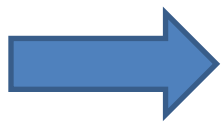


Revisit parameters for Conventional sources

Tohru Takahashi
contribution for LCWS/ILC2010

Motivation

- Preparation of positron sources by;
 - well established scheme and/or developable with existing resources
- 300Hz scheme
 - relaxes thermal problem on targets
 - lower speed rotation target will do
 - but still have the shock wave problem



survey (again) parameters of conventional targets in the drive beam energy – target thickness plane



See if conventional sources survives the ILC criteria

Methods

- Simulation by Geant4 with Tungsten
 - total positron yield
 - accepted positron yield with AMD acceptance
 - T.Kamitani, L.Rinolfi CLIC note 465
 - Peak Energy Deposit Density (PEDD)
 - Total Energy Deposit (TED)
- In space Beam Energy – Target Thickness
 - beam spot size at 1.0mm, 2.5mm, 4.0mm

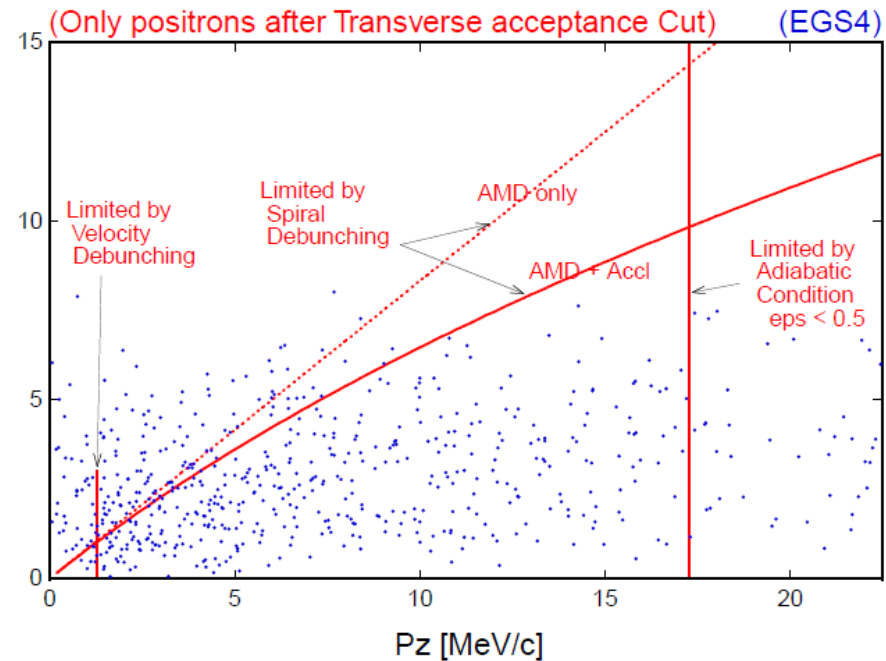
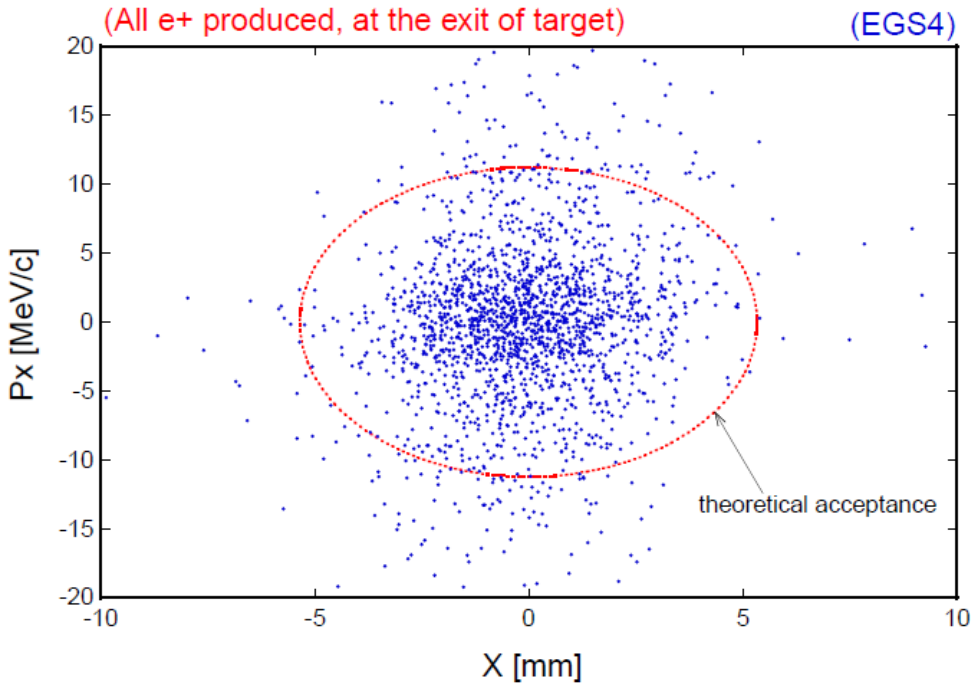
Acceptance estimate

