



Effect of PRC length mismatch on REFL error signals

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Simulation

Simulate a double cavity with 40m like parameters, using MIST

1f sidebands are not perfectly anti-resonant in arm, to avoid 2f resonance

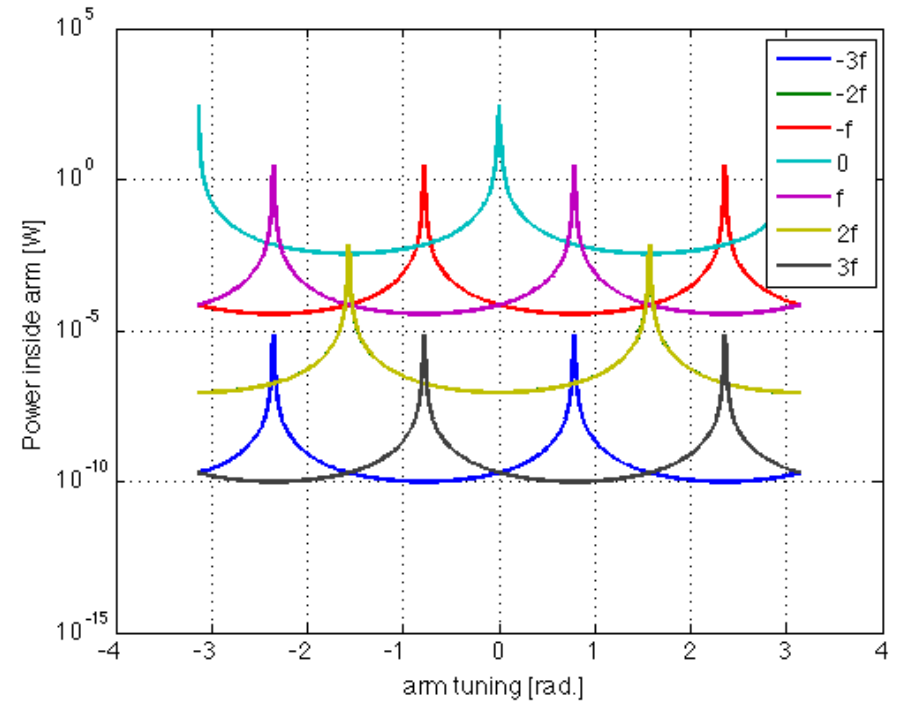
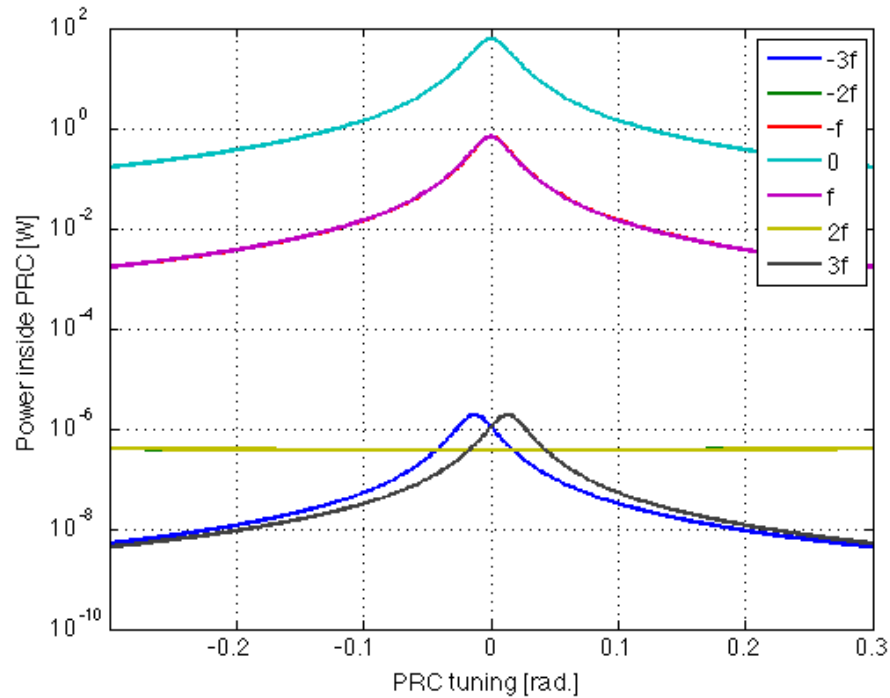
REFL error signals at 1f and 3f are extracted, while moving PRC tuning and arm tuning separately

