



**HIFI - CoP**

# TEST REPORT

**Doc. no.** : FPSS-xxxx

**Issue** : 1

**Date** : 14 September 2009

**Category** :

**Page** : 1 of 17

**Title**                      **Magnet tuning optimisation in CoP**

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**Date** : 14 September 2009

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**Authorised by** :

**Date** :

**Distribution**


**Document Change Record**

| Issue | Date              | Changed Section | Description of Change  |
|-------|-------------------|-----------------|------------------------|
| Draft | 29 June 2009      | All             | New Tech note          |
| 1.0   | 14 September 2009 | All             | Upgrade to test report |

**TEST REPORT**

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## 1 SUMMARY AND CONCLUSIONS

### Magnet tuning

In table 1 is listed the mean of the magnet-tune results for both the TV and the COP data-set. There is excellent agreement between the two.

| Band | TBTV<br>Hpol – Vpol | CoP<br>Hpol – V pol | Tuning strategy                             |
|------|---------------------|---------------------|---|
| 1    | 7.48 – 7.91         | 7.47 – 7.87         | Fixed value                                 |
| 2    | 8.56 – 8.05         | 8.56 – 8.05         | Fixed value                                 |
| 3    | 8.24 – 7.76         | 8.23 – 7.96         | Tune, mixer current dependent               |
| 4    | 5.25 – 5.25         | 5.25 – 5.24         | Tune, mixer current dependent               |
| 5    | 5.72 – 11.0         | 5.69 – 11.76        | Table, 2 <sup>nd</sup> order polynomial fit |

**Table 1; Optimum magnet setting.**

There are three points of attention:

- 1 Band 3 V-pol: There is a step in the optimum going from 3a to 3b. In 3b there is a gradual return to the value found in 3a. It reproduces with the TV results but the cause is un-explained.
- 2 Band 5, H-pol: can be set with a table, frequency dependence fitted with a 2<sup>nd</sup> order polynomial.
- 3 Band 5, V-pol: still unclear if the optimal setting is used, to be checked with mixer group.

Changes to the CUS related to magnet tuning are tracked in SCR Hifi-2917.

### Deflux results

When a LO-band is switched on it is tuned, defluxed and tuned. Analysis of these defluxes shows that flux had been trapped in bands:

Big: 3A H-pol, 3B H-pol + V-pol

Small: 1A V-pol, 2A H-pol, 2B V-pol, 4A H-pol, 4B H-pol

Big events could have lead to a less optimum mixer performance; the small events would go unnoticed. For now it is recommended to stick to the deflux scheme at LO-subband switch-on. If band 3 shows flux trapping at every deflux it is advisable to increase the deflux rate.

In band 5 V something is happening irregularly which leads to jumps between successful and unsuccessful magnet tuning. This is probably due to the flat fraunhofer pattern related to the high magnet current. Since band 5V is tuned in the third minimum magnet tuning is uncritical anyway.

### Jumps in Band 4

In the band 4 magnet tuning results jumps are observed. It is unclear whether these are jumps in LO-power or jumps in trapped flux. They might affect stability if they also occur outside the magnet-tunings.

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## 2 BAND 1

### Results:

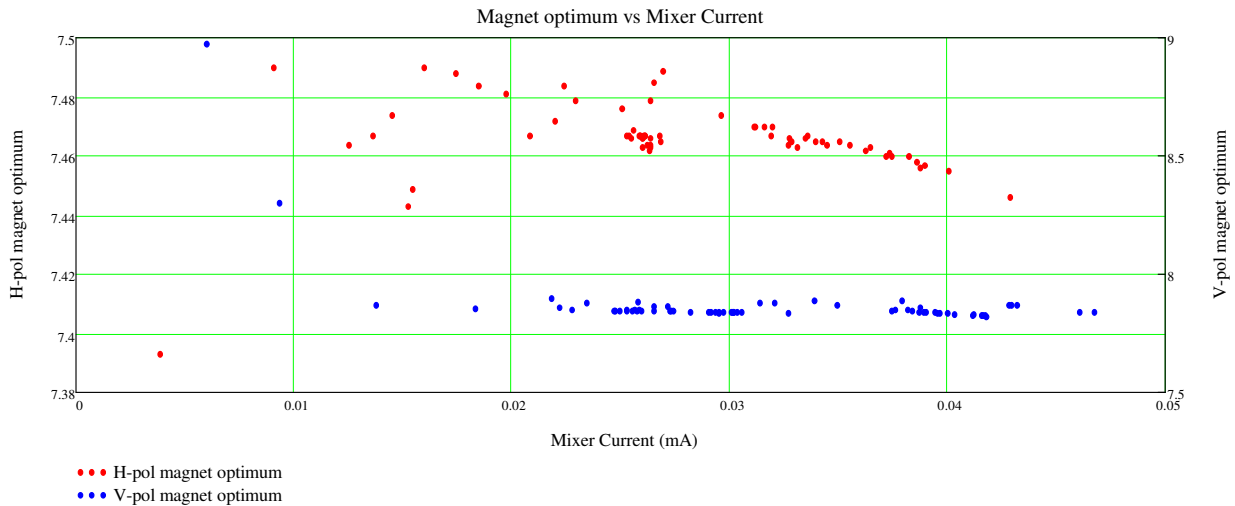
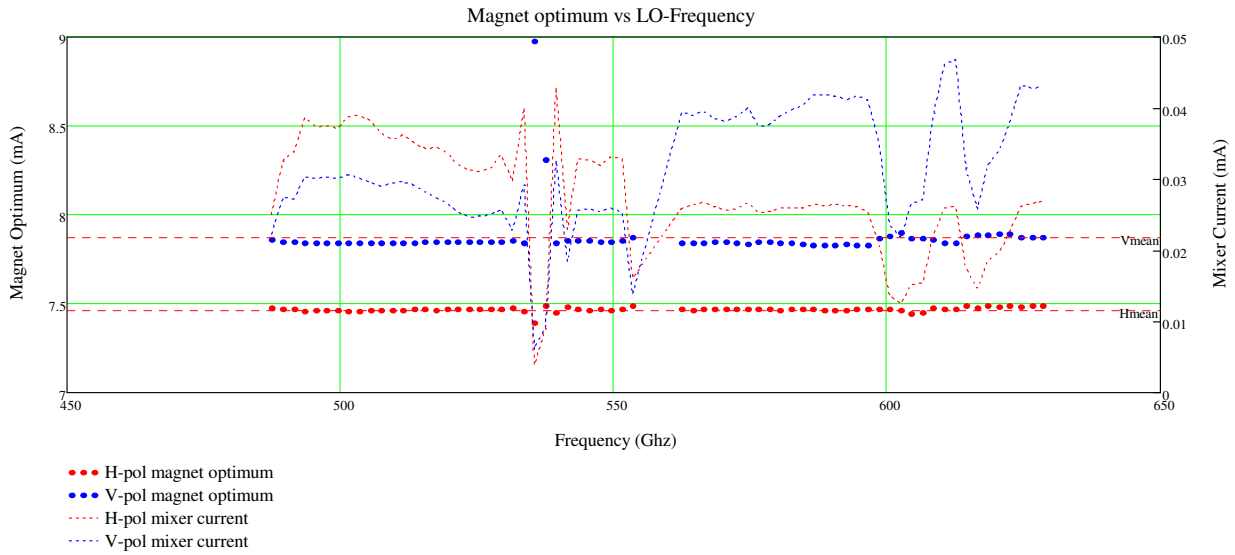
Band 1 is well behaved. No tuning is necessary, a fixed value will do. The V mixer shows a slightly larger spread around the optimum than the H mixer. Once in the V-mixer the deflux results in a minor shift of the tuning result indicative of potential flux trapping.

