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

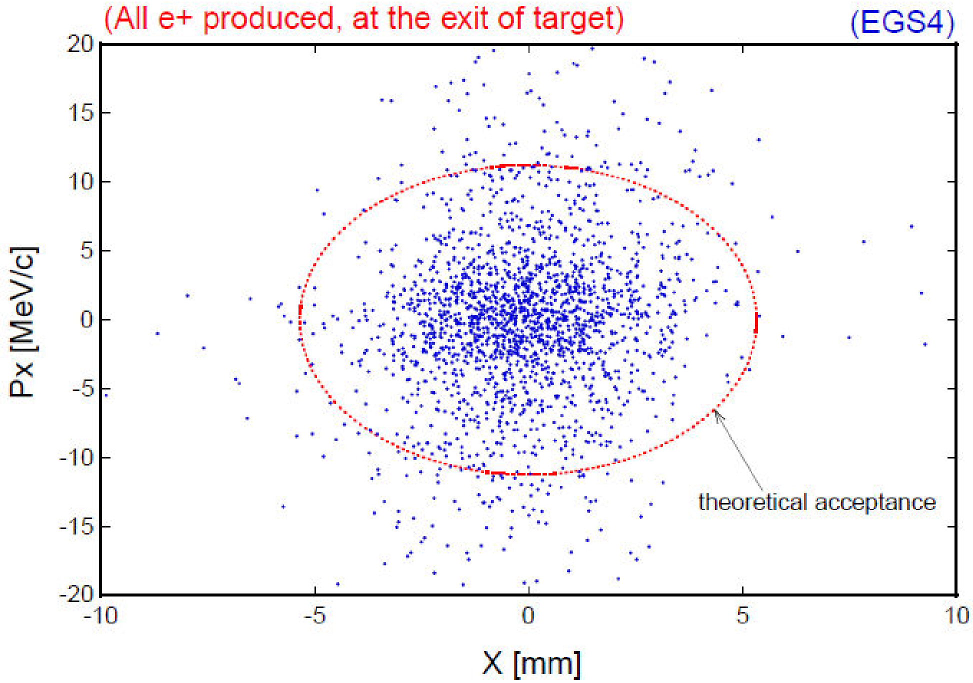
Acceptance estimate

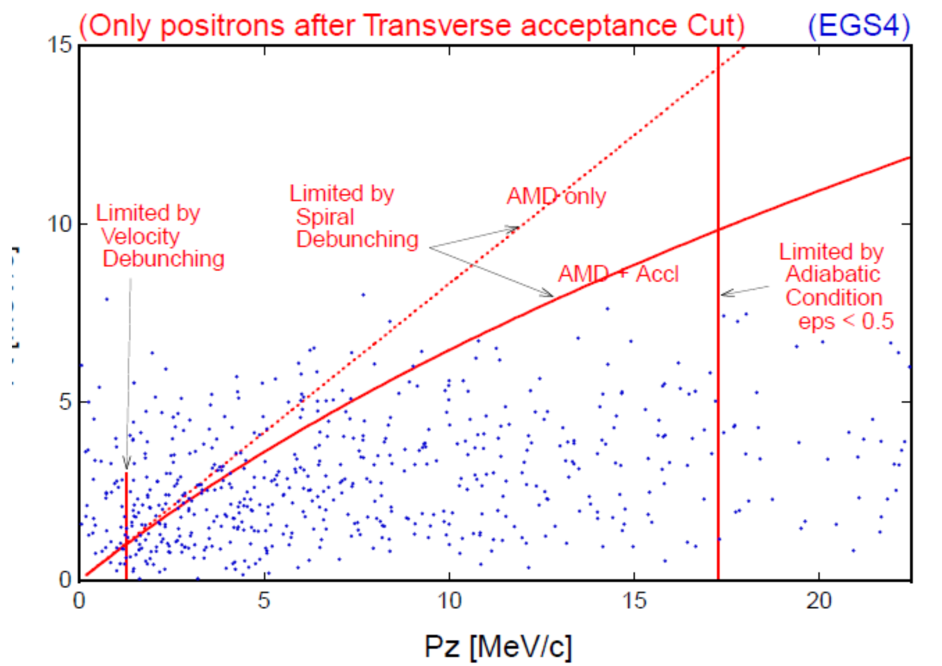
CLIC note 465

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

