UNIVERSITY OF CAMBRIDGE

Ultra-fast readout of a ferromagnet and anti-ferromagnet

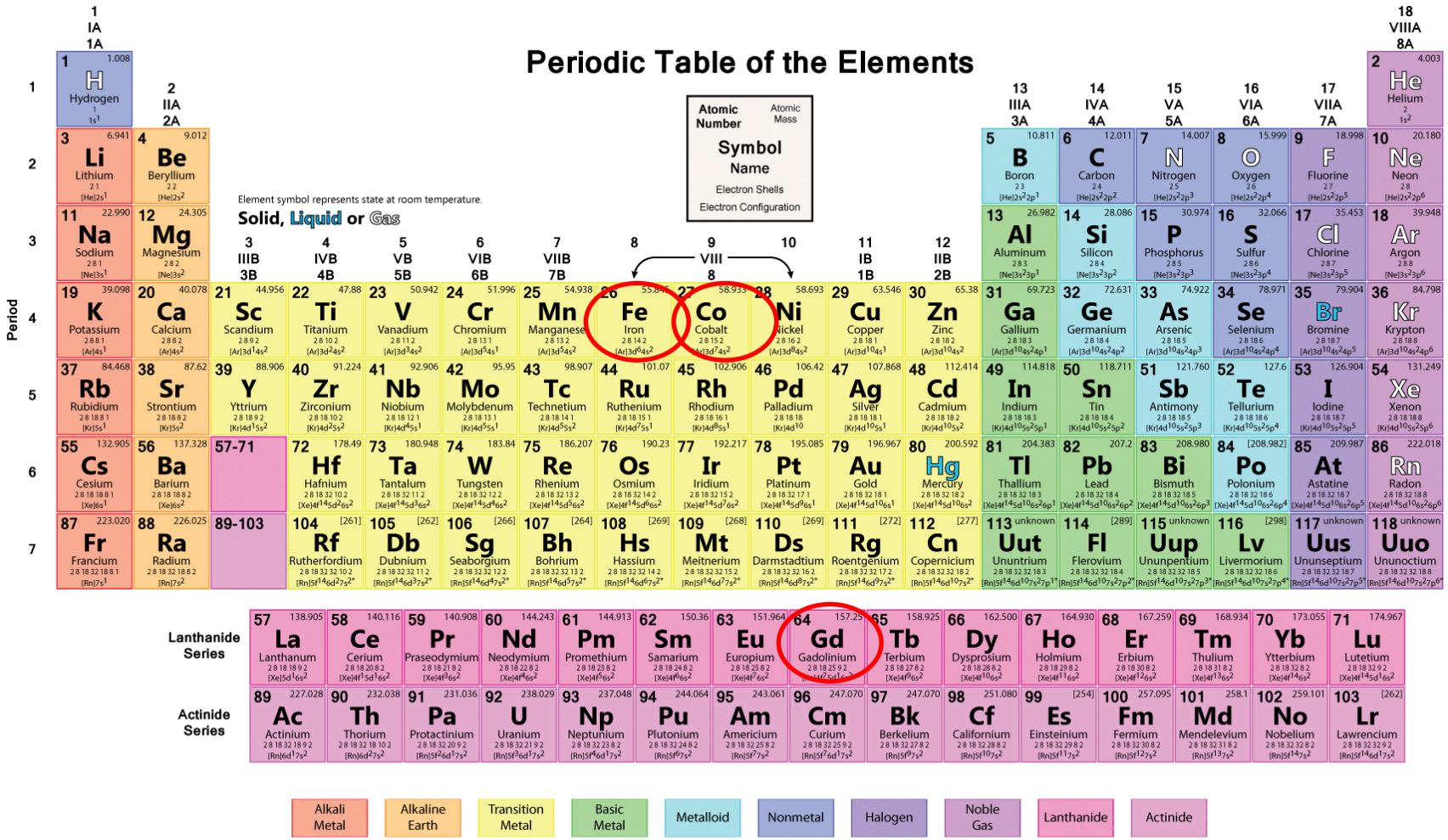
Chiara Ciccarelli

Mainz, October 2018

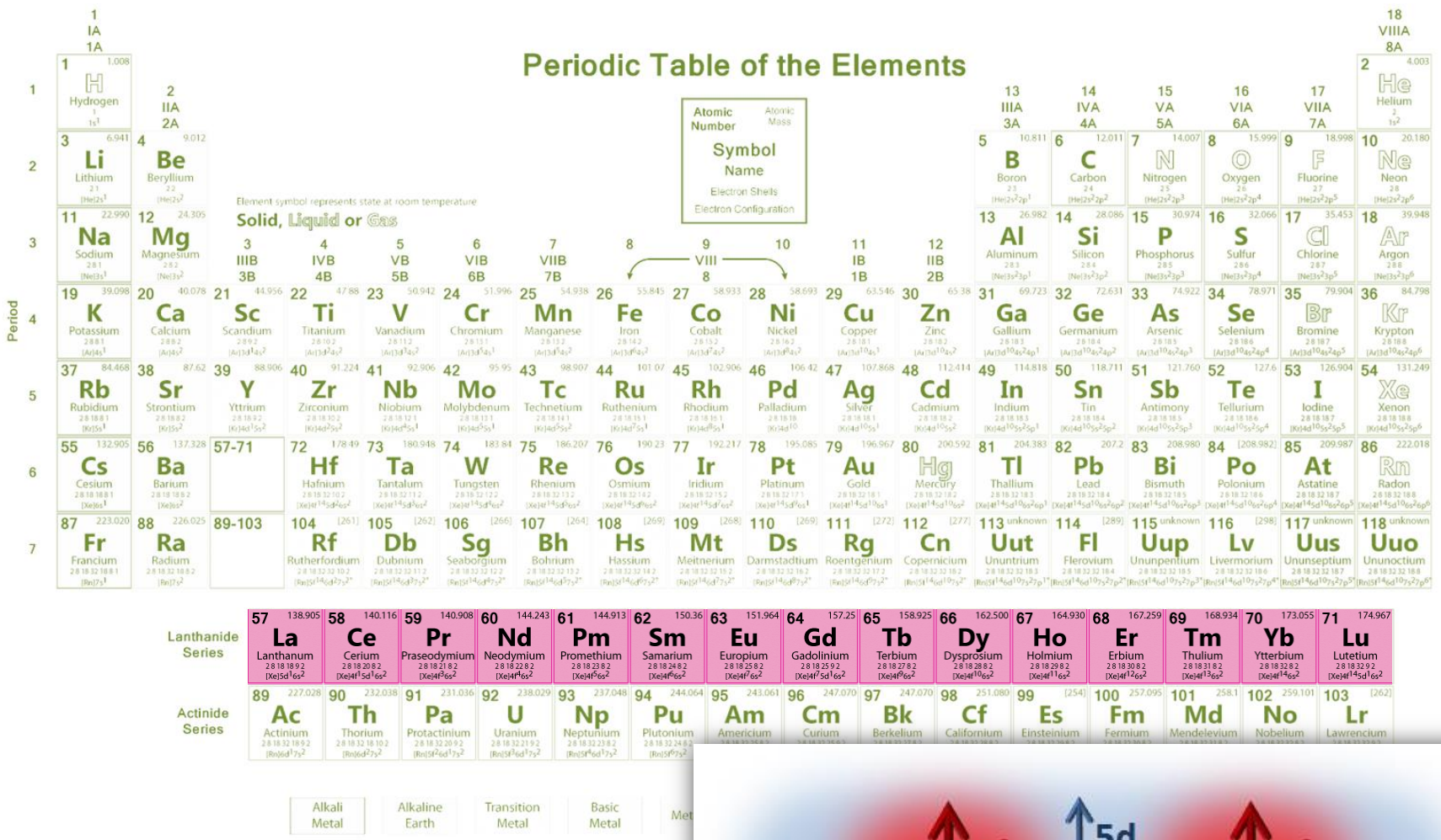
EXPERIMENT 1

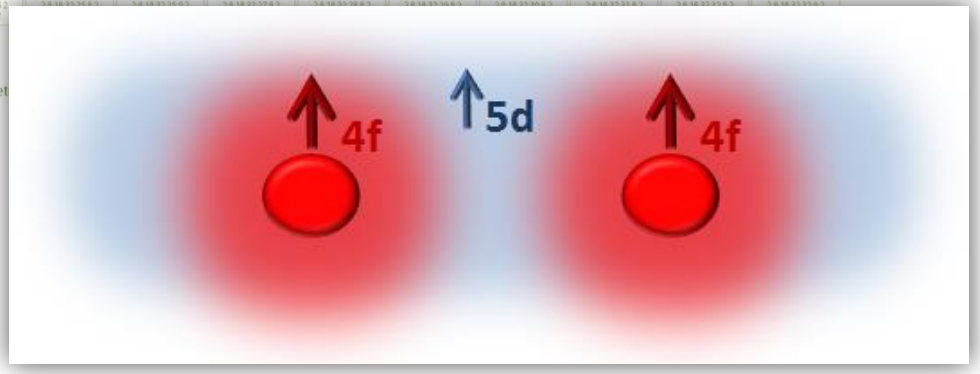
Element-selective spin emission from a ferrimagnet

