LC e+ sources

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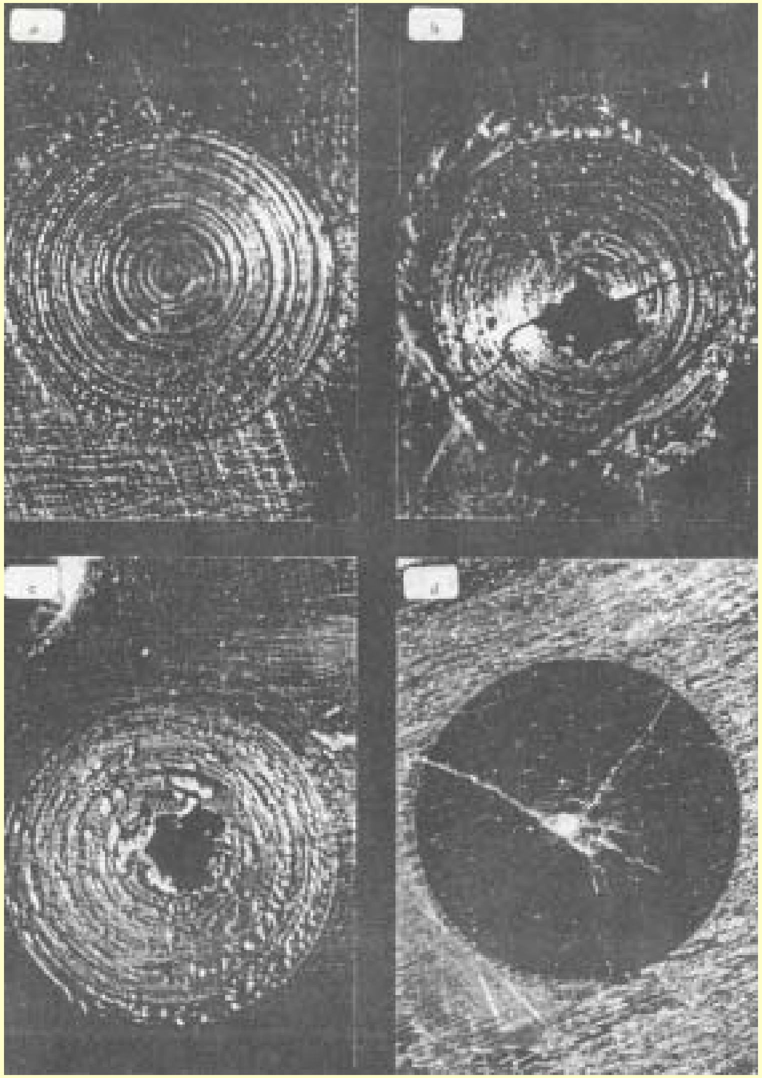
At Channeling e+ source Workshop