$pT < 0.1875$ MeV/c + 0.625 pL

1.5 MeV/c < pL < 17.5 MeV/c

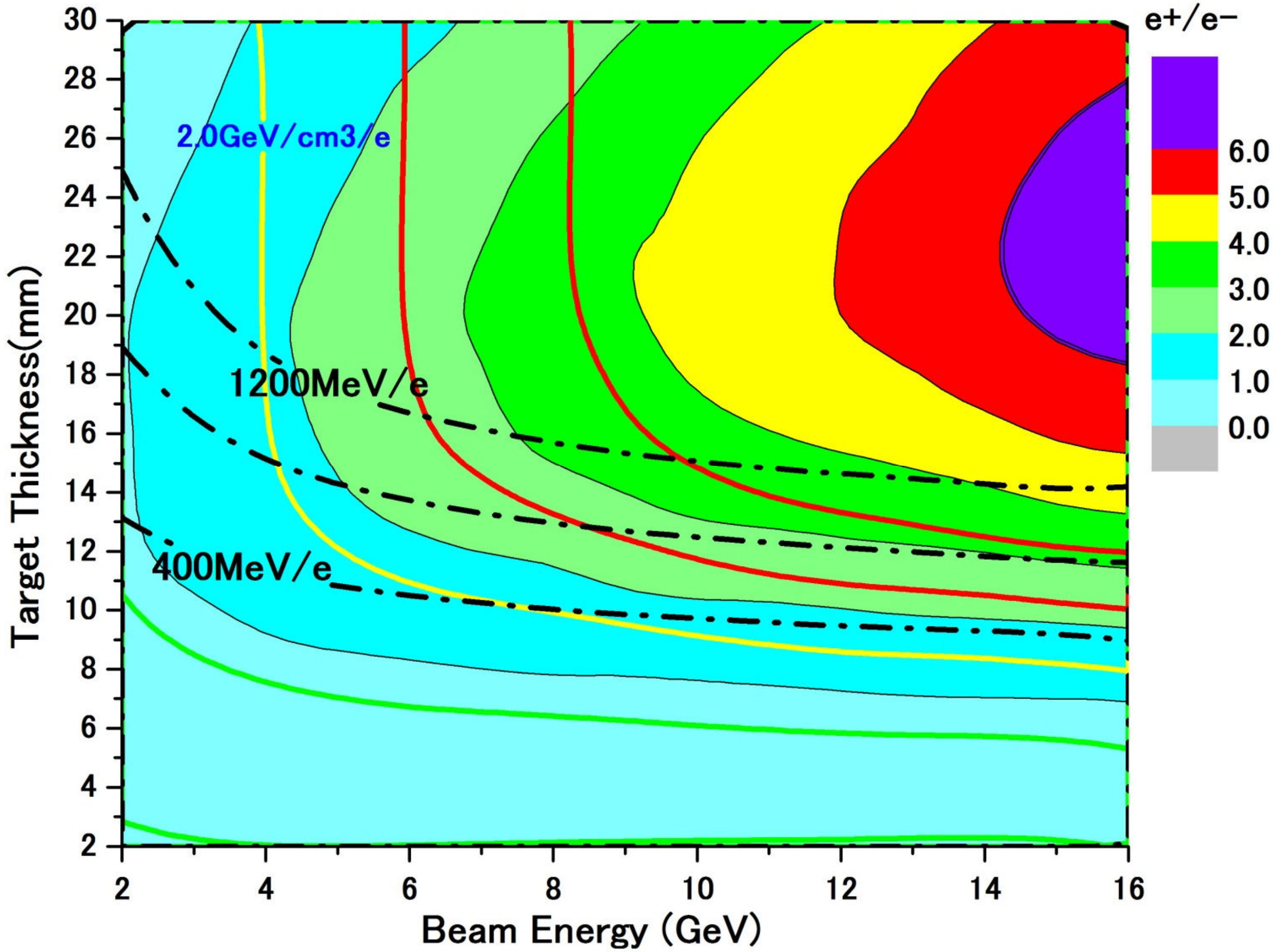




accepted e+ yield and PEDD with conventional scheme

e- directly on to Tungsten

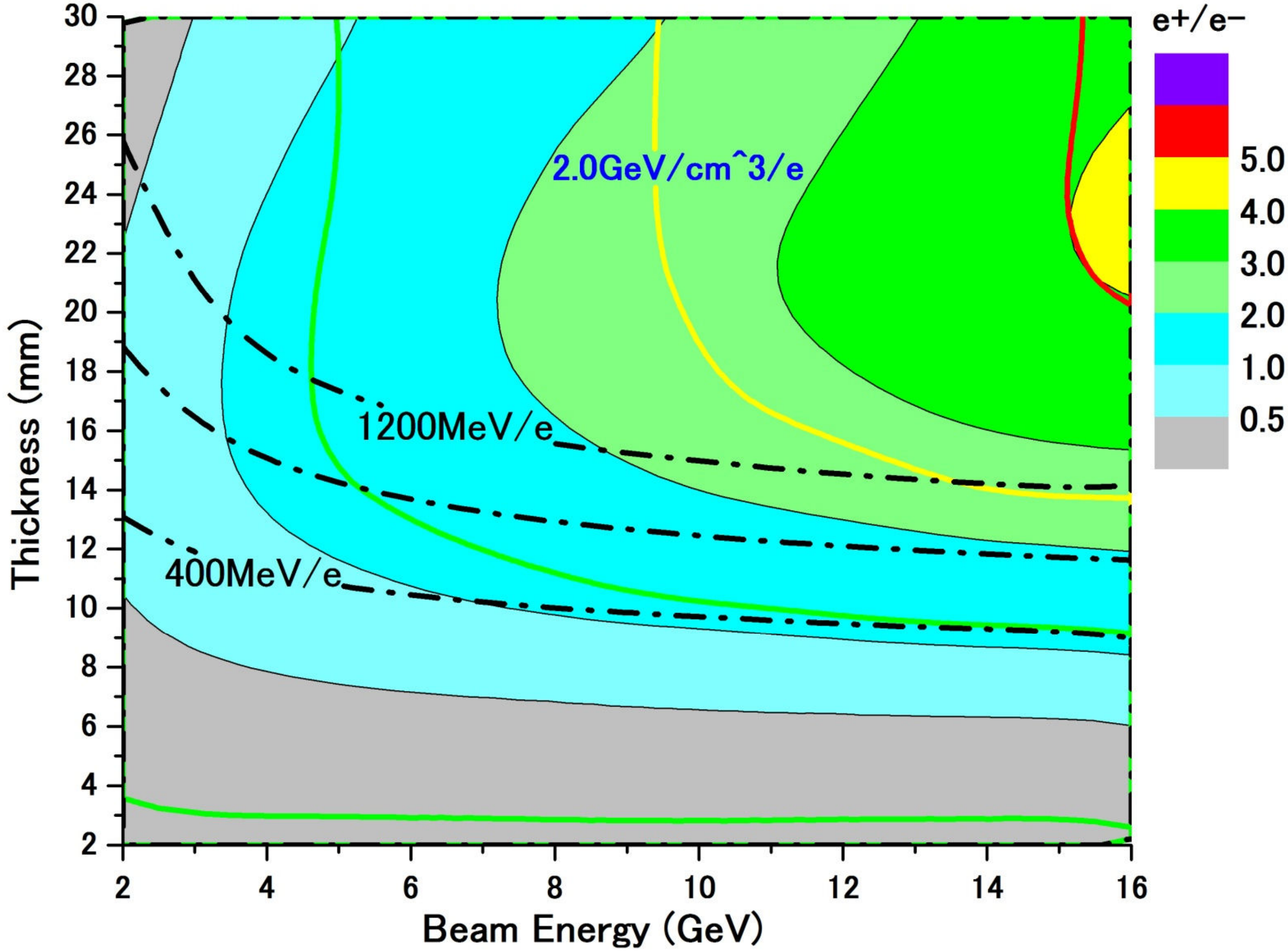
