SoLID SIDIS NH3 efficiency and acceptance

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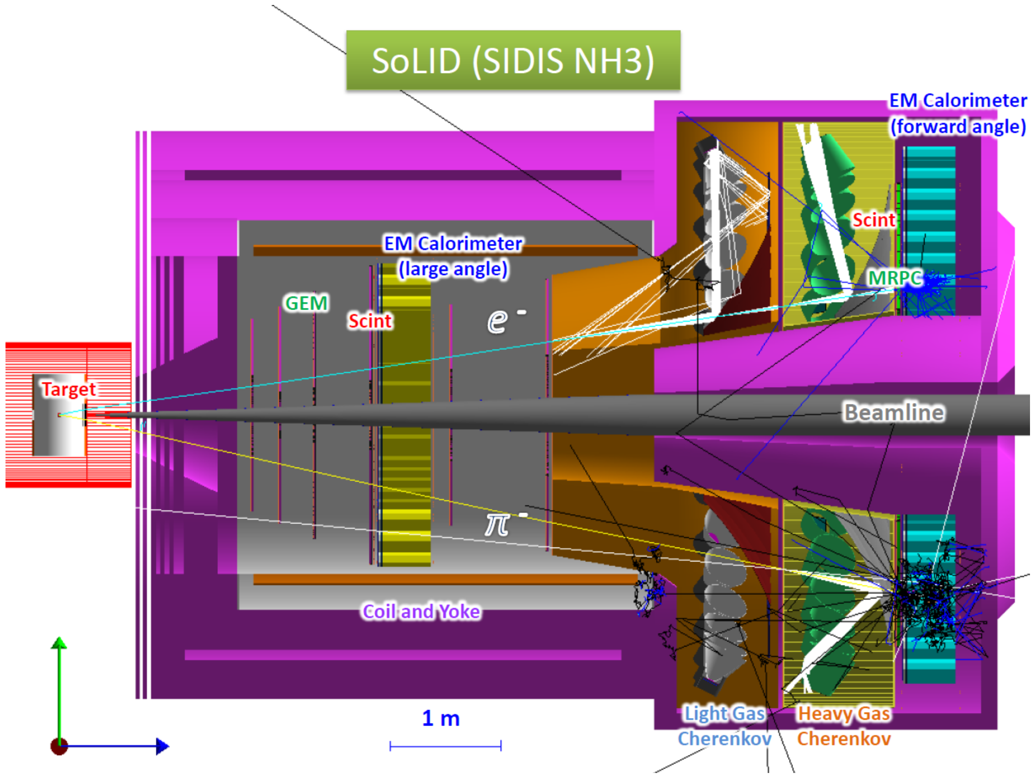
2017/10/10
2017/10/31
2017/11/07
2017/11/14

Setup

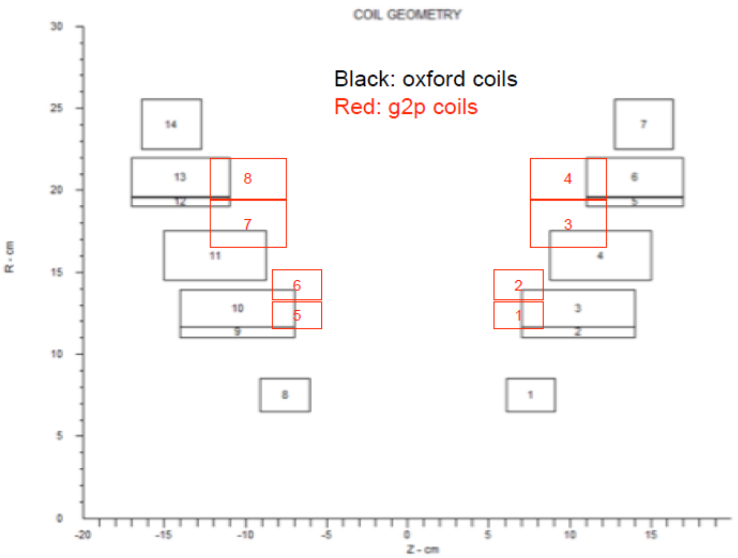
- Target field +Bz along +x axis which is parallel to the hall floor
- g2p field map with hallb coil "g2p_ptarget.dat" is calculated by Biot-Savart Law with a 2-D current density distribution in a fortran code and it gives result within 1% of measurement
- The wrong target field map "solenoid_ptarget.dat" was converted incorrectly from g2p field map with hallb coil. It was used in GEMC until 2017/10. it has same max field 5T, but ~50% larger field integral for beam than g2p field
- The field map "magnet_3.map" used in Comgeant for proposal was converted from g2p field map with hallb coil. It has some small conversion errors also and caused ~10% larger field integral for beam integral than g2p field
- The field map "oxford_ptarget.dat" is calculated according to Oxford design and has ~15% larger field integral for beam integral than g2p field

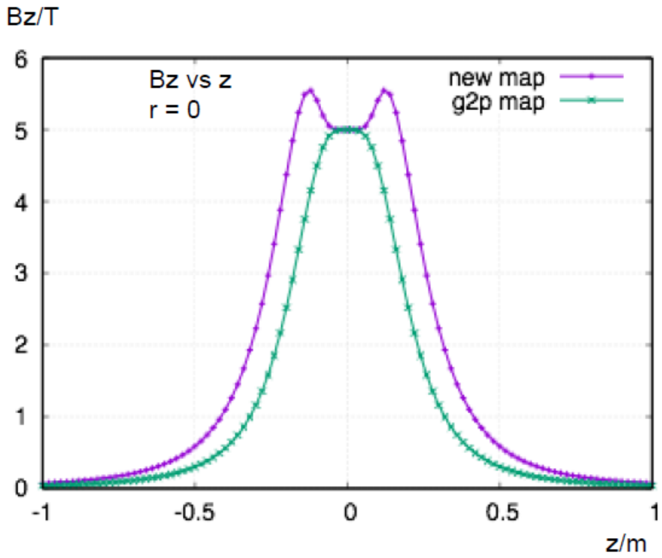


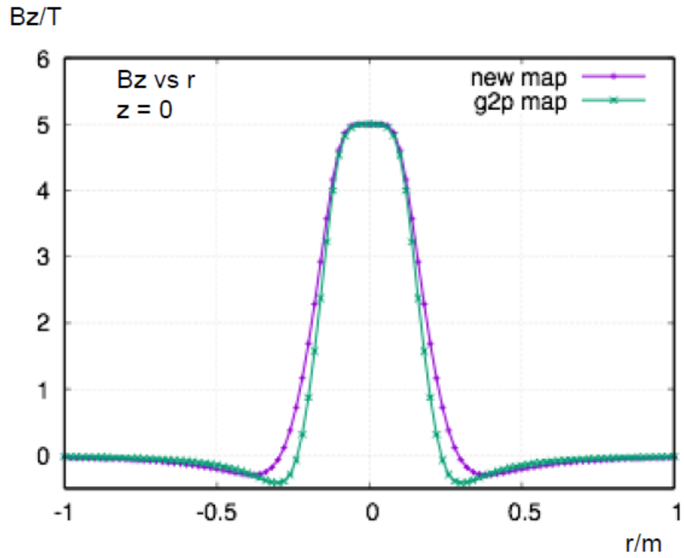
Details in backup slides

Oxford 2012 field map

- It has 7 pairs of coils instead of 4 pairs g2p hallb magnet has.
- The max field is 5T with ~10^-4 homogeneity and an opening angle of ± 25 deg
- Chao Gu created a map by modify the g2p hallb fortran code with the oxford coil position and current. It has ~15% more field integral along beam direction







Oxford field

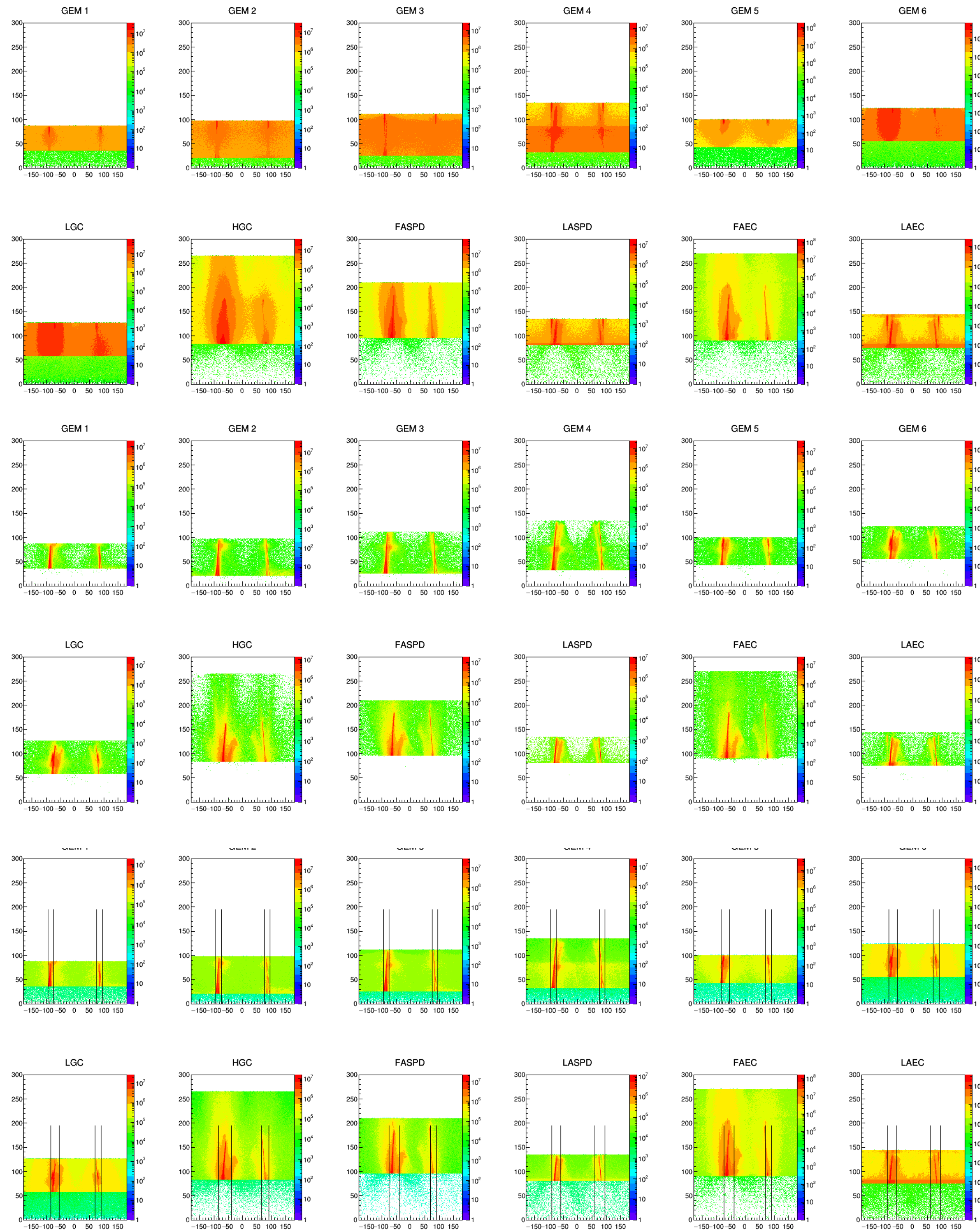
NH3

- Particle rate at detector entrance from BeamOnTarget in R vs Phi
- Rate of (e- and e+ and photon*0.5) is just a guess, real digitization would give better answers.
- Max rate for He3 reach 1e6 on GEM
- NH3 reaches 1e7 in red color, cut away red to keep the max 1e6 like He3

photon

e- and e+

e- and e+ And photon* 0.5 (except EC)