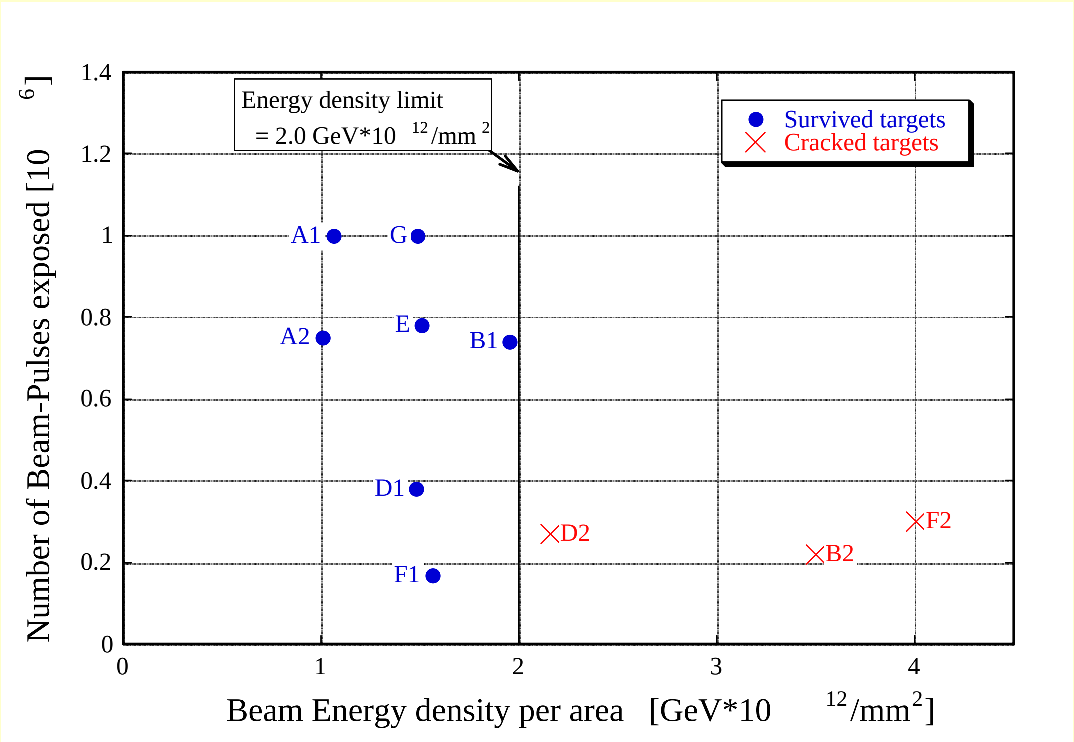
2003.Jan.17 at KEK

Comparison of the LC e+ sources

	JLC	NLC	CLIC	TESLA
Collision Energy [TeV]	0.5~1.0	0.5~1.0	1.0~3.0	0.5~0.8
Luminosity [10^{34}]	2.5	2.0	10.0	3.4
Ne+/pulse [10^{11}]	14.4	17.1	6.2	560.0
e+ (γ) generation	EM shower	EM shower	EM shower	Undulator
primary e- energy	10.0 GeV	6.2 GeV	2.0 GeV	250 GeV
Ne-/pulse [10^{11}]	19.2	28.5	20.8	560.0
Repetition rate	150 Hz	120 Hz	200 Hz	5 Hz
e- beam power	461 kW	340 kW	133 kW	11200 kW
e- radius on target	2.5 mm	1.6 mm	2.0 mm	(γ) 0.7 mm
# of target system	3	3 out of 4	1	1
Peak energy density	35 J/g	35 J/g	35 J/g	?
Target material	W75Re25	W75Re25	W75Re25	Ti
Target thickness	6.0 X0	4.0 X0	4.0 X0	0.4 X0
Matching system	AMD	AMD	AMD	AMD

Target Destruction Issue



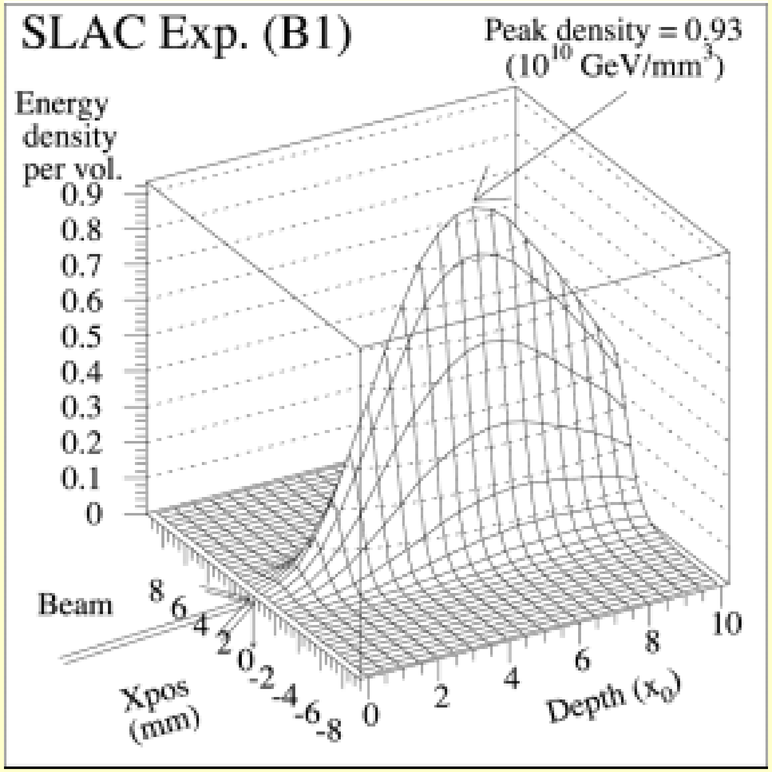


W75Re25 targets were irradiated by 20-GeV, 16-nC e- beam at SLAC. By changing the beam spot size, the energy density threshold for the destruction was studied.

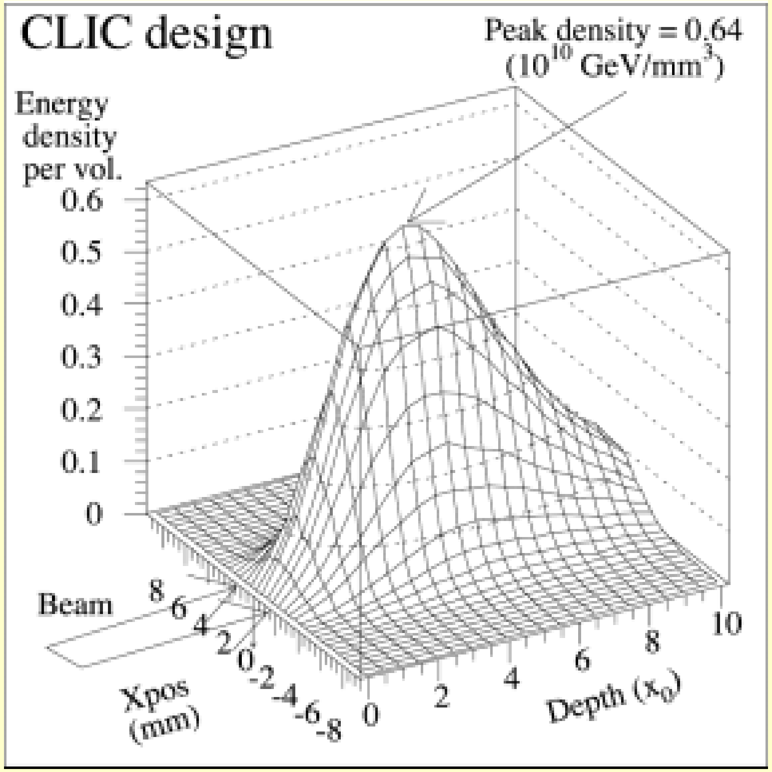
(S. Ecklund, SLAC-CN-128, 1981)