Rare earth-transition metals alloys



Rare earth-transition metals alloys

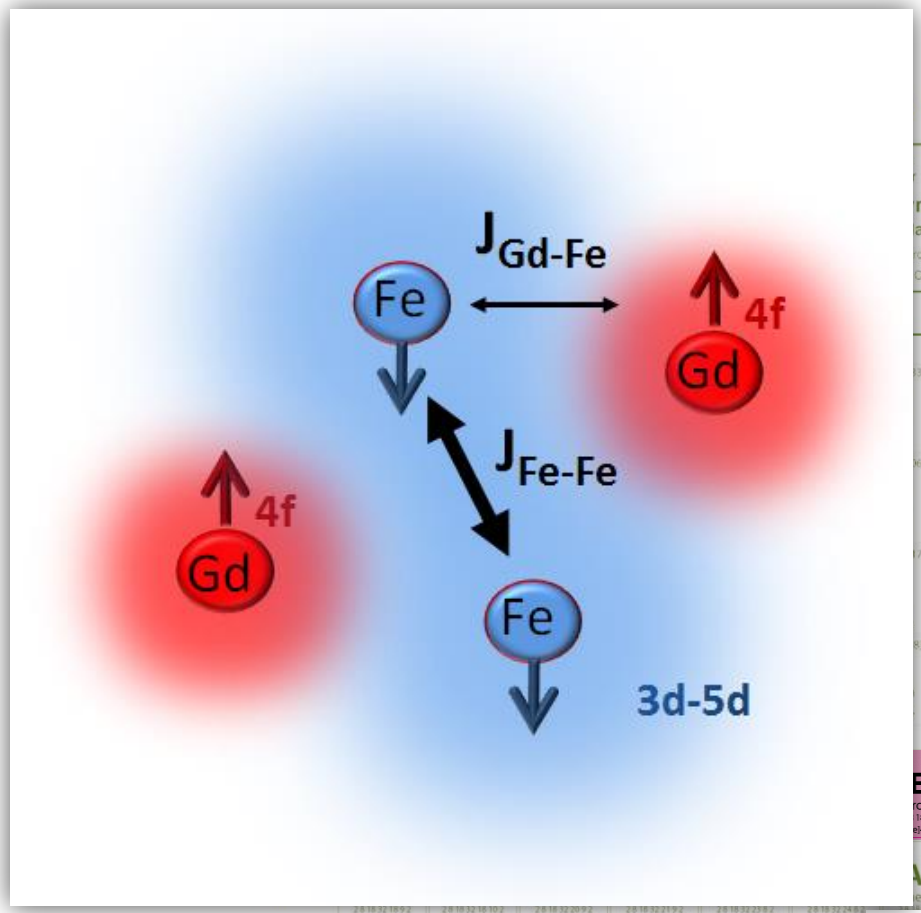


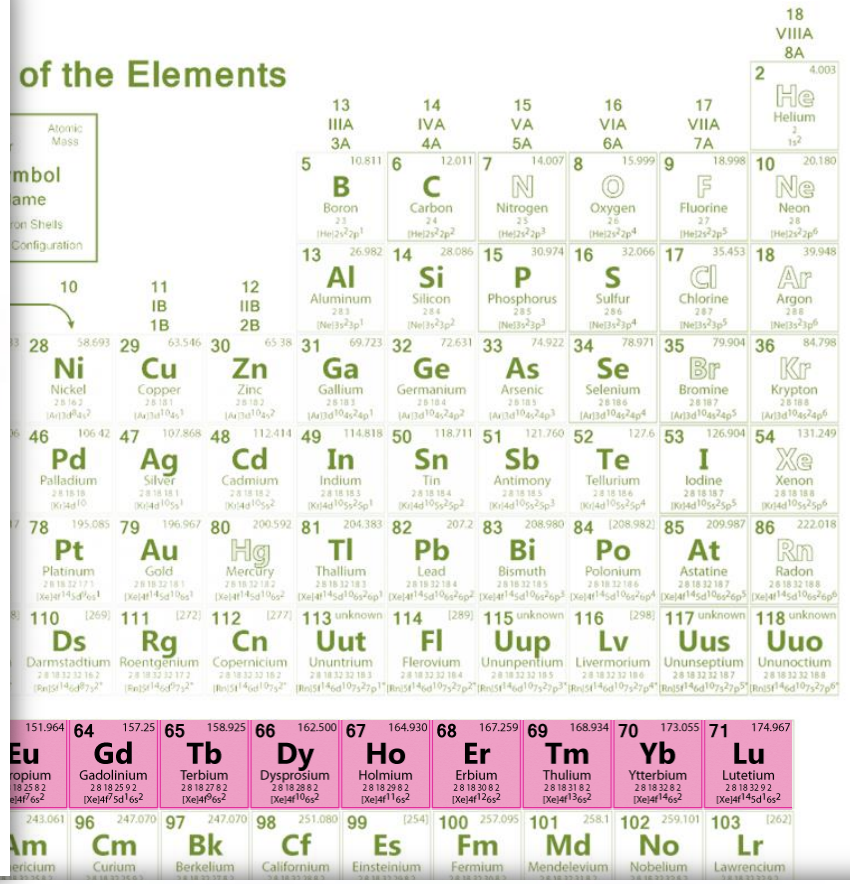


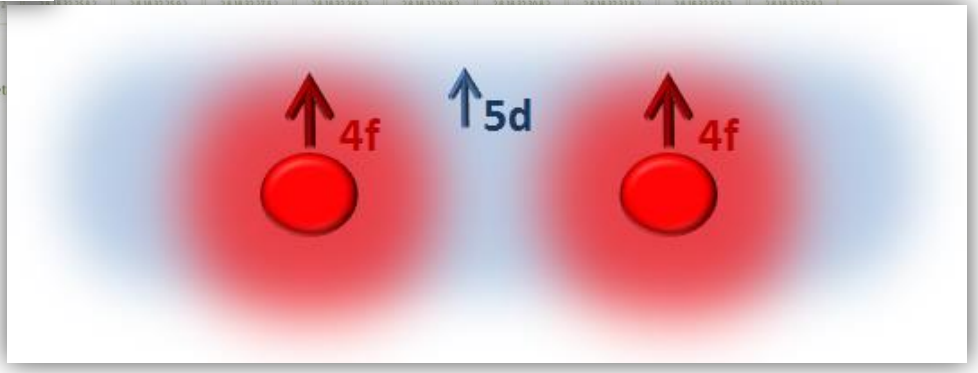
C.D. Stanciu et al., PRB 2006

J. Becker, PhD thesis, 2016

Rare earth-transition metals alloys

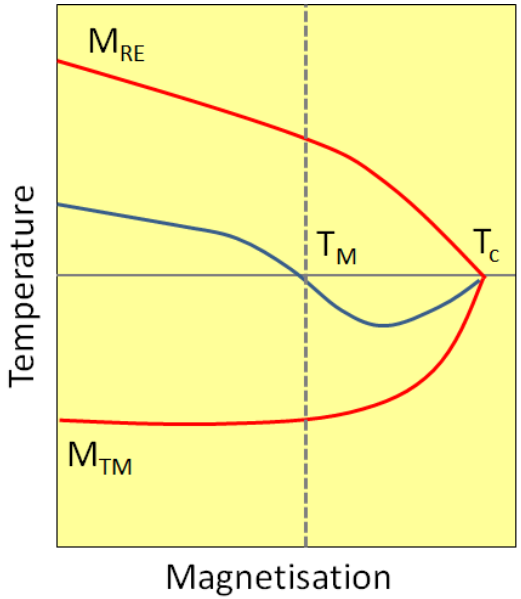


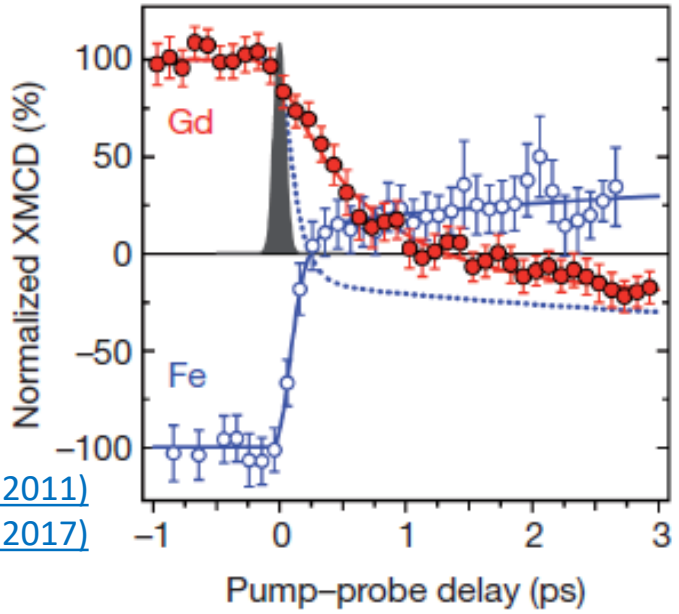




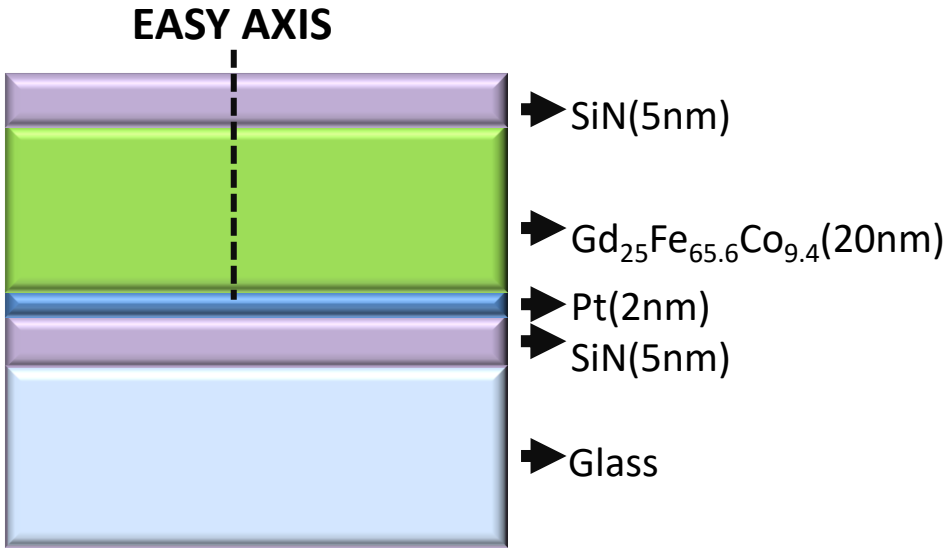
C.D. Stanciu et al., PRB 2006
J. Becker, PhD thesis, 2016

GdFeCo has a compensation temperature at which **M**=0

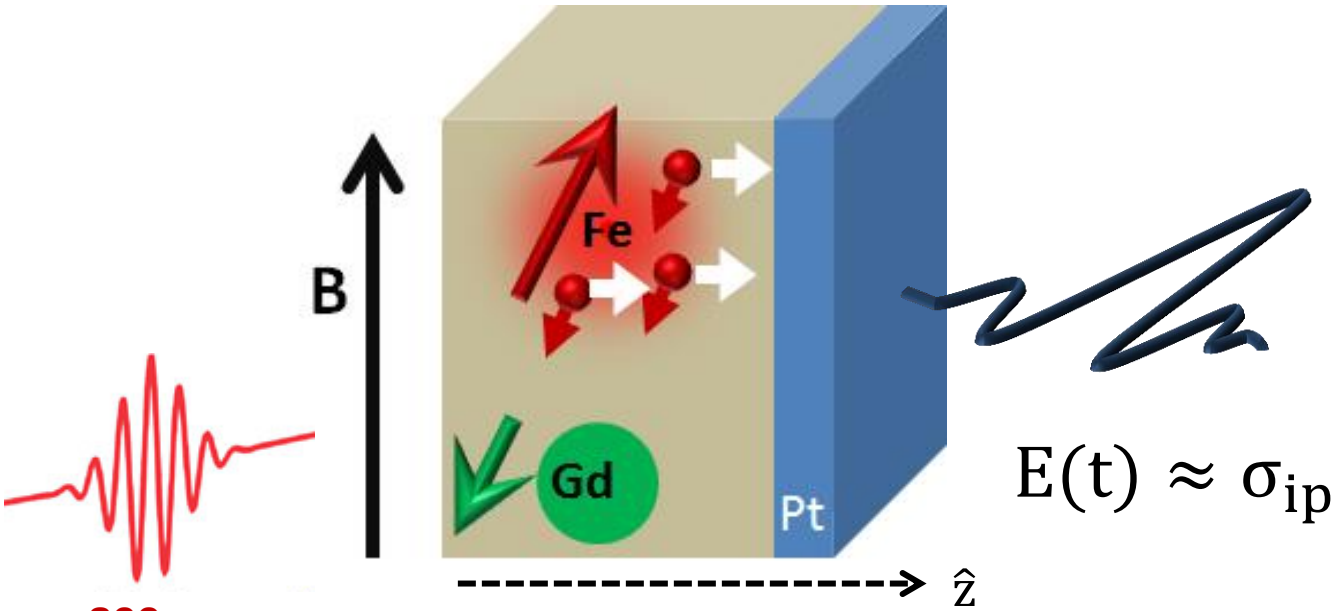




Radu, Nature 472, 205 (2011)
Becker, PRL 118, 117203 (2017)



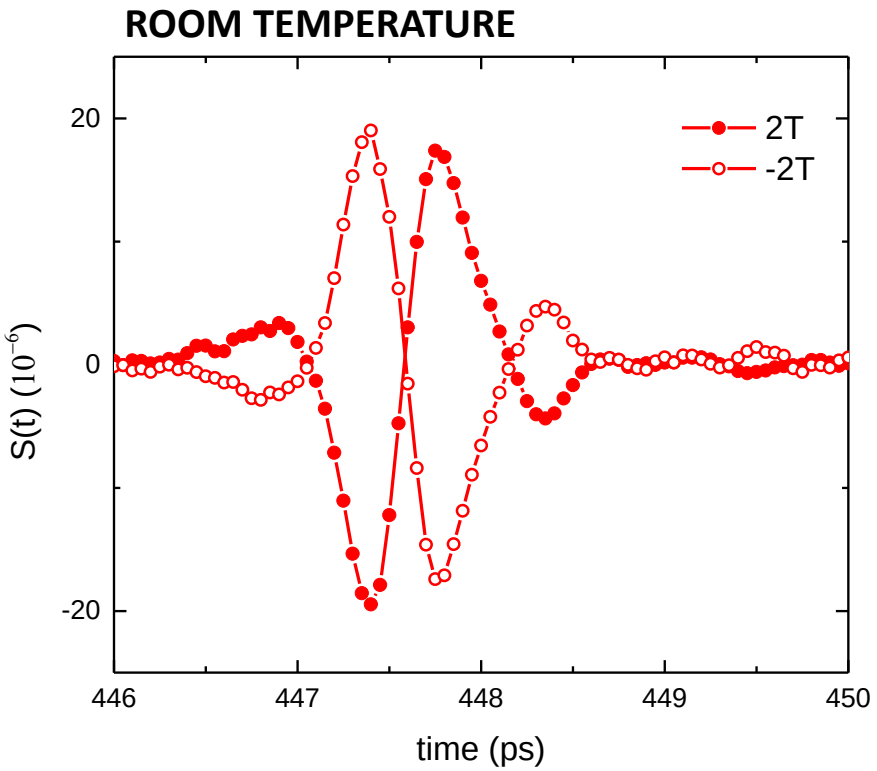
We use THz emission spectroscopy to measure spin-emission

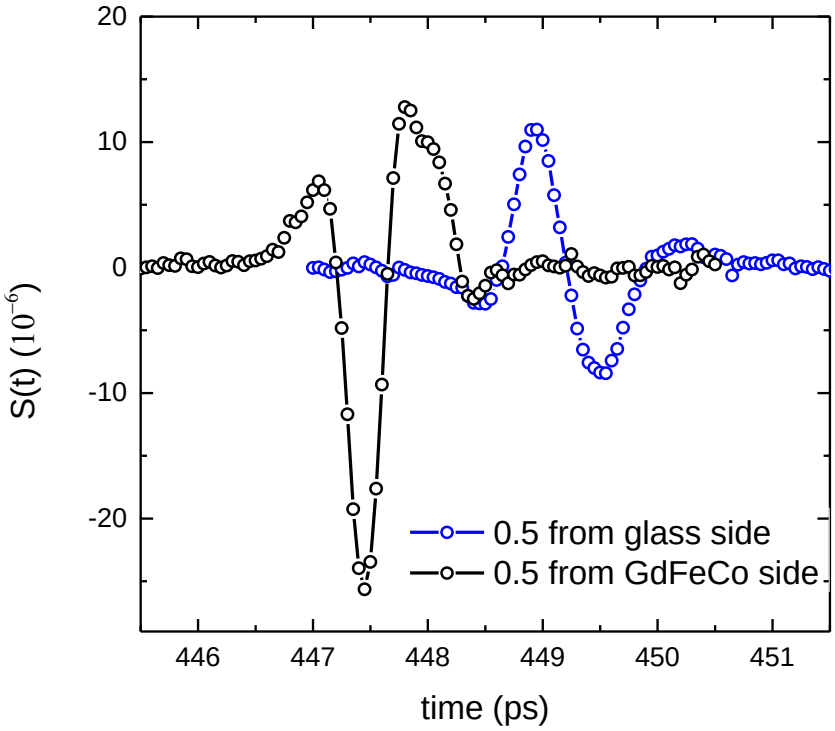


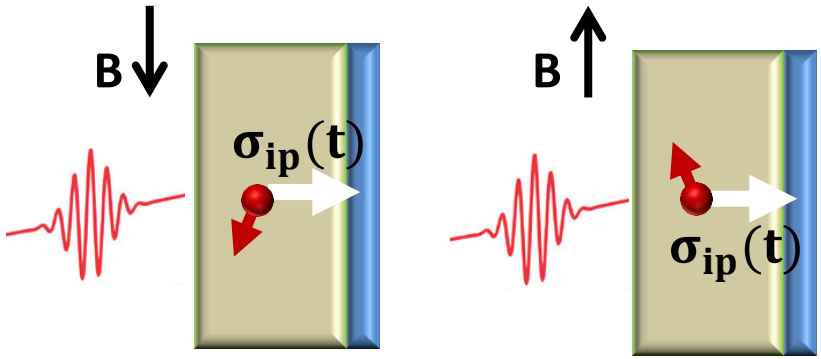
$$E(t) \approx \sigma_{ip}(t) \times \hat{z}$$

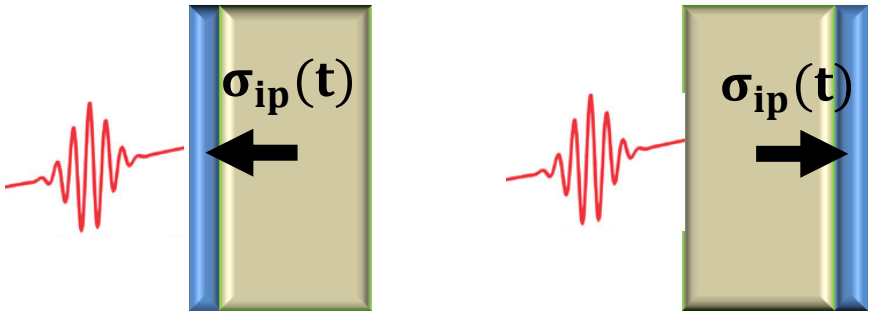
Seifert, Nature Photonics (2016)