Hmean = 7.466 mA

Hstdev = 0.013 mA

Vmean = 7.873 mA

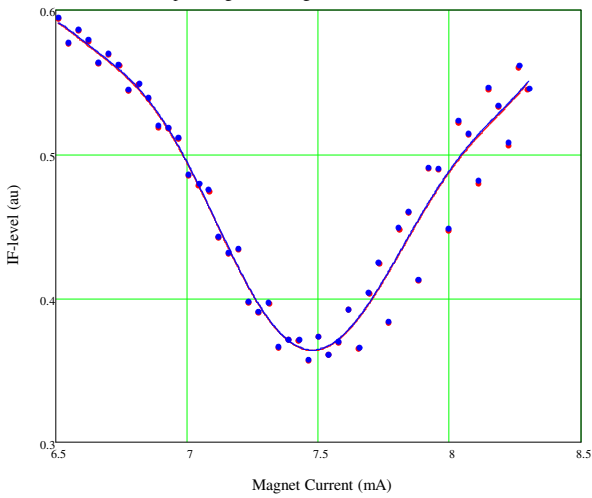
Vstdev = 0.147 mA



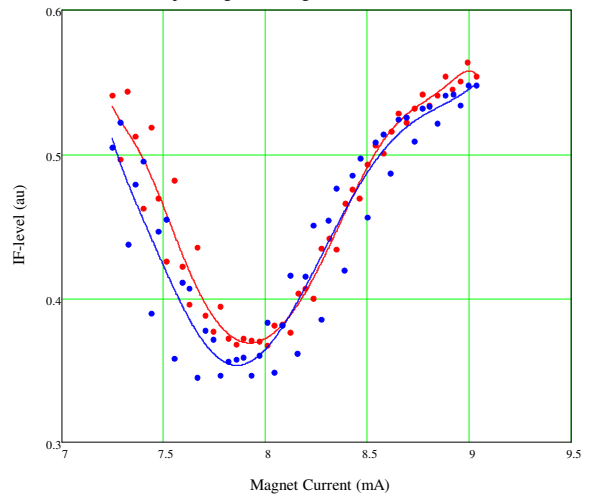
ObsID = 1342178644

BandName\_Band = "1a"

H-pol Magnet Tuning before and after deflux



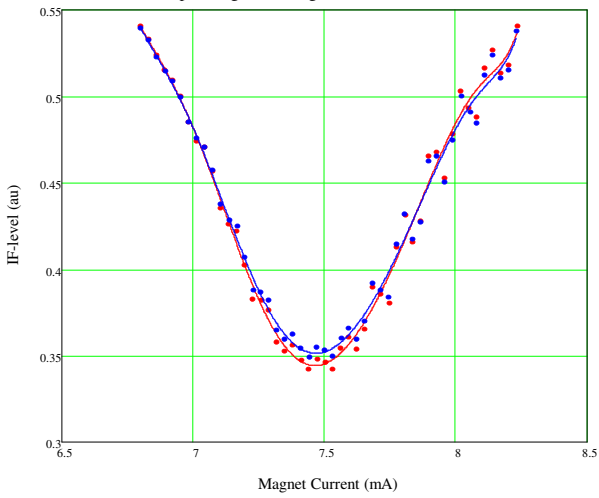
V-pol Magnet Tuning before and after deflux



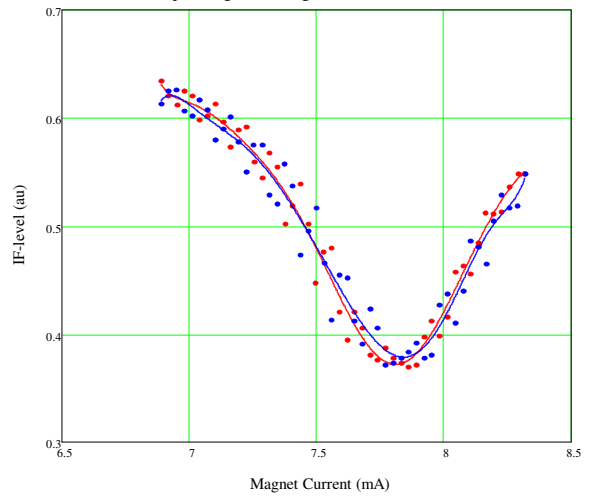
ObsID = 1342178648

BandName\_Band = "1b"

H-pol Magnet Tuning before and after deflux



V-pol Magnet Tuning before and after deflux



### 3 BAND 2

Results:

