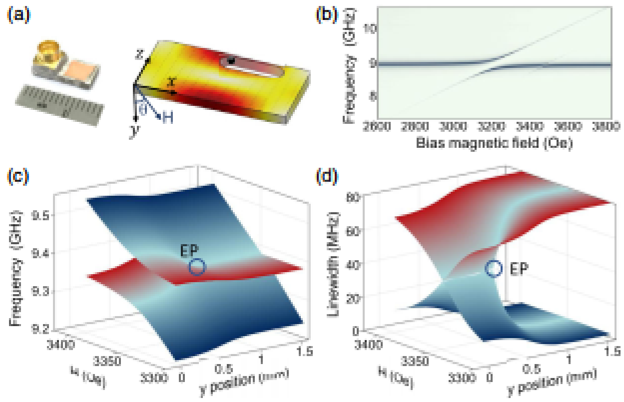
1. 磁子极化子

Magnon polariton: the coupling of magnon and microwave photon.

磁子极化子体系的作用：可以模拟非厄米体系



specified). The magnon mode, i.e., the ferromagnetic resonance of the YIG sphere, is tuned by the magnetic field: $f_m = \gamma H$ where $\gamma = 2.8$ MHz/Oe is the gyromagnetic ratio. When the magnon is tuned to near resonance with the cavity mode, they couple with each other through magnetic dipole-dipole interactions.

The magnon-photon coupling is characterized by measuring the cavity reflection at different H [Fig. 1(b)]. Intrinsic system parameters are extracted via numerical fitting: cavity frequency $f_c = 8.977$ GHz, cavity dissipation $\kappa_c = 54$ MHz, magnon dissipation $\kappa_m = 1.1$ MHz, coupling strength $g = 128$ MHz. Clearly, the magnon-

$$H = \begin{pmatrix} f_c & 0 \\ 0 & f_m \end{pmatrix} + \begin{pmatrix} -i\kappa_c & g \\ g & -i\kappa_m \end{pmatrix}. \tag{1}$$

Solving the Hamiltonian gives two eigenmodes at eigenfrequencies

$$\lambda_\pm = f_\pm + i\kappa_\pm = f_0 + i\kappa_0 \pm \frac{1}{2}\sqrt{(\Delta f - i\Delta\kappa)^2 + 4g^2}, \tag{2}$$

where $f_0 = (f_c + f_m)/2$, $\kappa_0 = (\kappa_c + \kappa_m)/2$, $\Delta f = f_m - f_c$, $\Delta\kappa = \kappa_m - \kappa_c$. The parameters needed for calculating the eigenfrequencies can be extracted from numerical fitting of the cavity reflection spectra [43].

来源：DOI:10.1103/PhysRevLett.123.237202

2. 三磁子相互作用

一个能量为 $\hbar w$，动量为 0 的磁子 (Kittel mode) 分裂为两个能量为 $\hbar w/2$，动量分别为 $\hbar k$ 和 $-\hbar k$ 的磁子。

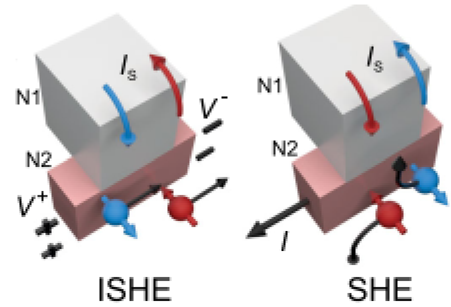
3. 顶层和底层 YIG 矫顽力大小

生长在 GGG 衬底上的底层 YIG 具有比顶层 YIG 更小的矫顽力。来源：https://doi.org/10.1038/s41928-020-0425-9

4. 电流，自旋流和电子自旋角动量之间的关系

SHE:$\mathbf{j_s} = \theta_{SH}\mathbf{j_c} \times \sigma$

ISHE: $$\mathbf{j}_c = \alpha_{SH}\frac{2e}{\hbar}\mathbf{j}_s \times \boldsymbol{\sigma}(t). \tag{3.34}$$

示意图：

来源：10.1103/RevModPhys.87.1213

5. 反铁磁自旋波和铁磁自旋波的区别

在铁磁体中，$\mathbf{k}\perp\mathbf{m}$ 和 $\mathbf{k}//\mathbf{m}$ 对应的自旋波色散关系不同，但是在反铁磁体中，这两种情况对应的自旋波简并，因为反铁磁自旋波不受偶极相互作用的影响，只取决于交换相互作用。