In the first configuration, the 55 MHz modulation is well matched to the PRC length

Then, the PRC length is changed by -4cm, -2cm, -1cm, -0.5cm

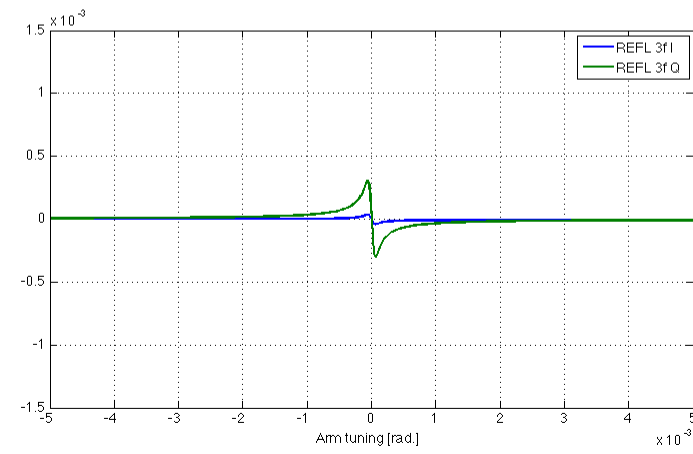
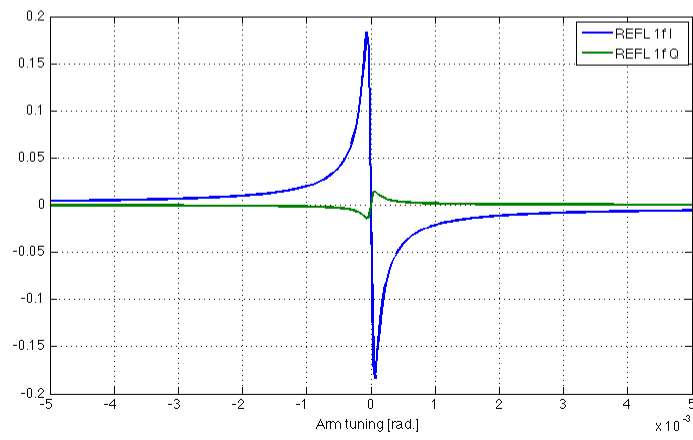
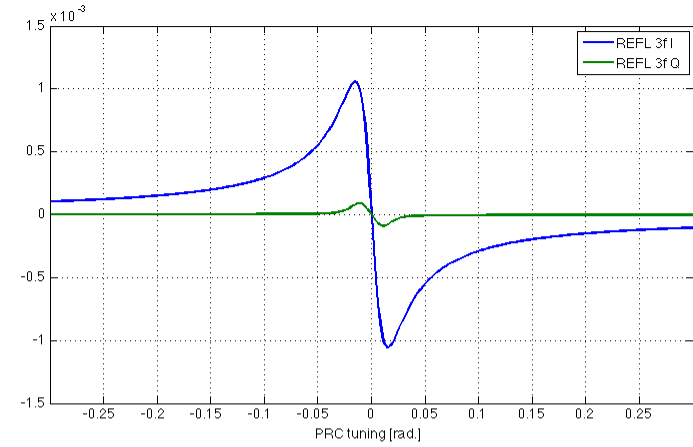
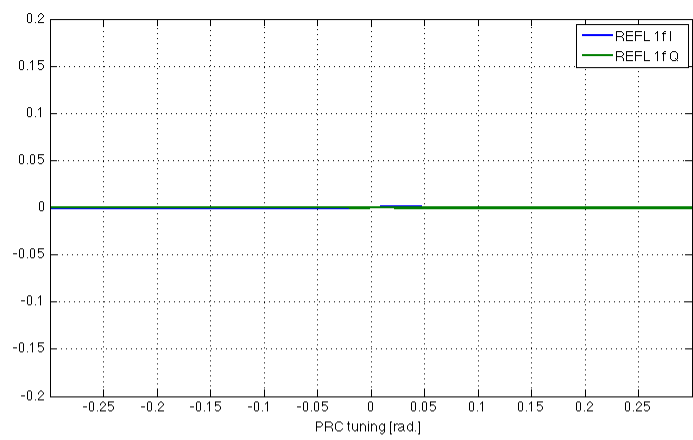
Tuned PRC length