The mitted THz radiation has the symmetry of the ISHE



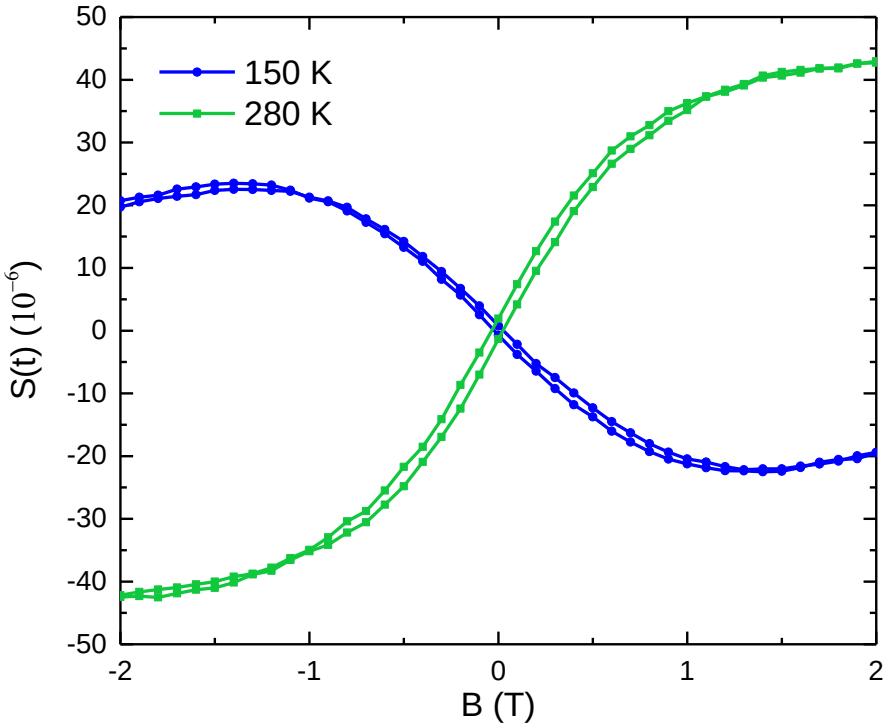


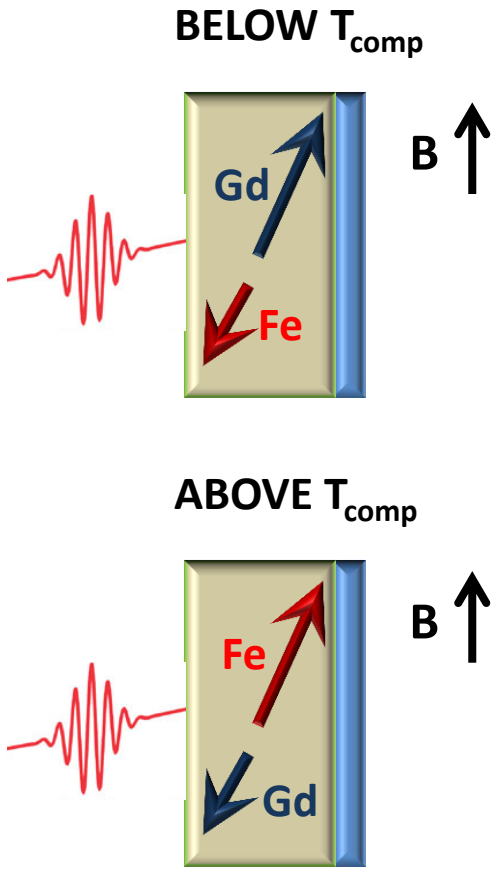




Huisman, et al., APL 2017

The mitted THz radiation is sensitive to the Fe spin only





Huisman, et al., APL 2017

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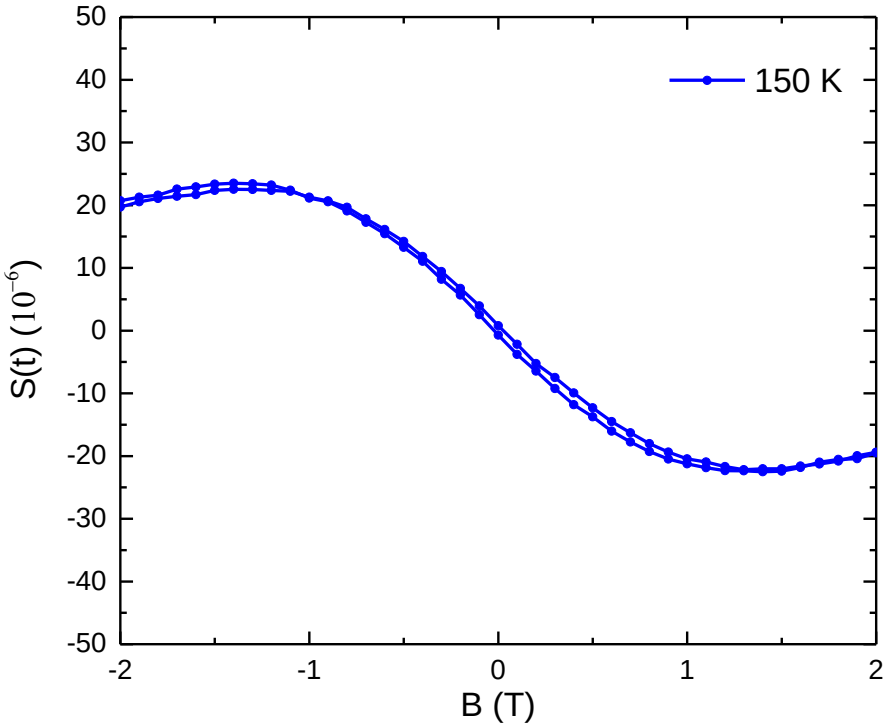

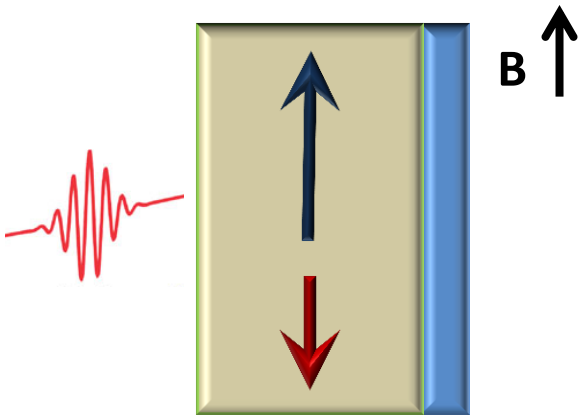

Huisman, et al., APL 2017

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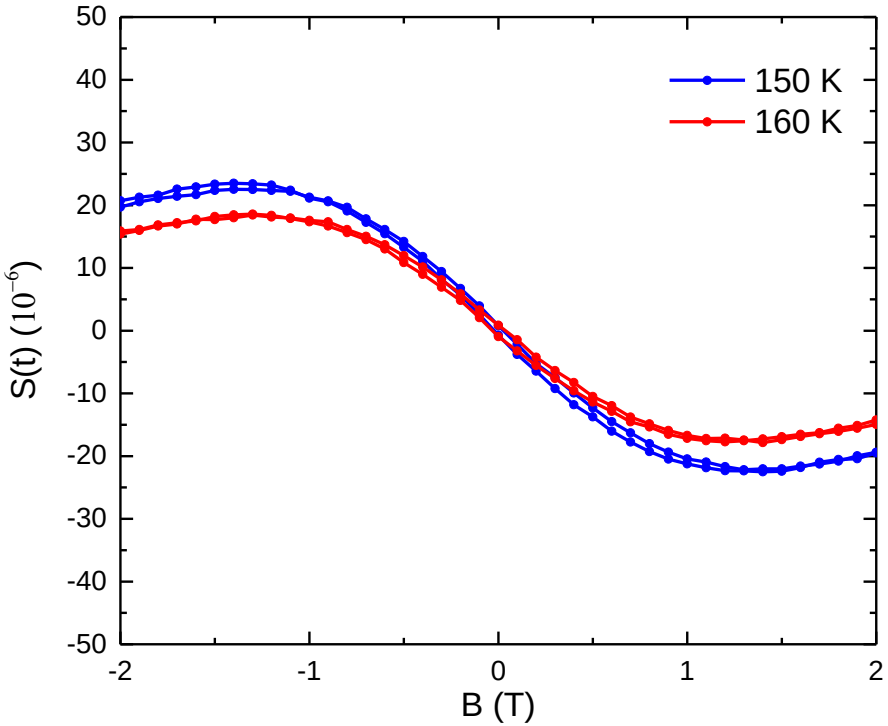

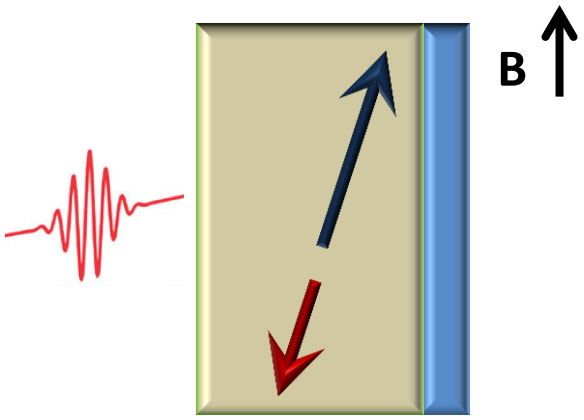

Huisman, et al., APL 2017

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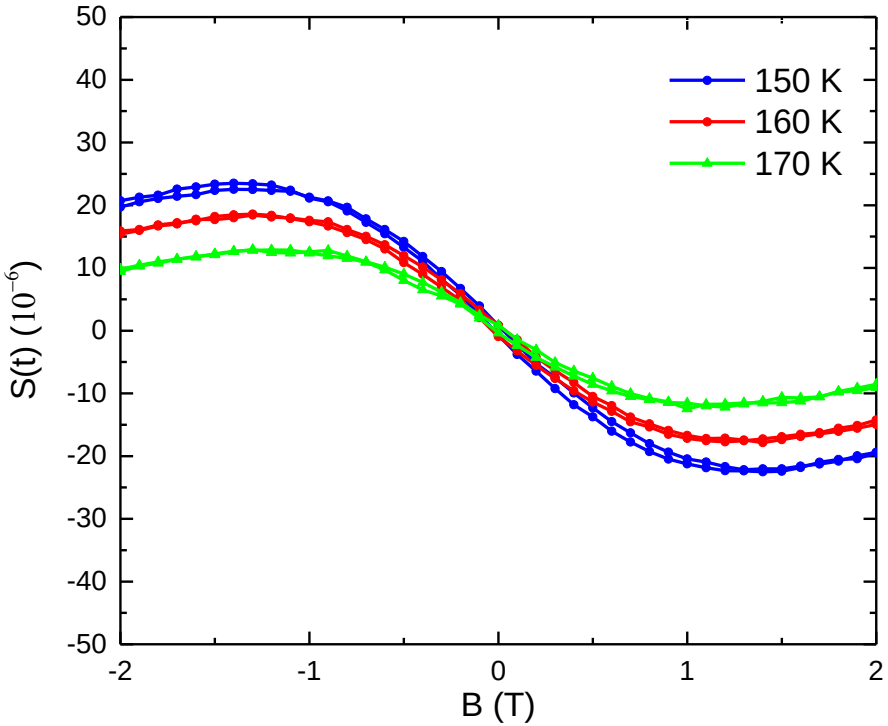

