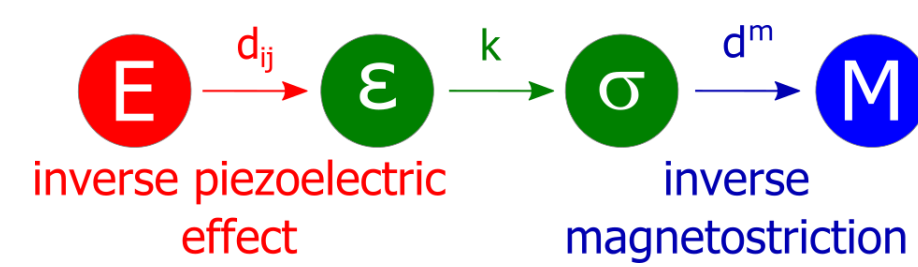


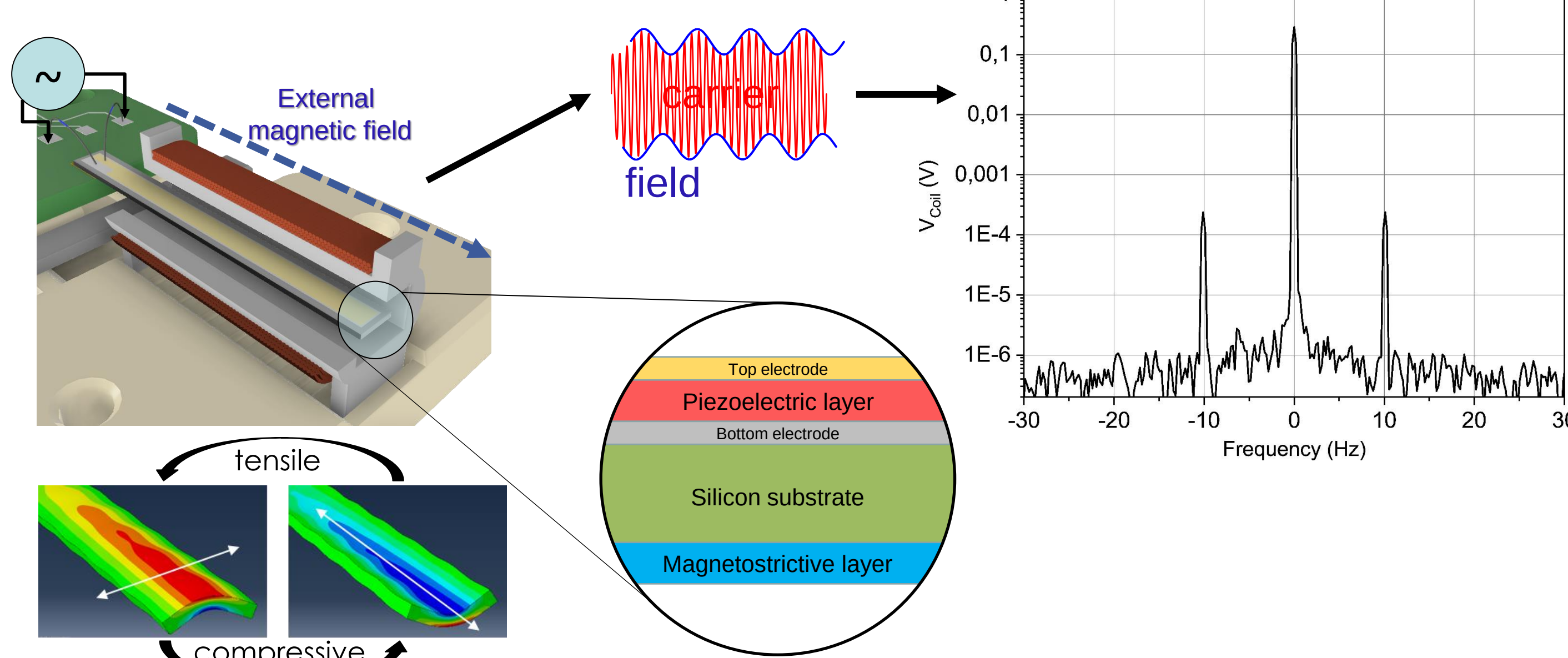
Motivation and Objectives

Converse ME effect



- Change in magnetization of sensing MS layer
- External magnetic field modulation
- Inductive read-out with coil