σ=2.5mm



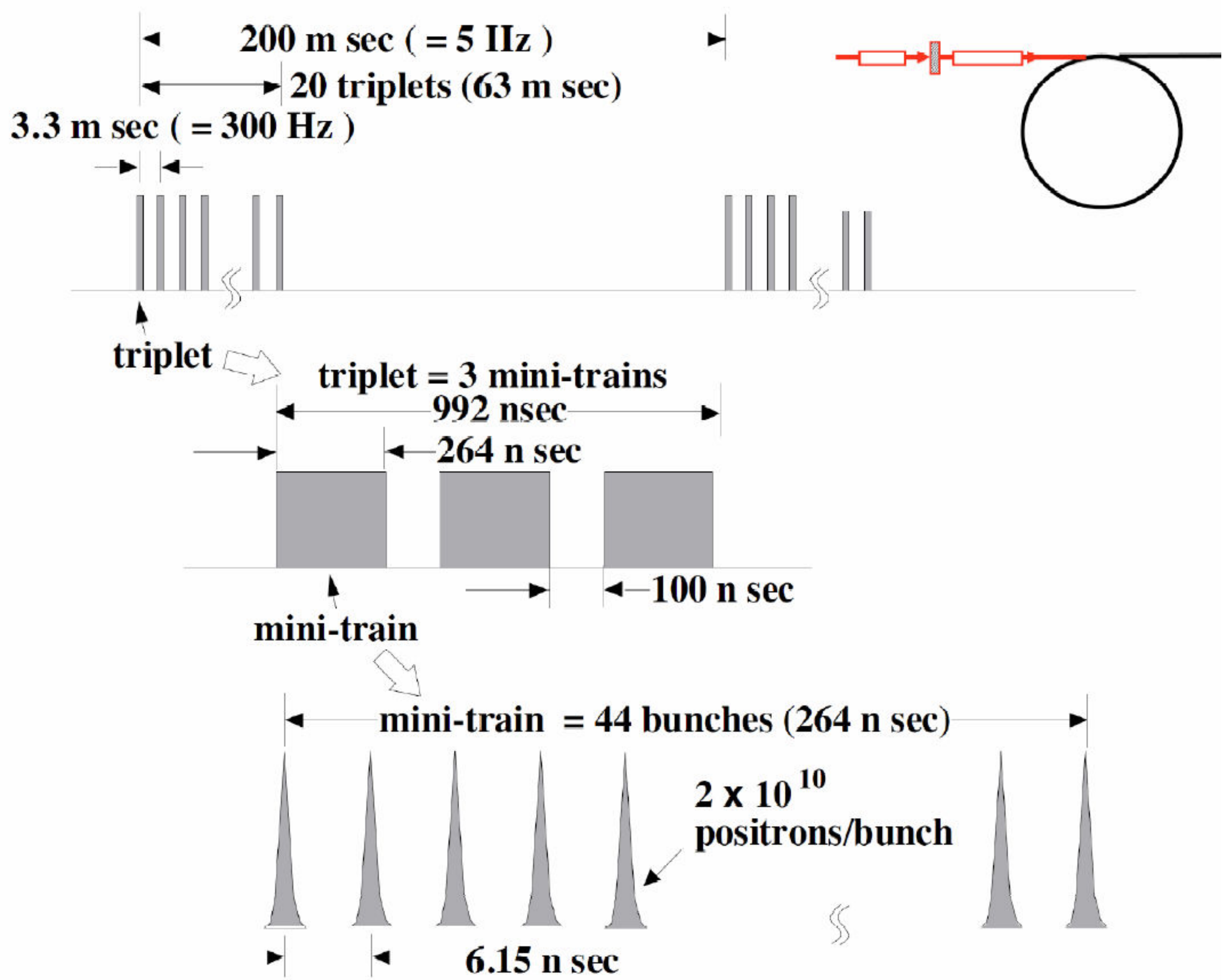
accepted e+ yield and PEDD with conventional scheme

e- directly on to Tungsten

σ=4.0mm



In the case of 300Hz scheme



different triplet hit different position on the target

132bunches in a triplet hit the same position on the target

Thermal diffusion

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

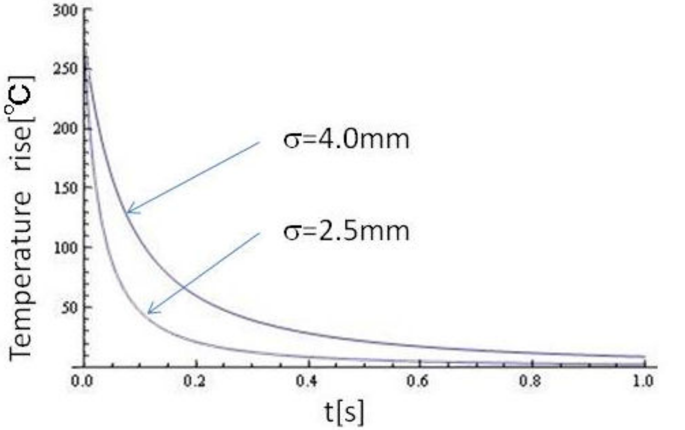
$$\alpha = -\frac{\lambda}{C_V}\beta^2$$