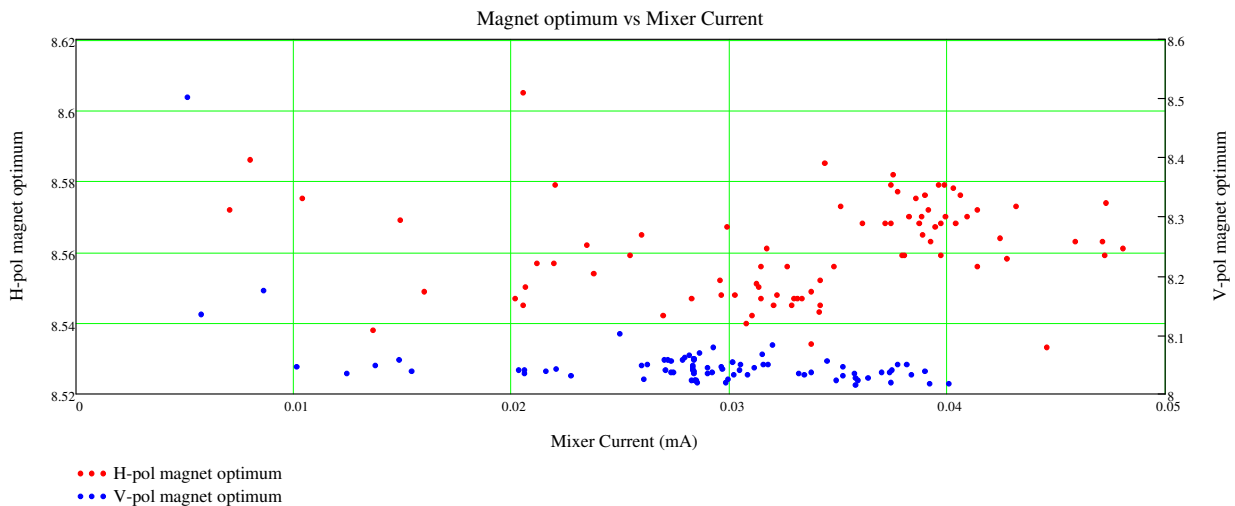
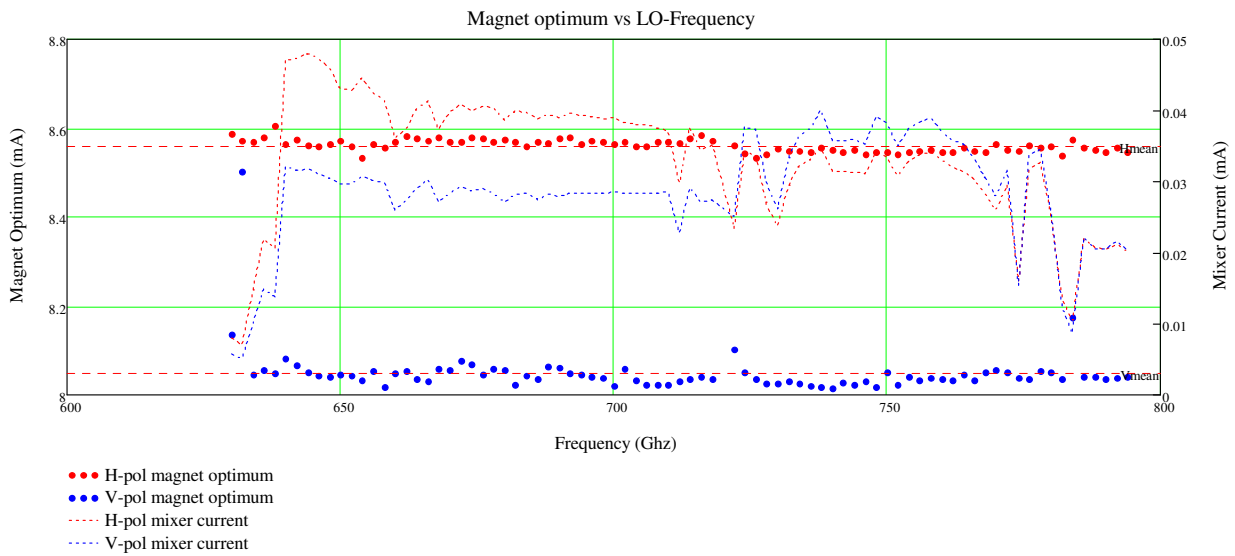
Band 2 is very well behaved. The tuning result can be replaced with a fixed value. Defluxing shows a minor change in tuning result for 2a H and 2b V.

Hmean = 8.561 mA

Hstdev = 0.014 mA

Vmean = 8.05 mA

Vstdev = 0.055 mA

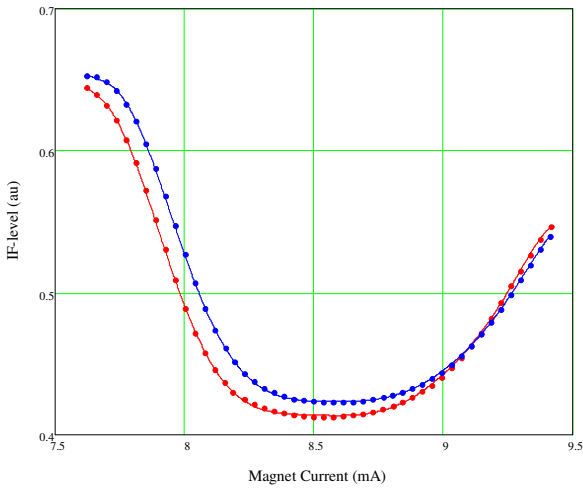




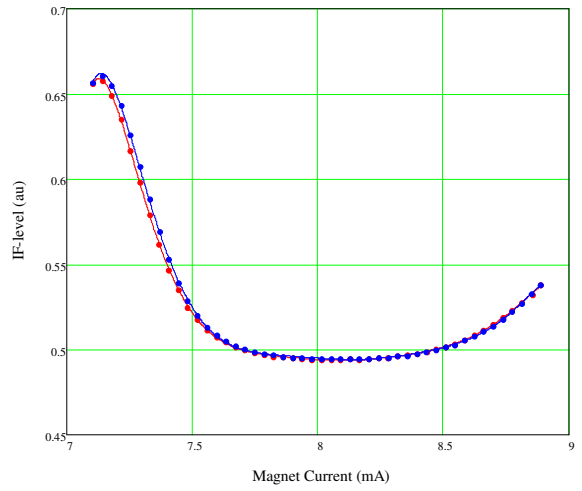
ObsID = 1342178652

BandName\_Band = "2a"

H-pol Magnet Tuning before and after deflux



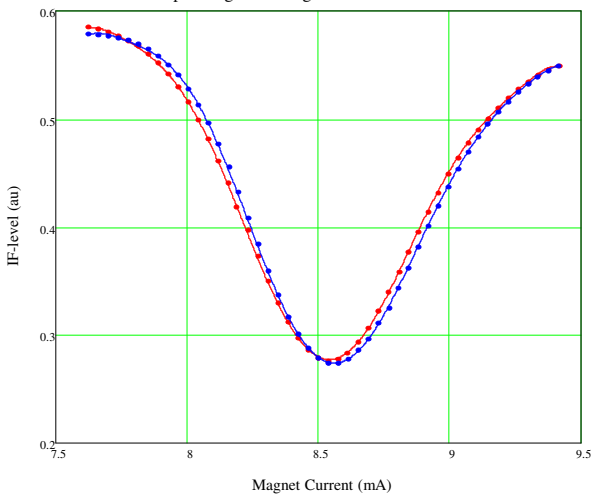
V-pol Magnet Tuning before and after deflux



