HESR Electron Cooler

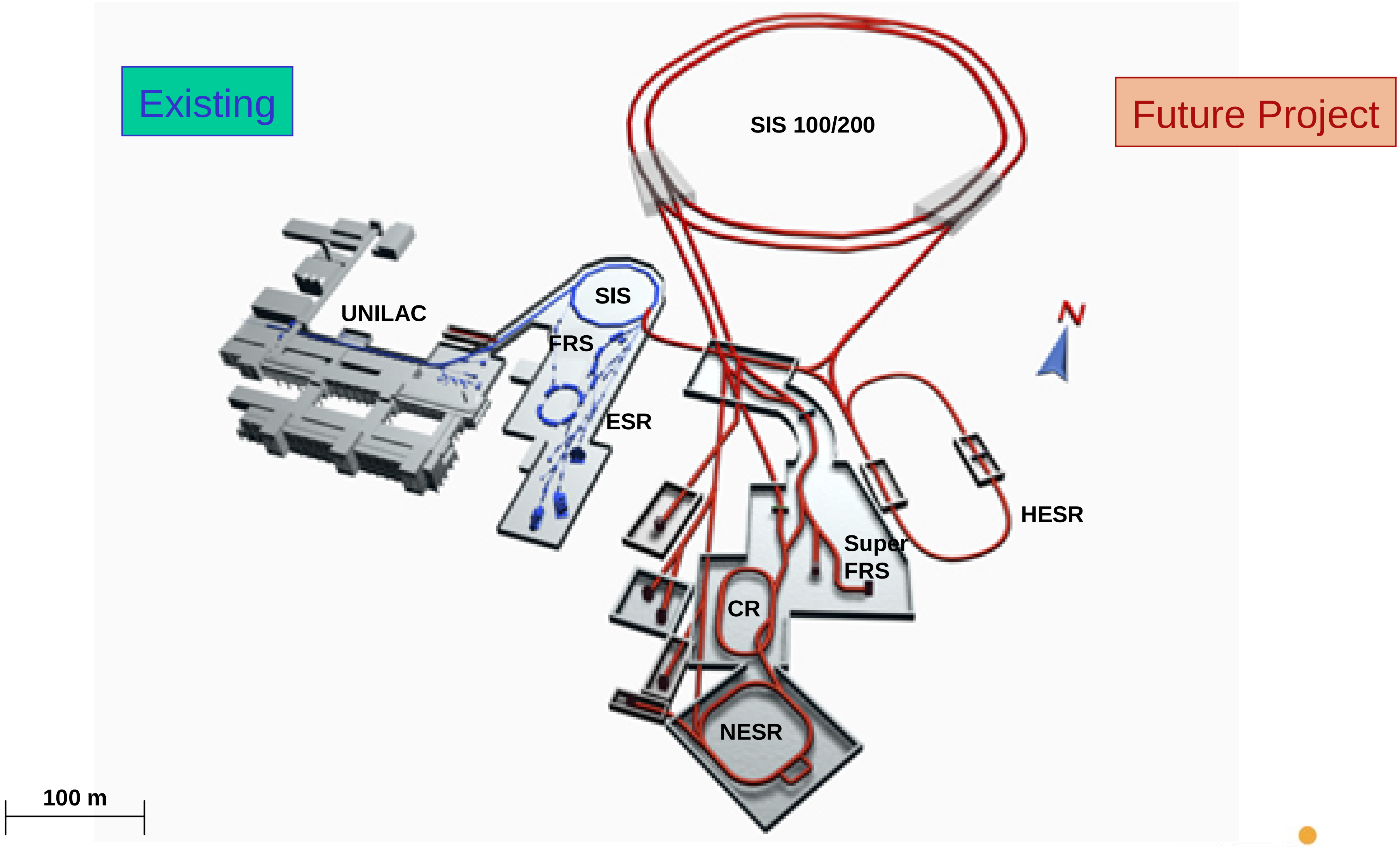
COOL05

Eagle Ridge, Galena, IL USA

September 18-23, 2005

D. Reistad, TSL

The Future International Facility at GSI: Beams of Ions and Antiprotons



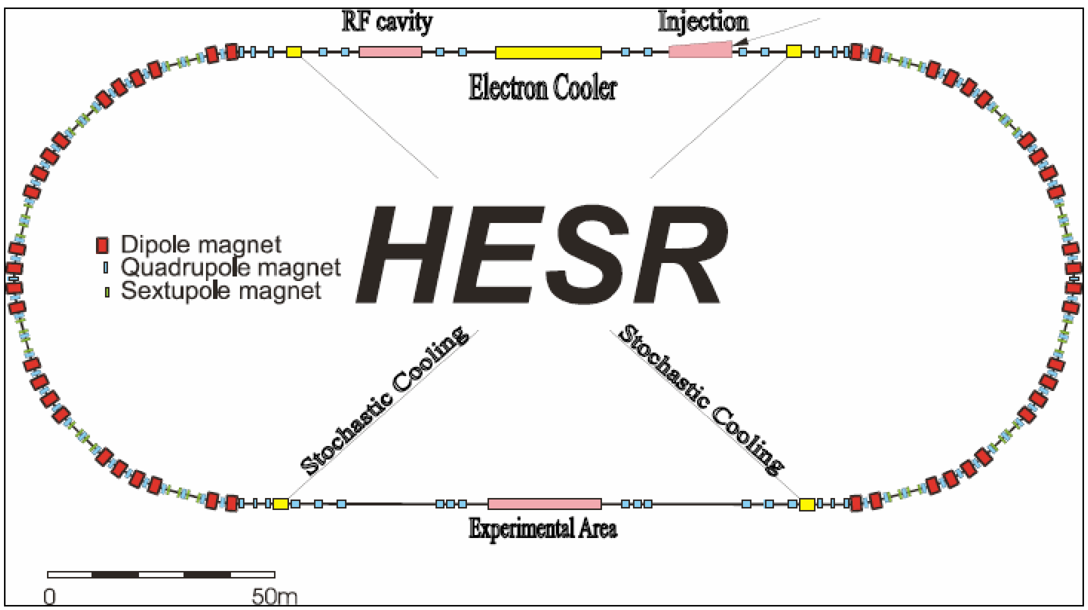
HESR

HESR 'flagship' beam parameters

Mode	pbar Energy	L [cm^{-2} s^{-1}]	$\Delta p/p$	ε [mm mrad]
High luminosity	8 GeV	2×10^{32}	10^{-4}	1
High resolution	8 GeV	2×10^{31}	10^{-5}	1

Number of antiprotons for an internal target area density of 4×10^{15} cm^{-2}:

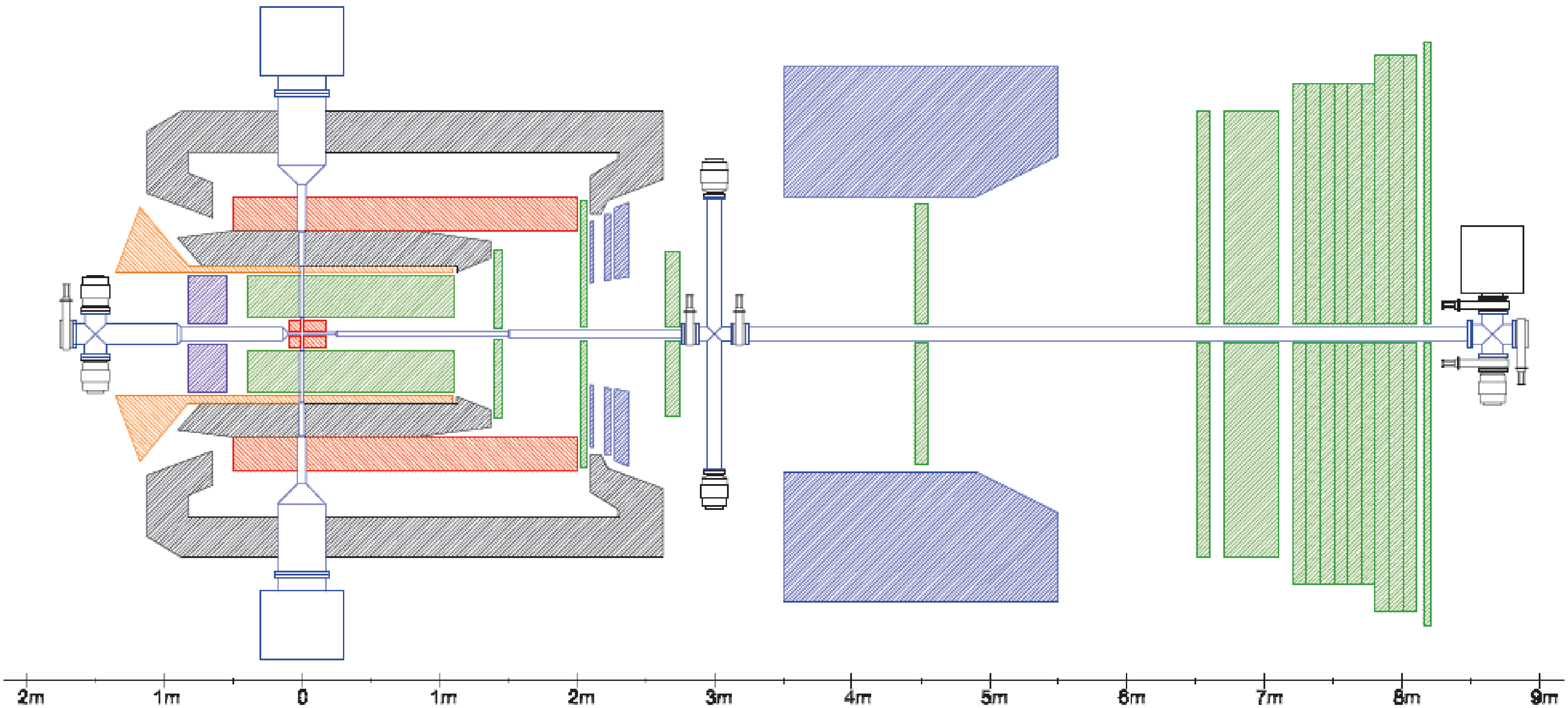
HL mode: 10^{11} (0.8-14.1 GeV)
HR mode:10^{10} (3-8 GeV)



