

Photon Flux around CESRc Wigglers

DHR 3/10/06

Prompted by discussion in the machine studies meeting 3/10/06 I estimated the photon flux around the CESRc wigglers to give a more accurate input condition for ECLLOUD calculations of EC densities.

A calculation in 2002 by Dave Rubin of the synchrotron radiation power density around the wigglers is given in a brief note by Dave and Yulin:

http://cesrelog.lns.cornell.edu/documents/charm/vac/sr_power011217.html

Dave Sagan's SYNRAD program was used to calculate the linear power density on inside and outside walls with the pretzel orbits. A typical plot is on the next page.

What is left is to calculate the photon characteristics.

The critical energy of the wiggler synchrotron radiation is about 5 keV with 2.1 T field and 1.9 GeV beam.

Sands gives the rate of photon emission as: $N' = \frac{15\sqrt{3}}{8} \frac{P_\gamma}{u_c}$ (5.12) where N' is the number

of photons per second, P_γ is the s.r. power, and u_c the critical energy.

This equation lets us use the watts/meter curve on Rubin's plots directly.

If we convert watts to eV/sec and put into the formula above we get:

$$N / m / s = \frac{15\sqrt{3}}{8} \frac{P_\gamma / m}{u_c} = 3.25 \frac{6.24 \times 10^{18} \times w / m}{5000} = 4.06 \times 10^{15} \times w / m$$

For example, 500 w/m corresponds to 2×10^{18} photons/sec/m. Since 100 mA is approximately 6.24×10^{17} electrons/second, each electron is emitting ~3 photons striking the 1 m section on each pass through the wigglers. (This would be for a single beam only. For a single beam the radiation will be on one side of the wigglers only.)

Measurements at KEK* found a reflectivity, R , of 33% and basic (per electron) photoelectric yield of 0.434 for $E_c = 4$ KeV photons incident at a 52 mrad angle. This would give more than 1 primary photoelectron per meter per beam electron on each pass.

* Y. Suetsugu et al., "Reduction of the Photoelectron Yield from a Copper Beam Chamber by Saw-Tooth Machining," PAC01, p.2179-2181 Chicago, 2001

SR Power from Wigglers @1.9 GeV, 100mA/beam
DLR, 12/07/2001