Oxford field

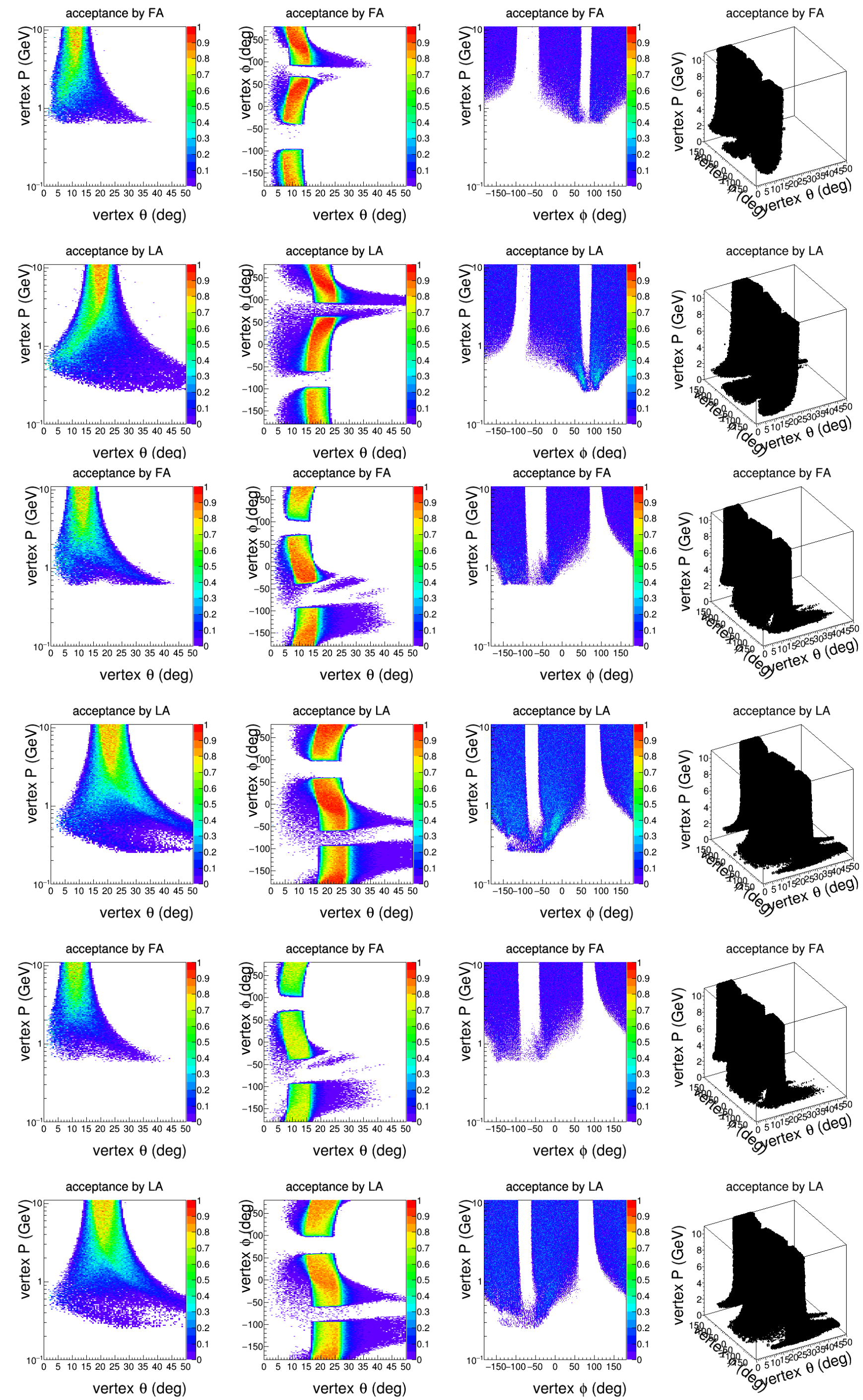
Acceptance

- With sheet of flame cut
- No material, just field and geometry effect
- No PID cut
- Assume cut on FAMRPC is same as FASPD
- Detection
  - e-, GEM+LGC+FASPD+FAEC or GEM+LASPD+LAEC
  - Pion, GEM+HGC+FASPD or GEM+LASPD
  - kaon, GEM+FASPD or GEM+LASPD