Sideband resonance conditions inside PRC and arm:



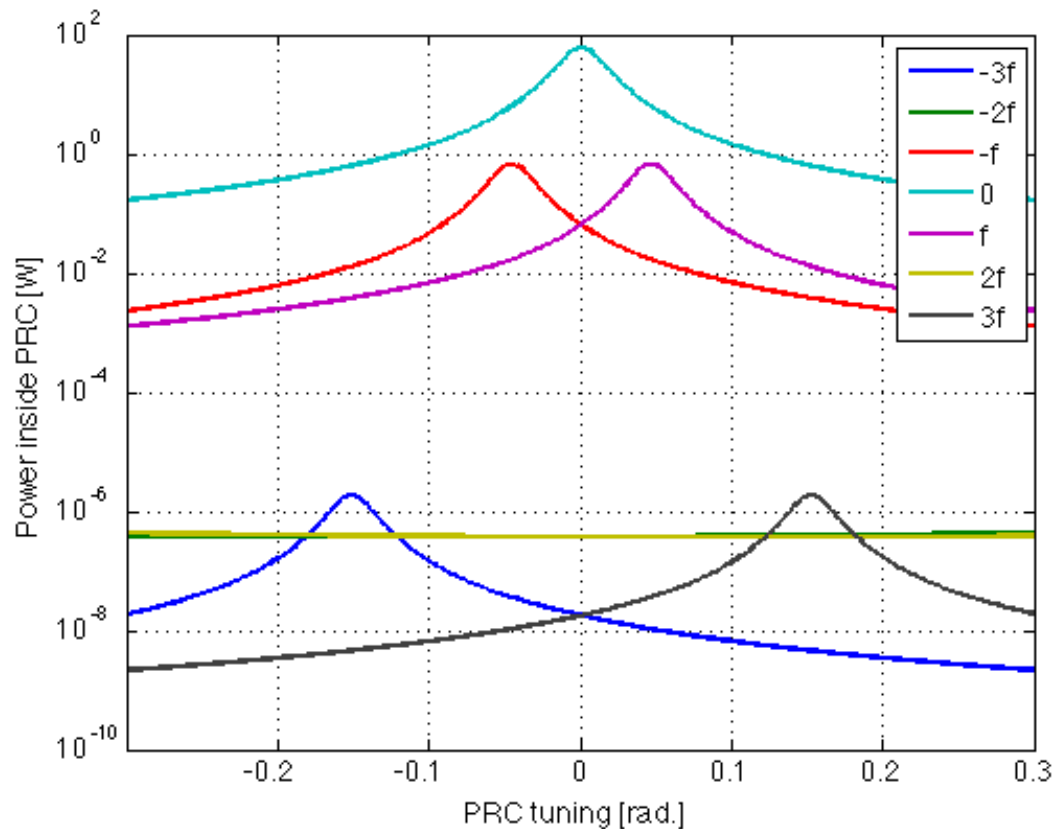
Tuned PRC length

Error signals, phase tuned to get PRCL in REFL_3f_I and CARM in REFL_1f_I



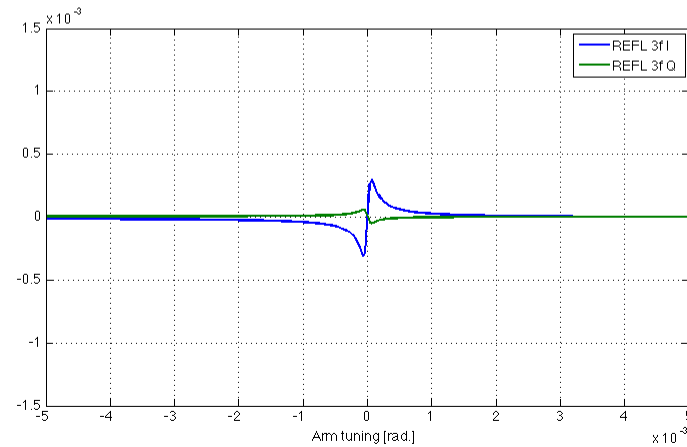
