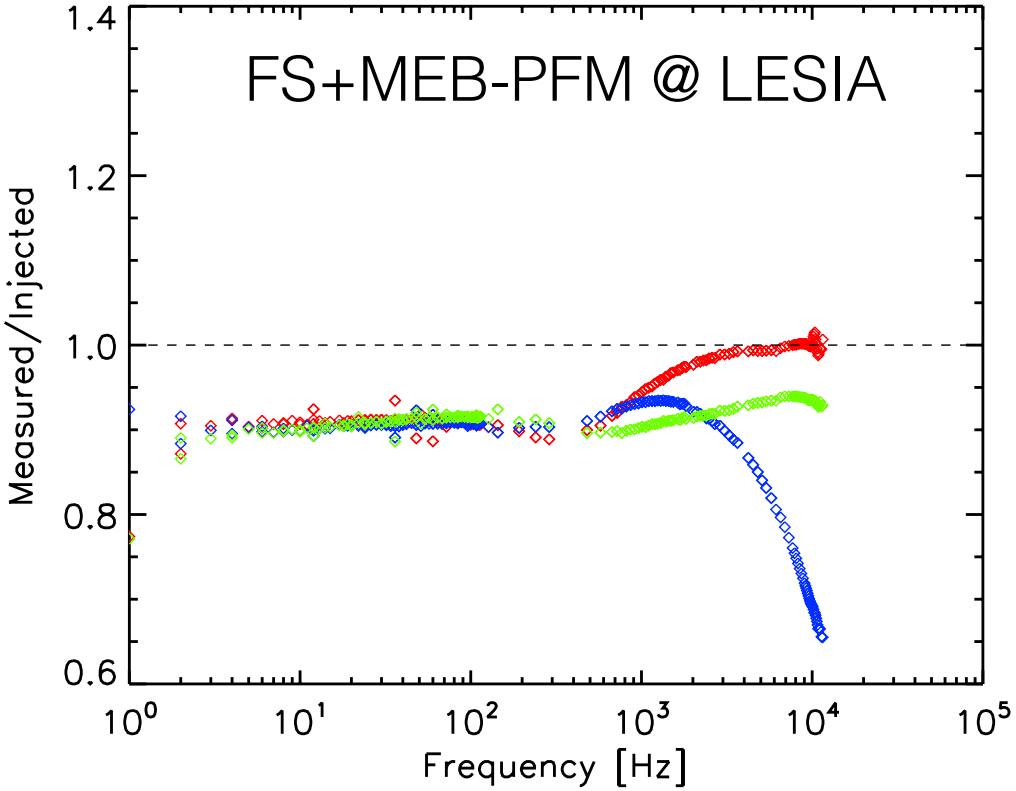
SCM TRASNFER Function



$$V_i = R_i B_i \longrightarrow B_i = R_i' V_i$$

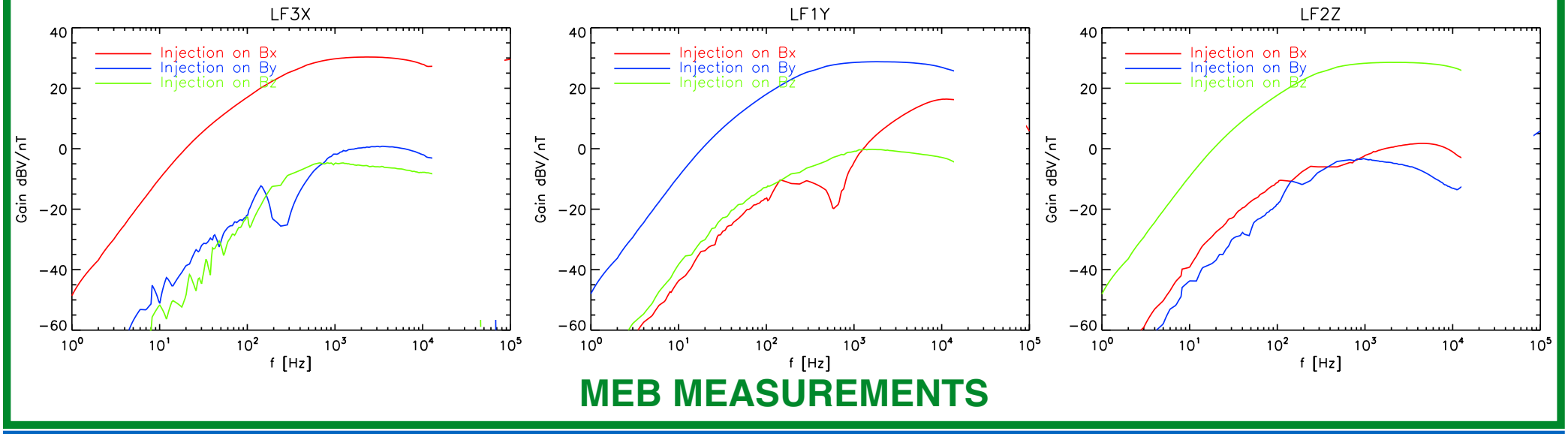
Multi channel injection - EYE



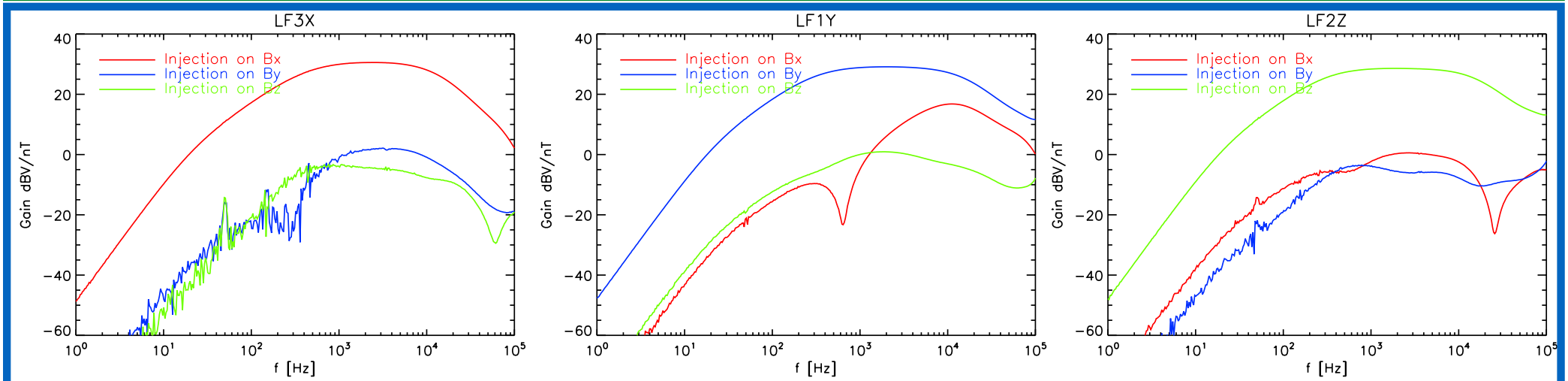


- As expected:
  - Different eyes for different SCM models
  - Mitigation procedure done at LPC2E for FS helped improving the cross talk
  - LF1Y is the most affected
  - Need for matrix transfert functions

