

CO₂ Compton Ring

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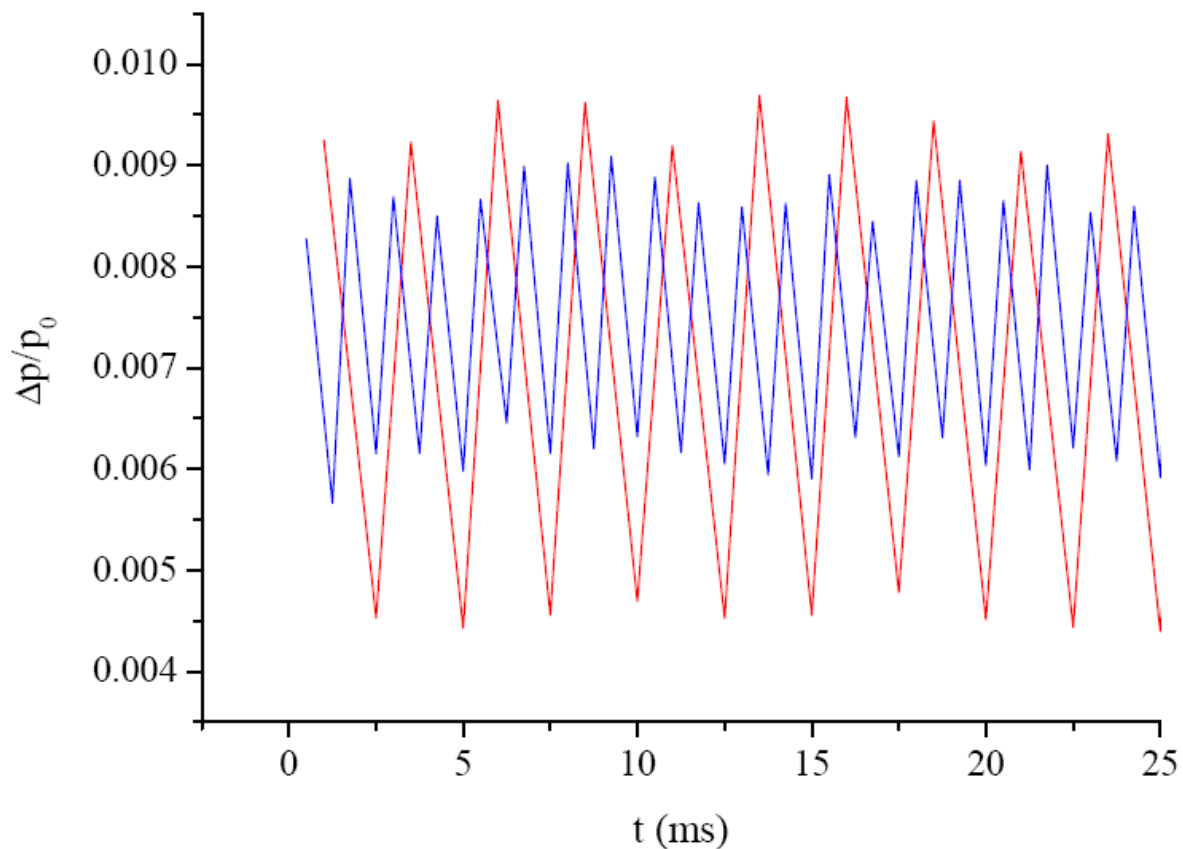
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Intensities of the CLIC positron subsystems

$$\langle(\Delta p/p_0)^2\rangle = f \cdot \tau_s \cdot \langle\delta^2\rangle / 4$$
$$E_{e^-} = 1.07 \text{ GeV}; \lambda_{\text{las}} = 1 \text{ } \mu\text{m}; \langle\delta^2\rangle^{1/2} \approx 0.01;$$
$$\tau_s = 2 \text{ ms} \Rightarrow \langle(\Delta p/p_0)^2\rangle^{1/2} \approx 1.25 \%$$
$$\tau_q \approx 21.5 \text{ s at } \sigma_{\text{RF}} = 6.25 \%$$