CLIC note 465

$$[r/0.53]^2 + [pT/11]^2 = < 1$$

$$pT < 0.1875 \text{ MeV/c} + 0.625 pL$$

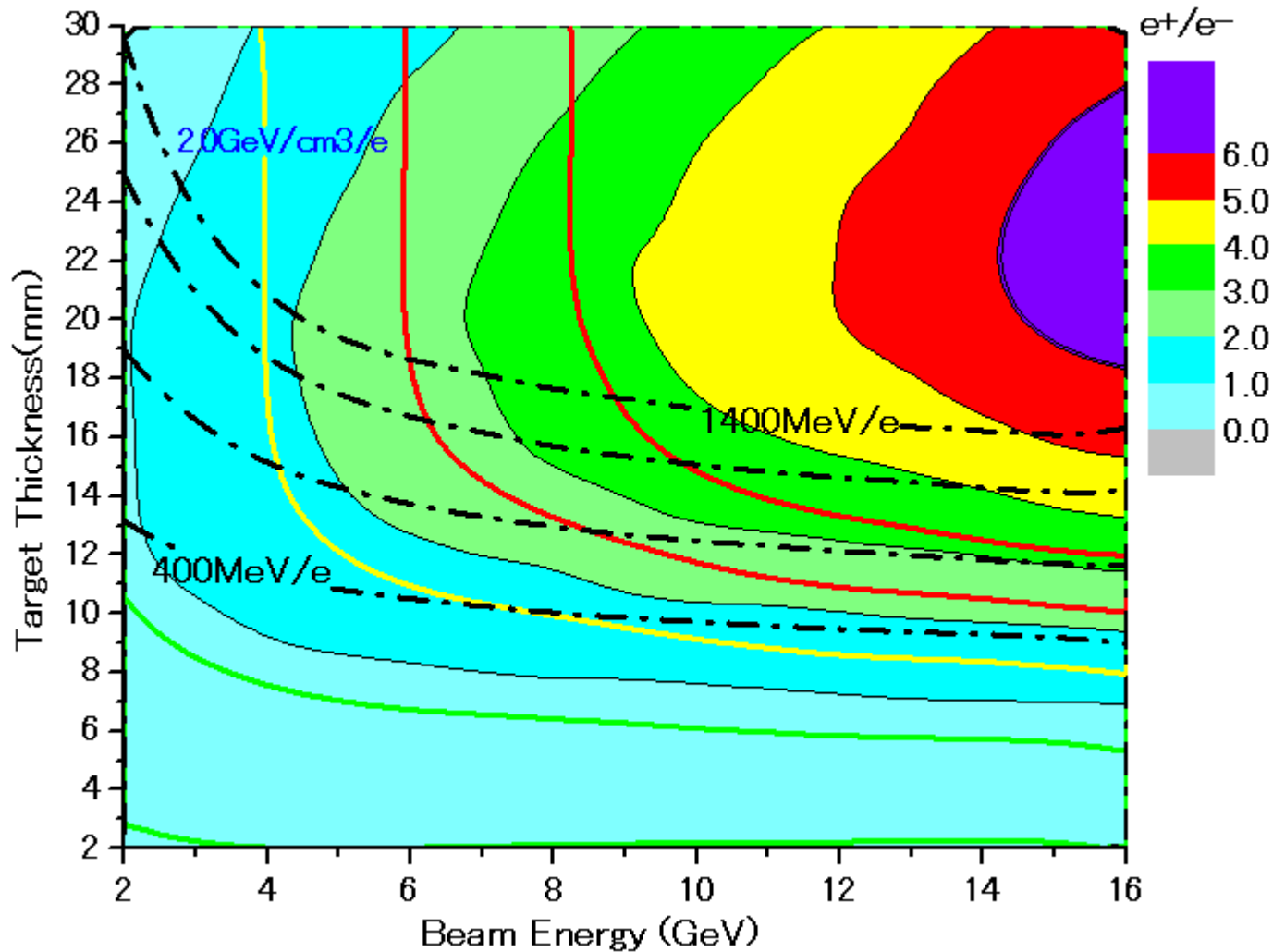
$$1.5 \text{ MeV/c} < pL < 17.5 \text{ MeV/c}$$



