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Spintronic emitters in the terahertz regime

Applied optical spectroscopy

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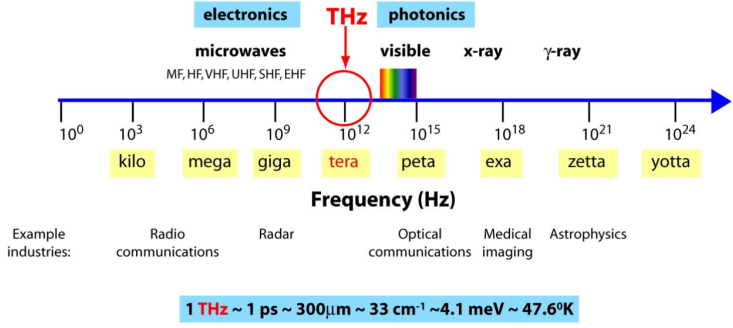
Outline

The THz Gap



1 THz ~ 1 ps ~ 300μm ~ 33 cm^{-1} ~4.1 meV ~ 47.6°K

The electromagntic spectrum from G. P. Williams, Rep. Prog. Phys, **69** (2005) .

Terahertz

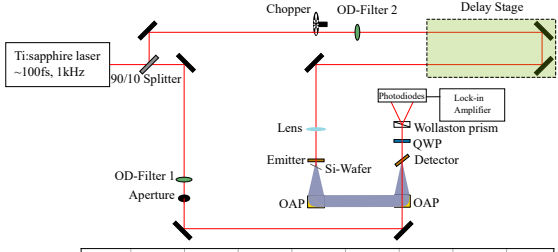
So why do we need terahertz radiation?

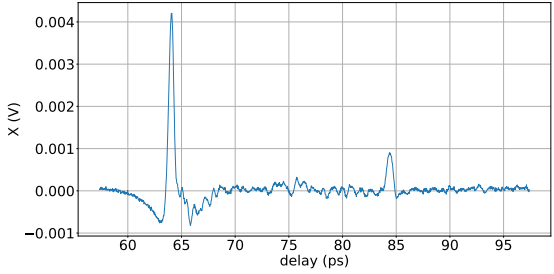
- medicine
- security
- data transmission & saving
- physics

Introduction

Common emitters:

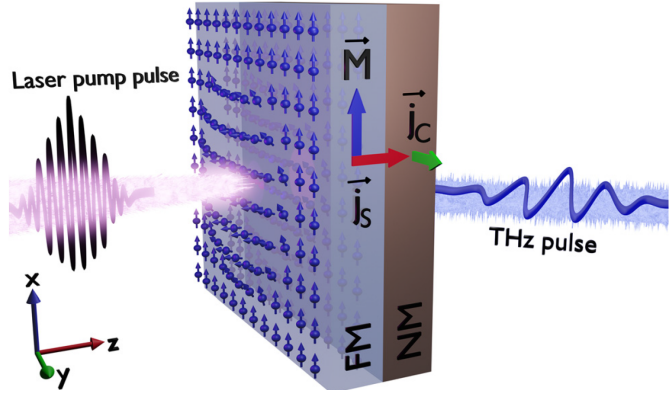
- PCA
- Non linear crystals



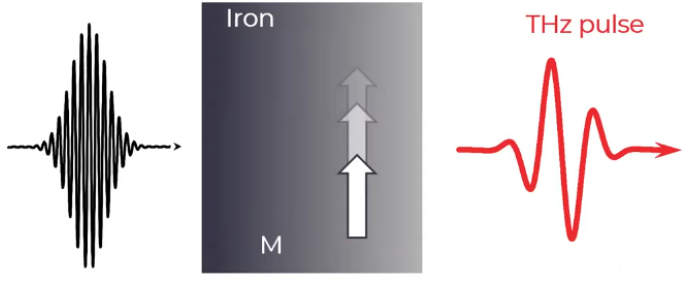


What are Spintronic emitters?

