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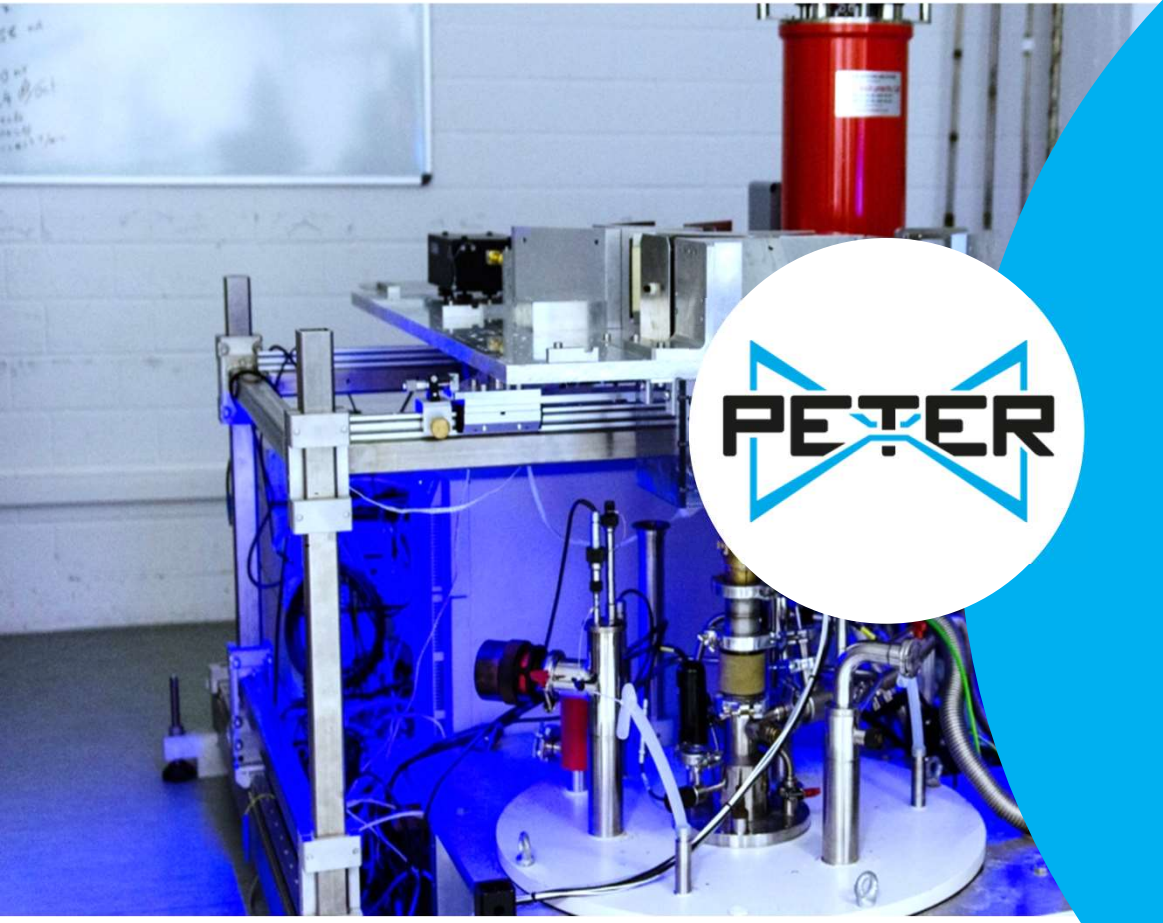
Institut für Physikalische Chemie



High Frequency EPR: New Tools for Investigating Thin Layers of Molecular Magnets

Lorenzo Tesi
University of Stuttgart
Joris van Slageren Group

RISING STARS SYMPOSIUM 2021
ICMM 2021 (Manchester)