accepted e^+ yield and PEDD with conventional scheme

e^- directly on to Tungsten

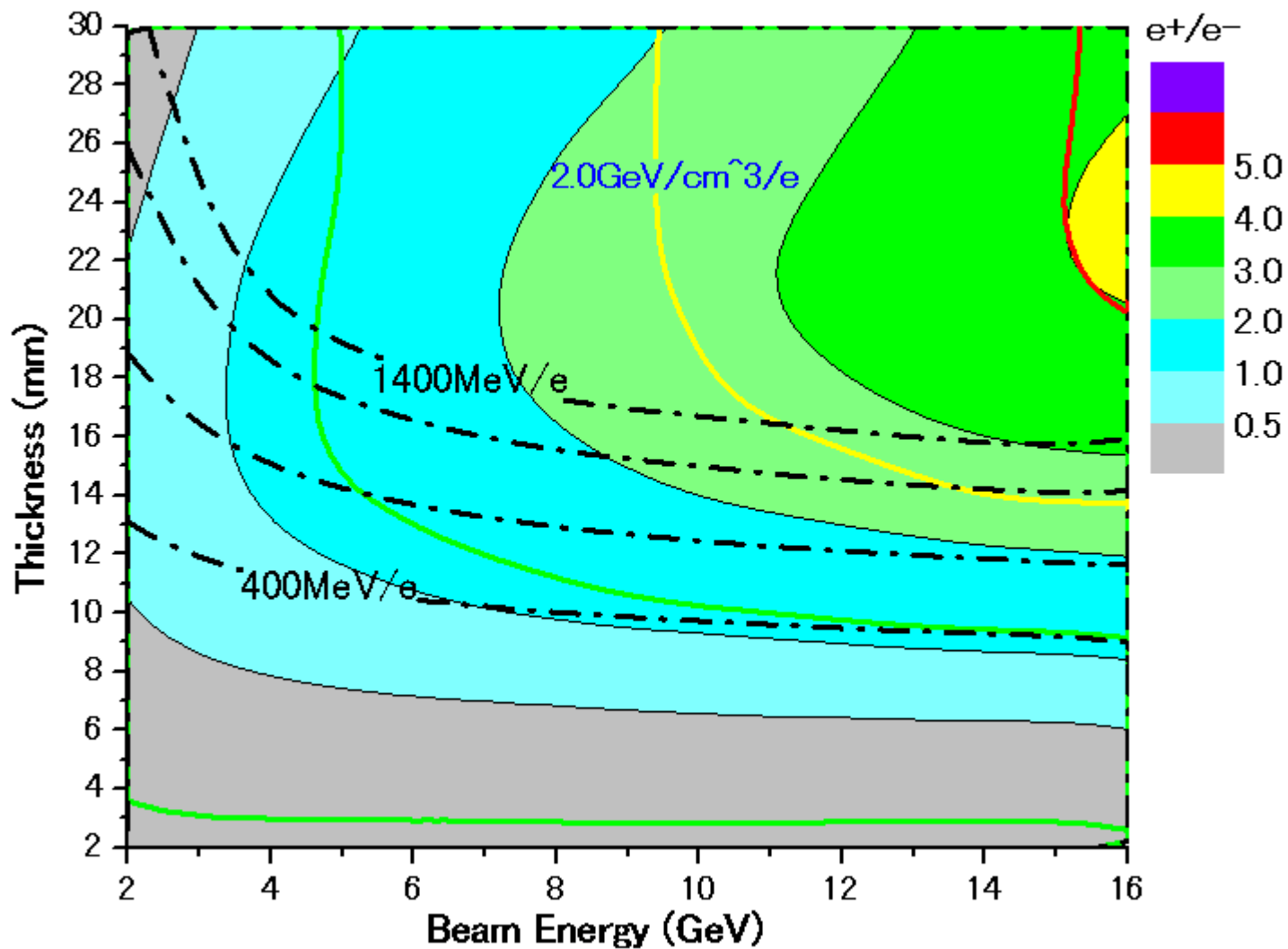