$$\lambda = 174 W/m \cdot K$$

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

time constant of the diffusion depends on beam spot size ~1/β

numerical calculation of thermal diffusion shows

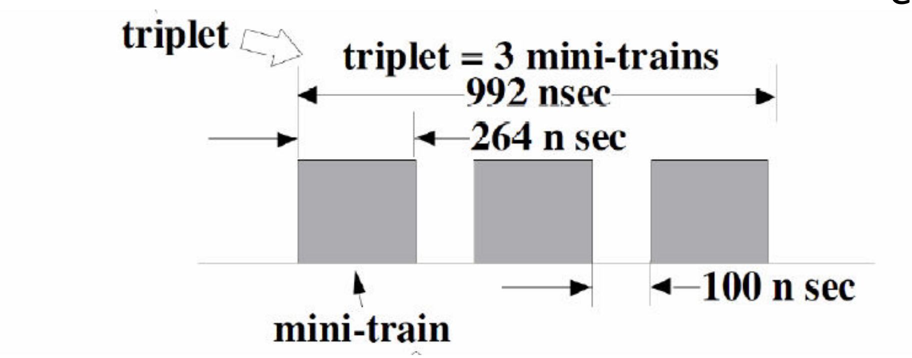


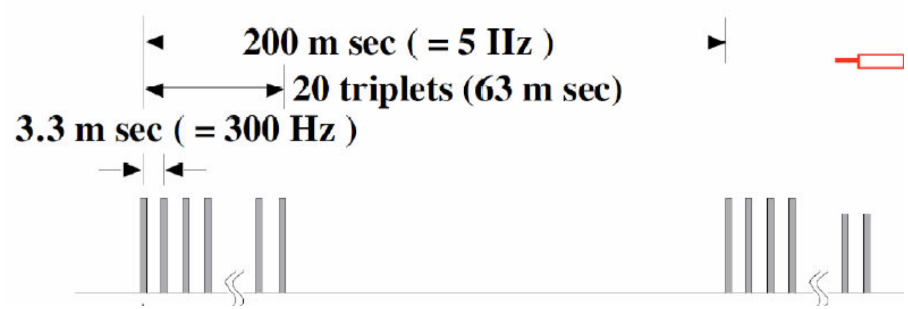
	1D	2D	3D
time constant σ=2.5mm σ=4.0mm	280ms 750ms	80ms 200ms	40ms 100ms

time constant is order of 100ms >> Ttriplet ~1μs

Assumption

each triplet hits different position on the target
elatively low (1~2m/s)rotational target

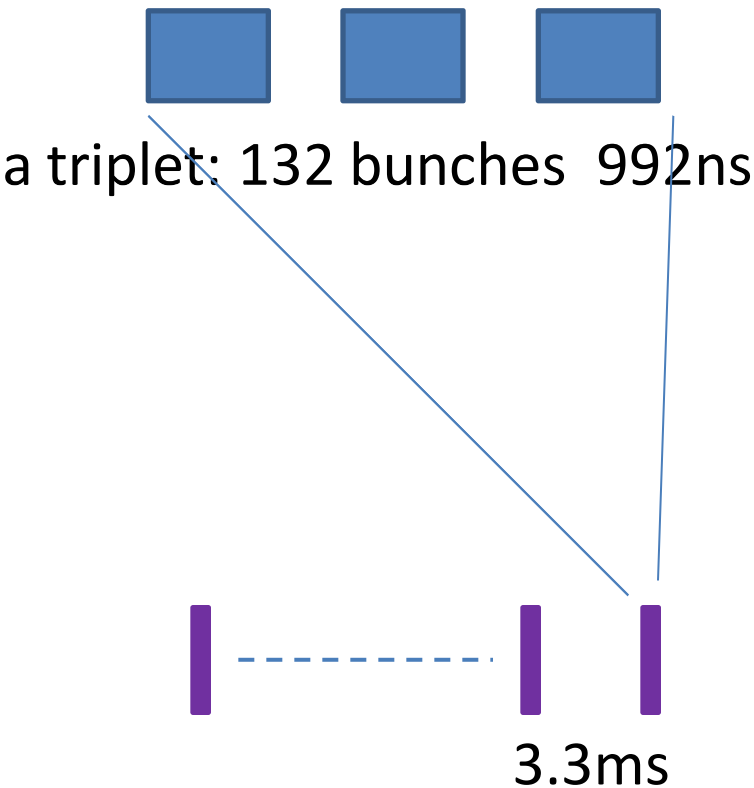




duration of a triplet ~ dumping time of shock wave
shoter than time scale of thermal dissusion