e-

Pi+

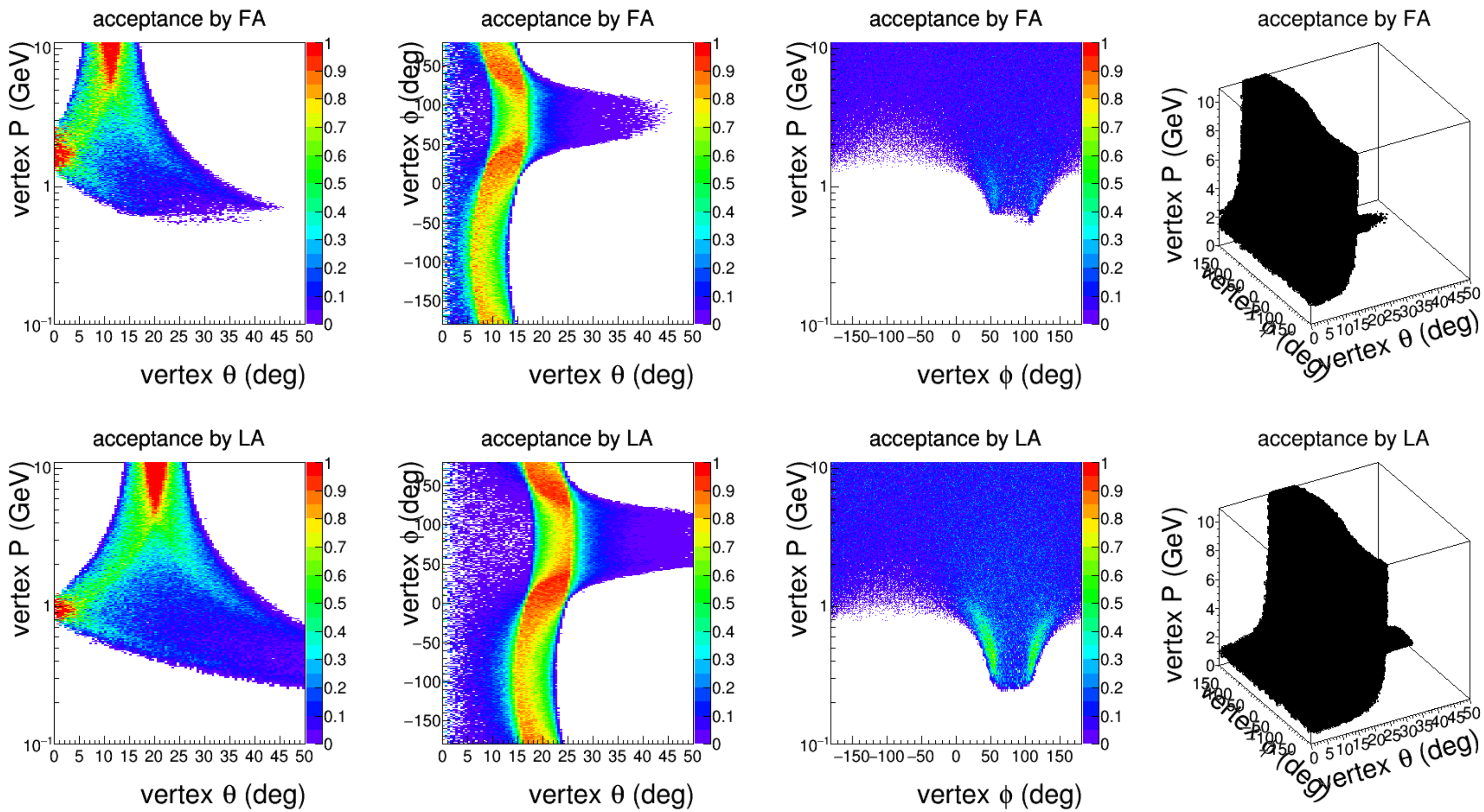
K+



Compare ptarget magnet

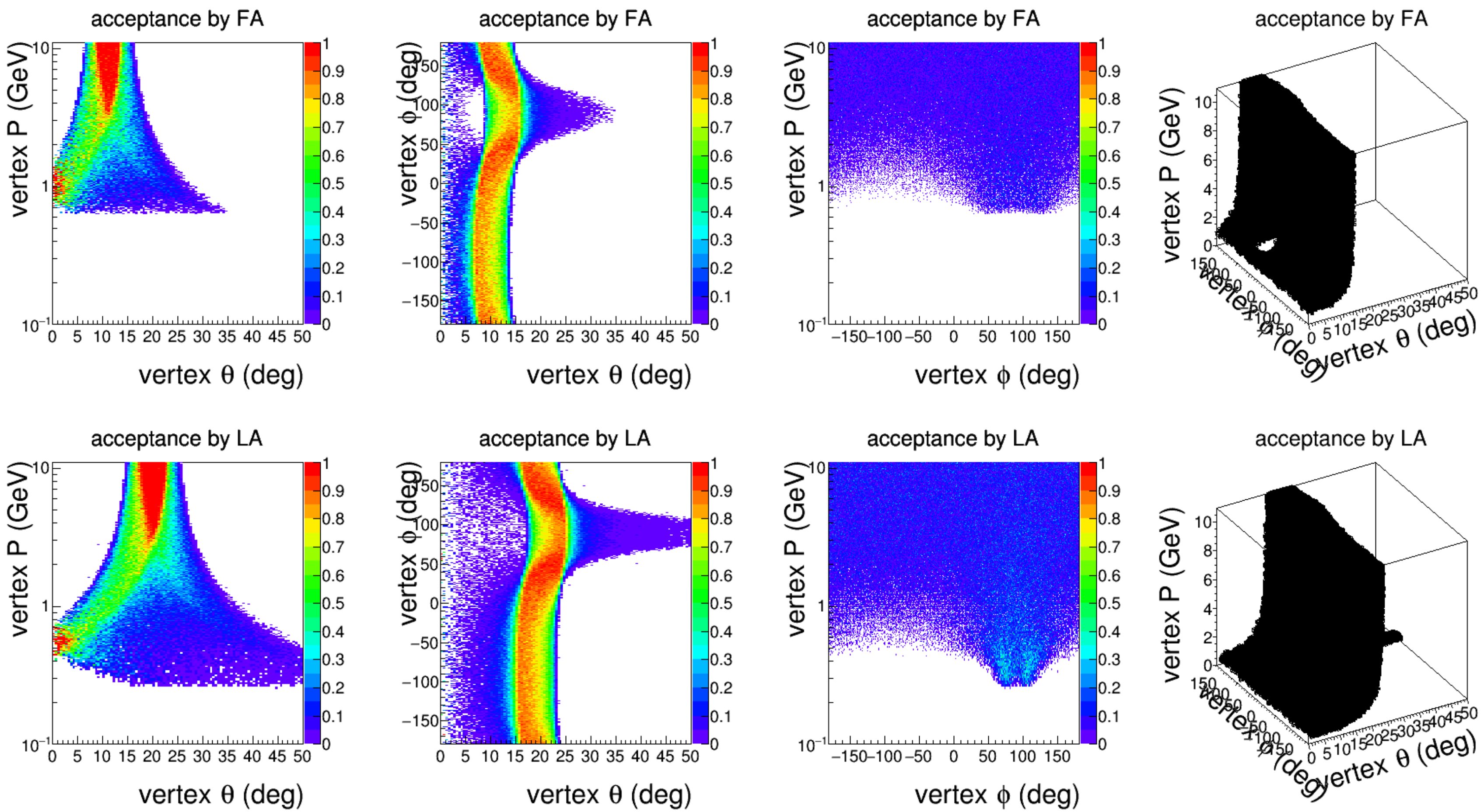
Wrong field

Pi- Acceptance without sheet of flame cut



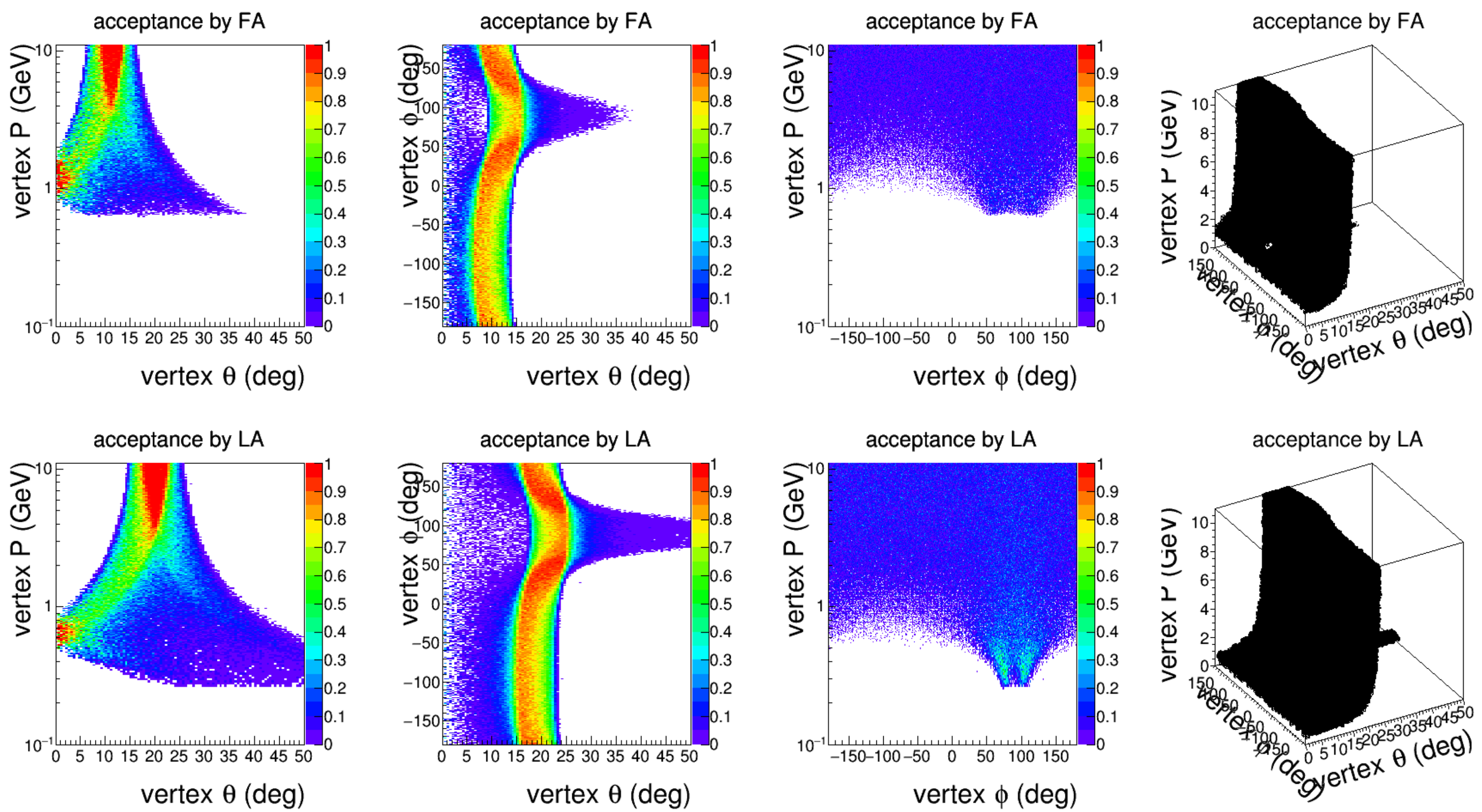
g2p field

Pi- Acceptance without sheet of flame cut



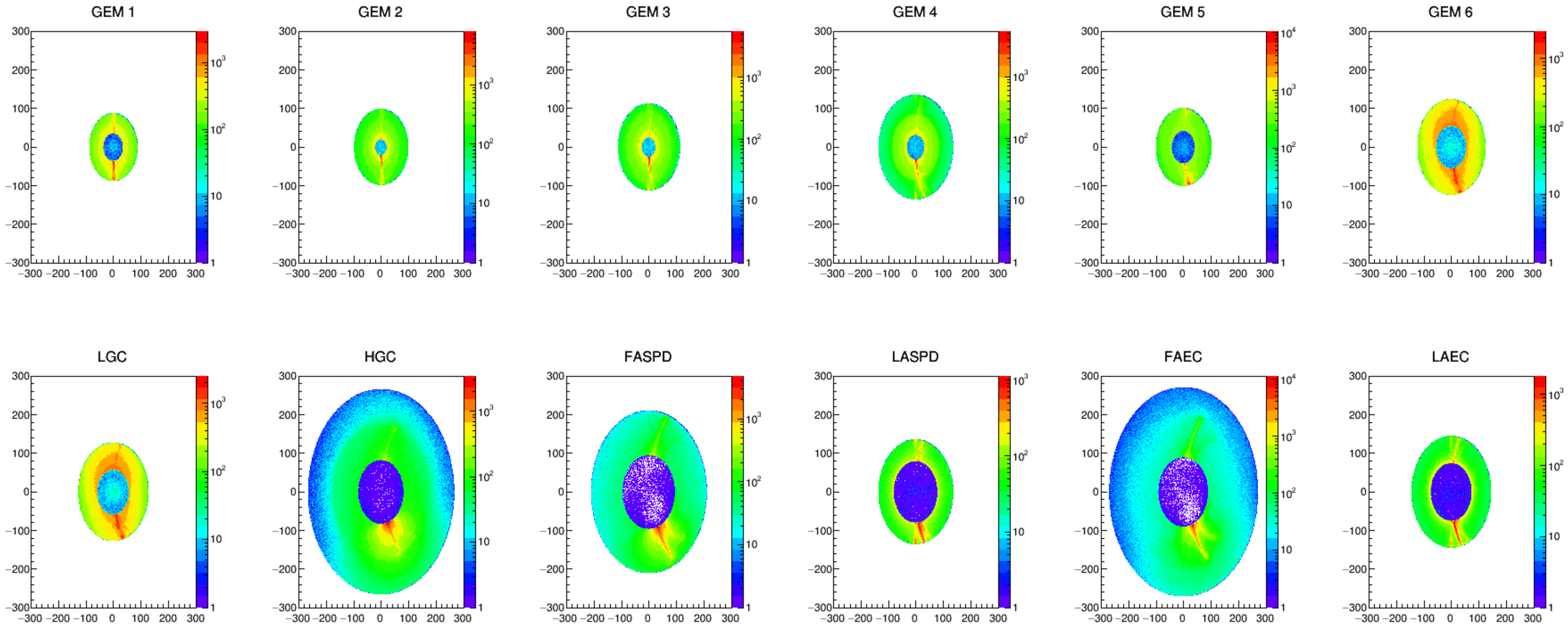
Oxford field

Pi- Acceptance without sheet of flame cut



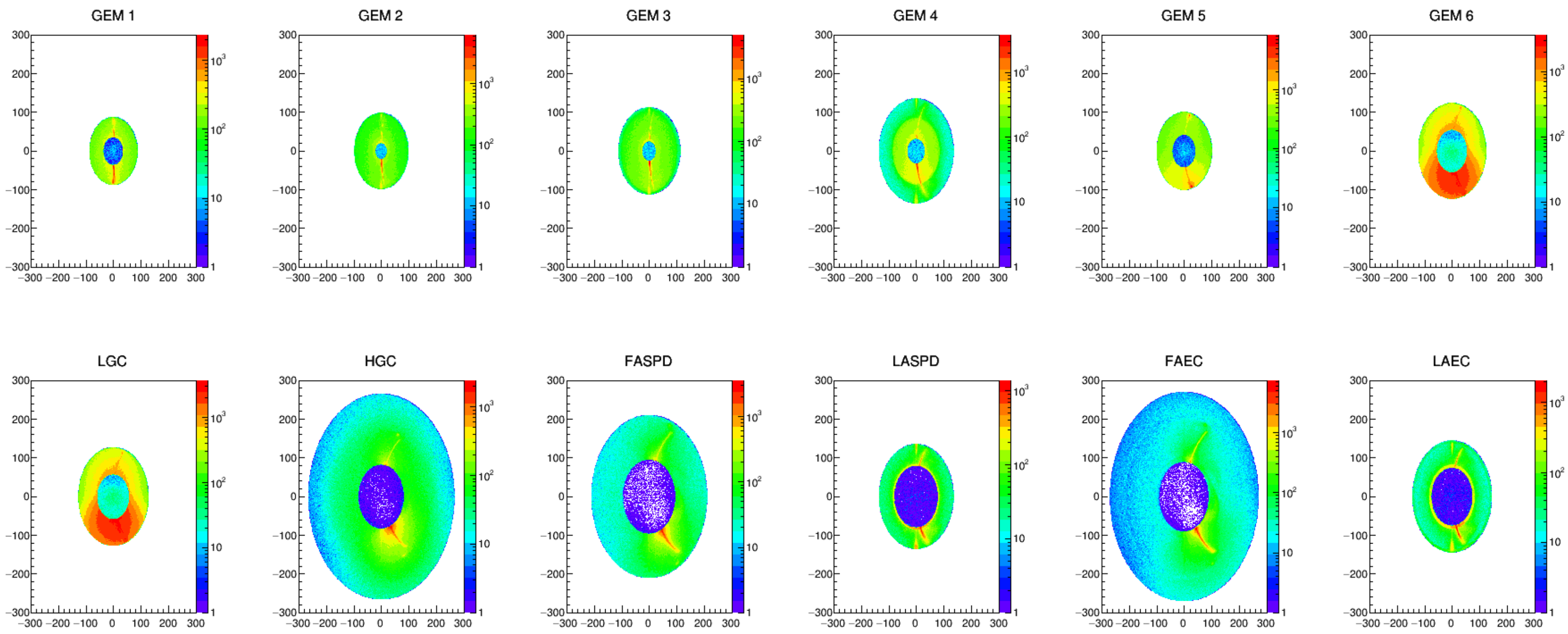
Wrong field