LFR ON - TDS HF



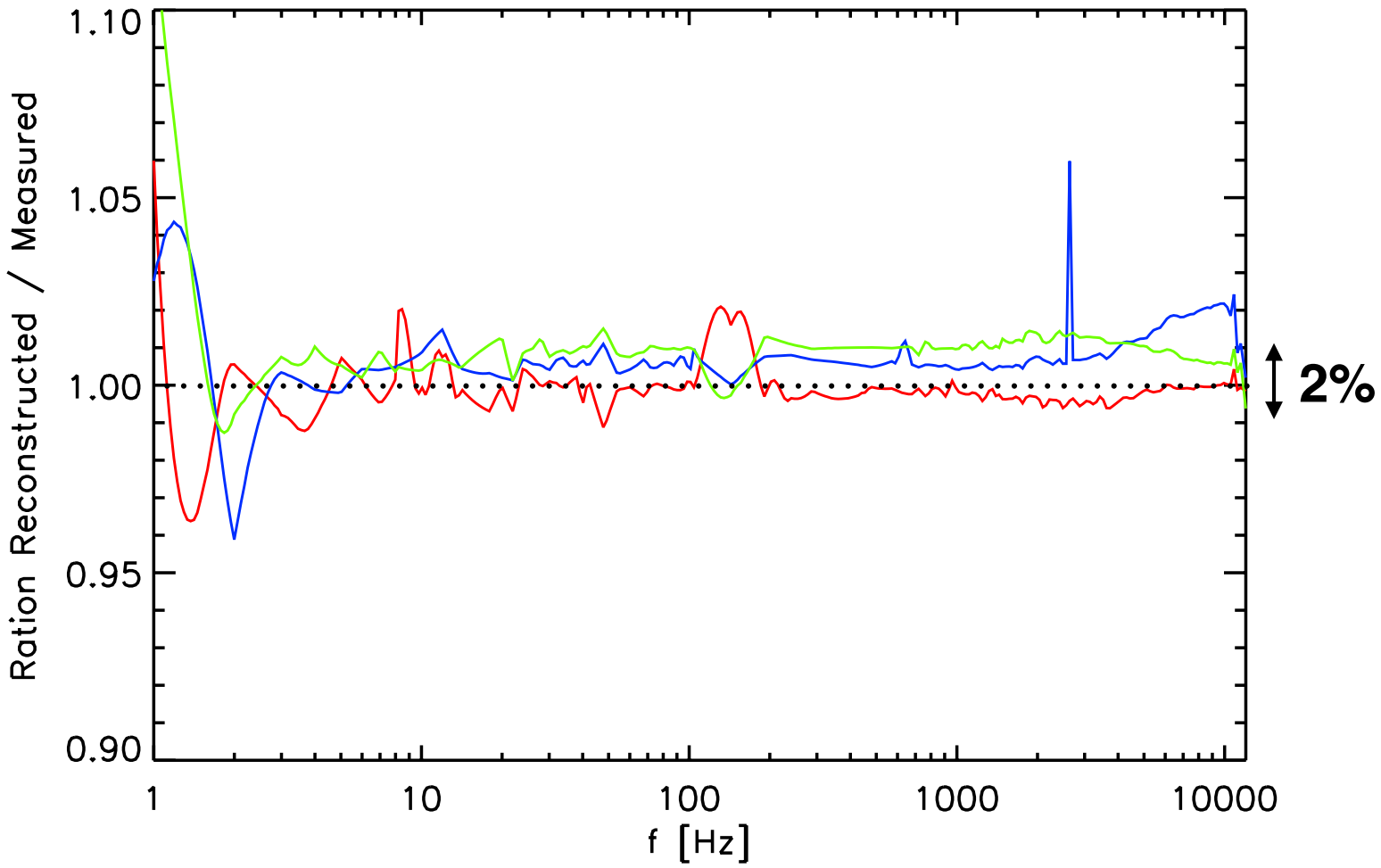
MEB MEASUREMENTS



NA MEASUREMENTS

Airbus calibration campaign

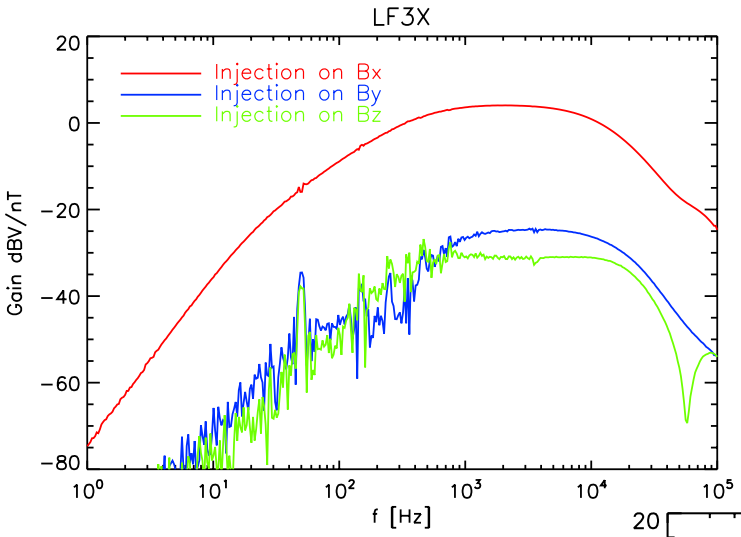
Ratio Reconstructed / Measured *(preliminary)*

