

# **SOLENOIDS FOR THE CTF3 INJECTOR**

L. Groening

# Solenoids for the CTF3–Injector (Nominal Stage)

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## Outline

- Adiabatic Beam Compression
- Axial Solenoidal Field
- Layout and Placement of Solenoids

Heating of electrons caused by compression neglectable, if:

$$\frac{\delta B_s}{\delta s} \cdot \lambda_c \ll B_s$$

$\lambda_c$  : cyclotron wavelength

For relativistic electrons:

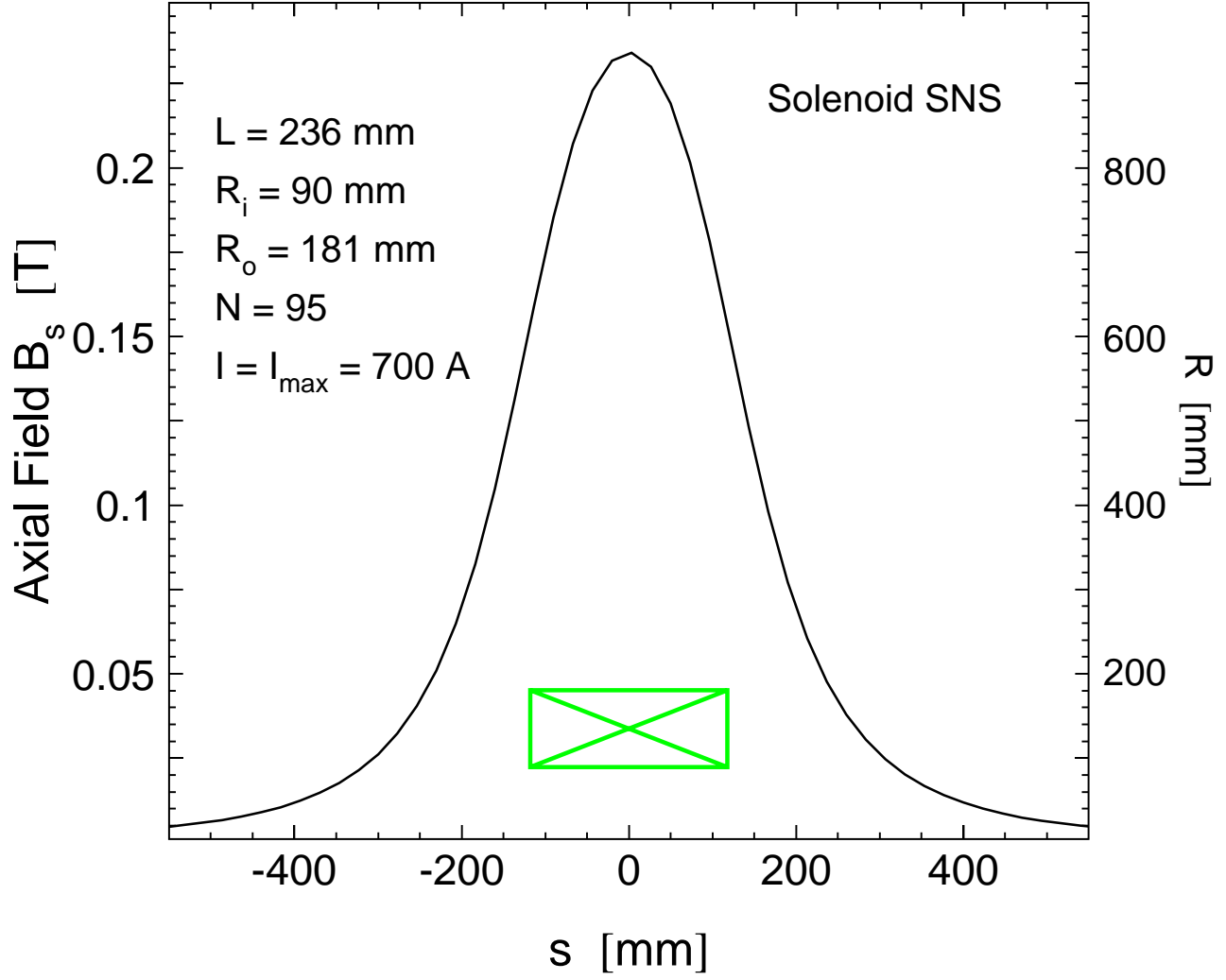
$$B'_s \ll 37 \frac{1}{\text{Tm}} \cdot \frac{B_s^2}{\gamma}$$

