

Accumulation of a large number of antiprotons and production of an ultra-slow antiproton beam-Ch2 Review

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07.Dec.2018

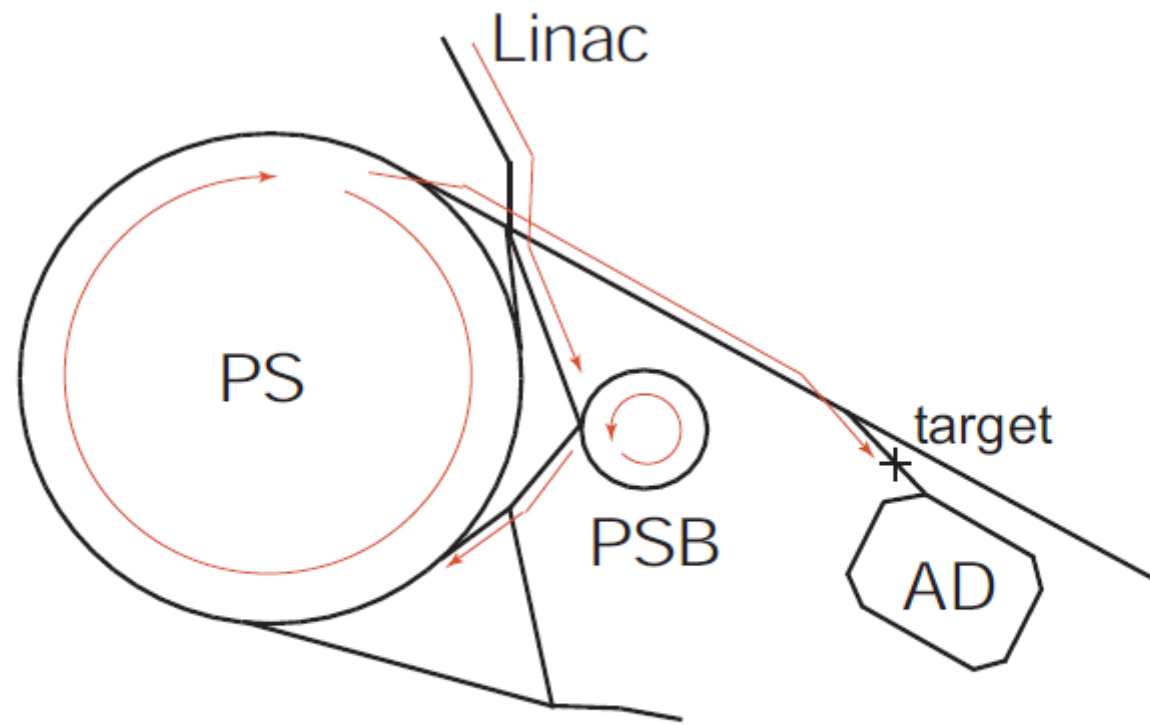


Figure 2.1: The PS-complex at CERN. The proton beams are injected from the Linac to the PS via PSB (PS Booster). The beam accelerated to $26 \text{ GeV}/c$ is incident on the target area and produces antiprotons.

Machine	Antiproton kinetic energy
from target area	2.7 GeV
AD	5 MeV
RFQD	$10\text{--}120 \text{ keV}$
MRT	$< 10 \text{ eV}$
Extraction beam line	$10\text{--}500 \text{ eV}$

Table 2.1: Scheme for production of ultra-slow antiprotons

LEGEND:

#	Designation	Mid-position [mm]	Length [mm]
1	Buncher	0	300
2	Beam transformer	450	~ 400
3	Manual vacuum valve	780	75
4	Wire chamber	1145	404
5	Vacuum chamber (removable)	1920	1360
6	Quadrupole no. 1	3052.5	560
7	Quadrupole no. 2	3692.5	560
8	H/V steerer no. 1	4237.5	350
9	H/V steerer no. 2	4784.5	350
10	Scintillator/watchdog no. 1	5059.5	200
11	Scintillator/watchdog no. 2	5594.5	200
12	UHV vacuum valve	5746	103
13	Energy corrector	5947.5	300
14	RFQ	7857.5	3520
15	Low-energy beam transport (LEBT)	9711.5	188
16	Diagnostics (optional)	10065	150
17	UHV vacuum valve	10191.5	103