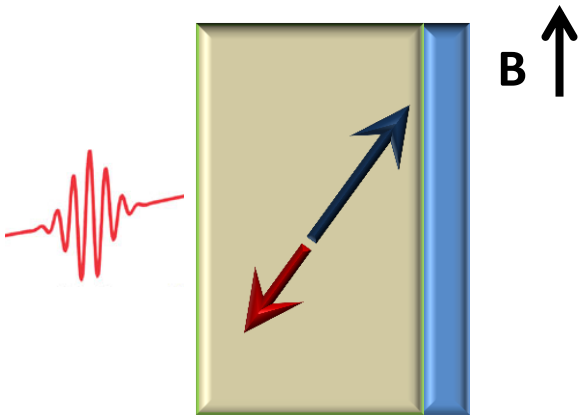

Huisman, et al., APL 2017

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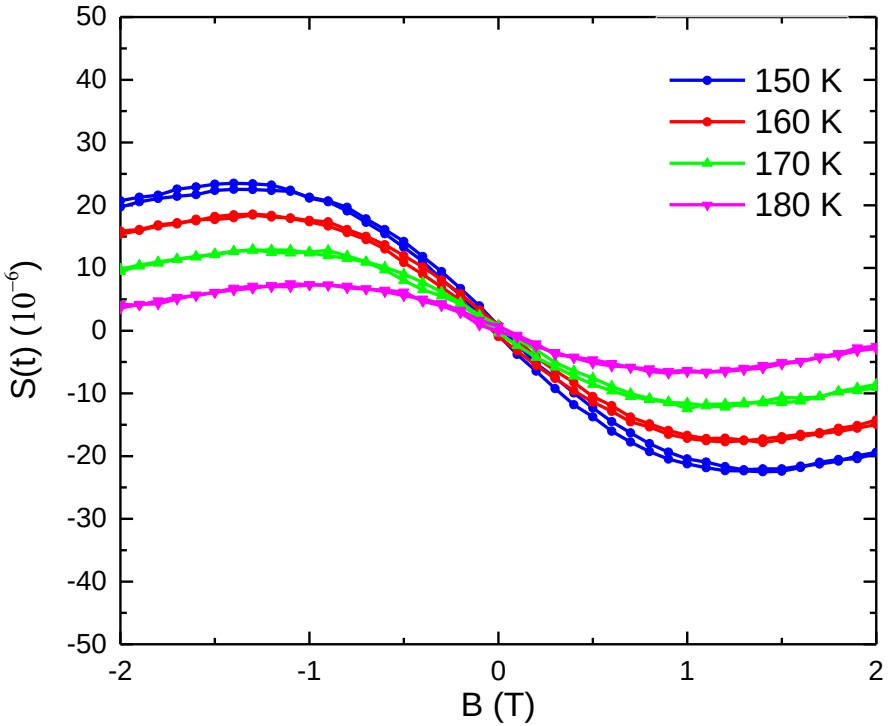
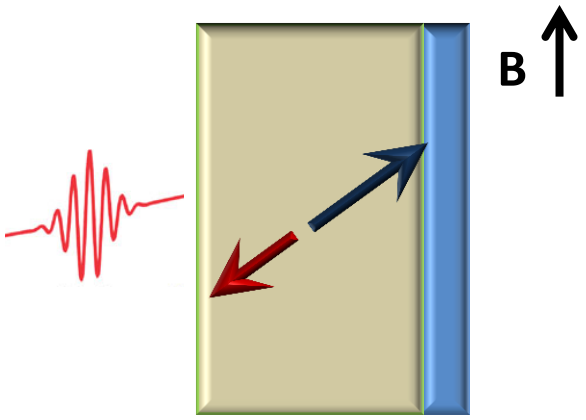
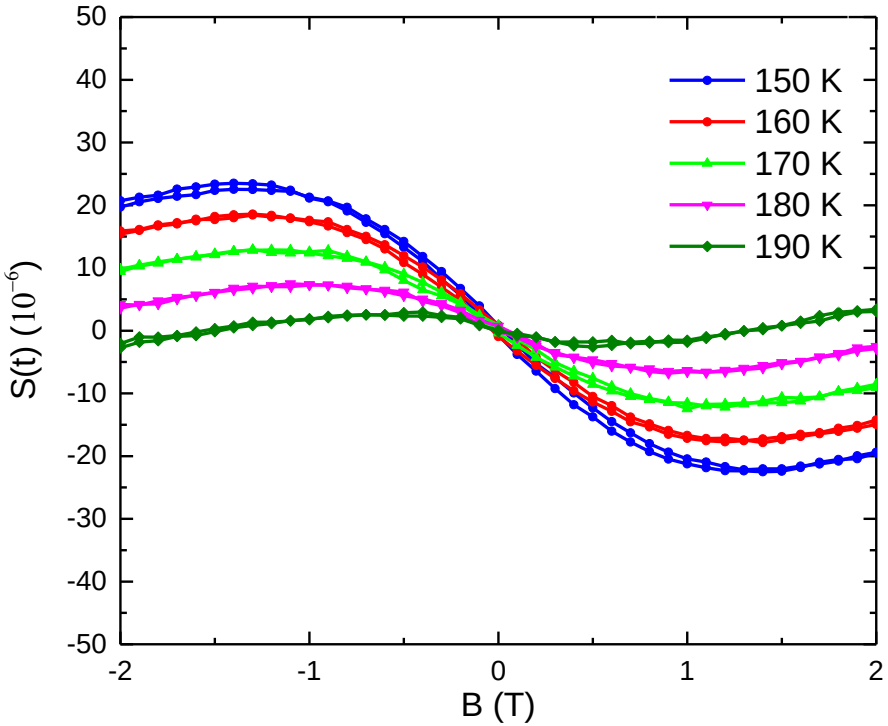
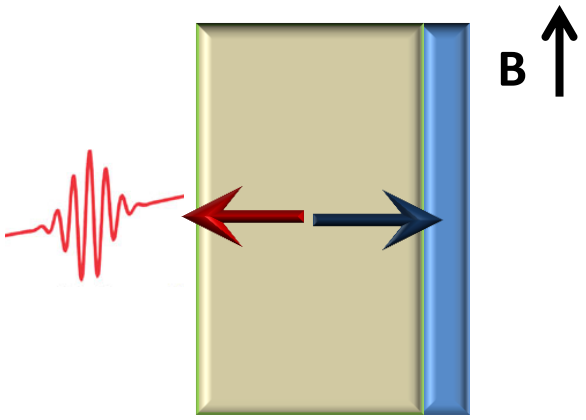




Huisman, et al., APL 2017

The mitted THz radiation is sensitive to the Fe spin only





Huisman, et al., APL 2017

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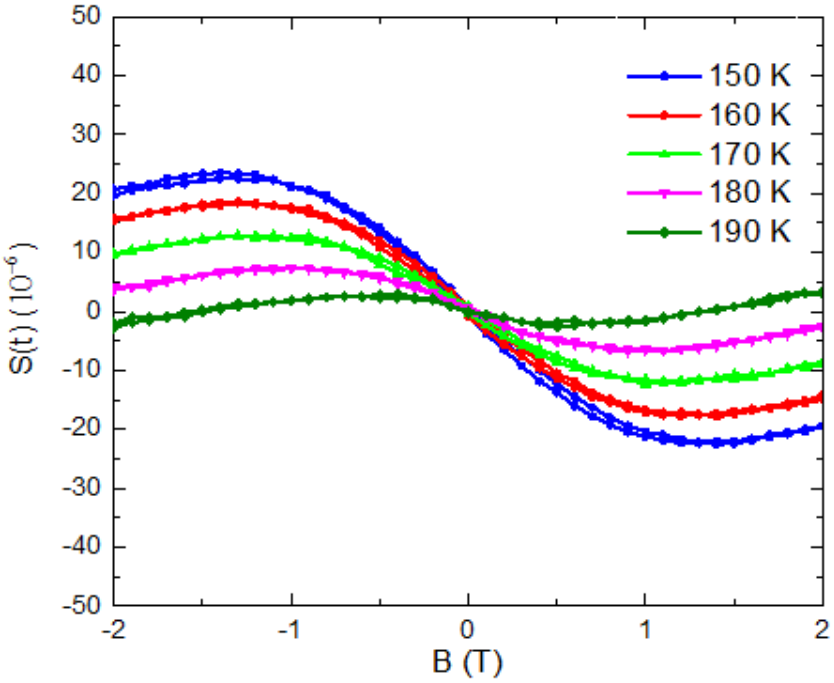
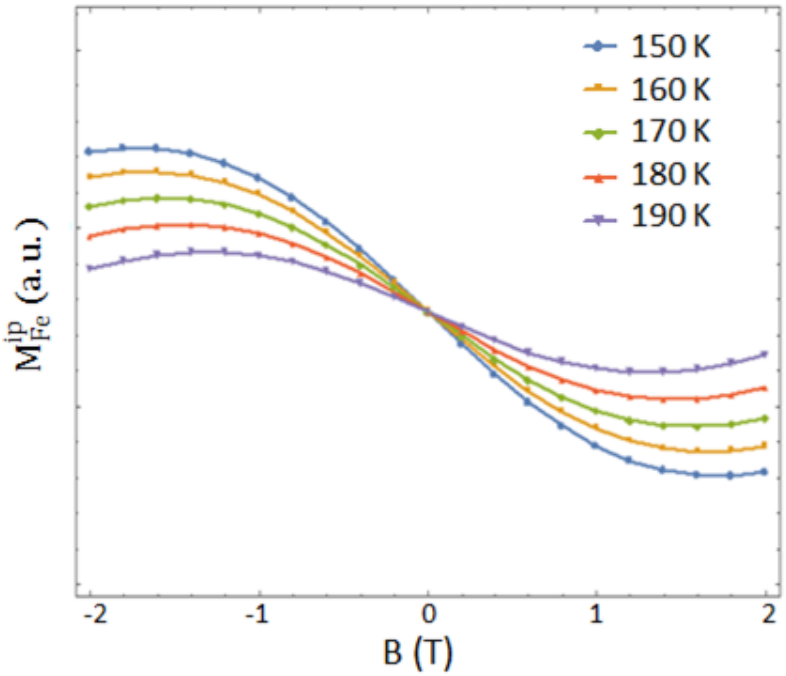




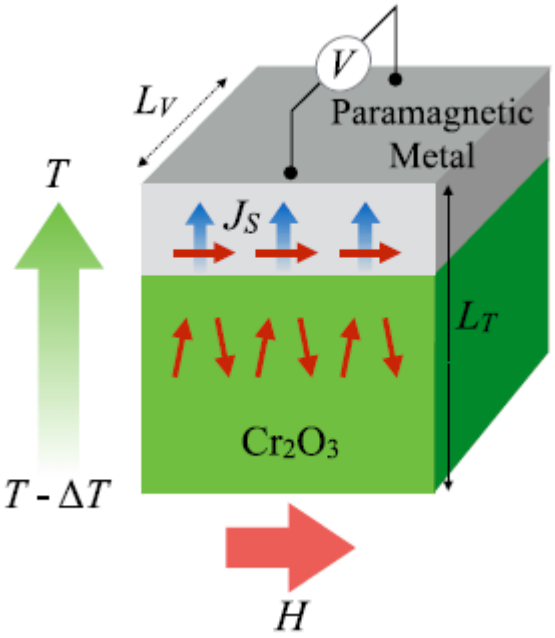
$$E = -M_1 B \sin(\theta_1) - M_2 B \sin(\theta_2) + J M_1 M_2 \cos(\theta_1 + \theta_2) - \frac{K}{2} M_1^2 \cos^2(\theta) - \frac{K}{2} M_2^2 \cos^2(\varphi)$$

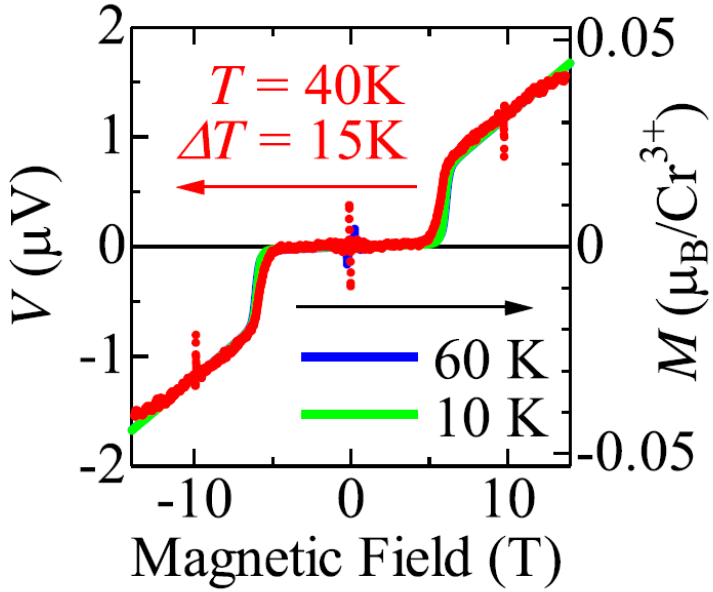
Huisman, et al., APL 2017

EXPERIMENT 2

Spin-Seebeck effect in antiferromagnets

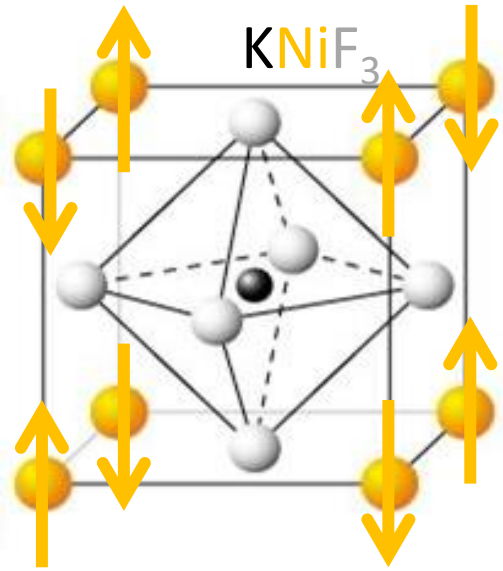
Spin-Seebeck in the DC limit

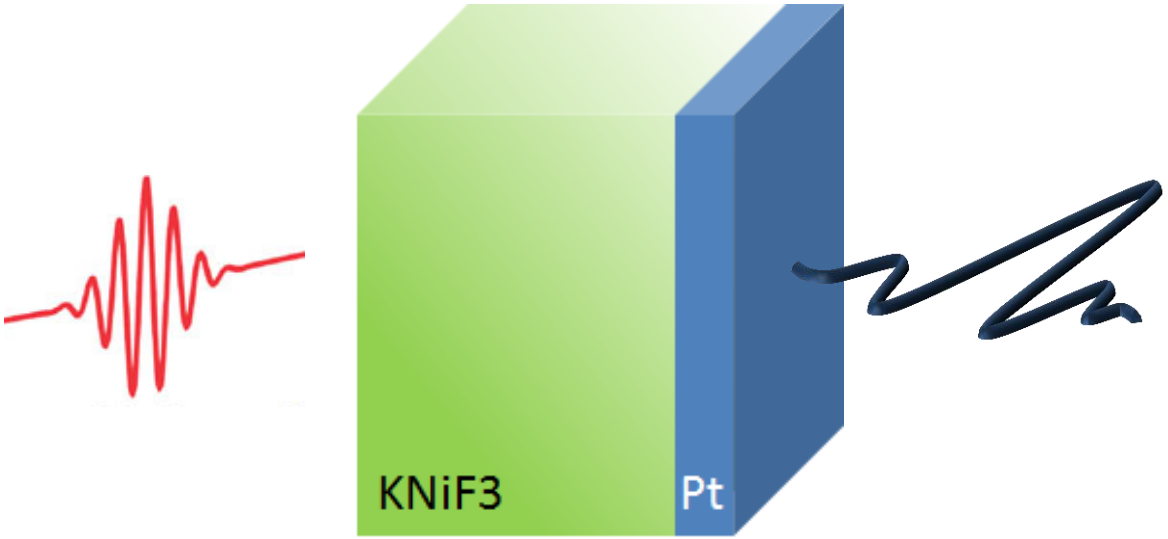




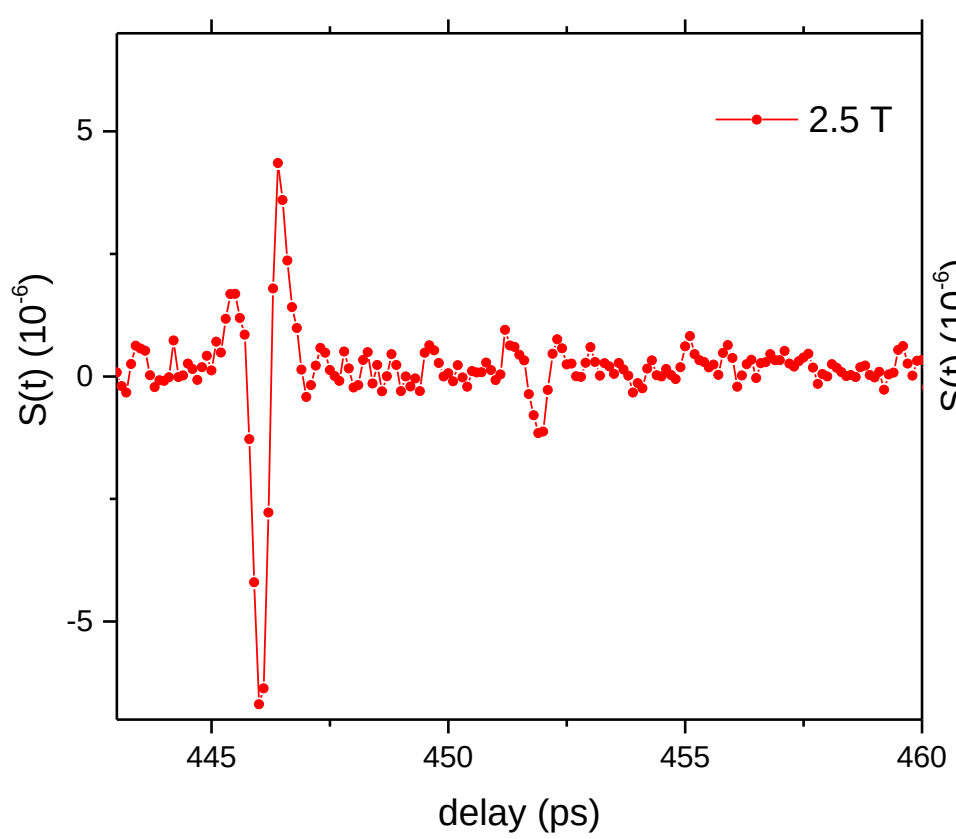
S. Seki, PRL 115, 266601 (2015)
S,M. Wu et al., PRL 116, 097204 (2016)