Particle counts at detector entrance from BeamOnTarget in Y vs X



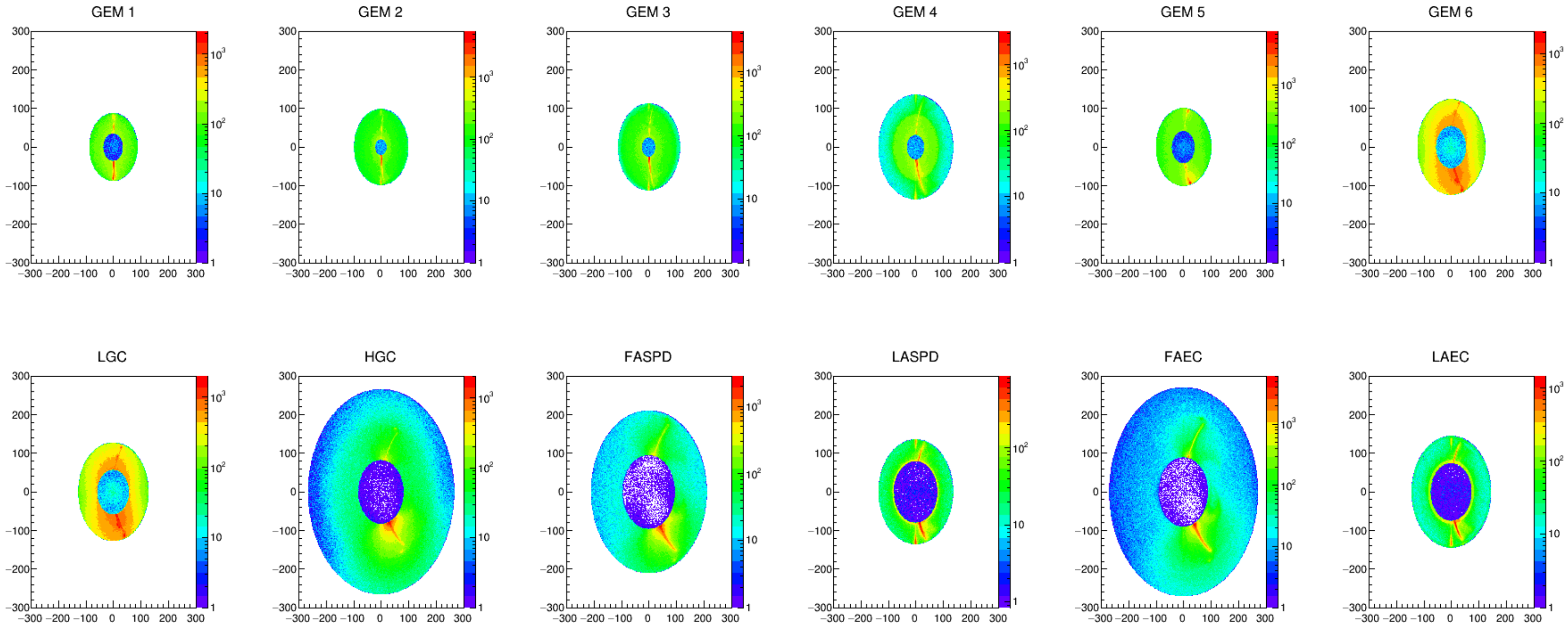
g2p field

Particle counts at detector entrance from BeamOnTarget in Y vs X



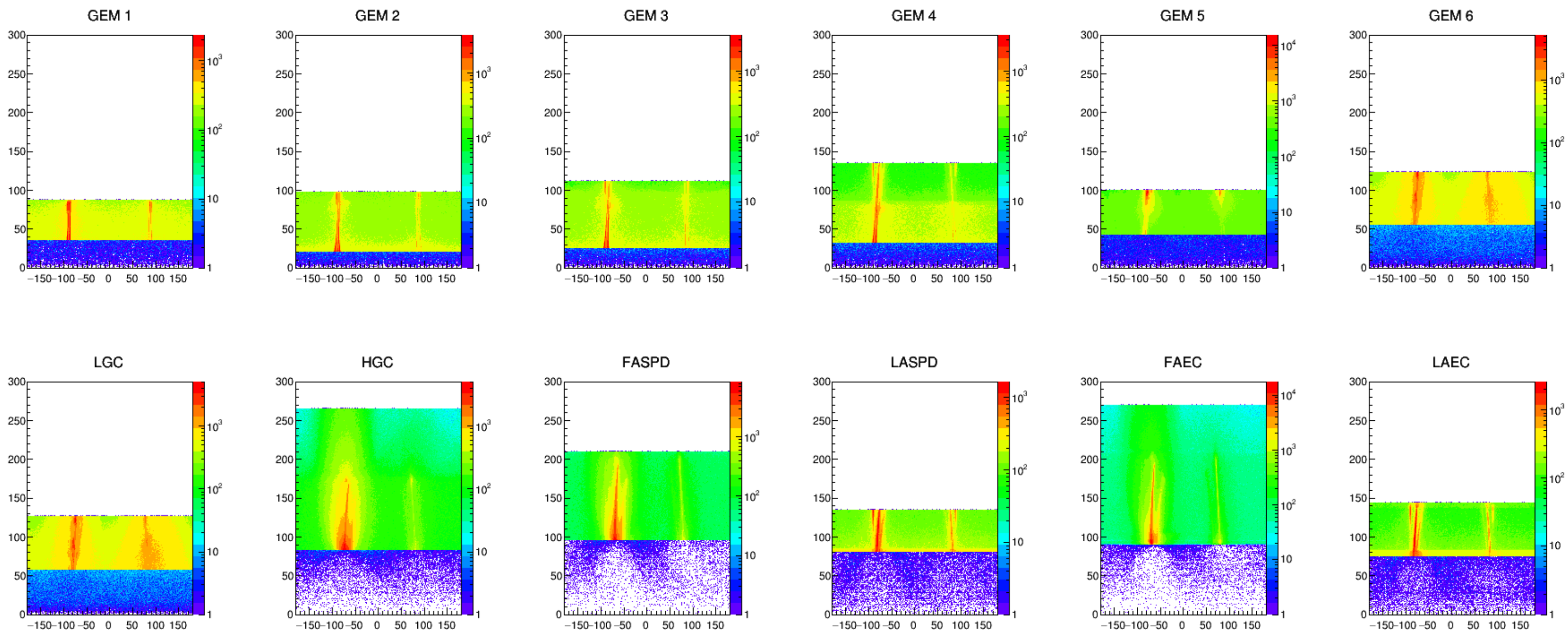
Oxford field

Particle counts at detector entrance from BeamOnTarget in Y vs X



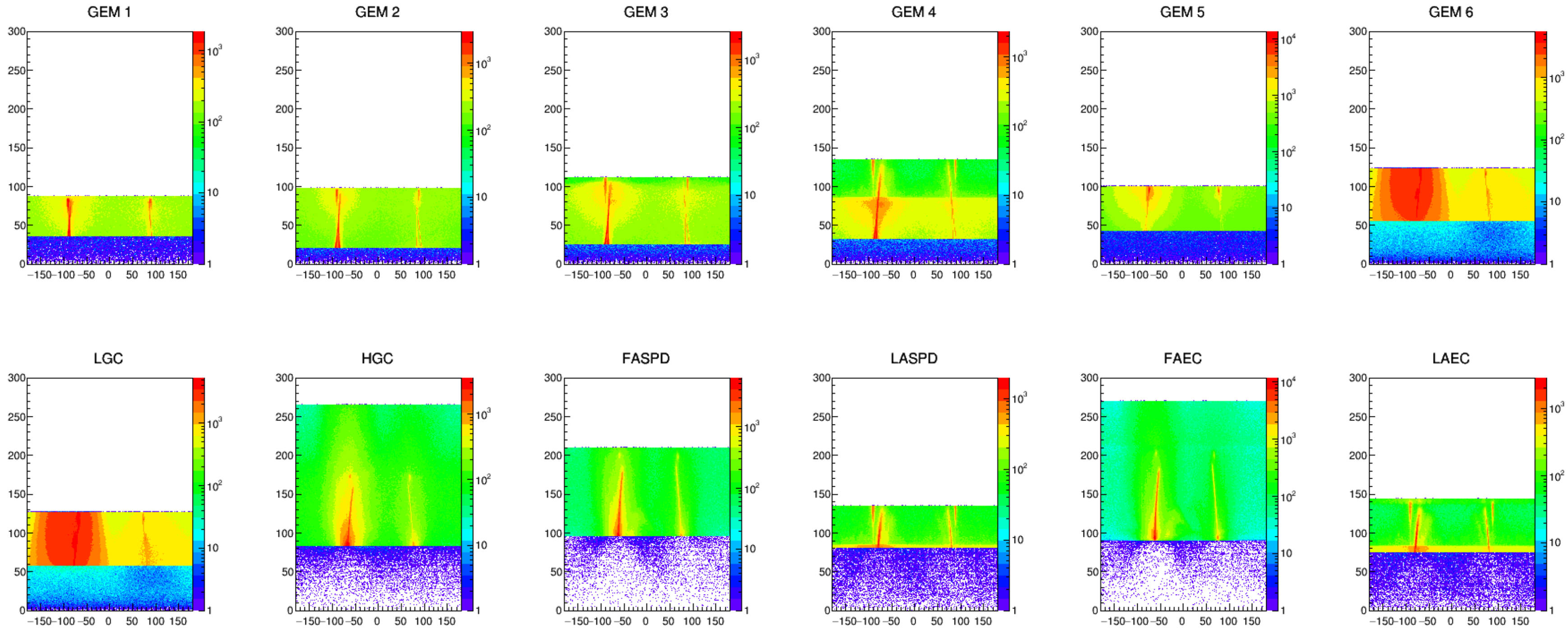
Wrong field

Particle counts at detector entrance from BeamOnTarget in R vs Phi