0 0.5m 1m

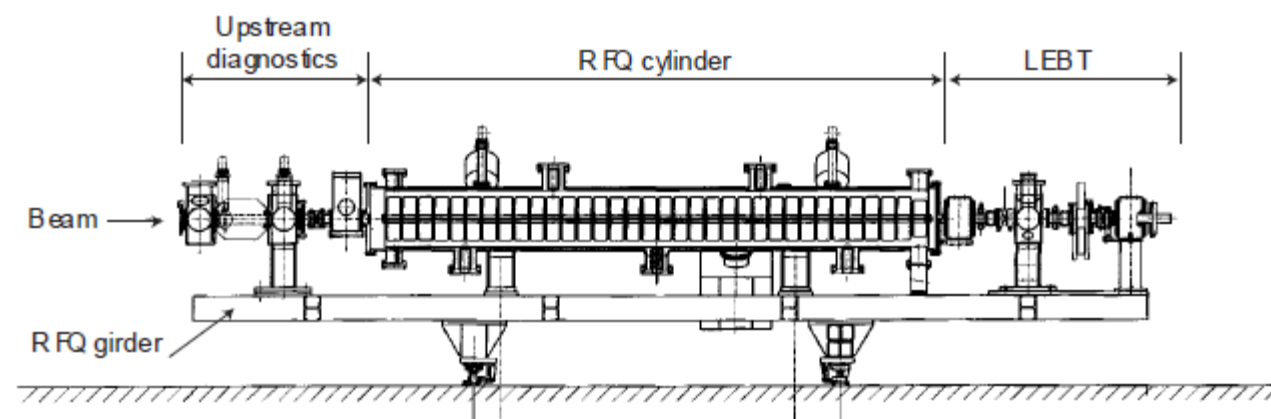
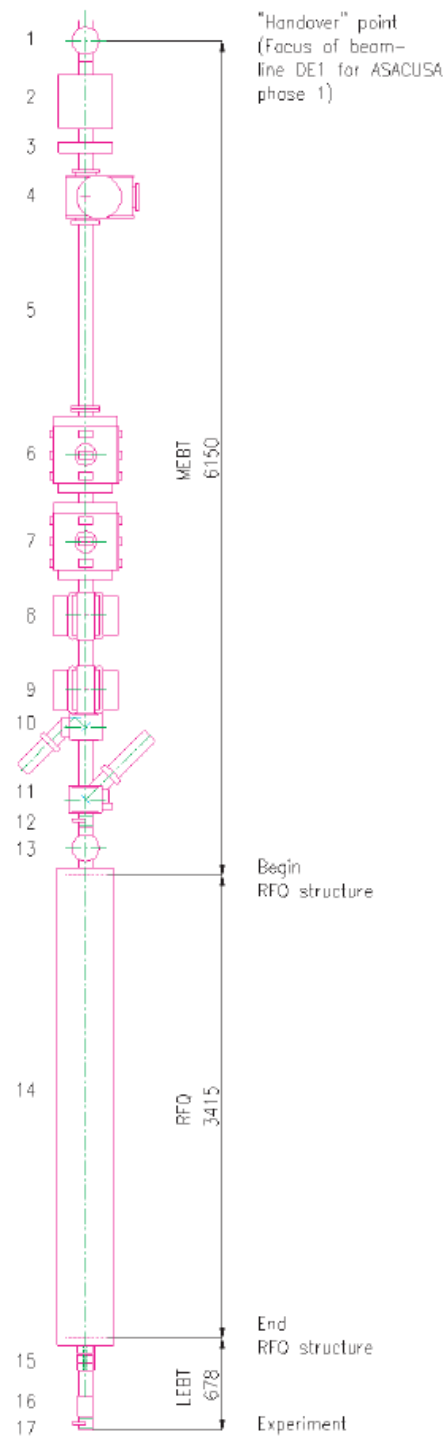


Figure 2.7: The structure of RFQD.

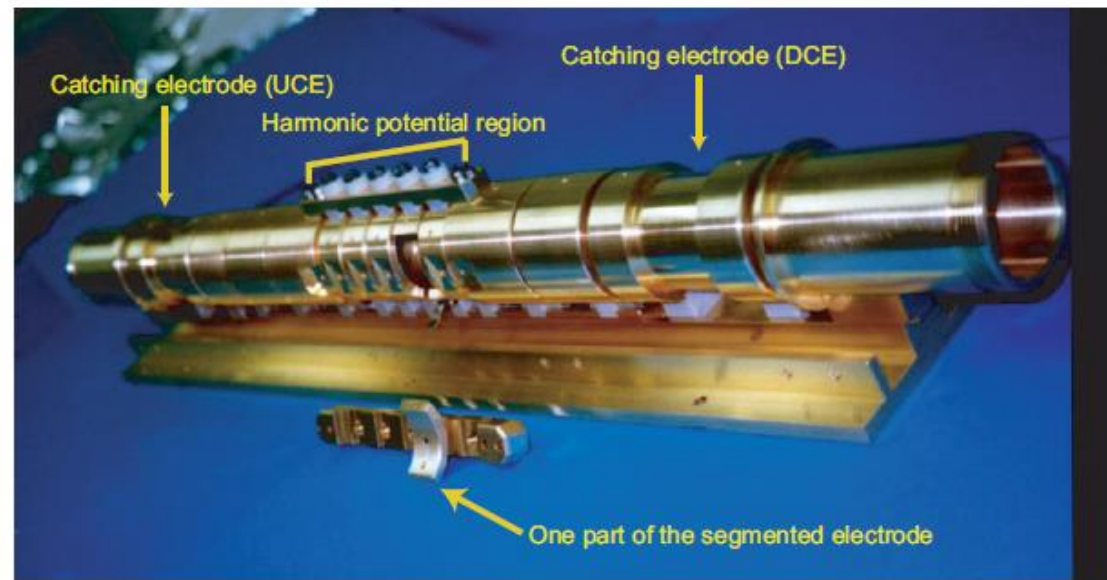


Figure 2.12: Picture of the MRT.