HESR ring/lattice parameters

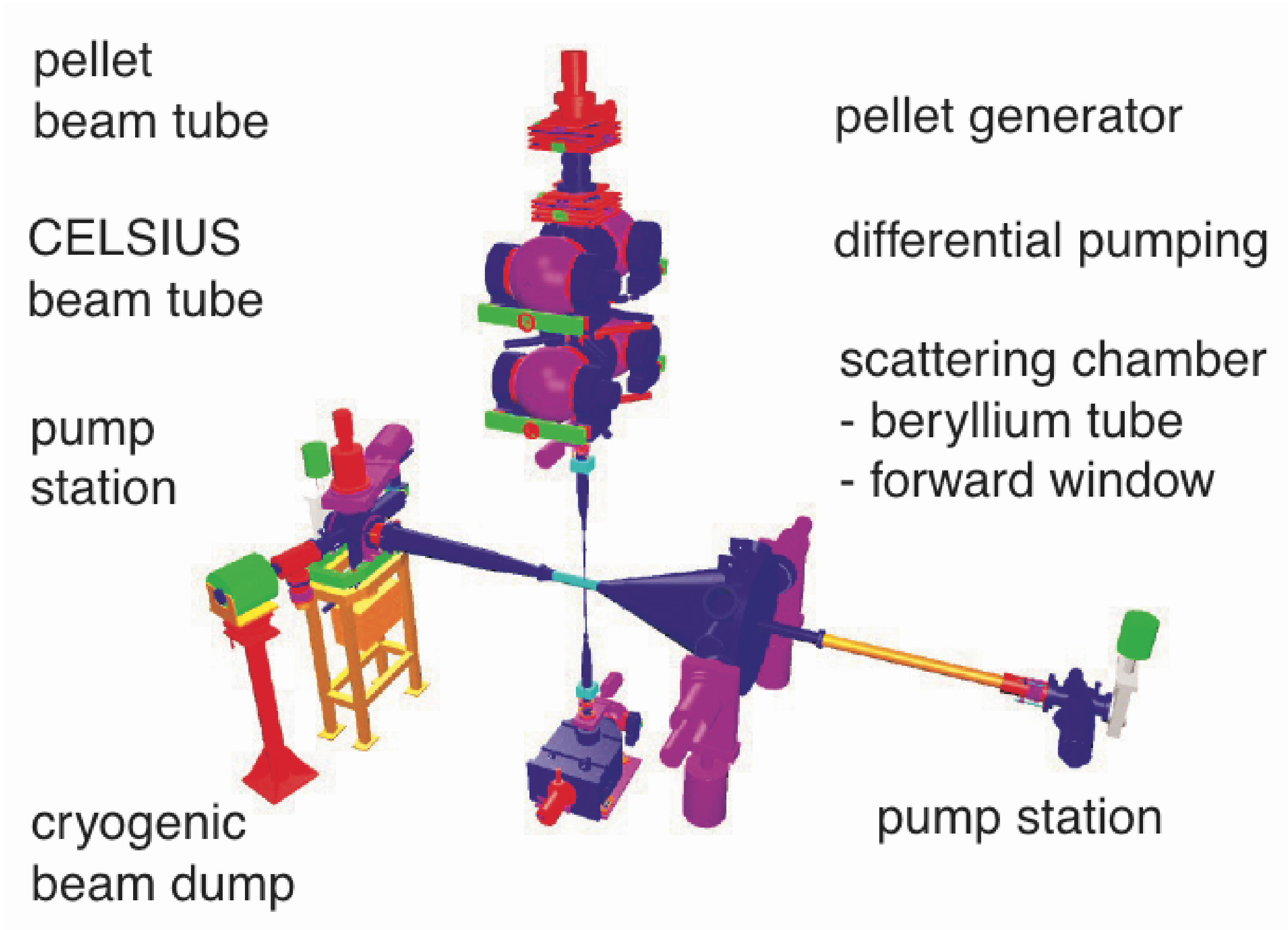
C [m]	570
$\langle D_x \rangle$ [m]	3.5
$\langle \beta_x \rangle$ [m]	7.5
γ_t	i8

PANDA @ HESR



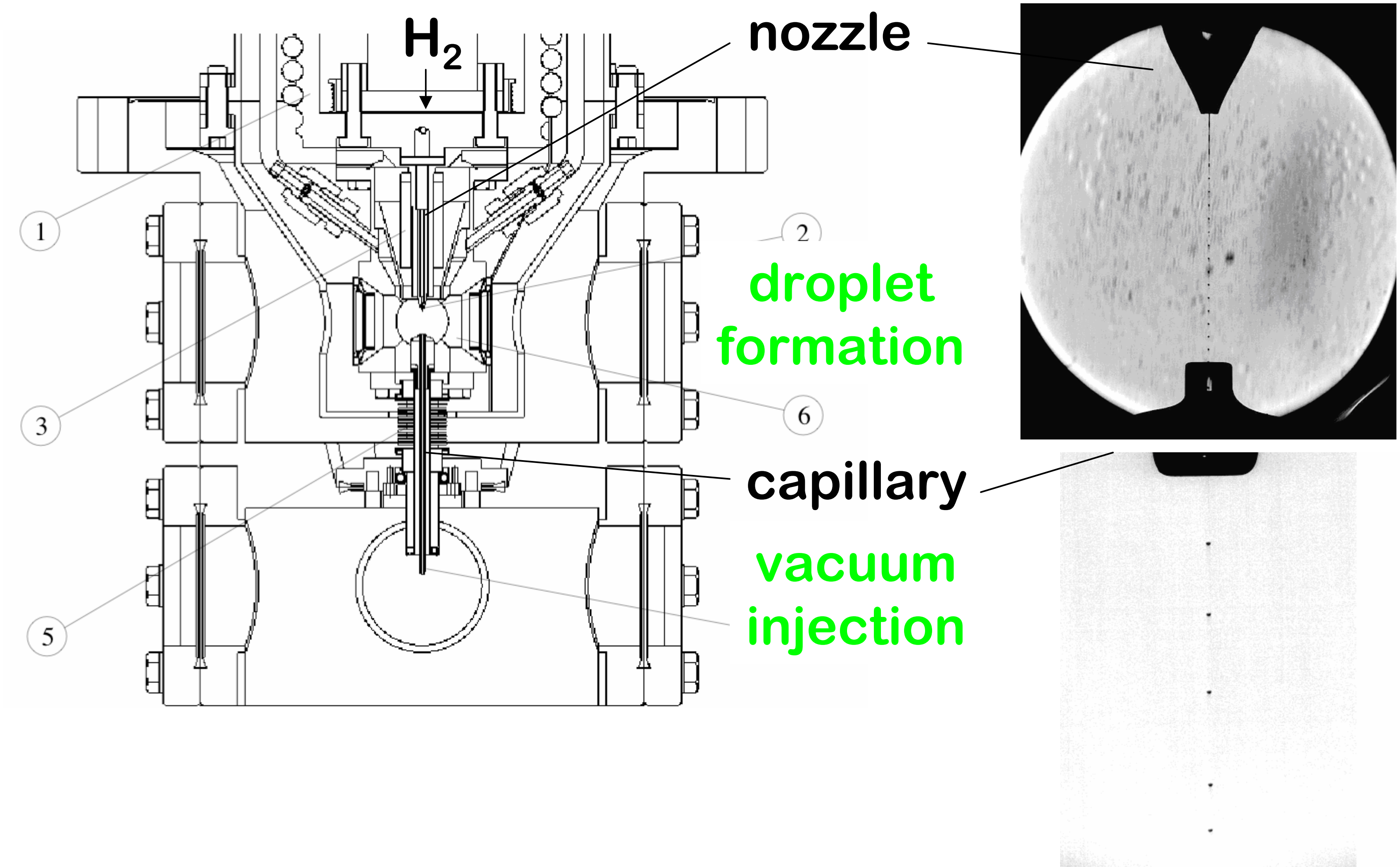
- Hydrogen pellet target
- 2 cm <u>diameter</u> beam pipe!

