THE CAPTURE EFFICIENCY OF HIGH FIELD FLUX CONCENTRATOR

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Abstract

A flux concentrator body cut leads to nonsymmetrical distortion of a transverse magnetic field. The results of positron tracking in distorted magnetic field and positron capture efficiency are present in this paper for incident electron bunch energy of 6.2 GeV and tungsten positron production target with length of 5 rad. length .

1 INTRODUCTION

In last time in the all well known world laboratories a new generation of height luminosity linear colladers with a height intense bunches is under consideration. To provide a height intense positron bunches a flux concentrator with height magnetic field strength up to 10 Tesla and higher is used as matching device. The matching device like a flux concentrator has a very important geometrical peculiarity it is a flux concentrator body cut from inside to outside surface. This body cut distorts a transverse magnetic field particularly in plate of cut thus the geometrical axis of flux concentrator and axis of a transverse magnetic field are not centered.

2 MAGNETIC FIELD

The flux concentrator body cut is a main geometrical peculiarity. Magnetic field strength inside of split is the same as field strength on a axis of flux concentrators or even higher. Operated peculiarity of a flux concentrator is that a Eddy current inducted on a outside surface comes trough split on a inside conical surface and concentrates at minimum bore aperture forming the area of strong magnetic field. The Eddy current concentration occurs inside of split as well as on inside conical surface. The Eddy current, moreover, is directed on a split edge inside of conical area from outcoming split point to minimum aperture. By this way a local longitudinal component of Eddy current is appeared on inside conical surface. This component of Eddy current forms strong planar magnetic field directed in plate of split which has the same strength as a transverse field of flux concentrator for ideal case (see fig.2.). The ideal case means not distorted magnetic field due to cut of flux concentrator body.

As a result transverse magnetic field strength on flux concentrator axis is about 10% - 15% from longitudinal field strength at this point. Magnetic field strength along of flux concentrator axis and transverse field at different longitudinal position are presented in Fig.1. Thus geometrical and magnetic axes are displaced. The value of displacement depends from longitudinal position. The distortion of longitudinal field is neglectable and its magnetic axis is well centered with geometrical axis of flux concentrator.

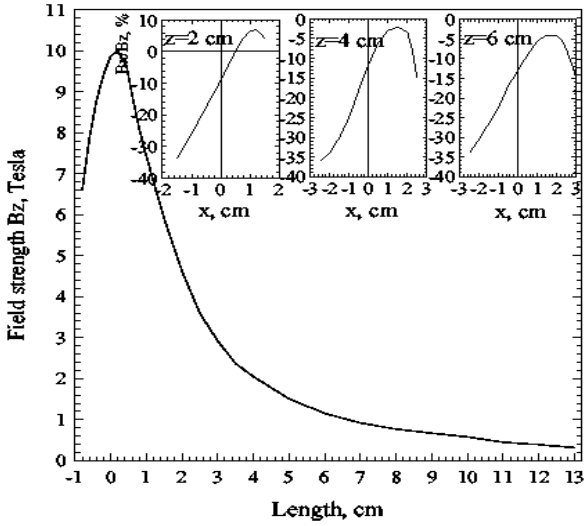

Figure 1 Longitudinal and transverse field distribution.

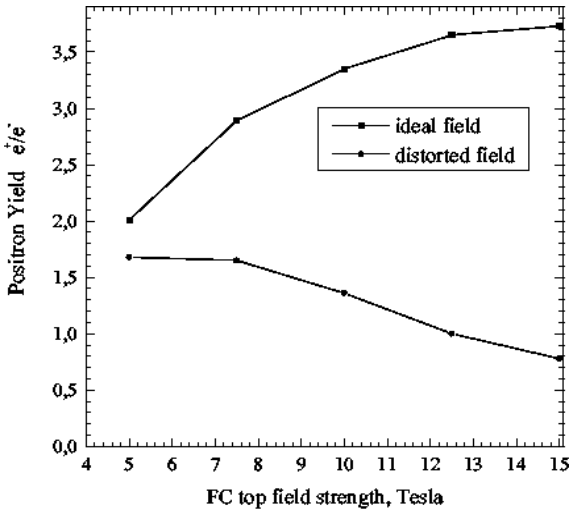

Figure 2 Azimutal field distribution at point z=3 cm for distance from longitudinal axis 1, 2, 2.5 cm.

3 FC CAPTURE EFFICIENCY

The magnetic and geometrical axes of ideal matching device are well centered and strength of transverse field on a axis ia equal to zero. In case of strength of transverse field is not equal zero the positrons move in strong transverse field directed perpendicularly of main particles motion. As a result positron bunch has an additional angle and is not centered with an accelerator line. This displacement decreases the positron capture efficiency

In this paper a comparison of positron capture efficiency was done for various strength of FC top

magnetic field. The incident electron bunch is centered with geometrical axes of flux concentrator and accelerator section. The parameters of FC and accelerator are next minimum bore diameter of FC is 1 cm, FC length is 16 cm, accelerating ration is 25 MeV/m, diameter of accelerator section is 2cm. Solinoid field strength is 0.5 Tela.

Positron yield was simulated based on GEANT statistics and dymanics in flux concentrator, uniform solenoid field. Energy cut at positron bunch energy of 250 MeV is ±10 MeV and time cut is ± 30 ps. Positron yield for ideal matching device as FC and device with distorted transverse field is shown in fig 3. In a second case yield in twice or even five times is decreased. Positron buch center after passing of matching device is displaced from accelerator section center about of 1.2–1.4 cm.

4 CONCLUSION

As positron yield simulation shows the capture efficiency of real matching device is as strong decreased as top field strength is higher. Thus in order to not lose a particle in addition the transverse magnetic field of flux concentrator should be compensated. Another way is to optimize correct offset between geometrical axes of FC and accelerator.

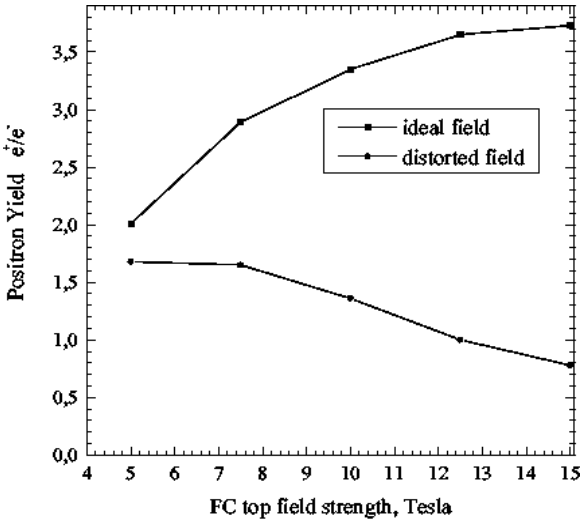

Figure 3 Positron yield for various Flux Concentrator top field strength.