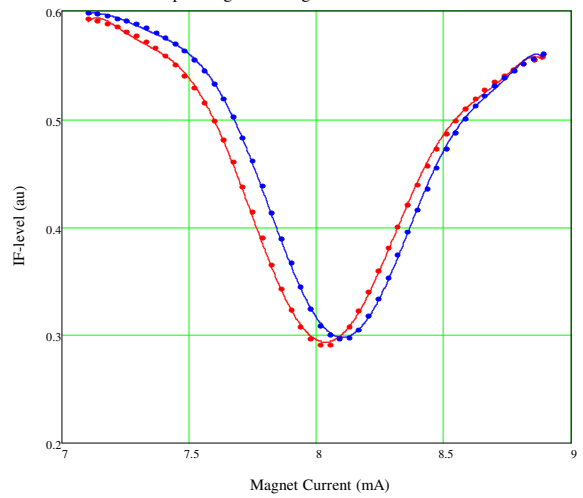
ObsID = 1342178656

BandName\_Band = "2b"

H-pol Magnet Tuning before and after deflux



V-pol Magnet Tuning before and after deflux



### 4 BAND 3

#### Results:

Looking at the tuning result vs mixer current plot it is clear that the H-mixer shows a pumplevel dependent behaviour and the V-pol has a frequency dependent component as well. Although the variation is not to big it is advisable to keep the magnet tuning in place.

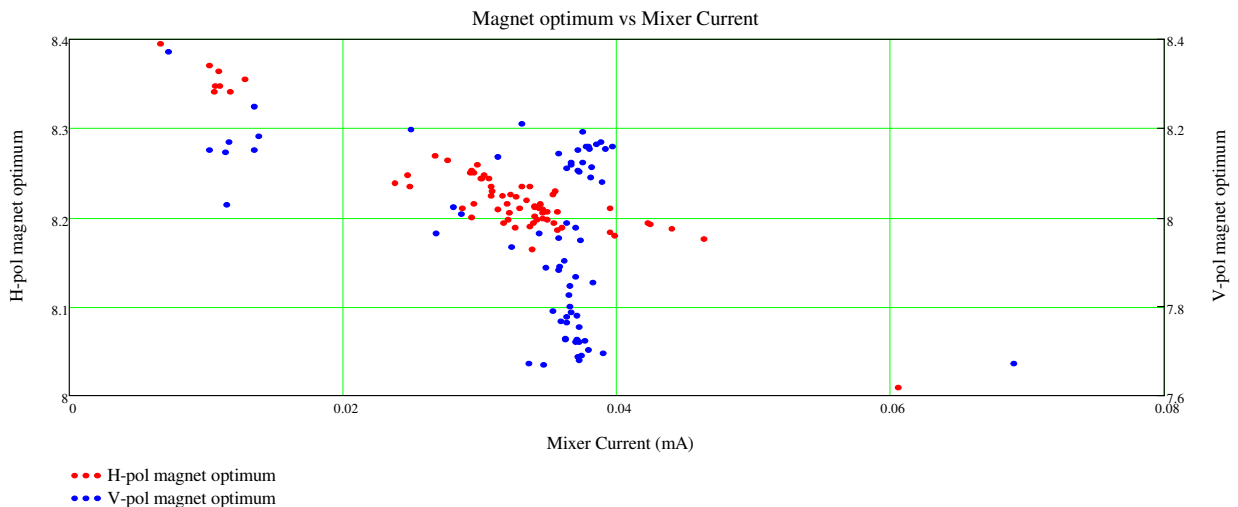
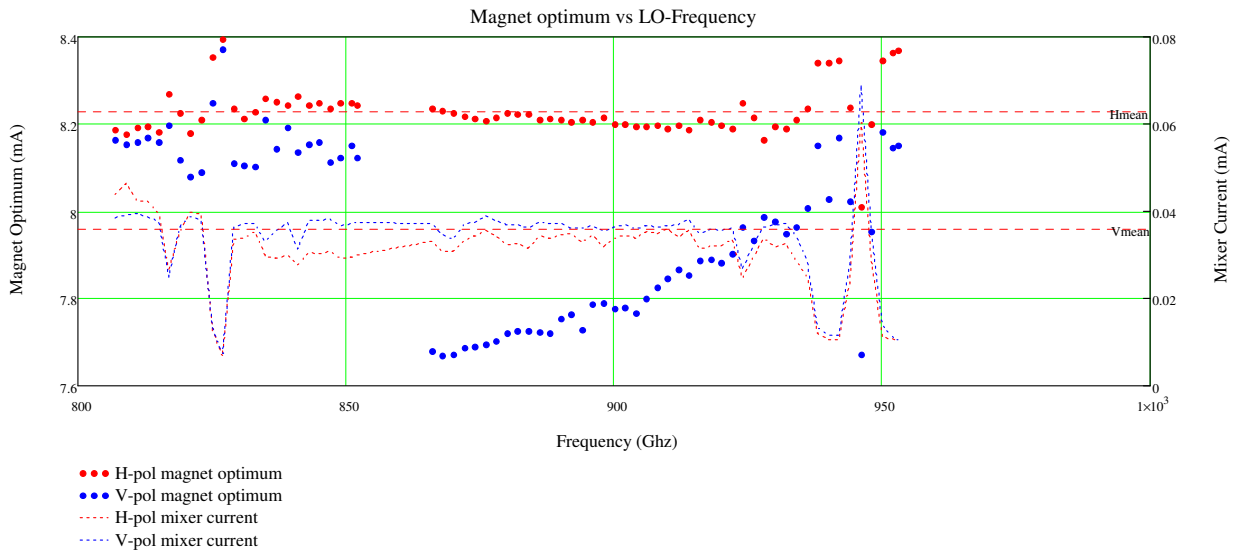
In three out of four cases defluxing is indicative of significant flux trapping. Band 3 should be monitored with respect to fluxtrapping and might require more regular defluxing.

