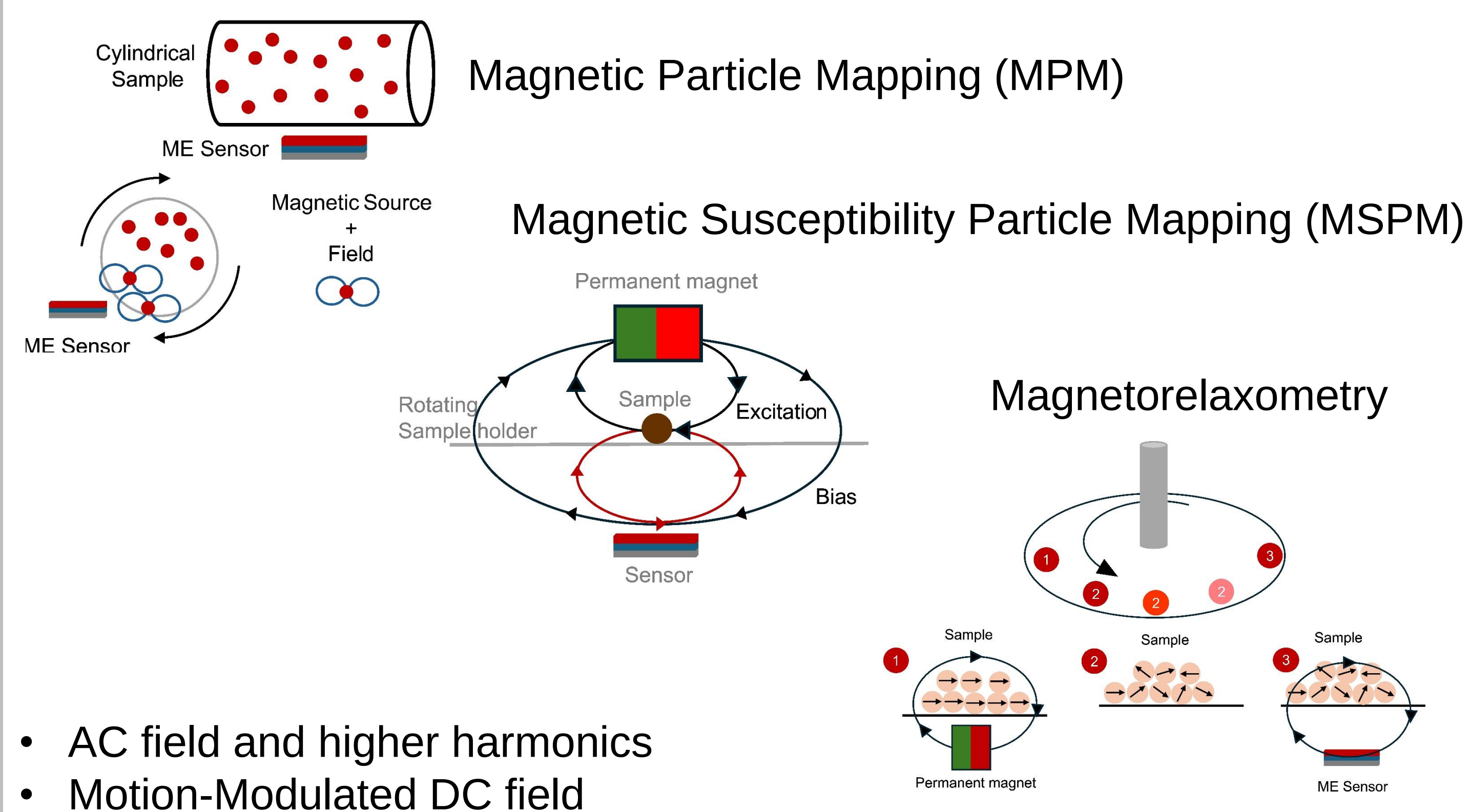


Objectives and Original Planning

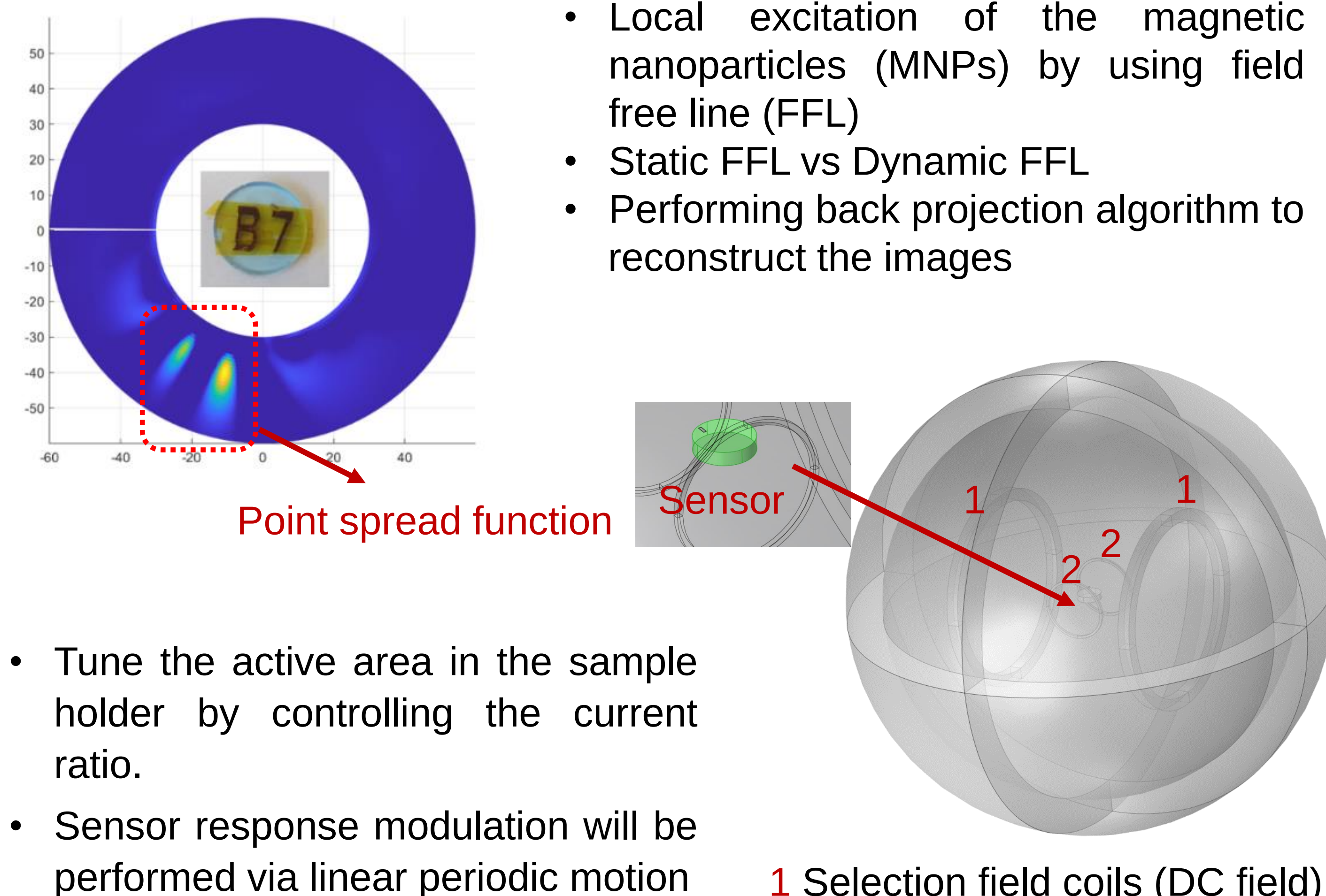
To investigate magnetoelectric sensors, developed in the CRC 1261, for the detection of living cells which are tagged with magnetic micro- or nanoparticles



- AC field and higher harmonics
- Motion-Modulated DC field
- Magnetic particles inside cells vs freely moving particles

