PSI Center for Neutron and Muon Sciences

ETH zürich

Kicker System for Muon Storage Tests in 2025

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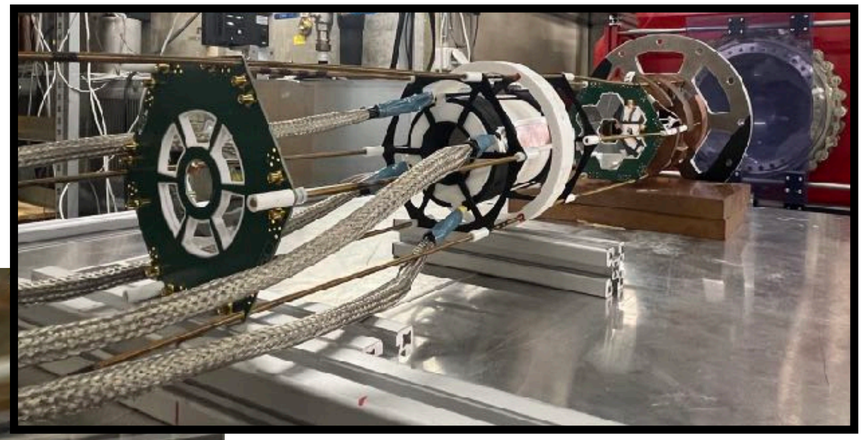
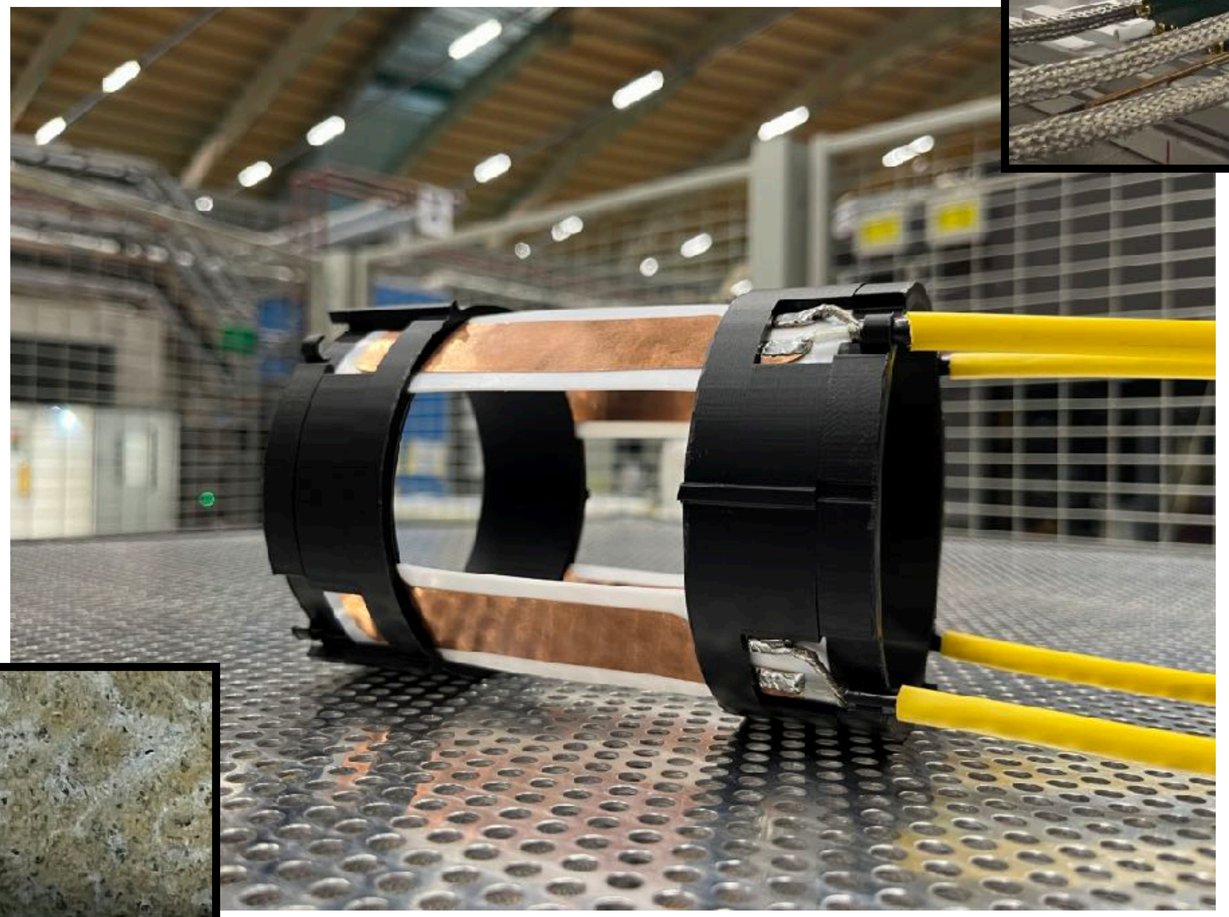
BVR 2025 - muEDM Review