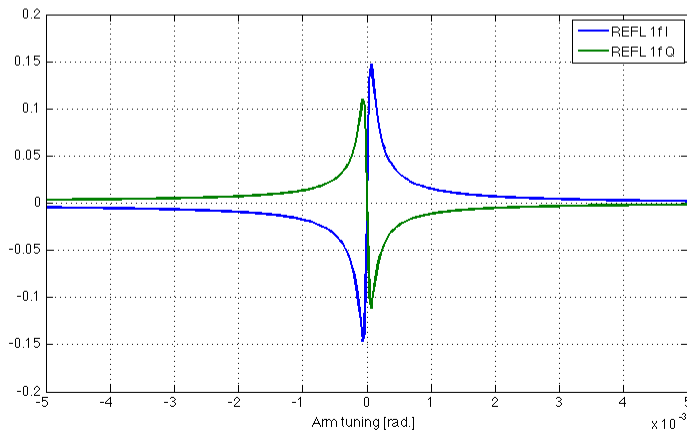
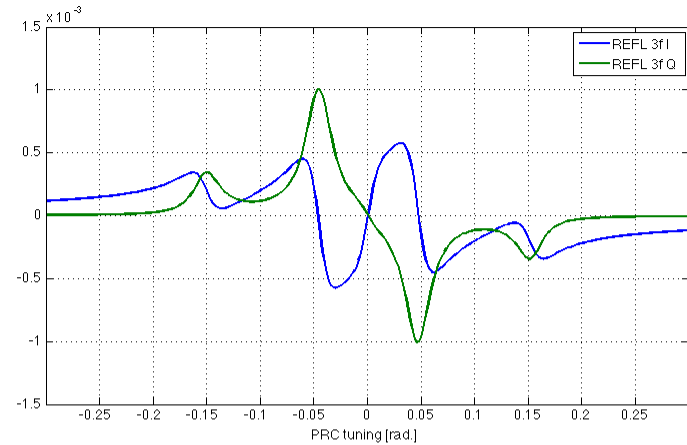
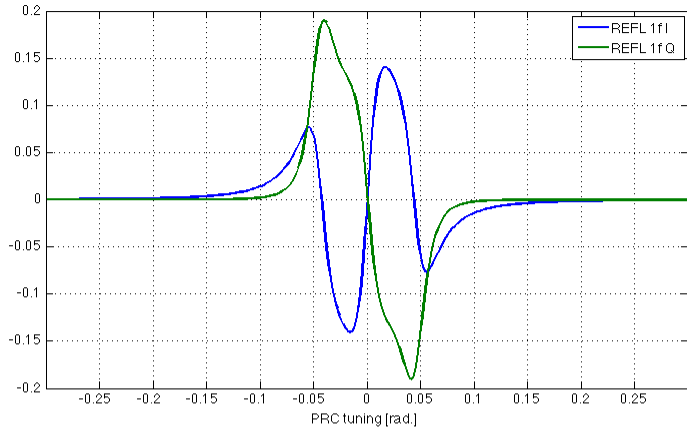
PRC length -4cm

Sideband resonance condition inside PRC (those inside arms are not changed)