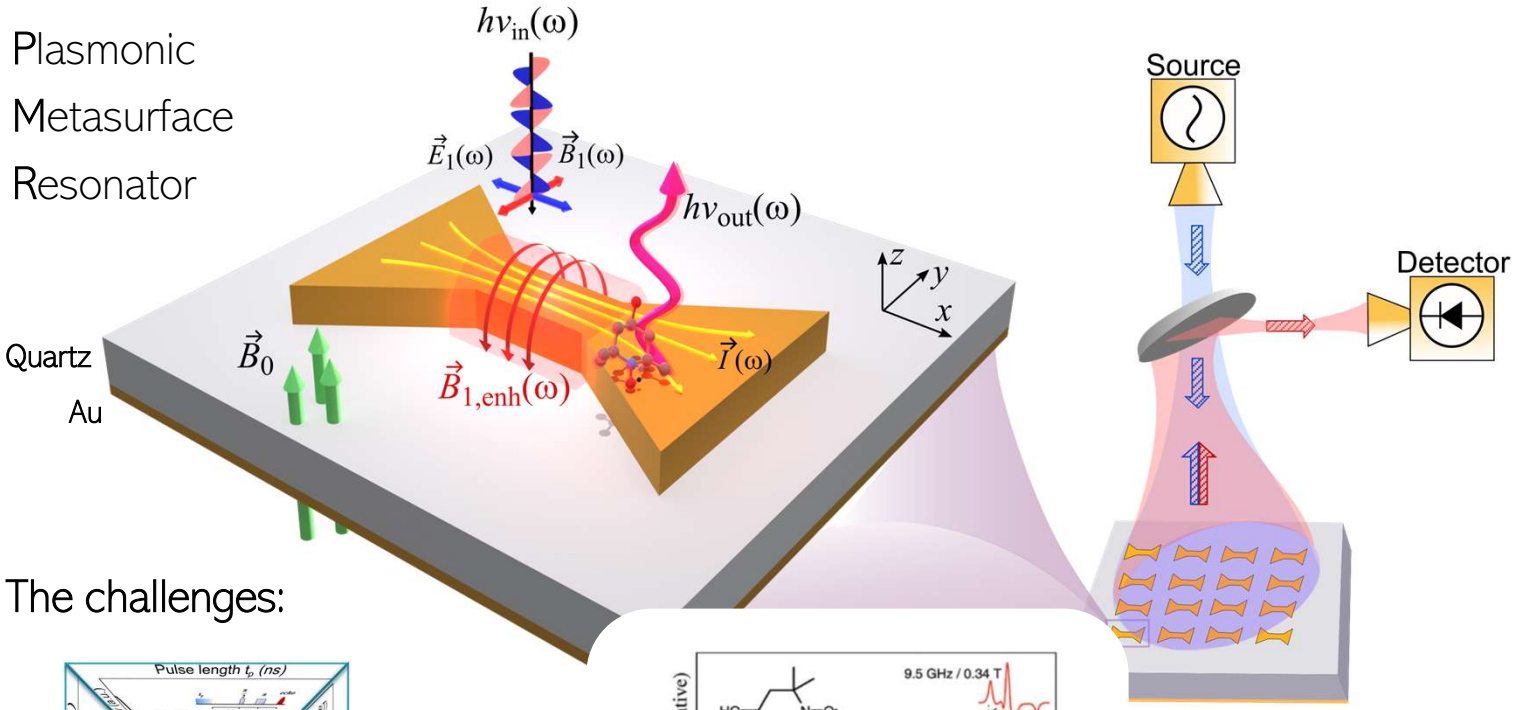
RISING STARS SYMPOSIUM 2021

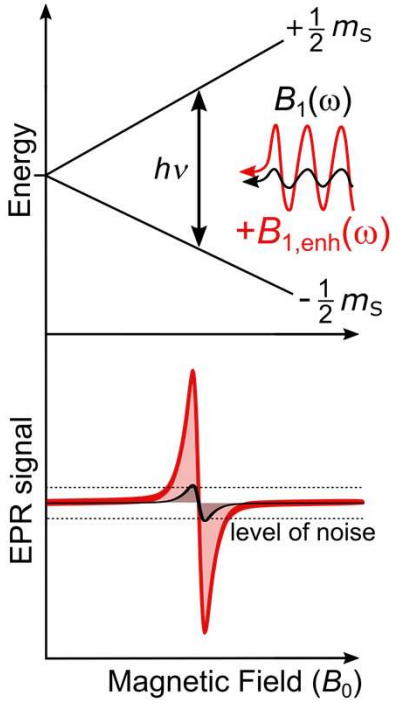
ICMM2021 MANCHESTER

11th June 2021

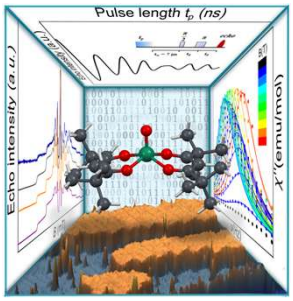
Introduction – How is the resonator working?

Plasmonic Metasurface Resonator

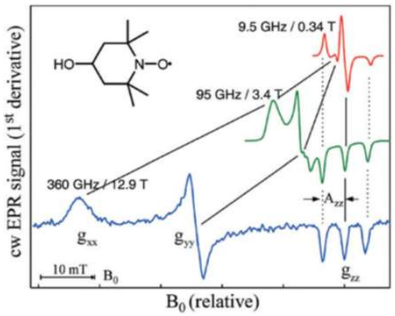




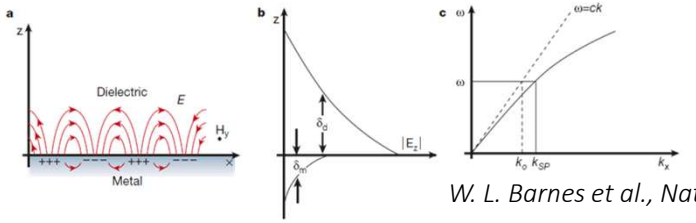
The challenges:



L. Tesi et al., Chem. Sci., 2016



K. Möbius et al., PCCP, 2004



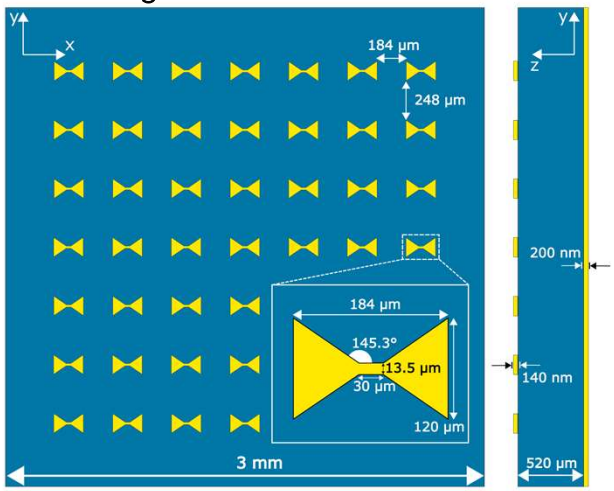
W. L. Barnes et al., Nature, 2003

(1) Measure Thin Layers; (2) Using High Frequencies (> 100 GHz); (3) Exploiting plasmonic effects in THz range

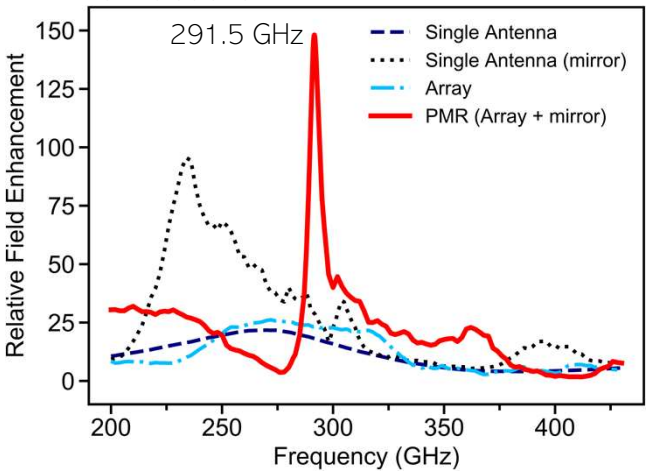
L. Tesi, D. Bloos, M. Hrton, A. Benes, M. Hentschel, M. Kern, A. Leavesley, R. Hillenbrand, V. Krapek, T. Sikola, J. van Slageren, Under Review

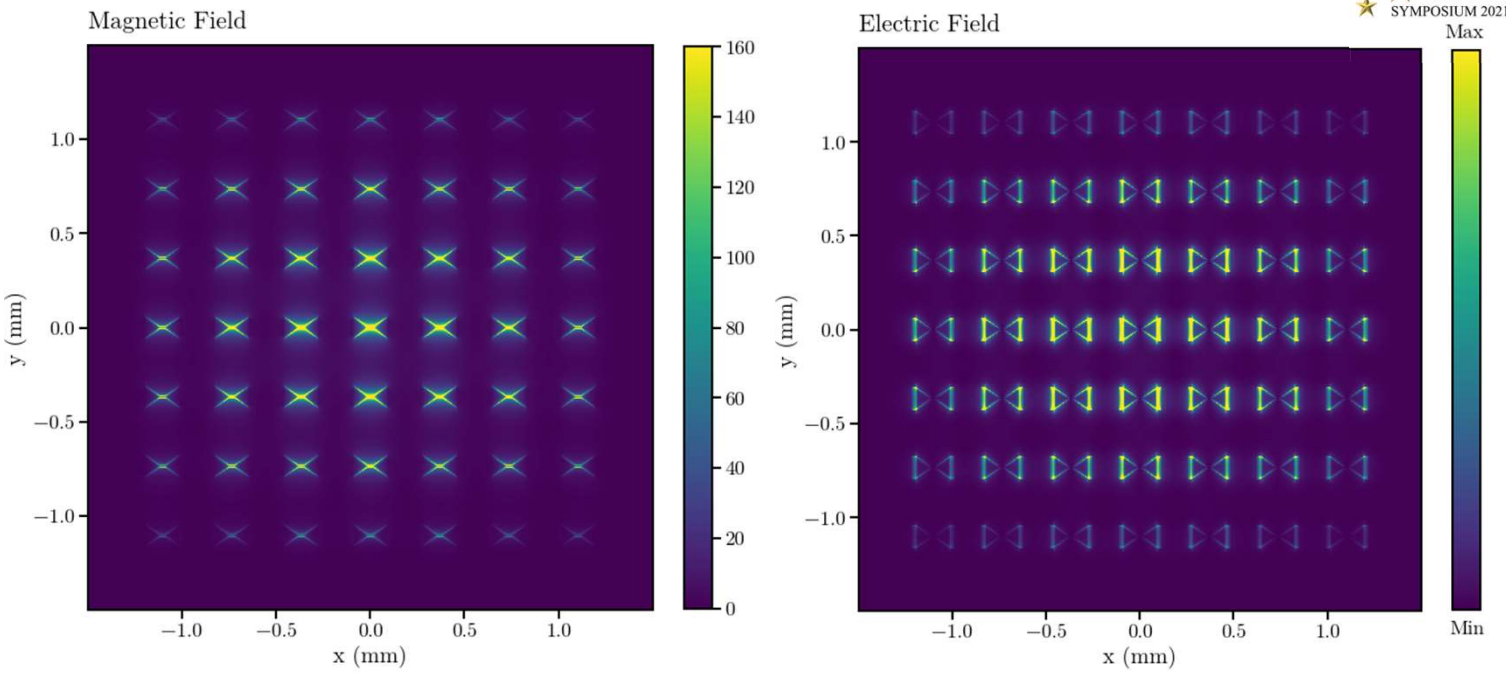
Design and Simulations of the PMR by CST Studio software

