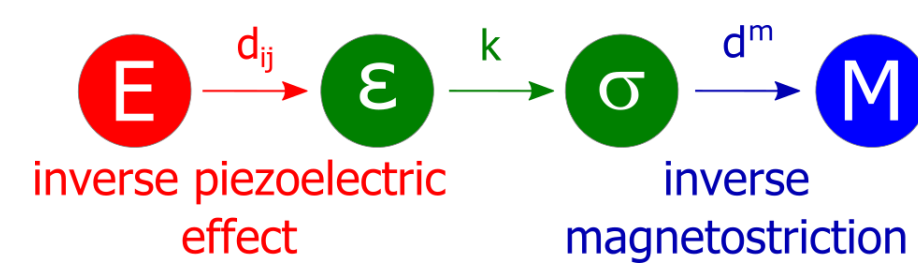


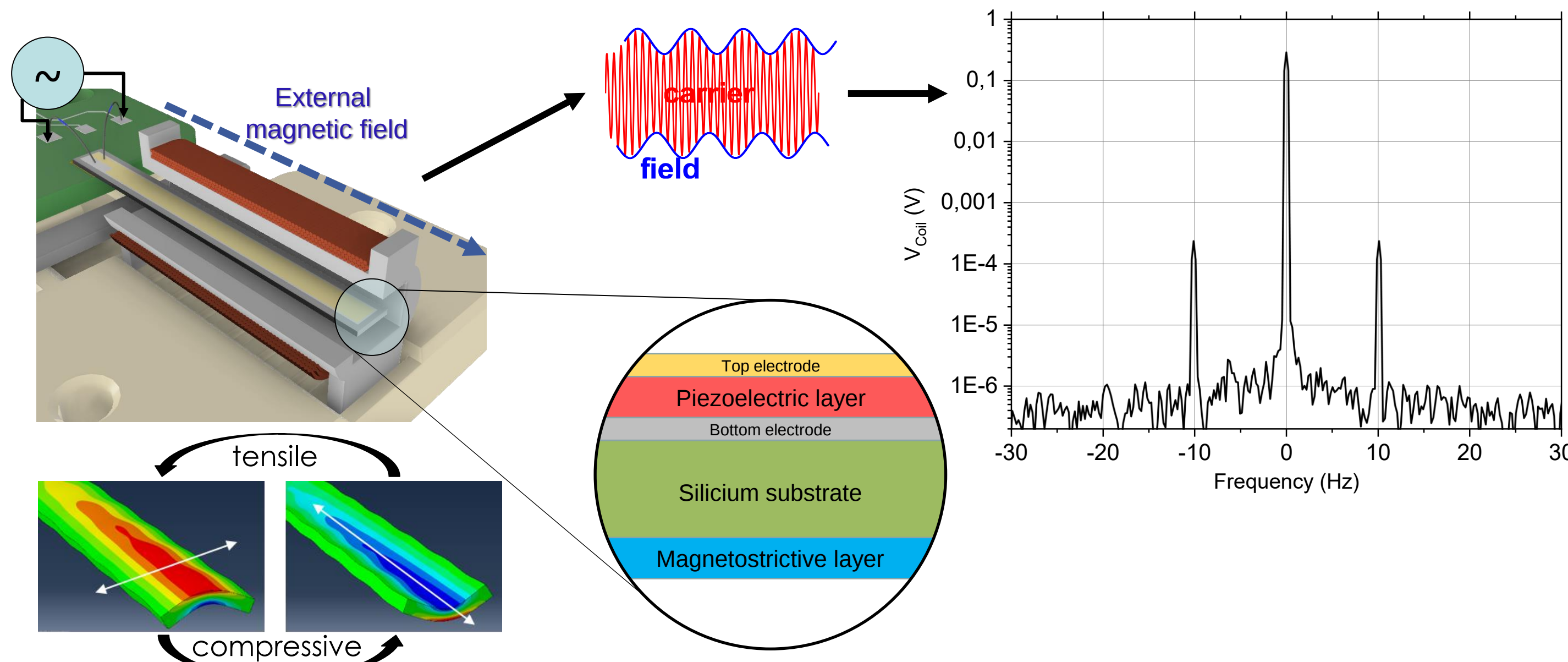
Motivation and Objectives

Converse ME effect



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

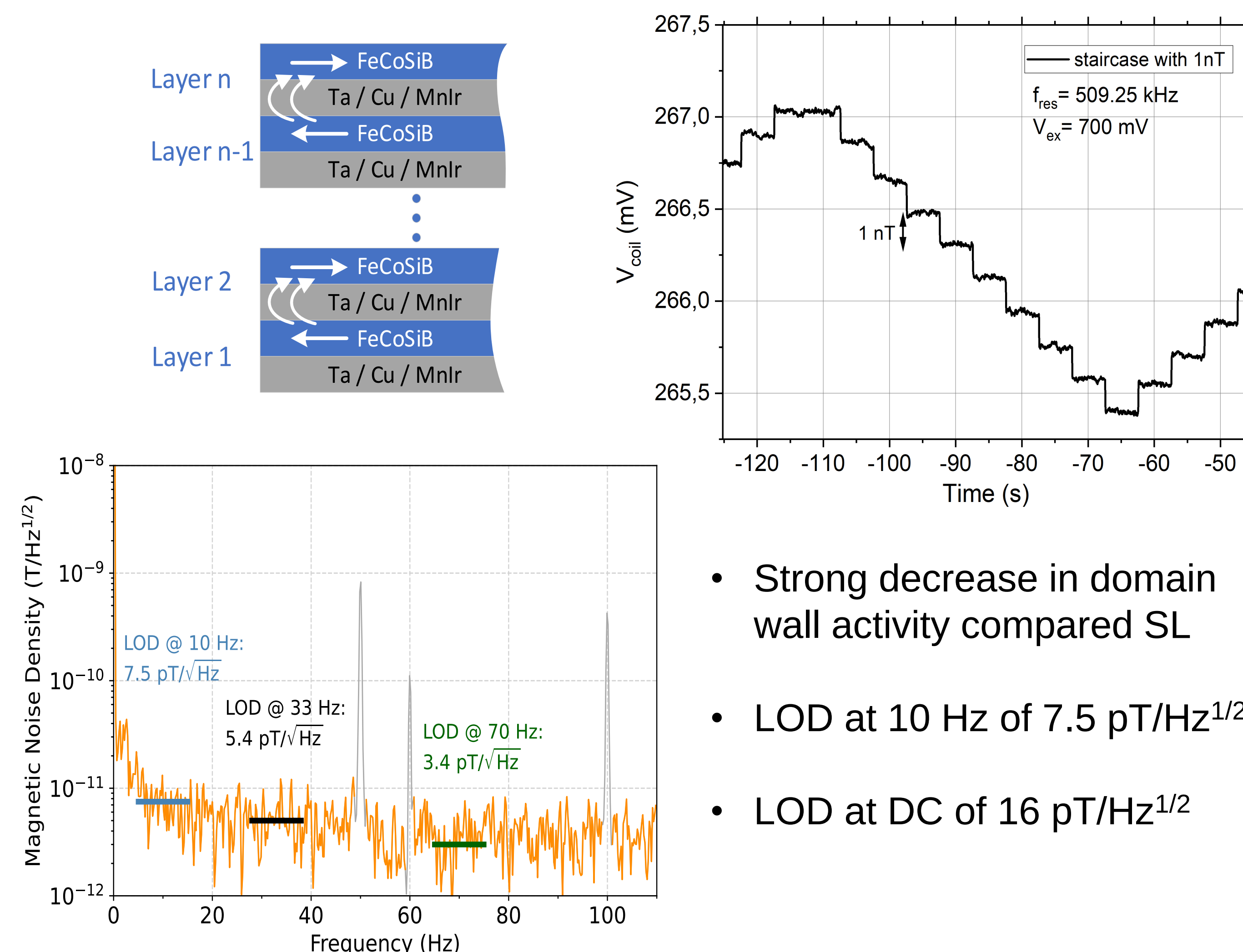
Piezoelectric excitation



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