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

Assumption



a train: 20 triplet
= 2640 bunches 63ms

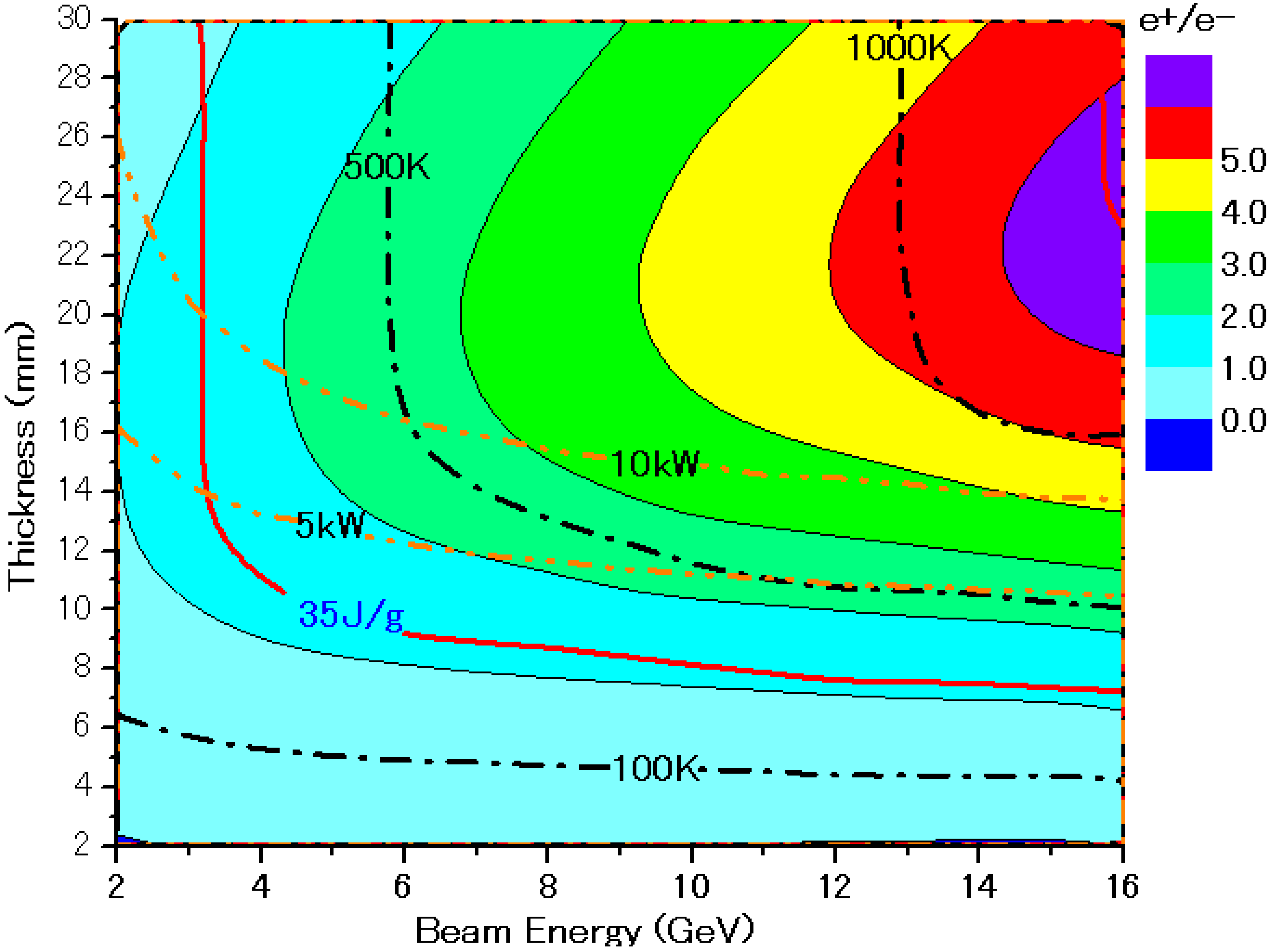
132 bunches
make a shock wave
heat same position on the target