PRC length -4cm

Error signals, demodulation phases not tuned



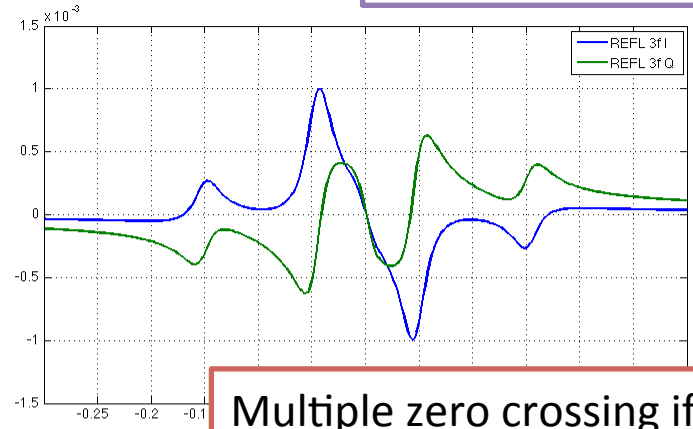
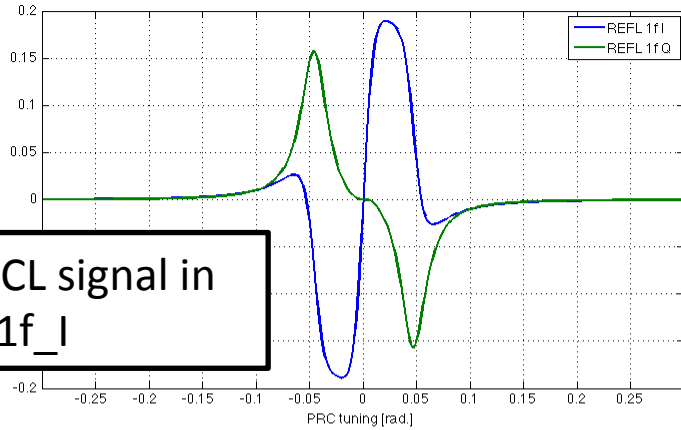


PRC length -4cm

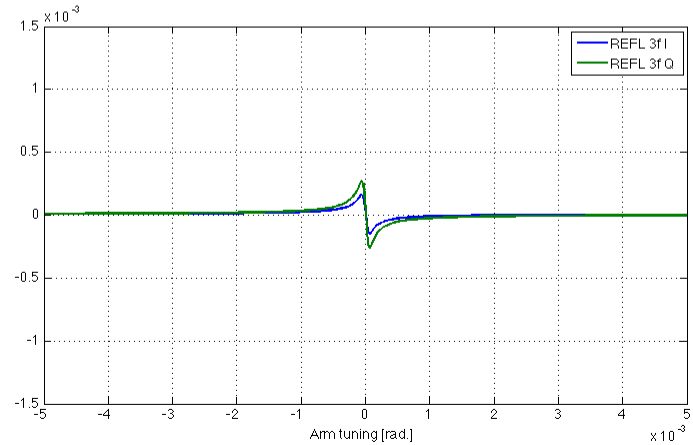
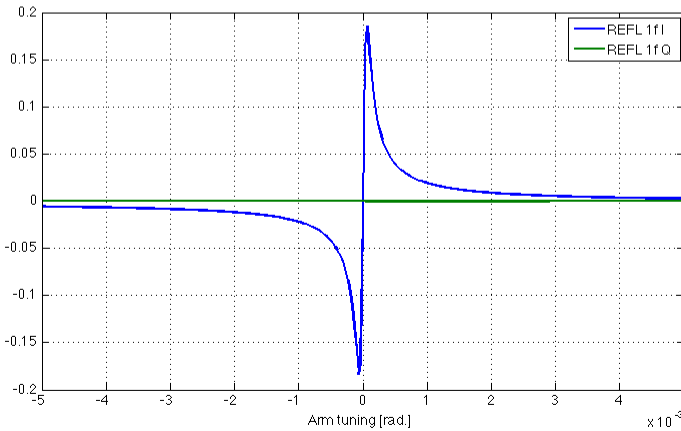
A bit of phase retuning gives better signals

Not obvious how to choose good phase!