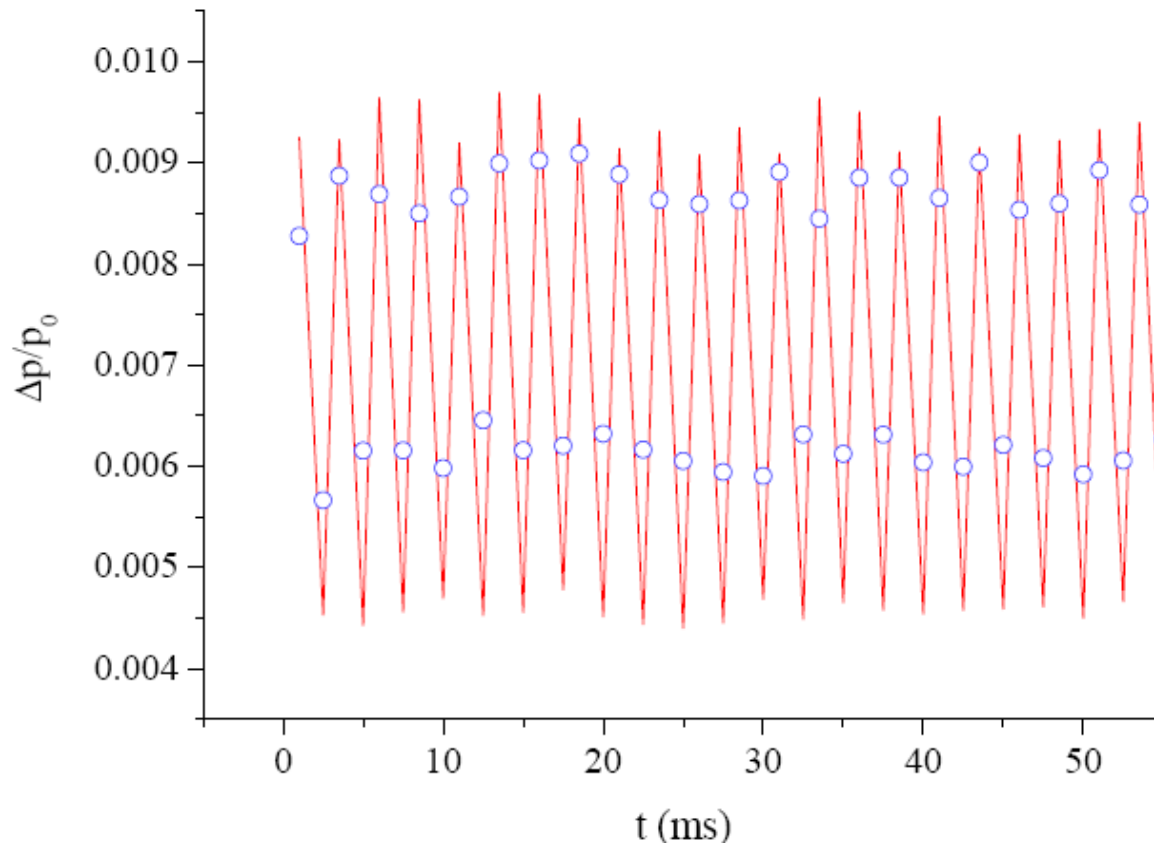
$$n_{\text{be}^+} = 4 \cdot 10^9 \Rightarrow Q_b = 0.64 \text{ nC}$$
$$N_{\text{e}^+} \approx 6.2 \cdot 10^{13} / \text{s} \Rightarrow I_{\text{e}^+} = 10 \text{ } \mu\text{A}$$
$$k = N_{\text{e}^+} / N_\gamma = 0.005 \Rightarrow N_\gamma \approx 1.2 \cdot 10^{16} / \text{s}$$
$$N_{\gamma \text{ tot}} = 1.8 \cdot 10^{16} / \text{s}$$
$$C_{\text{CR}} = 300 \text{ m, } I_{e^-} = 1 \text{ A, } N_{e^-} = 6.24 \cdot 10^{12}$$
$$f = N_{\gamma \text{ tot}} / N_{e^-} \approx 3000 \text{ } \gamma / e^- / \text{s}$$

Repetition rate of generation cycles



**Beam energy spread at repetition rate 400 & 800 Hz
(red & blue curves).**

Ring circumference



**Beam energy spread at ring circumferences 300 & 600 m
(red curve & blue circles).**

Rings parameters

C_{CR} (m)	f_{rep} (Hz)	λ_{las} (μ)	W_{las} (J)	σ_{l}^{xy} (μ)	σ_l^s (mm)	L_R (mm)	V_{RF} (MV)	σ_{RF} (%)	τ_q (s)
300	400	1	2.3	25×25	1	1.8	18	7.1	38
		2	1.8	40×40	2	2.4	16	5.4	45
		10	0.9	100×100	3	3	13	3.1	42
	800	1	2.3	25×25	1	1.8	16	6.5	21
		2	1.8	40×40	2	2.4	15	5.2	42
		10	0.9	100×100	3	3	10	2.9	36
600	400	1	2.3	25×25	1	1.8	16	6.4	25
		2	1.8	40×40	2	2.4	13	4.9	36
		10	0.9	100×100	3	3	10	2.8	40
	800	1	2.3	25×25	1	1.8	14	6.2	30
		2	1.8	40×40	2	2.4	12	4.6	22
		10	0.9	100×100	3	3	9	2.7	25

