J-PARC E70 / E94 MEETING

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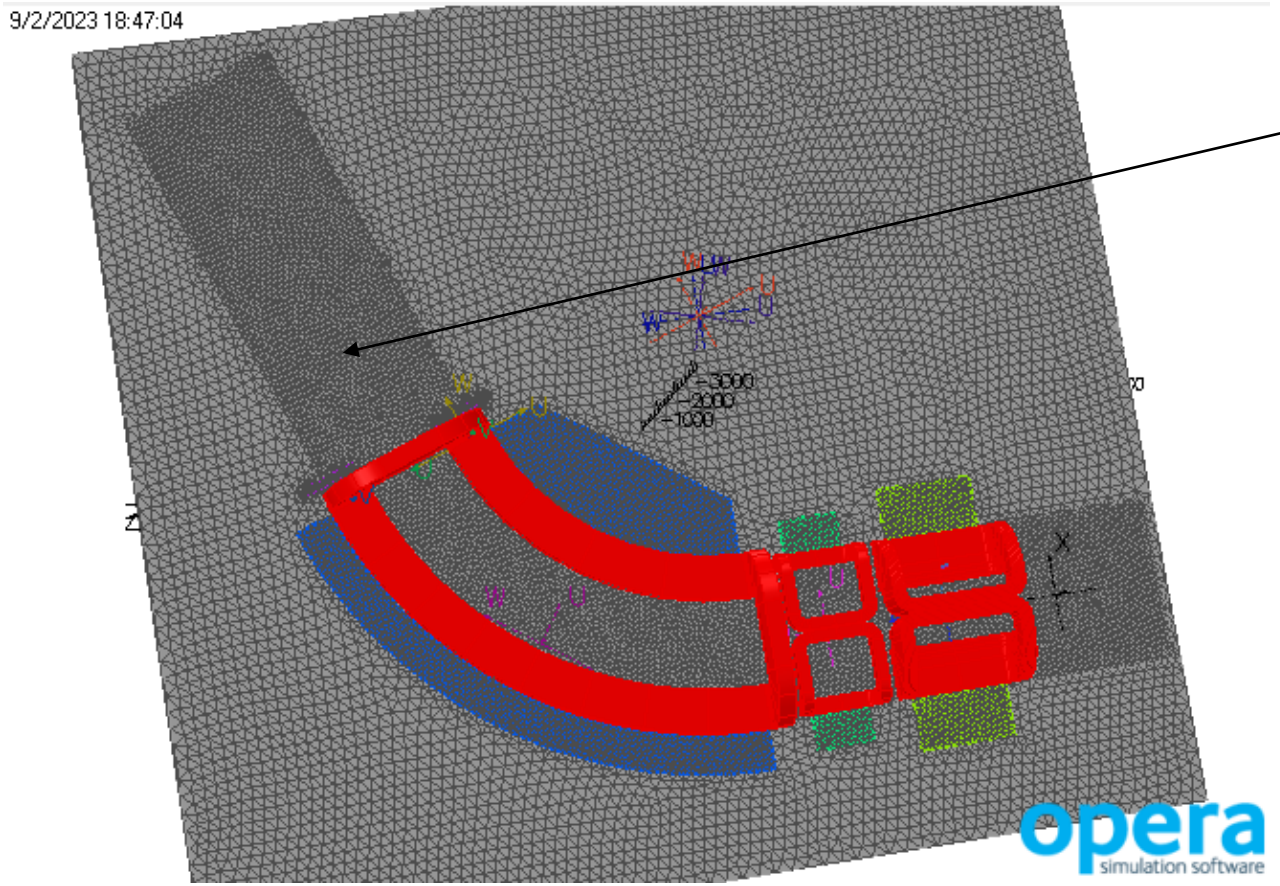
CONTENTS

S-2S Geant4 simulation (J-PARC E70 / E94)

1. **Magnetic field map for Geant4**
   - ➢dp/p is improved by changing from 20- to 4-mm mesh size

