Enhanced sensing of weak anharmonicities

Adhruth Ganesh

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$\mathcal{PT}$ symmetries and Exceptional points

- Open, Closed systems and $\mathcal{PT}$ symmetric systems
- Types of $\mathcal{PT}$ symmetries
- Non-Hermitian Hamiltonians
- Operators $\mathcal{P}, \mathcal{T}$
- Degeneracy (DP) vs Coalescence (EP)

Vacuum Induced Coherence

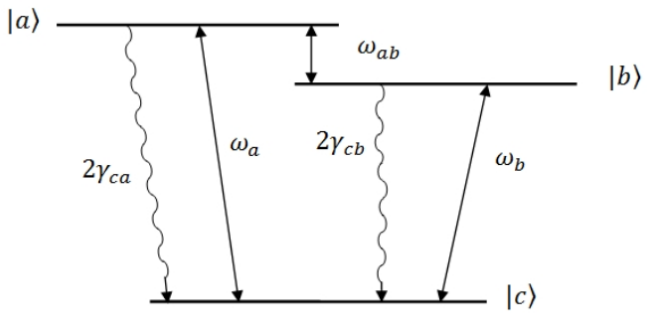

Figure: V system where we assume that the 2 excited energy levels are of nearly the same energy

$$\dot{\rho}_{aa} = -2\gamma_{ca}\rho_{aa} - \sqrt{\gamma_{ca}\gamma_{cb}}cos\theta(\rho_{ab}e^{i\omega_{ab}t} + \rho_{ba}e^{-i\omega_{ab}t})$$

$$\dot{\rho}_{bb} = -2\gamma_{cb}\rho_{bb} - \sqrt{\gamma_{ca}\gamma_{cb}}cos\theta(\rho_{ab}e^{i\omega_{ab}t} + \rho_{ba}e^{-i\omega_{ab}t})$$

$$\dot{\rho}_{ab} = -(\gamma_{ca} + \gamma_{cb})\rho_{ab} - \sqrt{\gamma_{ca}\gamma_{cb}}cos\theta(\rho_{aa} + \rho_{bb})e^{-i\omega_{ab}t})$$

Dissipatively coupled Anti-$\mathcal{PT}$ symmetric system

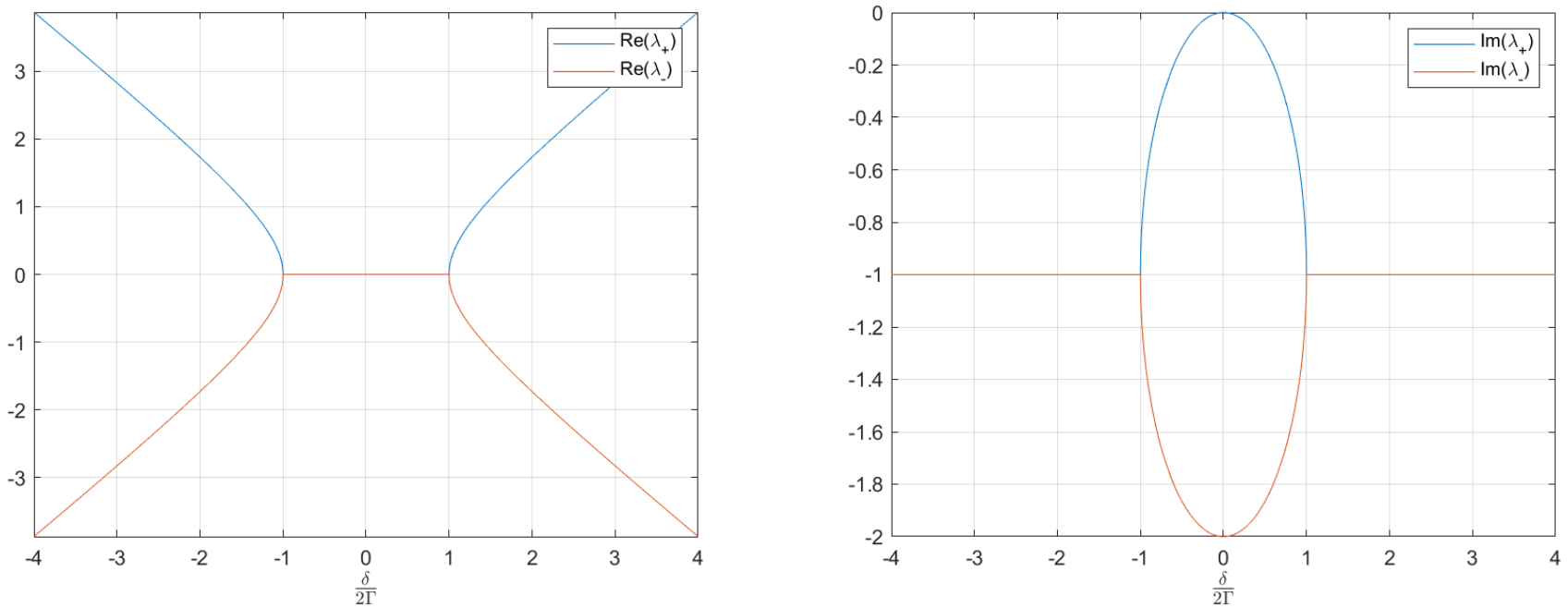

Figure: a) Eigenfrequencies for the given system. The EPs occur when $\delta/2\Gamma = 1$. b)Linewidths of the corresponding eigenfrequencies. The vaccum induced coherence linewidth supression occurs at $\delta = 0$

