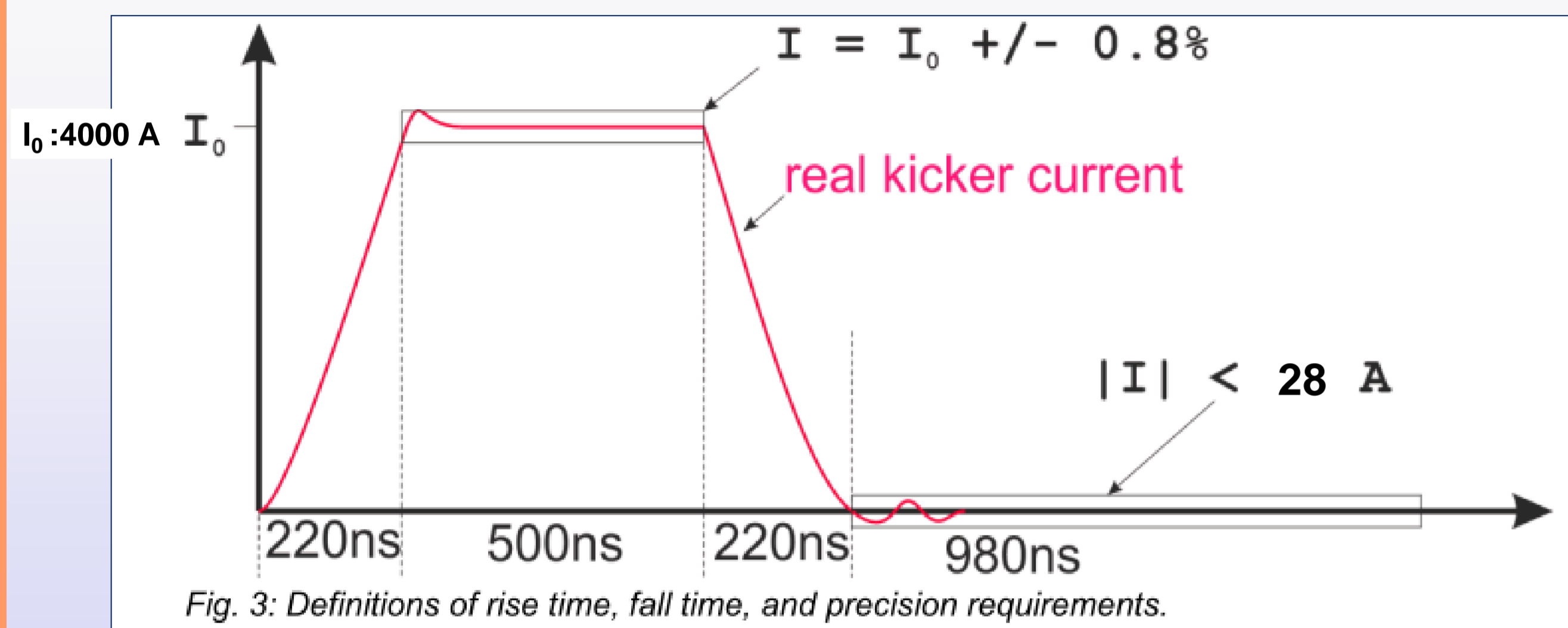


ABSTRACT

The High Energy Storage Ring (HESR) for Antiprotons is going to be built at FAIR in Darmstadt on the extended GSI campus. Charged particles (including protons and antiprotons) of 13 Tm magnetic rigidity will be injected into this synchrotron and storage ring. The injection system of the HESR ring is based on 4 UHV 360 mm long ferrite kickers, each kicker having to generate a 25 T.mm integral field, during 500 ns, with rise time and fall time lower than 220 ns. Each kicker is supplied by a 4000A / 40 kV pulser, based on Blumlein topology, with semi-conductor switches. A prototype of the pulser, using water lines instead of conventional coaxial cables, has been developed to feed the UHV kicker. Electric and magnetic measurements are presented, as well as magnetic transient modelling.