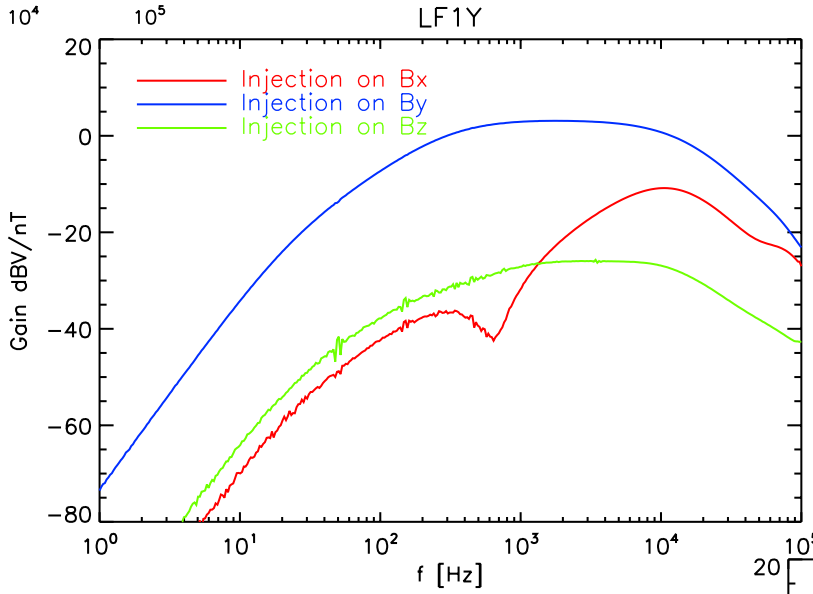


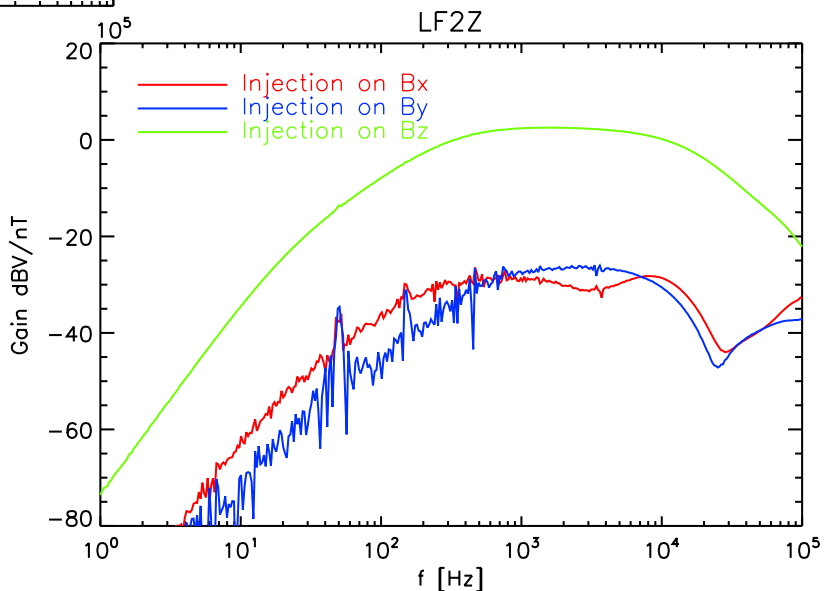
$$\begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix} = \begin{bmatrix} R_{xx} & R_{xy} & R_{xz} \\ R_{yx} & R_{yy} & R_{yz} \\ R_{zx} & R_{zy} & R_{zz} \end{bmatrix} \begin{bmatrix} B_x \\ B_y \\ B_z \end{bmatrix} \longrightarrow \begin{bmatrix} B_x \\ B_y \\ B_z \end{bmatrix} = \begin{bmatrix} R'_{xx}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

Measurements also done for other modes :

- **LFR OFF, TDS LFM (back up)**
- TDS HF, LFR ON (MF antenna)
- Onboard calibration







SCM waveform Calibration

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

(+20°)

(-50°)

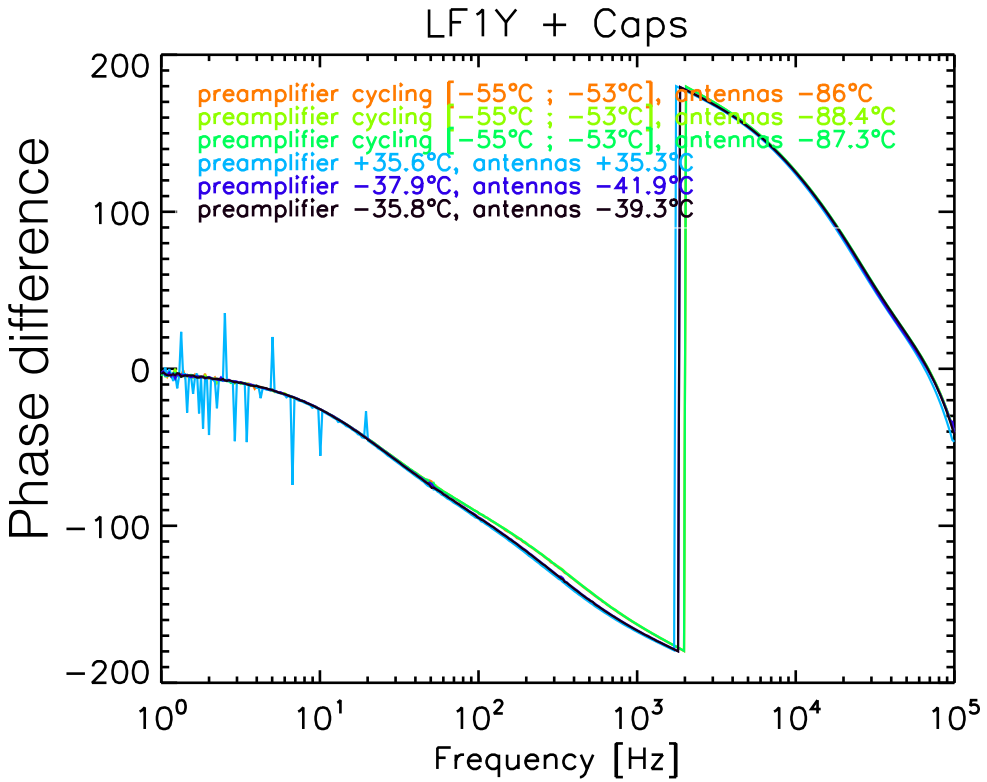
$$\begin{bmatrix} V_x \\ V_y \\ V_z \end{bmatrix} = \begin{bmatrix} R_{xx} & R_{xy} & R_{xz} \\ R_{yx} & R_{yy} & R_{yz} \\ R_{zx} & R_{zy} & R_{zz} \end{bmatrix} \begin{bmatrix} B_x \\ B_y \\ B_z \end{bmatrix}$$