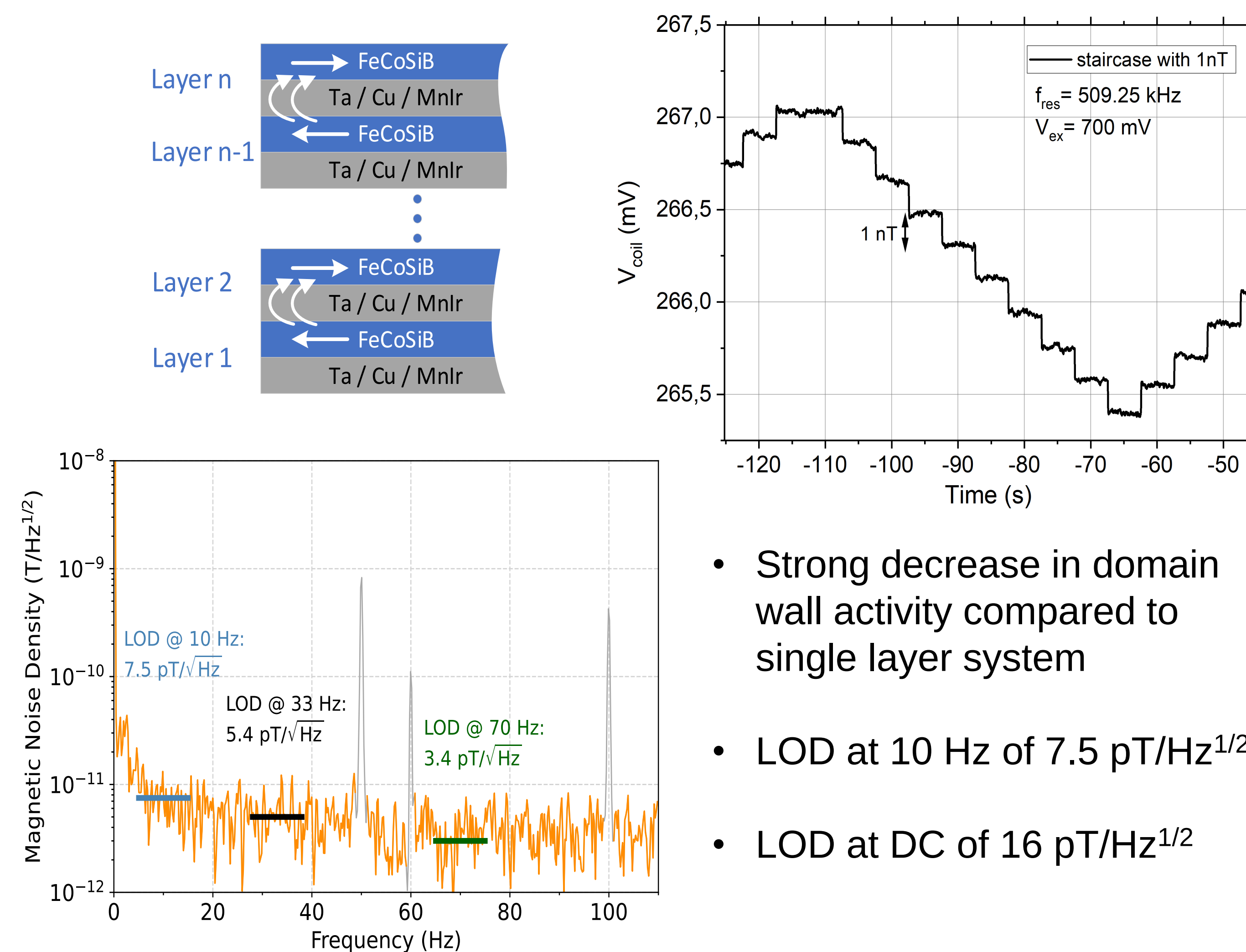
Piezoelectric excitation



Main objectives: physical model design, fabrication & characterization of sensors