HESR SPECIFICATIONS



- Jitter (std deviation) : < 5 ns
- Ripple after pulse : +/- 28 A
- Repetition rate: 0,1 Hz

CONCEPT

Pulser topology

- Blumlein structure
- No transmission line
- Solid state switches (IGBT) and SiC diodes

Advantages

- Voltage divided by two compared to single forming line
- Best compromise between rise time, amplitude and constraints on HV switch

Drawbacks

- Improved reliability
- Forming lines doubled, but no need for transmission line
- More complex than single forming line

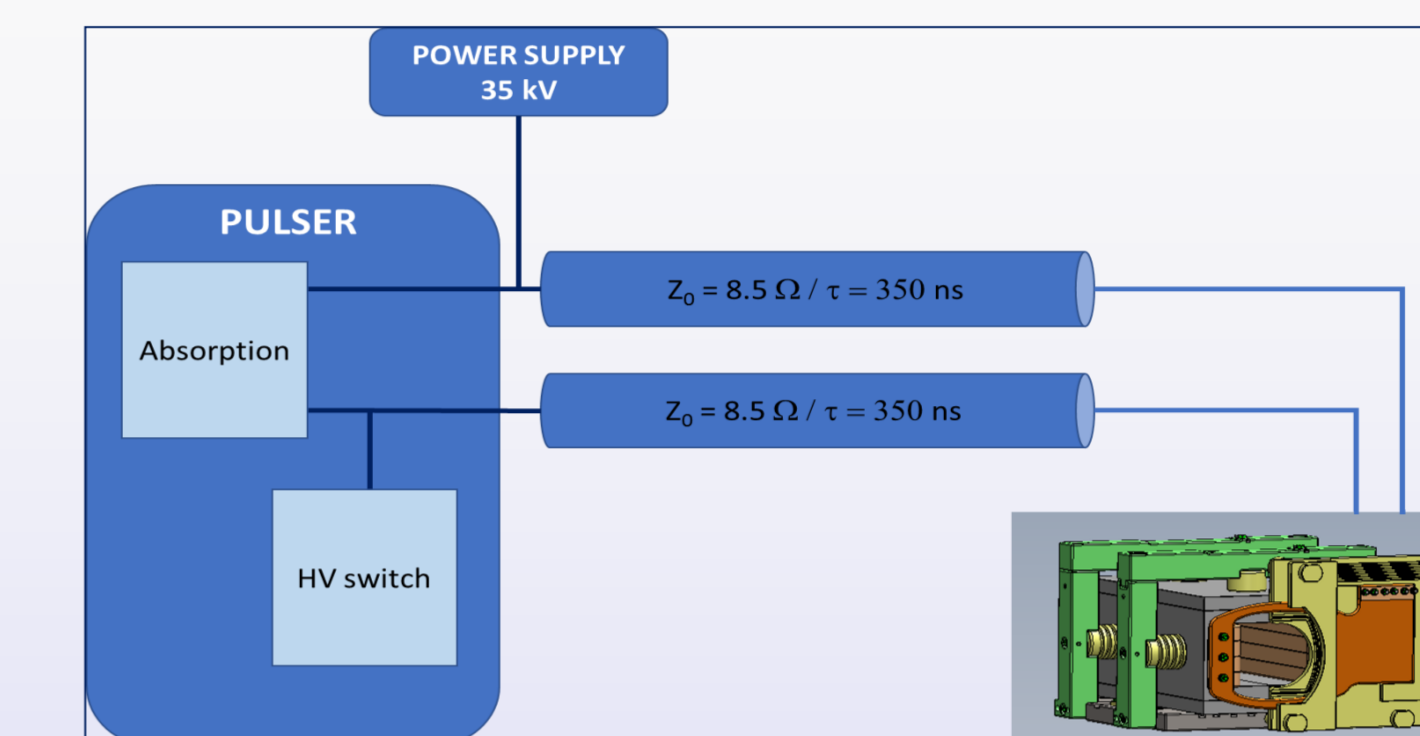
Kicker magnet

- Single turn ferrite kicker
- UHV environment
- Bakeable at 250 °C
- Four kickers in line / two kickers per chamber
- Polarity reversal on each kicker