2. **Mass squared**
   - ➢Sample ROOT files can be used

OPERA3D(TOSCA) → GEANT4



TOSCA calculation

- 70-mm min. mesh size for the volume where particles pass through

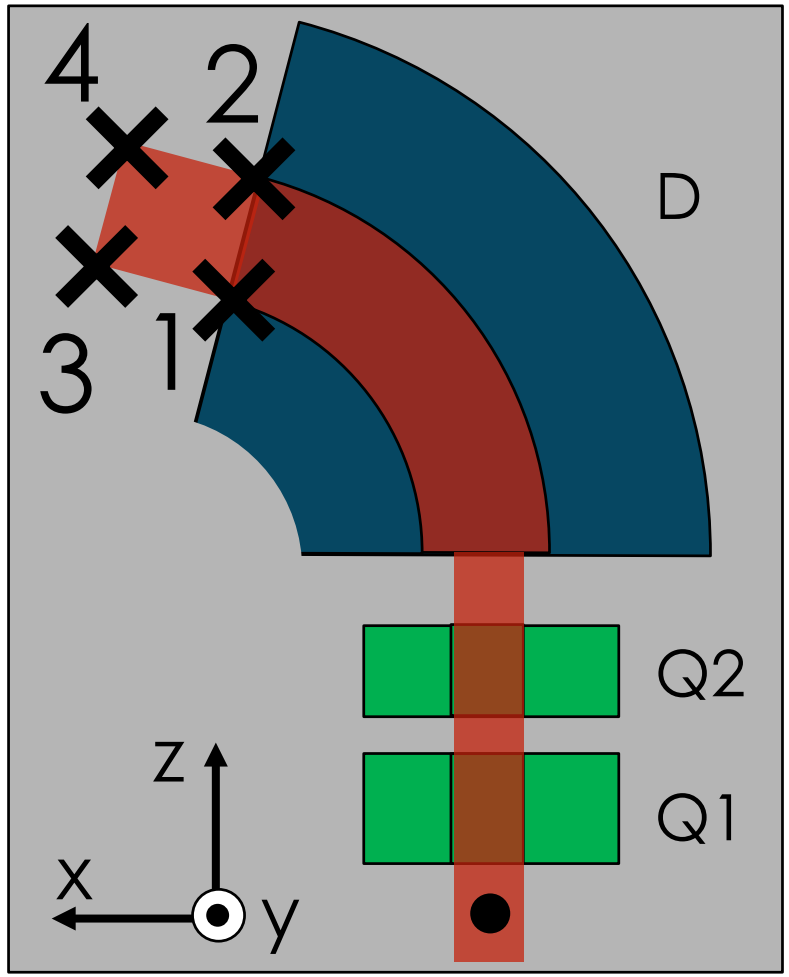
Interpolation
by Post Processor

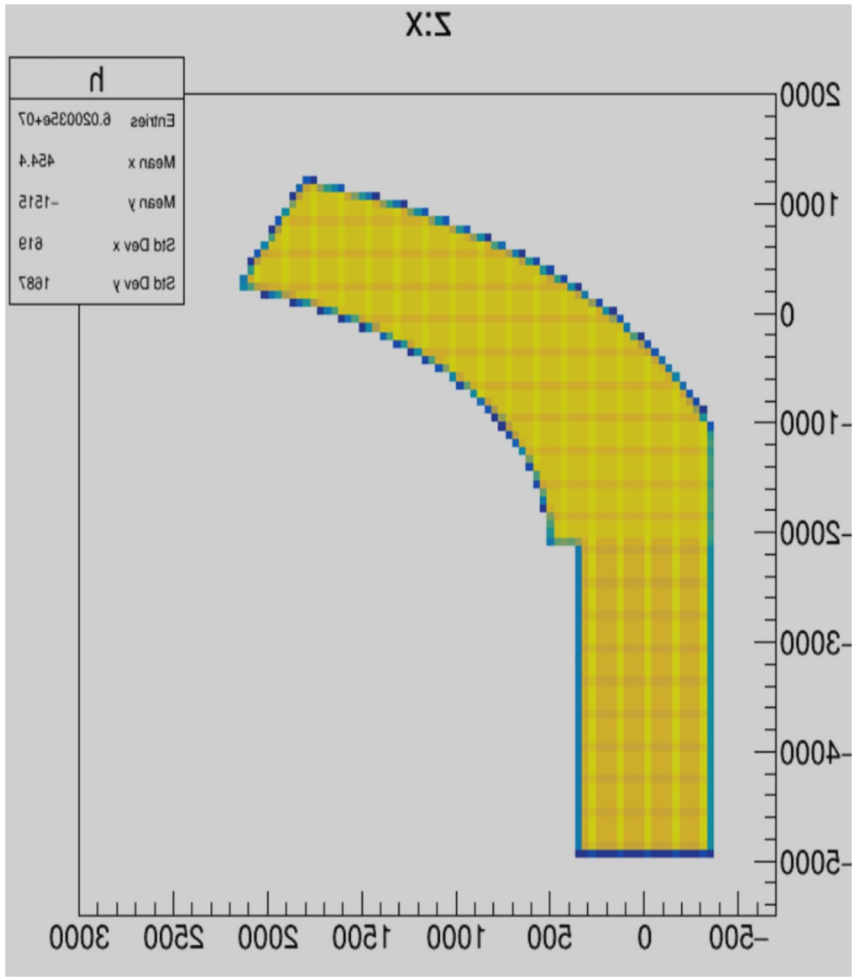