WASA Pellet Target



- **access and availability restricted**
- **development of the PTS !**

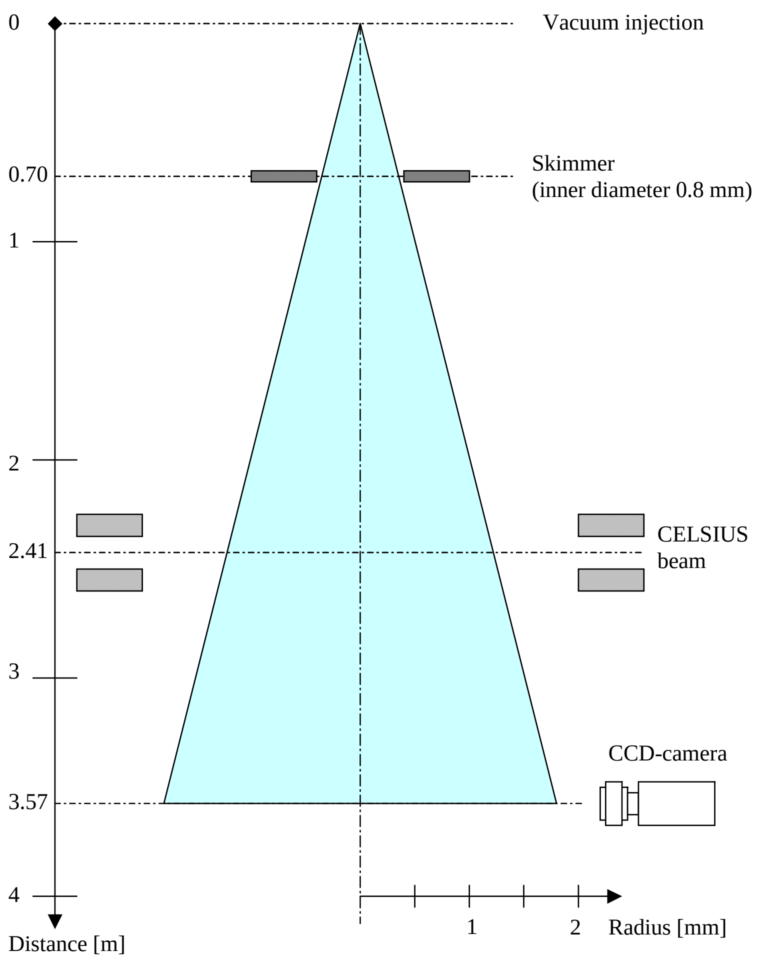
Pellet Generation Principle

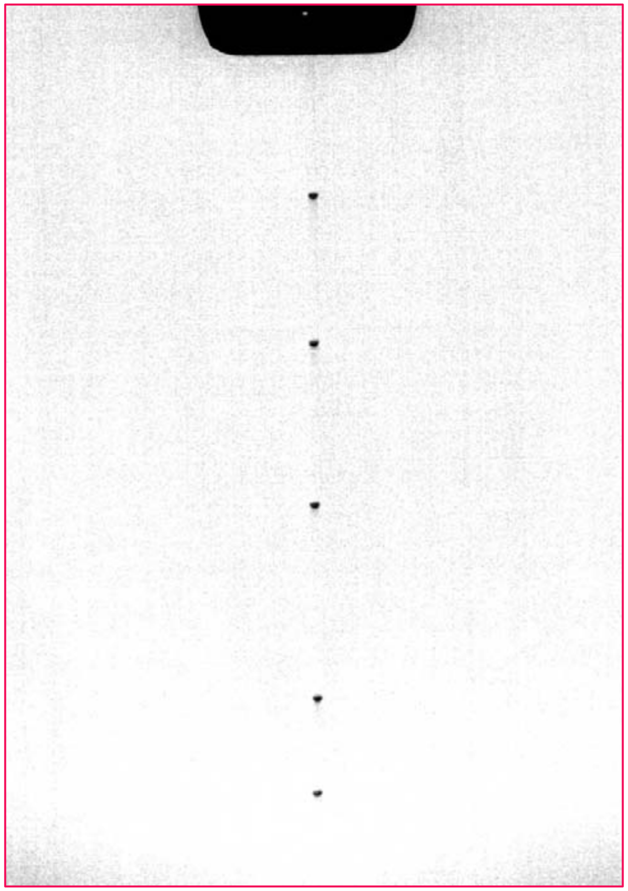


At WASA:

width of pellet stream: 2 mm

vertical separation of pellets: 3 mm

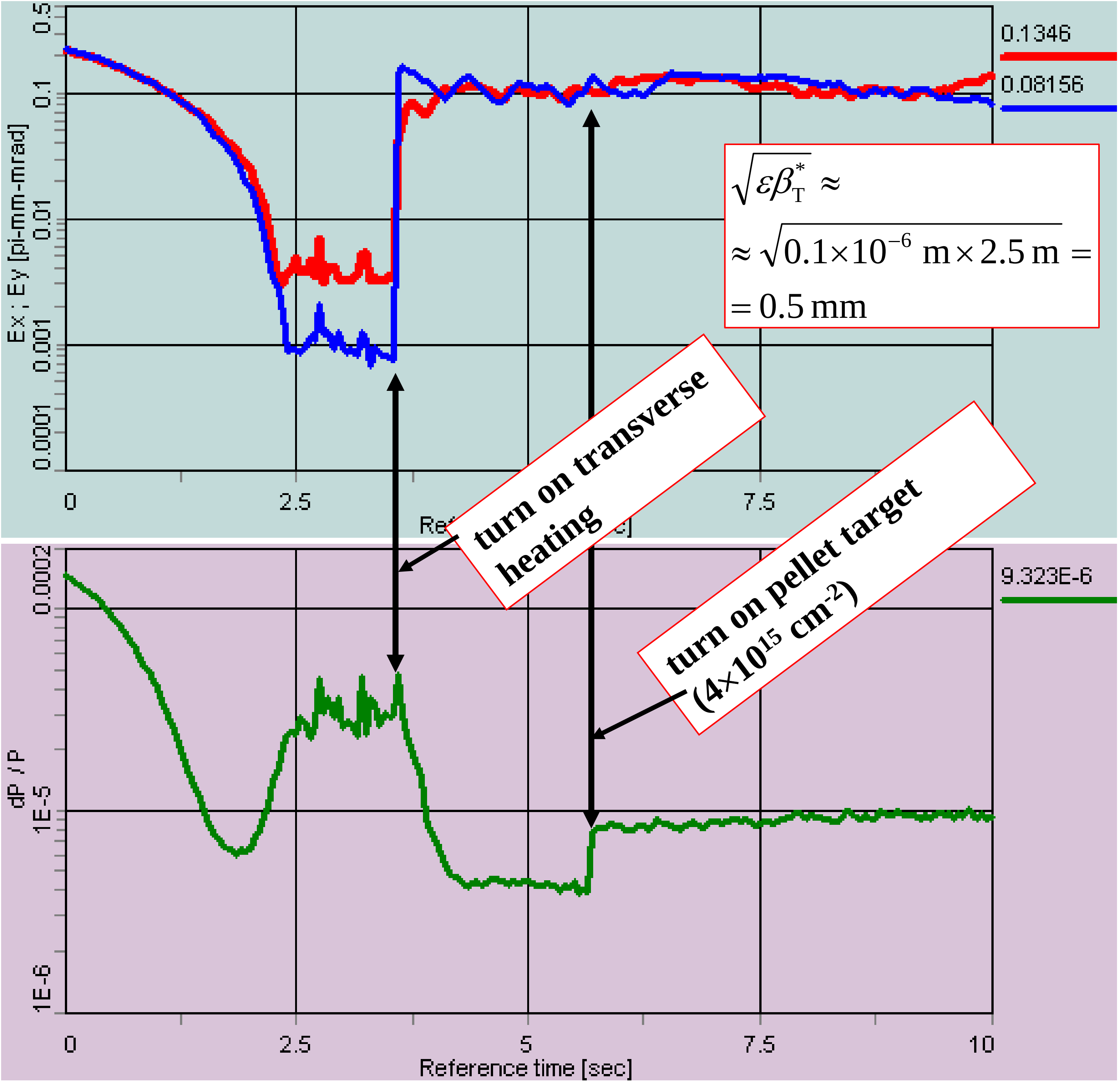




PANDA needs a 2-3 mm big beam with $10^{10} – 10^{11}$ antiprotons with momentum spread $10^{-5} – 10^{-4}$, and without any halo.

This can not be achieved with electron cooling alone.

We need also very good beam scraper system and/or stochastic halo-cleaning system.