$\sigma = 2.5\text{mm}$



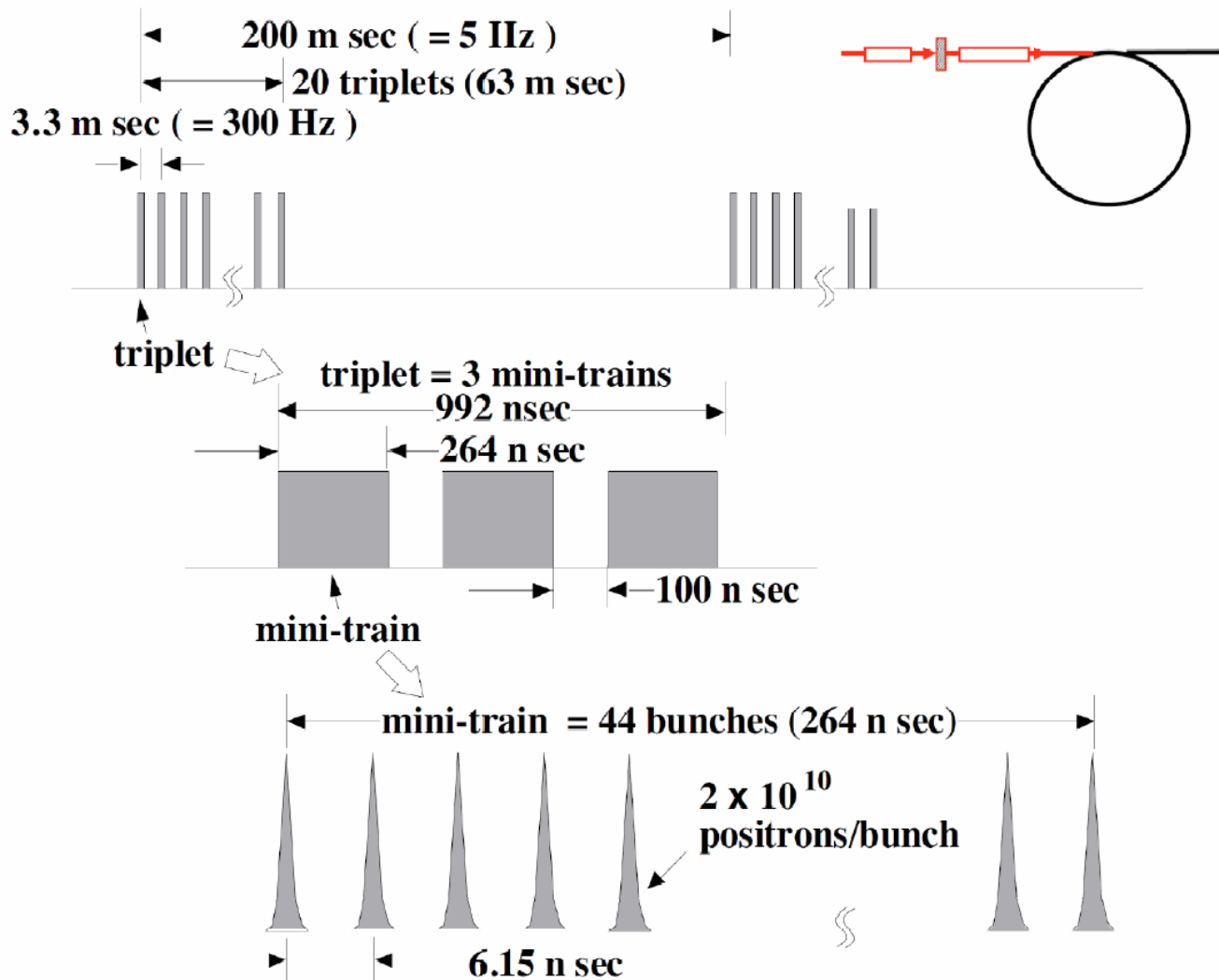
accepted e+ yield and PEDD with conventional scheme

