Mini Review on XFEL Kicker-Septum Scheme
10.02.2009

Participants

V. Balandin
F. Brinker
W. Decking
H.J. Eckoldt
N. Golubeva
J. Keil
B. Krause
T. Limberg
K. Müller
F. Obier
A. Petrov

Goals:

- Summarize status of XFEL beam distribution kicker-septum scheme with emphasize on septum technology options
- If possible identify septum solution which should be worked out in further detail

Presentations:

Introduction into XFEL separation scheme - W. Decking

WD pointed out the tough relative stability requirements for the kicker (< 3e-4) and the septum (<3e-5), coming form the requirement of a 1/10 σ beam stability.
Note that the relative stability requirement for the septum was originally given wrong by an order of magnitude!
He mentioned the three different options which have been investigated:
1) Hor. Kicker + Hor. DC Septum
2) Hor. Kicker + Hor. AC Septum
3) Ver. Kicker + Hor. Lambertson Septum

Separation Options for hor./ver. kicks - N. Golubeva

NG described the optics work that has been done to check the feasibility of a vertical kicker in combination with a horizontal Lambertson septum. The added complexity due dispersion correction in two planes is manageable; all open questions would concern any of the three solutions.

DC Septa Designs (Current Sheet and Lambertson) - B. Krause

BK presented the original current sheet septum design (from 2005). This required a maximum current of about 28 kA in the septum bar. Subsequent design changes (energy reduction, gap reduction) could reduce this to about 10 kA. HJE mentioned that supplying this device with power from a power supply in XS1 would lead to huge cable cross sections and/or large cable losses (in the order of 1-2 MW). It was also mentioned that the septum bar with its large current density and resulting cooling will pose a major failure risk to the vacuum system of the machine.
An alternative design for a Lambertson type septum was presented. The electrical parameters of this magnet are very conventional. The resulting effective septum bar width will most likely be larger than in the previous case. The overall system integration appears to be also more complicated, with wide poles needed to provide large enough good field regions. A variant of the Lambertson septum which would provide simultaneous deflection for TD1 and TD20 was presented. Issues here are saturation effects in the septum bar.

AC Septa Design and Stability - K. Mueller

KM showed his design for a pulsed septum. The idea is based on the septum design for DESY III and has been modified to better fit XFEL needs: the geometry was adopted, cooling channels have been moved out of the beam plane etc. Advantages of the AC septa design are:

- an easier integration into the vacuum system (complete magnet would go into the vacuum tank) and resulting from this most likely the smallest effective septum bar width
- large pulsed current allow for large magnetic fields, thus shortening the complete system (but note that the maximum allowable field is about 0.5 T at 22 GeV to avoid incoherent synchrotron radiation effects)
- small average power consumption due to the small duty cycle

KM also presented an idea for a flat top stabilized septum pulser. HJE expressed his concern that the regulation can only be as good as the measurement and he doubted that accurate enough measurement devices are available for these fast pulses. Other participants expressed their concern about mechanical and thermal stability – all in view of the extremely demanding accuracy requirements.

DC Power Supply Stability - H.-J. Eckoldt

HJE stated that a DC power supply with 1e-6 is impossible (although the HERA-p dipole was that stable due to the large inductance in the circuit), and 1e-5 would be state of the art. A better definition of the stability timescales is required. The 1e-5 is needed on short time scales, long term drifts can be corrected by slow FB systems. It was also mentioned that these demanding stability requirements hold in principle for all deflections after the IBFB systems, thus adding 3 more dipole power supplies to HJE list.

Results

After some discussion the round comes to the following conclusions:

- The combination of a vertical kicker and a Lambertson septum seems to pose the smallest operational risk to the XFEL. The open problems are not unique to this solution and seem to be manageable.
- The decisive argument is the strict stability requirement. Participants were in doubt that measurement possibilities down to the 1e-5 level exist for the current of a pulsed device. In case of a DC type device field measurements with NMR probes might be able to yield the stability demands.
- VB and NG will work out a separation scheme based on this option shortly and discuss the hardware options with BK and AP. Vacuum issues should be integrated as early as possible (WD has already contacted Torsten Wohlenberg about this).
- Stability specifications will be documented for all dipole magnets.

Minutes taken by Winni Decking