Fiducialisation of MQX quadrupoles

A proposal for discussion with SU & MEL, July 18, 2005, B.Jeanneret

Introduction

Contrary to most other LHC magnets, MQX are single bore assemblies. Therefore a 'geometrical axis' (GA) cannot be determined with the usual method. In twin bores elements, a best plane is least-square fitted with the cold bore axis data of the two apertures. Then two parallel lines with the nominal separation are adjusted in this plane. Another approach must be used for MQX elements

MQX

The geometry of the MQX cold bore is measured first at FNAL. According to Ranko, a plane is determined such as to be perpendicular to the field orientation, i.e. ensuring in principle the quadrupole field map to be straight. Therefore this orientation must be preserved, because the field orientation is no more further measured at CERN.

The comparison of CERN and FNAL cold bore geometry indicates that the shape of the cold bore is stable (except for MQXB, see below). On the other hand, the profiles do not always overlap, i.e. the referential is not fixed such as to offer the best GA in all cases. And whenever only CERN data are hand, obviously a fit to GA was not always applied. Therefore, more work is needed, starting with the definition of a goal and of a procedure.

Proposal for adjustment

1) Perform a combined fidu/AC-mole measurement in order to check that the GA and the MQ axis coincide, and if they don't, to allow finding an adequate compromise. This was already recommended by MEB (MEB 87 & 88).
2) Define the orientation of a plane P which is parallel to the one fixed at FNAL.
3) In the RST (xsz) referential, consider that only the RT components of the vector normal to the plane must be preserved at first order in further transformation. This means that only rotations around S are forbidden.
4) Fit a GA by allowing translations along R and T, and rotations around R and T.
5) This procedure is sufficient for MQXA and MQXC. The case of MQXB is complicated by the presence of three external supports. It is visible in the existing data that the central jack was not adjusted at FNAL and/or at CERN. Therefore a step must be added to the above procedure in order to adjust the central jack. This most likely implies to iterate the above at least once. The aim is to get the flattest profile of the MQXB assembly.

In addition, the longitudinal positioning of the assembly must be set (see difference FNAL/CERN). This may be done by adding the V-flange data to the profiles measured with the fidu/AC-mole step.

Further shifts may be applied later by ABP in order to satisfy other constraints (big corrector block in MQXC which must be well centered, etc).