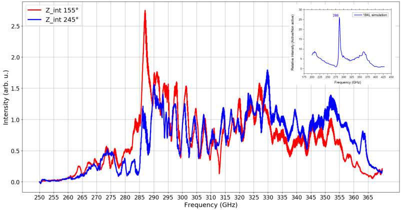
EPR angular measurements

Martin Hrtoň

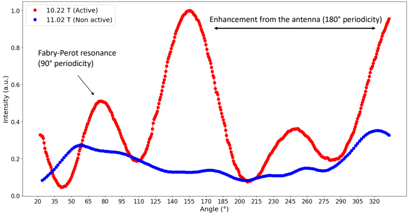
- origin of the sharp oscillations in the EPR spectra

Results from the FFDMR Maps

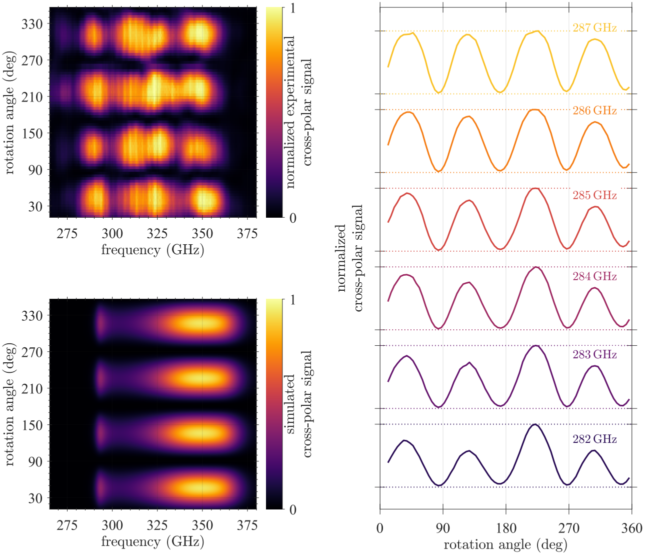


- appearance of 4 maxima with different height in the angular profile (same height expected)

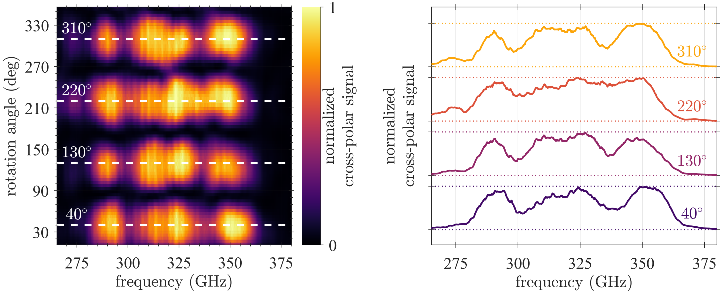
Results from AFDMR Maps



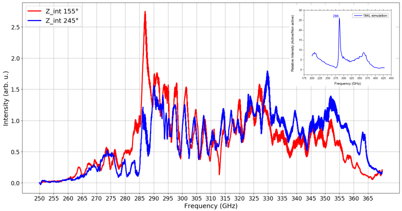
angular profile changes rather erratically as we change frequency



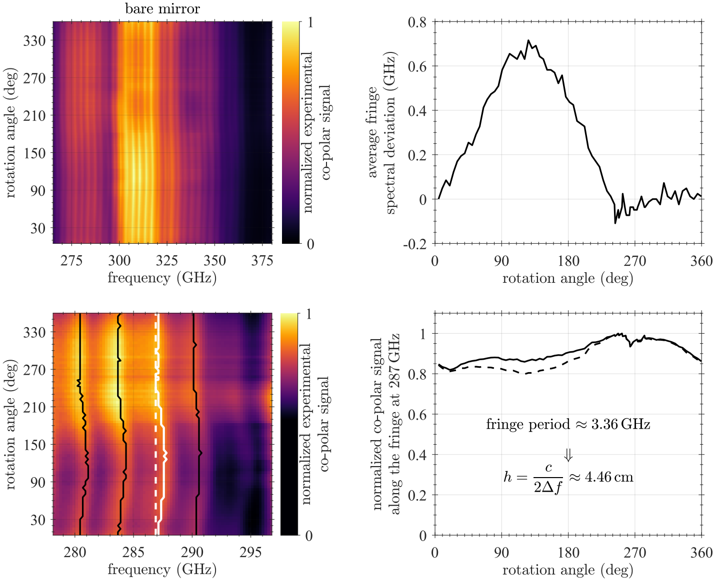
sharp contrast between the magnitude of oscillations observed in the EPR (bottom) and the overall (top) cross-polar spectra