<u>3 GeV</u>, 68.3 % of anti-protons

I_e = 1 A

r_0 = 5 mm

l_C = <u>30 m</u>

B = 0.2 T

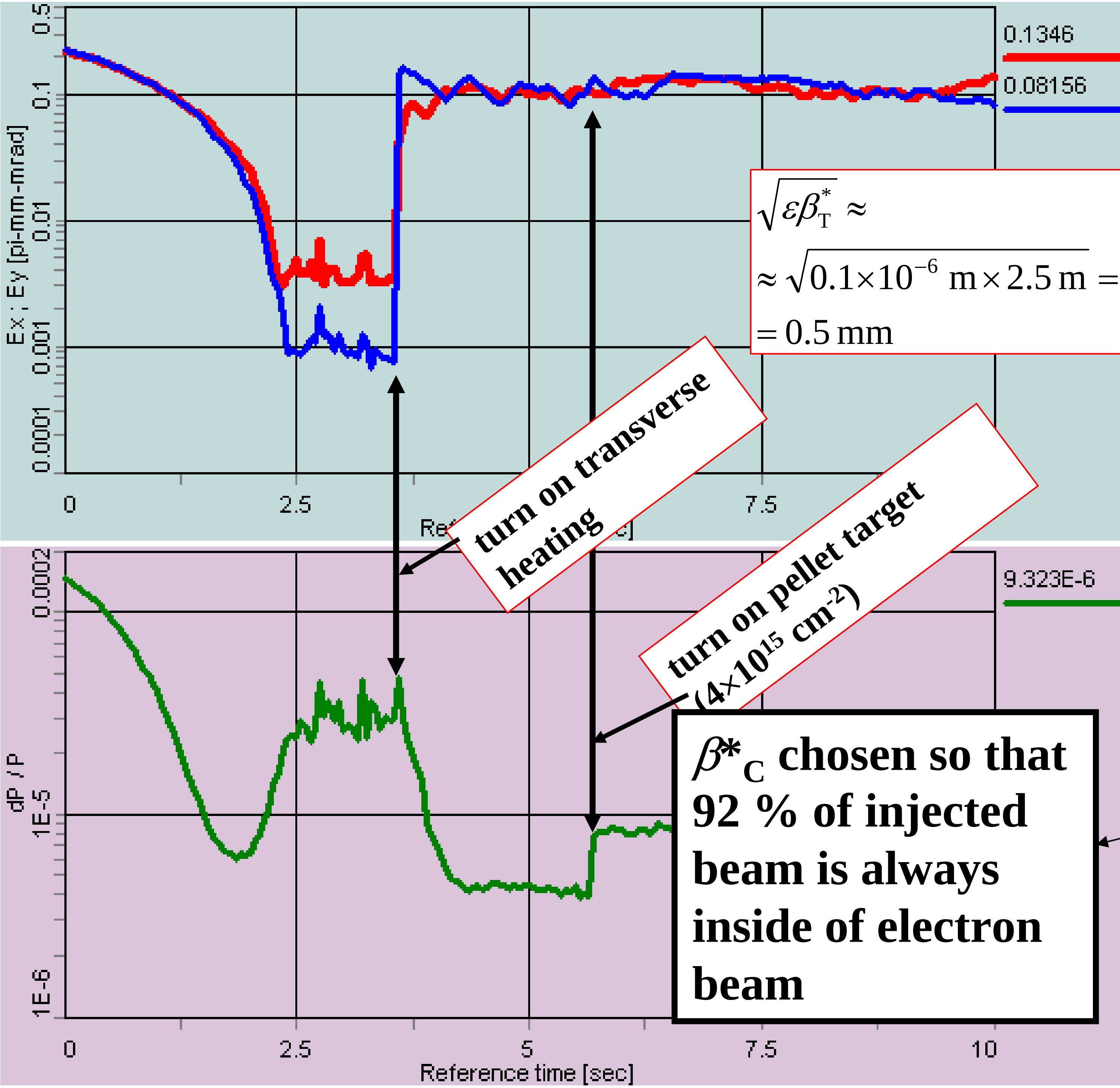
kT = 1 eV

$\theta = 10^{-5}$ radians

β^*_C = 50 m

β^*_T = 2.5 m

$N_{pbar} = 10^{10}$



3 GeV, 68.3 % of anti-protons

$I_e = 1$ A

$r_0 = 5$ mm

l_C = **30 m**

$B = 0.2$ T

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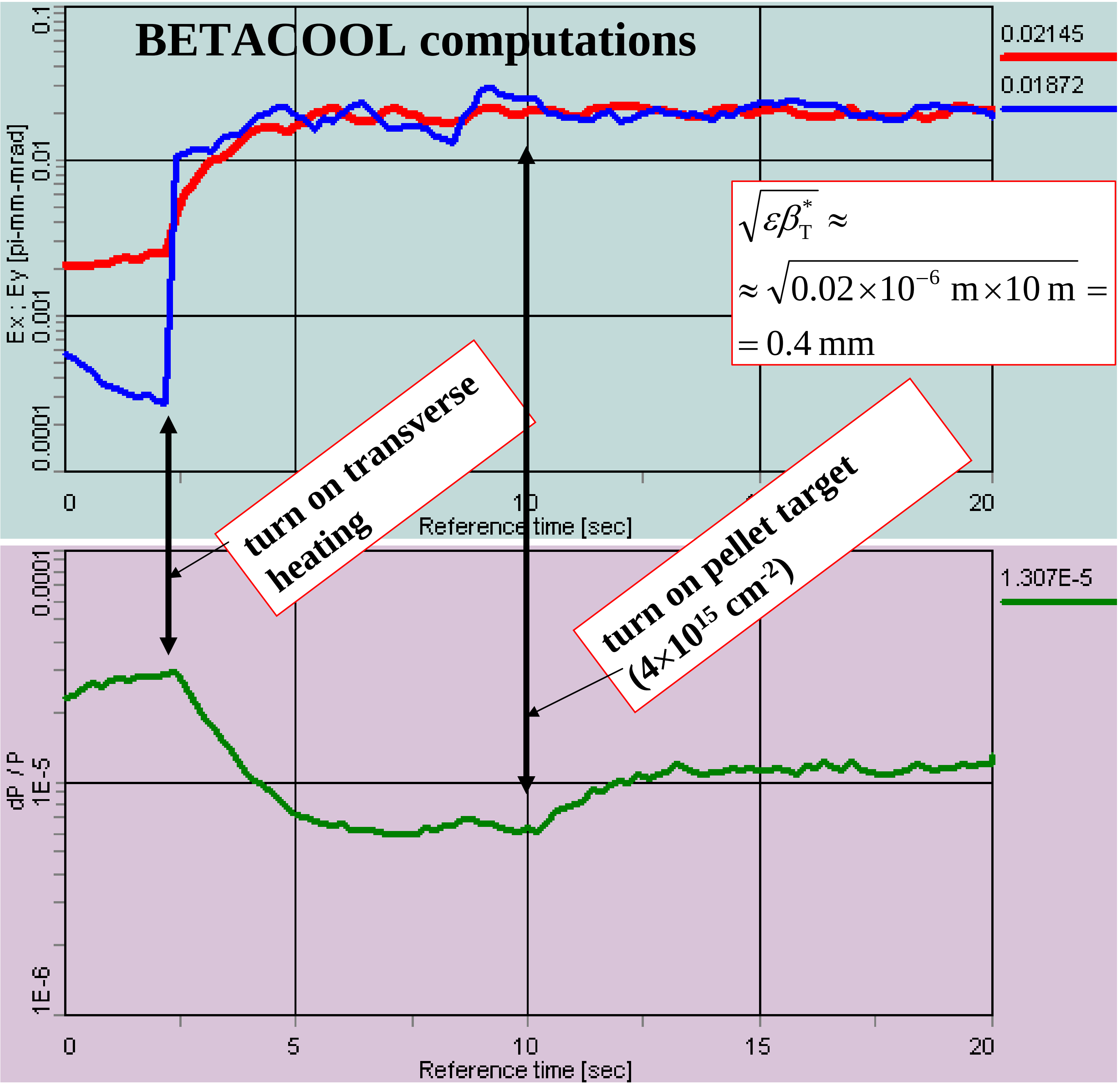
$\beta^*_C = 50$ m

