Influence of environmental parameters on calibration drift in superconducting RF cavities

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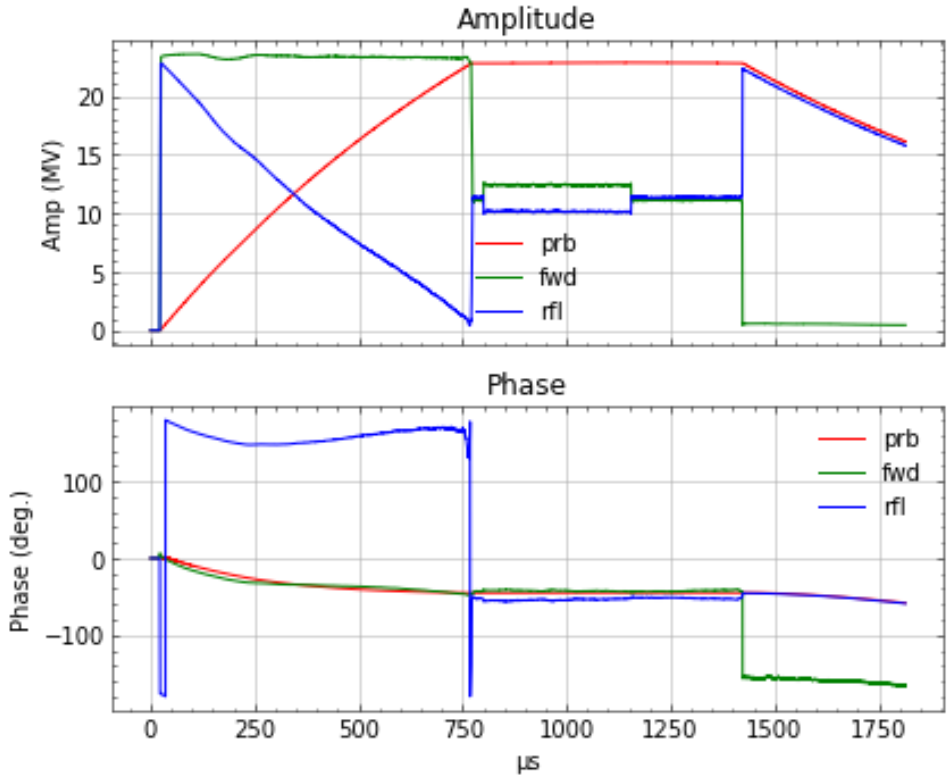
Long-term Calibration Drift