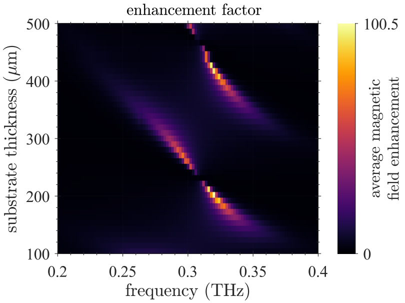
Results from the FFDMR Maps

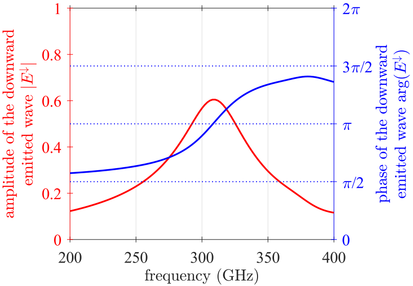


Bare mirror co-polar measurement - fringe bending



Effective layer model





magnetic field — current distribution

$$\vec{H}(\vec{r},\omega) \sim \vec{P}(\vec{r},\omega)$$

$$\vec{P}(\vec{r},\omega) = p(\omega)\vec{\mathcal{P}}(\vec{r},\omega)$$

excitation amplitude — mode spatial distribution (given by antenna geometry)

$$p(\omega) = \alpha(\omega)\left[E_0(\omega) + E_{\text{sca}}(\omega)\right]$$

$$p(\omega) = \alpha(\omega)\left[E_0(\omega) + g(\omega)p(\omega)\right]$$

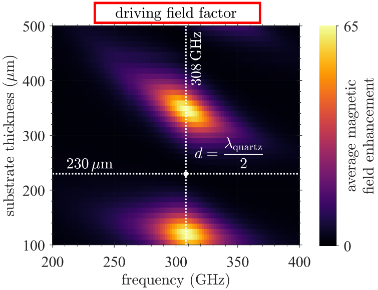
antenna feedback factor

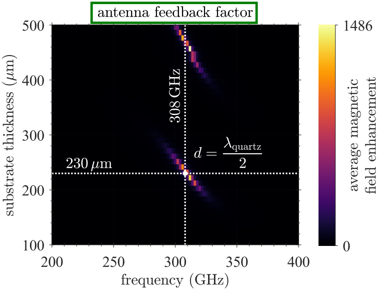
$$p(\omega) = \frac{\alpha(\omega)E_0(\omega)}{1 - \alpha(\omega)g(\omega)}$$

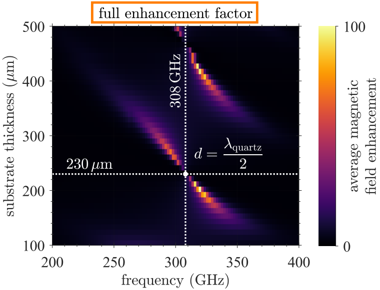
positive feedback can lead to a large field enhancement

$$\frac{p(\omega)}{p_0(\omega)} = \frac{\left(1 - \dfrac{r_{12} + r_{23}e^{2ik_2d}}{1 - r_{21}r_{23}e^{2ik_2d}}\right)/(1 - r_{12})}{1 + \dfrac{E^{\downarrow}}{1 - r_{12}}\dfrac{t_{21}r_{23}e^{2ik_2d}}{1 - r_{21}r_{23}e^{2ik_2d}}}$$

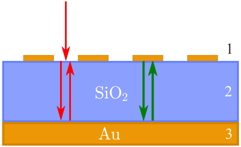
Fabry-Perot resonator - Salisbury screen effect