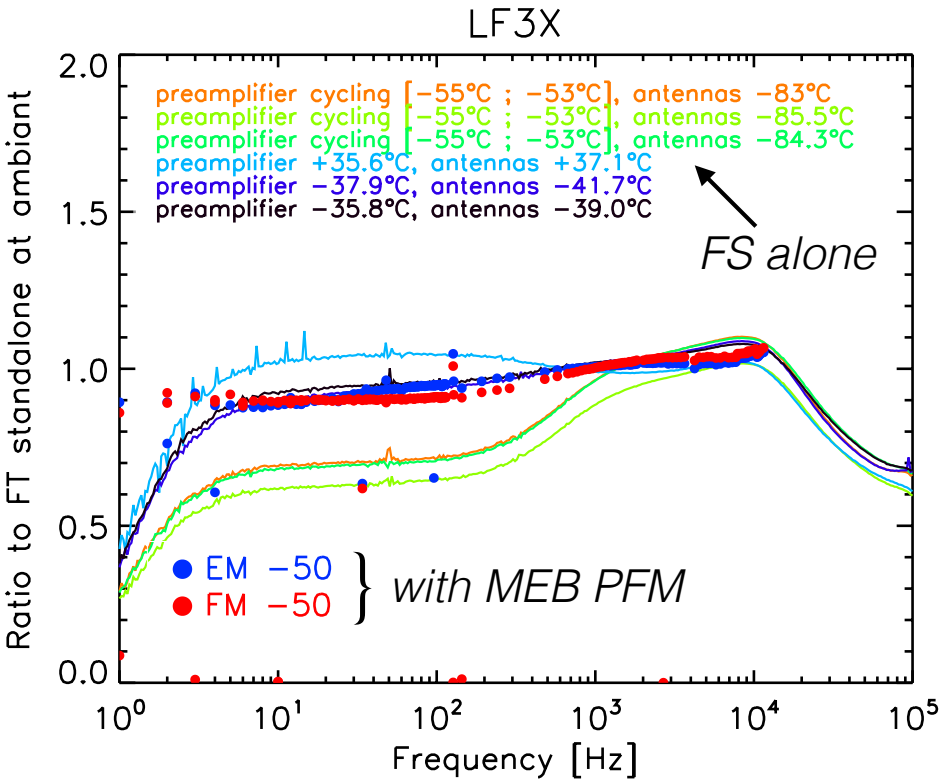
- All FS measurements made at T_{amb}
  - but will operate a T_{PA}=-50°C, $T_{Antenna}$=-57.7°C
  - Extrapolation in temperature is needed

1. Found out how to extrapolate in temperature

2. Test extrapolation in temperature
   - FM cross talk measurements made at T_{amb}, and FM simultaneous injection at T_{PA}=-50°C (LESIA test).
   - Compute calibration matrix from SCM FM + MEB PFM cross talk measurements at +20°
   - Extrapolate at T_{Ant}=-57°
   - Calibrate FM+MEB PFM measurements at T_{PA}=-50°C