Kicker Coil

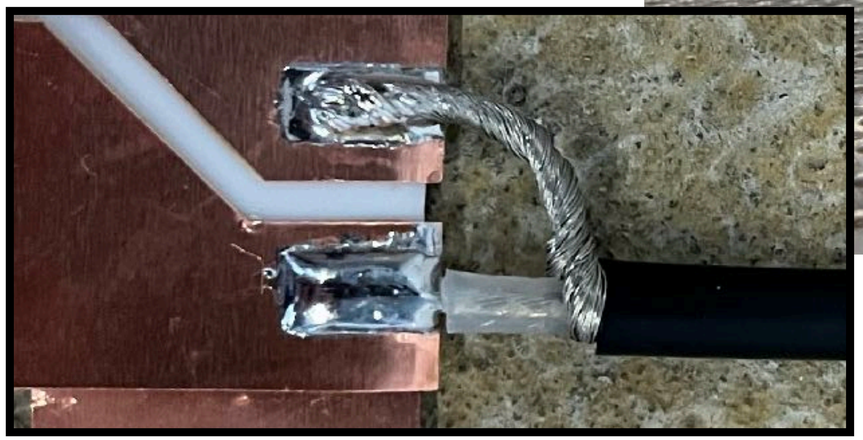
Support structure prototype implemented for Sept beamtime, with work ongoing to optimise for minimum thickness.





Sept beamtime established that a grounded braid around each of the coaxial cables significantly shields the detectors from the kicker pulse.

Central and outer conductors of the coaxial cables are both used to transmit current.