Local volume Energy Density

SLAC Limit condition

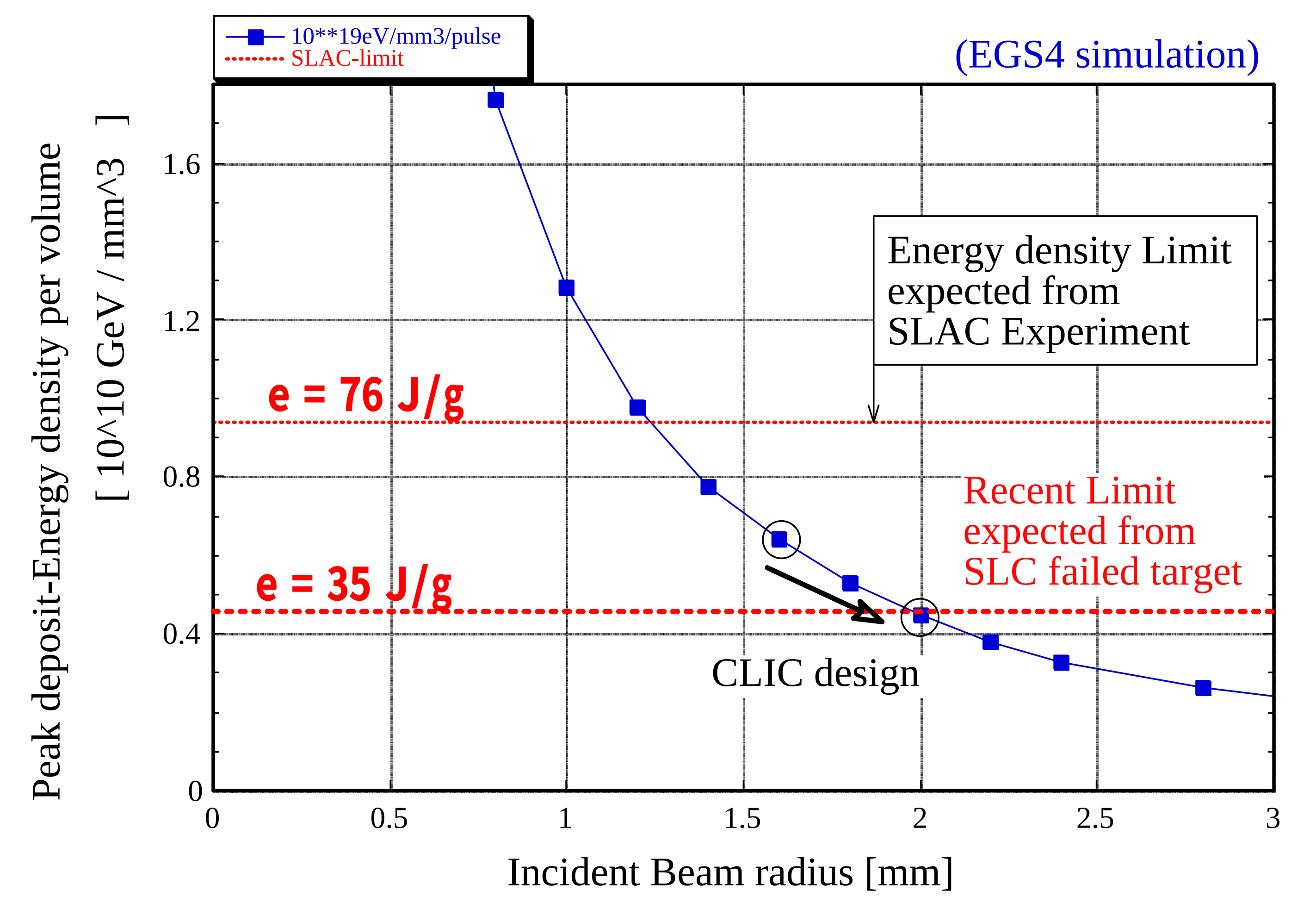


CLIC Design



Local volume density is more essential for the destruction.