Results of the Second Funding Period

Exchange Bias coupled magnetostrictive multilayers



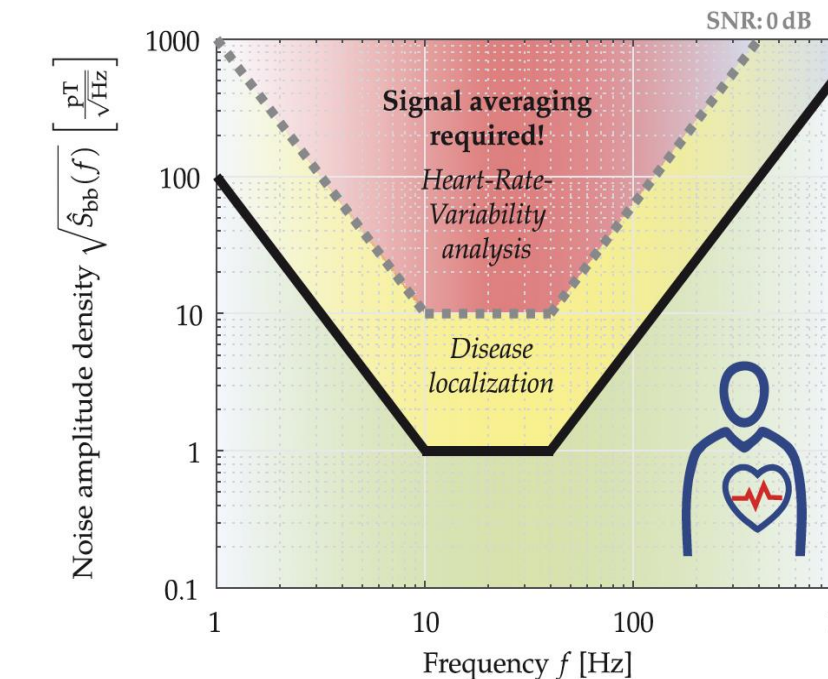
- Strong decrease in domain wall activity compared SL
- LOD at 10 Hz of 7.5 pT/Hz^{1/2}
- LOD at DC of 16 pT/Hz^{1/2}

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 (new results to be added till March 6th)

