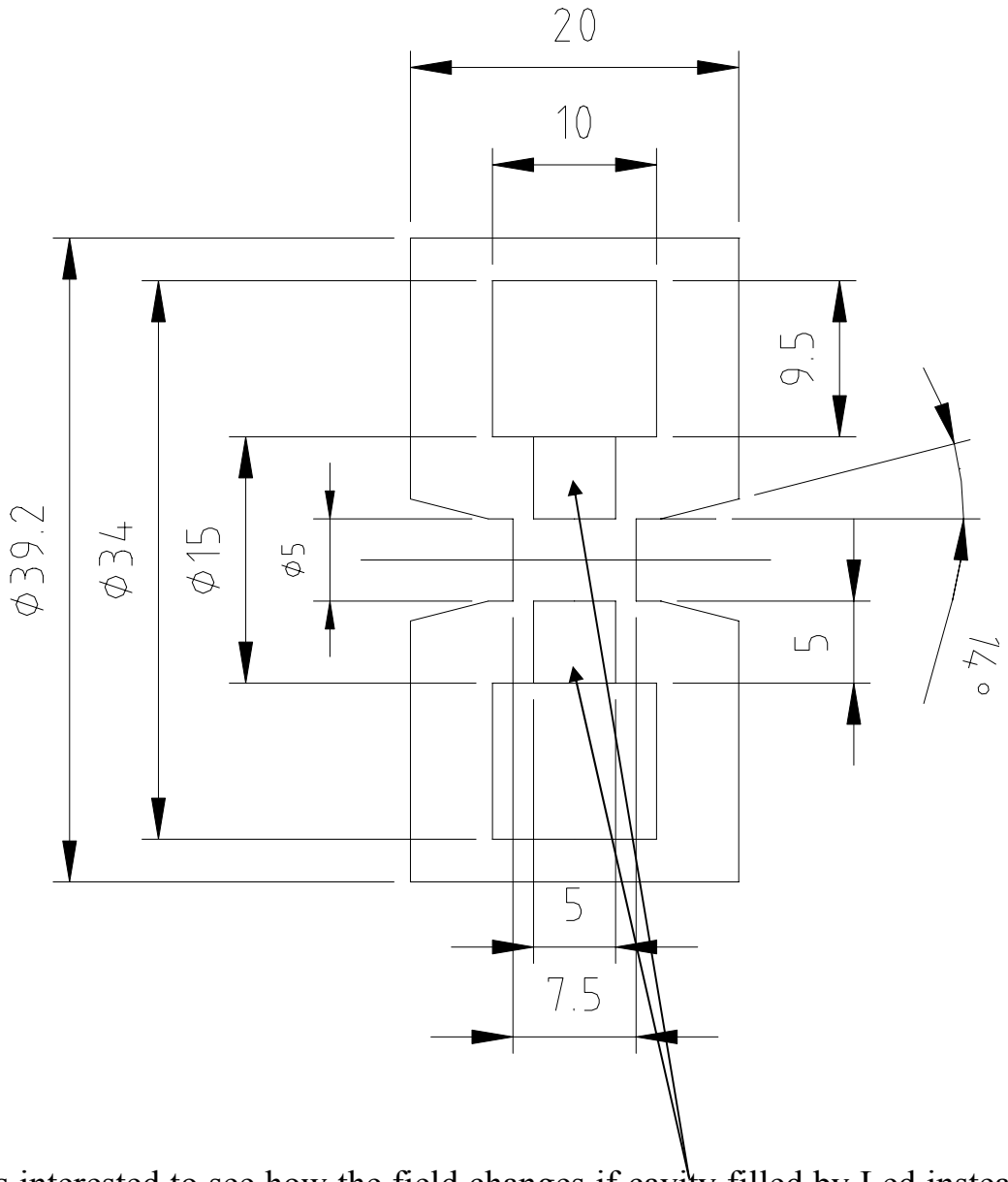
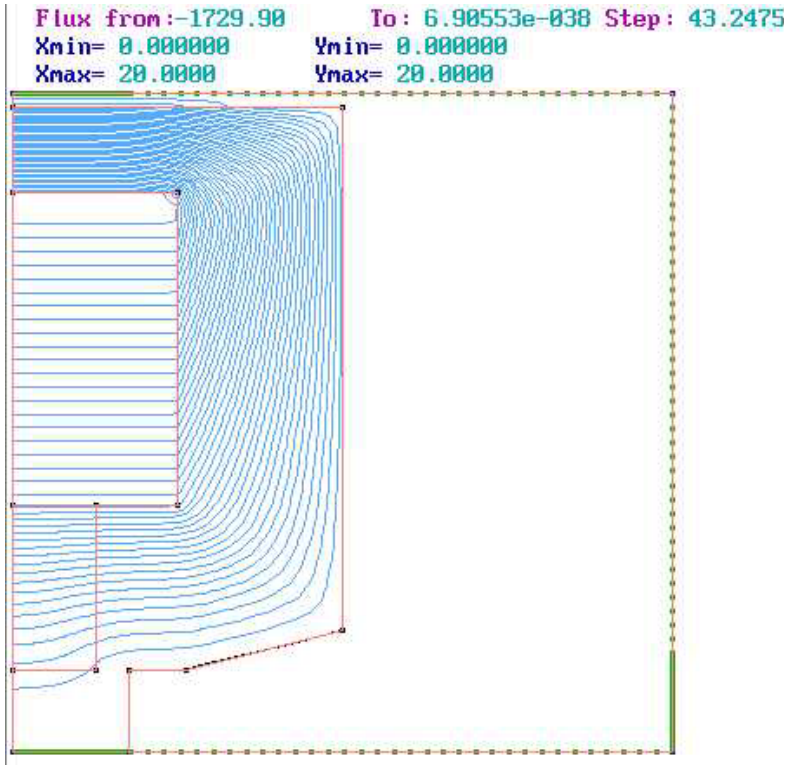
May 27, Cornell A.Mikhailichenko