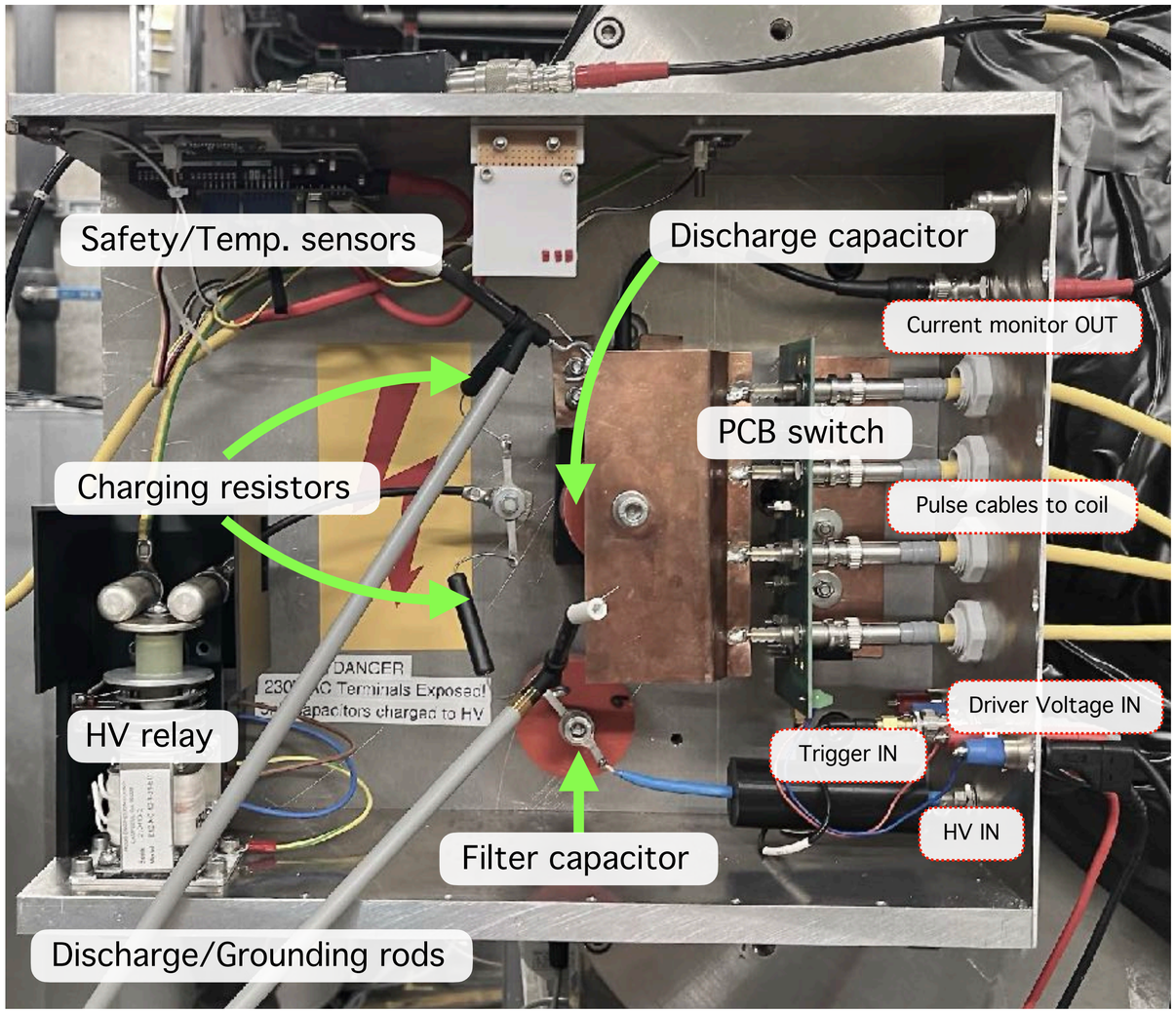


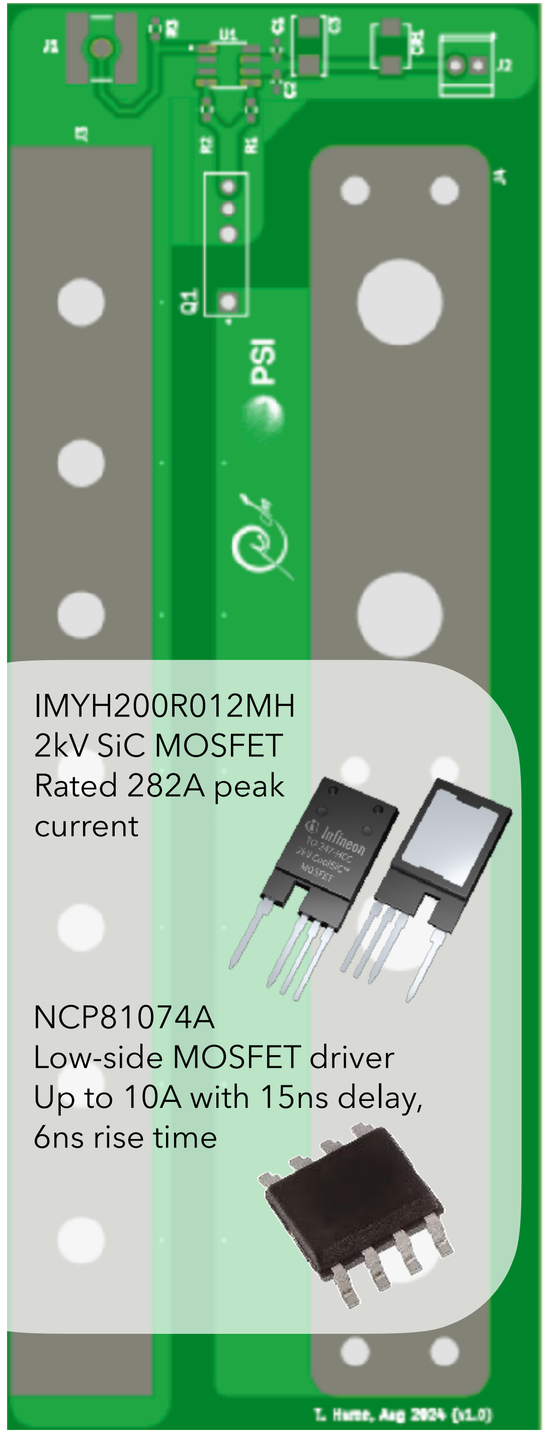
Pulse Generator Design (Sept. 2024)