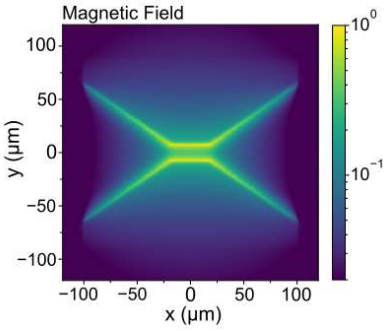
Final design of the PMR

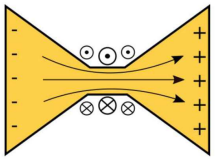


Simulations

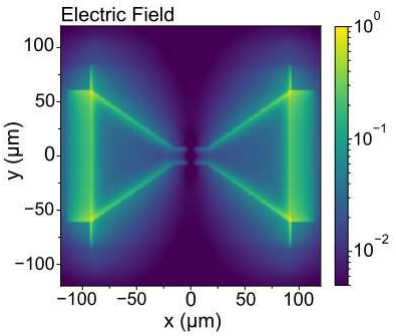








Longitudinal Dipole Mode



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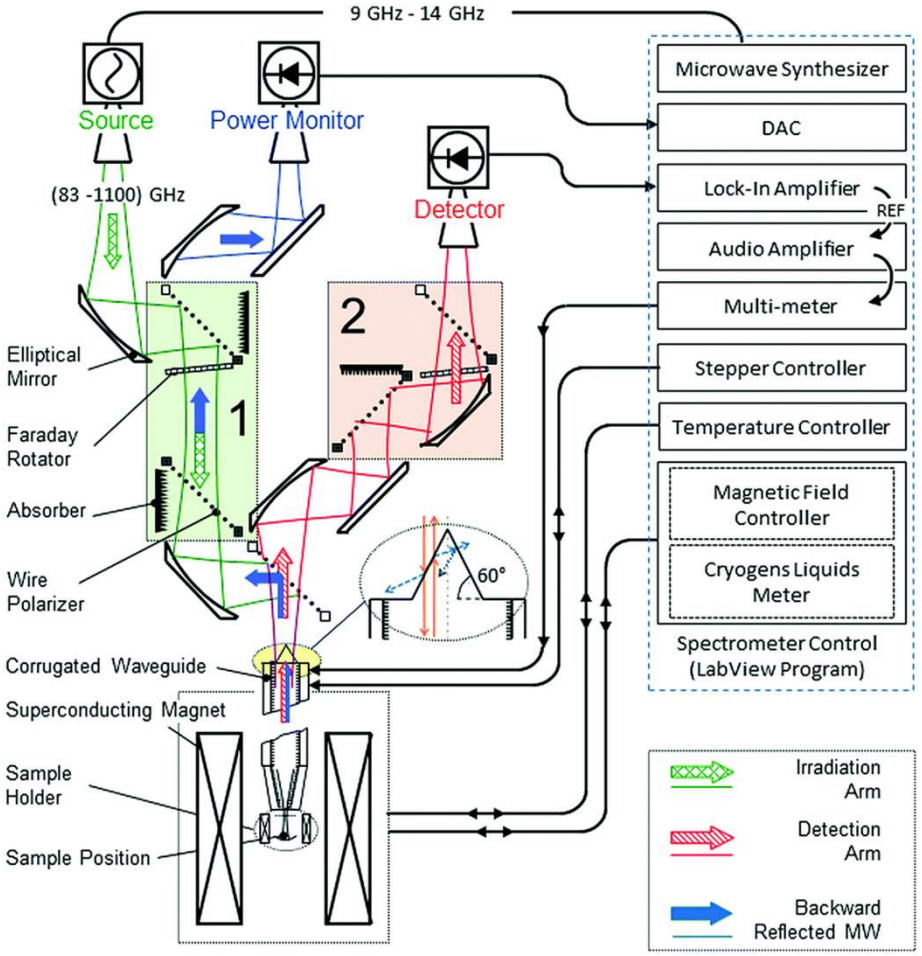
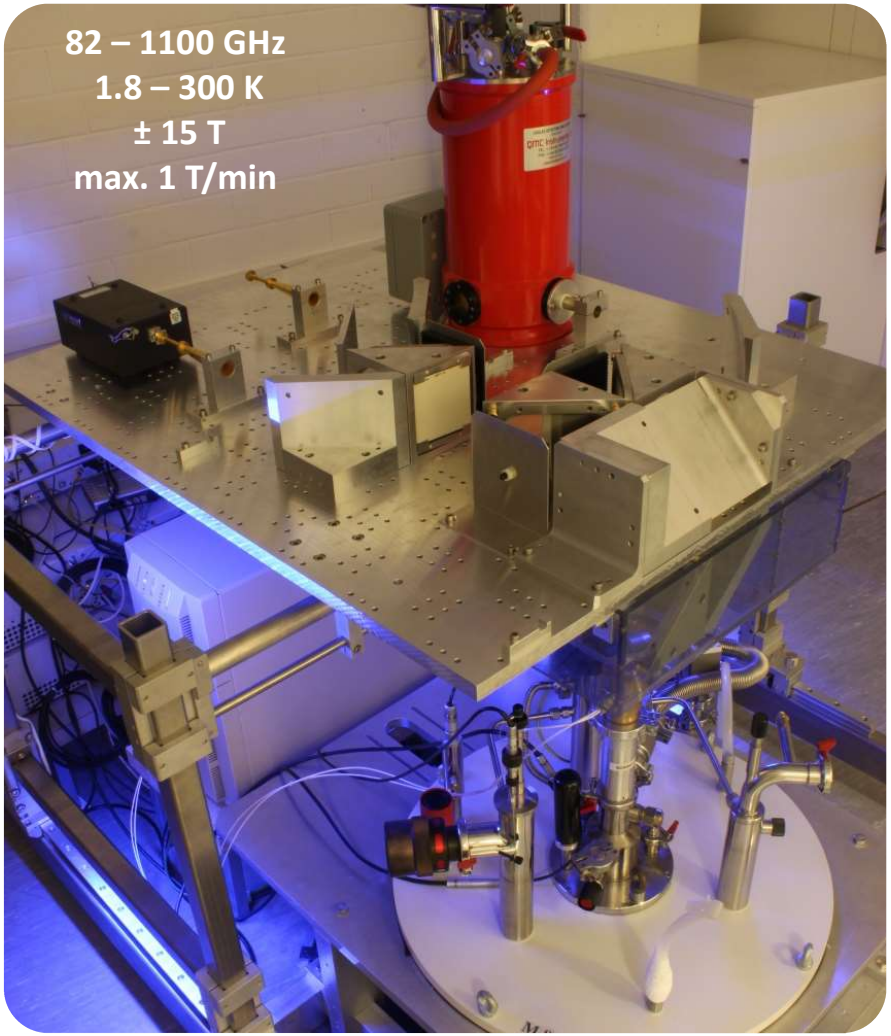
High Frequency EPR Setup: an overview