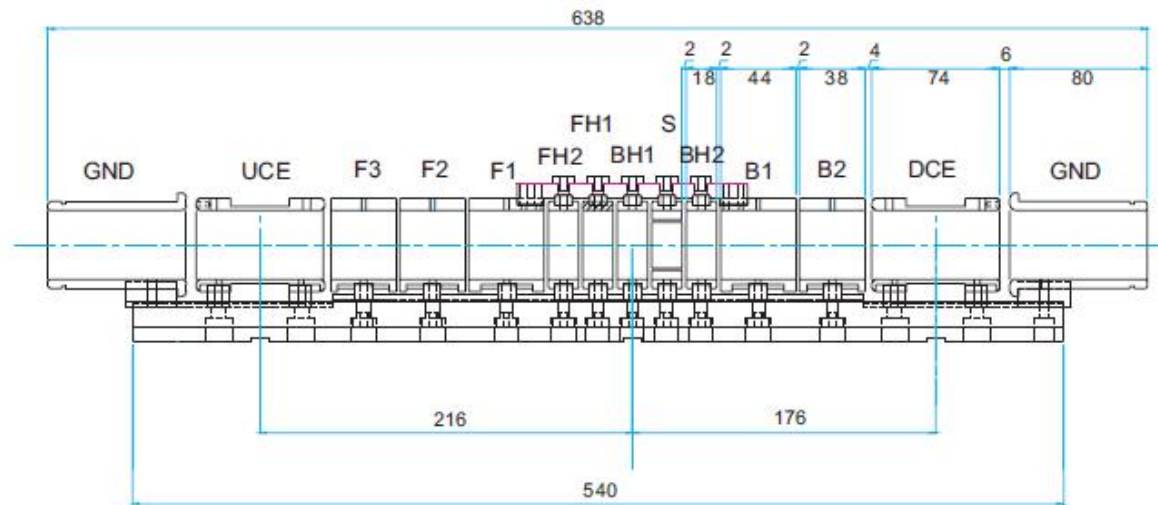


Figure 2.13: MRT electrodes.

it can stably confine a large number of particles.

