



LINEAR COLLIDER COLLABORATION

Designing the world's next great particle accelerator

Undulator based e⁺ source:

ILC e⁺ source WG

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Yokoya-san's list of main topics

R&D plan for the undulator scheme

- Possible discussion topics may be
 - Define the thin target case as the standard parameter for 250GeV?
 - Need corresponding design change of target. (heat conduction, wheel weight ...)
 - Further effort of reducing PEDD on FC
 - QWT as bottom line

Thin target as baseline?

- Andriy Ushakov:
 - With the baseline undulator parameters and $L_{\text{und}} = 231\text{m}$, a thinner target is more efficient for $E_{\text{cm}} = 250\text{GeV}$
 - Substantially lower energy deposition:
 - Target thickness 1cm instead of 1.5cm \rightarrow reduction to $\sim 57\%$
 - PEDD decreases only slightly but shouldn't be a problem
 - Energy deposition in FC can be reduced by $\sim 25\%$
- \rightarrow Thinner target is an excellent option for improvement
 - To do: Design for the wheel (slim design) with efficient heat removal
 - 3kW in a 1cm thick, 3cm high target rim cooled by thermal radiation (without radiator!) yields an average temperature of $\sim 600^\circ\text{C}$
- Further possibilities for optimization ?

Undulator

- With current undulator parameters $L_{\text{und}} = 231\text{m}$ are required for $E_{\text{cm}} = 250\text{GeV}$
- So far, all optimizations were done with ideal undulator field
 - Photon yield (e+ yield) with realistic undulator field?
 - Photon polarization (and P_{e+}) with realistic undulator field?
- Studies so far:
 - D. Scott, J. Clarke, PRL 107, 174803(2011) \rightarrow 4m undulator module test
 - talks of M. Jenkins and A. Alrashdi at POSIPOL'15)
 - Prel. Results:
 - Photon yield (e+ yield) seems ok with realistic undulator field and assuming $E_{e-} = 150\text{GeV}$ or 250GeV ;
 - Polarization is more complicated, has to be checked

OMD

- QWT or FC? $Y_{\text{QWT}} \sim 0.6 Y_{\text{FC}}$
 - With QWT the gain due to lower load on a thin target is ‘gone’:
 - FC, nominal lumi: 3kW deposited in 1cm target
 - QWT, nominal lumi: ~5kW deposited in 1cm target
 - Radiation cooled target is rotating in the slit between focusing and bucking magnet of the QWT. Heating of the QWT? Cooling??
 - Studies are necessary

My personal conclusion

- Optimization of target alone is not sufficient
- Must include:
 - Optimized undulator parameters?
 - **more realistic undulator:**
 - Realistic yield and polarization
 - beam induced heating of undulator
 - D. Scott (PhD, 2008): total heating of undulator module due to SR and image current must be $<1\text{W/m}$;
estimated peak values for SR could reach 20W/m (Jenkins, PhD, 2015),
 - SR collimator design for $E_{e^-} \geq 150\text{GeV}$ and $L_{\text{und}} \sim 150\text{m}$ undulator length exists. Check/update it for $E_{e^-} \geq 120\text{GeV}$ and $L_{\text{und}} \sim 231\text{mOMD}$
- Manpower??