e- directly on to Tungsten

$\sigma=4.0\text{mm}$



In the case of 300Hz scheme



Thermal diffusion

$$T(t) \sim T_0 e^{\alpha t}$$

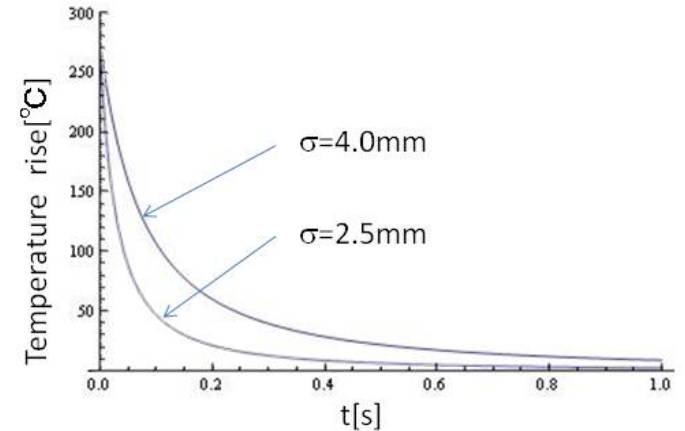
$$\alpha = -\frac{\lambda}{C_V} \beta^2$$

$$\lambda = 174 \text{ W/m} \cdot \text{K}$$

$$C_V = 2.5 \times 10^6 \text{ J/m}^3 \cdot \text{K}$$

time constant of the diffusion depends on beam spot size $\sim 1/\beta$

numerical calculation of thermal diffusion shows

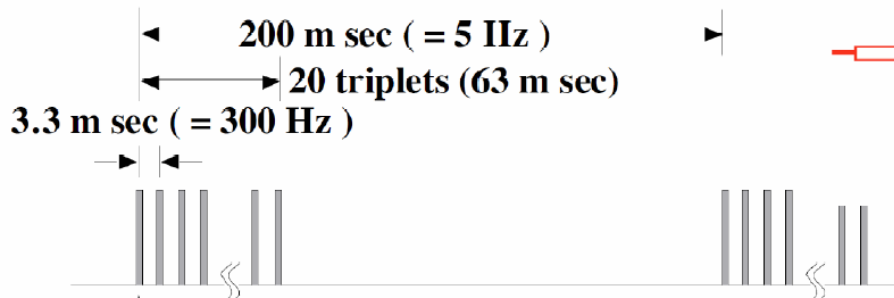
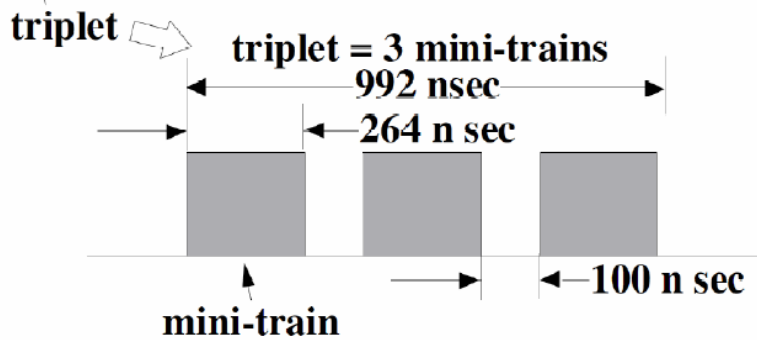


	1D	2D	3D
time			
constan	280ms	80ms	40ms
t	750ms	200ms	100ms
	$\sigma = 2.5 \text{ mm}$		
	$\sigma = 4.0 \text{ mm}$		

time constant is order of 100ms $\gg T_{\text{triplet}} \sim 1 \mu\text{s}$

Assumption

each triplet hits different position on the target
relatively low ($1\sim 2\text{m/s}$) rotational target



duration of a triplet \sim dumping time of shock wave
shorter than time scale of thermal dissipation