Research Plan Changes

From the concepts of motion modulation and field free line to device design

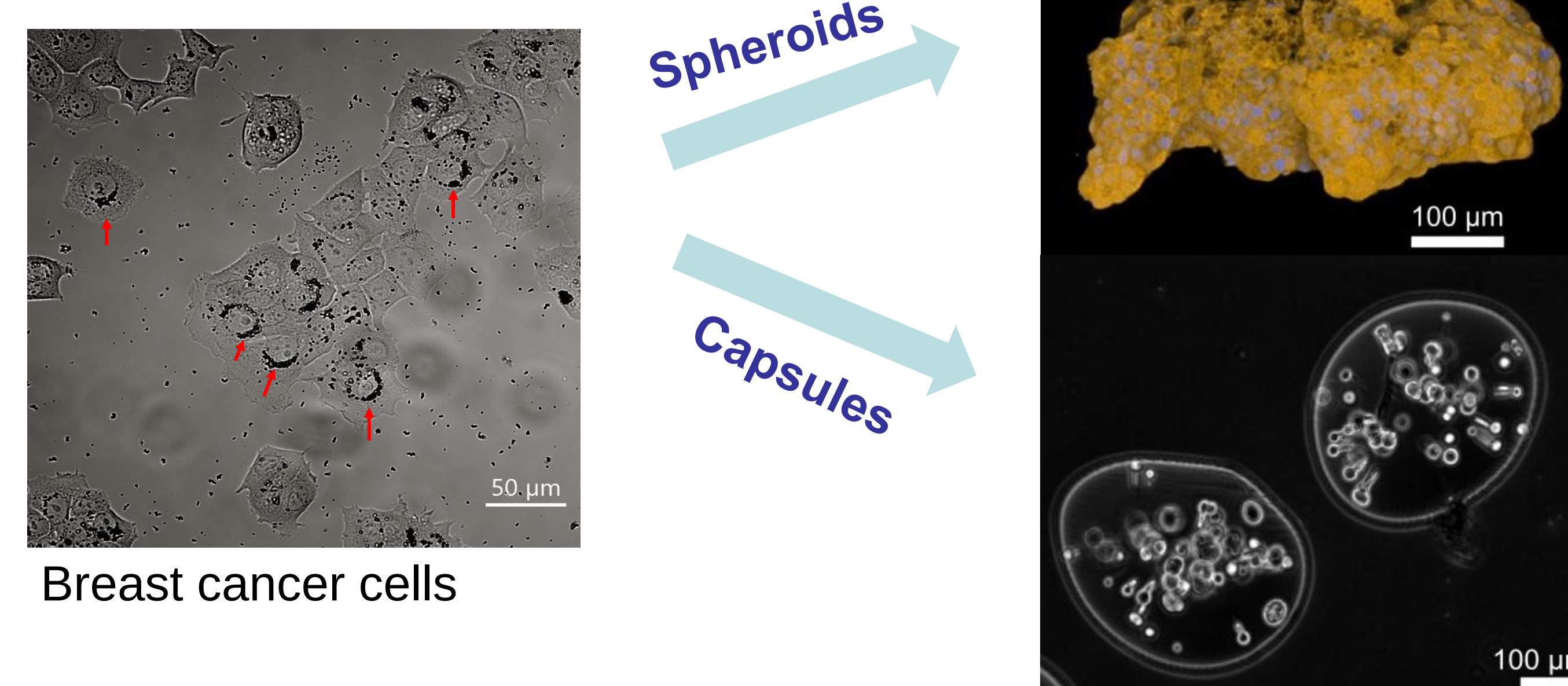


- Tune the active area in the sample holder by controlling the current ratio.
- Sensor response modulation will be performed via linear periodic motion

- Selection field coils (DC field)
- Driving field coils (AC/DC field)