Redection of energy density by enlarging the beam spot size



Multiple Target system

From http://www-project.slac.stanford.edu/lc/wkshp/snowmass2001/

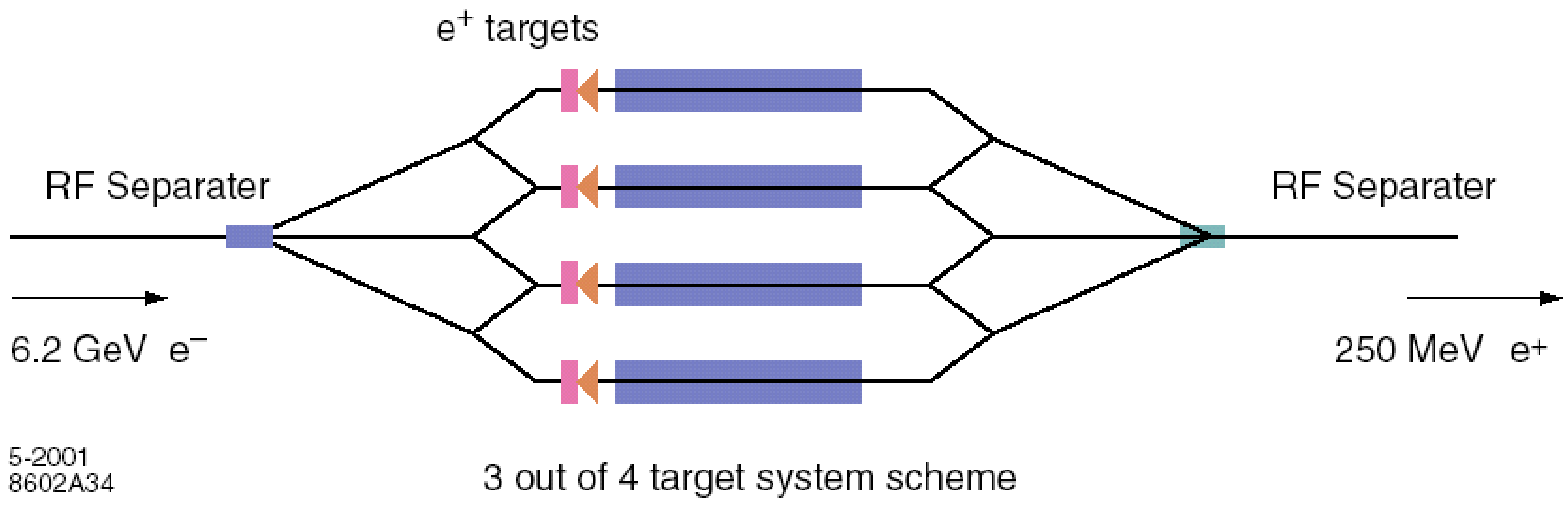
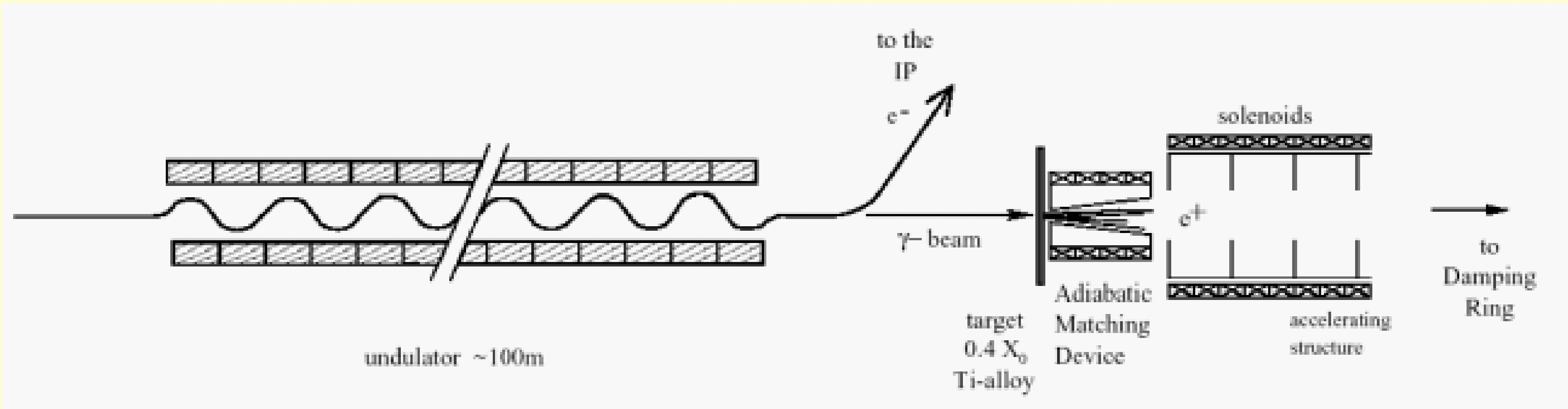


Figure 5.3: Schematic of the 3x4 NLC positron target system

- A bunch train is separated into 3 sparse trains by the RF separator
- Each trains hit one of the three target - capture section system
- They are merged by another RF deflector