UHV Chamber

- UHV environment
- Bakeable at 250 °C, bakeout system integrated
- Two chambers, designed and supplied by JÜLICH

PULSER DESIGN



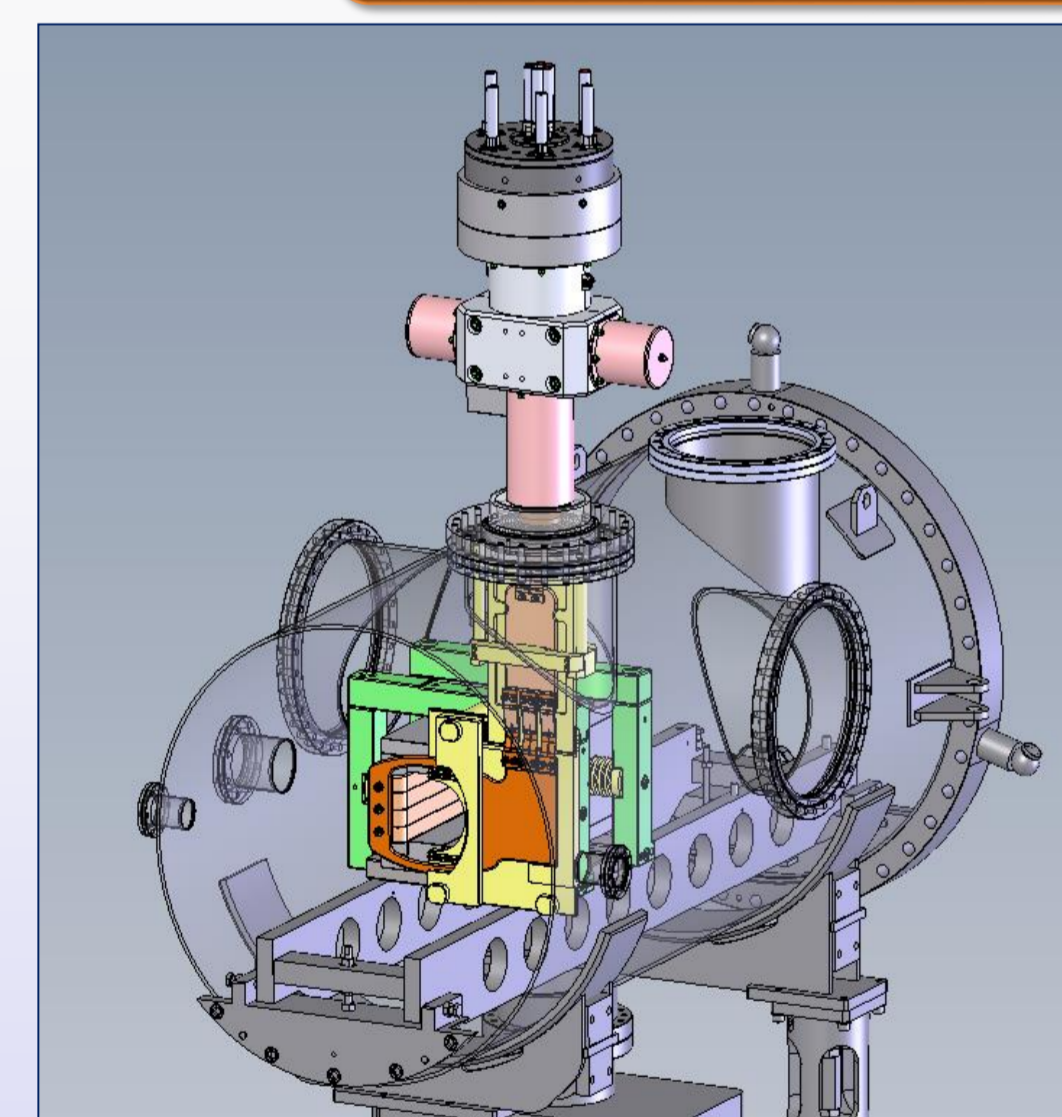
Structure of the pulser

- Nominal current : 4 kA