132 bunches in a triplet contributes both shock wave and thermal damage

Assumption

a triplet: 132 bunches 992ns

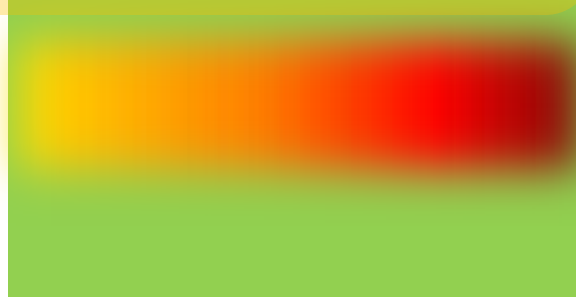
A diagram showing three blue rectangular blocks representing bunches, arranged horizontally. Two thin blue lines extend from the top corners of the first and third blocks downwards towards the text below.

3.3ms


A diagram showing three purple vertical bars representing triplets, arranged horizontally. A dashed blue line connects the top of the first bar to the top of the second bar. Two thin blue lines extend from the top corners of the first and third bars upwards towards the text above.

a train: 20 triplet
= 2640 bunches 63ms

132 bunches
make a shock wave
heat same position on the target

A rectangular heatmap showing a horizontal gradient of colors from green on the left to red on the right, representing a shock wave heating a target.