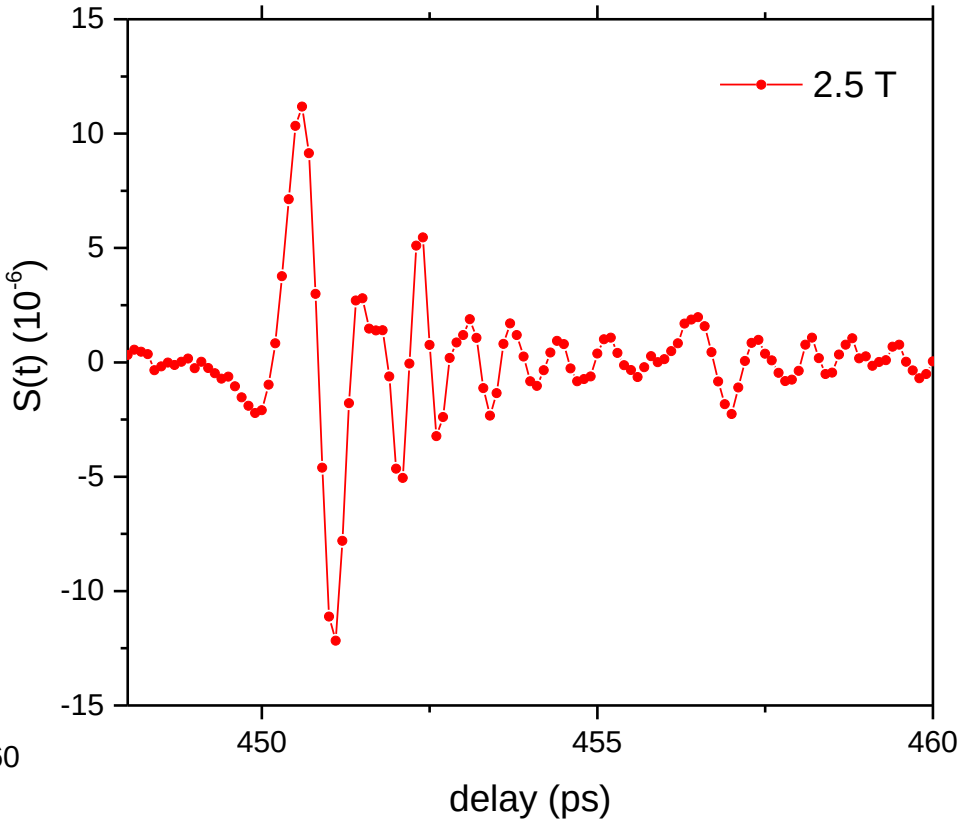
Spin-Seebeck in the picosecond limit

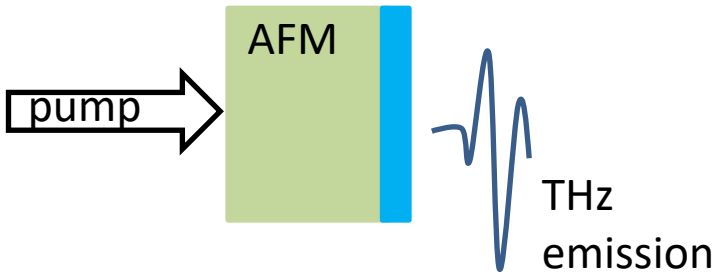


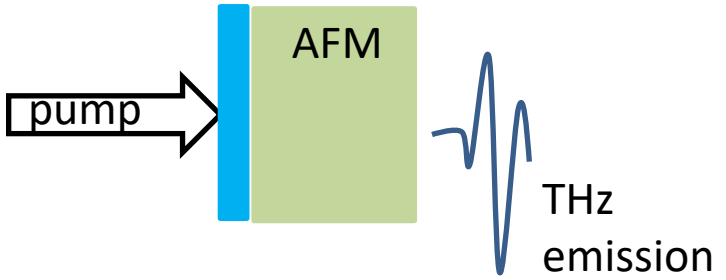


A broad-band THz radiation is emitted from the Pt

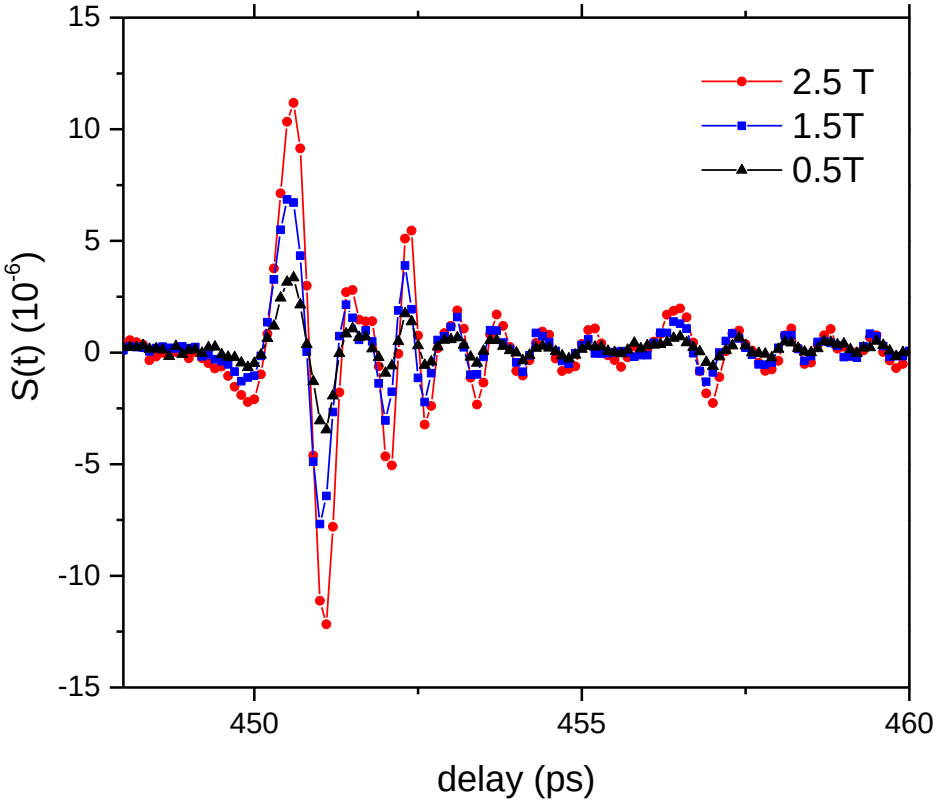


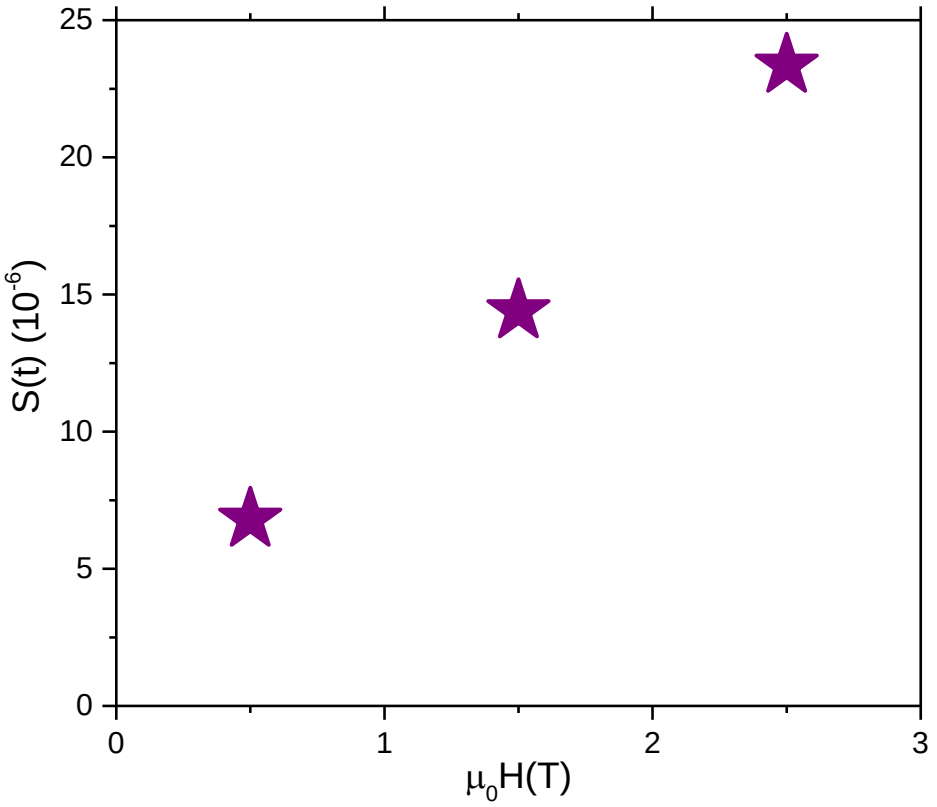






The THz emission is linear in magnetic field





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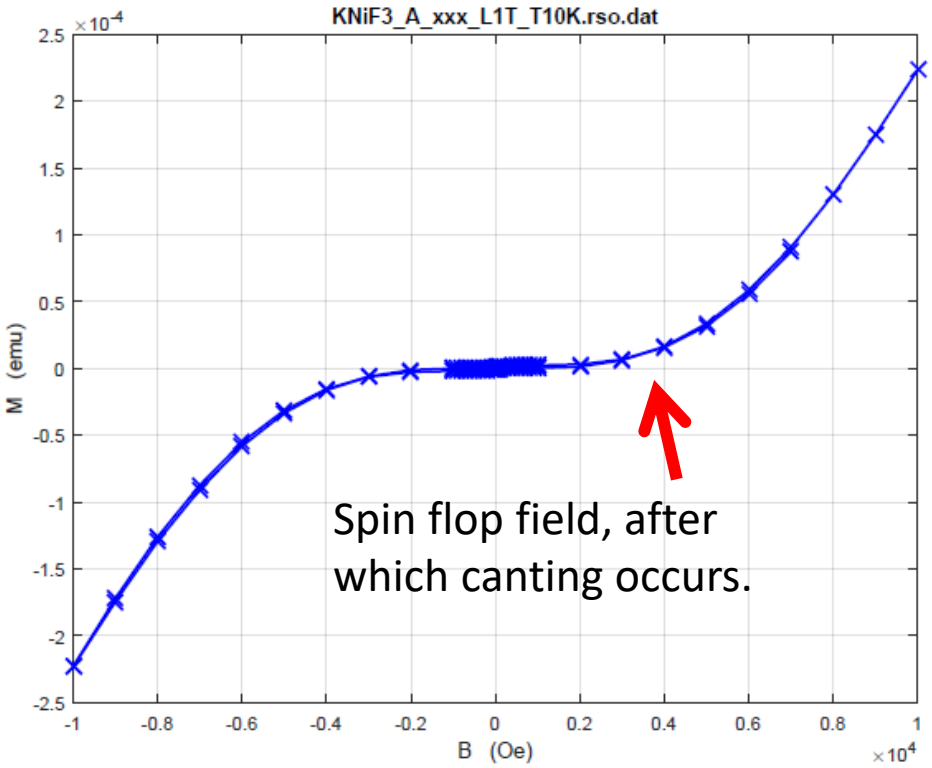
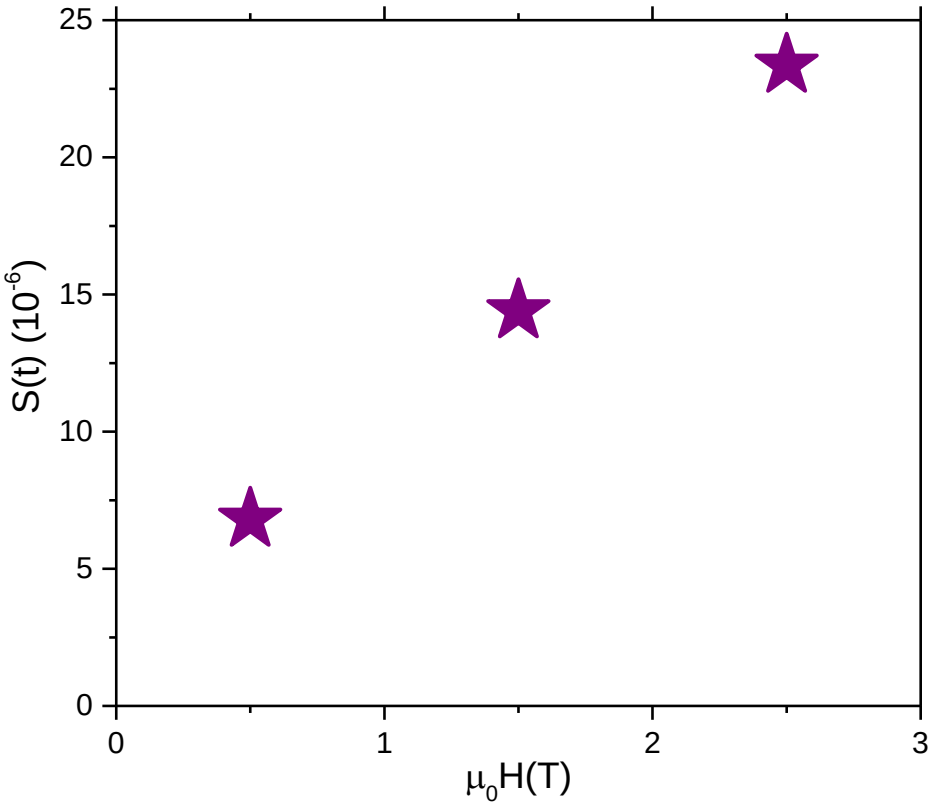
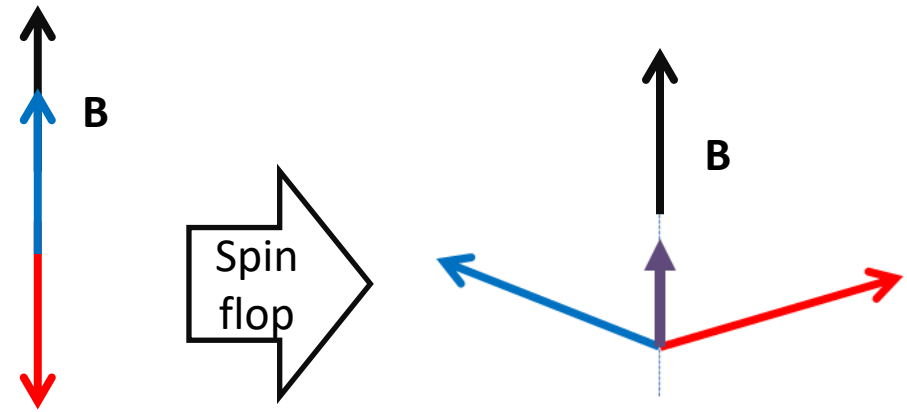
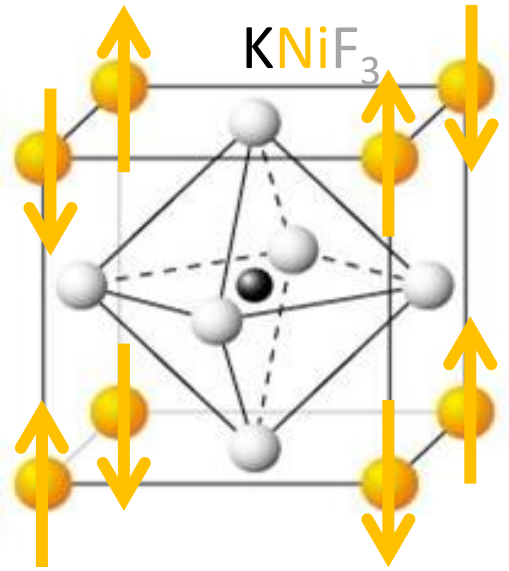