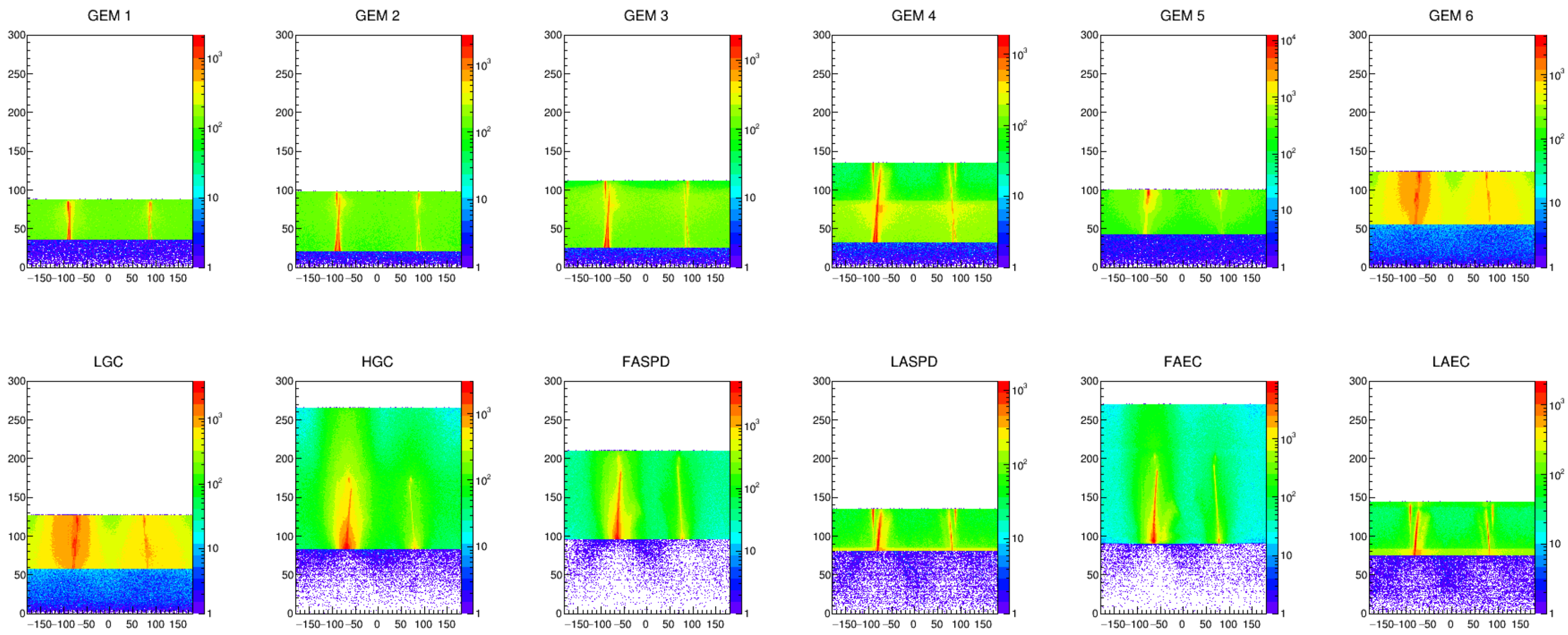
g2p field

Particle counts at detector entrance from BeamOnTarget in R vs Phi



Oxford field

Particle counts at detector entrance from BeamOnTarget in R vs Phi

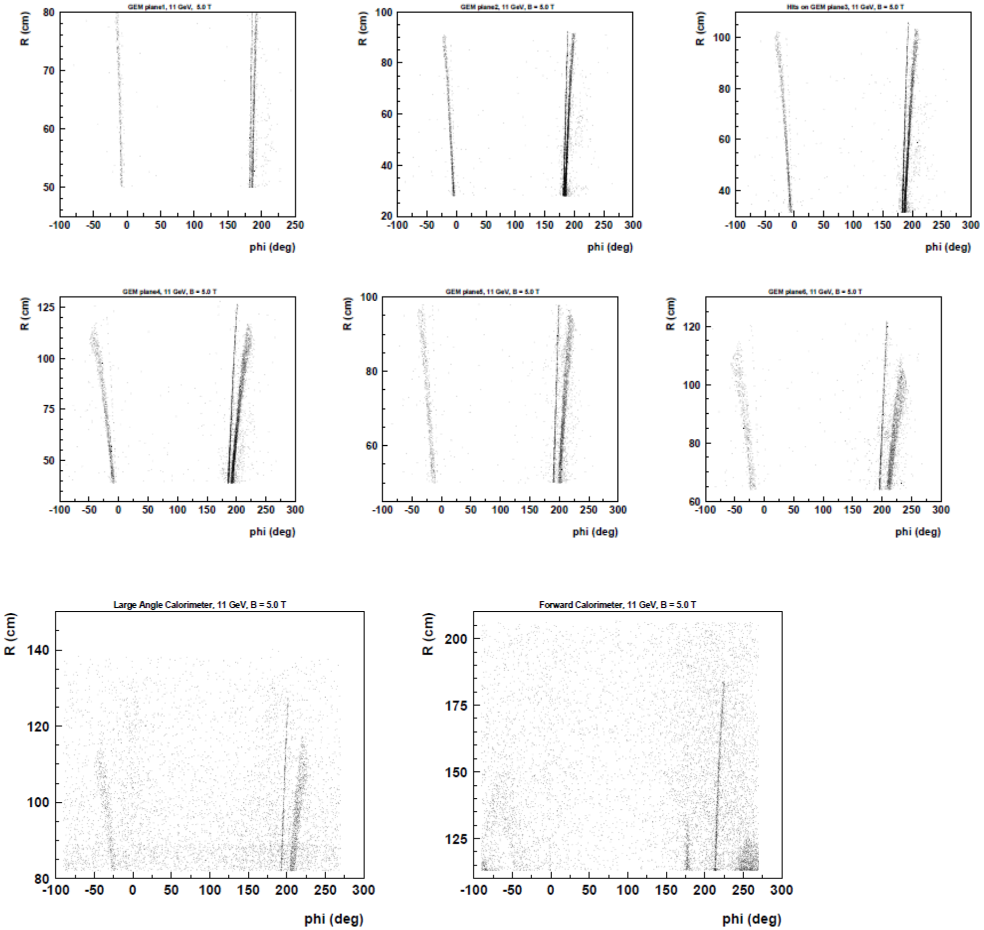


Oxford magnet detail

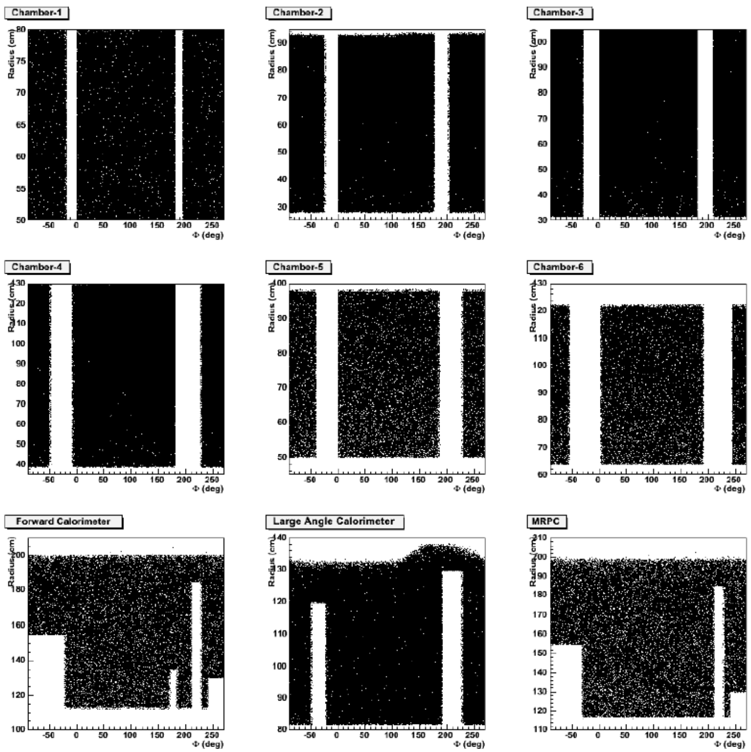
Chao Gu and Chao Peng

g2p target field is used in the proposal stage, but its map has some errors and cause about 10% larger field integral