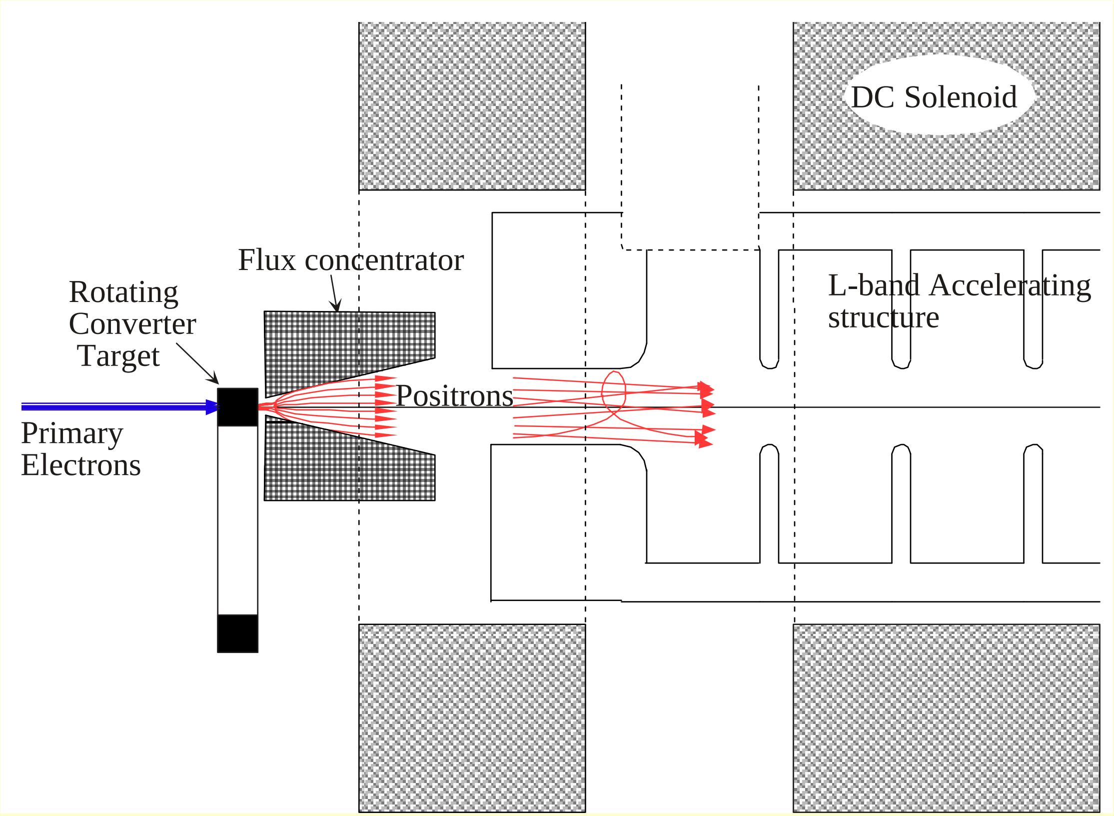
TESLA e+ source



Beam intensity in a pulse is too large to irradiate directly the target material. Instead, very high energy e- beam and undulator are used to generate 20 MeV photons.

Target material is very thin (0.4 X0) to reduce the energy deposition, however, sufficient for the low energy photons.