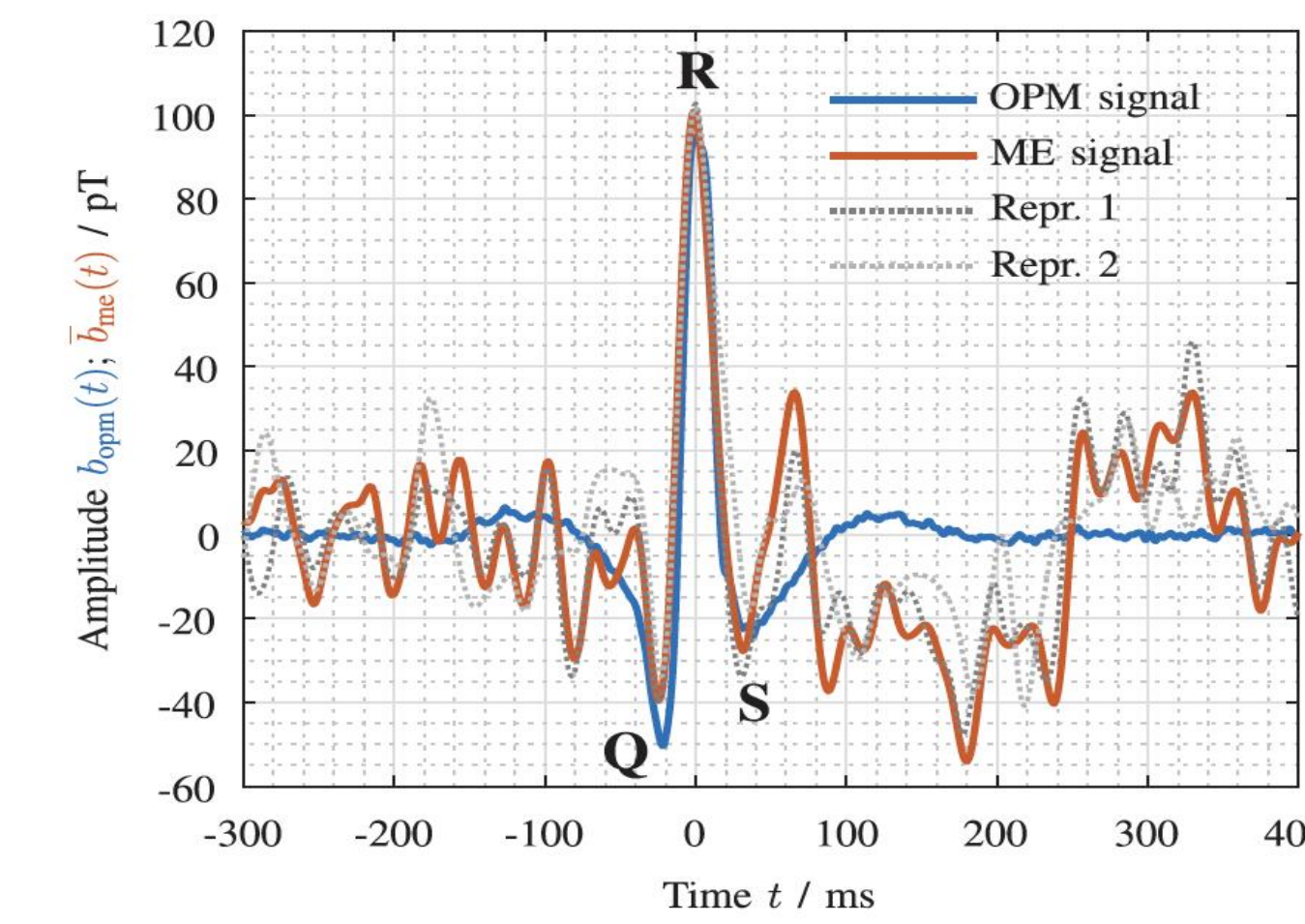
Thickness in μm	Frequency of U-mode in kHz	Excitation voltage in mV	Sensitivity at 10 Hz in kV/T	Noise density at 10 Hz in μV/Hz ^{1/2}	LOD at 10 Hz in pT/Hz ^{1/2}
350	513.9	200	20.3	1.1	51
525	734.3	1000	12.9	5.6	437
1000	1101.2	2000	15.7	8.2	525