Results of the Second Funding Period

Exchange Bias coupled magnetostrictive multilayers



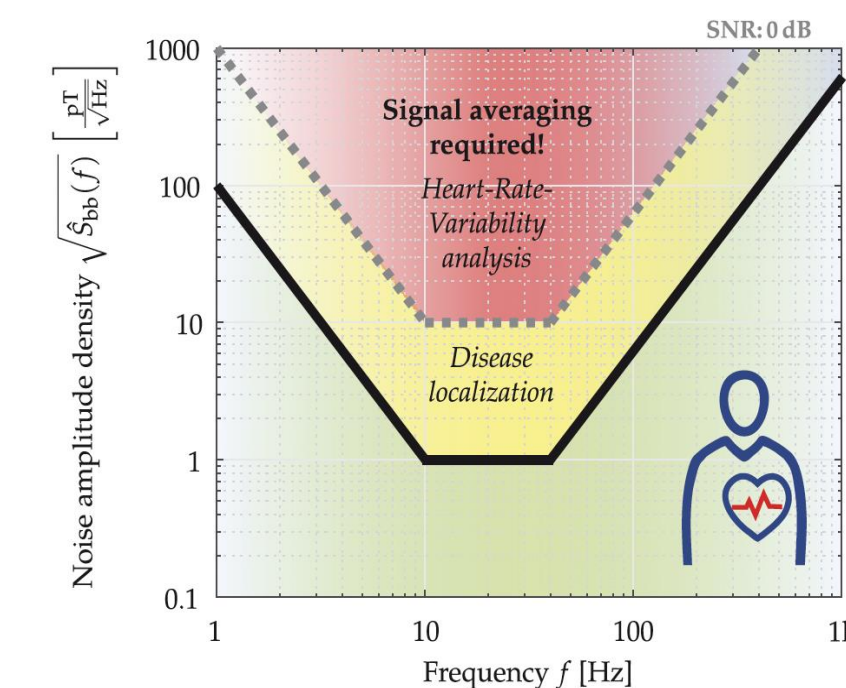
- Strong decrease in domain wall activity compared to single layer system
- LOD at 10 Hz of 7.5 pT/Hz^{1/2}
- LOD at DC of 16 pT/Hz^{1/2}

Influence of the frequency of the U-mode

- Single layer 4 μm FeCoSiB on varying substrate thickness