Temperature dependency of transfert function





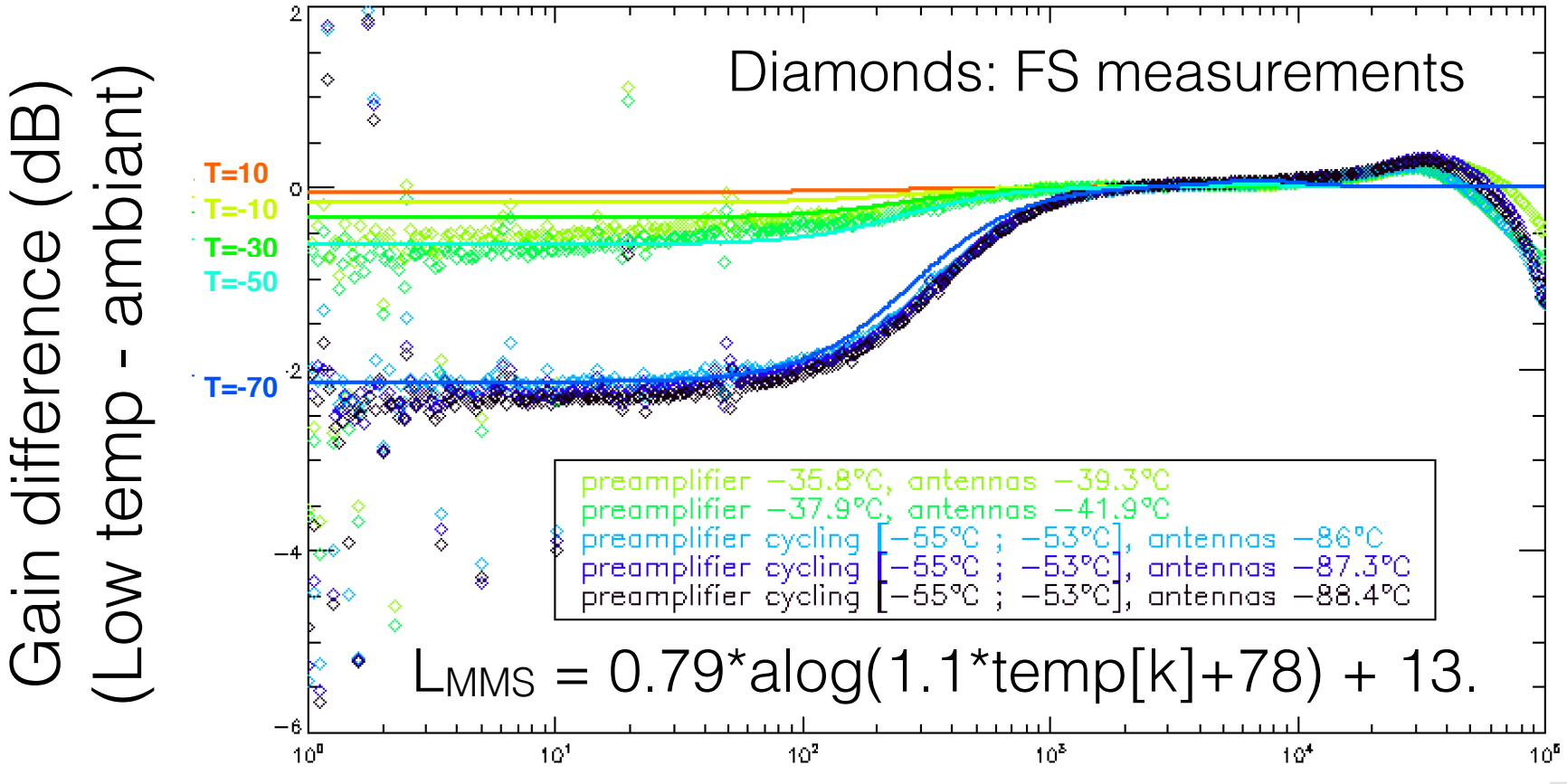
- ➡ Phase is constant
- ➡ Gain is changing, but similarly on different SCM models
- ➡ Temperature sensitivity is on **antenna only**

Building on MMS Experience

- MMS/SCM response is decreasing with low temperature (eclipse), similarly to what is seen on SOLO/SCM-FS
  - Can be reproduced with $L_{MMS} = 0.79*\text{alog}(1.1*\text{temp}[k]+78) + 13.$

