Spin Torque Driven Excitations

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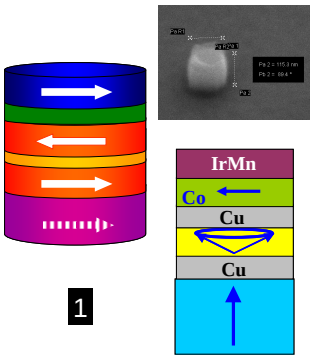
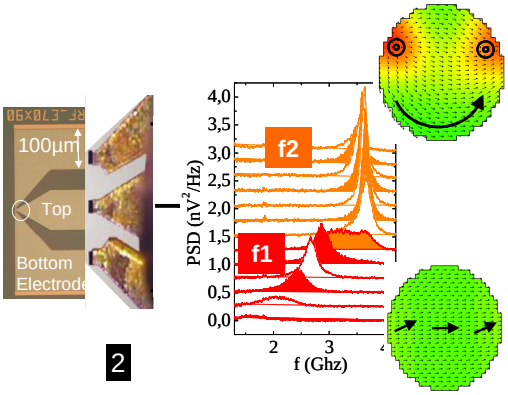
Microwave magnetization dynamics induced by spin transfer torque leads to large amplitude steady state oscillations. The spin transfer provides an energy feedback to counteract natural Gilbert damping. The challenges are to understand the associated linear and non-linear magnetization dynamics properties and to optimize the dynamic performances (output power, linewidth and frequency characteristics) for potential applications as integrated tuneable microwave oscillators.



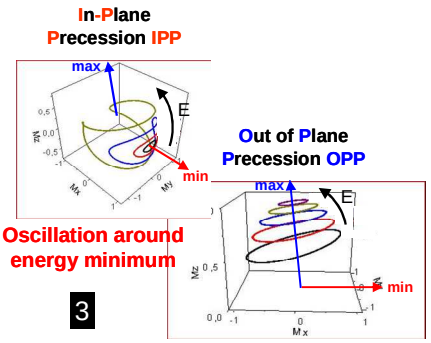
1

Materials development and nanofabrication to test new ideas of different magnetic stacks and device configurations



2

Frequency domain excitation spectra and comparison to micromagnetic simulations



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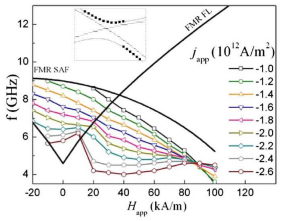


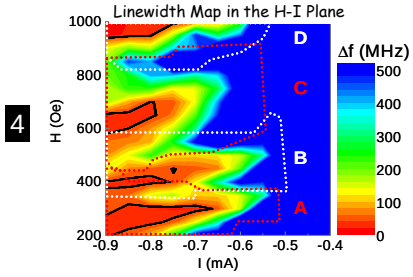
Oscillation around energy maximum

Simulations to understand the mode character and the role of dynamic interactions between the layers inside a stack

- **Designing magnetic stacks for tuning dynamic properties (1)**
  Perpendicular Polarizer, Synthetic Antiferromagnet SAF, Magnetic Tunnel Junction MTJ

- **Understanding the excitation spectra (2, 3, 4)**
  Determining the dynamic mode spectra and the state diagram from experiments and simulations; determining the linear and non-linear properties of the magnetization dynamics

- **Understanding the physical origin of linewidth broadening (5, 6, 7, 8)**
  Developing techniques to extract phase noise and to address important fundamental and technological questions on linewidth broadening



4

Linewidth vs Current and Field revealing the conditions for minimum linewidth.

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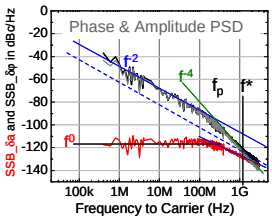
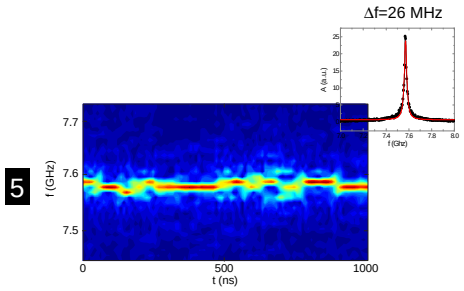


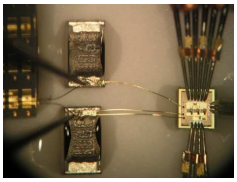
Phase and amplitude noise power spectral density extracted from time domain revealing different power-law dependencies vs frequency.



5

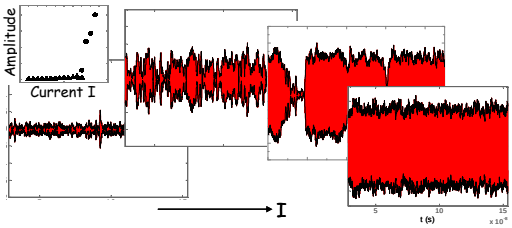
Linewidth broadening due to frequency fluctuations revealed by frequency-time spectrogram analysis.

8



Coupling of the oscillator device to an impedance matched amplifier (CMOS technology)

6



Time domain traces for increasing current revealing the critical current (vanishing og extnctions and sharp increase of intensity).

Collaboration