- Ferromagnetic Material (FM)
- Non Magnetic (NM)
- Magnetic field

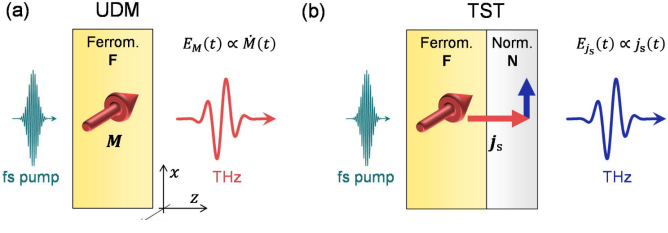


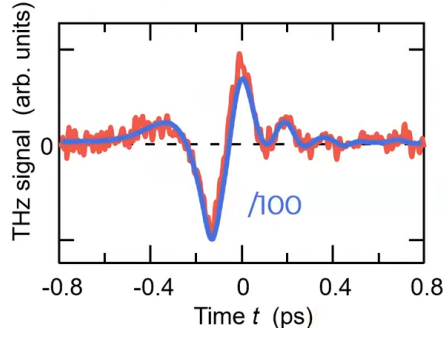
How does it work?



$$E_{\mathrm{DM}} \propto \dot{M}(t)$$

Stronger if we attach NM

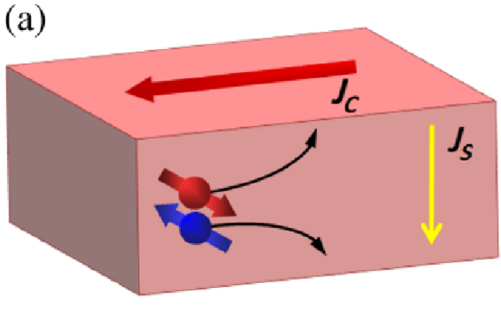




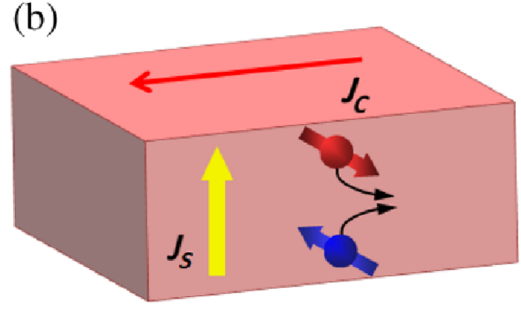
Where does the current come frome?

Inverse Spin Hall effect!

Spin Hall effect



Inverse Spin Hall effect



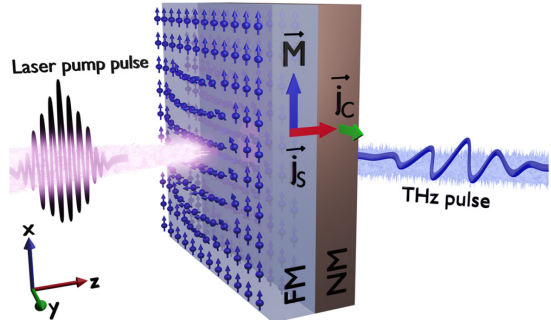
In the emitter

Lets summarize:

- FM with magnetization
- spin current j_s through fs-laser pulse
- spin current to charge current