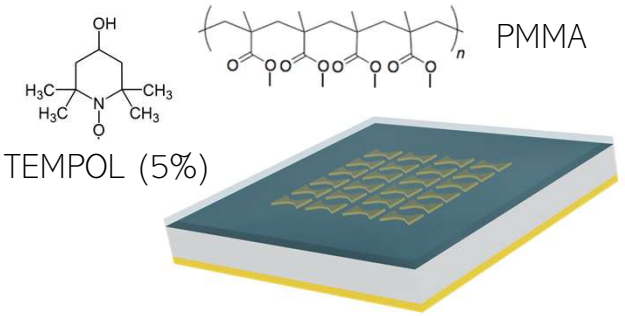




P. Neugebauer, D. Bloos, R. Marx, P. Lutz, M. Kern, D. Aguilà, J. Vaverka, O. Laguta, C. Dietrich, R. Clérac, J. van Slageren, PCCP, 2018, 20, 15528

Application of the Plasmonic Metasurface Resonator

EPR Sample

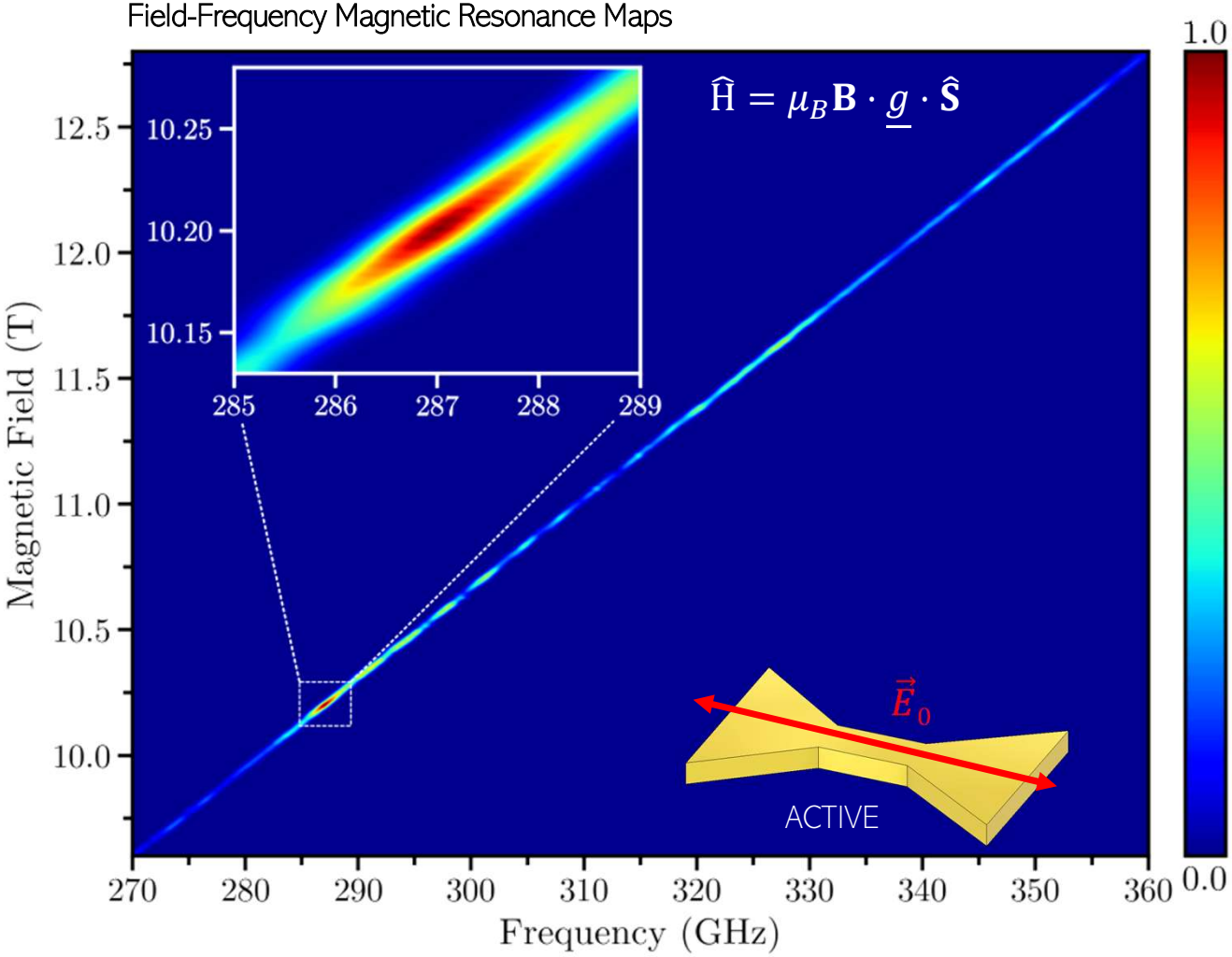


Film thickness 330 ± 10 nm

Post-processing analysis

- Remove of the Standing wave
- Fit with derivative of Gaussian type linewidth
- Integration of the fit
- Plot ⟶