Use of the converse ME sensor for cardiological measurements



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

- Heart R wave detected
- Comparison with OPM signal



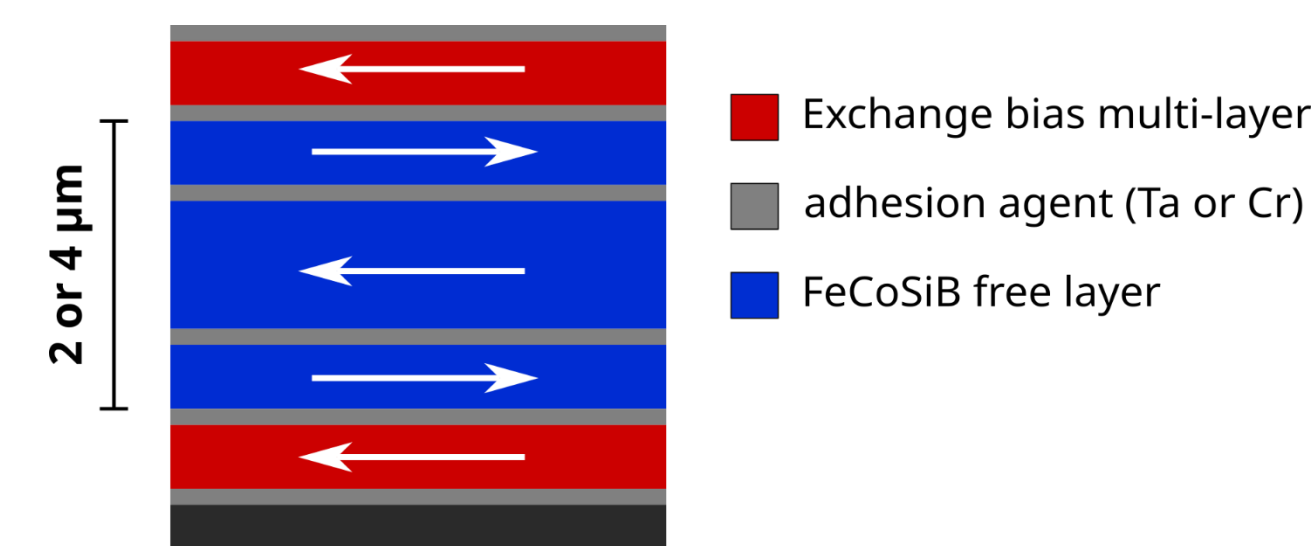
Work Plan for Third Funding Period

Research methods

Fabrication of cantilevers in CAU clean room, Functional and structural characterization

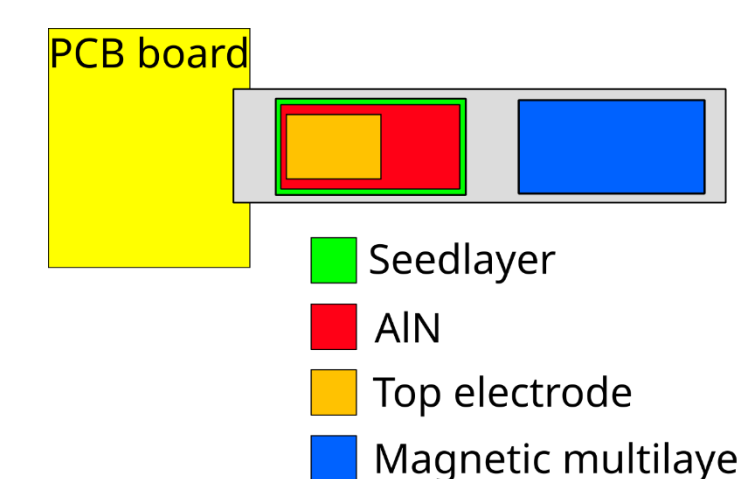
Work plan