- Expectation of increased sensitivity with increasing frequency not met
- LOD decreases

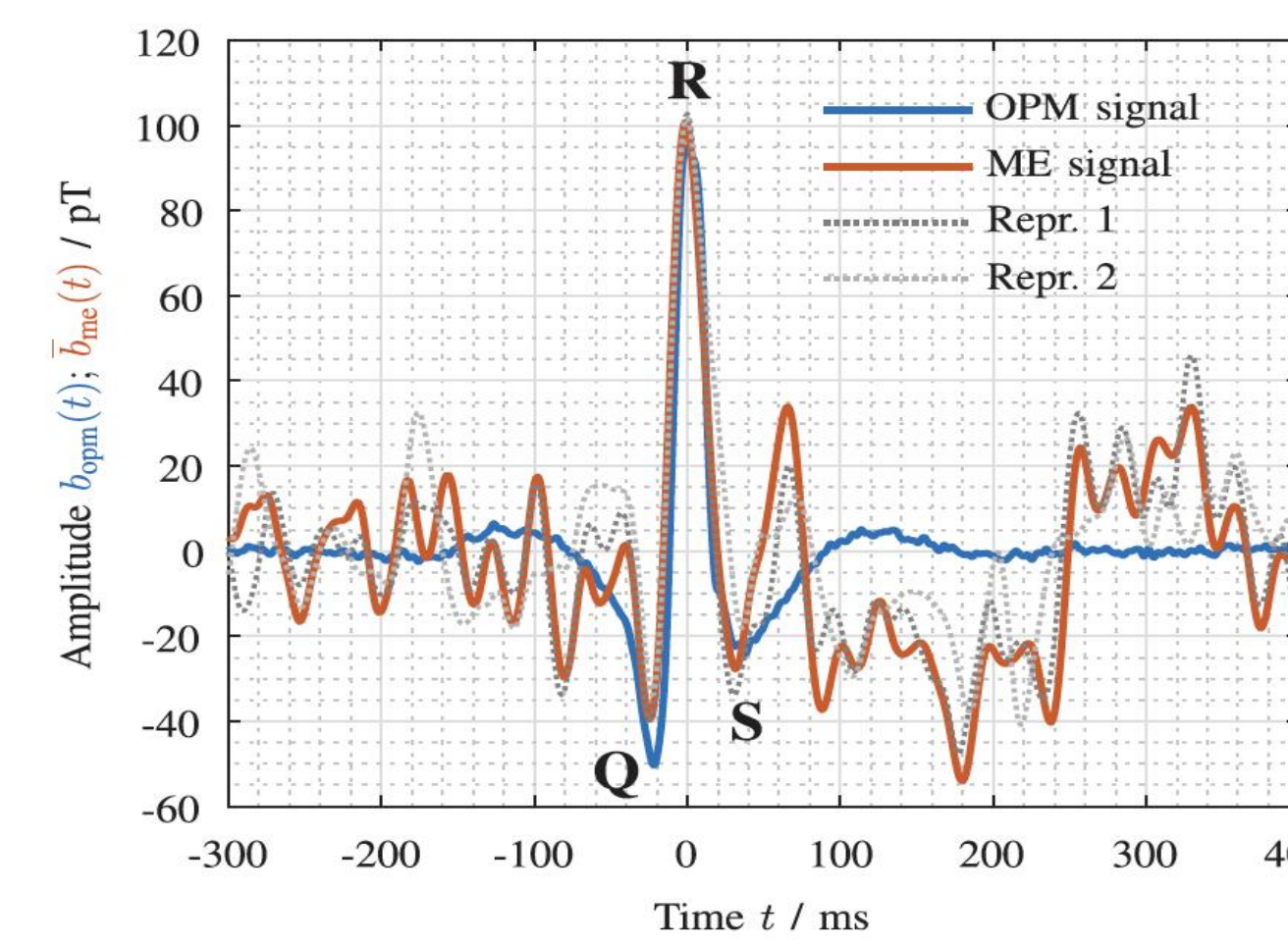
Thickness in μm	Frequency of U-mode in kHz	Excitation voltage in mV	Sensitivity at 10 Hz in kV/T	Noise density at 10 Hz in μV/Hz ^{1/2}	LOD at 10 Hz in pT/Hz ^{1/2}
350	513.9	200	20.3	1.1	51
525	734.3	1000	12.9	5.6	437
1000	1101.2	2000	15.7	8.2	525