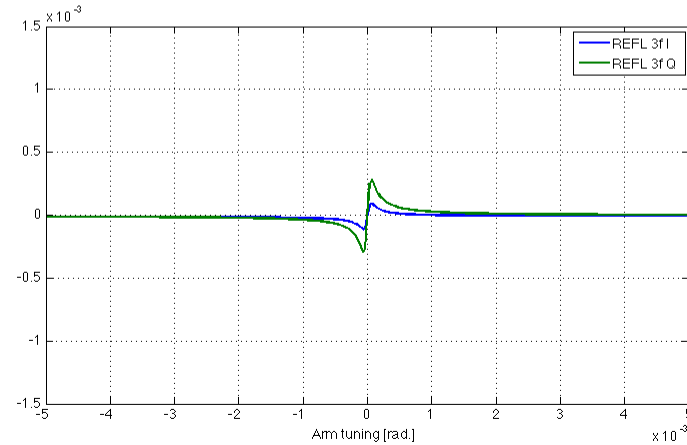
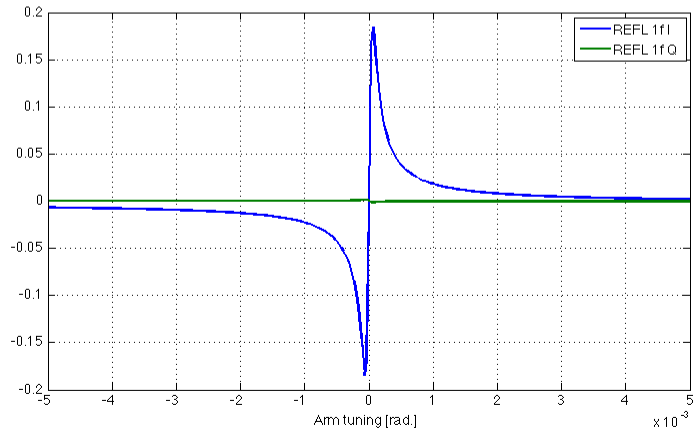
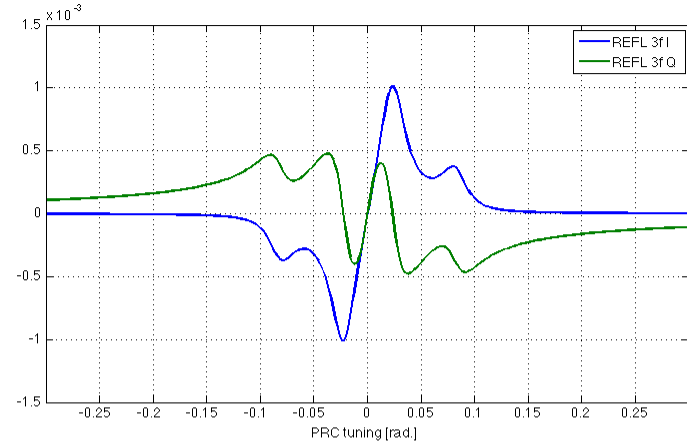
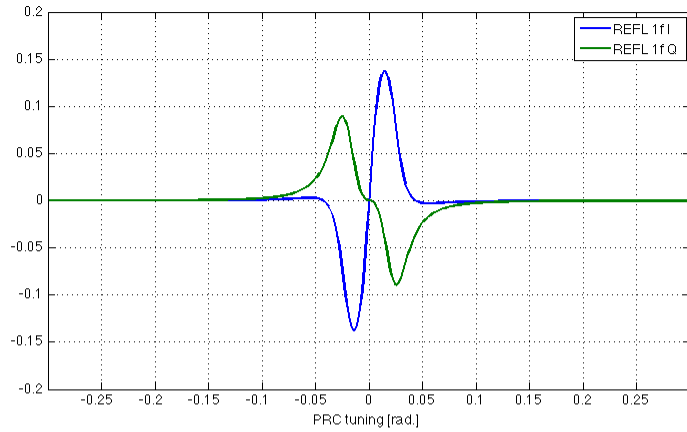
Big PRCL signal in REFL_1f_I