WP1 Magnetostrictive multilayer system



- Close cooperation with A1
- Sensor system performance characterization
- Further improvement of exchange bias multilayer systems

WP2 Single side U-mode sensor



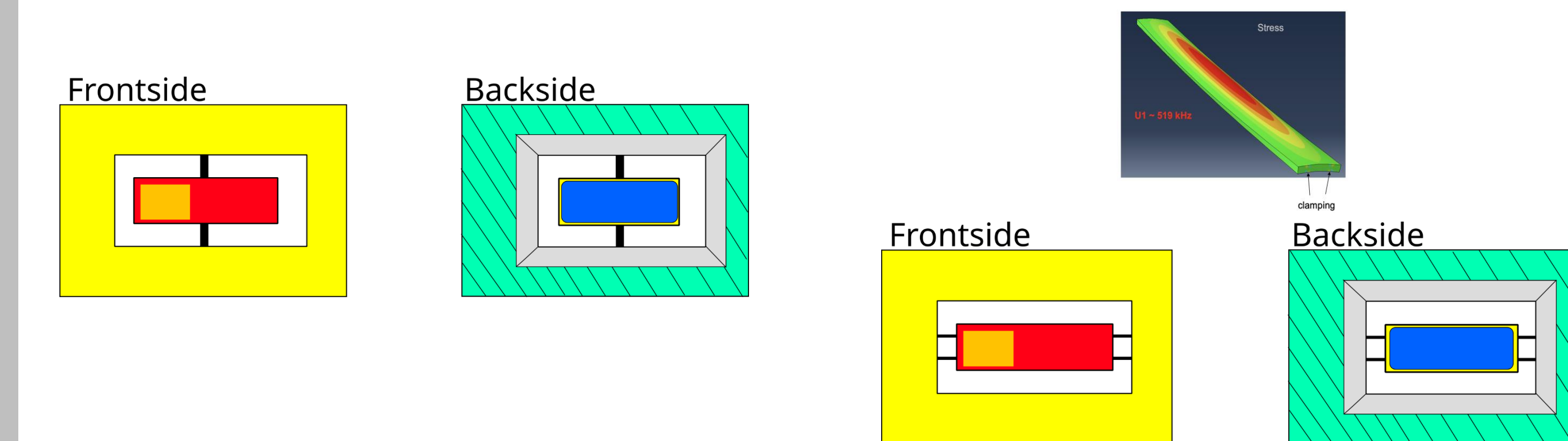
- Piezoelectric excitation and MS layer system on the same side
- simplified fabrication, no capacitive coupling inside coil
- Way toward miniturization