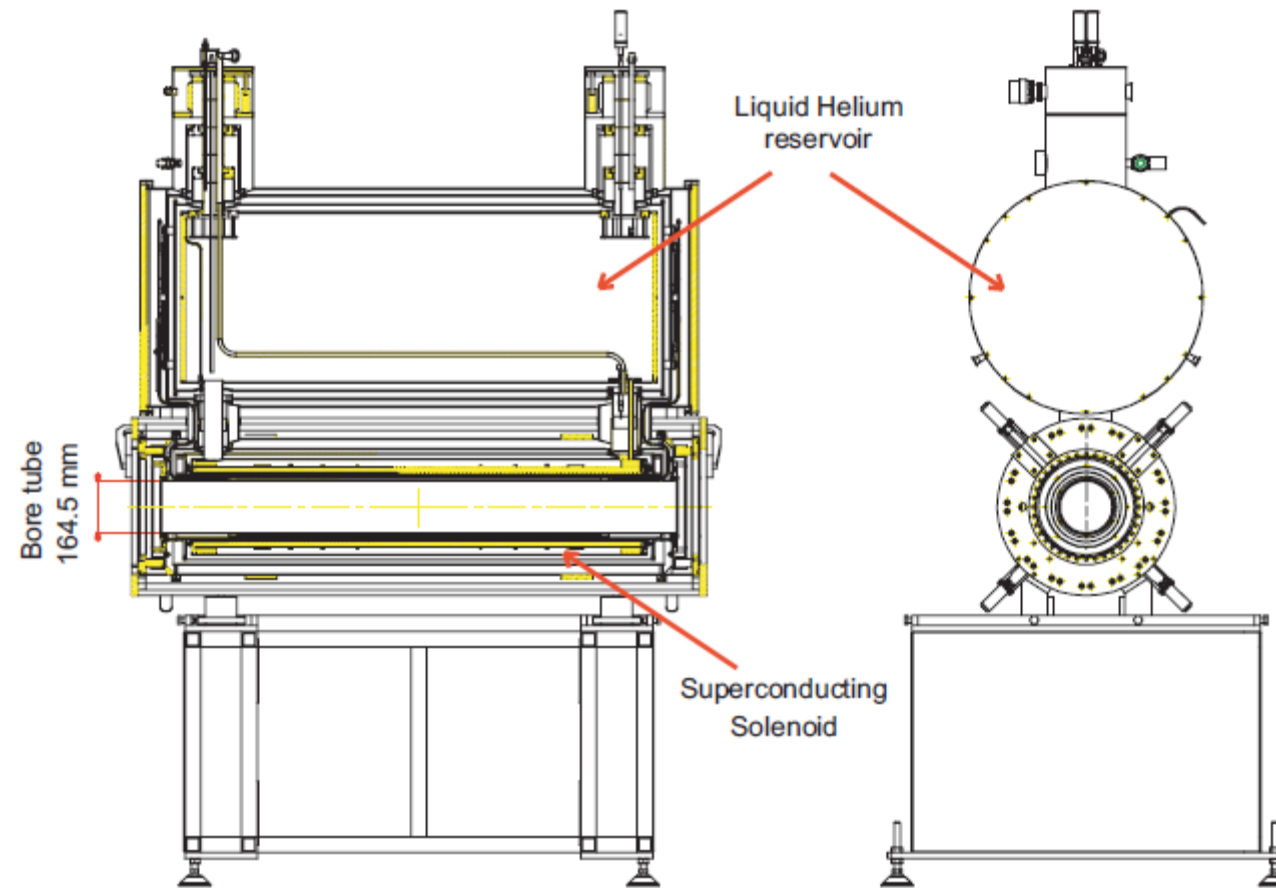


Figure 2.15: Design of the superconducting solenoid with liquid helium reservoir.

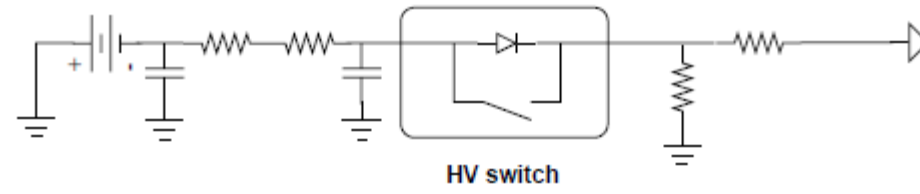


Figure 2.16: Circuit diagram of high-voltage transistor switch

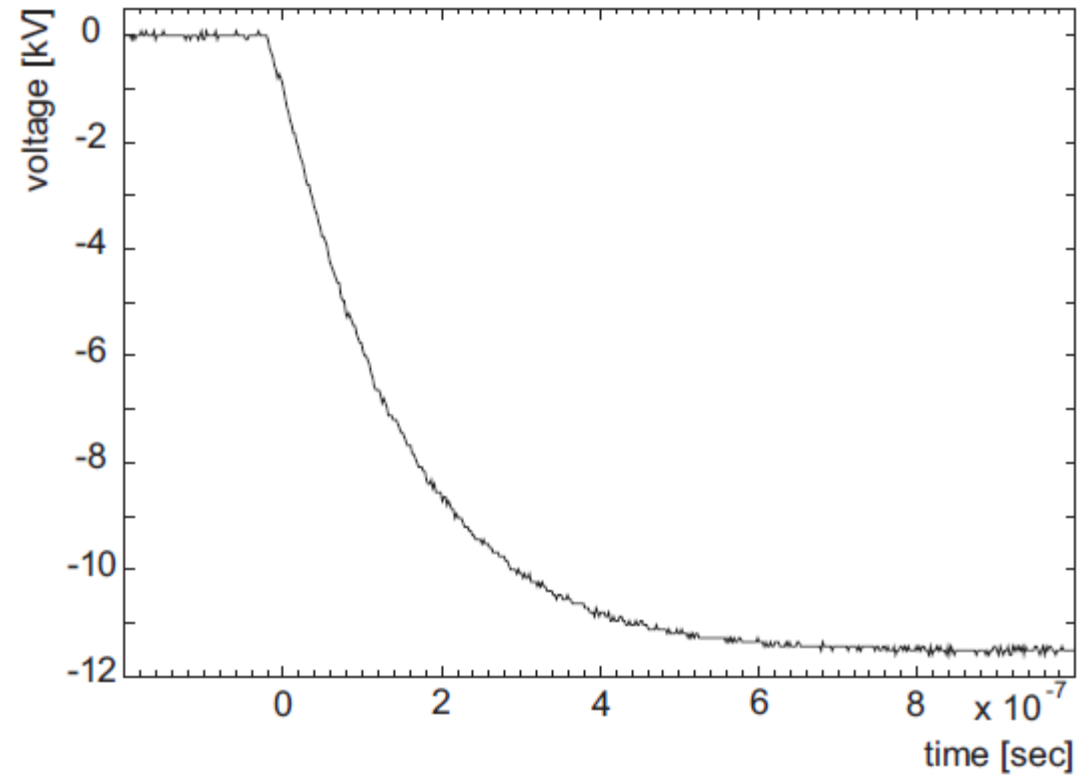
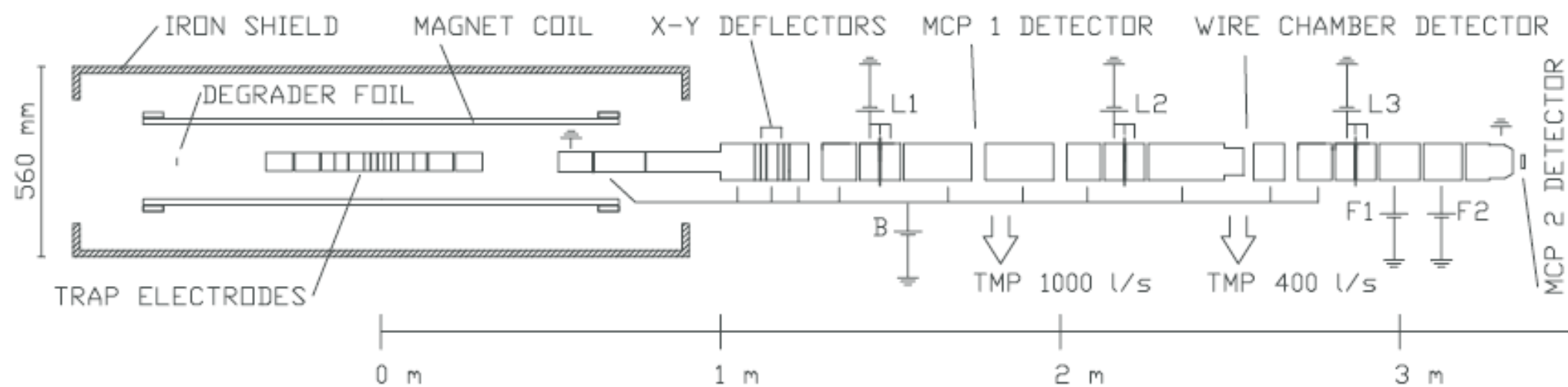
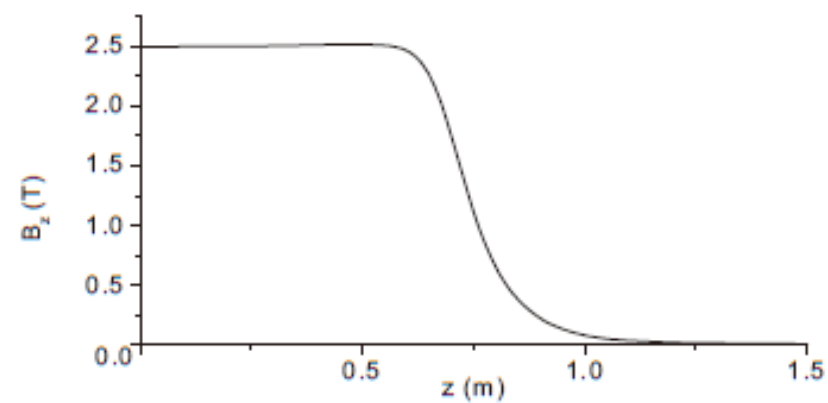