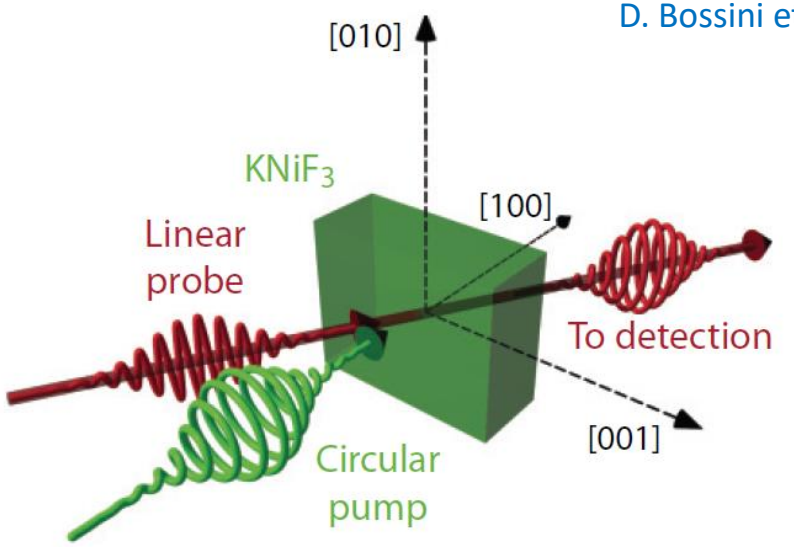


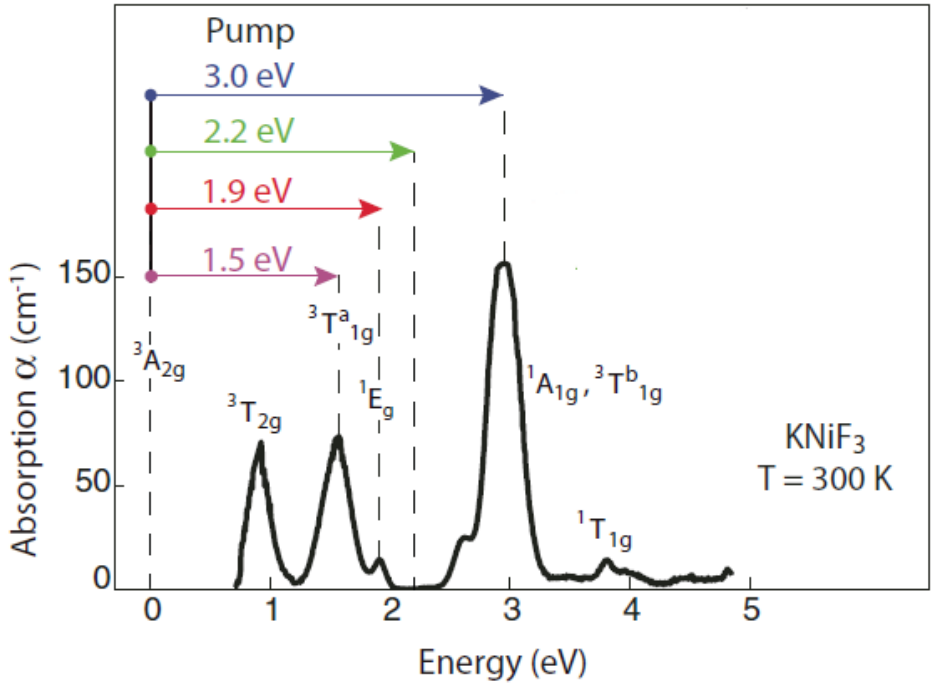


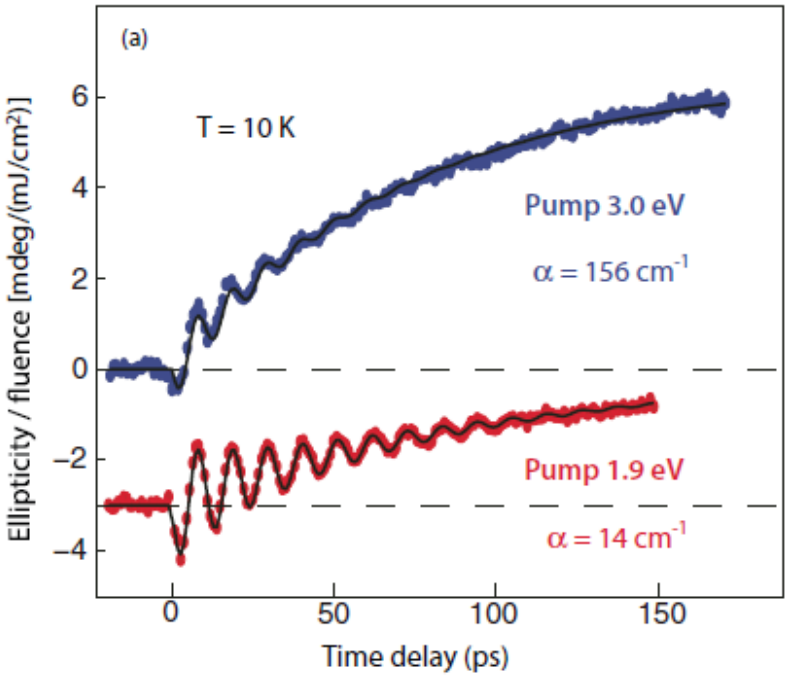
$KNiF_3$



D. Bossini et al., PRB 2014







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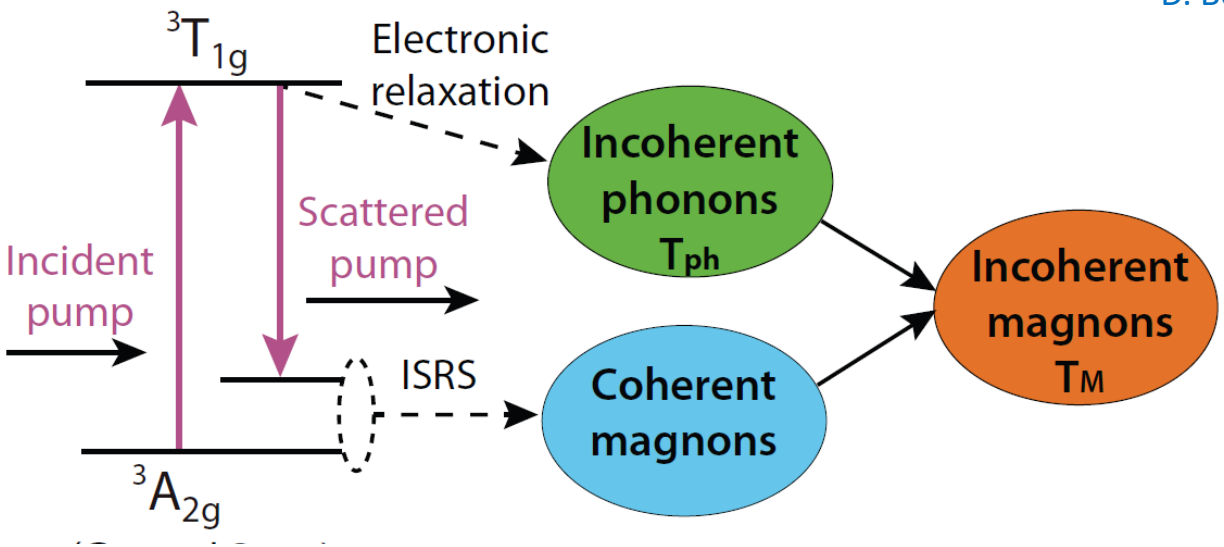
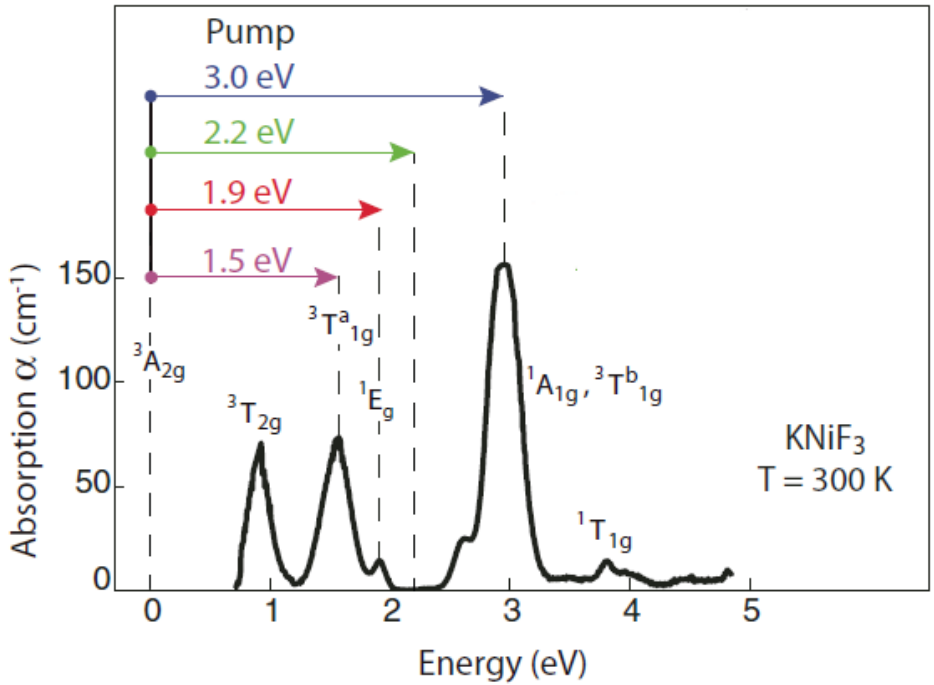
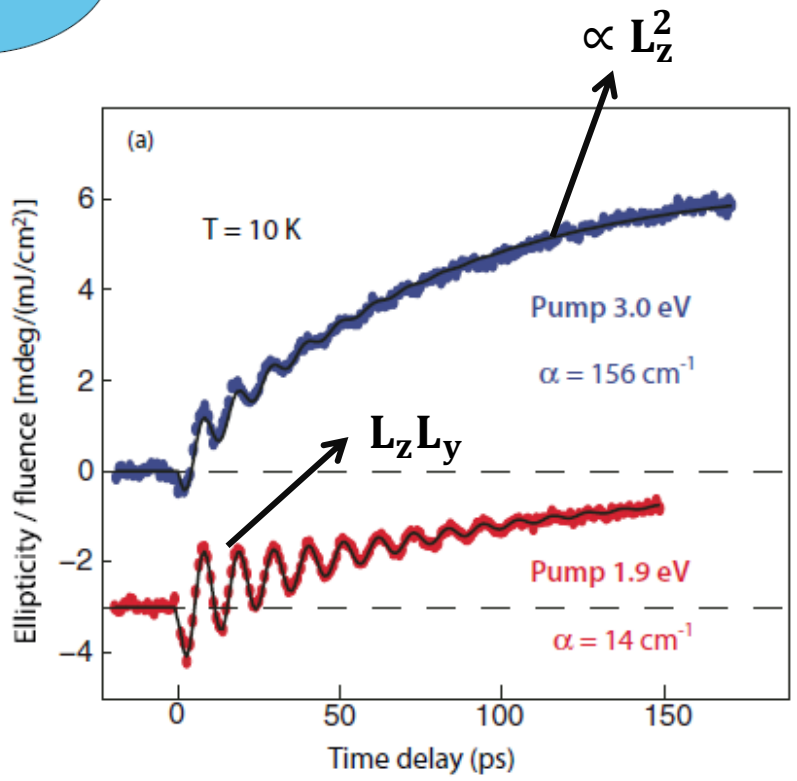
D. Bossini et al., PRB 2014