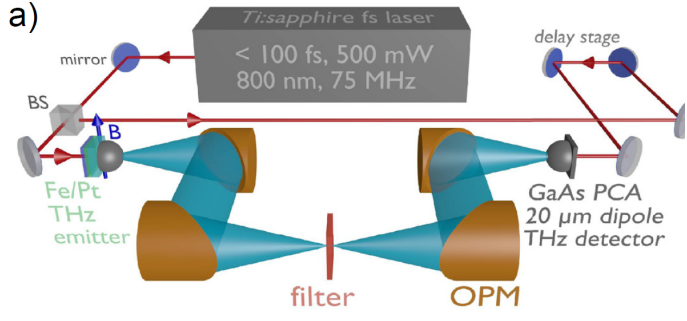
$$j_c = \gamma j_s$$

- charge current generates THz-Field

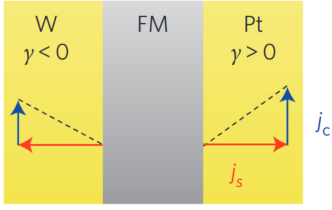


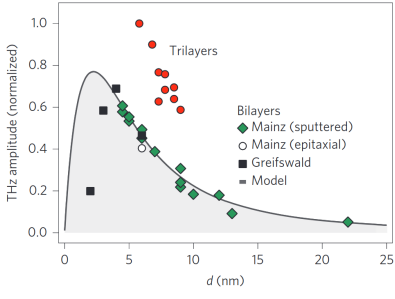
Setup

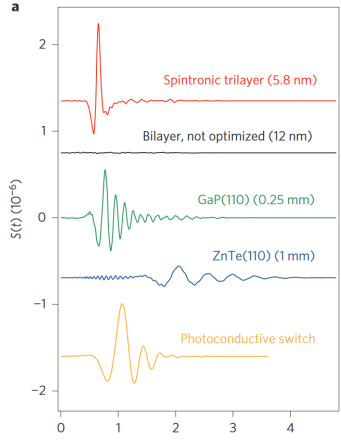
- Just change emitter
- Apply B-Field
- Put ***Si***-lens behind crystal



Two Layers are not the end

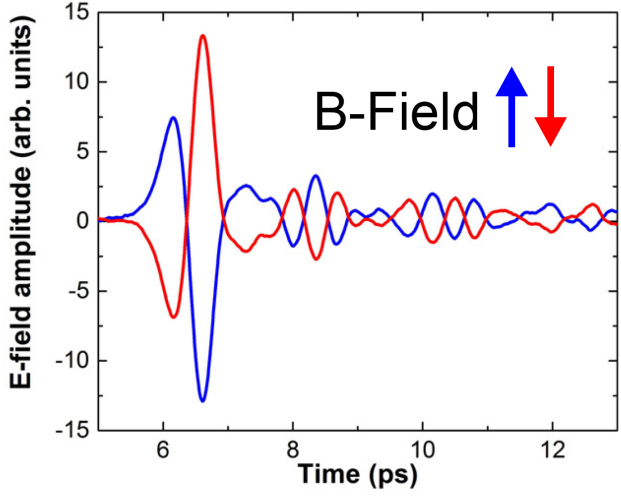






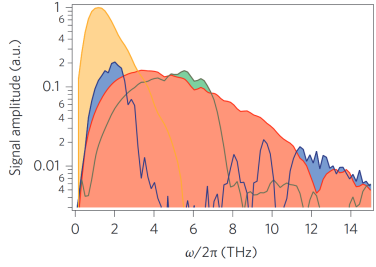
Polarization

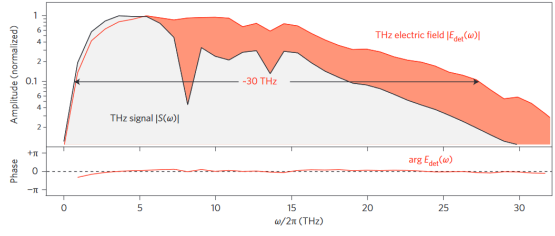
- Change in B-Field changes THz-Field Polarization
- No filter needed
- → Easy change of THz-Field Polarization



Broadband

- Super Broadband Signal
- Achieved with
  W*/*Co*40*Fe*40*B*20/*Pt **(**5.8 nm**)**





Conclusion

- Easy to setup
- Cheap to produce
- High damage threshold
- Easy change in Polarization
- Very Broadband (no phonon modes)
- No problems with phasematching

Thank you all for your attention!

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