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

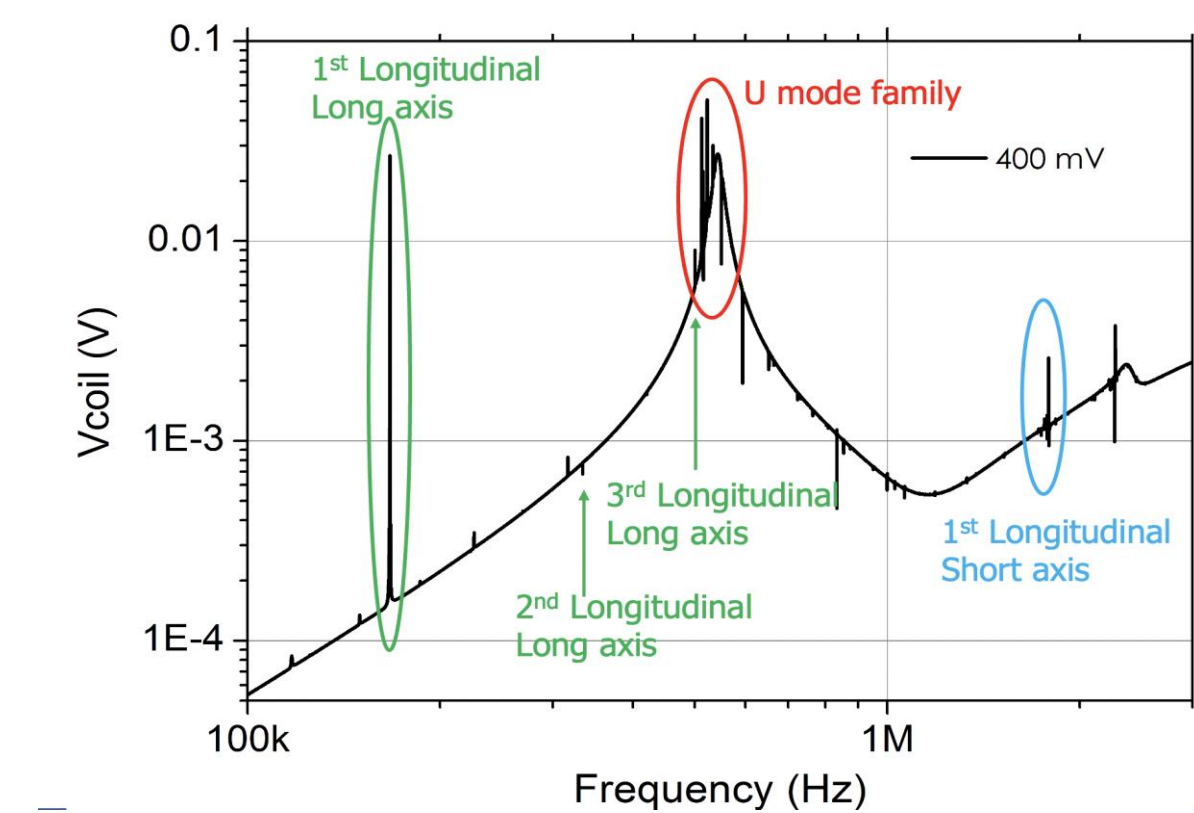
WP4 MEMS process

- 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 transvers 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€