Artificial tumors like phantoms

Magnetic particles are uptaken and stored by cells

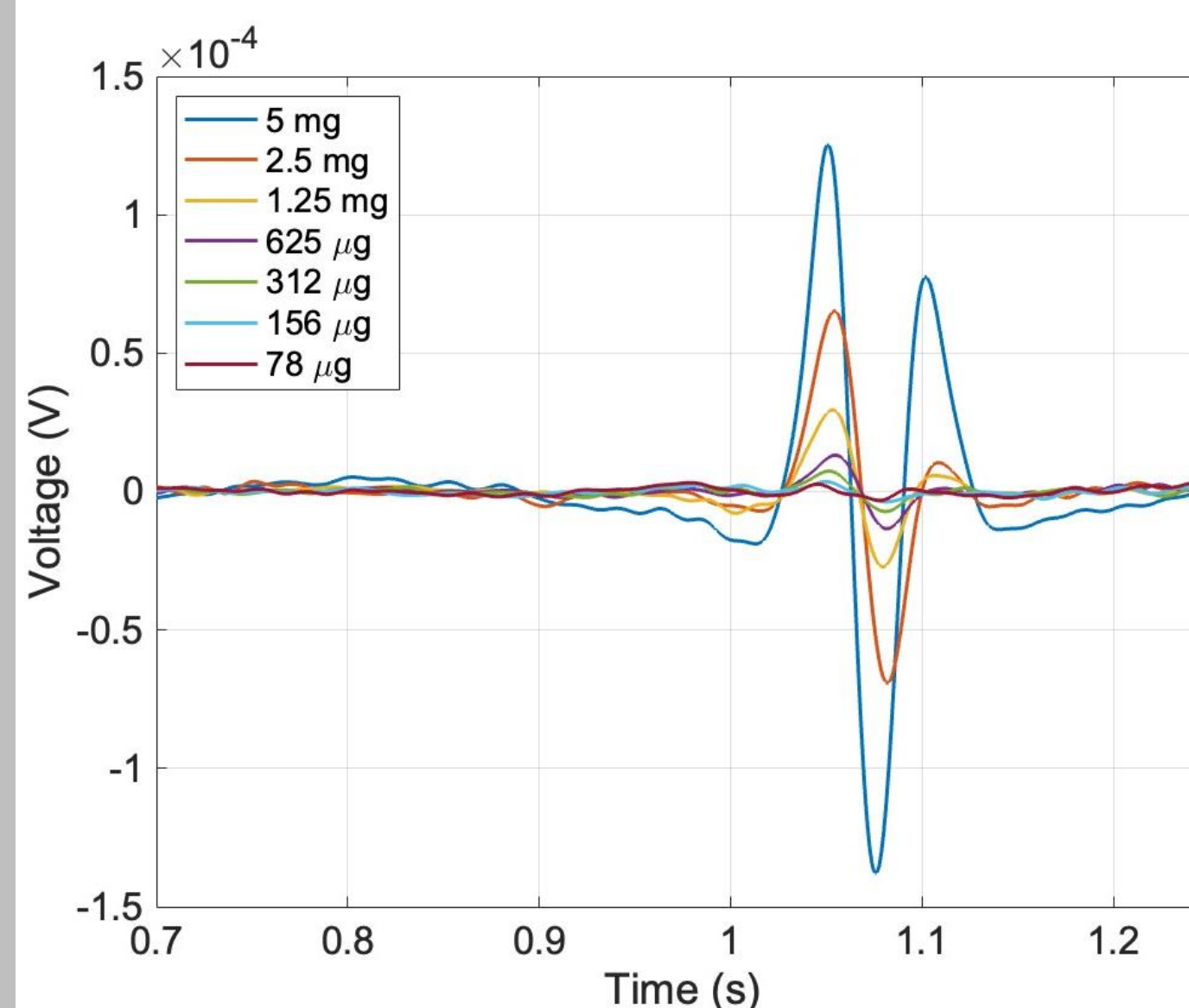


- 3D biological models mimic better the natural architecture and function of vivo tumors.
- A method to generate tumors like capsules was patented by Ruprecht-Karls-Universität Heidelberg, Germany. Application No. EP23207537.4
- A higher density of magnetically labeled cells can be confined in smaller volumes to reach the L.O.D. of our magneto-electric sensors