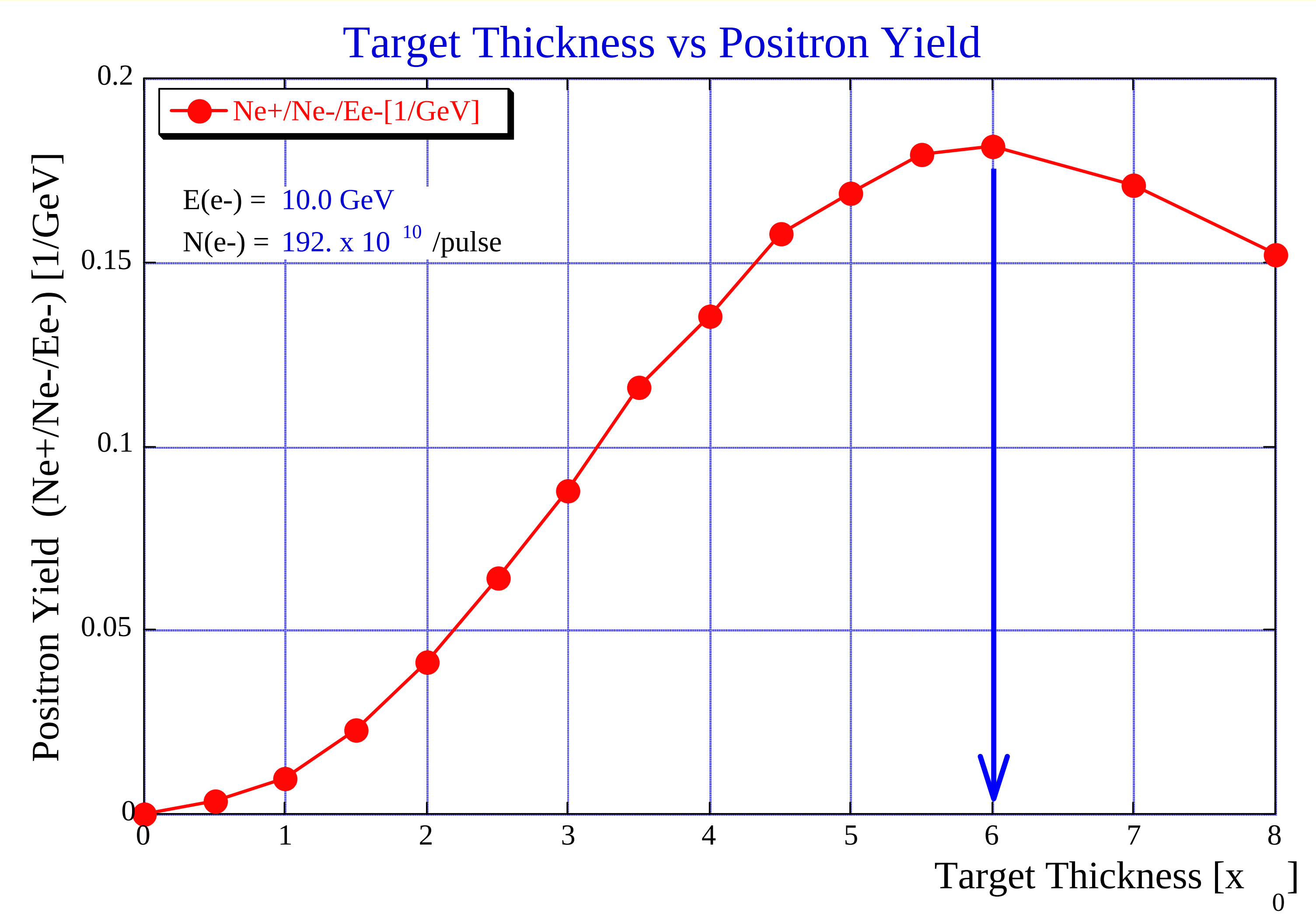
JLC Positron Source



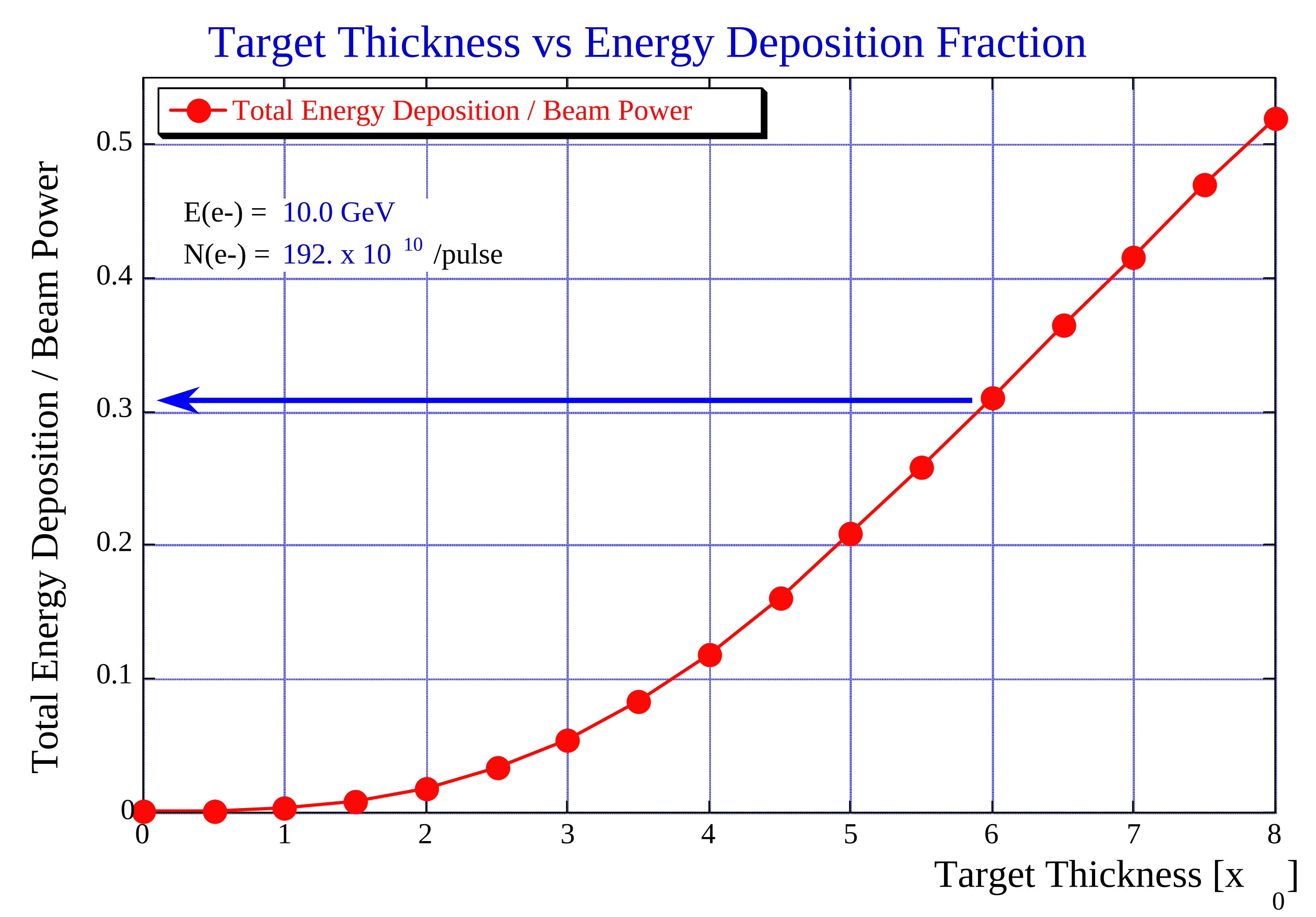
- W75Re25 target
- Thickness 6.0 X0
  (=21mm)
- Adibatic matching system
  Bi = 7.0 T, Bf = 0.5 T
- L-band capture section
  up to 180 MeV
- S-band Linac
  up to 1.98 GeV
- Pre-damping ring and
  Main damping ring
  at 1.98 GeV