Use of the converse ME sensor for cardiological measurements



- MCG on healthy, live volunteer
- Pilot study of applicability

- Heart R wave detected (60s averaged)
- Comparison with OPM signal

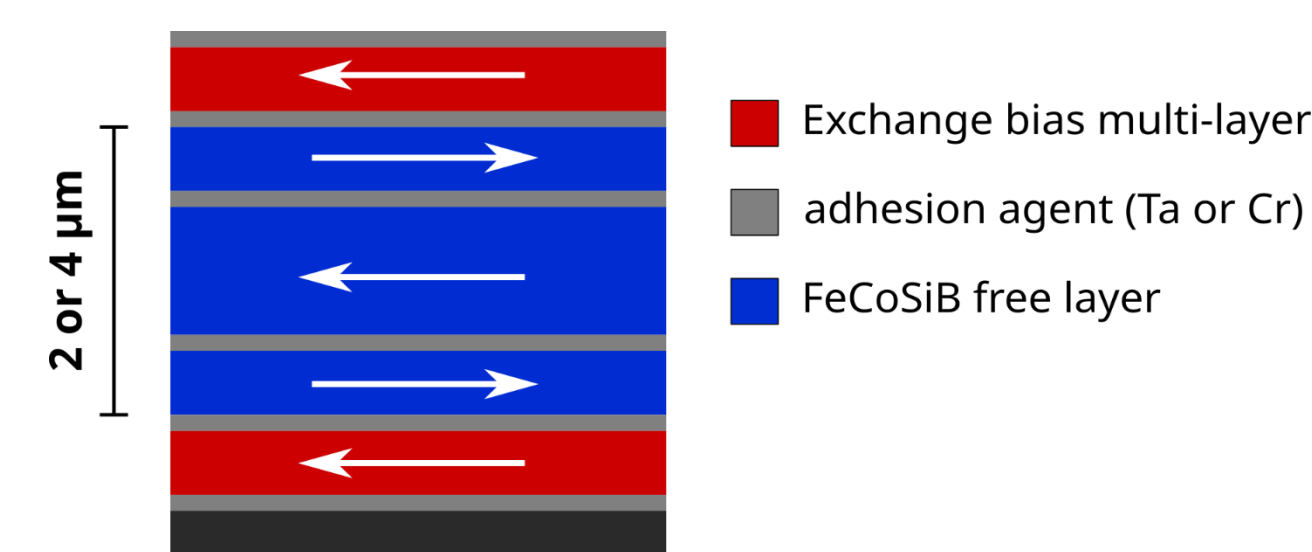


Work Plan for Third Funding Period

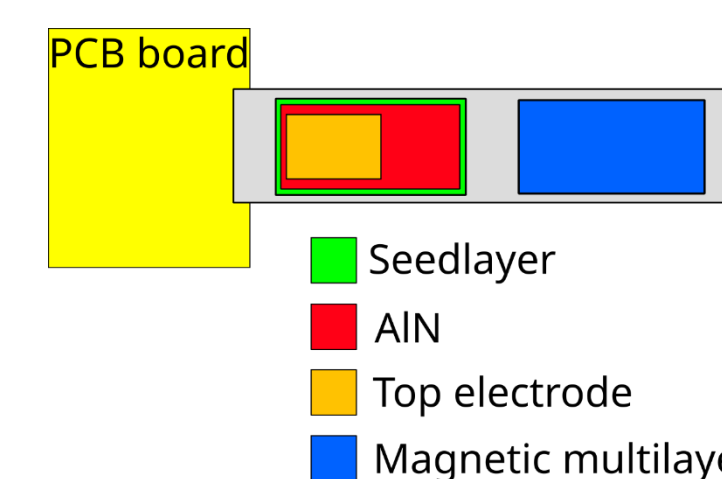
Research methods

Fabrication of cantilevers in CAU clean room, structural characterization, functionality of sensor system

WP1 Magnetostrictive multilayer system



WP2 Single side U-mode sensor

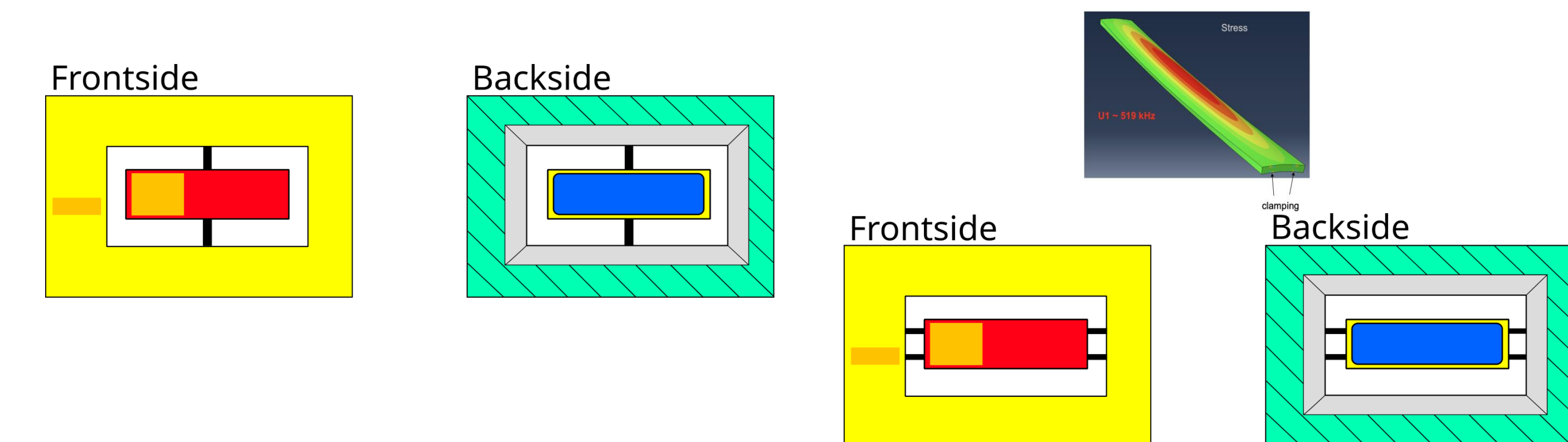


WP3 U-modes with higher quality factor

- Bandwidth of 1 kHz sufficient
- Higher Q → higher sensitivity
- Sensors in small vacuum tube with coil wound around it