update in 2012



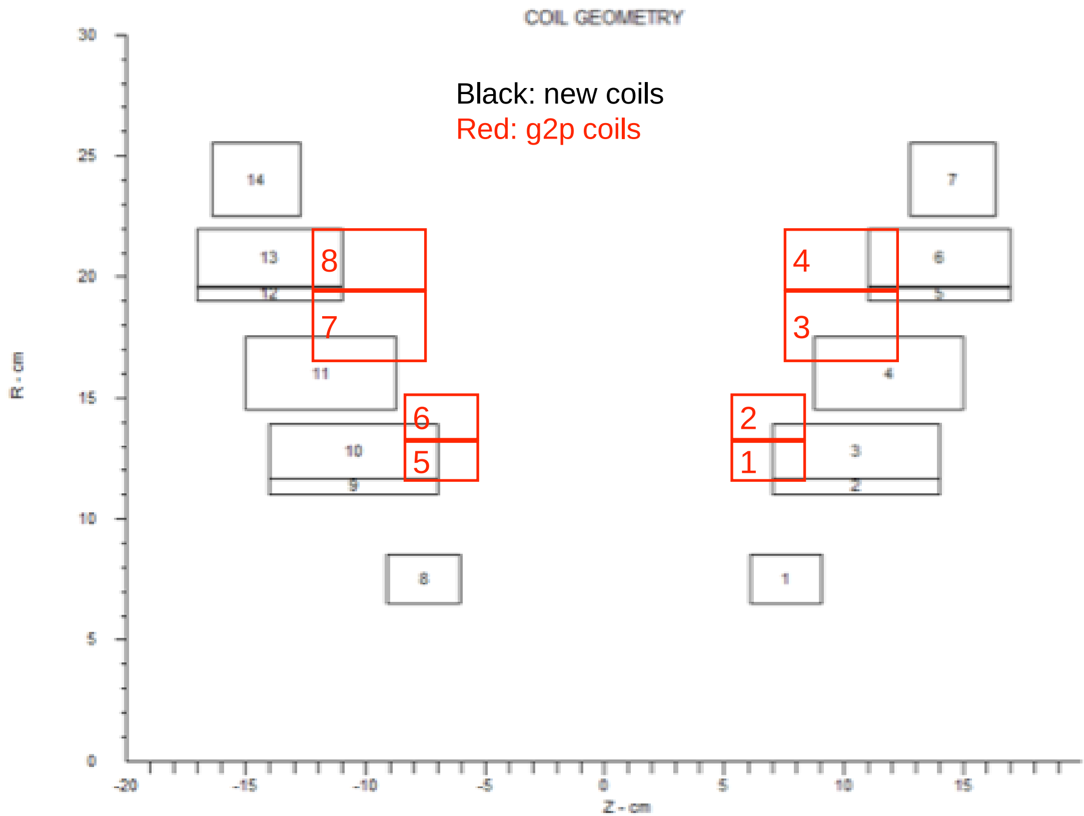
Original proposals in 2011



Oxford 2012 field map

Chao Gu

- New Helmholtz coil set for SoLID NH3 target designed by Oxford
  - The currently using field map is the g2p target field map
  - No ferromagnetism material and cylindrical symmetric, the field map could be calculated by Biot-Savart Law with a 2-D current density distribution
  - g2p has a code to do this calculation, it is updated with the characteristics of the new coil set



Chao Gu

Oxford 2012 field map

- The calculation is consistent
  - From the design report, the central field of the new coil set is 5.0 T at 106.0958 A current (this is the only known field value for this coil in the design report)
  - The central field calculated with the code reads 4.9996 T, so it is consistent with the design report

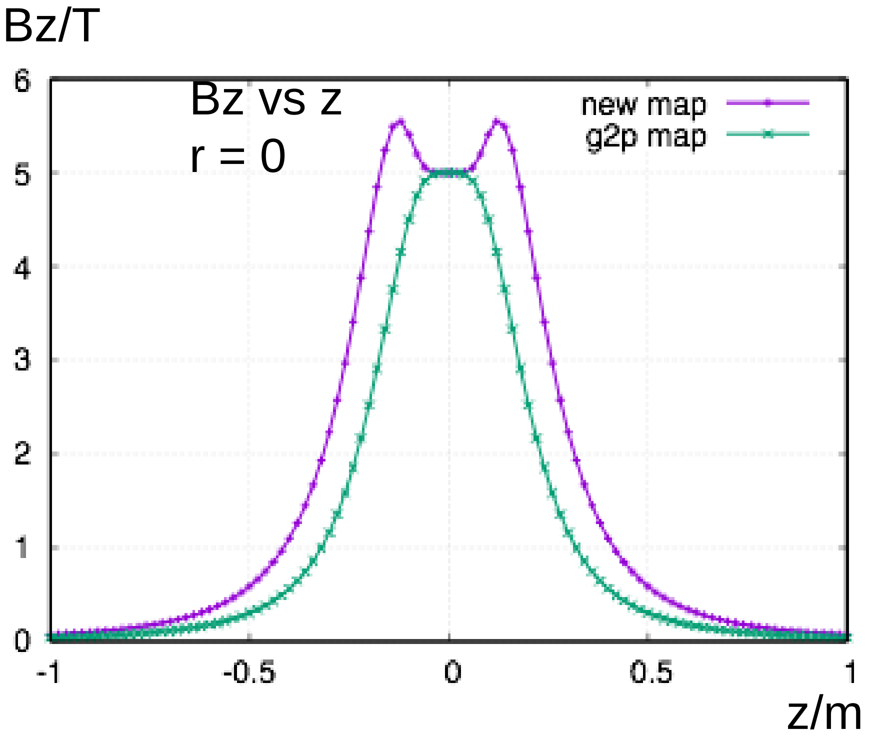
Coil Characteristics

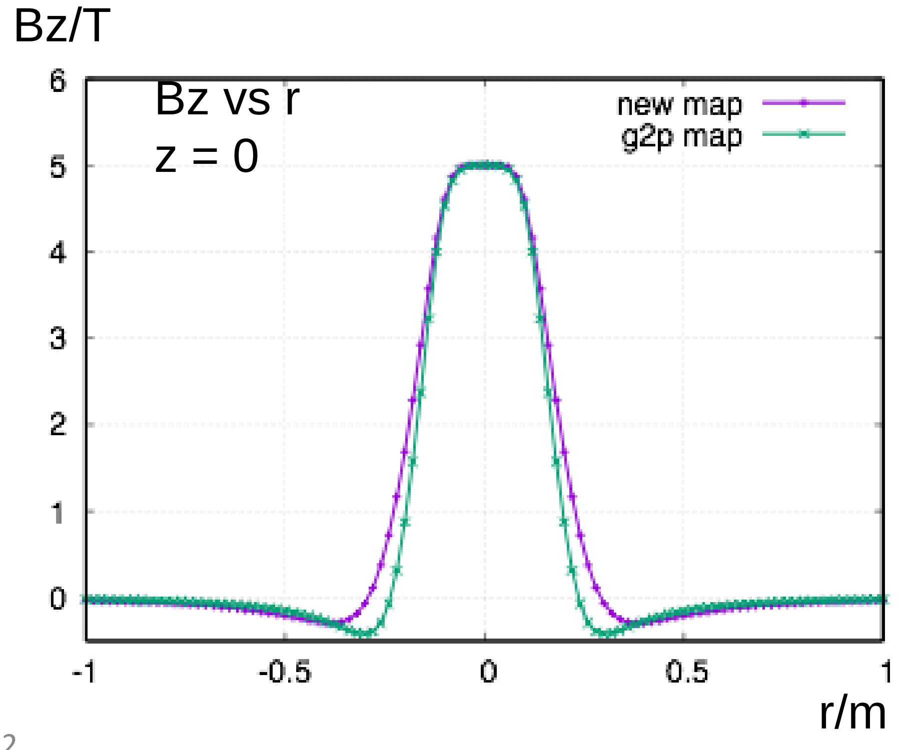
Coil No.	Wire Type	Inner Radius (cm)	Outer Radius (cm)	Layers	Turns	Turns Density (turns/cm^2)	Left Axial Boundary (cm)	RightAxial Boundary (cm)	Operating Current (A)
1	F54/70	6.500	8.516	28	-1118	-183.702	6.070	9.090	106.096
2	F55/85	11.000	11.688	8	616	128.000	7.000	14.000	106.096
3	F54/85	11.688	13.924	26	2003	128.000	7.000	14.000	106.096
4	F54/70	14.500	17.524	42	3515	186.000	8.750	15.000	106.096
5	F54/70	19.000	19.576	8	638	184.5055	11.000	17.000	106.096
6	F54/60	19.626	21.982	38	3534	250.000	11.000	17.000	106.096
7	F54/50	22.500	25.516	58	3853	350.000	12.750	16.400	106.096
8	F54/70	6.500	8.516	28	-1118	-183.702	-9.090	-6.070	106.096
9	F55/85	11.000	11.688	8	616	128.000	-14.000	-7.000	106.096
10	F54/85	11.688	13.924	26	2003	128.000	-14.000	-7.000	106.096
11	F54/70	14.500	17.524	42	3515	186.000	-15.000	-8.750	106.096
12	F54/70	19.000	19.576	8	638	184.5055	-17.000	-11.000	106.096
13	F54/60	19.626	21.982	38	3534	250.000	-17.000	-11.000	106.096
14	F54/50	22.500	25.516	58	3853	350.000	-16.400	-12.750	106.096