each triplet hits
different position on the target

Parameter Plots for 300 Hz scheme

e- directly on to Tungsten

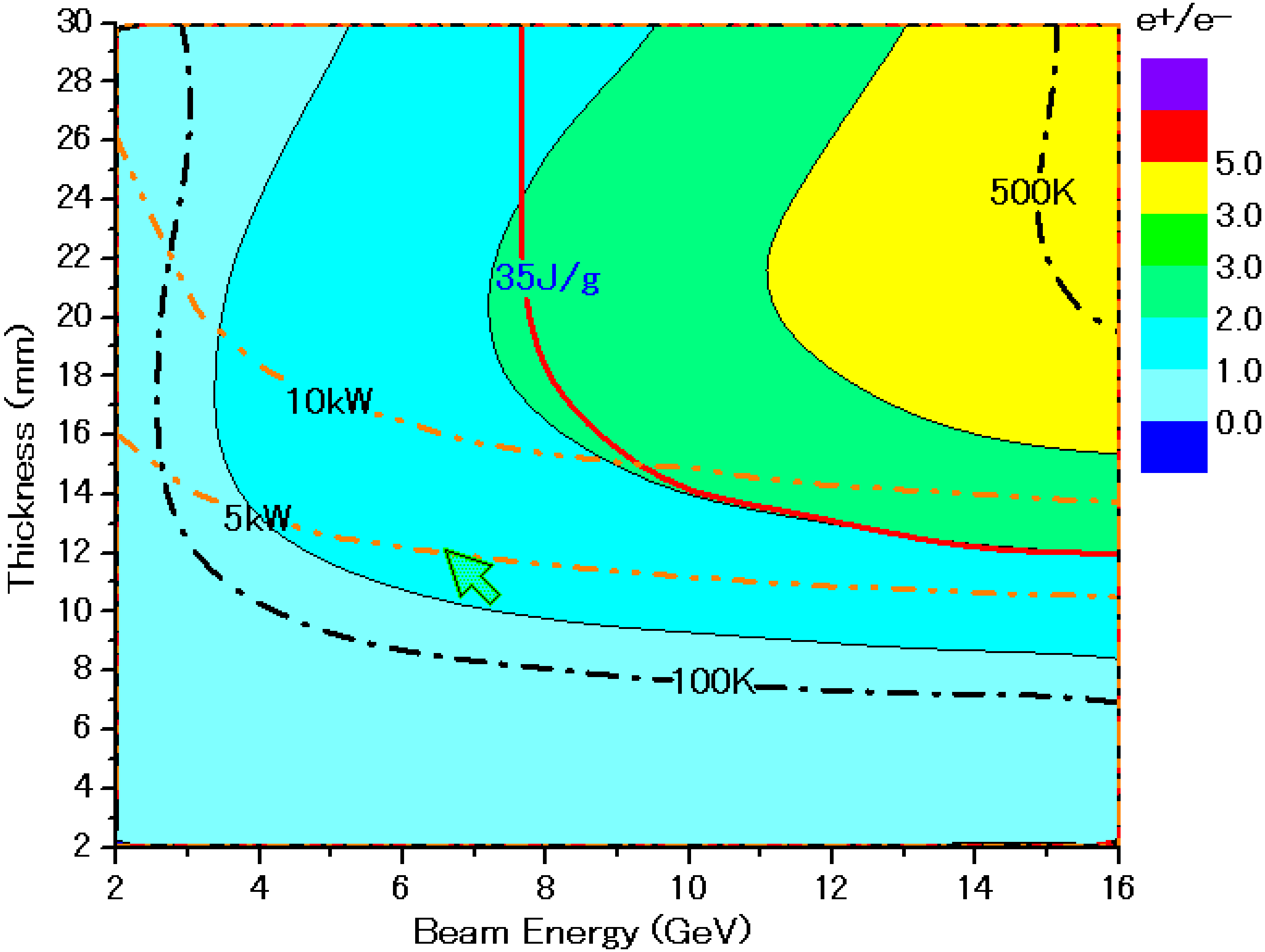
σ=2.5mm



Parameter Plots for 300 Hz scheme

e- directly on to Tungsten

σ=4.0mm



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