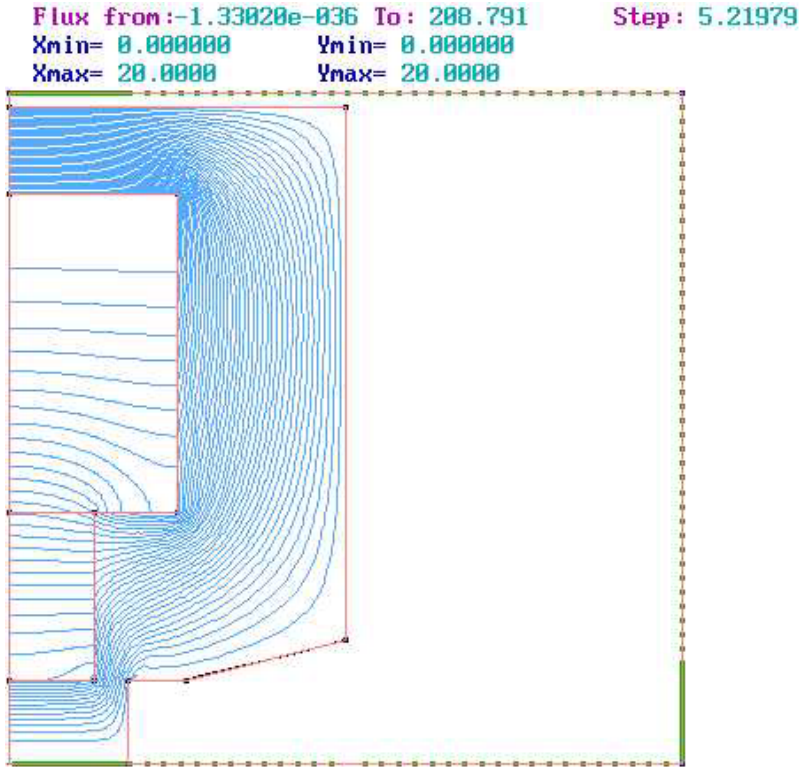
DESY/EFREMOV SPECTROMETER

I used dimensions given by Peter as the following.