Results

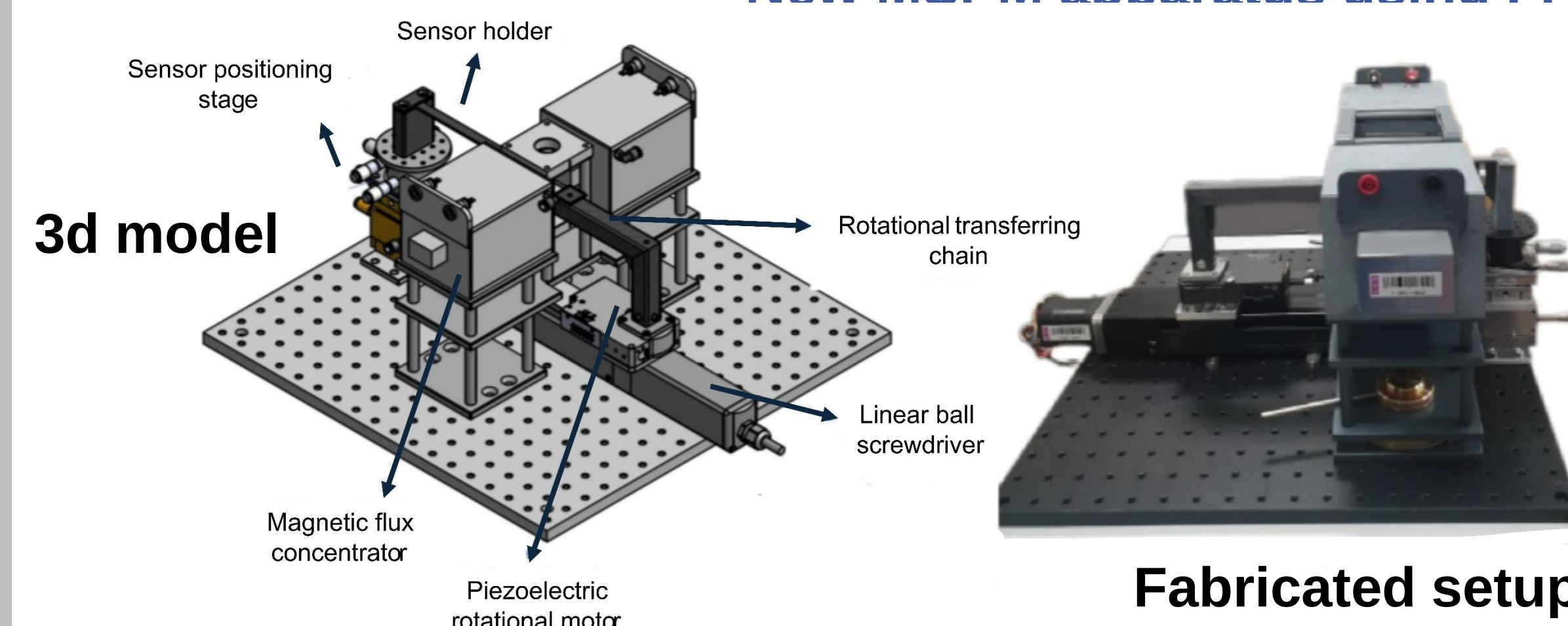
Research methods

Signal of magnetic particles detected by the MSPM device



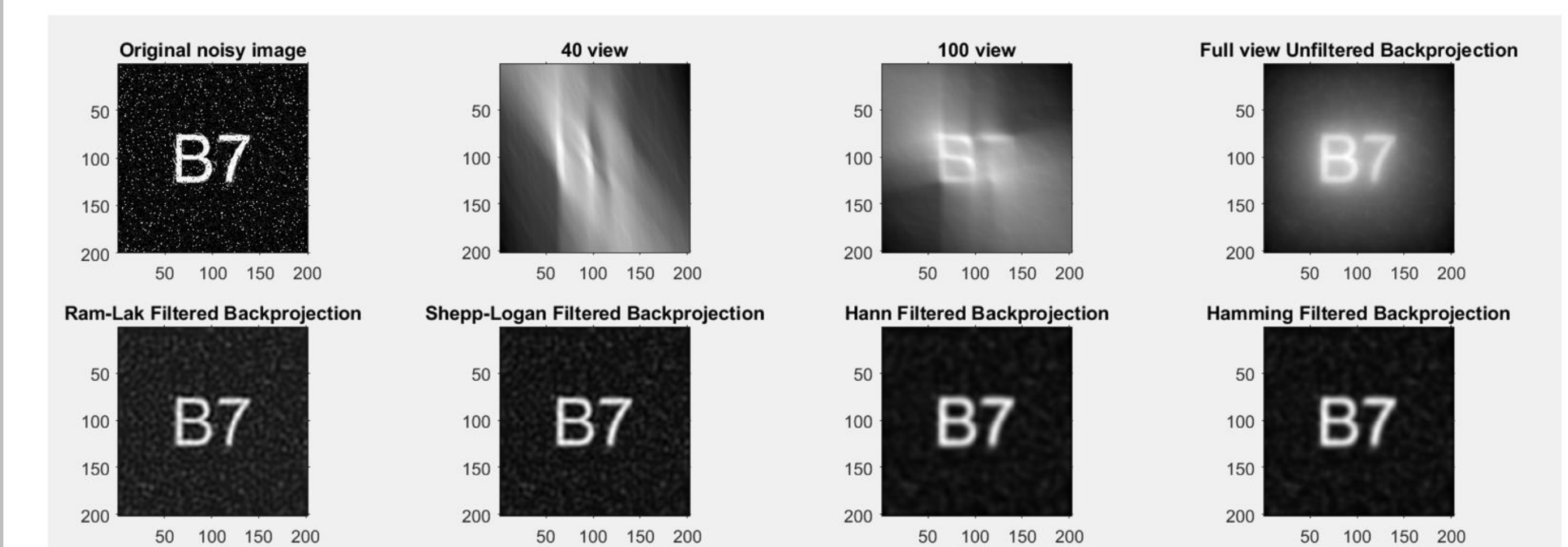
- As the system faces challenges in accurately detecting 2D shapes at the voxel level a new device was designed.
- The new device aims to concentrate the excitation field onto a target area, mitigating the point spread function issues