$\beta^*_T = 2.5$ m

$N_{pbar} = 10^{10}$



8 GeV, 68.3 % of anti-protons

$I_e = 1$ **A**

$r_0 = 5$ **mm**

$l_C = \underline{30\ \mathrm{m}}$

$B = 0.2$ **T**

$kT = 1$ **eV**

$\theta = 10^{-5}$ **radians**

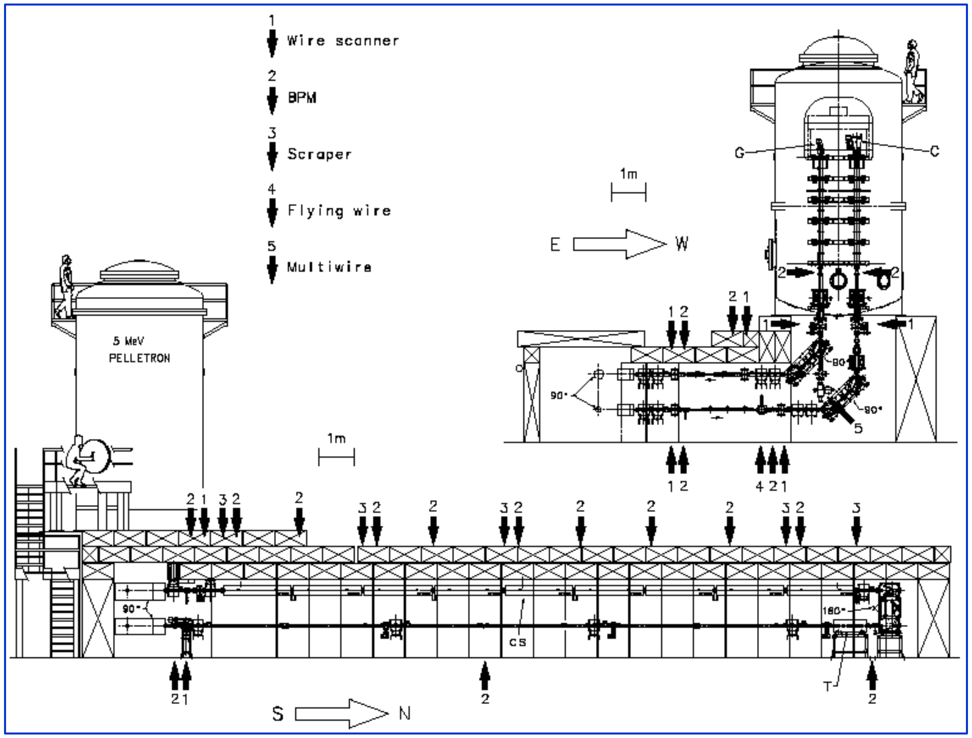
$\beta^*_C = 100$ **m**

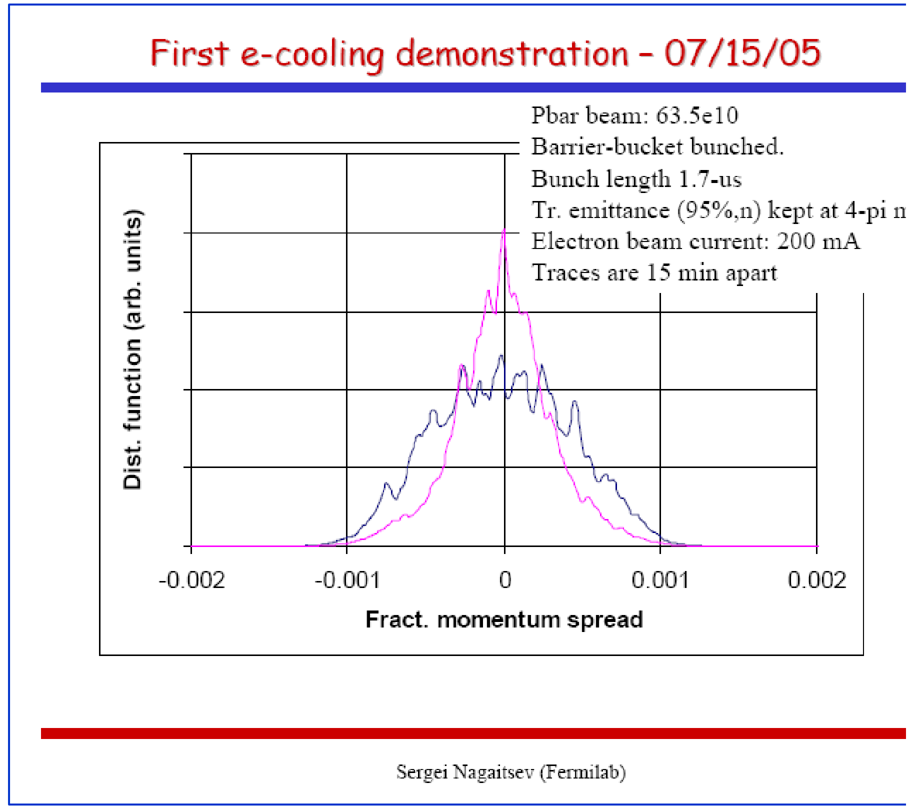
$\beta^*_T = 10$ **m**

$N_{pbar} = 10^{10}$

Prior Art:

FNAL RECYCLER 4.3 MeV electron cooling system

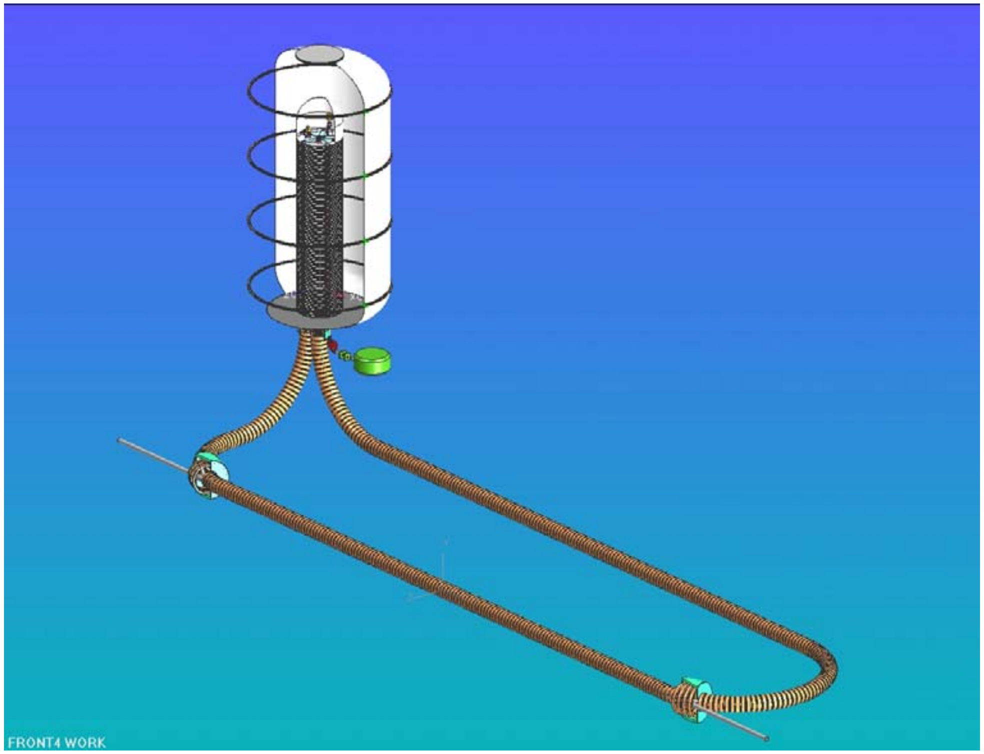




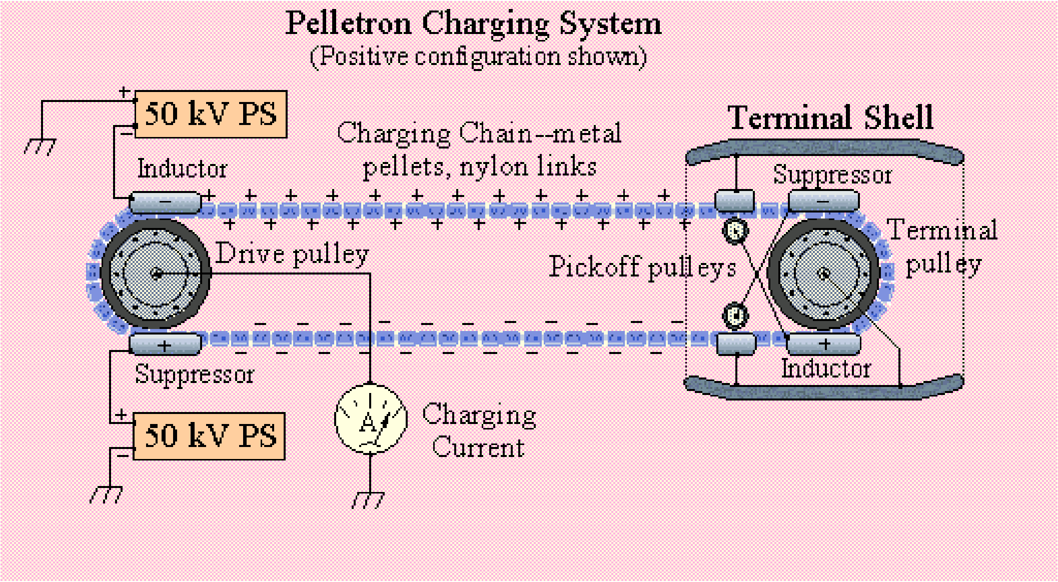
CONGRATULATIONS!!!

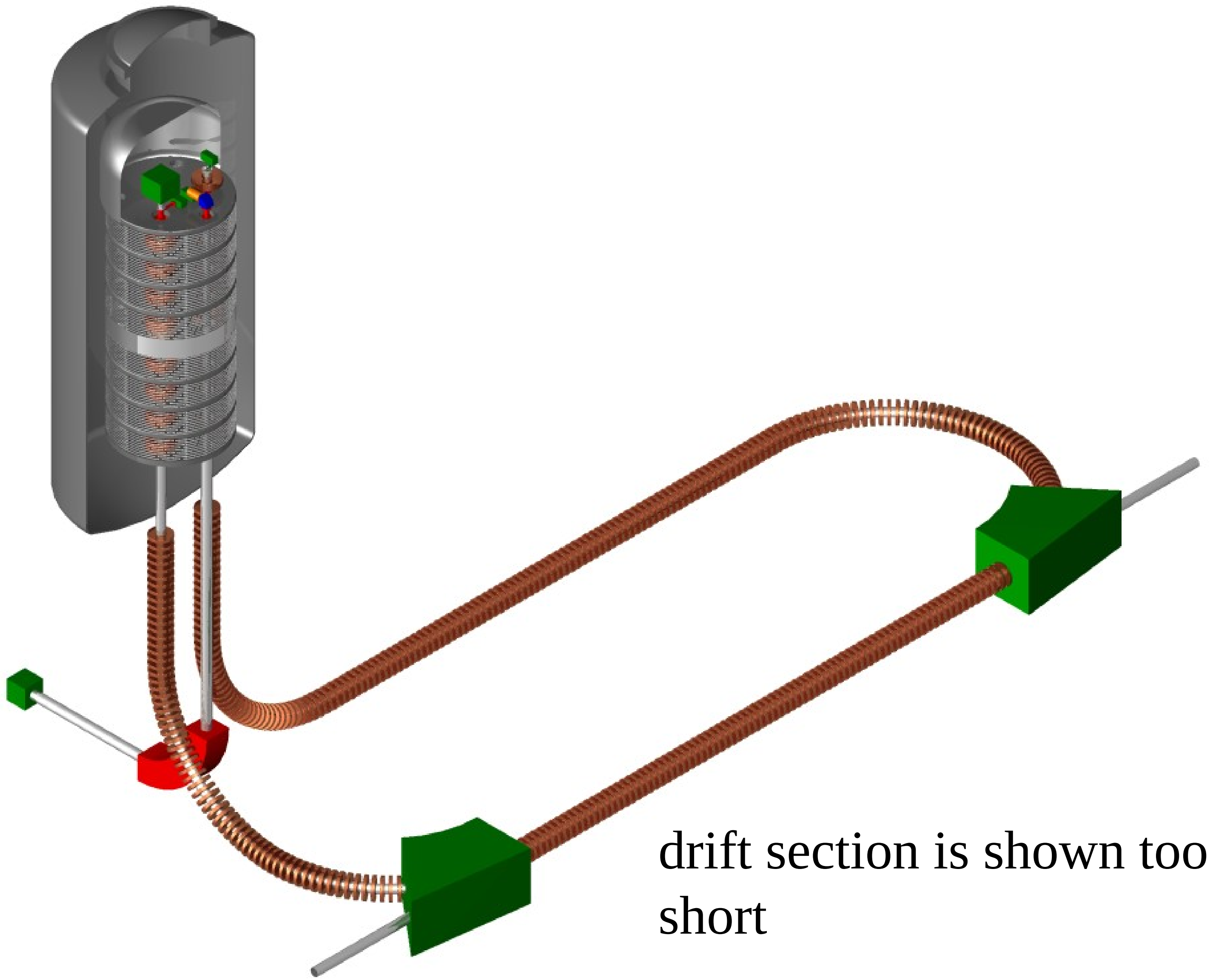
Prior Art, continued:

The Budker Institute in Novosibirsk (BINP) has performed a detailed study. They propose a 30 m long electron-cooling section with a 0.5 T longitudinal magnetic field with straightness 10^{-5} radians (rms). They propose to produce the high voltage (up to 8 MV) with an H^- cyclotron, which charges the high-voltage terminal.

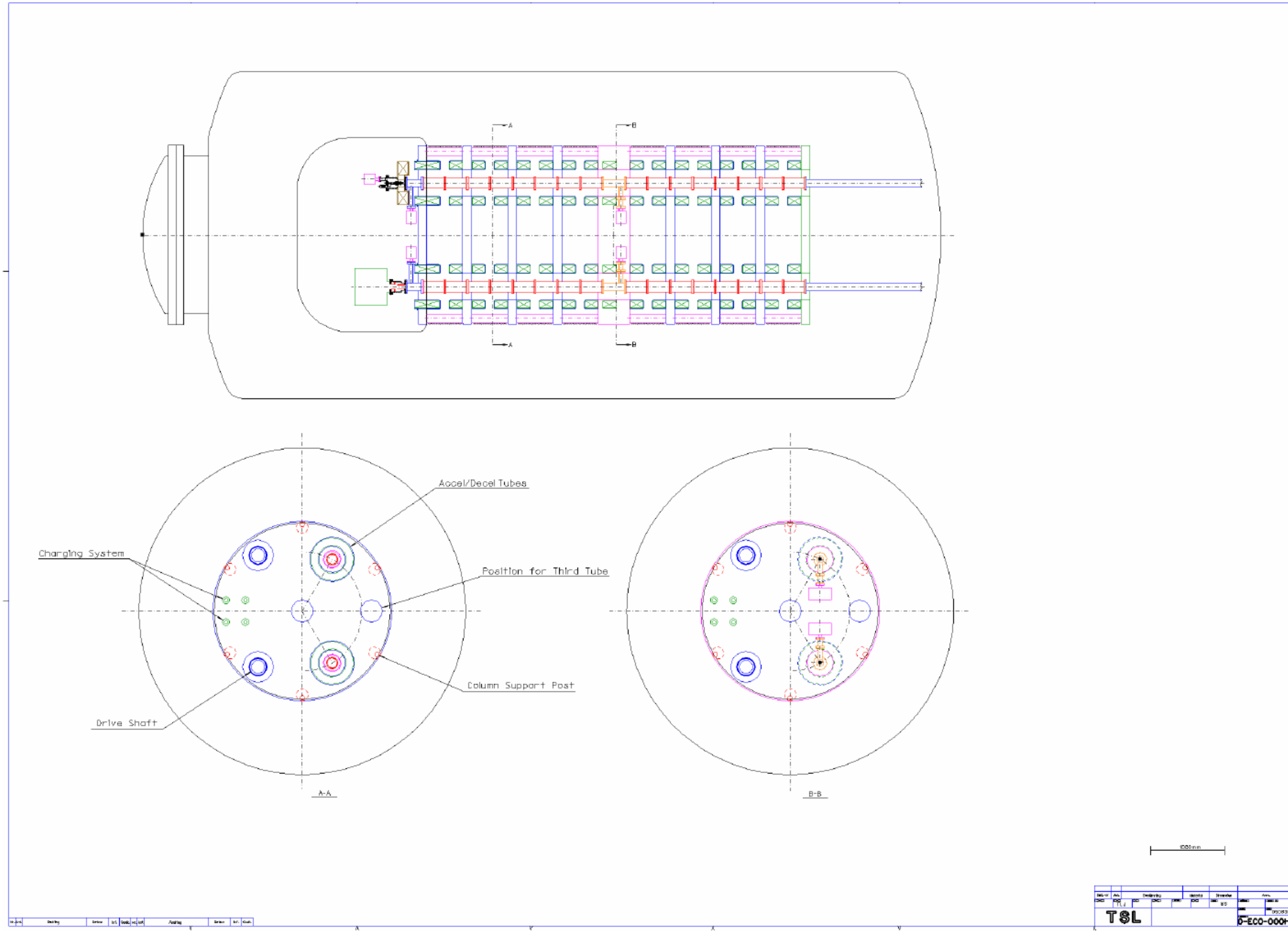


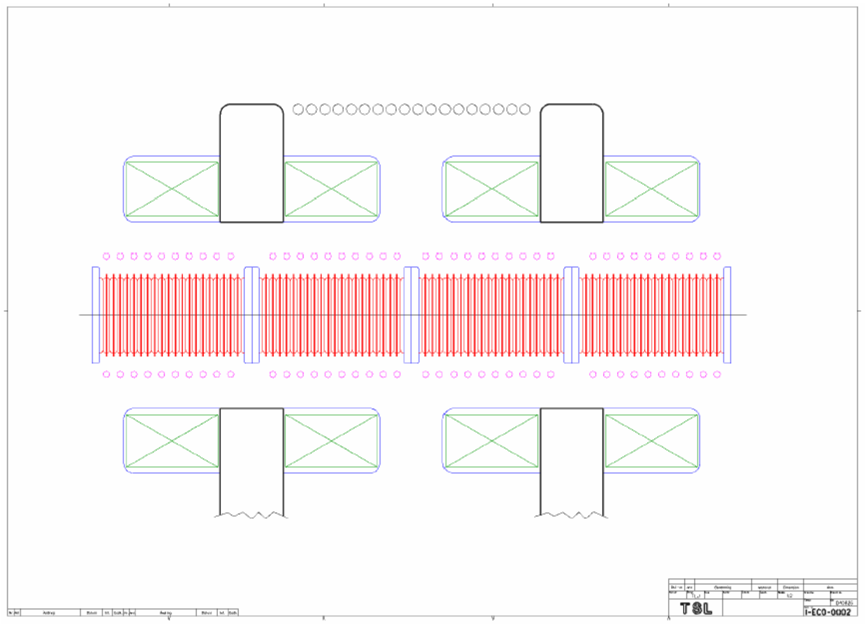
We are looking at alternatives, especially to use more conventional means to achieve the high voltage van de Graaff accelerators ("Pelletrons") as in Fermilab…