Field-Frequency Magnetic Resonance Maps



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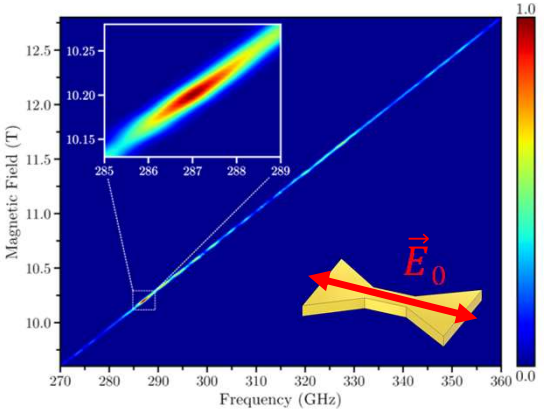
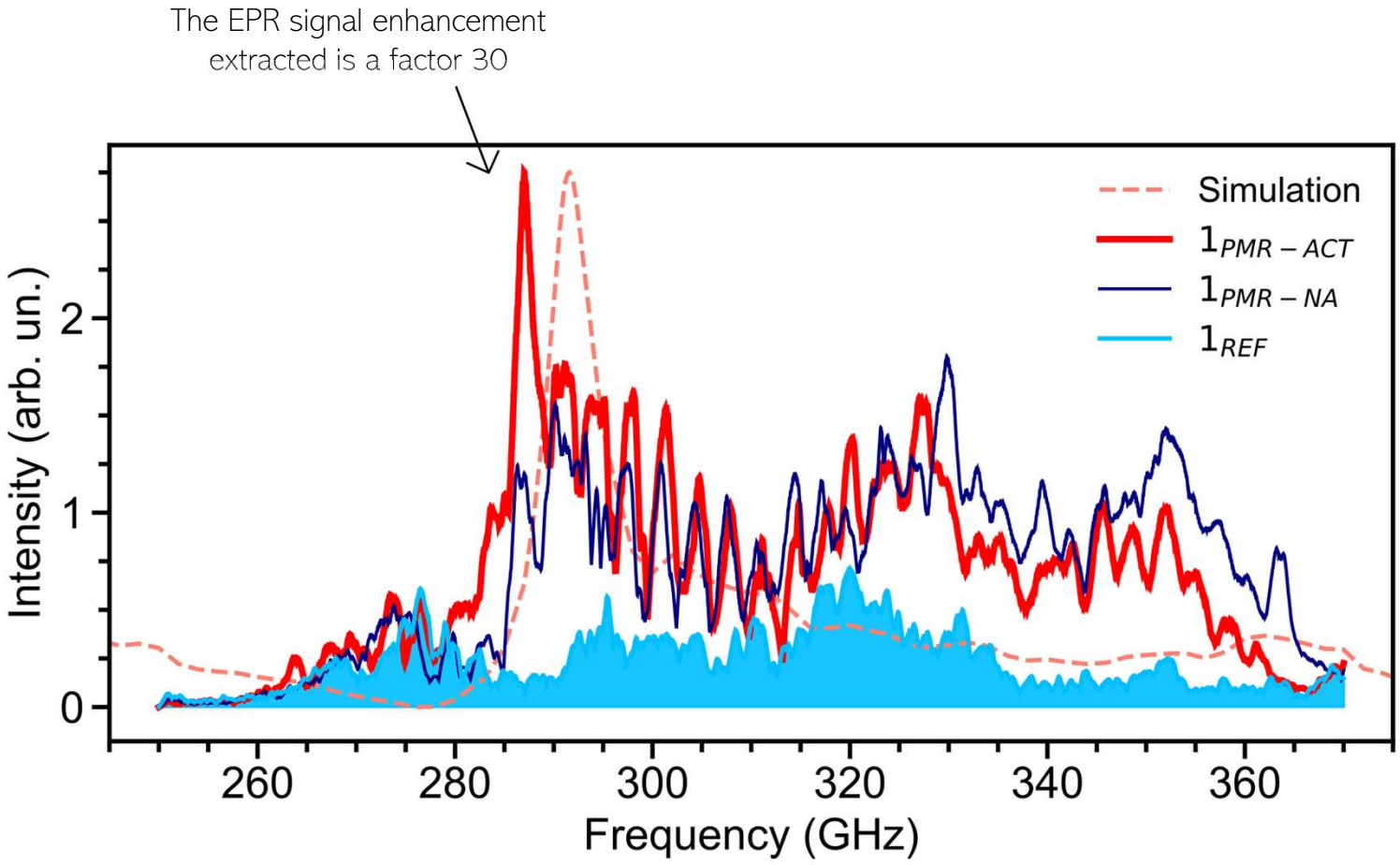
Application of the Plasmonic Metasurface Resonator



Same measurements for:

- PMR at 0° (active) + sample
- PMR at 90° (non-active) + sample
- Reference sample: bare quartz + sample



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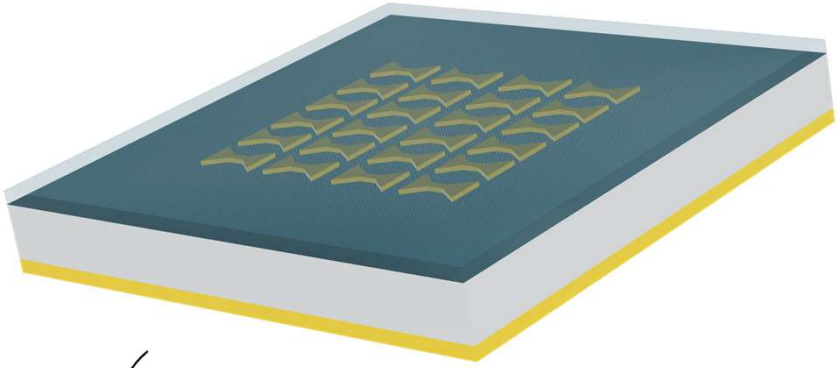
Conclusions and Perspectives

