Conversion Targets for Compton Sources

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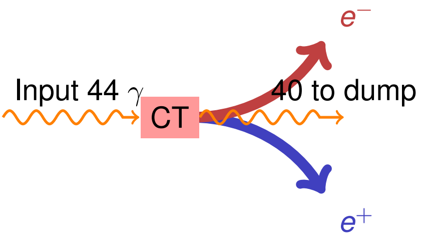
Gamma–to–positrons Conversion: Bottleneck



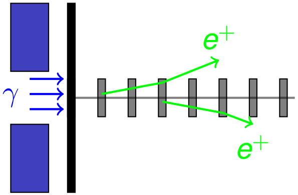
- Budget of conversion (ILC RDR)
  - 44 input gammas / positron
  - 3 gammas 'heat up' the conversion target (CT)
  - 40 gammas to dump
- ILC positron bunch at CT output
  - bunch current 4.8 kA (3.2 nC, 200 μm)
  - with 1.5 overhead $\approx$ 7.5 kA
- Electron bunch at CT output
  - = to positron bunch
  - charge and current neutralization

Separation of the positrons from the electrons is an issue

Compton Sources

- Autonomous operation
  - one positron bunch built up from 1000 gamma pulses
  - easier to process the positron bunches
  - diminishing of power load in CP
  - effective materials for CT (Ta, W) acceptible
- Low energy of (circulating) electrons
  - eases collimation of gammas
- Required efficient conversion and powerful laser pulses
- Required intense electron beams

Sliced Rod Converter



- Path length of positrons much shorter than of gammas
  - increased yield of positrons (reduced losses)
  - decreases target heat load
  - Long CT (in rad. lengths) may be employed
- Drawbacks
  - large input spot of gammas (5…15 mm)
  - large radius (emittance) of output input spot of gammas

Sliced–rod target performance

per one incident gamma, tungsten

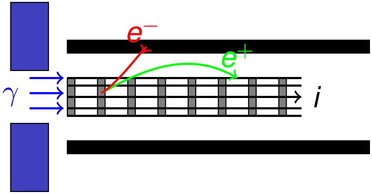
Rod length 1 m, $L_m = 3$ r.l. (maximal yield)

$E_{\max}$ (MeV)	r_{rod} (mm)	input	heat	pass	ϵ (mm rad)	rms r_{out} (mm)
20	10	2.08	0.33	0.75	11.0	43
20	5	1.79	0.20	0.59	6.4	36
30	10	1.75	0.28	0.44	8.8	35
10		44	3	40		2...3

Baseline RDR ILC, material Ti, 0.4 r.l.

Focusing by Current in Sliced–Rod CT

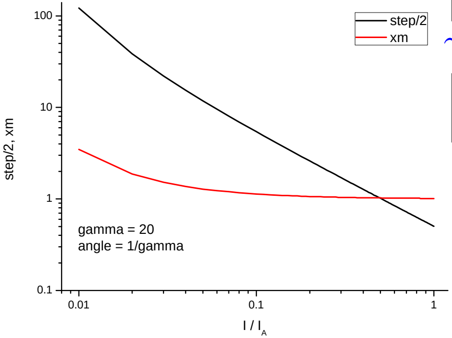
Idea borrowed from the lithium lens



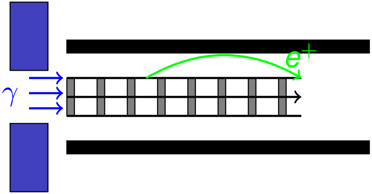
- Current along wires induces magnetic field, which
  - expels out electrons
  - focuses positrons
- Output positron beam waist diminished (emittance as well)

Focusing by current in sliced-rod CT

Analytic estimations



Max off–axis deviation and half-step vs. current ($I_{\mathrm{A}} = 17\,\mathrm{kA}$)



- Trajectory of positron determined by
  - rod current, and emitting angle
  - energy of positrons,
  - and emitting angle.
- Trajectory of positron scaled as rod radius

Feasibility of Sliced Rod with Current Focusing

- Emittance of the output positron bunches approaches the limit of those produced from thin foil target, while efficiency of conversion is high.
- Power load of the target lowered due to expelling of electrons (magnet field is defocusing for them), and bypass of most of positrons the target components.
- Kicker technology may be employed to feed the rod.
- Electric field can increase focusing effect, the current may be lower