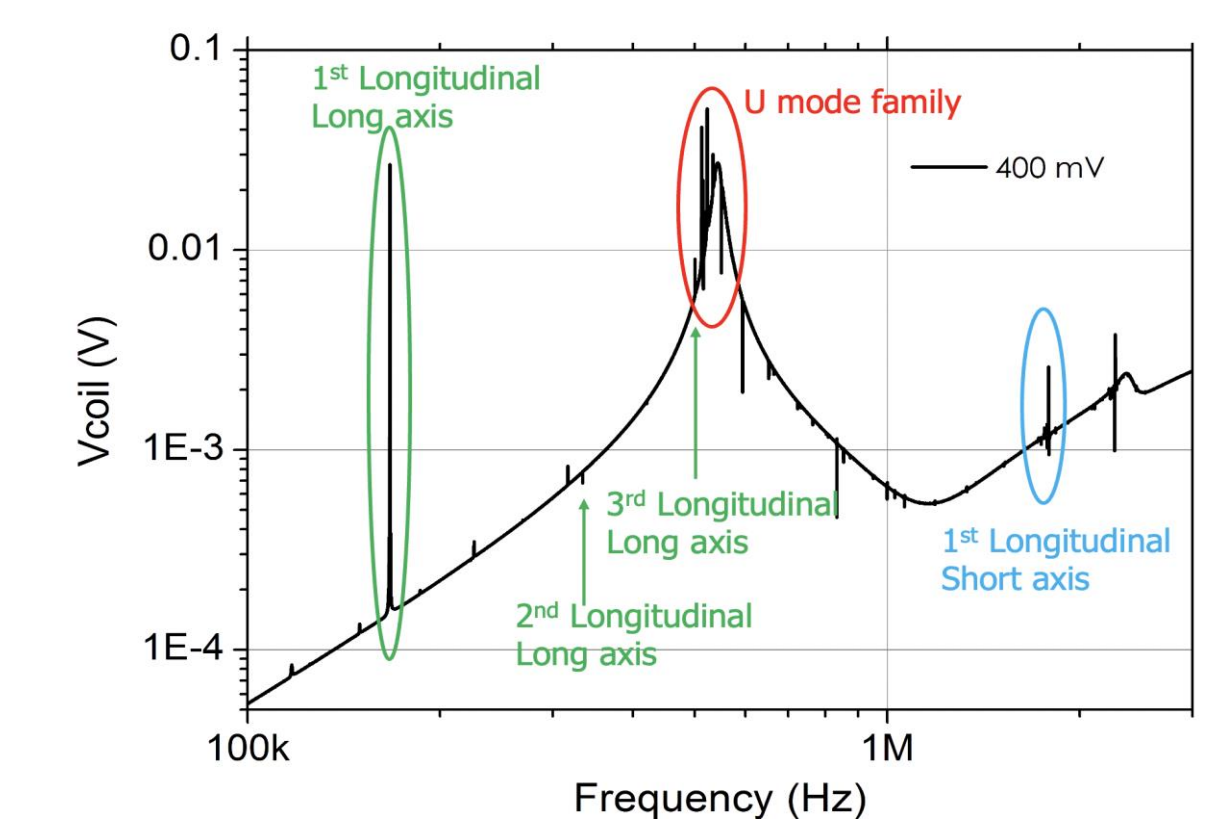
WP4 MEMS process

- Development of MEMS process with alternate clamping of cantilever
- Side clamping for use of longitudinal modes
- Double sided clamping for more homogeneous excitation



WP5 MHz oscillation modes

- Research of alternative oscillation modes using transverse longitudinal modes along long axis (1st harmonic)



WP6 Cardiological measurements

	2024		2025				2026				2027				2028	
	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
WP1 – Magnetostrictive multilayer system																
WP2 – Single side U-mode sensor																
WP3 – U-Modes with higher quality factor																
WP4 – MEMS process																
WP5 – MHz oscillation modes																
WP6 – Cardiological measurements																

Collaborations

- A1:** Collaboration in the investigation of magnetic domain structures
- A6:** Microstructural characterization
- A8:** Modelling of the sensors
- A10:** Modelling of the noise, in operando MOKE measurements
- B1:** Analog electronics, noise floor characterization, LOD measurements
- B9:** Using converse ME sensors for cardiological measurements
- Z1:** Sensor fabrication, vibrometry measurements
- Z2:** Instrumentation and sensor characterization
- Participation in focus groups**
- F1:** Magnetic layers; **F3:** Comparison of sensor concepts
- F4:** Magnetolectric sensors; **F6:** Biomedical applications

Funds Requested

1 Postdoctoral researcher, consumables: 45 k€

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[A7-5] Urs, N. O.; Golubeva, E.; Röbisch, V.; Toxvaerd, S.; Deldar, S.; Knöchel, R.; Höft, M.; Quandt, E.; Meyners, D.; McCord, J.: Physical Review Applied 13 (2020) 024018. - **A10, Z2**

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