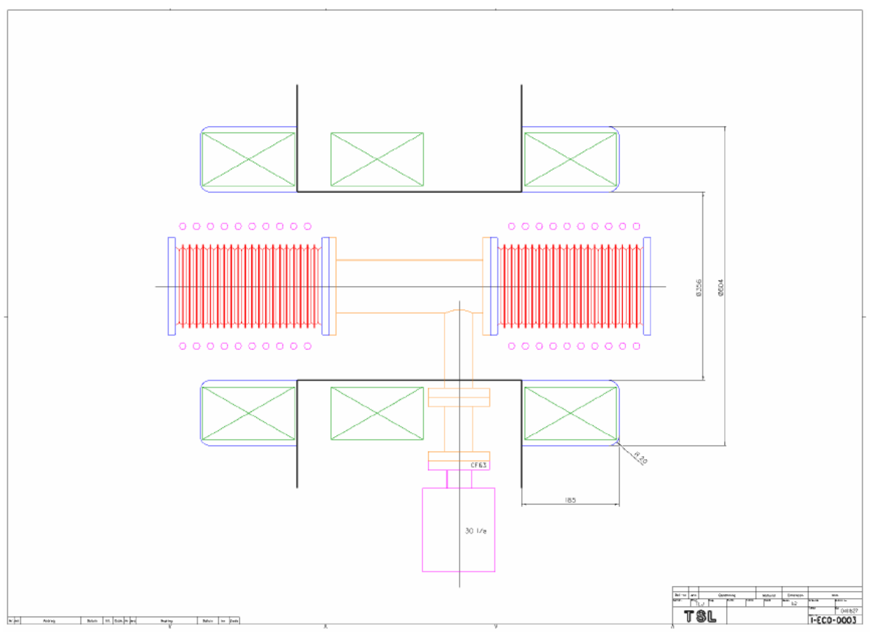


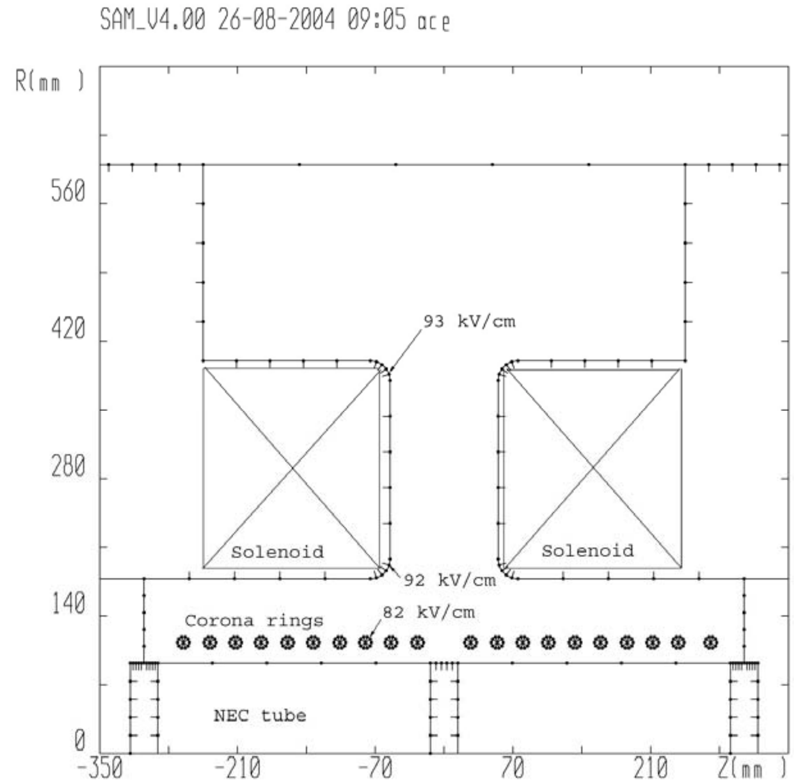


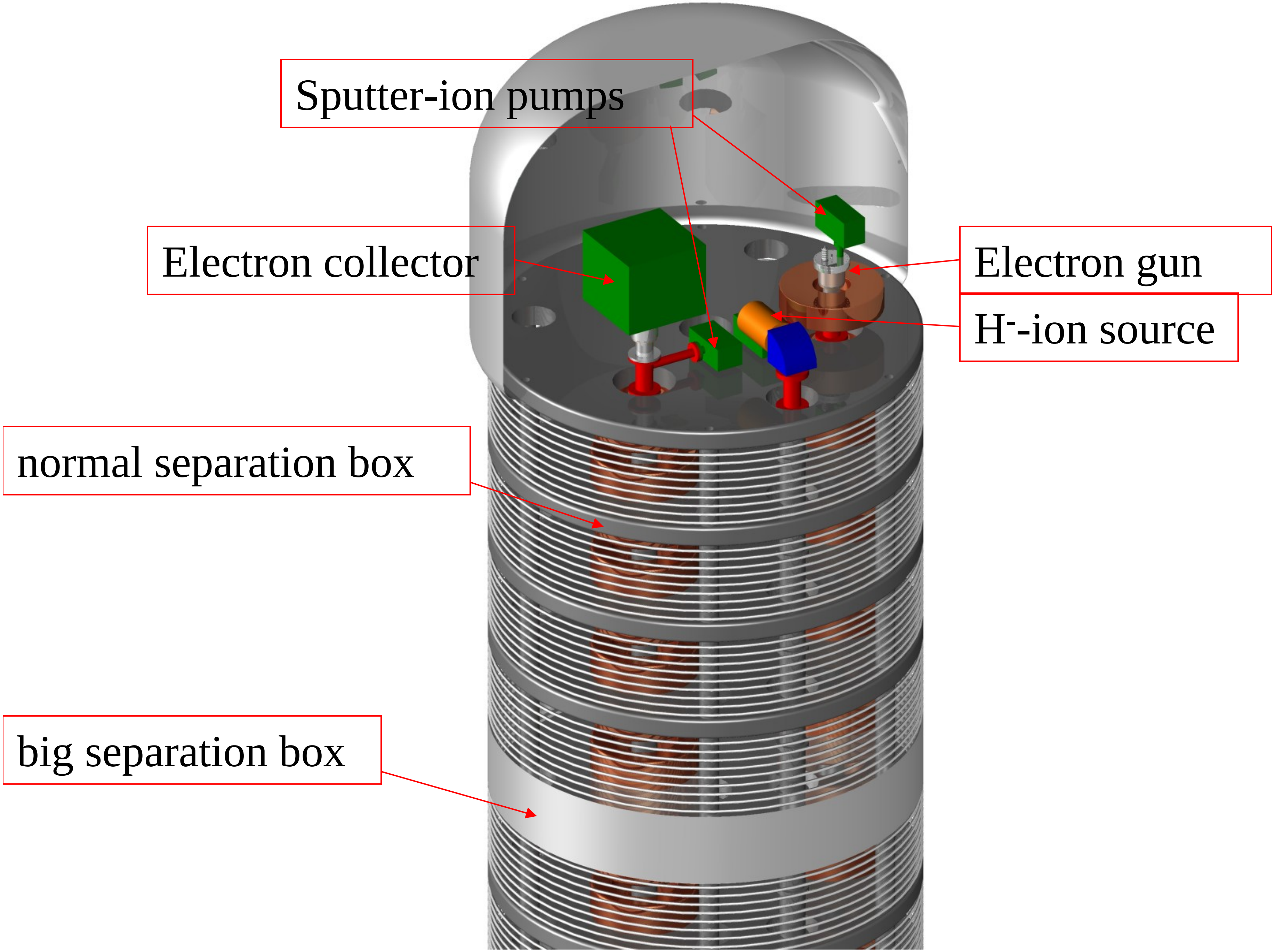
drift section is shown too short


A
B
Accel/Decel Tubes
Charging System
Position for Third Tube
Column Support Post
Drive Shaft
A-A
B-B
1000 mm
TSL
0-ECO-0001-F