Final energy: 26 MeV

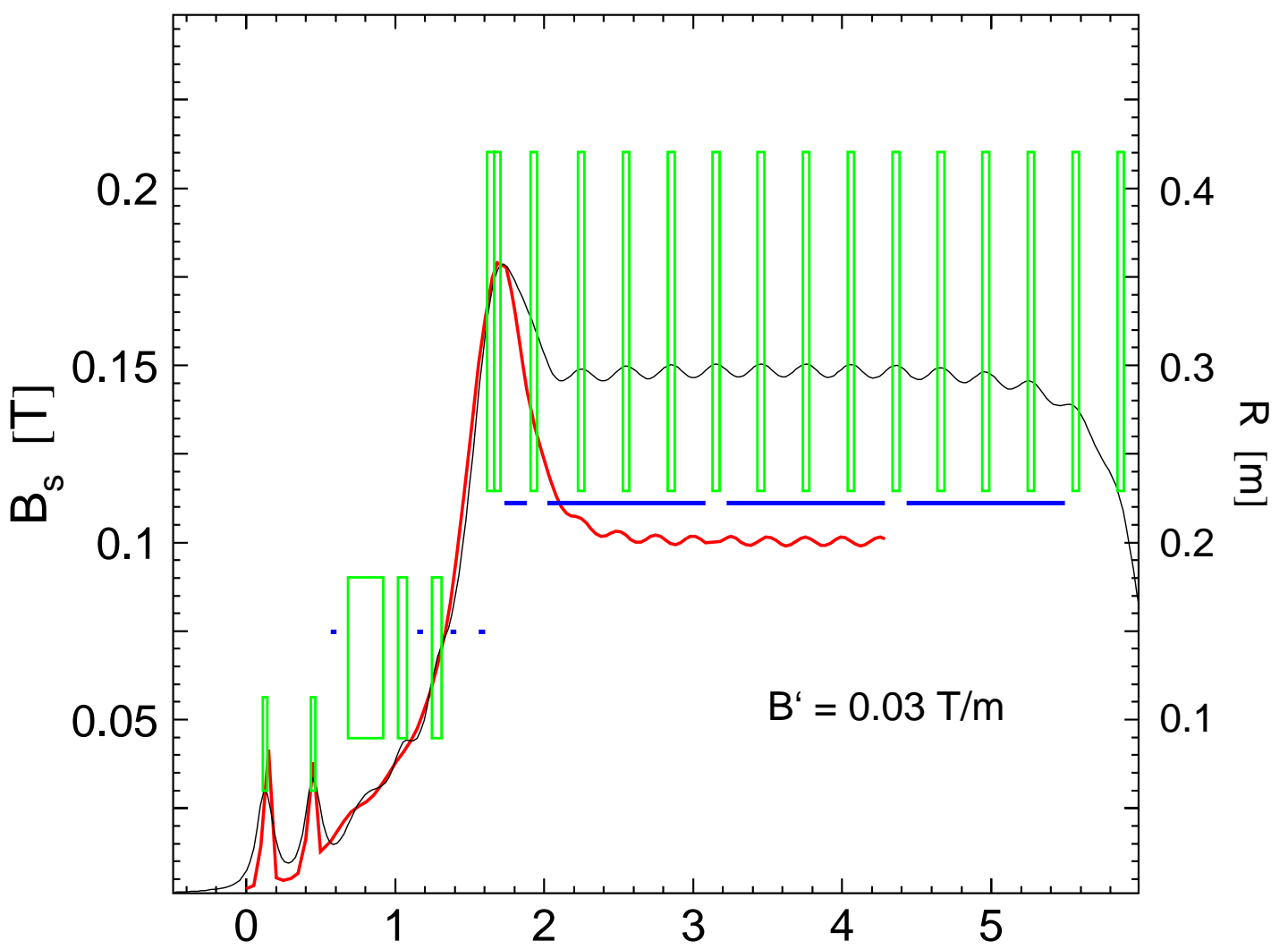
Magnetic field: 2 kG

$$B'_s \ll 0.03 \frac{\text{T}}{\text{m}}$$

Axial field  $B_s$  along Solenoid axis :