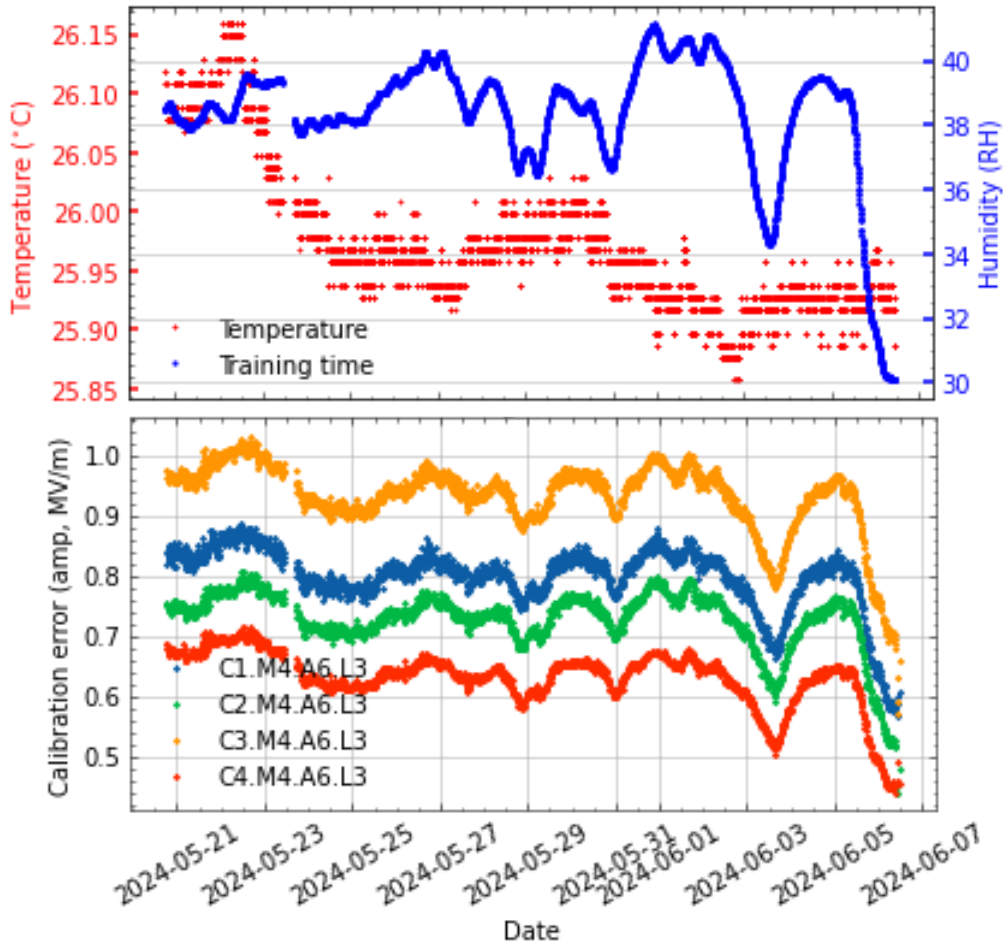
$V_P^V = V_F^m + V_R^m$ **The vitrual probe** is defined by summing the calibrated RF signals V_F and V_R.



Amp $E_A = \sum_{i=0}^{N=16K} \left|V_{P\,i}^m - V_{P_i}^V\right| / N$

Phs $E_P = \sum_{i=0}^{N=16K} phs\left(V_{P\,i}^m - V_{P_i}^V\right) / N$

Humidity and Temperature



Calibration Error (Amp)

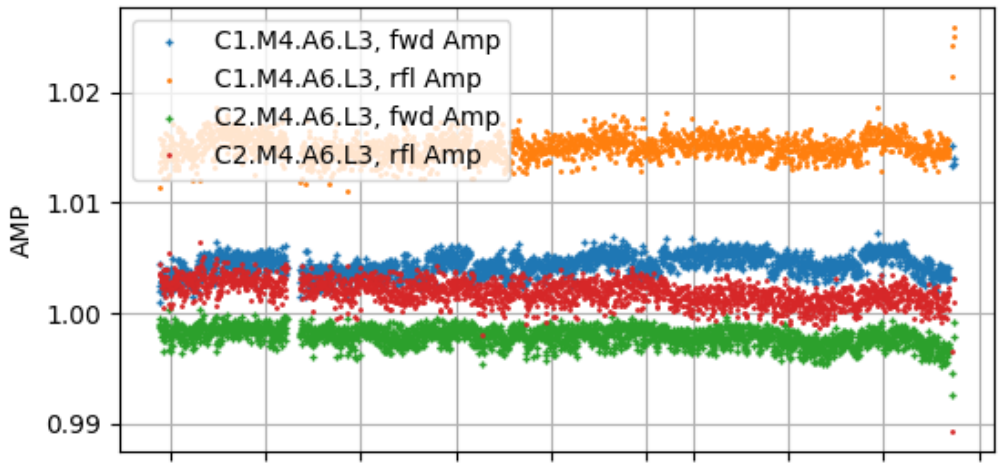
Calibration Error:

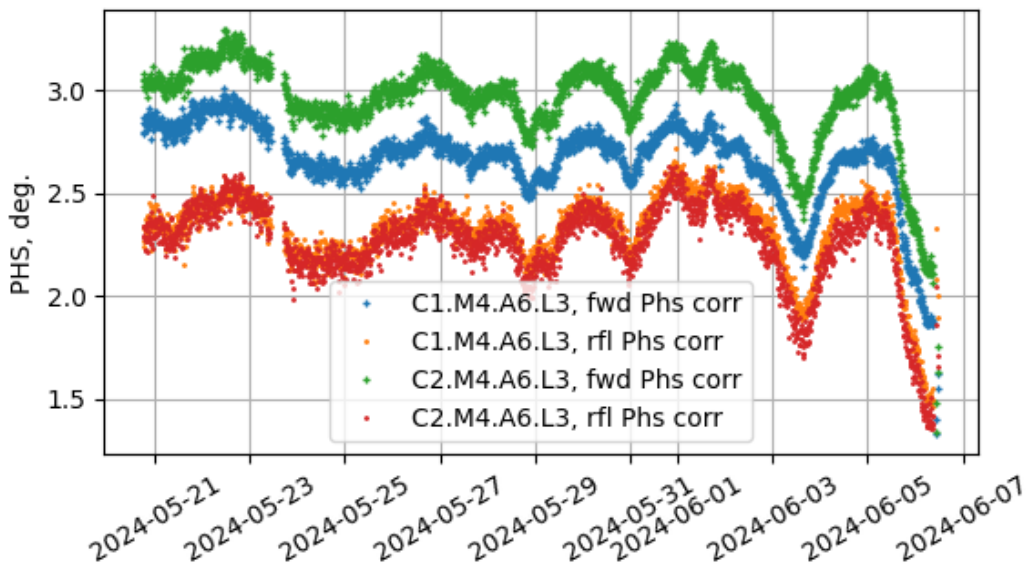
$V_P^m - V_P^V$

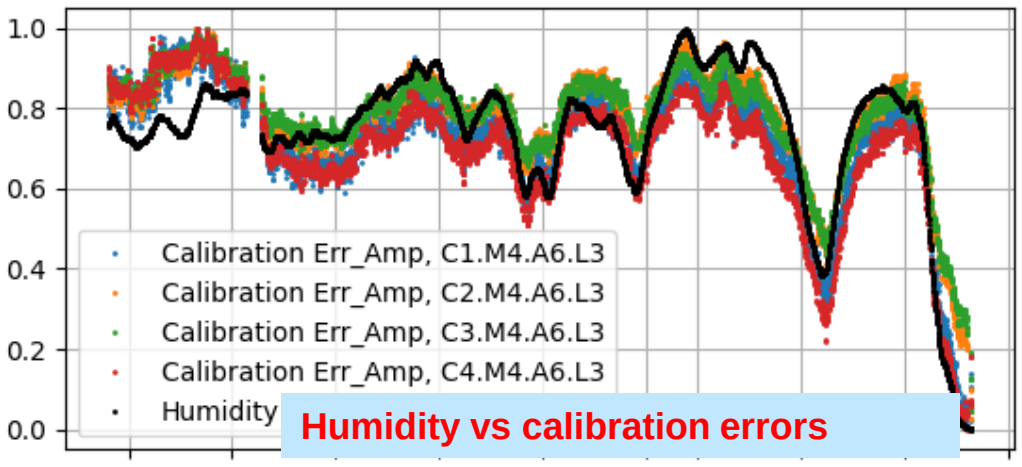
The difference between V_P^m and V_P^V.

Drift induced by environmental parameters.