- Nominal voltage : 36 kV
- Line impedance : 8.5 Ohm

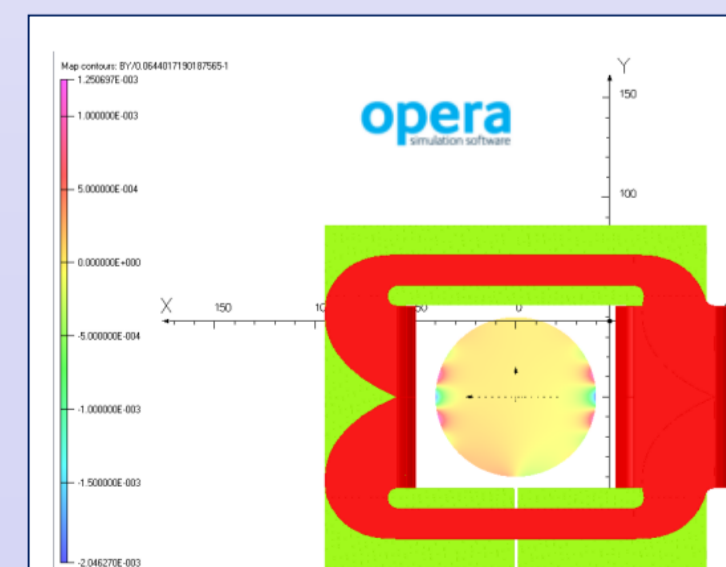
Spice simulation of the system at 4350 A



KICKER DESIGN



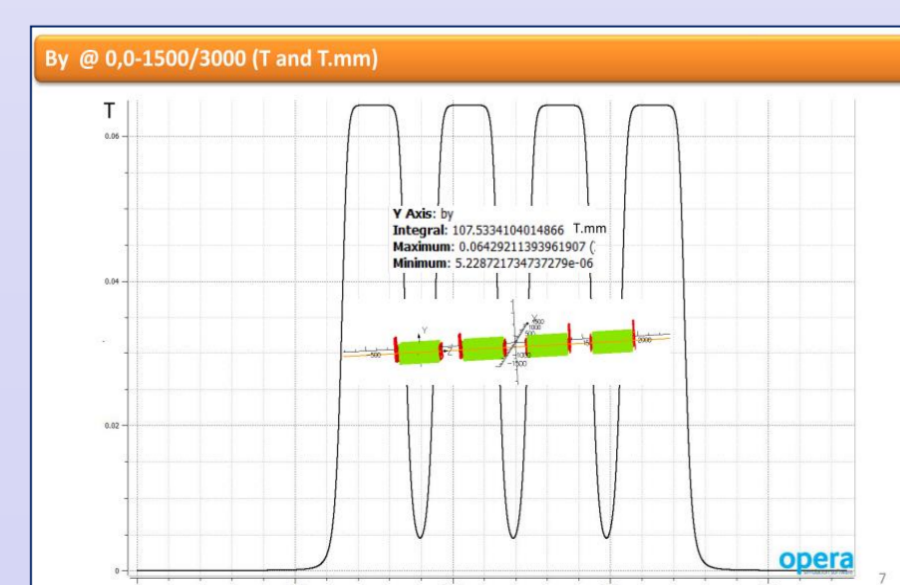
Homogeneity optimization on 40 mm radius GFR