Figure 2.17: Rising time of the fast HV switch.

1. The low energy antiproton beam should be transported from the MRT in the strong magnetic field to the target area with a high efficiency.
2. The beam size at the target position should be less than several millimeters.
3. The pressure difference between the trap area and the target area should be larger than six orders of magnitude.
4. The beam energy at the target should be variable from 10 eV to 1000 eV.



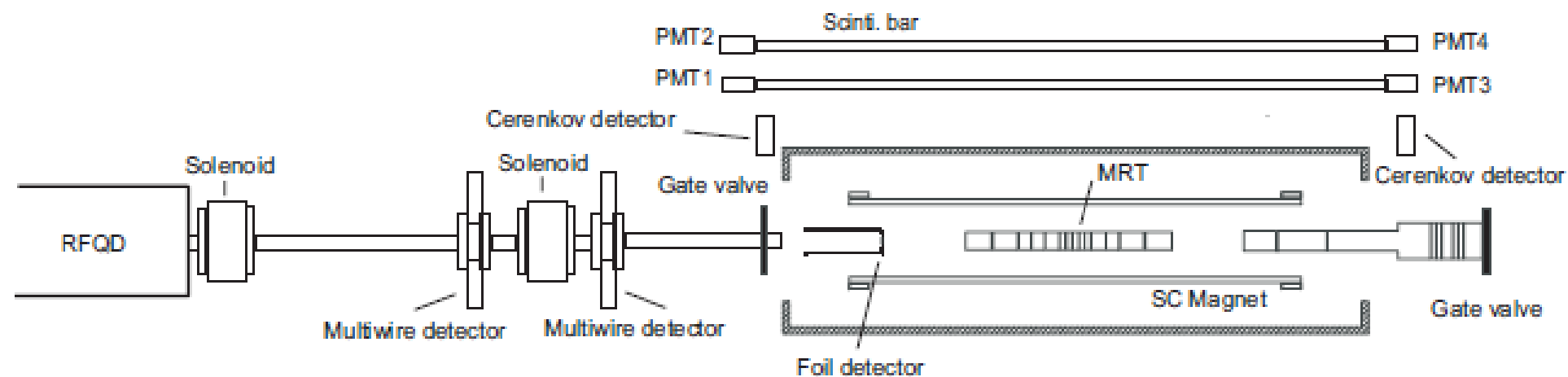


Figure 2.21: Configuration of detectors around our experimental beam line.