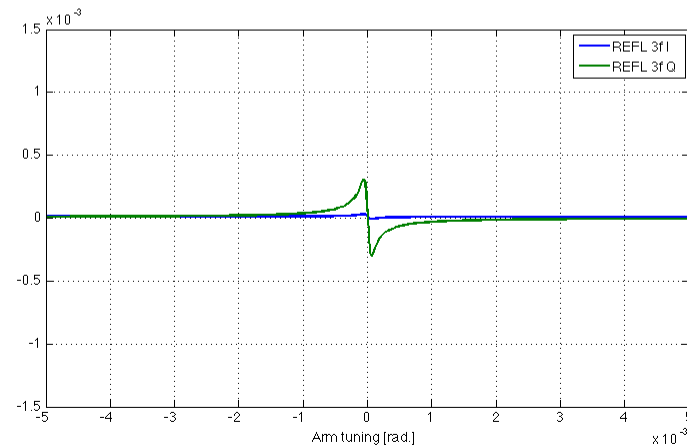
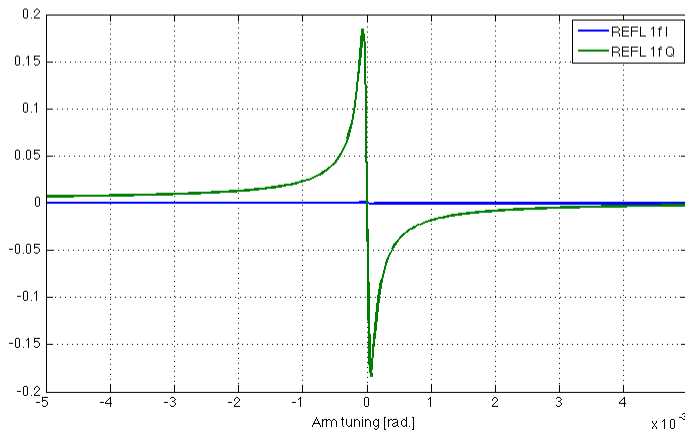
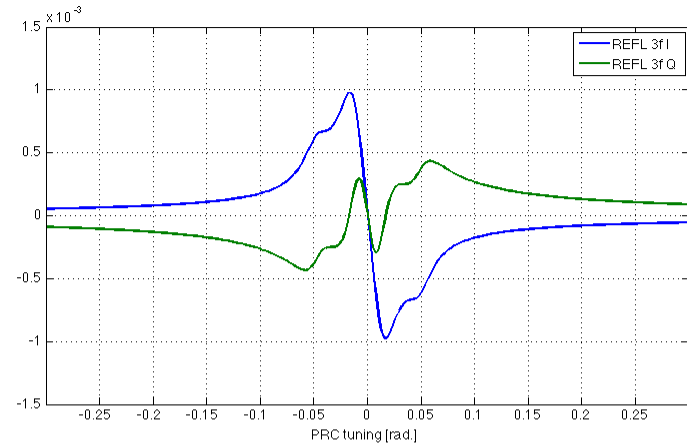
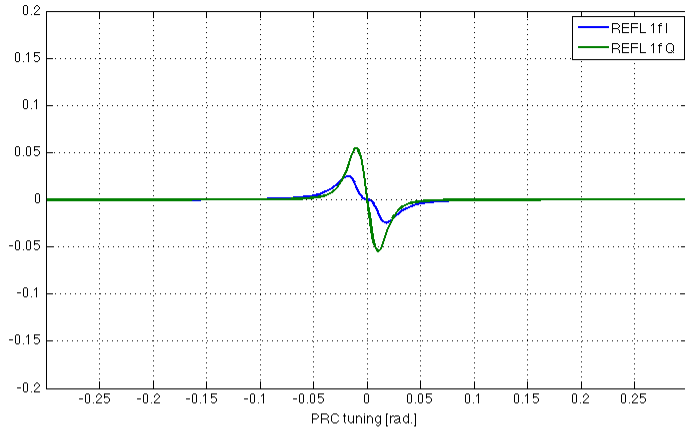
Multiple zero crossing if phase is not good