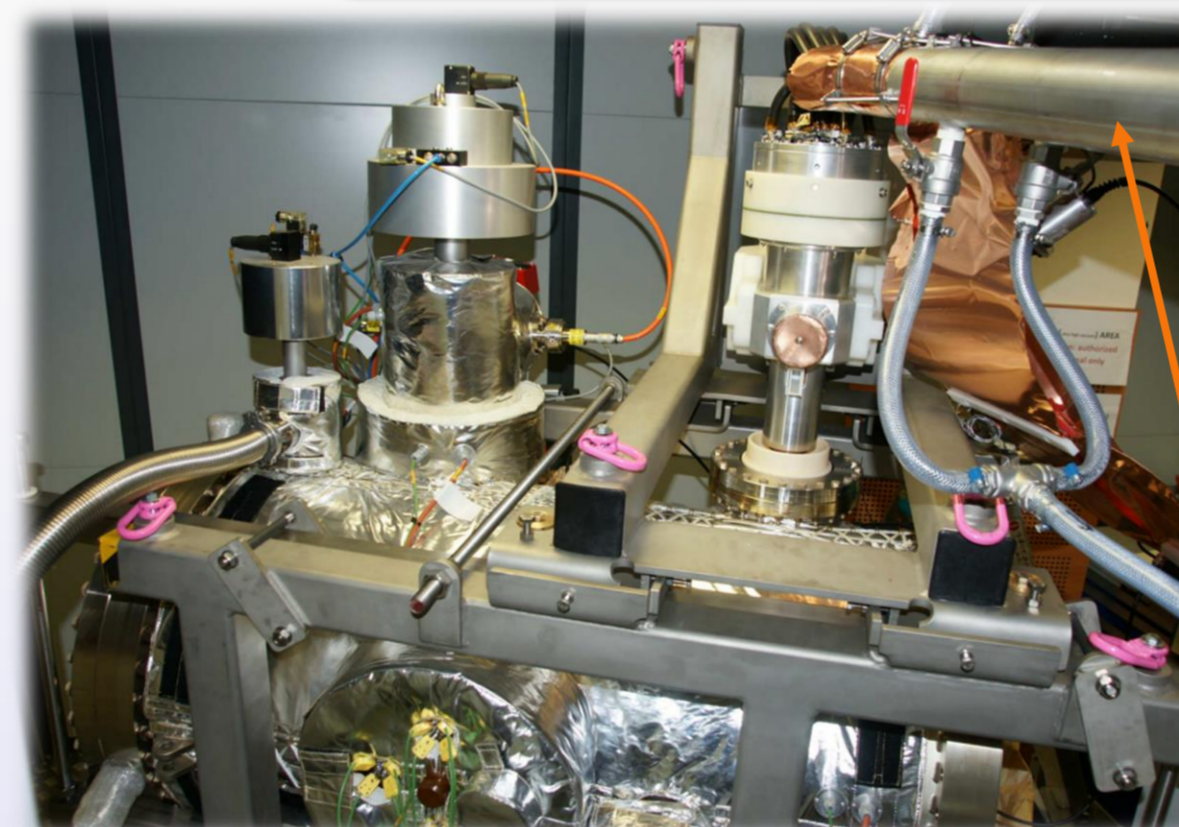
Kicker parameters

- Yoke length : 360 mm
- Gap: 92 mm
- Global field integral (4 kickers) : 98 T.mm
- Field integral quality : +/-0.75%
- Inductance per kicker : 700 nH
- Ferrite type : CMD5005