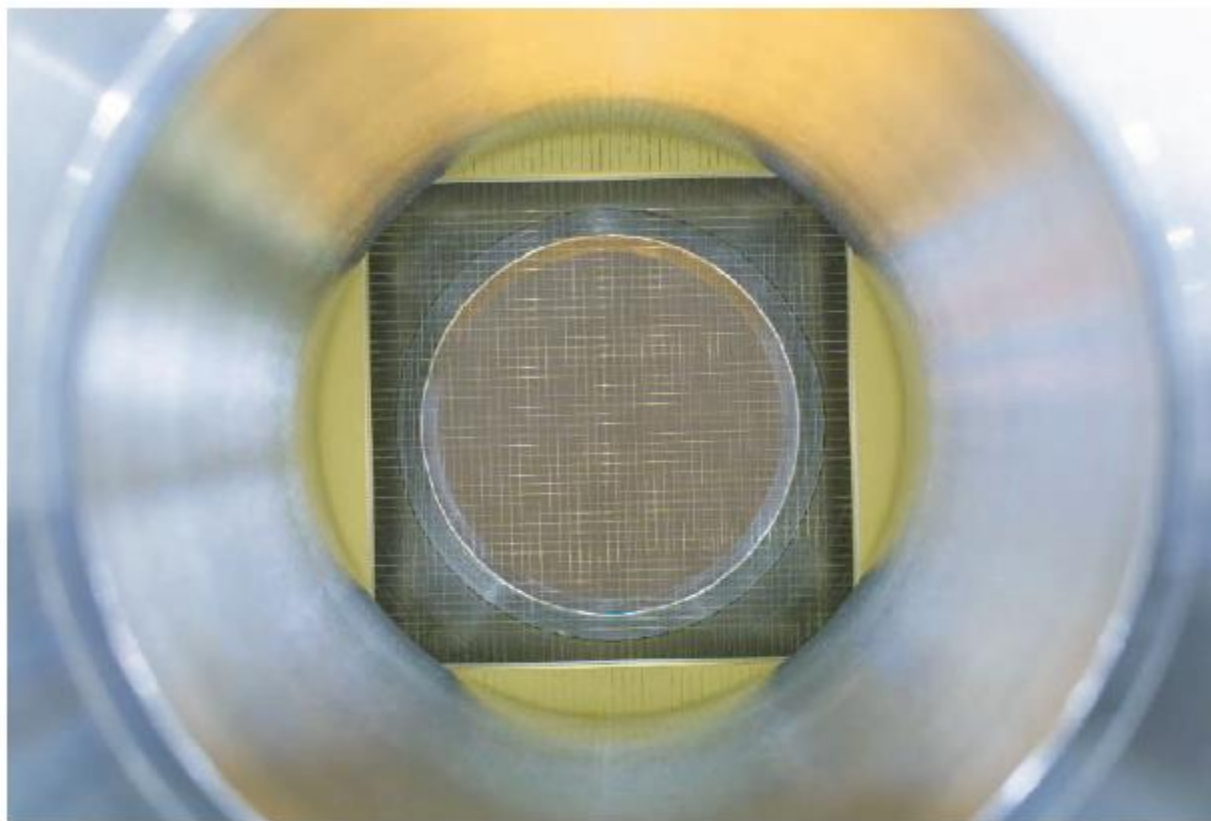


Figure 2.22: Picture of secondary emission beam profile monitor consists of 2-dimensional wires ($20\mu\text{m}\phi$).