Hmean = 8.229 mA

Hstdev = 0.057 mA

Vmean = 7.961 mA

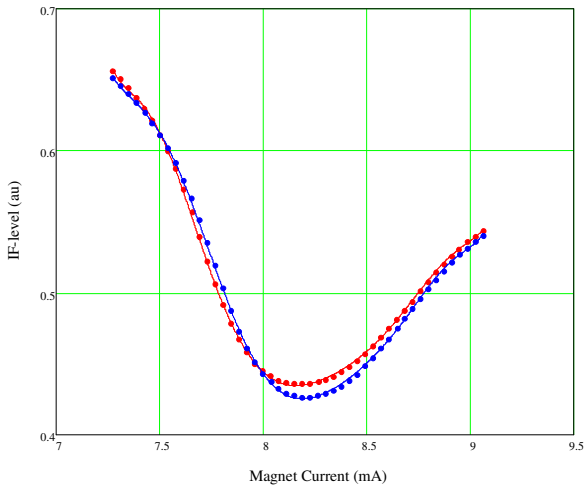
Vstdev = 0.191 mA



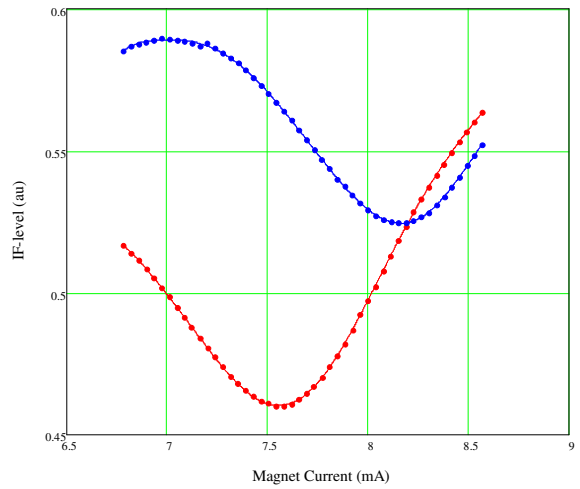
ObsID = 1342178660

BandName\_Band = "3a"

H-pol Magnet Tuning before and after deflux



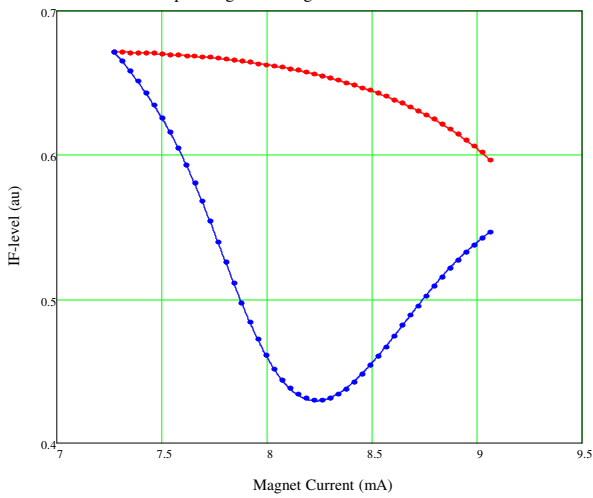
V-pol Magnet Tuning before and after deflux



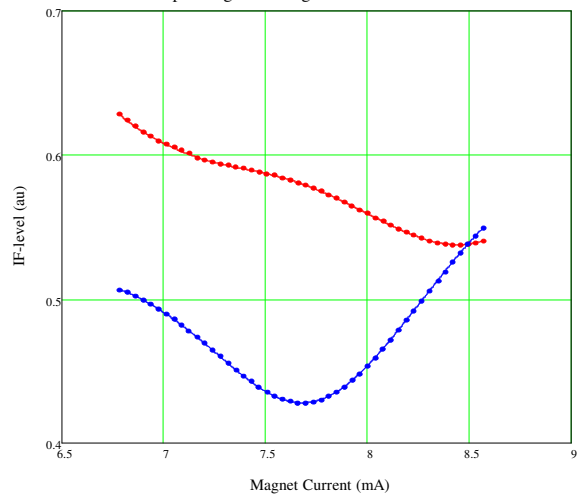
ObsID = 1342178831

BandName\_Band = "3b"

H-pol Magnet Tuning before and after deflux



V-pol Magnet Tuning before and after deflux



5 BAND 4

Results:

Band 4 shows a pumplevel dependence in the tuning result. It is therefore advisable to keep the tuning routine in place. Around 1080 GHz the tuning result for the H-mixer deviates for unknown reasons.

In the H-mixer some minor fluxtrapping was found after defluxing.