c/o O. Le Contel

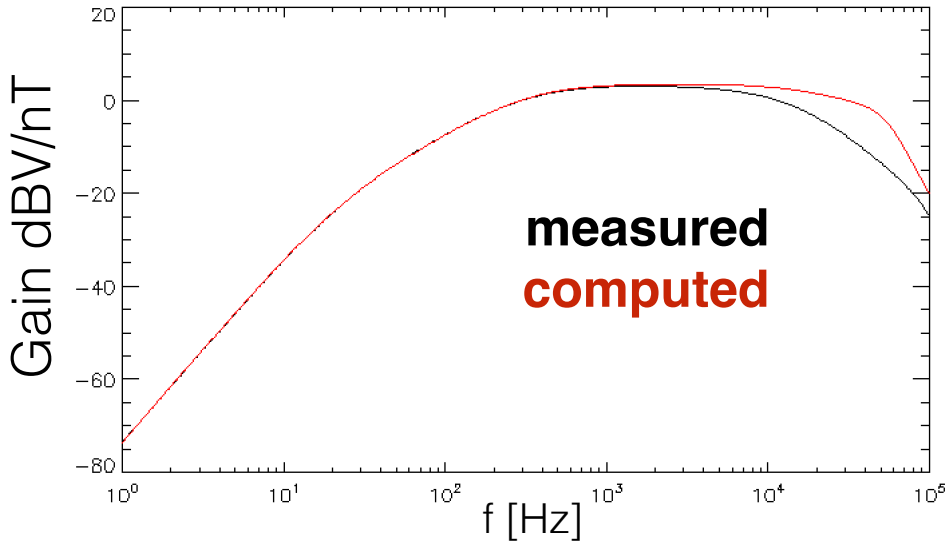
- We can compare with SOLO/SCM-FS

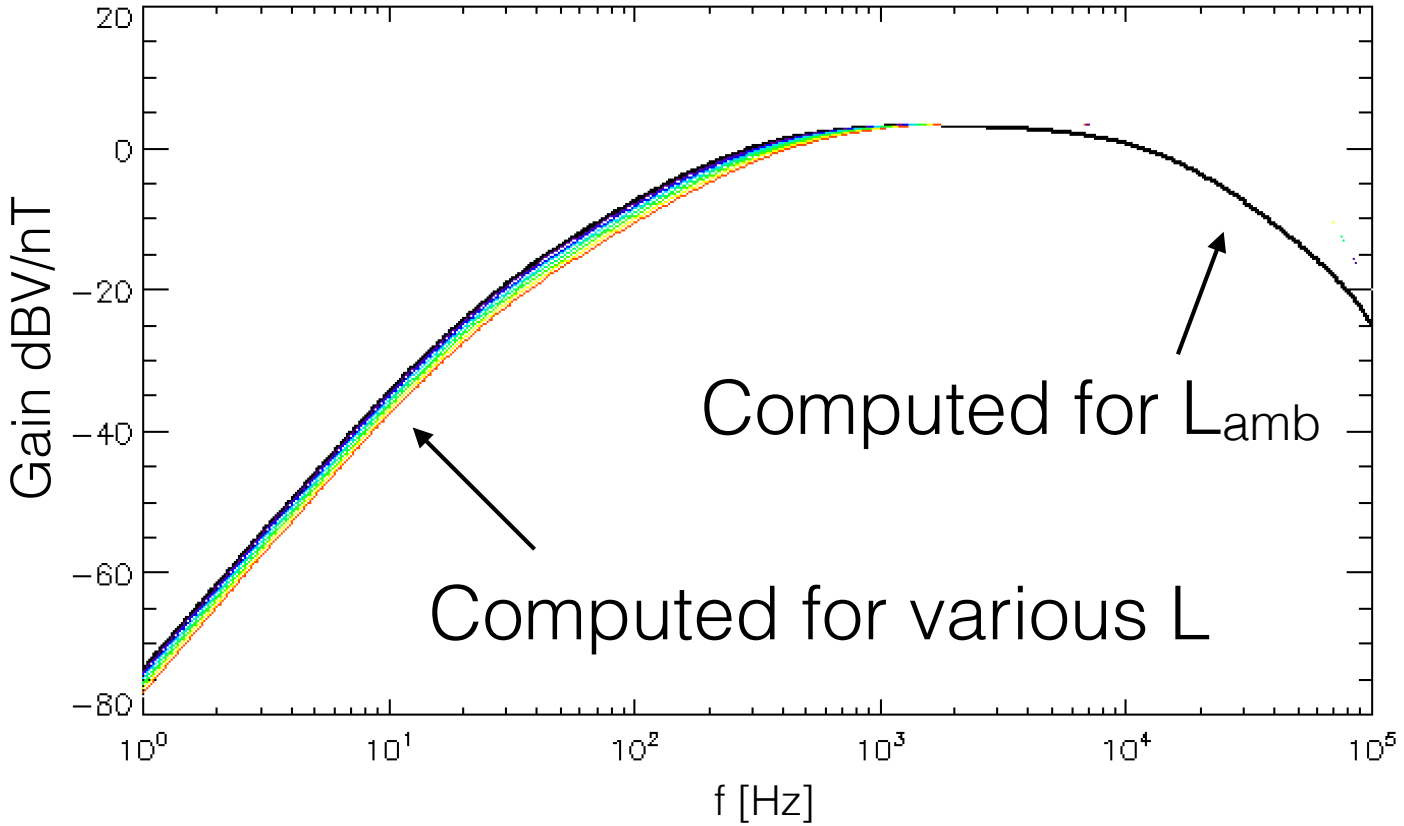


Analytical Transfert function for SCM

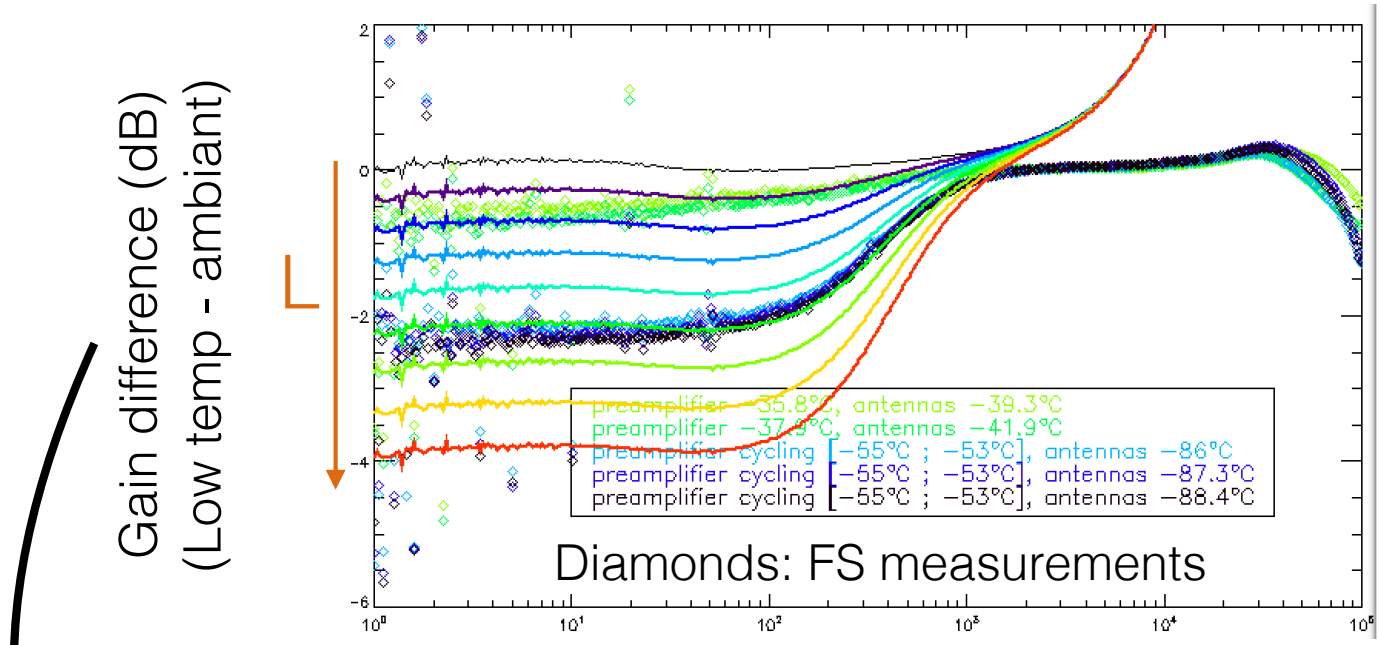
$$\frac{V_o}{B}(\omega) = \frac{-j\omega\mu_a NSG}{1 - L_p C\omega^2 + j\omega(R_{sc}C + GM/R_{fb})}$$

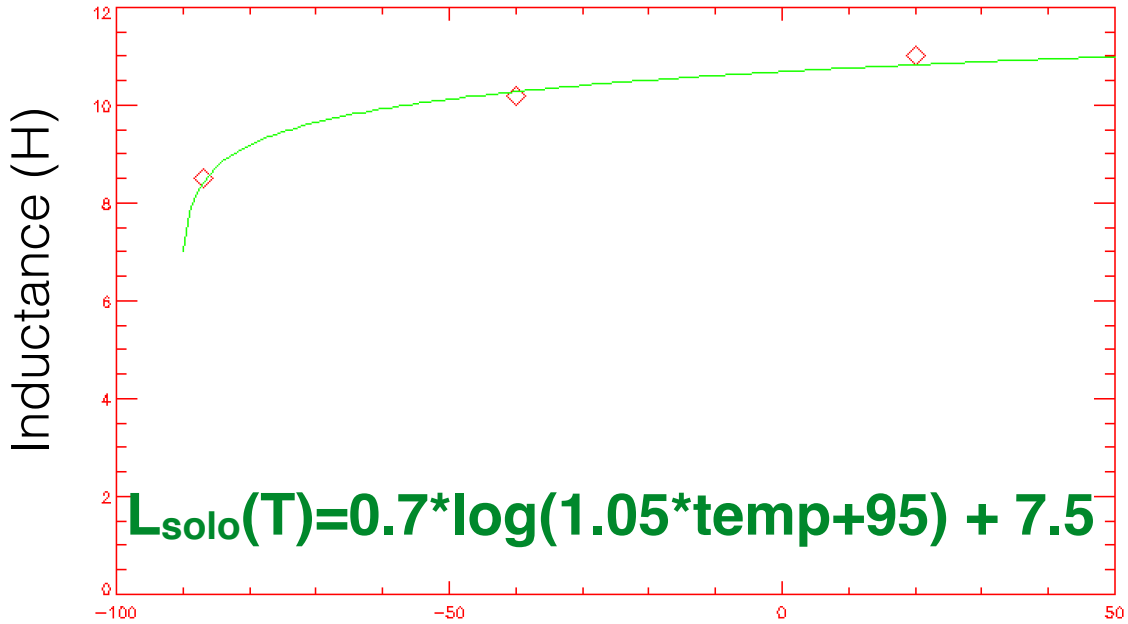
- Analytical formulae from equivalent circuit.
- Low frequency part dominated by the inductance of antenna
  - **μ_a** and **M** depend on **L**





Extrapolation in temperature





NB: $L_{solo}(T)$ will be measured !

And the results is …

Conclusion

- Airbus measurements successful
- Good confidence on behavior on temperature
  - Need to measure $L_{ant}(T)$.
- Extrapolation in temperature can be tested on FM
- NB: For the MF channel, no way to distinguish between contribution of each channel… This is better : 1 axis does not give anyway spatial information.
- Investigate the effect of cross talk on onboard calibration