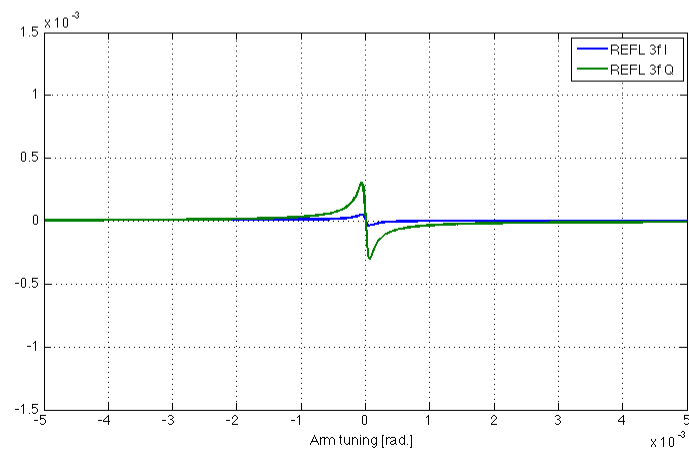
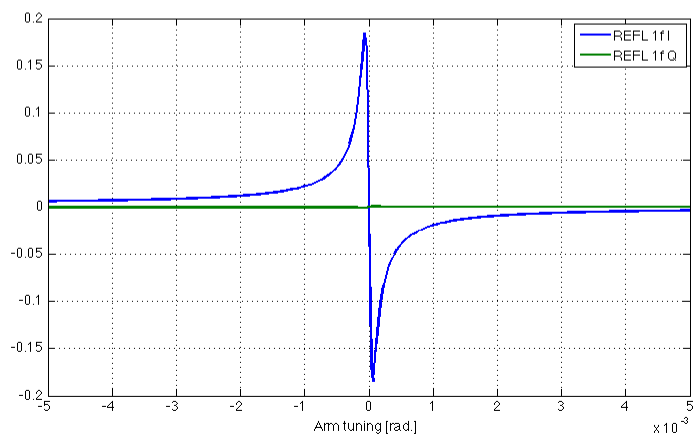
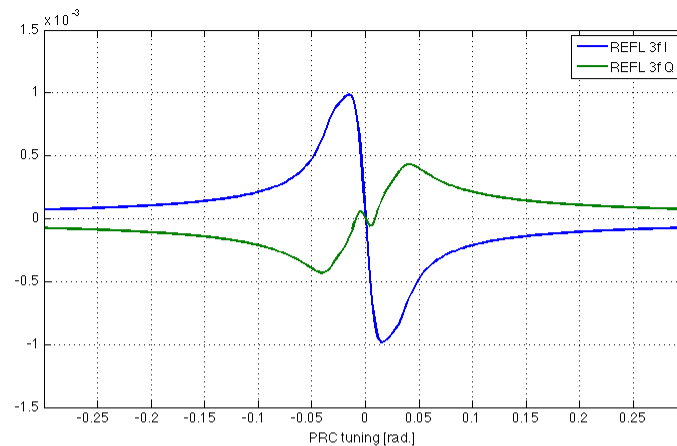
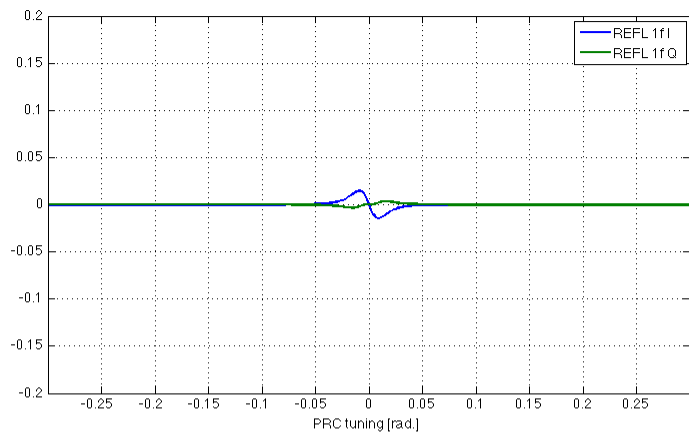
Retuning the phases:



Retuning the phases:



Retuning the phases:





Some conclusion

A mismatch between PRC length and modulation frequency **do have** an effect on error signals

Multiple zeros appear in REFL_3f/PRCL that can be removed by careful tuning of the demodulation phase (however, the shape of the signal makes difficult to understand which phase is good...)

No visible effect on REFL_1f/CARM

But a **large PRCL signal appears in REFL_1f_I**, which is used to control CARM. Is this a problem?

A mismatch of the order of **0.5 cm has a small effect.**