Pulsed wire field measurements of 38-period superconducting undulator prototype
There are 3 wire-based methods. All of them are based on the similarity of the interaction of an accelerated charged beam and a conductor with an electric current with a magnetic field. The difference is which kind of current is applied to the wire:

- **DC** *(Displacement of the wire at the ends of the magnetic device are being explored)*
- **AC** *(Resonance vibrations of the wire are being explored)*
- **Pulse** *(A wave that occurs when a short current pulse applied to the wire is being explored)*

In the Pulsed method (PWM), a short (~ 1-100 μs) current pulse, from a unit to tens of amperes, is passed through a wire. Due to the influence of a magnetic field, the wire is deformed, then the resulting deformation propagates along the wire as the acoustic wave. This wave is detected by a wire position sensor located outside the undulator. Data from the sensor directly shows the first or second integral of the field, depending on the pulse duration.
PWM

Advantages:

• Almost no limits on magnetic device aperture. Wire diameter is close to typical beam transverse size (0.1 mm).

• Rapid data obtaining. Measurements can be made every few seconds.

• Both transversal components can be measured simultaneously.

Disadvantages (problems):

• Wave dispersion. Signal is need to be corrected via Fourier analysis.

• Wire is very sensitive to vibrations (incl. sounds) of the environment.

• Wire sagging.
Experimental setup

- Undulator
- Wire
- Pulse generator
- Wire position sensor
Wire position sensor

Diagram showing a wire passing through a slit with a light source and a photodiode.
Test undulator (outside the cryostat)

Parameters:
• Period ≈ 3 cm
• Field amplitude = 0.75 Tesla
• $K \approx 2.2$
Results

[Raw data from wire position sensor, CuBe wire $\phi 200 \mu m$]
Results
[“preparations”, brass wire Ø140 µm]

Calibration curve of wire position sensor
Sensitivity – 0.283 Volts/µm
Results

[Raw data from wire position sensor, brass wire $\phi 140 \, \mu m$]

Wave reflection

30 A
10 µs

30 A
100 µs
Results
[reconstructed, brass wire $\varnothing 140 \, \mu m$, 30 A 10 $\mu s$ pulse]

![Graph of 60+160 A in SC coils](image1)

![Graph of 160+60 A in SC coils](image2)
Further work

- Find the dependence of wire displacement on field amplitude and integral value
- Obtaining 1\textsuperscript{st} and 2\textsuperscript{nd} field integrals separately from each other

- Wire vibrations (caused by environment) suppressing:
Thank you for attention!

Note: This paper is based on my bachelor diploma work and will be continued