Chao Gu

Oxford 2012 field map

- Compare the field map of this new field with the g2p field map, the symmetric axis of the coils is along z axis in the lab system
- The integrated BdL of the new field map is
  - 42% larger than the g2p field map (longitudinal setting)
  - 15% larger than the g2p field map (transverse setting)

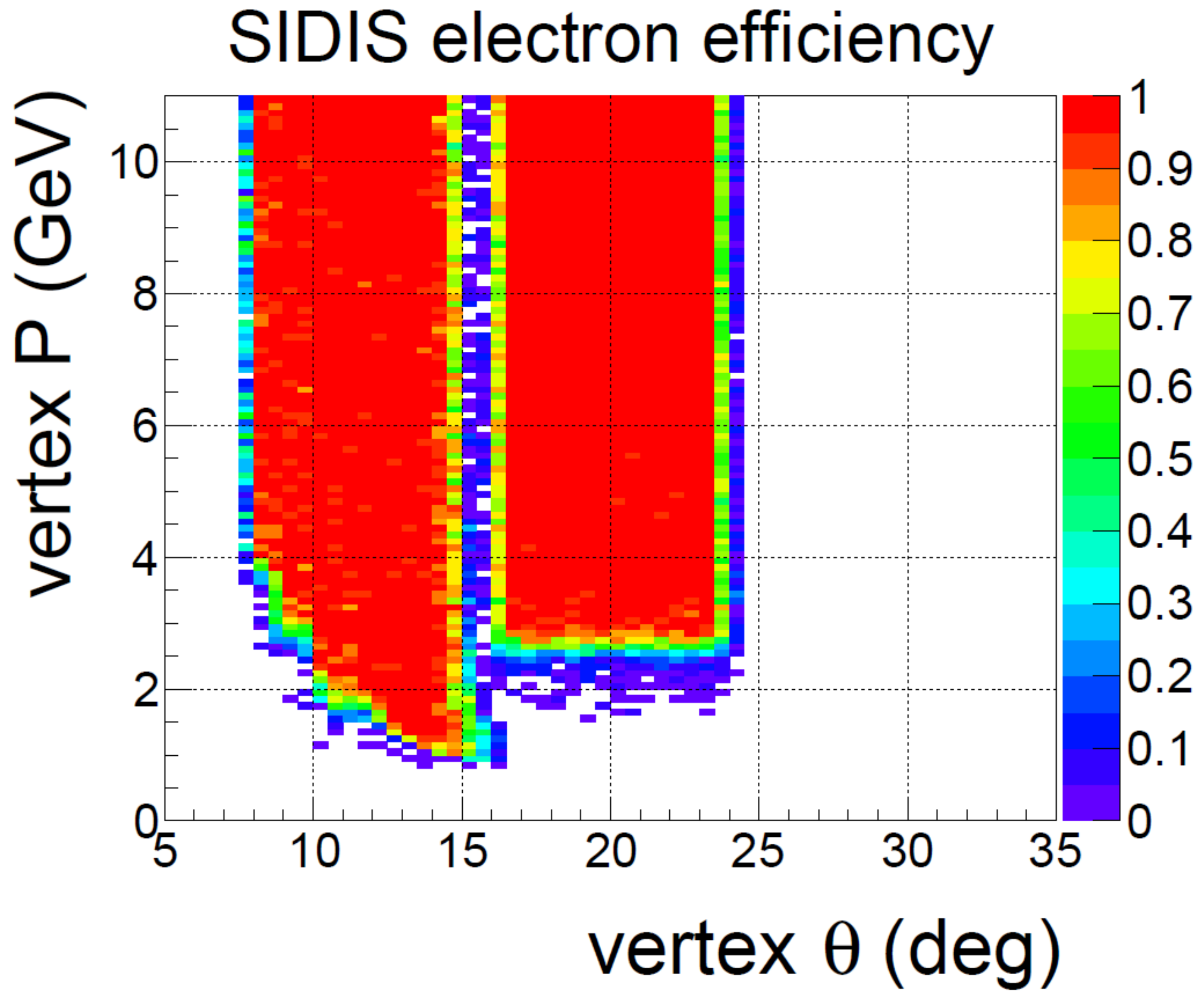




backup

Trigger condition

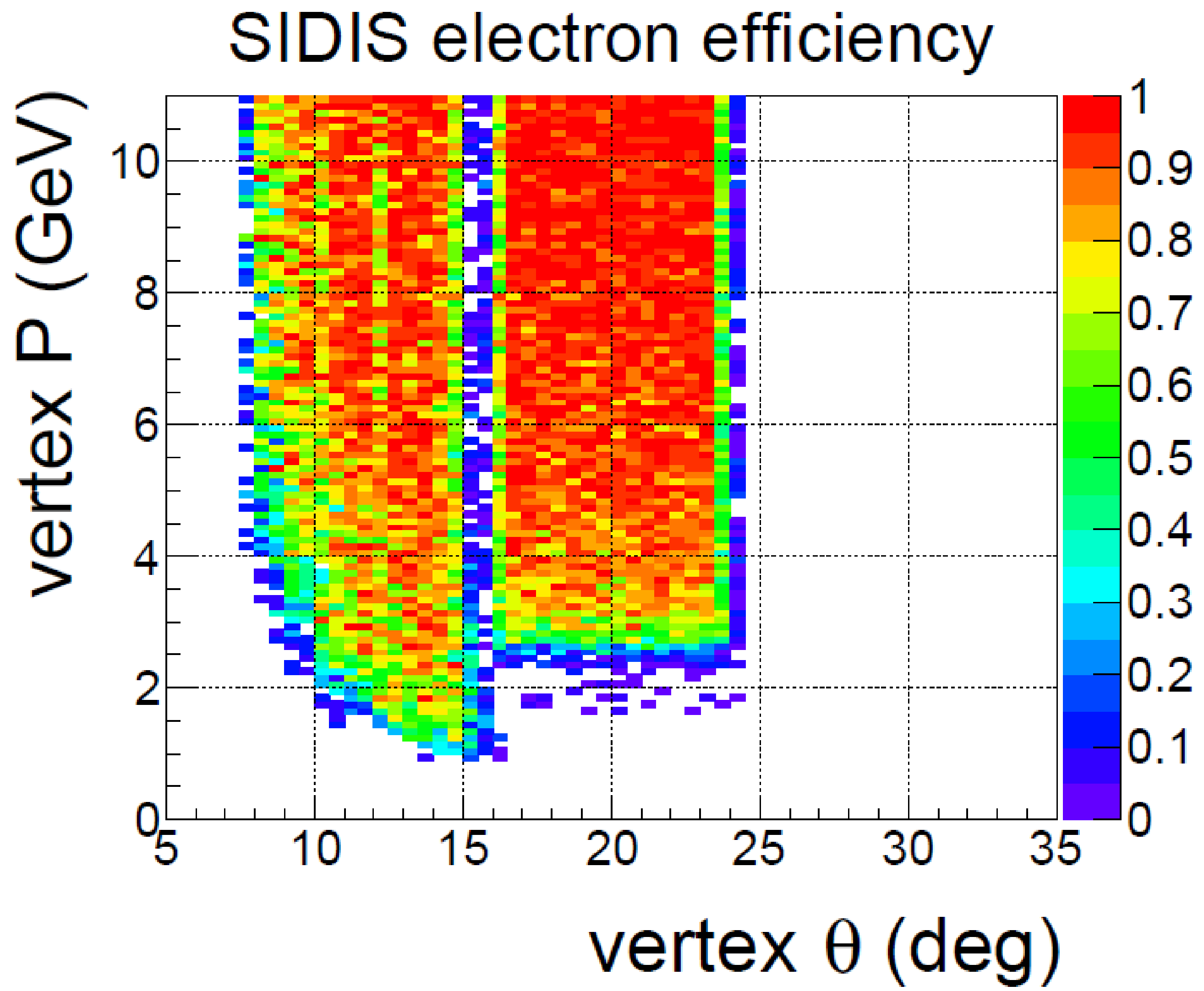
EC only simulation, vz(-355,-345)cm
eff_EC > 98%