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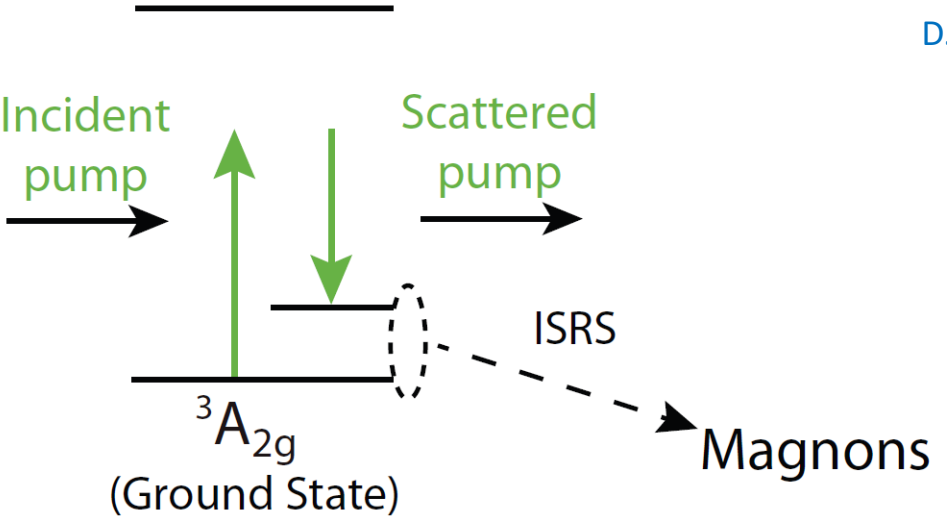
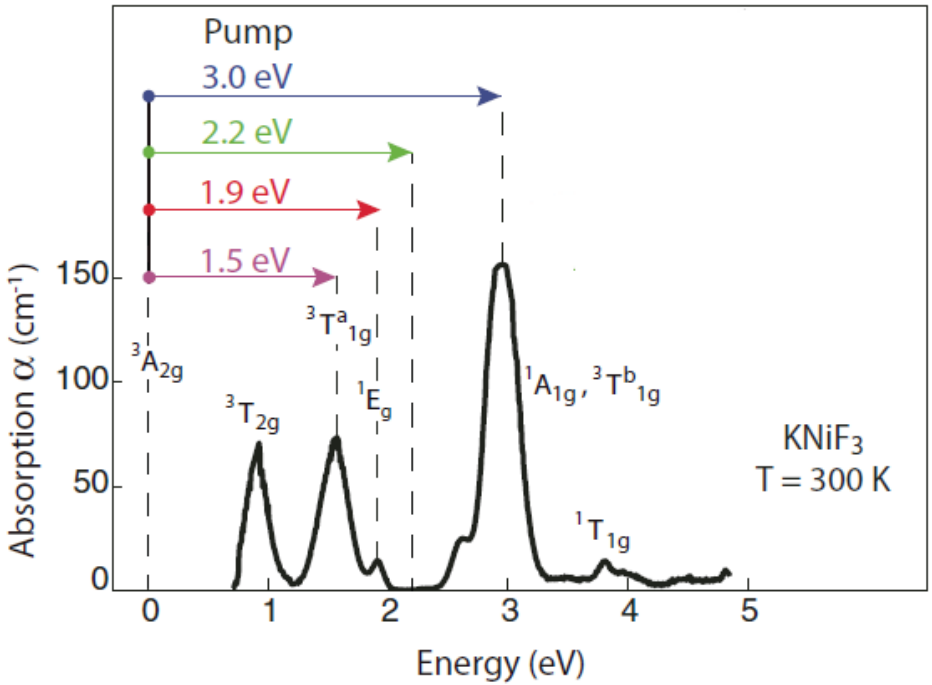
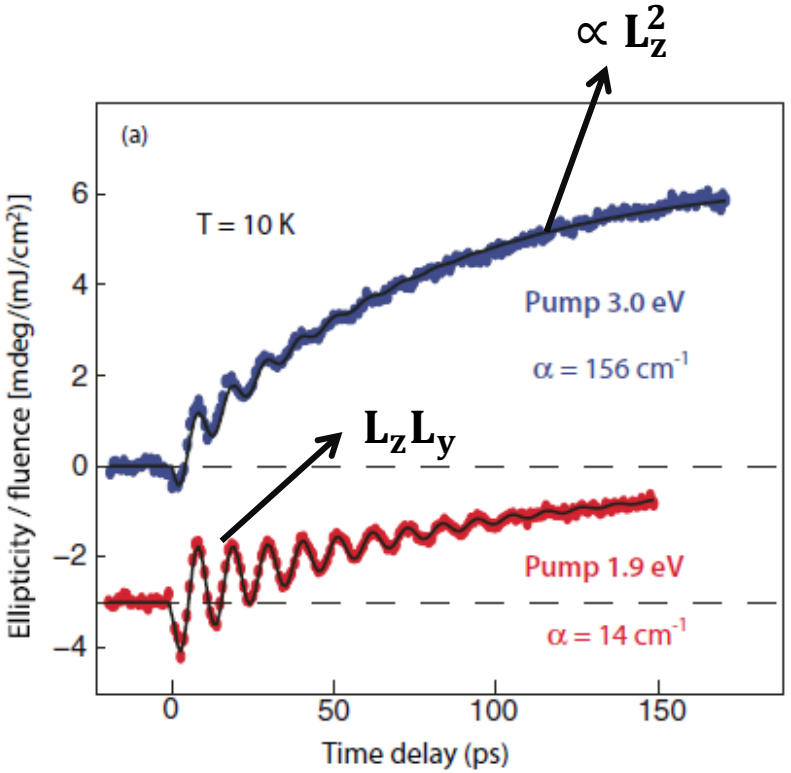
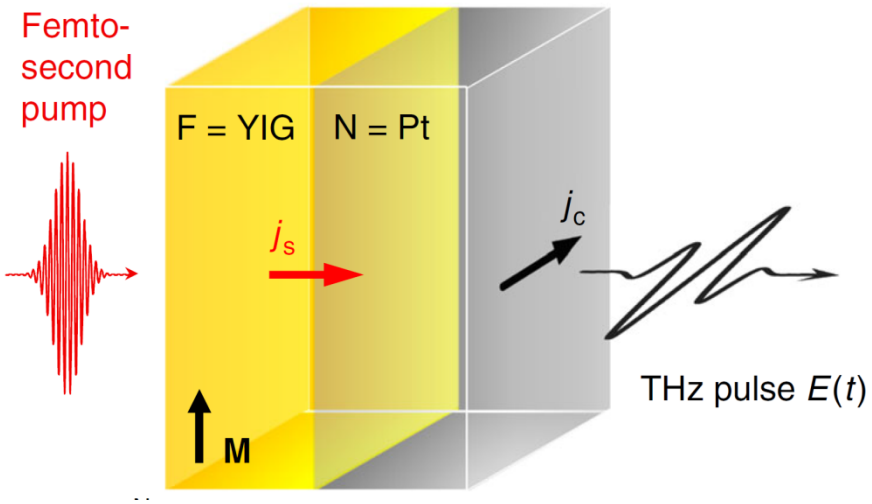


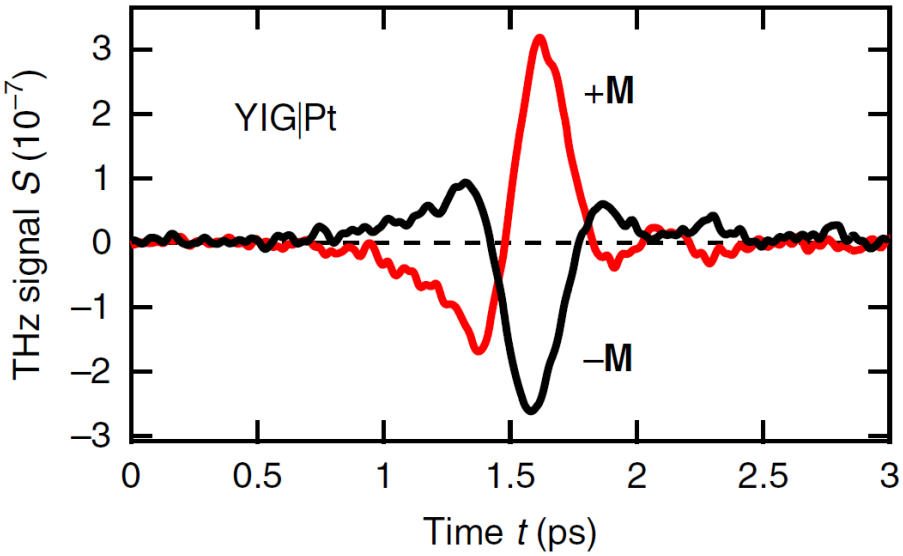


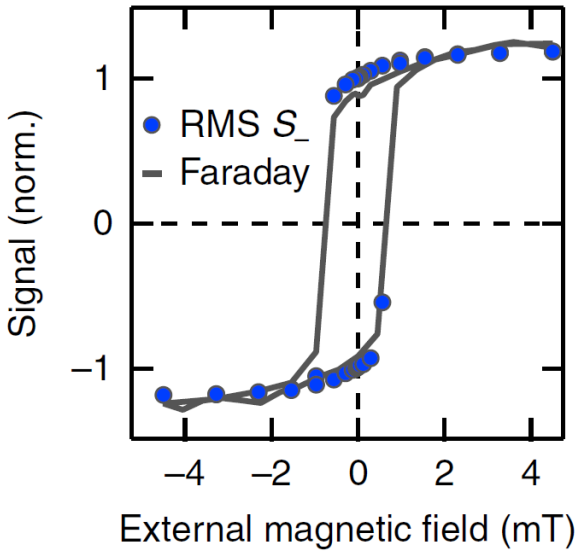


Ultra-fast spin-Seebeck in YIG/Pt

Seifert et al., Nature Comm. 2018







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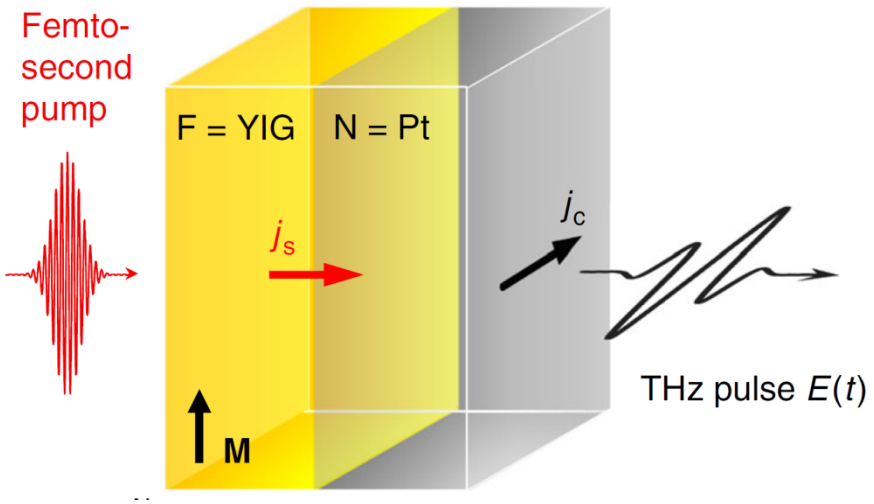
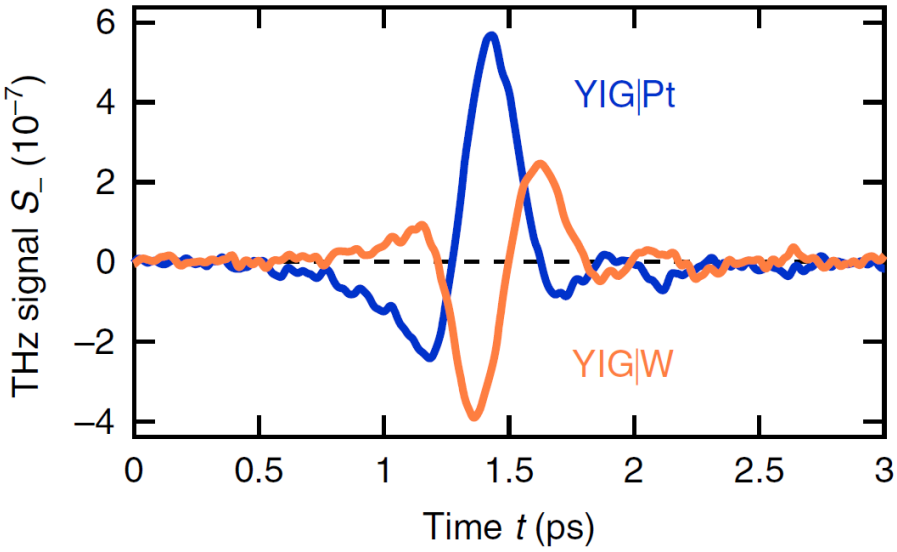
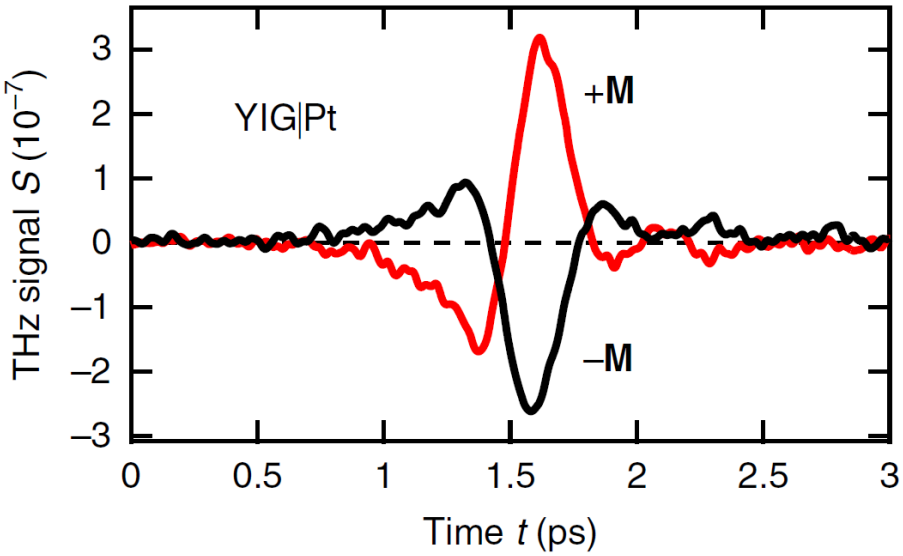
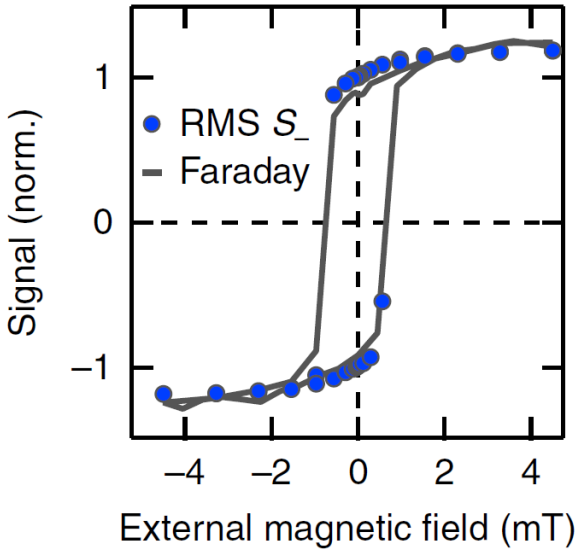