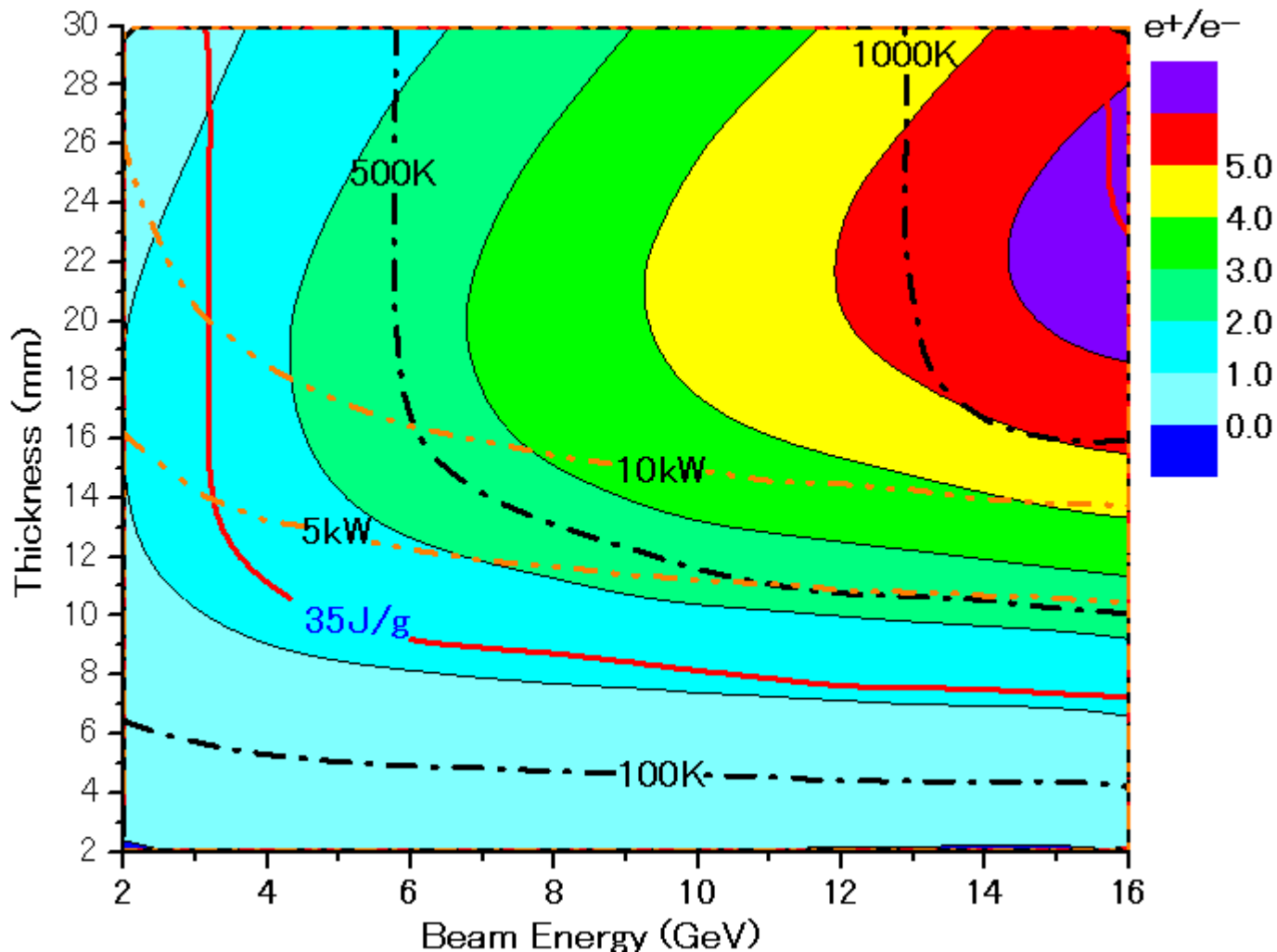
each triplet hits
different position on the target

A large green circle representing a target. A yellow starburst shape is located on the left side of the circle, indicating the impact point of a triplet.