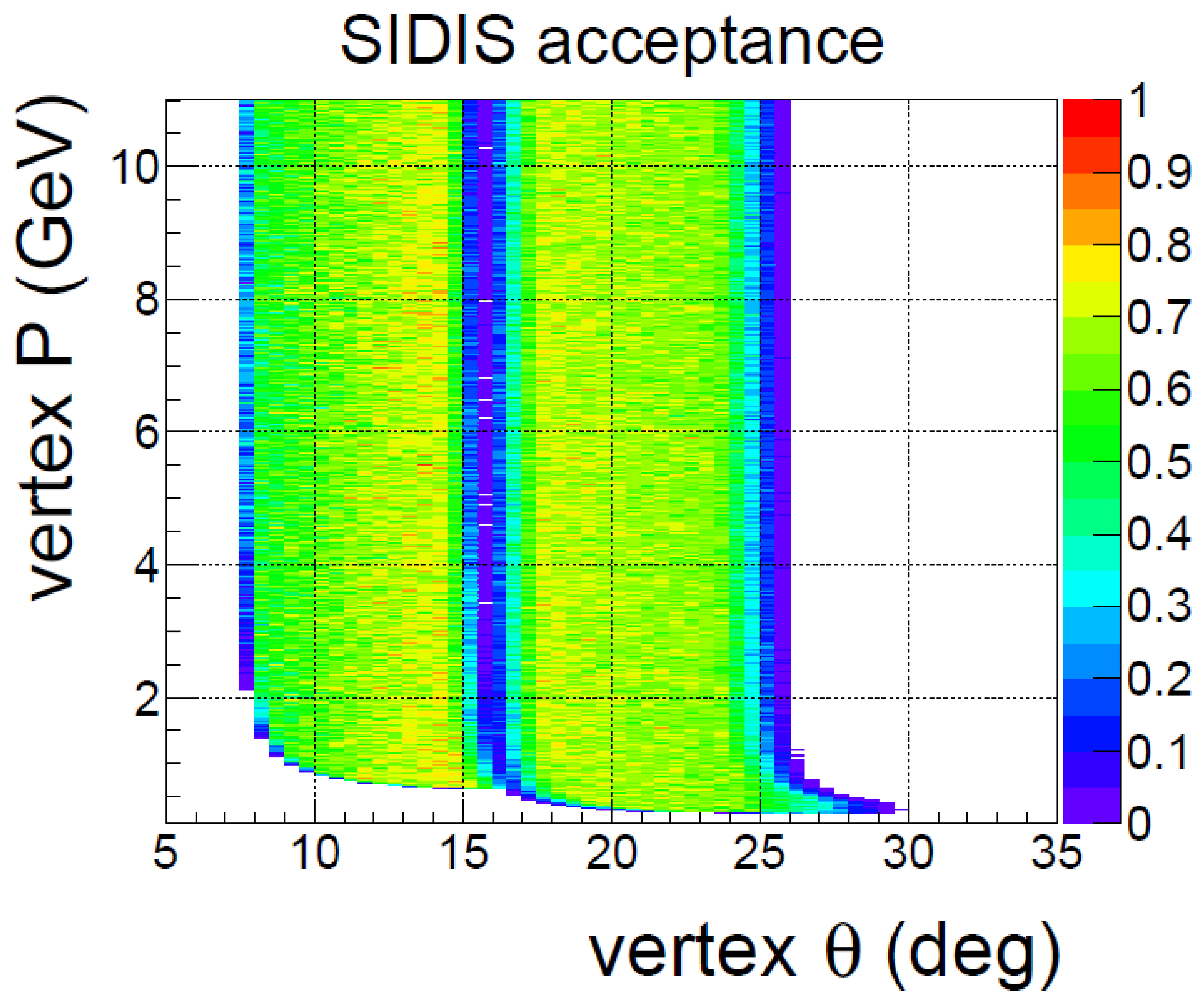
Trigger condition

full simulation, vz(-355,-345)cm

(eff_FAEC & eff_LGC & eff_FASPD) > 88%, (eff_LAEC & eff_LASPD) > 95%



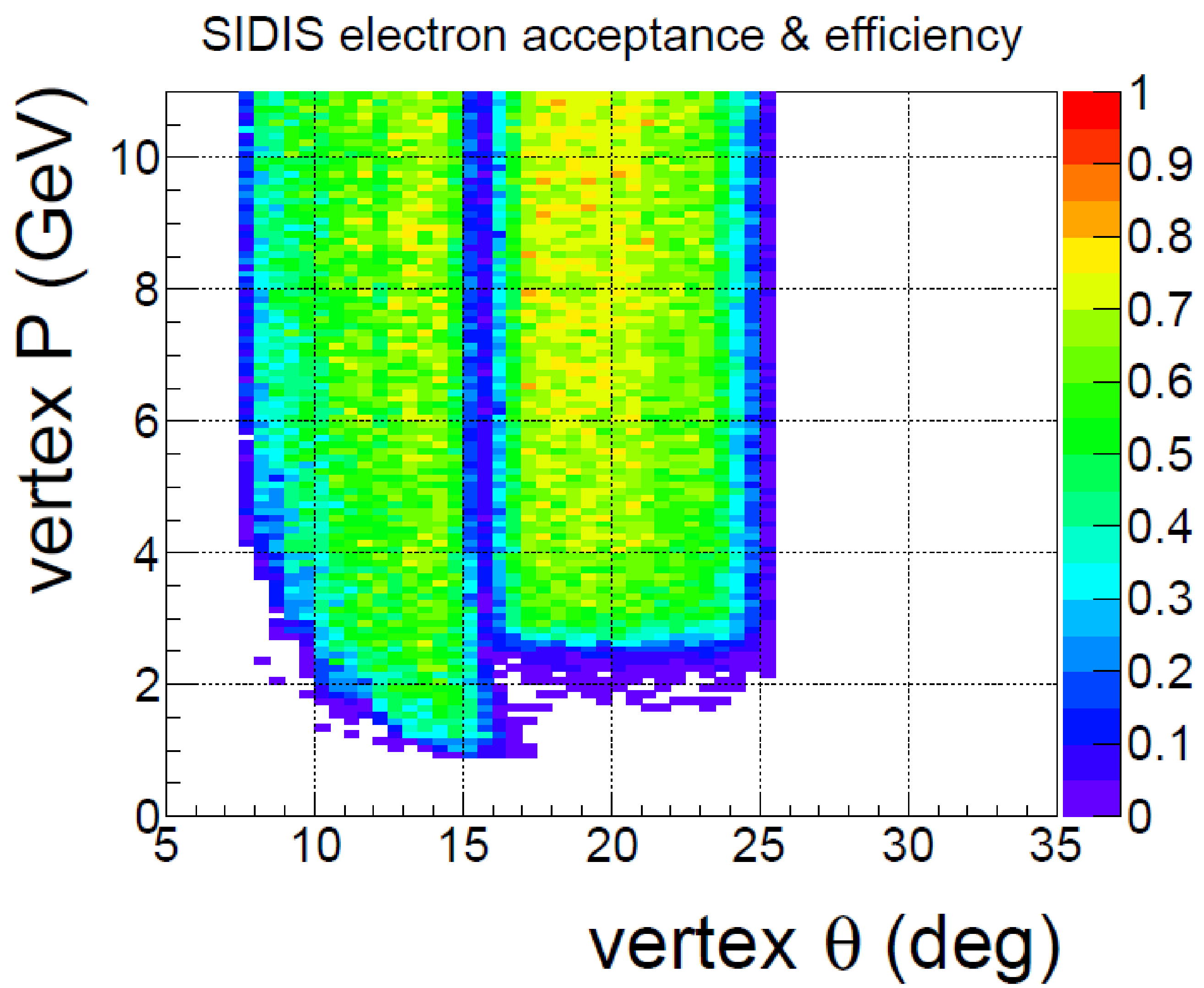
No material simulation, vz(-370,-330)cm
acc > 70%



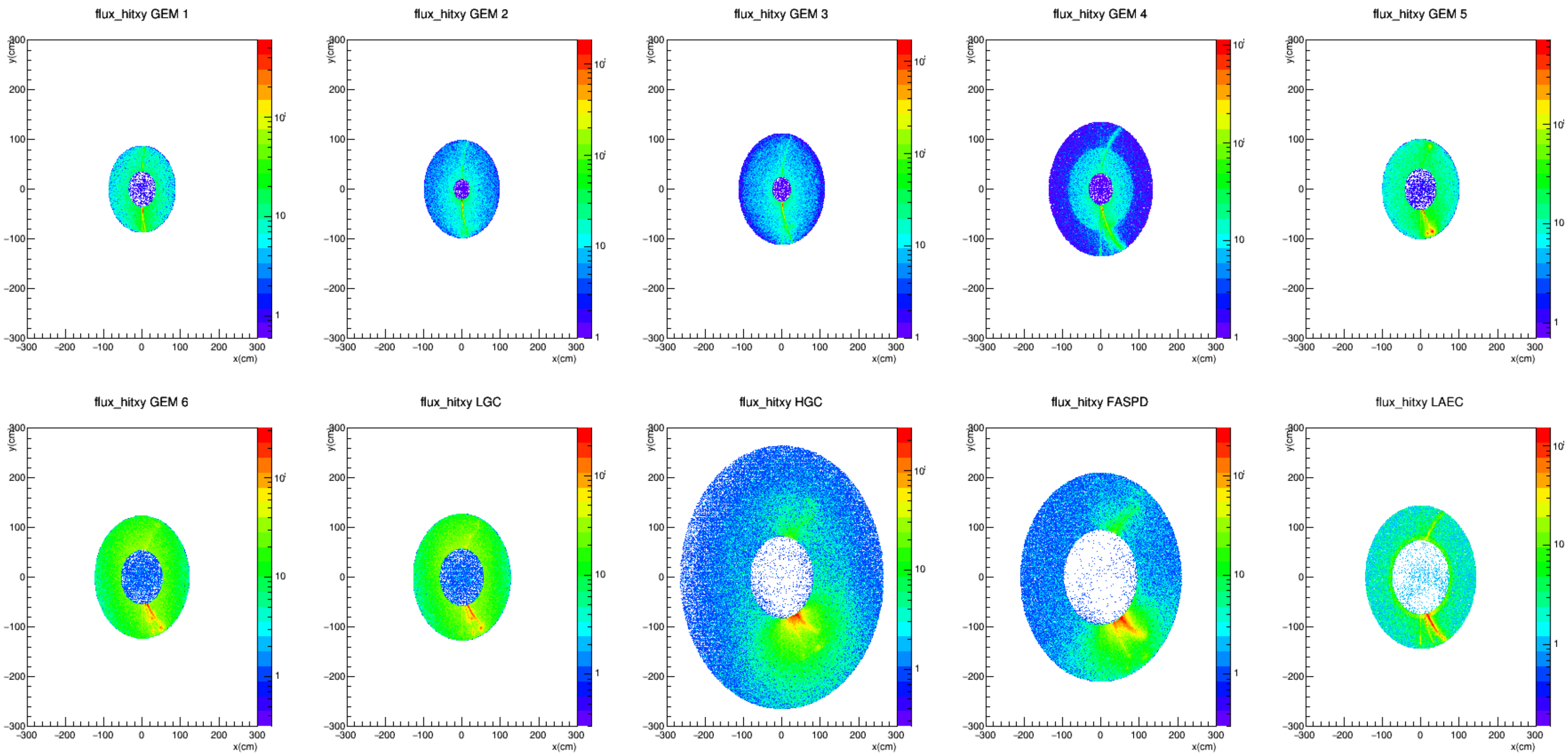
Trigger condition

full simulation, vz(-370,-330)cm

(eff_FAEC&eff_LGC&eff_FASPD)&acc>60%, (eff_LAEC&eff_LASPD)&acc>70%



hits


flux_hitxy GEM 1
flux_hitxy GEM 2
flux_hitxy GEM 3
flux_hitxy GEM 4
flux_hitxy GEM 5
flux_hitxy GEM 6
flux_hitxy LGC
flux_hitxy HGC
flux_hitxy FASPD
flux_hitxy LAEC
y(cm)
x(cm)

eDIS accepted by EC and GEM after cutting on sheet of flame