In this work

The EPR signal enhancement extracted is a factor 30 **for a thin layer**

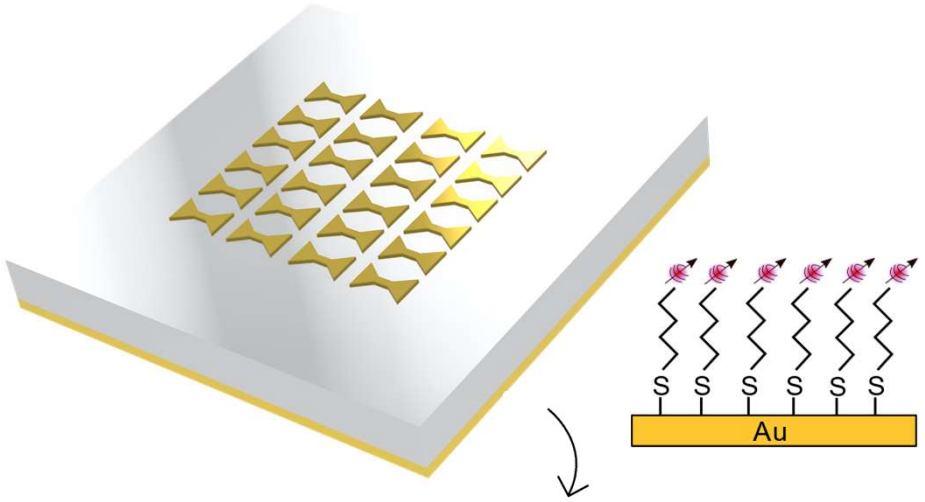


- Improve the signal for thin layer samples;
- Improve the signal for micro-crystal samples

Work in progress

The EPR signal enhancement increases to 7500 for **monolayer samples**

10^{10} spins/G·Hz$^{1/2}$ at 10 K ⟶ **10^{6} spins/G·Hz$^{1/2}$ at 10 K**



- Measurement of self-assembled monolayer;
- Integration of molecules on surface for spintronic applications

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Acknowledgements (for questions ⟶ lorenzo.tesi@ipc.uni-stuttgart.de)

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All the people involved in this work…

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CIC nanoGUNE nanoscience cooperative research center

BRNO UNIVERSITY OF TECHNOLOGY

CEITEC

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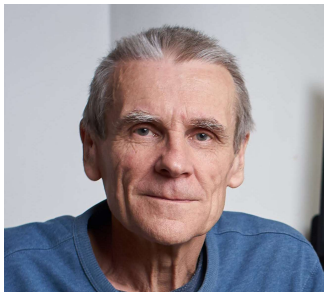
Dr. Dominik Bloos

Prof. Rainer Hillenbrand



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Dr. Vlastimil Křápek

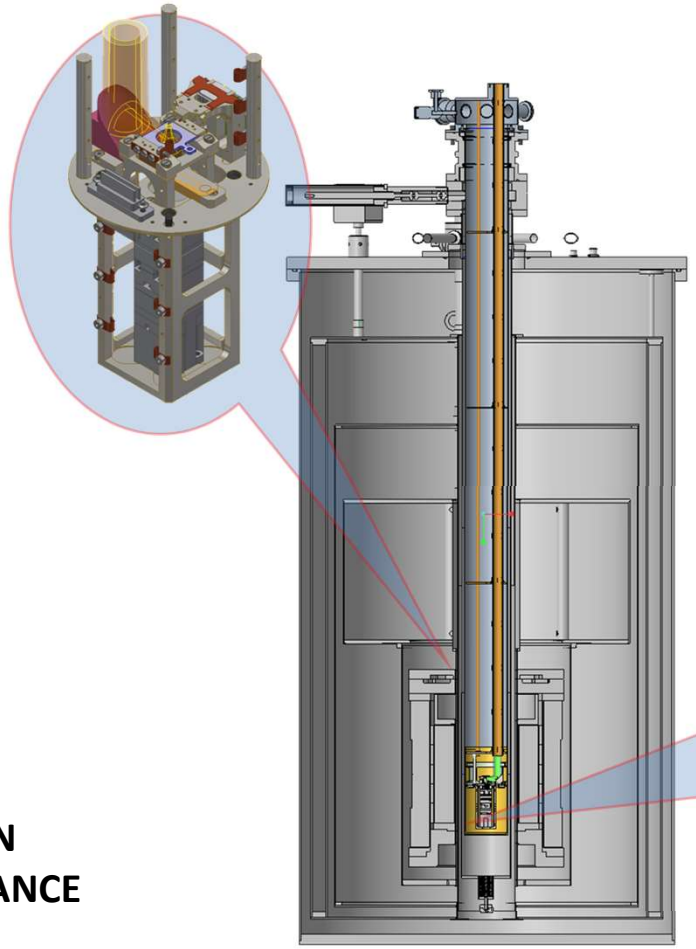
PETER

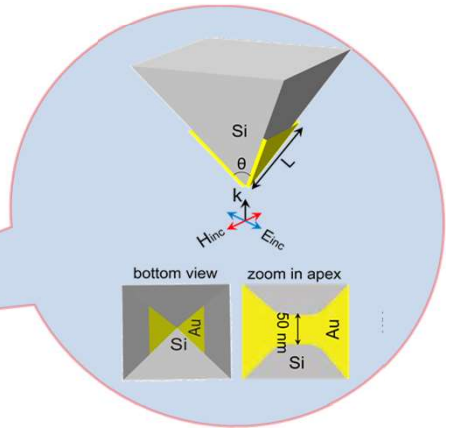
HORIZON 2020

…and you for the attention!

General aim

- Combine advantages of High Frequency Electron Spin Resonance (HFESR) with Scanning Probe Microscopy.
- Achieve a working prototype.





PLASMON
ENHANCED
THz
ELECTRON SPIN
RESONANCE

Coordinator
Tomáš Šikola

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