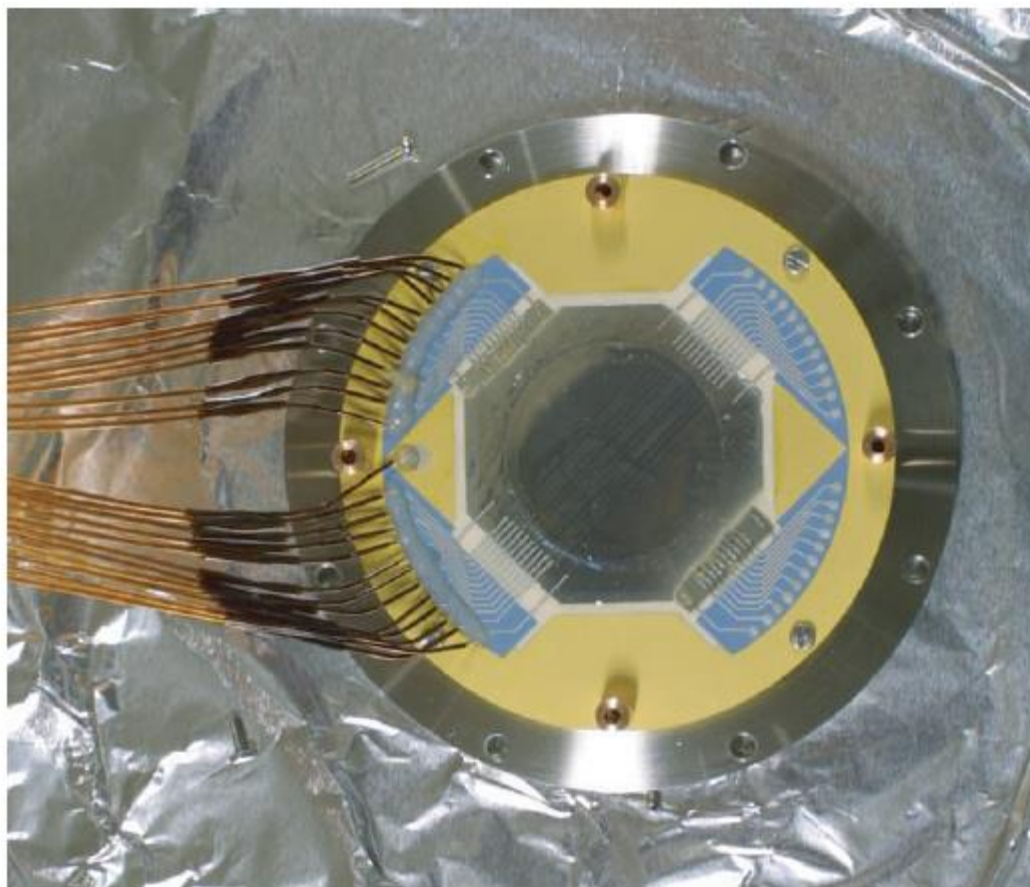


Figure 2.23: Top view of X-Y patterned ultra-thin foil electrode.

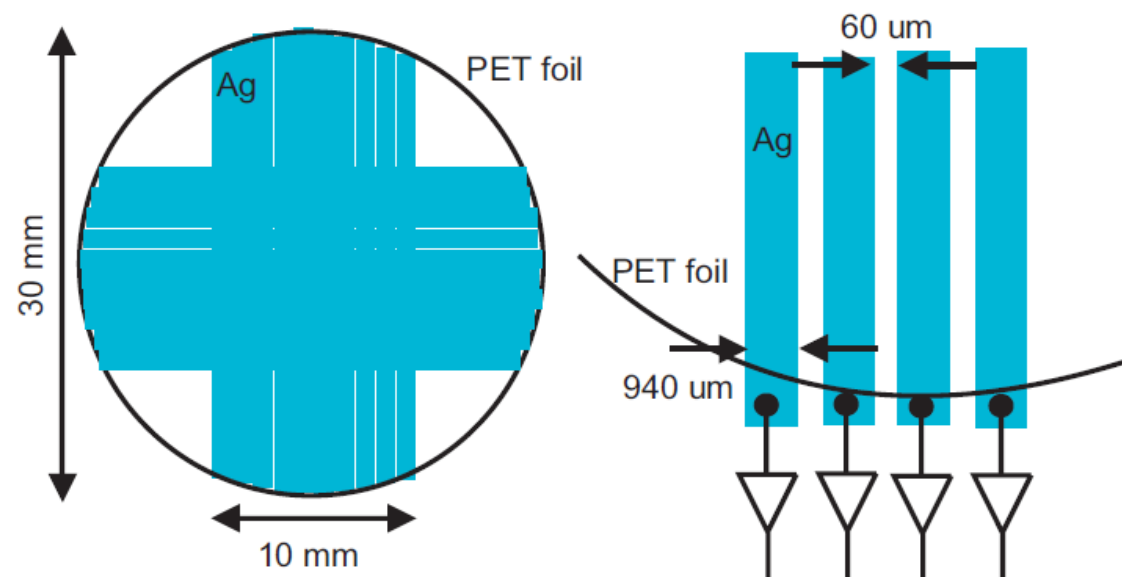


Figure 2.24: Schematic of the foil detector.