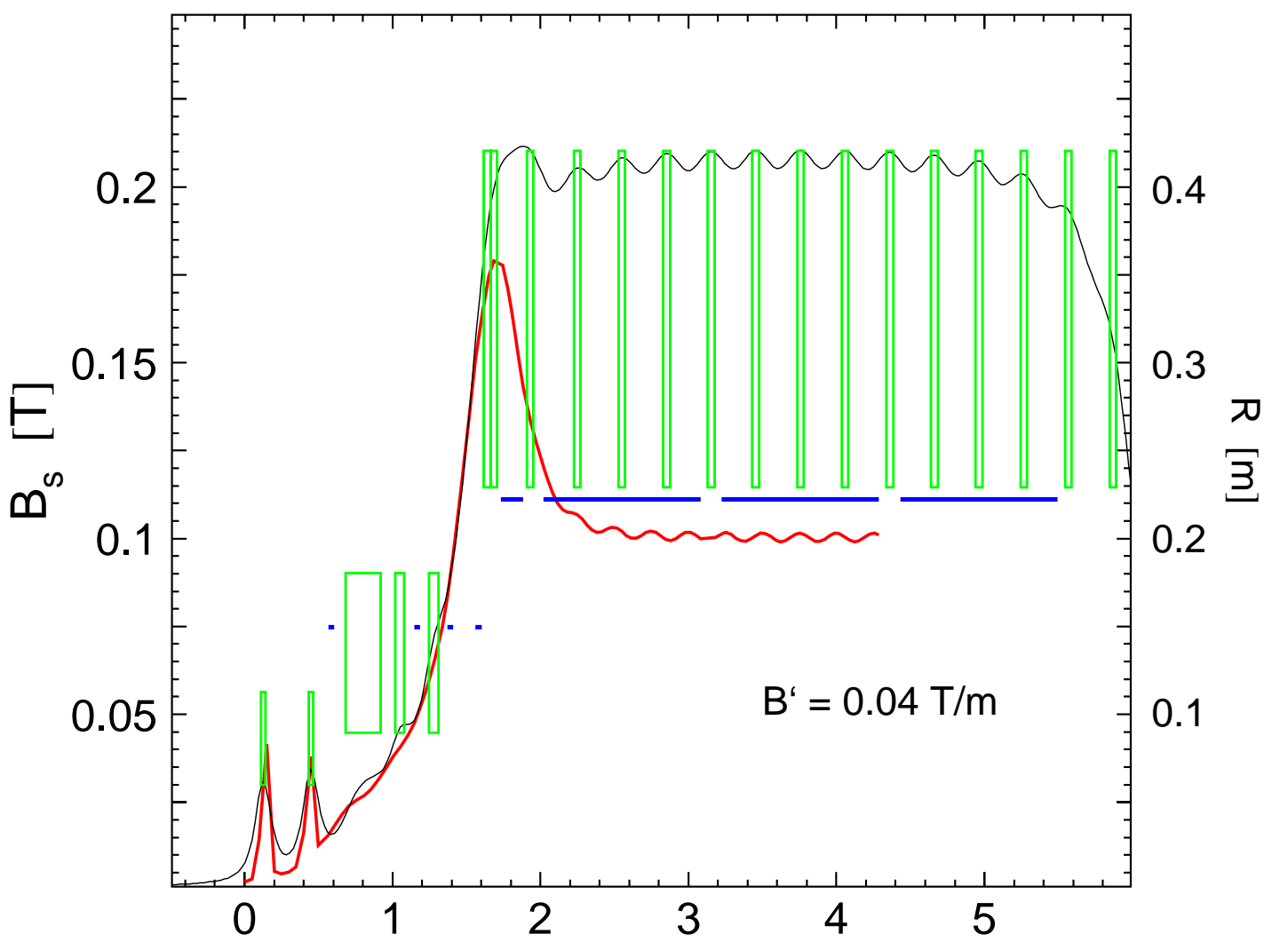


$$B_s = \frac{\mu_0 N I}{2L(R_o - R_i)} \left[ \left( \frac{L}{2} - s \right) \ln \frac{R_o + \sqrt{R_o^2 + \left( \frac{L}{2} - s \right)^2}}{R_i + \sqrt{R_i^2 + \left( \frac{L}{2} - s \right)^2}} - \left( \frac{L}{2} + s \right) \ln \frac{R_i + \sqrt{R_i^2 + \left( \frac{L}{2} + s \right)^2}}{R_o + \sqrt{R_o^2 + \left( \frac{L}{2} + s \right)^2}} \right]$$



$s_0/m$	$L/mm$	$D_i/mm$	$D_o/mm$	$N$	$I_{max}/A$	$I/A$	circuit	$R/m\Omega$	$P/kW$	existing
0.127	33	120	226	185	20	20	A	871	0.349	yes
0.449	33	120	226	185	20	20	A	871	0.349	yes
0.800	236	180	362	95	700	50	B	11.6	0.0291	yes
1.050	62	180	362	23	700	175	C	5.63	0.172	yes
1.279	62	180	362	23	700	175	C	5.63	0.172	yes
1.640	45	460	844	72	700	460	D	151	31.9	yes
1.685	45	460	844	72	700	460	D	151	31.9	yes
1.930	45	460	844	72	700	460	D	151	31.9	no
2.248	45	460	844	72	700	500	E	654	163	no
2.550	45	460	844	72	700	500	E	654	163	no
2.852	45	460	844	72	700	500	E	654	163	no
3.153	45	460	844	72	700	500	E	654	163	no
3.455	45	460	844	72	700	500	E	654	163	no
3.757	45	460	844	72	700	500	E	654	163	no
4.059	45	460	844	72	700	500	E	654	163	no
4.360	45	460	844	72	700	500	E	654	163	no
4.662	45	460	844	72	700	500	E	654	163	no
4.964	45	460	844	72	700	500	E	654	163	no