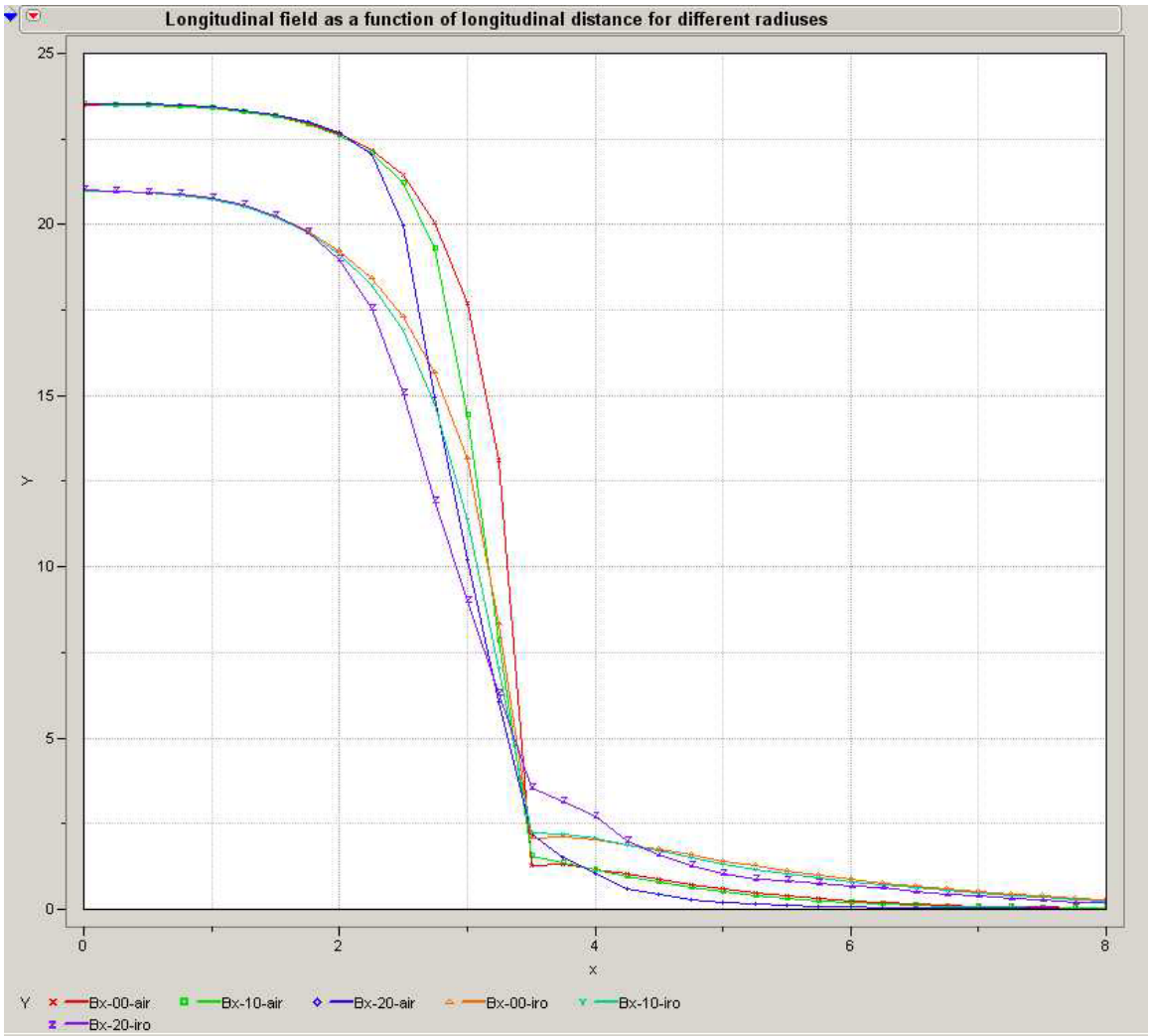
Was interested to see how the field changes if cavity filled by Led instead if iron. Also was nice to see some field homogeneities. Of cause, Led in magnetic calculations is equivalent to the Air.