E(e-) = 10 GeV
N(e-) = 192x10^10
150 Hz Rep. Rate

Target Thickness Optimization

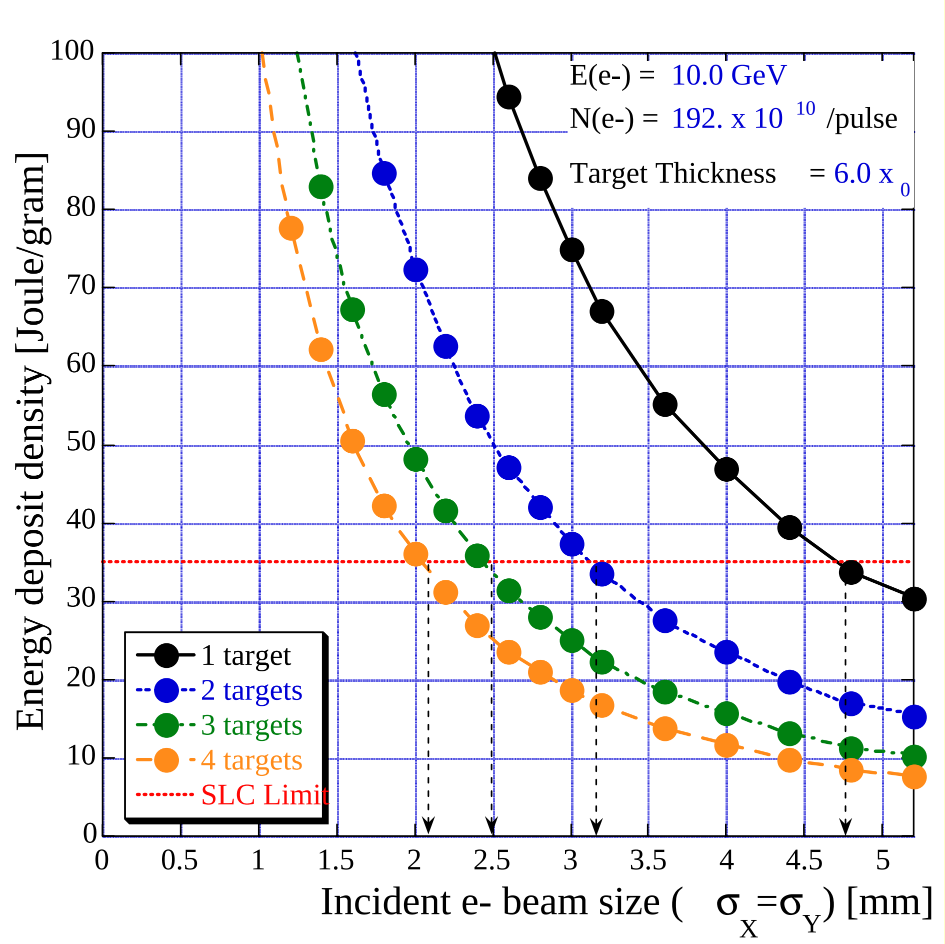


Total Energy Deposition



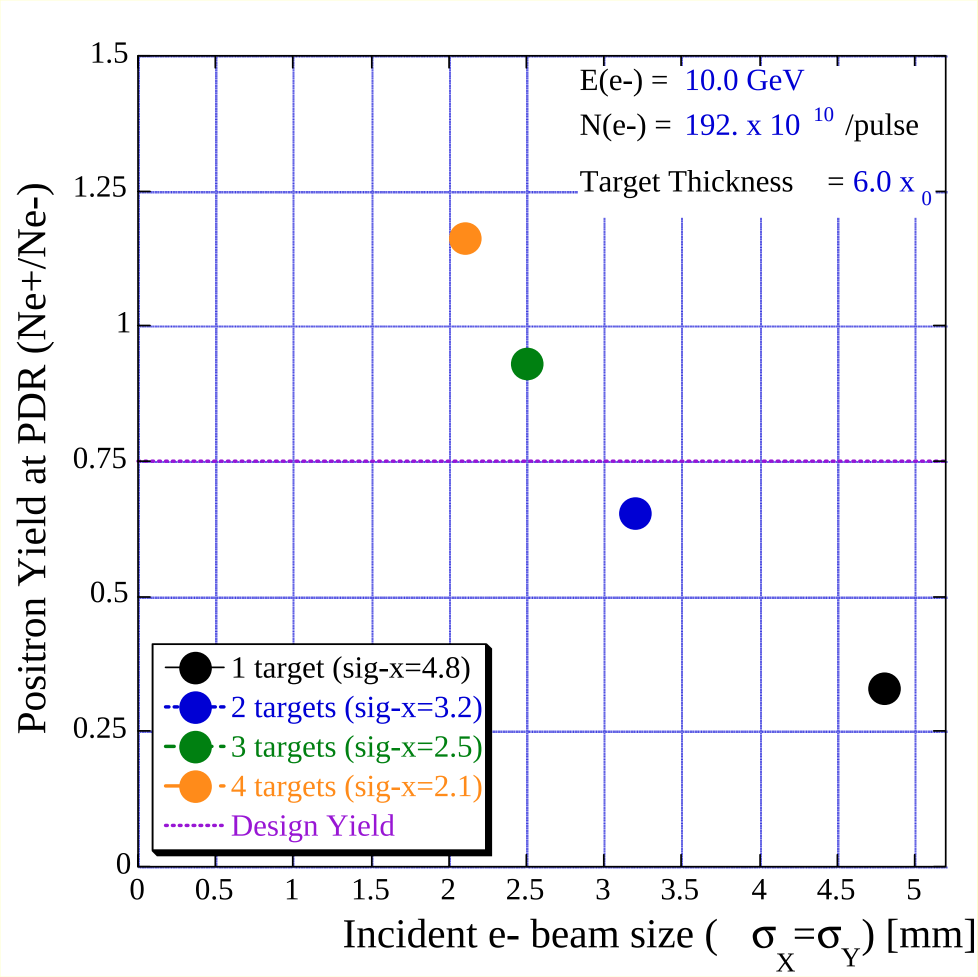
30% of Beam Power is deposited on the target