New MSPM apparatus using FFL approach



Back projection method for B7 ground truth

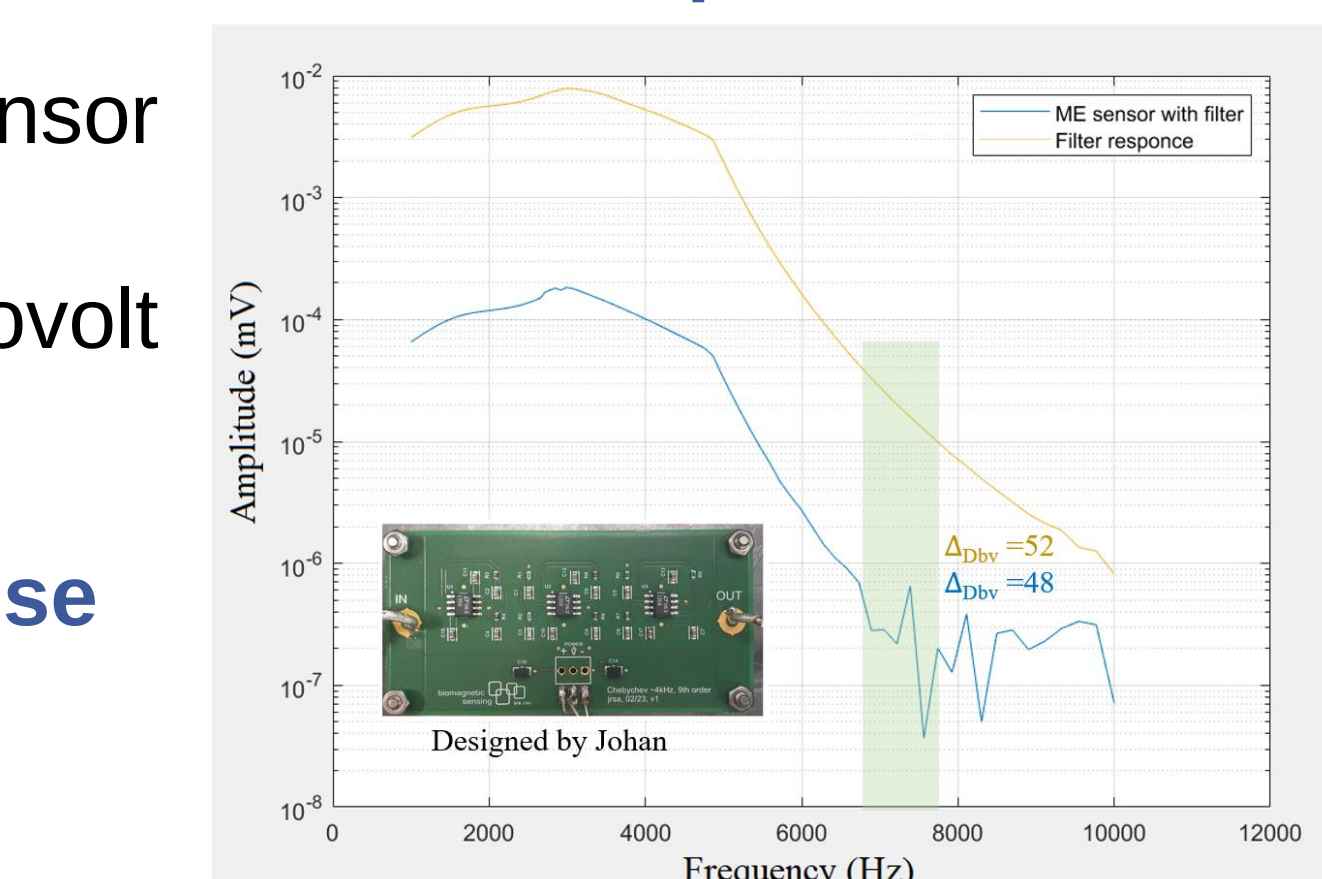
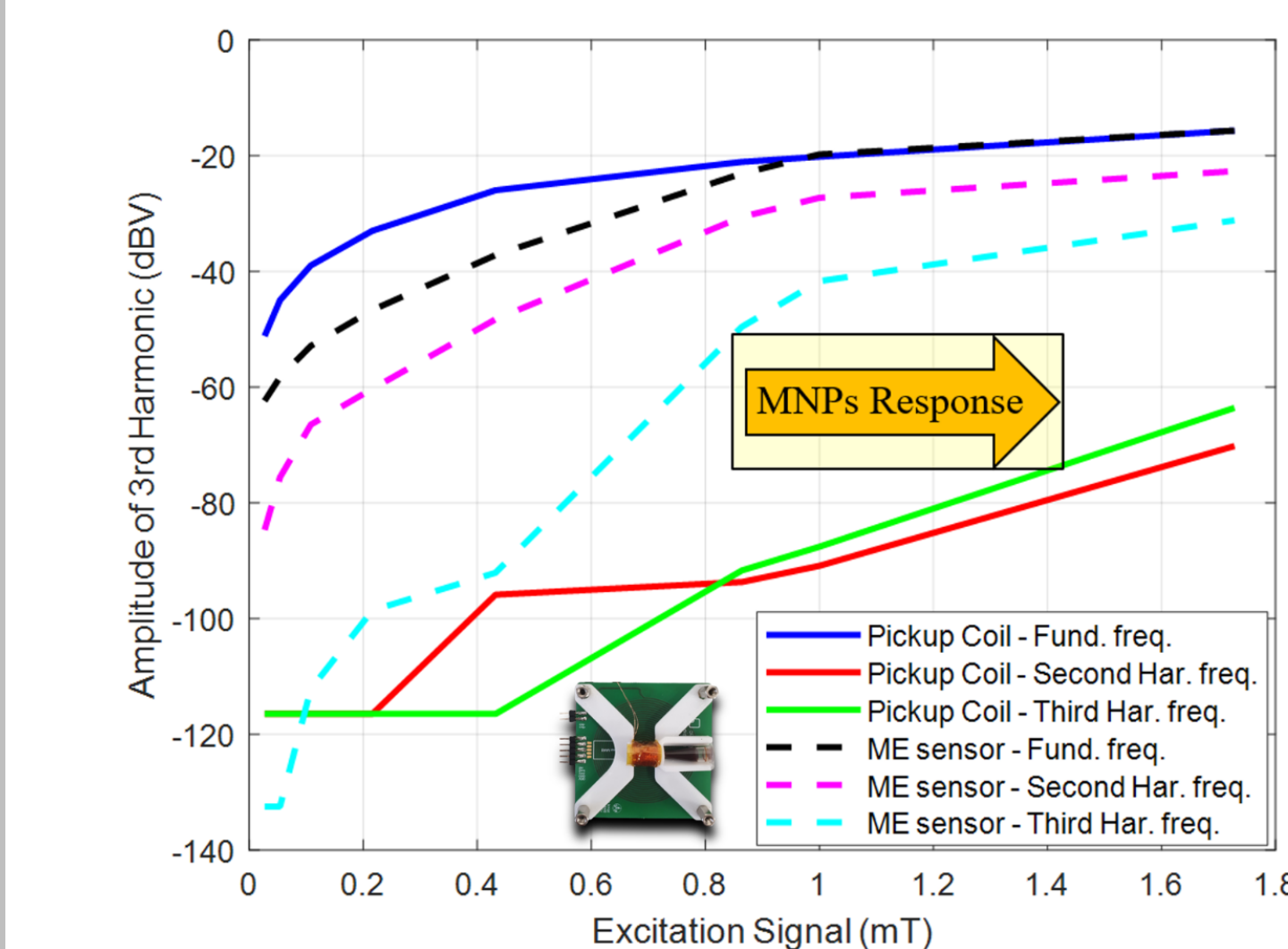
- The iterative filtered back projection via inverse optimization algorithm can improve the resolution of the reconstructed image