$$\lambda_{\pm} = -i(\gamma_0 + \Gamma) \pm \sqrt{\delta^2/4 - \Gamma^2}$$

Experiment setup

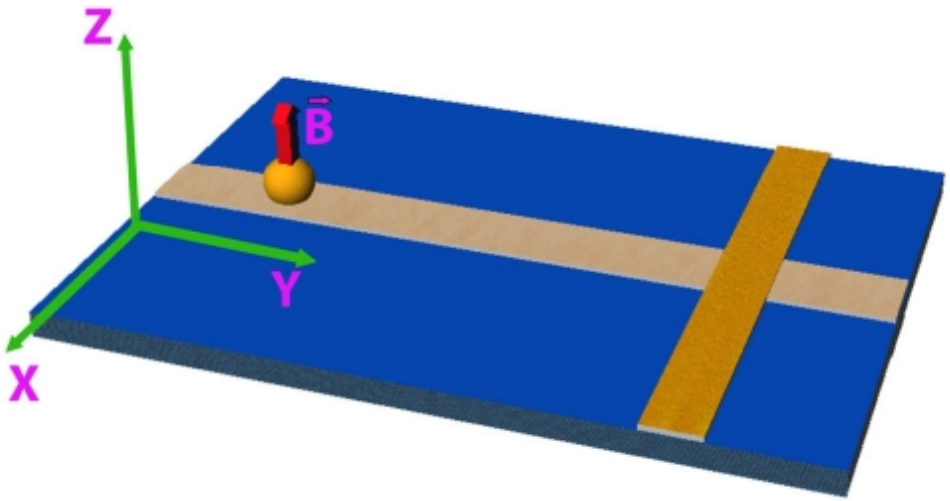

Figure: This is the given experimental setup, where the yellow sphere represents the YIG sphere and the microwave cavity runs transverse to the waveguide which interacts with YIG sphere through the transmission line.

Sensing Capabilities

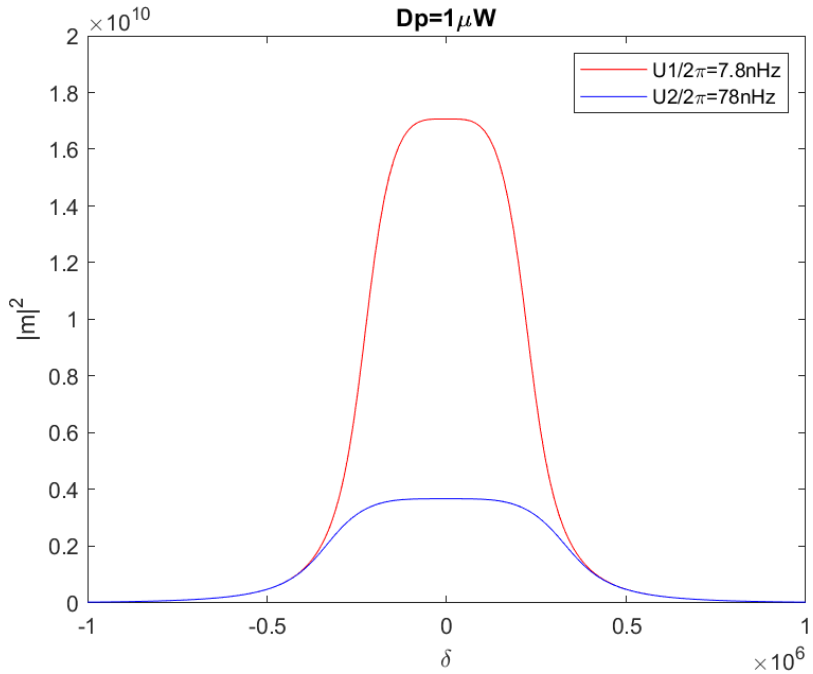

Figure: Spin currents plotted for different nonlinearities for a given drive power. Here we see that a 10 fold increase in the anharmonicity corresponds to a significant increase in the induced current which aids in the sensitivity

Sensing Capabilities

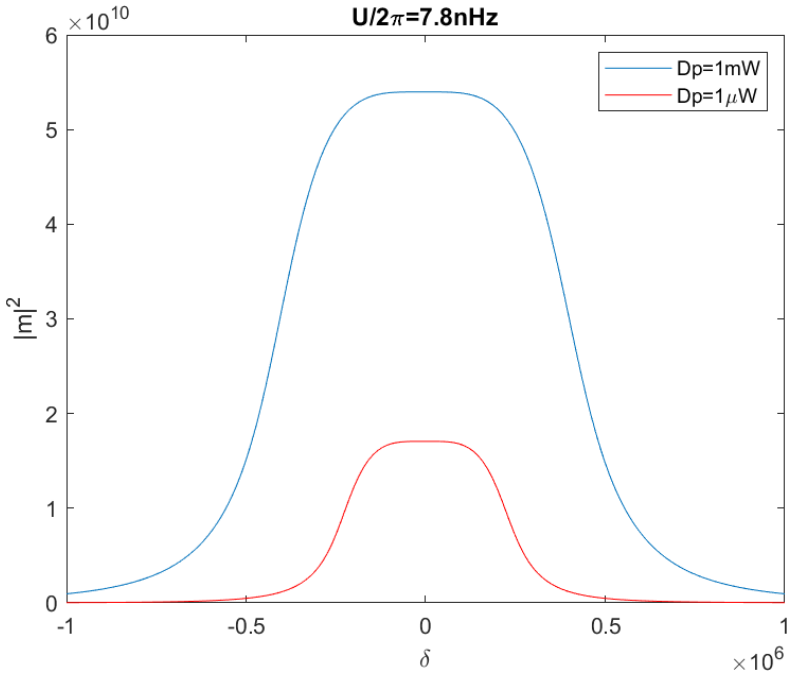

Figure: Same nonlinearity but different drive powers. It is clearly seen that increaesing the drive power enhances the sensing for a weak anharmonicity.