Simulation parameters:

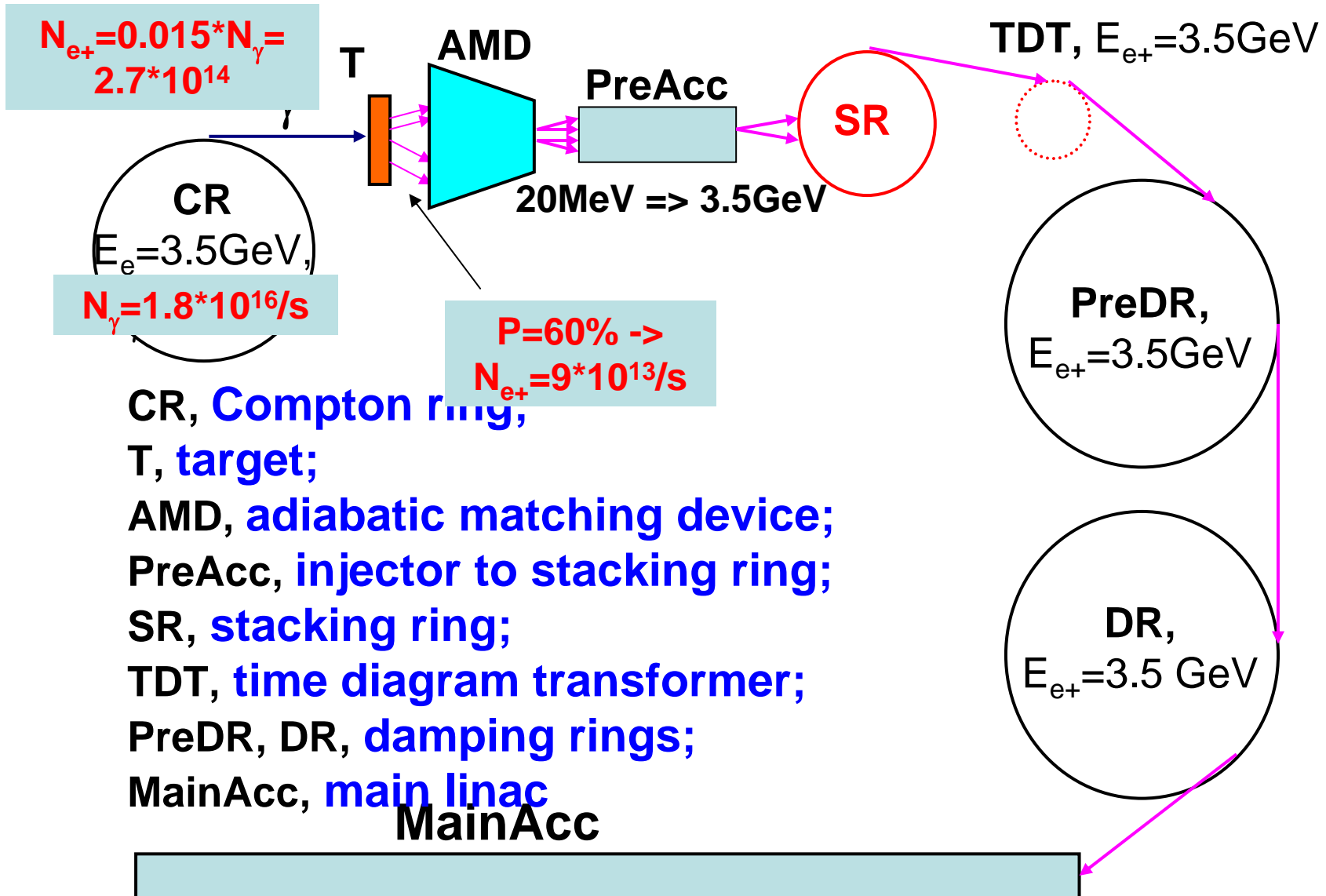
Transversal beam size $\sigma_x * \sigma_y = 80\mu * 20\mu$;

Momentum compaction $\alpha_1 = 5 * 10^{-4}$; 0.001 ($C_{CR} = 600m$; 300m)

Normal collision in horizontal plane, crossing angle is 8°;

Maximal gamma-quanta energy $\varepsilon_{\gamma max} = 20$ MeV

Layout of positron complex



CR, Compton ring;
T, target;
AMD, adiabatic matching device;
PreAcc, injector to stacking ring;
SR, stacking ring;
TDT, time diagram transformer;
PreDR, DR, damping rings;
MainAcc, main linac

Summary

At present, there is a high risk of the design of the Compton ring with solid state lasers

Compton ring with mode locked CO₂ laser is the best candidate for polarized positrons source

Mode locked CO₂ lasers are not developed yet, but there are some ideas for their development.