Pre-filtering of the signal source with 9th order low pass filter

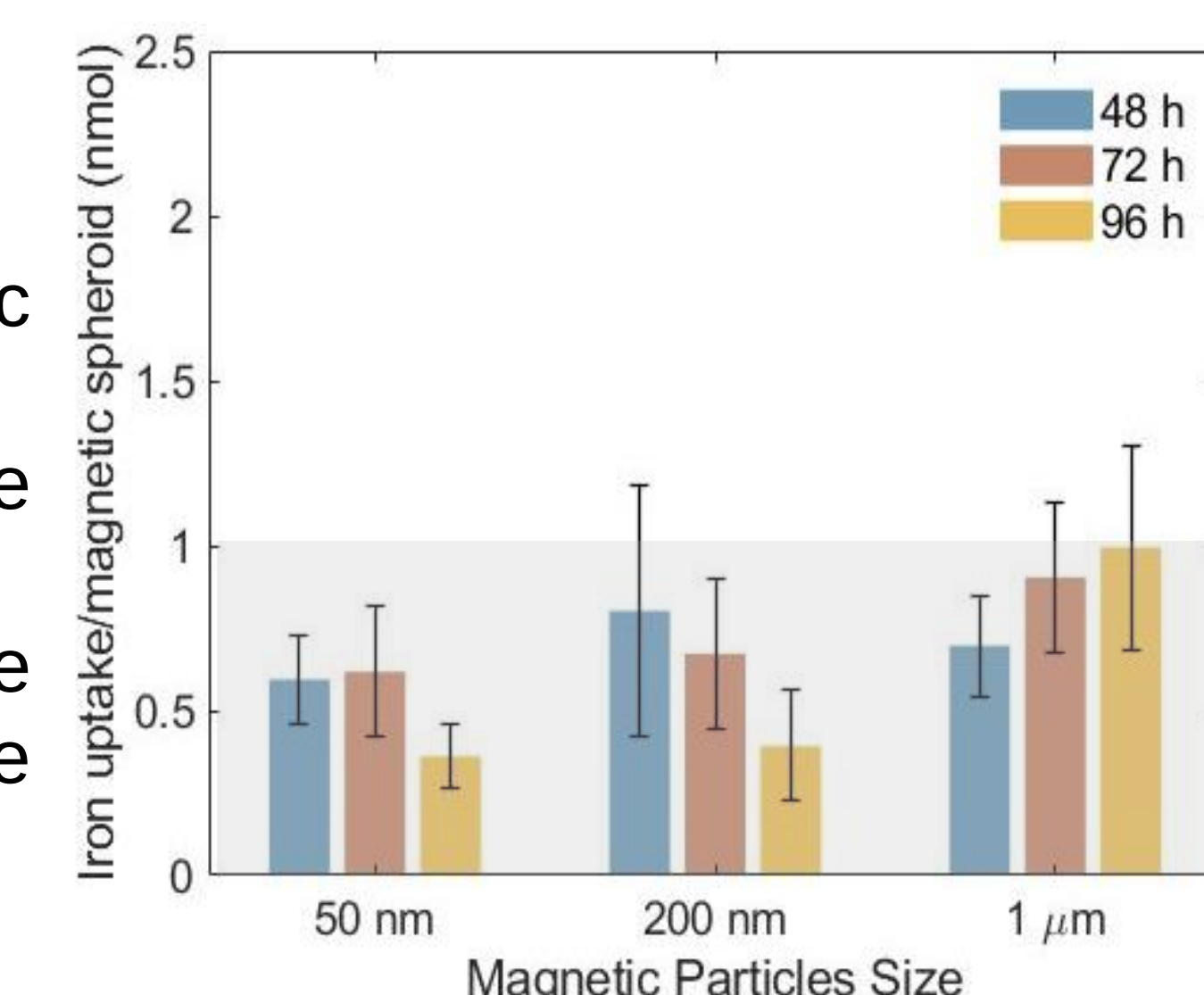
- The quality factor of the sensor amplifies the harmonic response
- Filter performance in the microvolt range

Sensor and pick up coil response without nanoparticles



- Source nonlinearity covers the third harmonic response of particles
- The pick-up coil does not exacerbate the nonlinearity issue

Iron content in spheroids



- Co-incubation of cells with magnetic particles
- The iron uptake changes with the size of the particles
- The cut-off iron uptake concentration for most of the magnetic spheroids is 1 nmol

Staff Funded During Second Funding Period

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