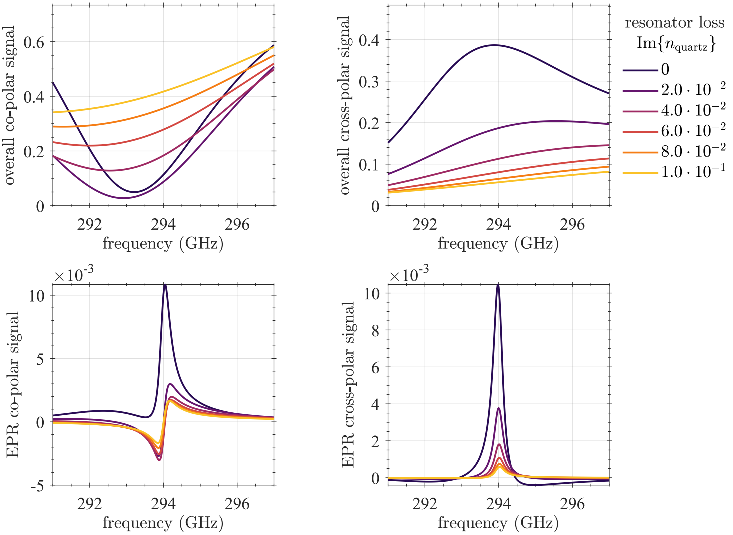




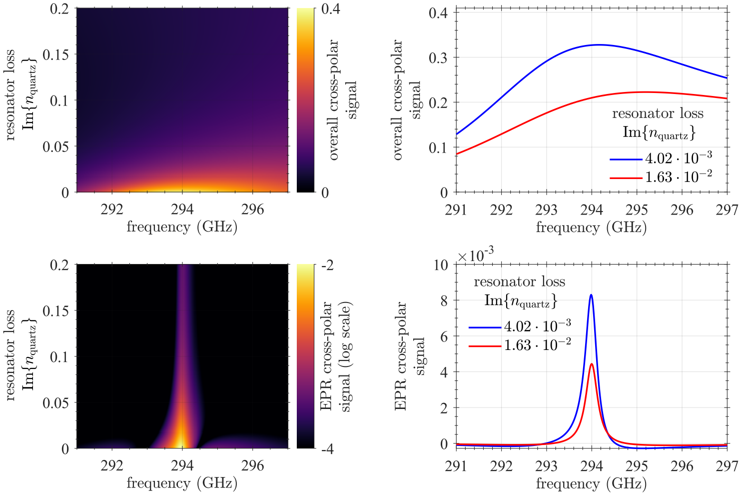


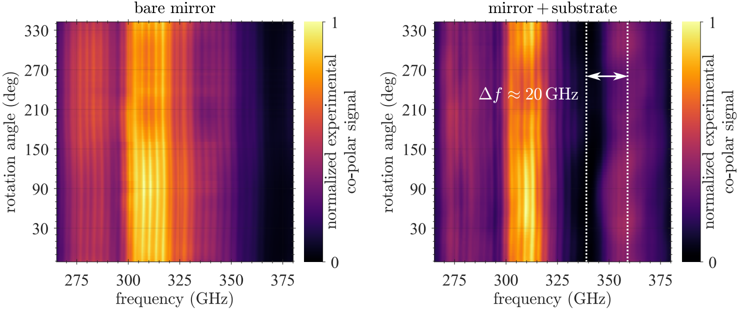
$$\frac{p(\omega)}{p_0(\omega)} = \frac{\left(1-\frac{r_{12}+r_{23}e^{2ik_2d}}{1-r_{21}r_{23}e^{2ik_2d}}\right)/(1-r_{12})}{1+\frac{E^{\downarrow}}{1-r_{12}}\frac{t_{21}r_{23}e^{2ik_2d}}{1-r_{21}r_{23}e^{2ik_2d}}}$$




overall co-polar signal
frequency (GHz)
overall cross-polar signal
frequency (GHz)
resonator loss
Im{n_{quartz}}
0
$2.0 \cdot 10^{-2}$
$4.0 \cdot 10^{-2}$
$6.0 \cdot 10^{-2}$
$8.0 \cdot 10^{-2}$
$1.0 \cdot 10^{-1}$
EPR co-polar signal
$\times 10^{-3}$
frequency (GHz)
EPR cross-polar signal
$\times 10^{-3}$
frequency (GHz)

Fabry-Perot resonator losses





$$d = \frac{c}{2 n_{\mathrm{eff}} \Delta f} \approx 3.6\,\mathrm{mm}$$