A pulse generator was developed at PSI for the Sept 2024 testbeam.

The pulse was generated by discharge of a 5nF capacitor over the kicker coil with a low-side switch.

- Peak current 32A/quadrant
- Osc. frequency 6MHz
- Osc. damped $\tau \sim 500\,\mathrm{ns}$
- Operating voltage 1.5kV



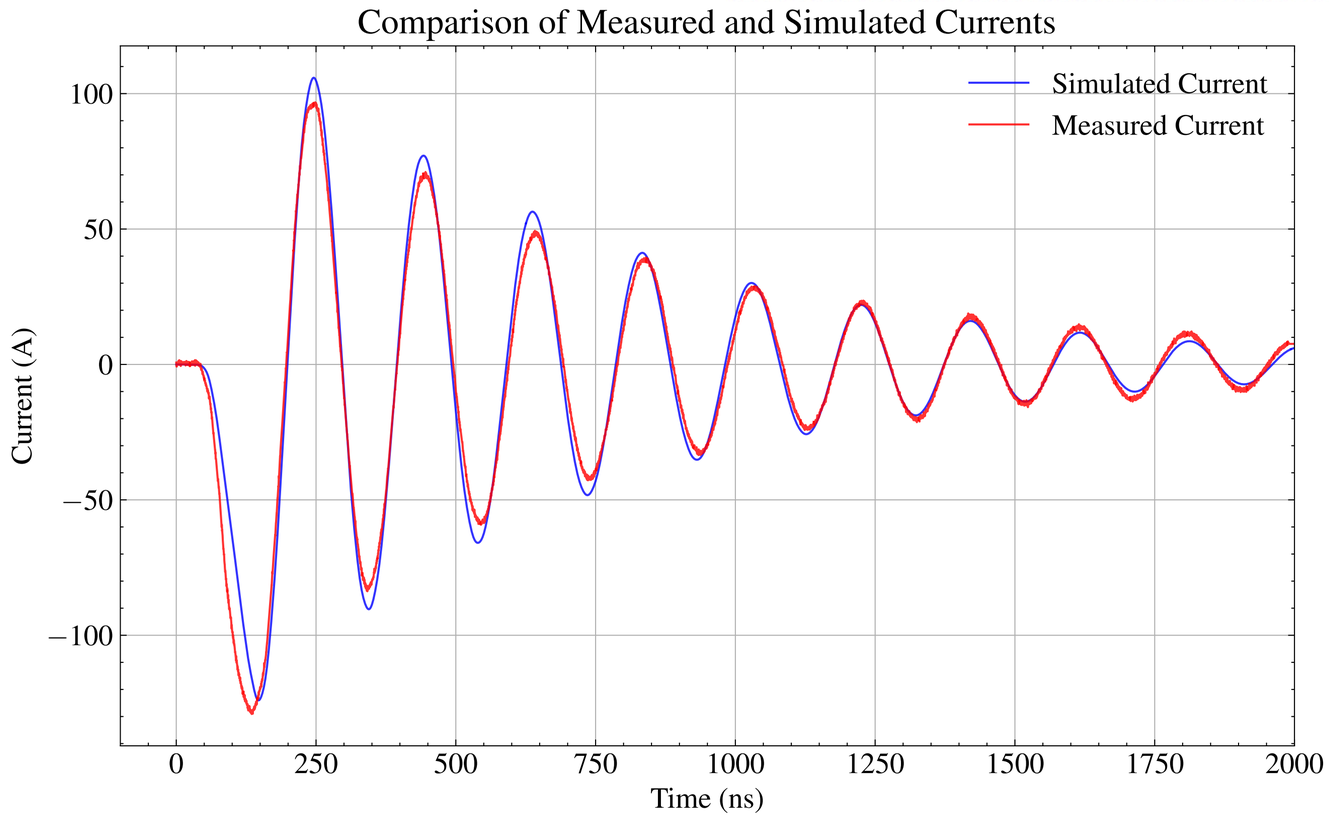


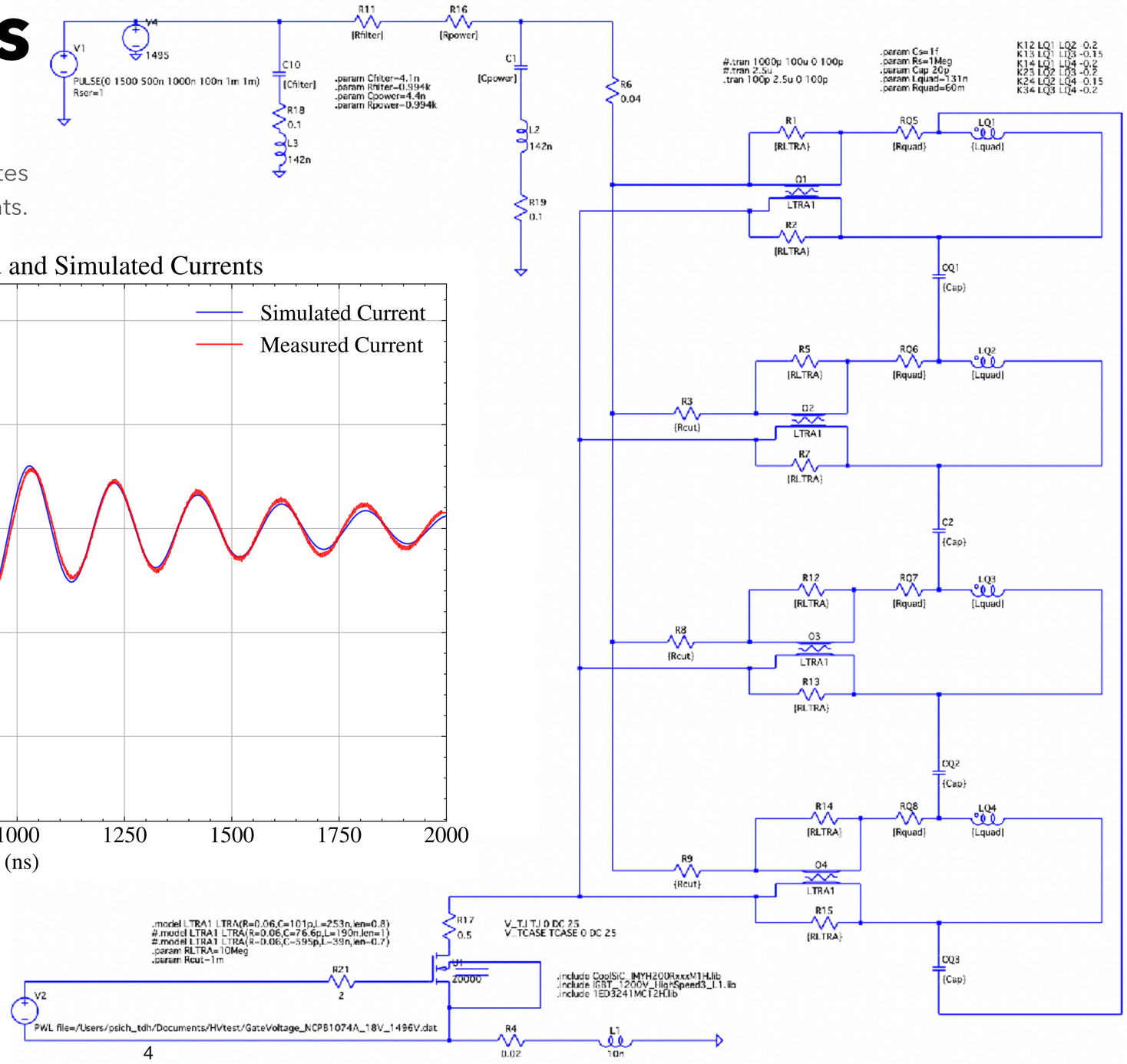
IMYH200R012MH
2kV SiC MOSFET
Rated 282A peak current