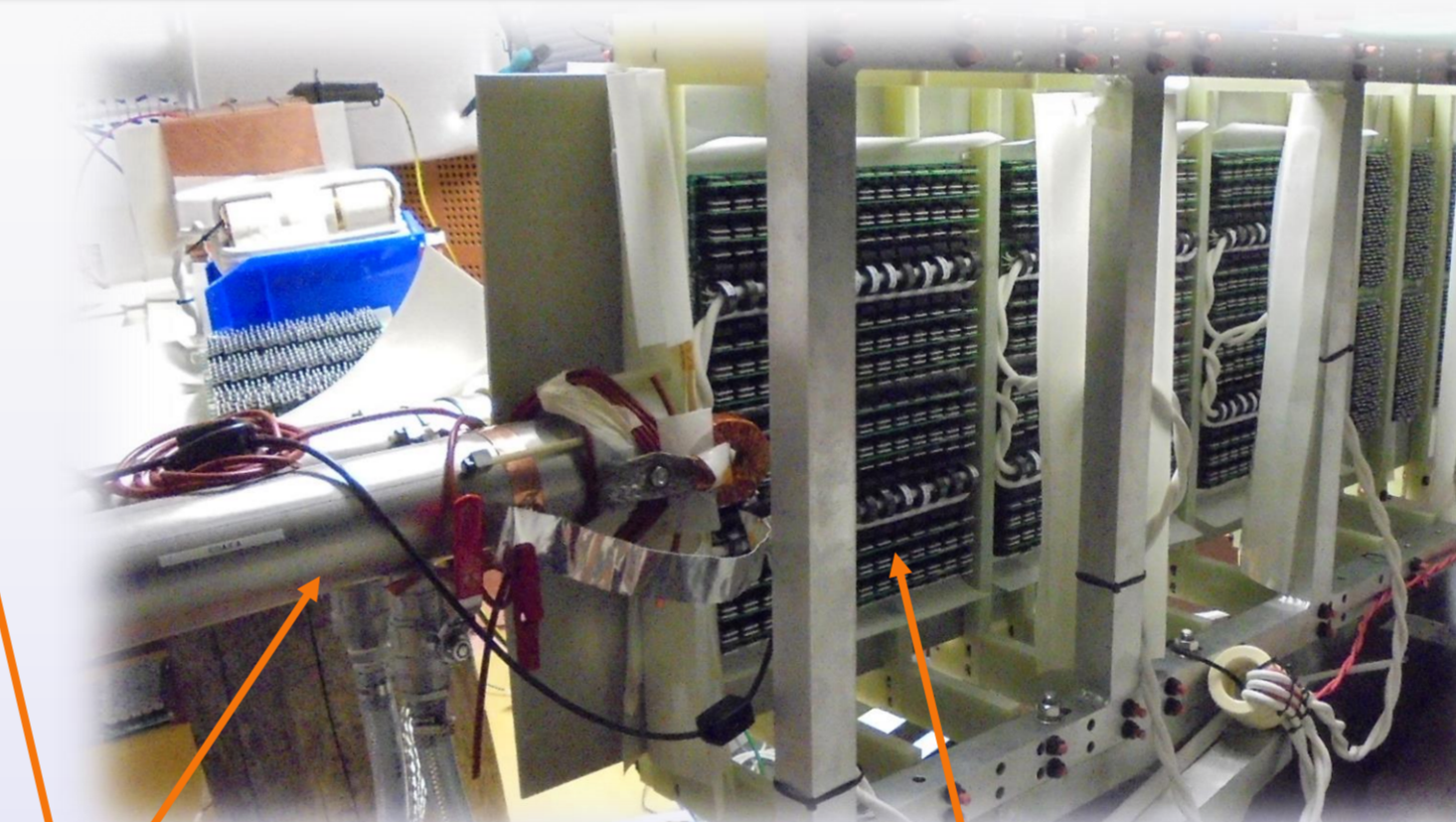
Global field of the four kickers



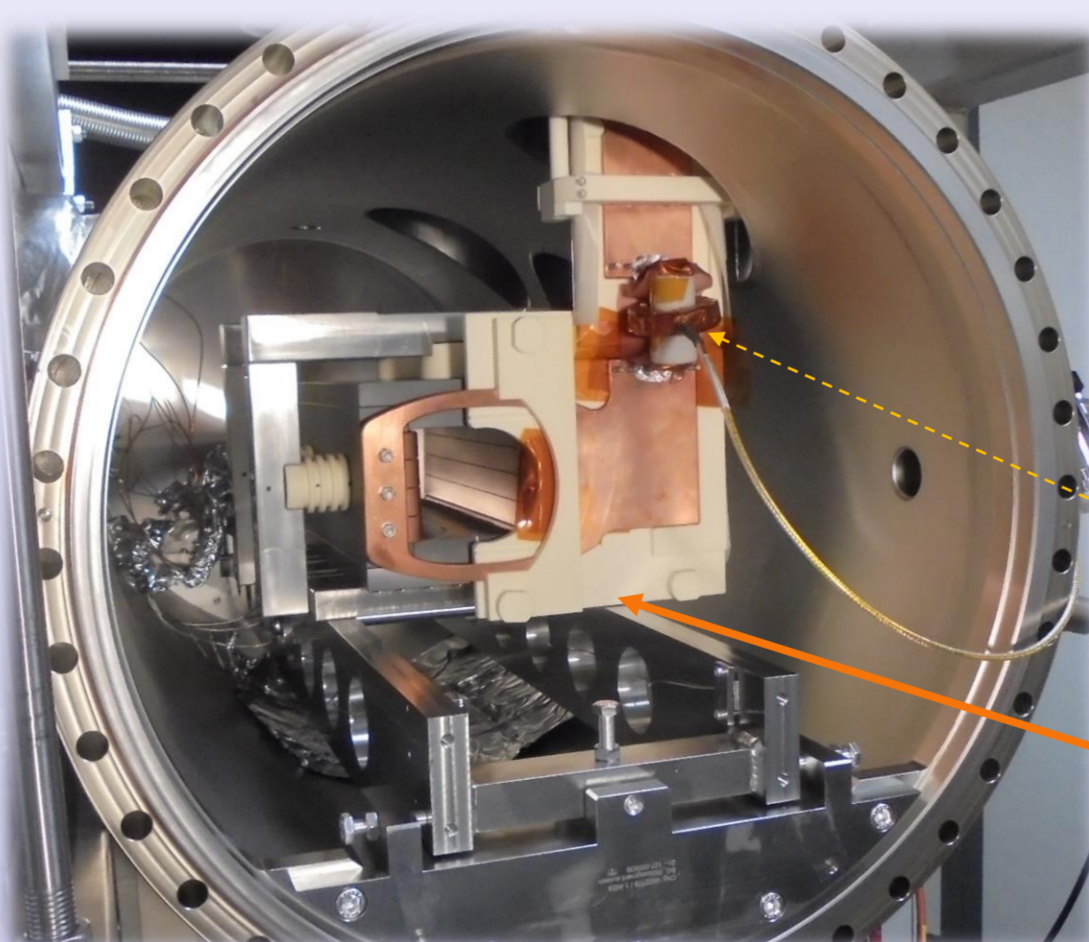
PROTOTYPE



WATER LINES BLUMLEIN
7.5 meters length
Ultra pure water generator



PULSER
Composed of 6 HV switch cards
in matrix, and SiC diodes

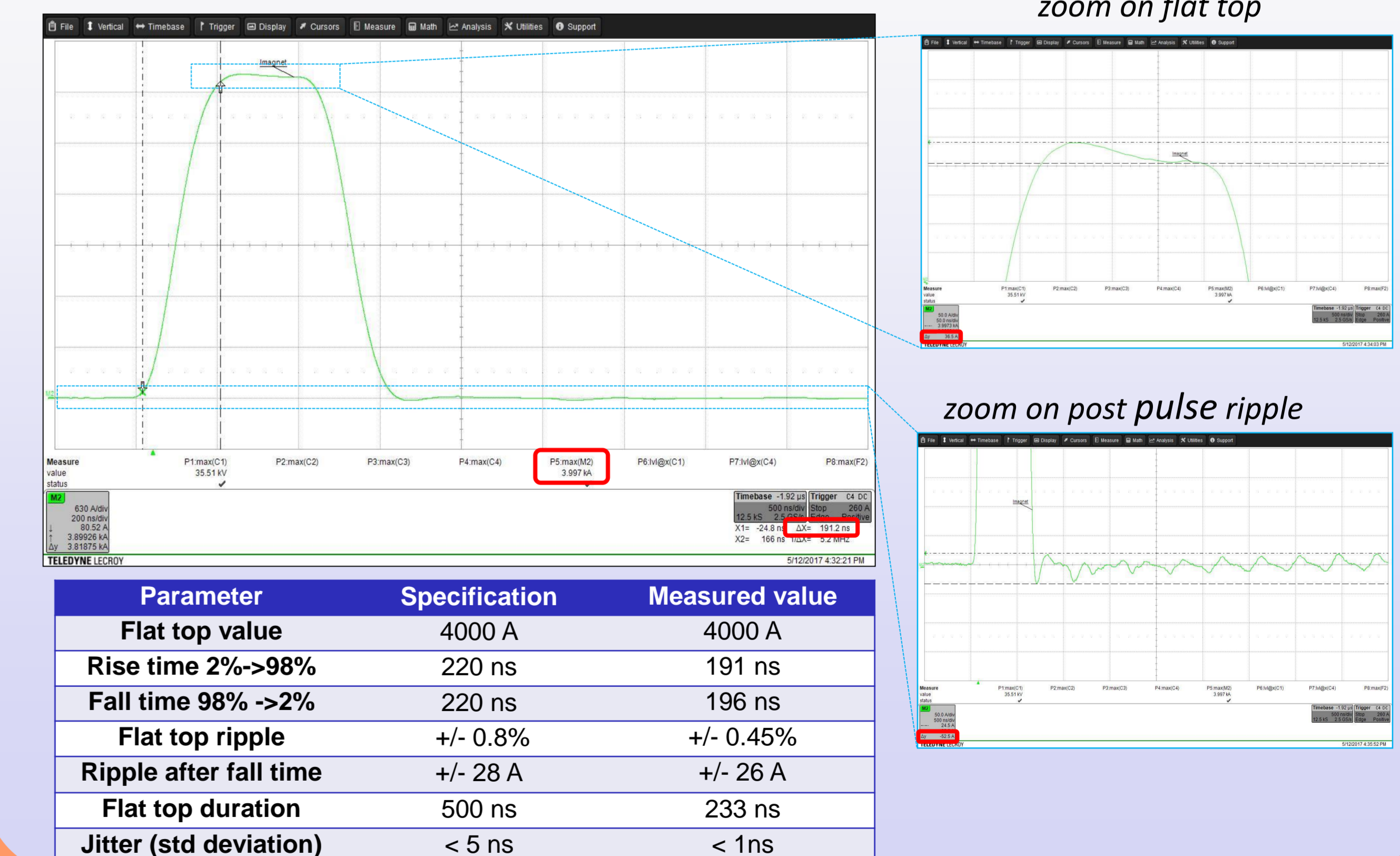


Current sensor
(for tests only)

KICKER IN UHV TANK,
in final configuration

MEASUREMENTS

Measure at 4 kA (100% of nominal current) / 35.5 kV



CONCLUSIONS

Interesting results have been reached at 100% of nominal current on the prototype, the requirements of the system are matched. Further tests will be performed in the next weeks to validate operation in UHV environment. Final configuration will use HV coaxial cables. The measurements confirm the relevance and versatility of this concept. It could be considered for many other pulsed applications.