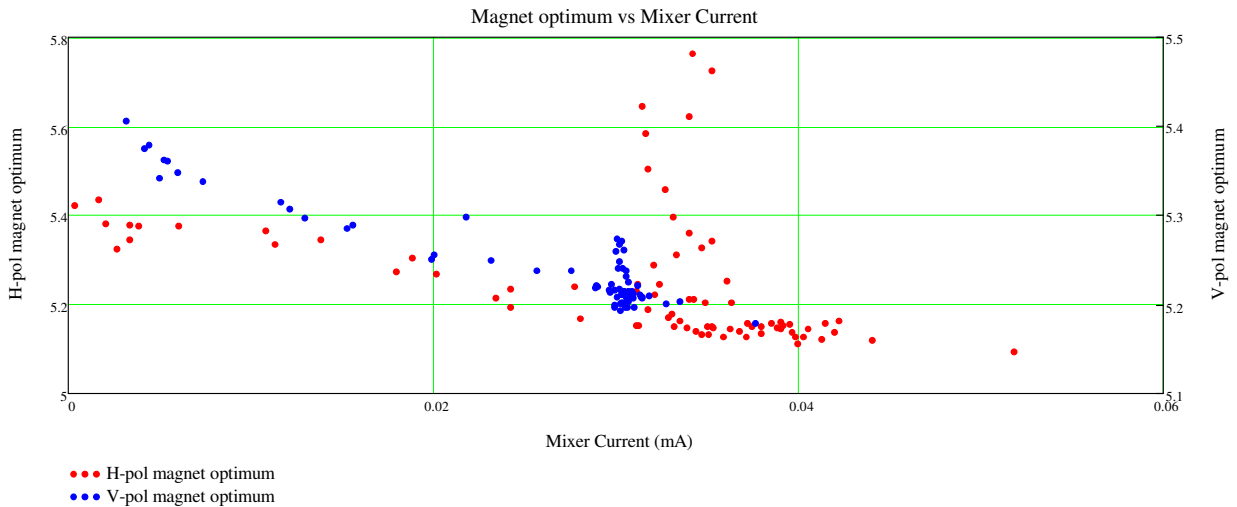
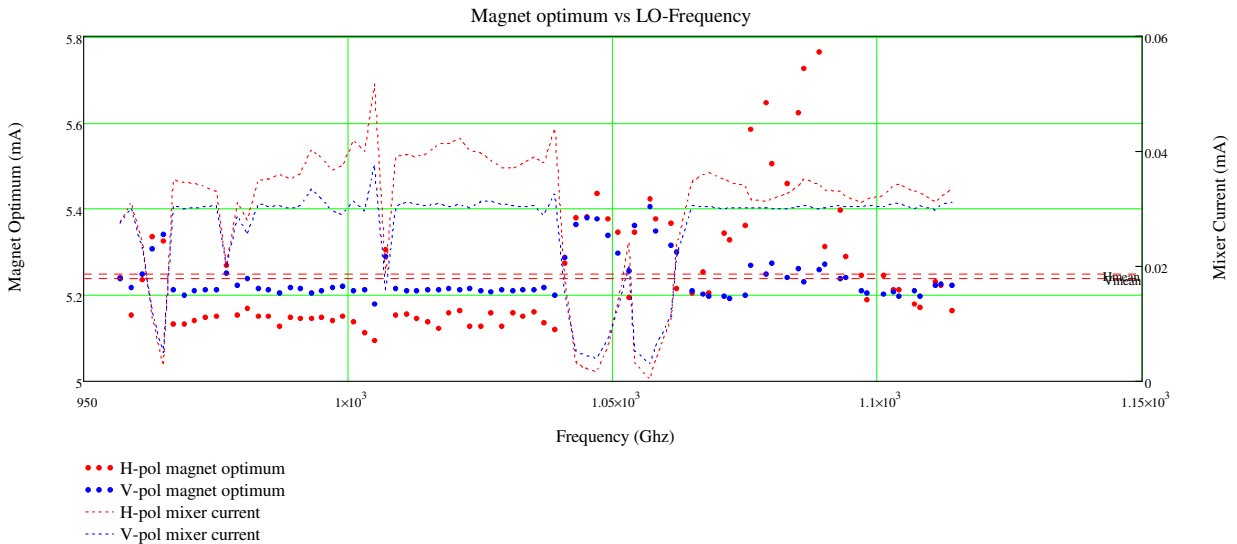
In both mixers a large fraction of the individual tuning curves show small jumps in IF-power. These might be related to flux movement in either magnet or junction or they might have their origin in the LO. Either way they could affect overall stability.

Hmean = 5.251 mA

Hstdev = 0.146 mA

Vmean = 5.24 mA

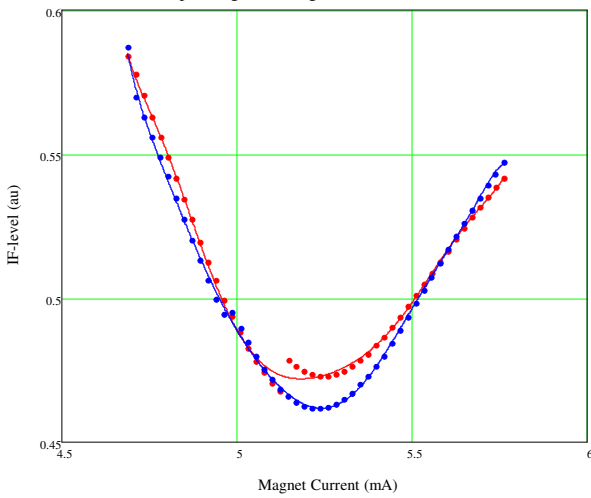
Vstdev = 0.05 mA



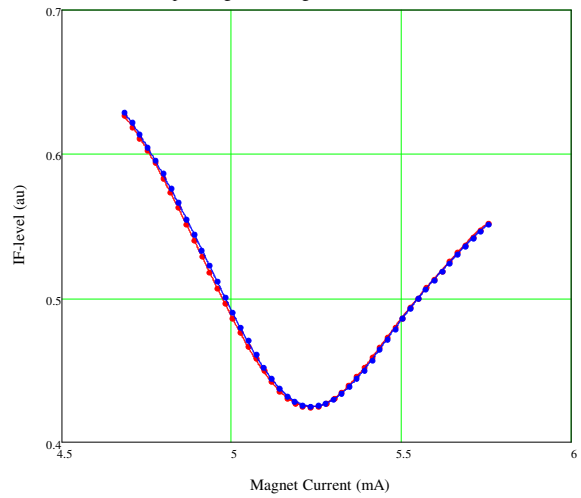
ObsID = 1342178663

BandName\_Band = "4a"

H-pol Magnet Tuning before and after deflux



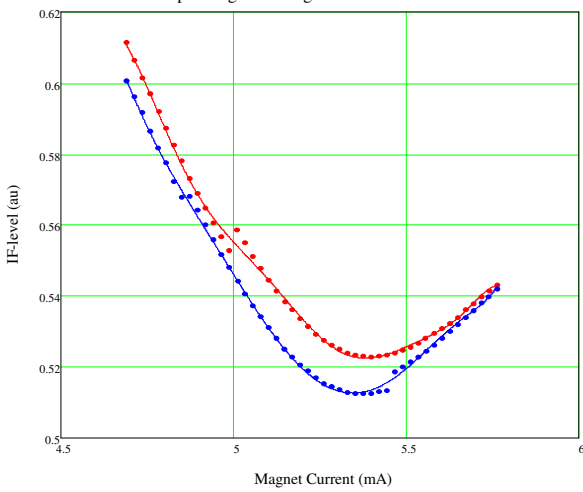
V-pol Magnet Tuning before and after deflux



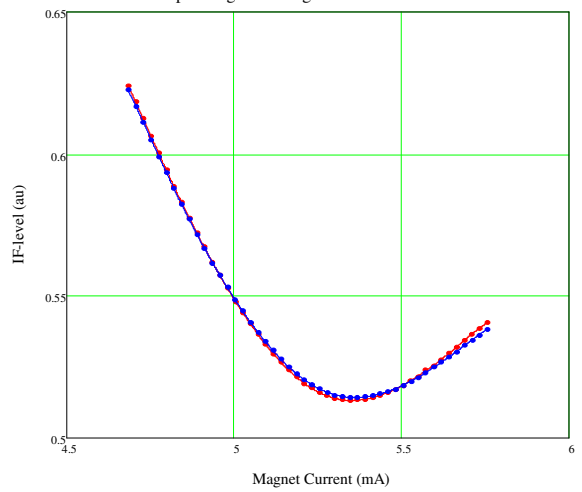
ObsID = 1342178666

BandName\_Band = "4b"