NCP81074A
Low-side MOSFET driver
Up to 10A with 15ns delay, 6ns rise time

Optimised Simulations

A simulation of the current pulser setup (5nF discharge into all four coil quadrants in parallel) is well matched by simulation incorporating estimates of stray components and deriving gate-supply voltage from measurements.

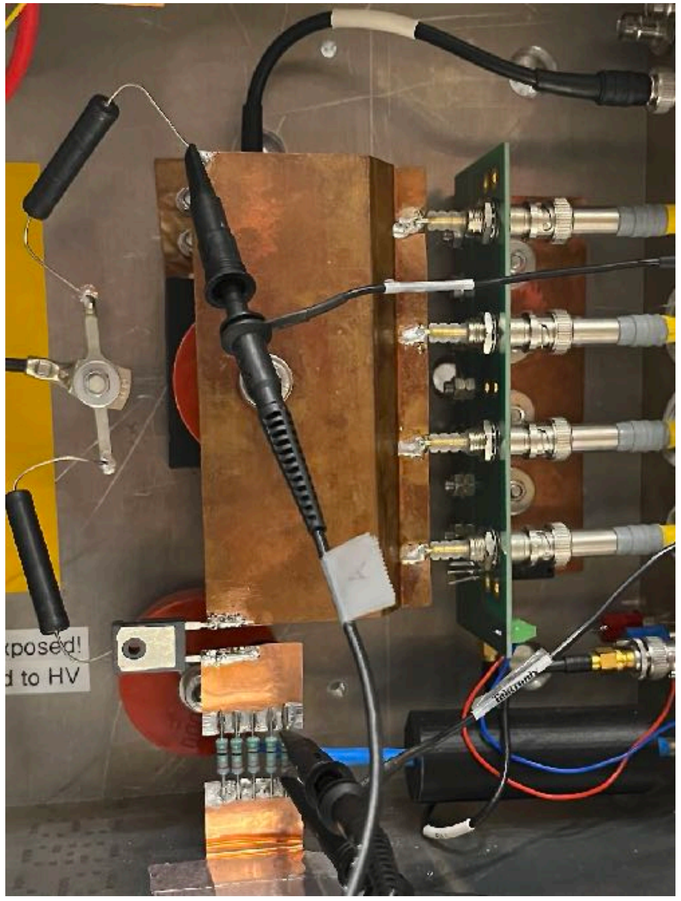


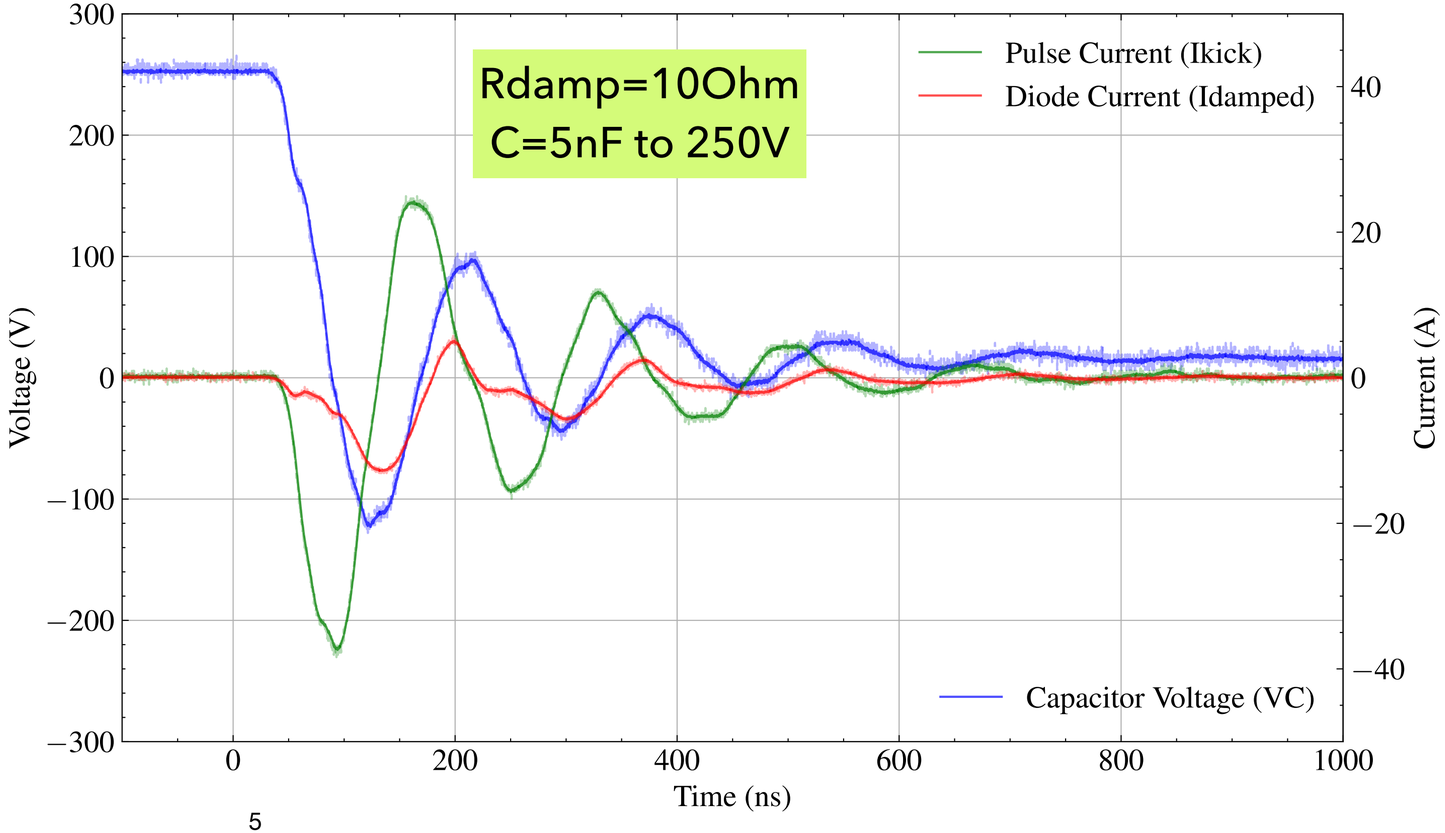


Adaptation for damped pulse

GC50MPS33H
3.3kV 40A SiC Schottky diode
SiC offers:
- low capacitive charge for fast switching
- low reverse recovery current for speed & heat efficiency

Additional damping will generate a pulse shape suitable for muon storage tests in 2025, where oscillations close to the frequency of the longitudinal betatron oscillation are permissible.