5.266	45	460	844	72	700	500	E	654	163	no
5.567	45	460	844	72	700	500	E	654	163	no
5.897	45	460	844	72	700	500	E	654	163	no

Table 1: Parameters for the solenoids of the CTF3 injector ( $B_s = 1.5$  kG).



$s_0/m$	$L/mm$	$D_i/mm$	$D_o/mm$	$N$	$I_{max}/A$	$I/A$	circuit	$R/m\Omega$	$P/kW$	existing
0.127	33	120	226	185	20	20	A	871	0.349	yes
0.449	33	120	226	185	20	20	A	871	0.349	yes
0.800	236	180	362	95	700	50	B	11.6	0.0291	yes
1.050	62	180	362	23	700	175	C	5.63	0.172	yes
1.279	62	180	362	23	700	175	C	5.63	0.172	yes
1.640	45	460	844	72	700	460	D	101	21.4	yes
1.685	45	460	844	72	700	460	D	101	21.4	yes
1.930	45	460	844	72	700	700	E	704	345	no
2.248	45	460	844	72	700	700	E	704	345	no
2.550	45	460	844	72	700	700	E	704	345	no
2.852	45	460	844	72	700	700	E	704	345	no
3.153	45	460	844	72	700	700	E	704	345	no
3.455	45	460	844	72	700	700	E	704	345	no
3.757	45	460	844	72	700	700	E	704	345	no
4.059	45	460	844	72	700	700	E	704	345	no
4.360	45	460	844	72	700	700	E	704	345	no
4.662	45	460	844	72	700	700	E	704	345	no
4.964	45	460	844	72	700	700	E	704	345	no
5.266	45	460	844	72	700	700	E	704	345	no
5.567	45	460	844	72	700	700	E	704	345	no
5.897	45	460	844	72	700	700	E	704	345	no

Table 1: Parameters for the solenoids of the CTF3 injector ( $B_s = 2.0$  kG).