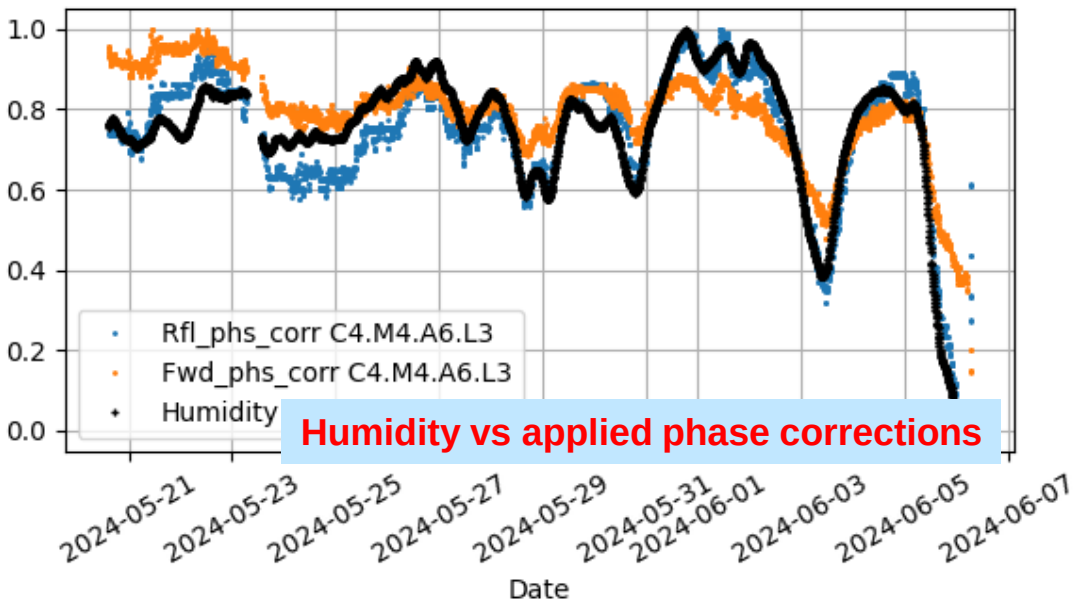
Correlation between humidity / temperature and calibration errors and recalibration coefficients