Seifert et al., Nature Comm. 2018

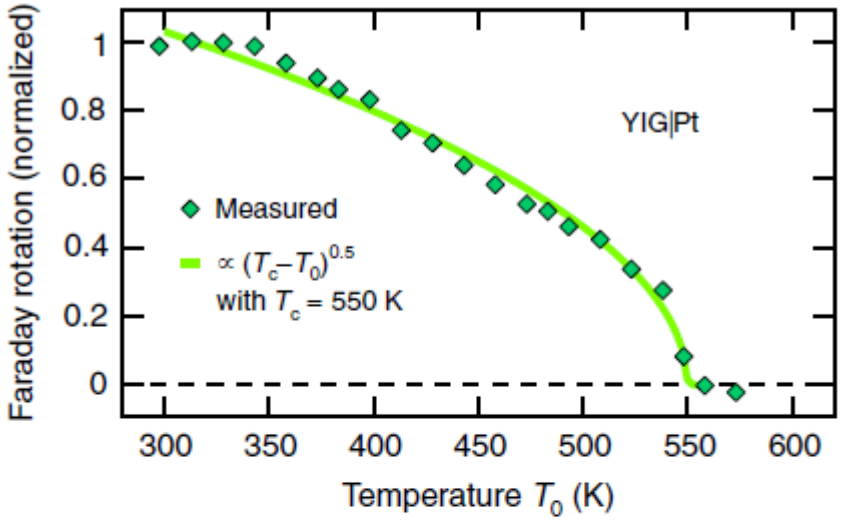


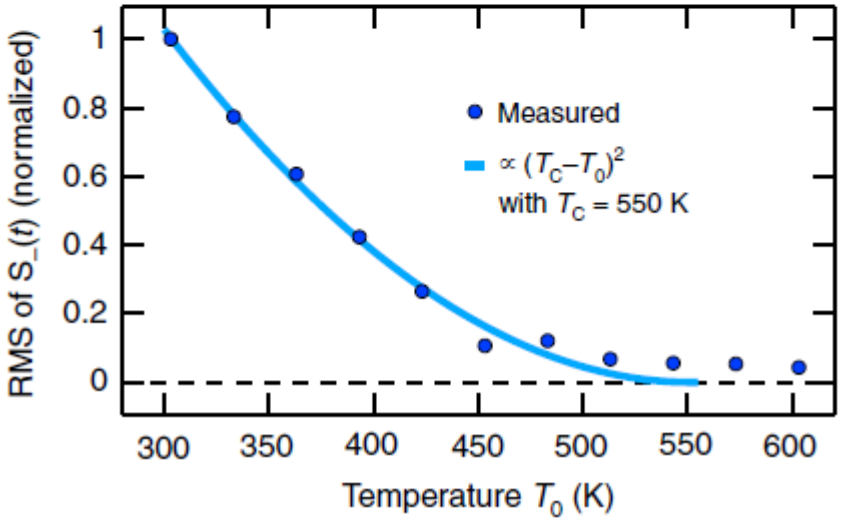




Ultra-fast spin-Seebeck in YIG/Pt

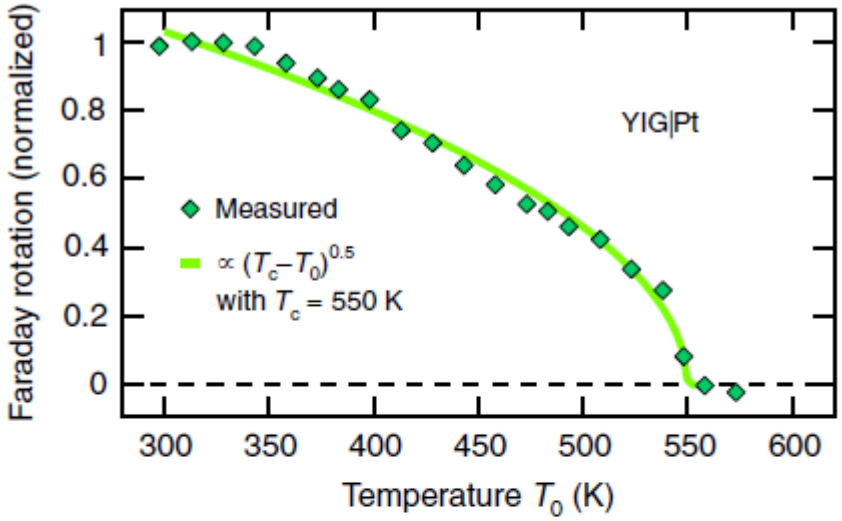
Seifert et al., Nature Comm. 2018

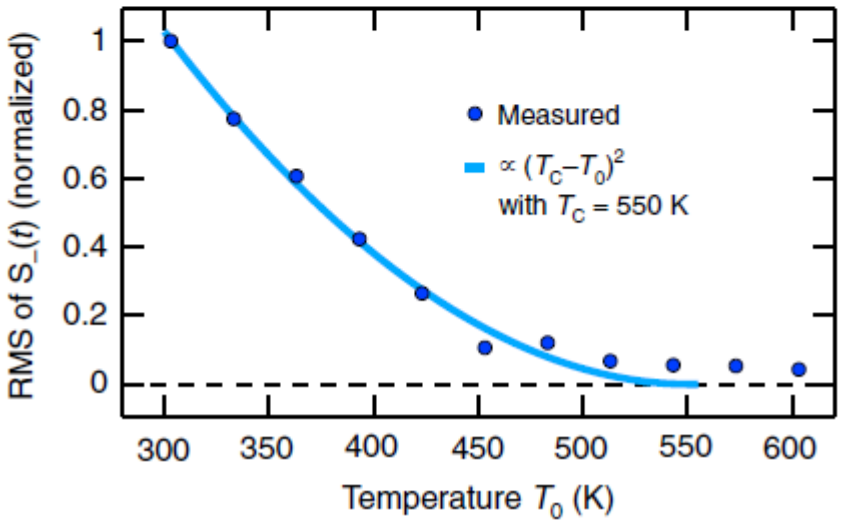




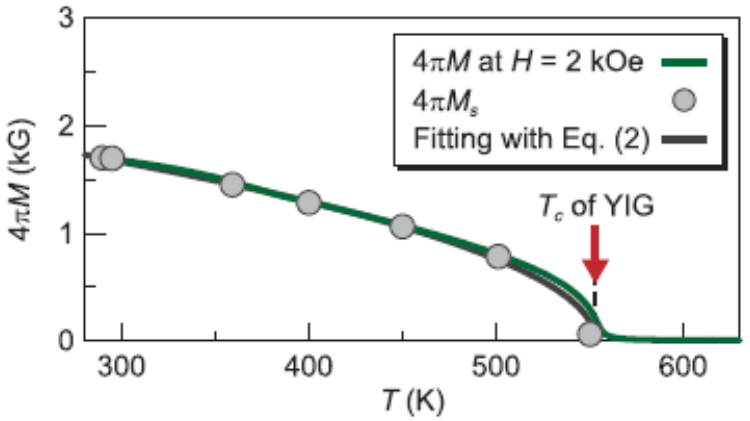
Ultra-fast spin-Seebeck in YIG/Pt

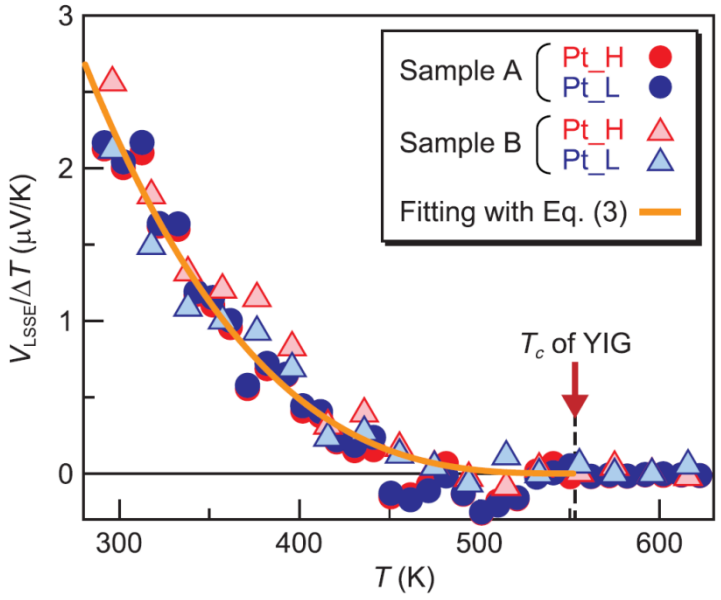
Seifert et al., Nature Comm. 2018





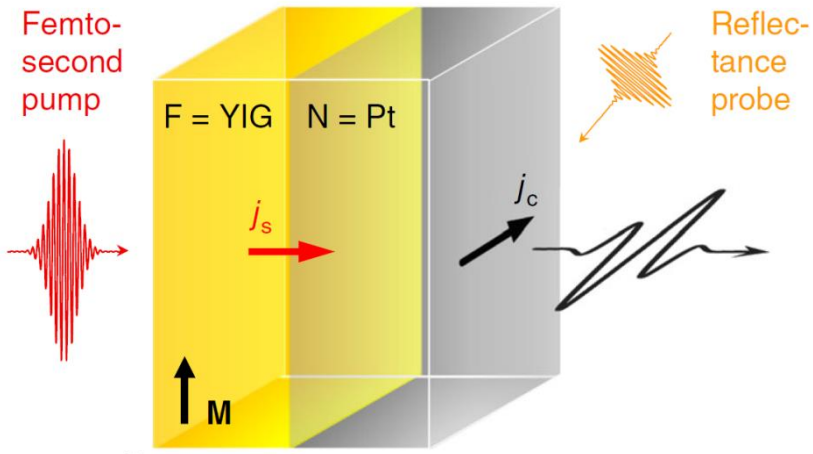
Uchida et al., PRX 4, 041023 (2014)

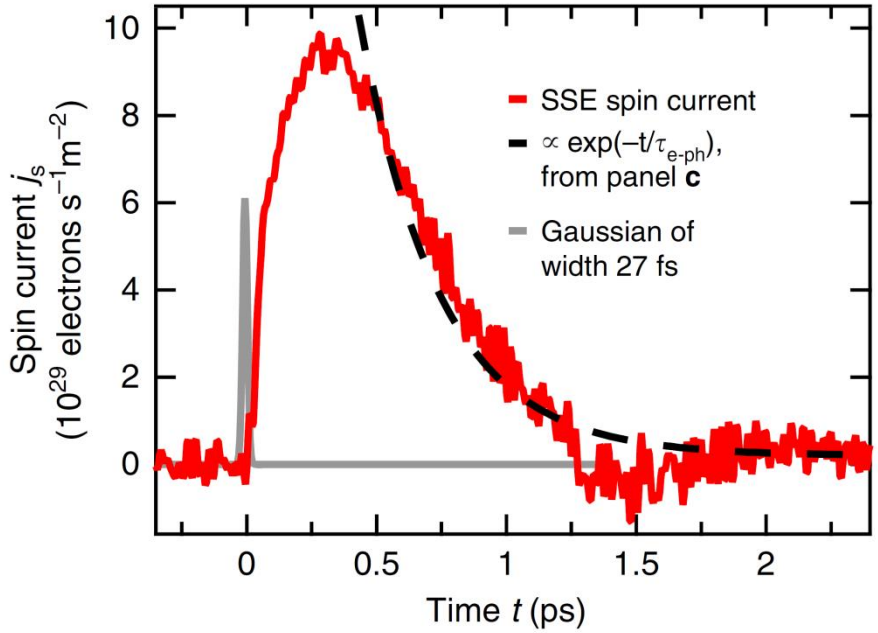


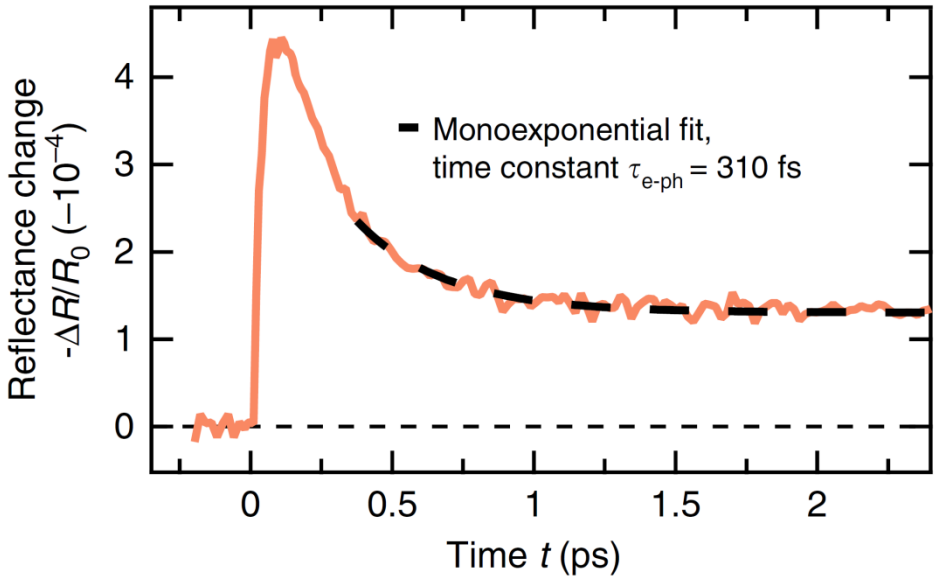


Ultra-fast spin-Seebeck in YIG/Pt

Seifert et al., Nature Comm. 2018







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