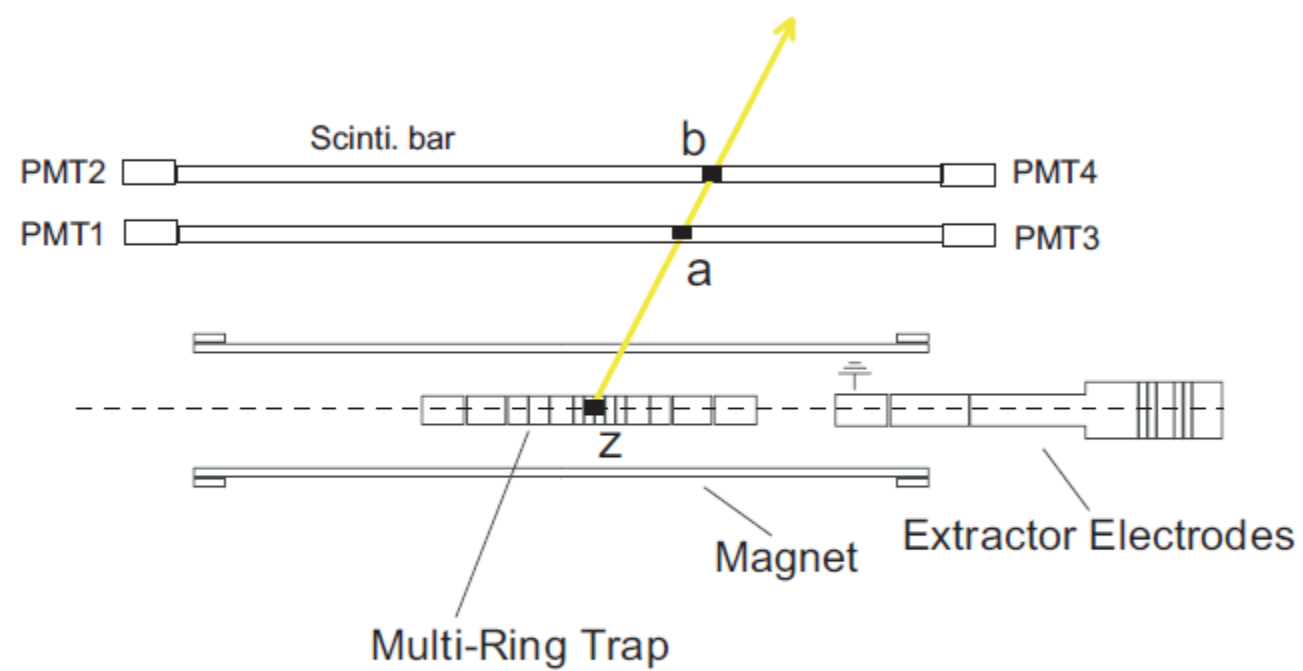


Figure 2.26: Schematic view of track detector.

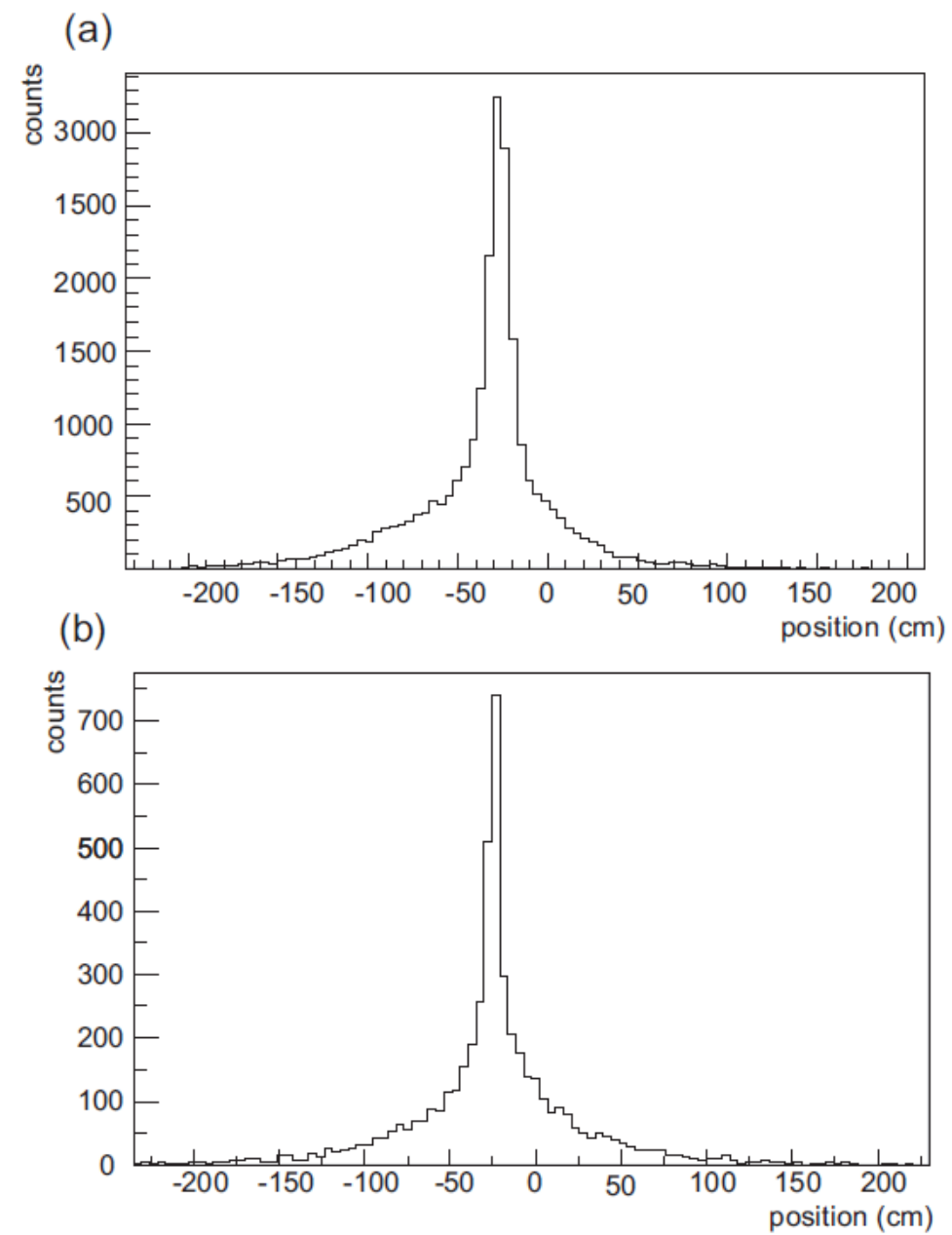


Figure 2.27: (a) Experimentally obtained annihilation positions of antiprotons. (b) Calculated positions of antiprotons annihilations in the MRT.

Thank you