Humidity vs calibration errors



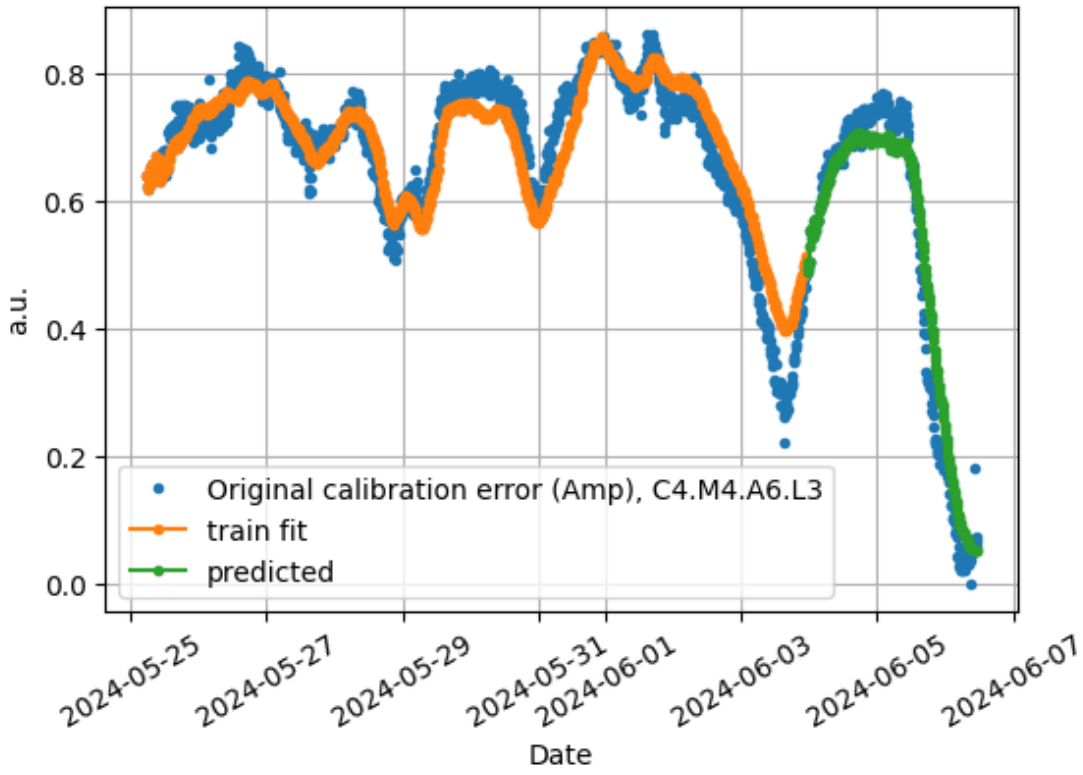
Humidity vs applied phase corrections

Humidity is strongly correlated to the calibration error of RF signals as well as the applied phase corrections.

Predicting calibration errors and phase corrections

Fitting of Calibration Error

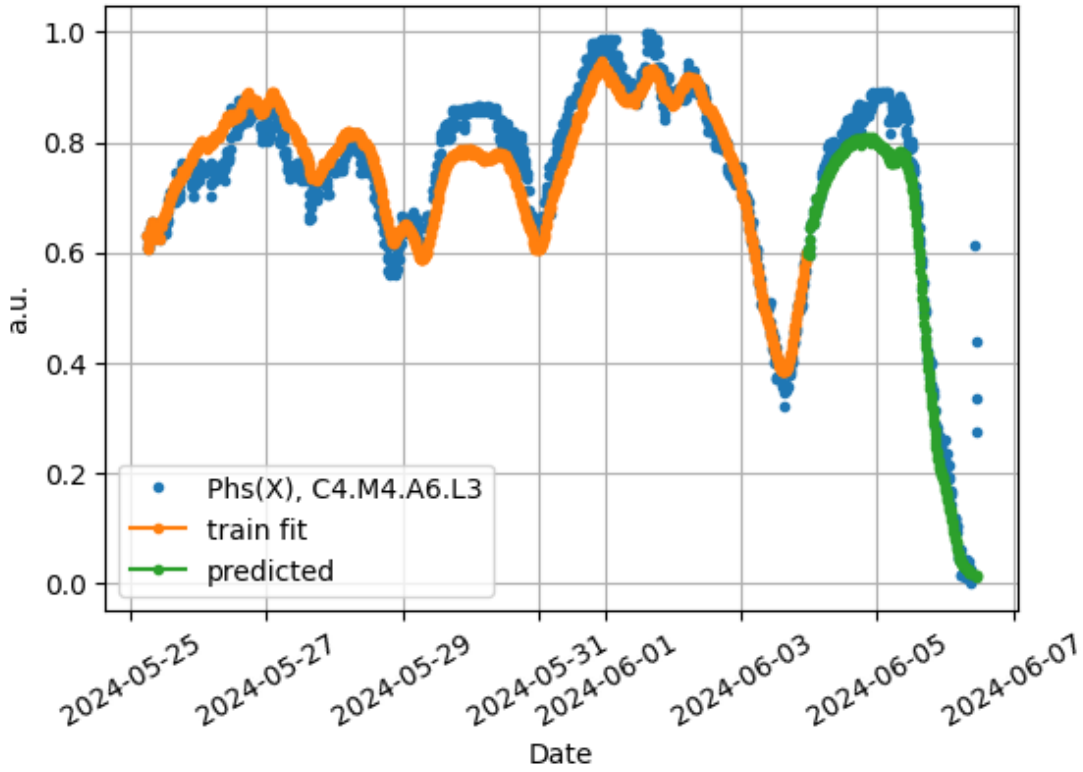
Calibration error (Amp, C4.M4.A6.L3)



Input: Humidity, Temperature, $w_{1/2}$
Output: Calibration error (absolute Amp)

Fitting of Calibration Coefficients

Phase correction (C4.M4.A6.L3)



Input: Humidity, Temperature
Output: Phase correction

Build Polynomial NARMAX Models using **FROLS** (Forward Regression Orthogonal Least Squares) algorithm;
basis_function = Polynomial(degree= 3)