Local volume Energy density



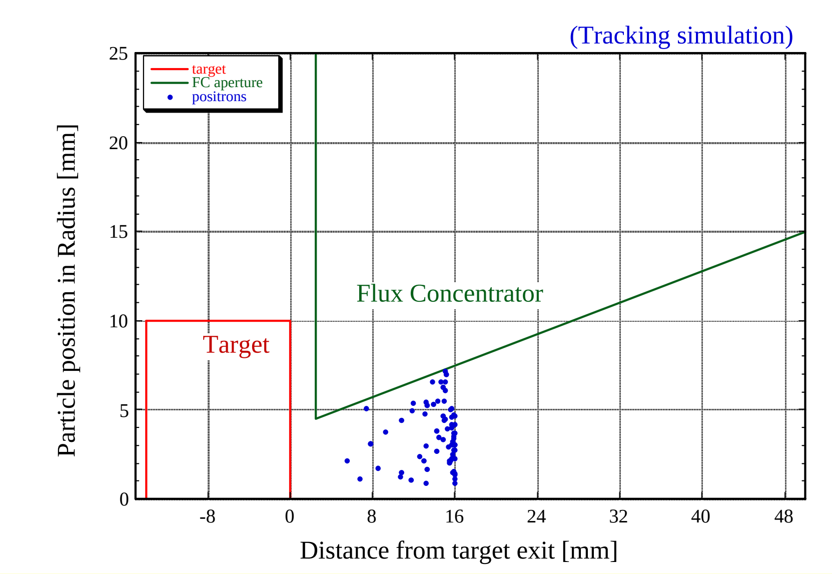
To make the peak energy denisty below the destruction limit, very large spot size or multiple target system is necessary.

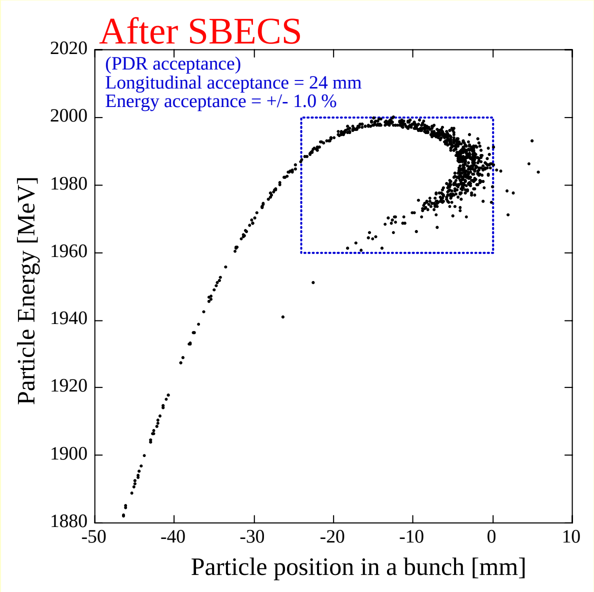
Positron Yield vs Beam spot size



With large spot size, the positron yield is lower. Single or 2 target system is not acceptable. At least, 3 target system is necesarry.

Positron Yield Estimation





- **Positron Generation at target (EGS4)**
- **Positron Tracking in the capture section (SOLEIL)**
- **Positron Tracking in the e+ 1.98-GeV linac (SAD)**
- **Elimination with Pre-damping Ring acceptance (both in transverse and longitudinal phase space)**

Proposals to Channeling Experts

- Design Goal of Channeling target for JLC
  to replace W75Re25 to crystal

  Comparable positron yield with

  1/3 of Peak energy density

- Search for the target material (crystal or hybrid) which generates sufficient positrons and comfirm it experimentally
- Establish the channeling simulation code which is consistent with the experiments
  - To generate sample particles for realstic yield estimation
  - To estimate the energy density distribution in the target