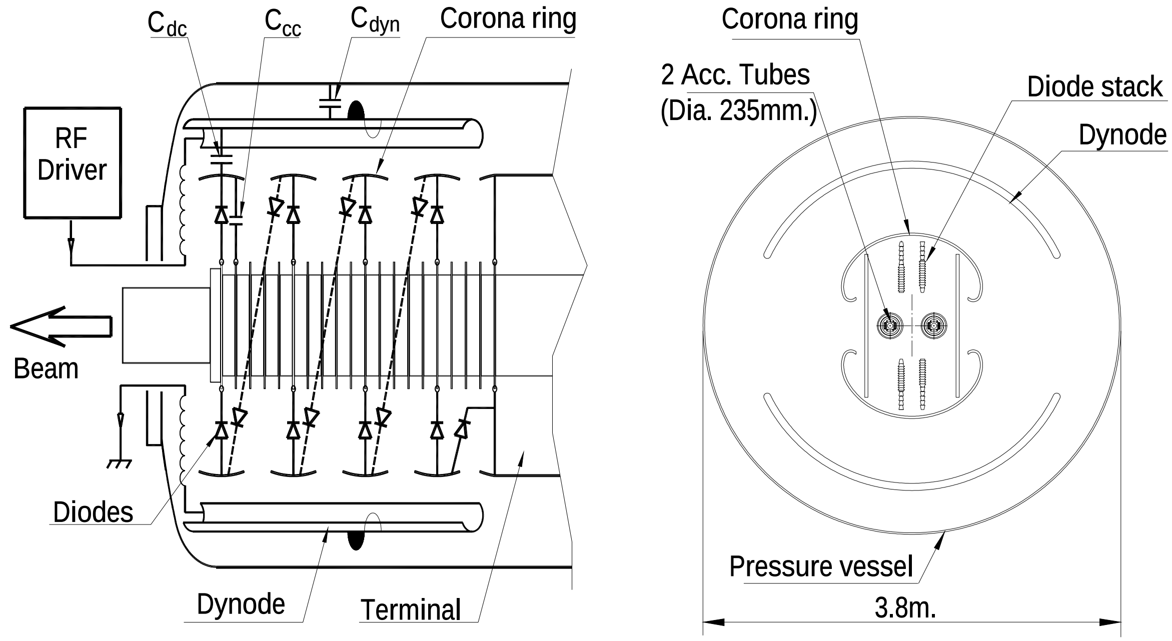

TSL

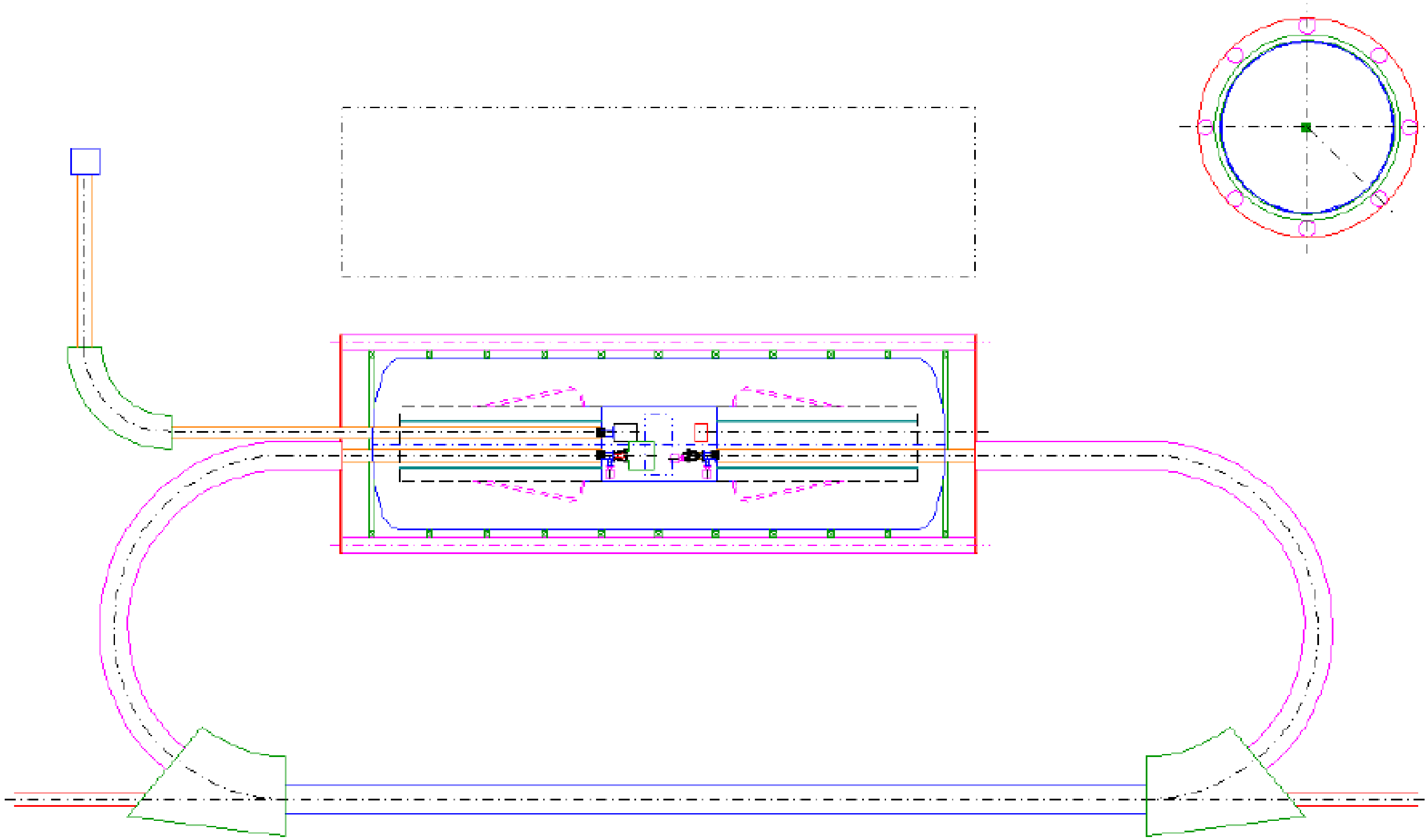

TSL


SAM_V4.00 26-08-2004 09:05 ace
R(mm)
560
420
280
140
0
-350
-210
-70
70
210
Z(mm)
93 kV/cm
92 kV/cm
82 kV/cm
Solenoid
Solenoid
Corona rings
NEC tube


Sputter-ion pumps
Electron collector
Electron gun
H^--ion source
normal separation box
big separation box

… or (cascade generators, so called (“Dynamitrons”)





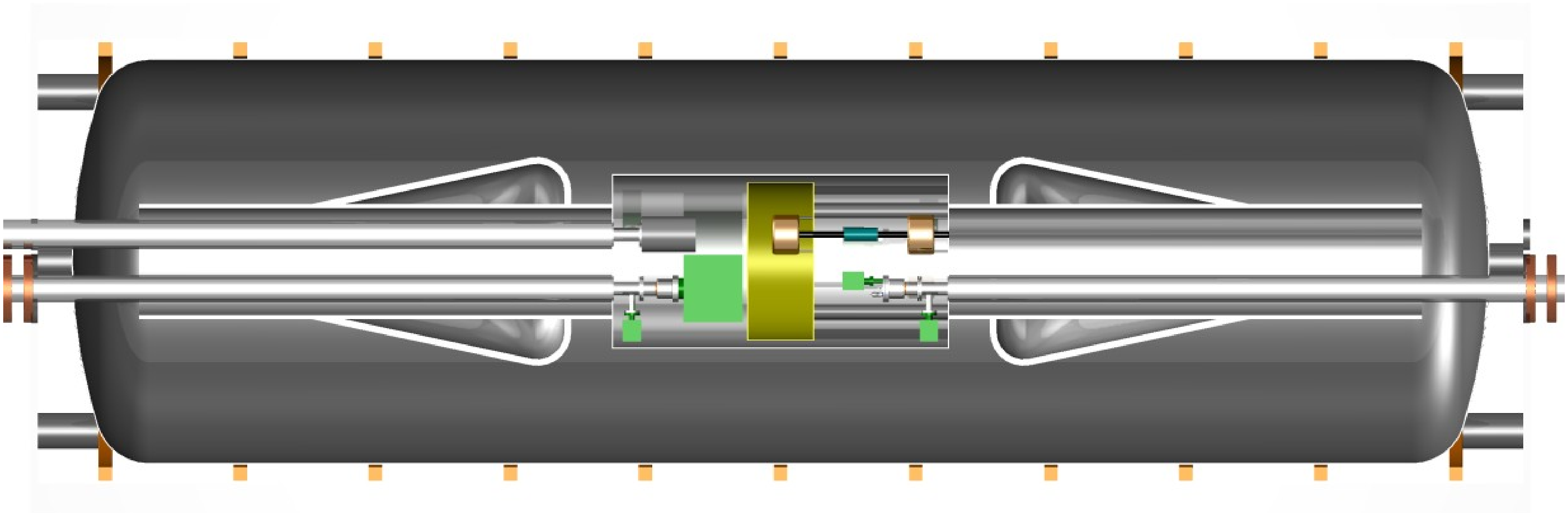
TLJ 1:50

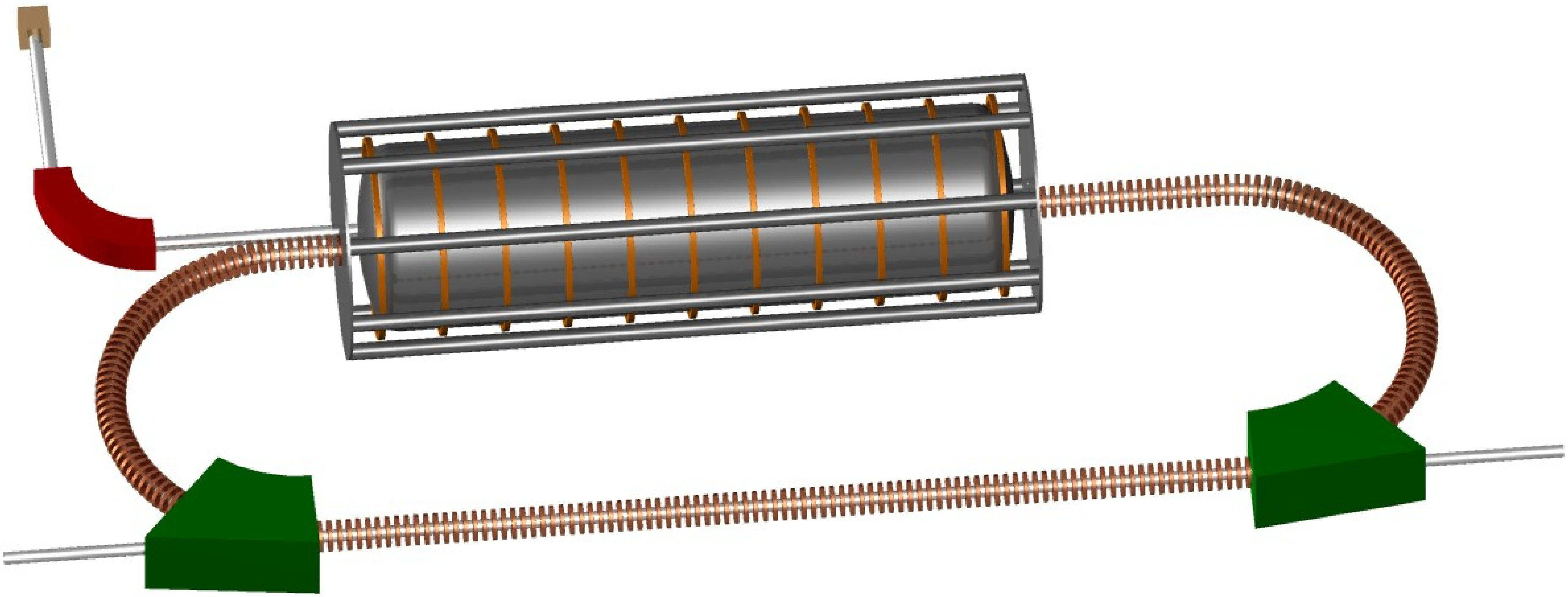
TSL

Prel. layout of HESR electron cooler

050906

Z-ECO-0014-A





Advantages of Pelletron:

- experience at FNAL
- possibilities for copying from FNAL (getting help from FNAL?)
- proven UHV performance
- no need for extensive R&D

Advantages of Dynamitron

- low impedance on electrodes (150 MΩ vs 10 GΩ)
- proven performance with 10^{-5} voltage stability and ripple
- fast regulation of voltage without corona spikes
- horizontal layout (no need for tower)

We will continue study of both alternatives, but hope to make a choice shortly.

Updated Technical Report must be ready 15 December.

We would very much like to again establish collaboration with BINP, also with JINR, FNAL, BNL...