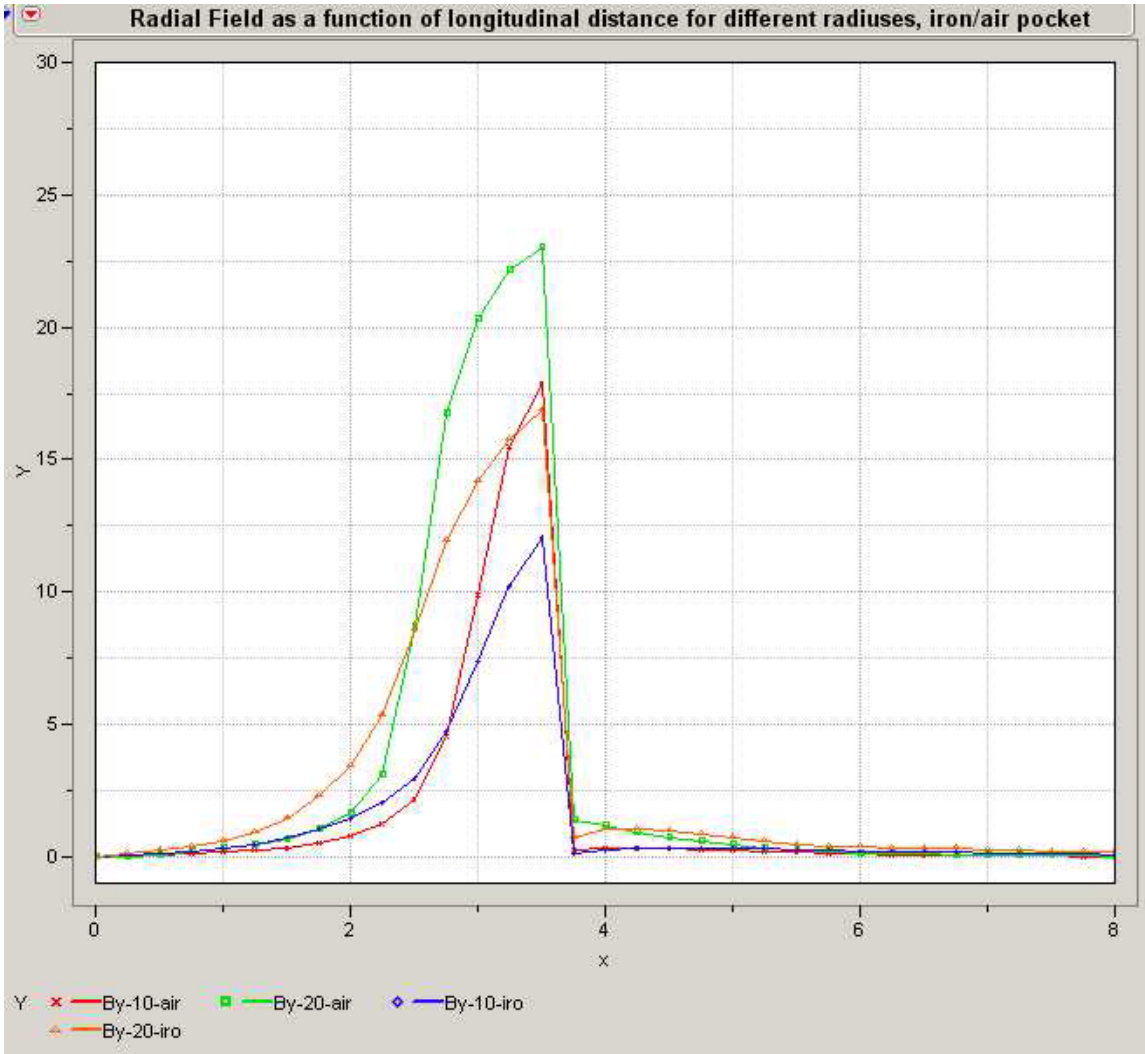
These figures show how lines behave in two cases. At the top-the cavity filled by iron, at the bottom- it is Air.

Iron used in modeling Steel 10 in Russian classifications. I used 10 kA-turns of current. Despite the lines look as much more concentrated in case with Air-filled cavity, the field difference is not so impressive.
At the figure below the longitudinal field as function of longitudinal coordinates is represented. This done for three different radiuses: zero (at axis), 1-cm and 2-cm off center lines. All field distributions start from center of magnet.



One can see that the lines are rather smooth. Gain is field is ~12% only. There is field outside the iron in region of re-conversion target.
Bx-10-air, for example means, that this is distribution for Bx taken at 10 mm radius if the cavity is Air filled. Bx-20-iro means, that this is distribution for Bx taken at 20 mm radius if the cavity is Iron filled and so on.

At the figure below transverse field is represented as function of longitudinal (axial) coordinate.



Some slop at the curves occurs when the coordinate point passes the iron boundary. Finite slope explained by finite step of making graph in longitudinal direction; in reality it is a zero width drop.

Despite the field is higher in case of Air gap, homogeneity indeed is better for the Iron-filled gap. This is in contrast with designer's expectations.

So the 10kA-turns occupy ~100cm^2 area, which even in case of 50% filling efficiency gives~2A/mm^2 which is ~10 times lower, what is allowed for water cooled hollow conductors.

That is the primary source of mistake done by designers here–the coil might be ~10 times more compact. Once made, this mistake as a snowball carried all behind.

Except of big size, this device might work, however. Not of cause such effectively, as my ten times smaller one, but work. My optimized device does not generate outside field -- that might be vital for us however.
We can accommodate the jaws although with compact design there is much more freedom, somehow spectrometer requires this. Our calorimeter, in contrast, requires more room. Calorimeter, spectrometer and target –are the subject of other topics, however.

It was important for me to find the source of discrepancy as it looked, that people have find something interesting. Nothing at all --just a mistake.
Field enhancement is just evolutionary, not revolutionary, and field is less homogeneous for the Led filled gap.
What confuses people probably- it is the way how computer codes (VECTOR Field for example) plots the field lines in cylindrical geometry- the distance between them defined by the *flux difference*, not by the *field value* as in planar geometry. Looks that this fact was not known by KEK people too.
Printout for the field was shown at our meeting- that fuzzy shaken curves - are result of improper smoothing procedure.
I choose 10 kA turns, just for example. As the coil is working in so relaxing conditions one can take the current even ten times bigger.

I believe, however, that there is no room for a modification, it is too late.