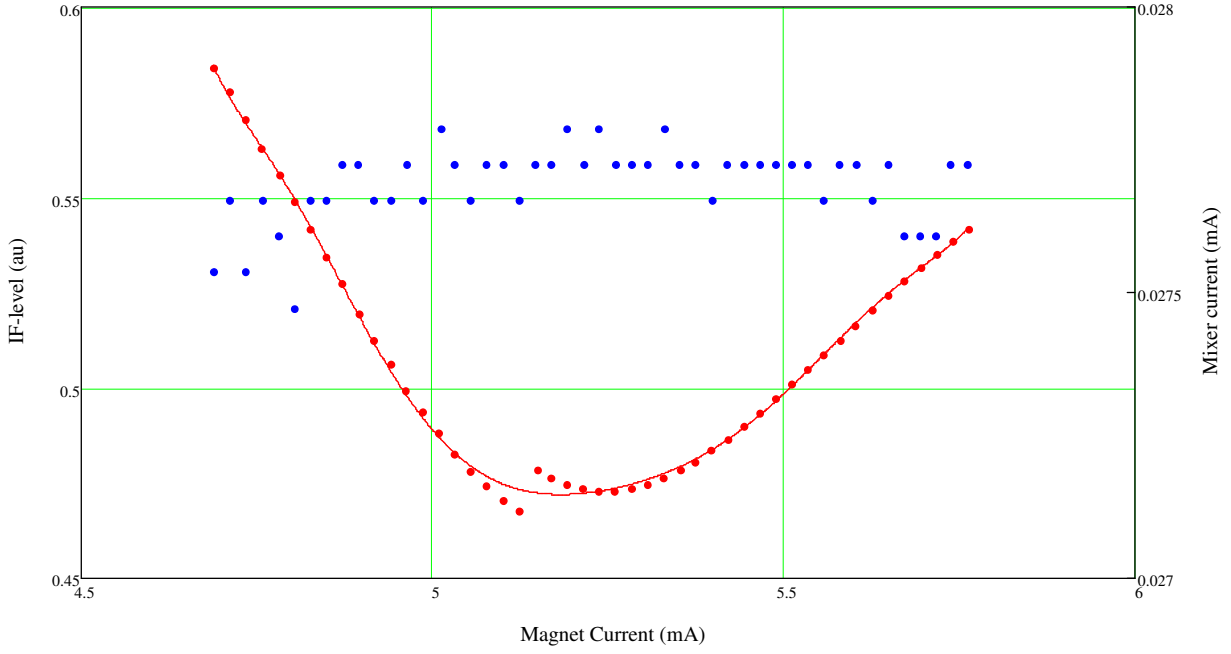
H-pol Magnet Tuning before and after deflux



V-pol Magnet Tuning before and after deflux



Step in H-pol Magnet Tuning



### 6 BAND 5

#### Results:

The H mixer shows frequency dependence. Magnet tuning is not necessary and can be replaced by a frequency dependent tuning table (tabel 2).

The V-mixer is tuned in the 3<sup>rd</sup> minimum. It is not yet clear wether this reduces mixer performance. The tuning results jump between the edge (untuned) and succesful tuning because the fraunhofer pattern is very flat already.

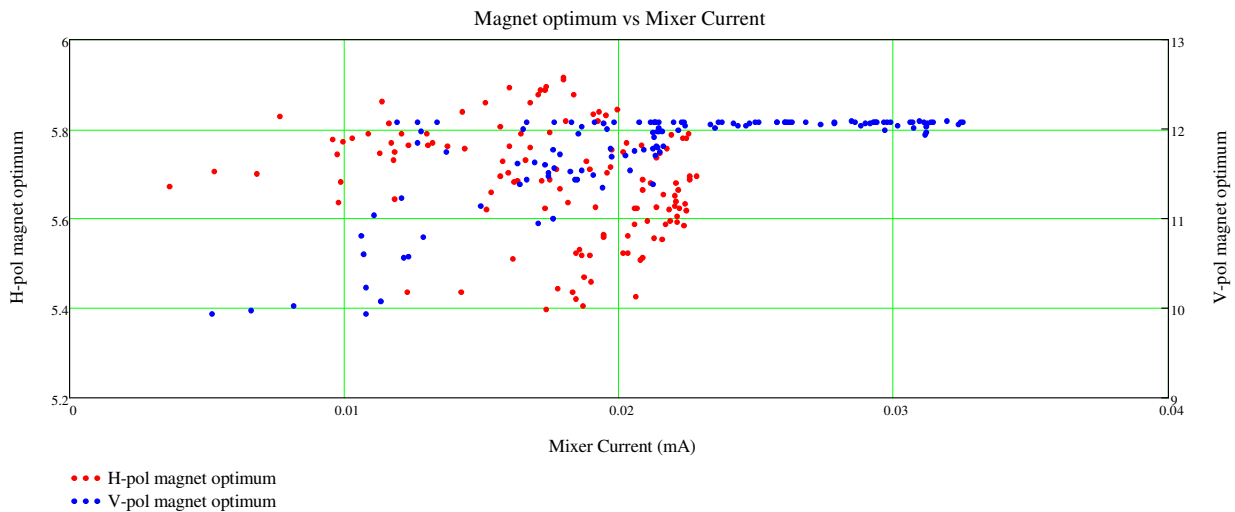
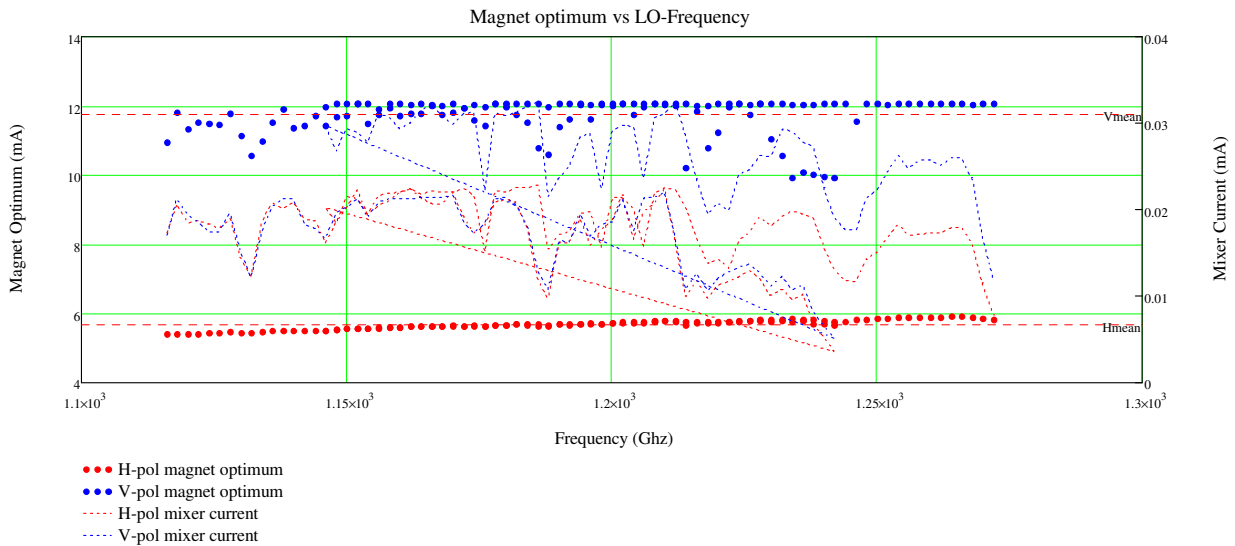
Although the band 5 heater reputedly does not function well there is some change in tuning results before and after defluxing. Statistics?