Parameter Plots for 300 Hz scheme

e- directly on to Tungsten

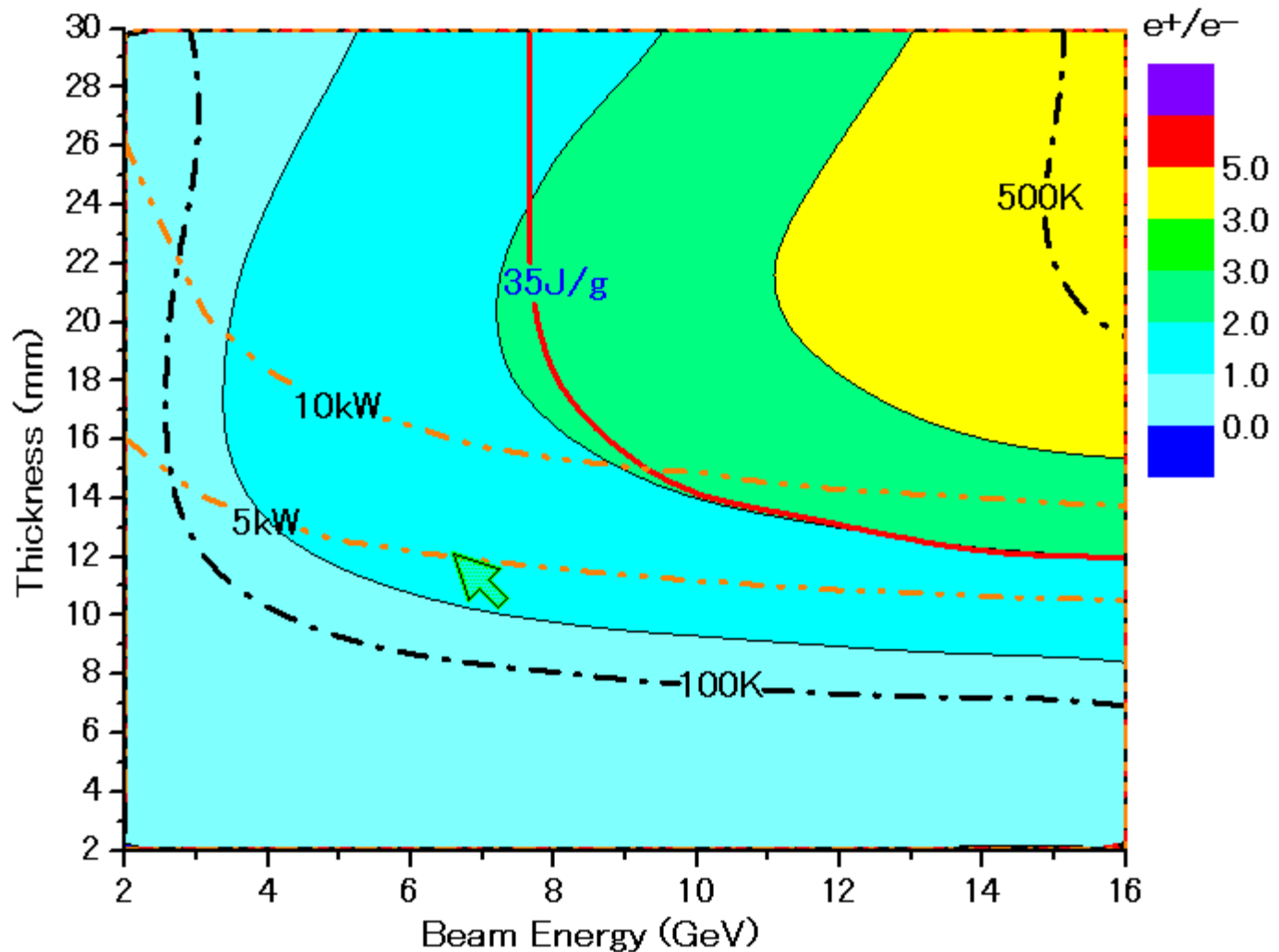
$\sigma=2.5\text{mm}$



Parameter Plots for 300 Hz scheme

e- directly on to Tungsten

$\sigma=4.0\text{mm}$



summary

- Conventional target might have solution for ILC with 300Hz scheme
- to go forward
 - need detail study for capture section as
 - relatively large beam size is preferred
 - heating has to be studied including cooling system
 - shock wave threshold has to be understood particularly under multi bunch condition