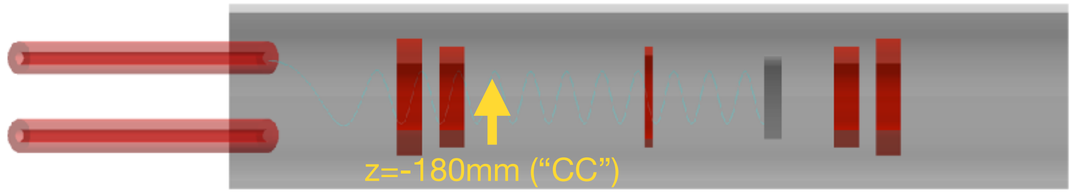
Acceptance Map

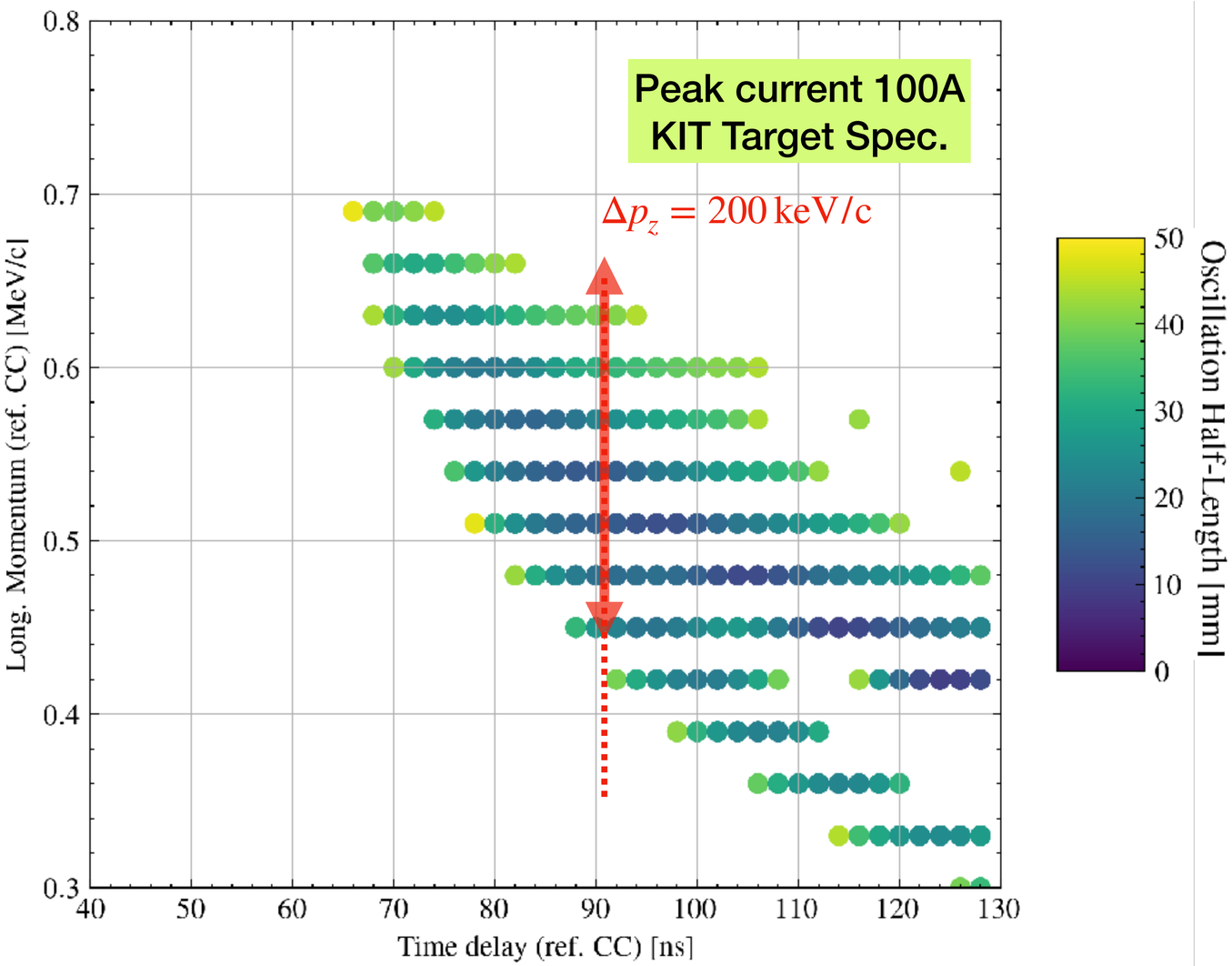
Muons injected near the exit of the correction coils (CC) are plotted on the acceptance map if they are stored for given input parameters:

- longitudinal momentum
- time delay

The colour indicates the half-length of the oscillation in the weakly-focusing field.

The time of the pulse must be fixed, therefore must be chosen for maximum acceptance of the momentum distribution.





Matching with betatron oscillation

The pulse width can be matched to the longitudinal betatron oscillation in the weakly focusing storage field.

When the muon turns around, the pulse gives the opposite amplitude to further reduce the remaining longitudinal momentum.