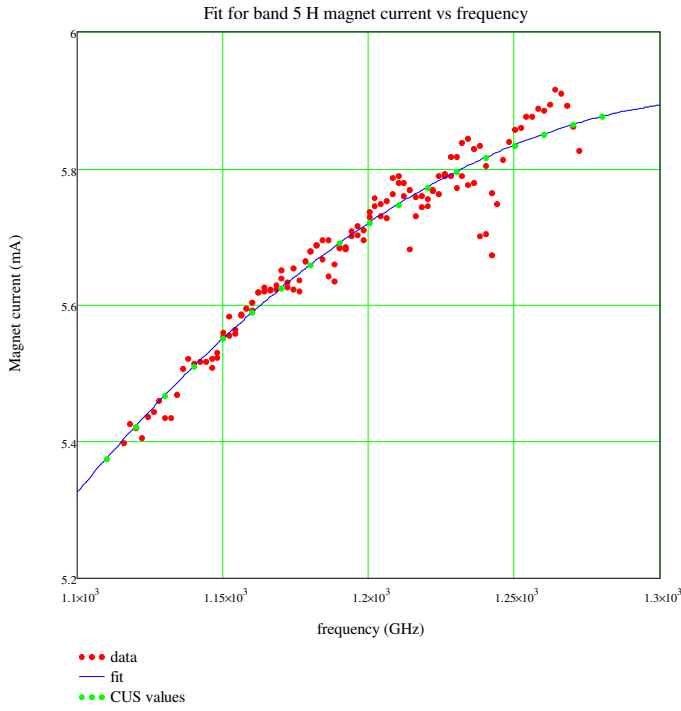
Hmean = 5.685 mA

Hstdev = 0.123 mA

Vmean = 11.763 mA

Vstdev = 0.521 mA





$$f(x) := vs_3 + vs_4 \cdot x + vs_5 \cdot x^2$$

$$vs_3 = -13.611$$

$$vs_4 = 0.029$$

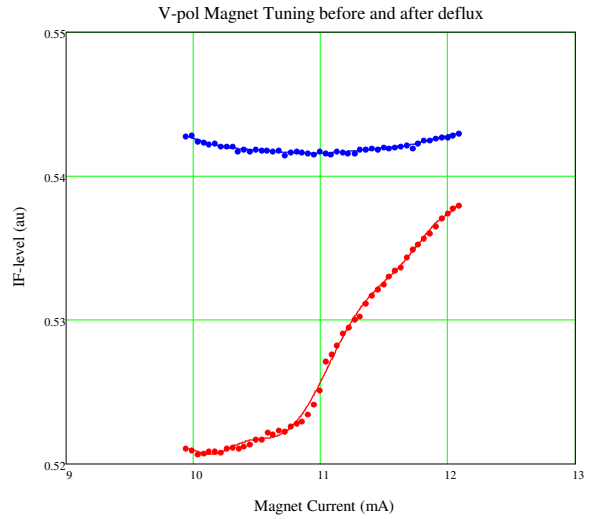
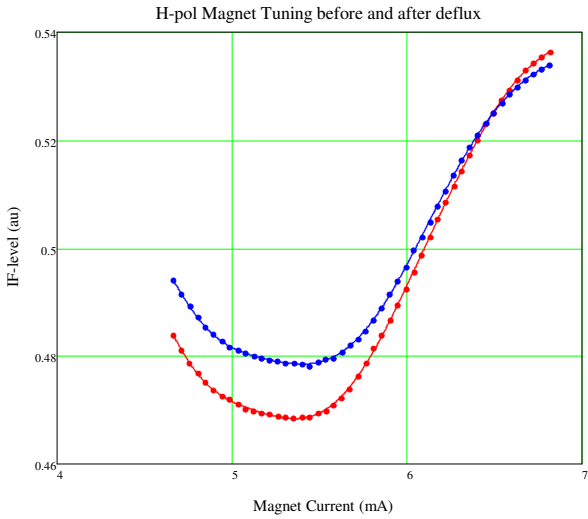
$$vs_5 = -1.106 \times 10^{-5}$$

Figure x; Band 5 magnet tuning results and 2<sup>nd</sup> order polynomial fit.

| Frequency (GHz) | Magnet current (mA) |
|-----------------|---------------------|
| 1110            | 5.38                |
| 1120            | 5.42                |
| 1130            | 5.47                |
| 1140            | 5.51                |
| 1150            | 5.55                |
| 1160            | 5.59                |
| 1170            | 5.63                |
| 1180            | 5.66                |
| 1190            | 5.69                |
| 1200            | 5.72                |
| 1210            | 5.75                |
| 1220            | 5.77                |
| 1230            | 5.80                |
| 1240            | 5.82                |
| 1250            | 5.83                |
| 1260            | 5.85                |
| 1270            | 5.86                |
| 1280            | 5.88                |

Table 2; CUS Interpolation table for band 5 H.





ObsID = 1342178801

BandName\_Band = "5b"