Magnetic field (MF) map

- 20-mm mesh (current version)
- 10-mm mesh
- 4-mm mesh

c.f.) 1-mm mesh is used for HKS

PICK UP GRID POINTS FOR ONLY USED VOLUME





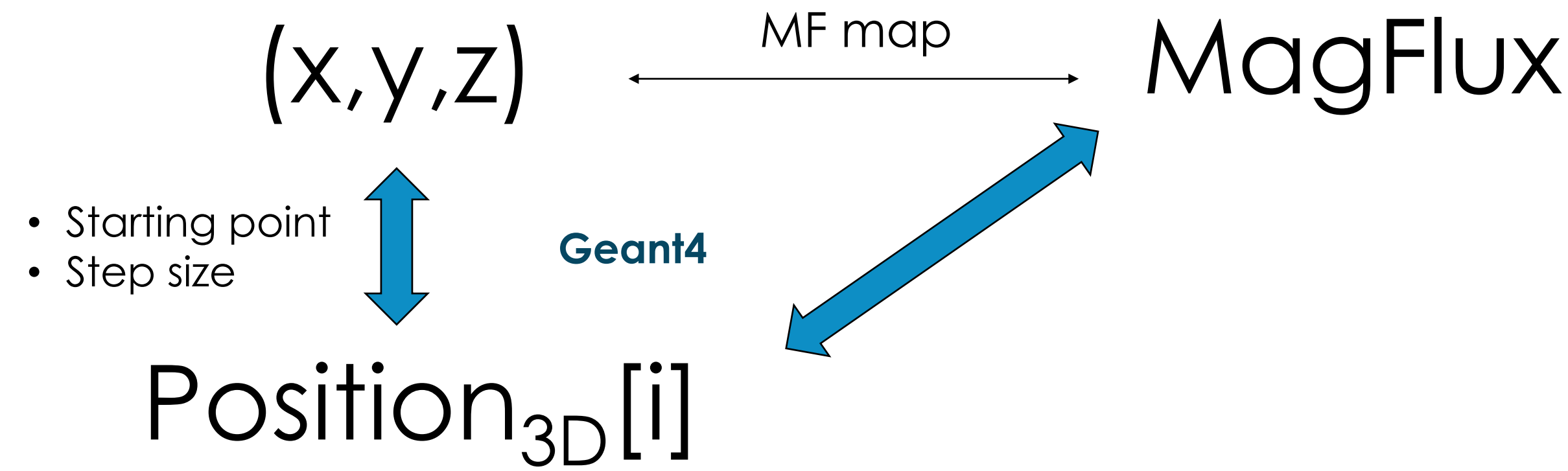
4-mm mesh
31 GB → 3.2 GB

LOCATION OF THE MF MAPS

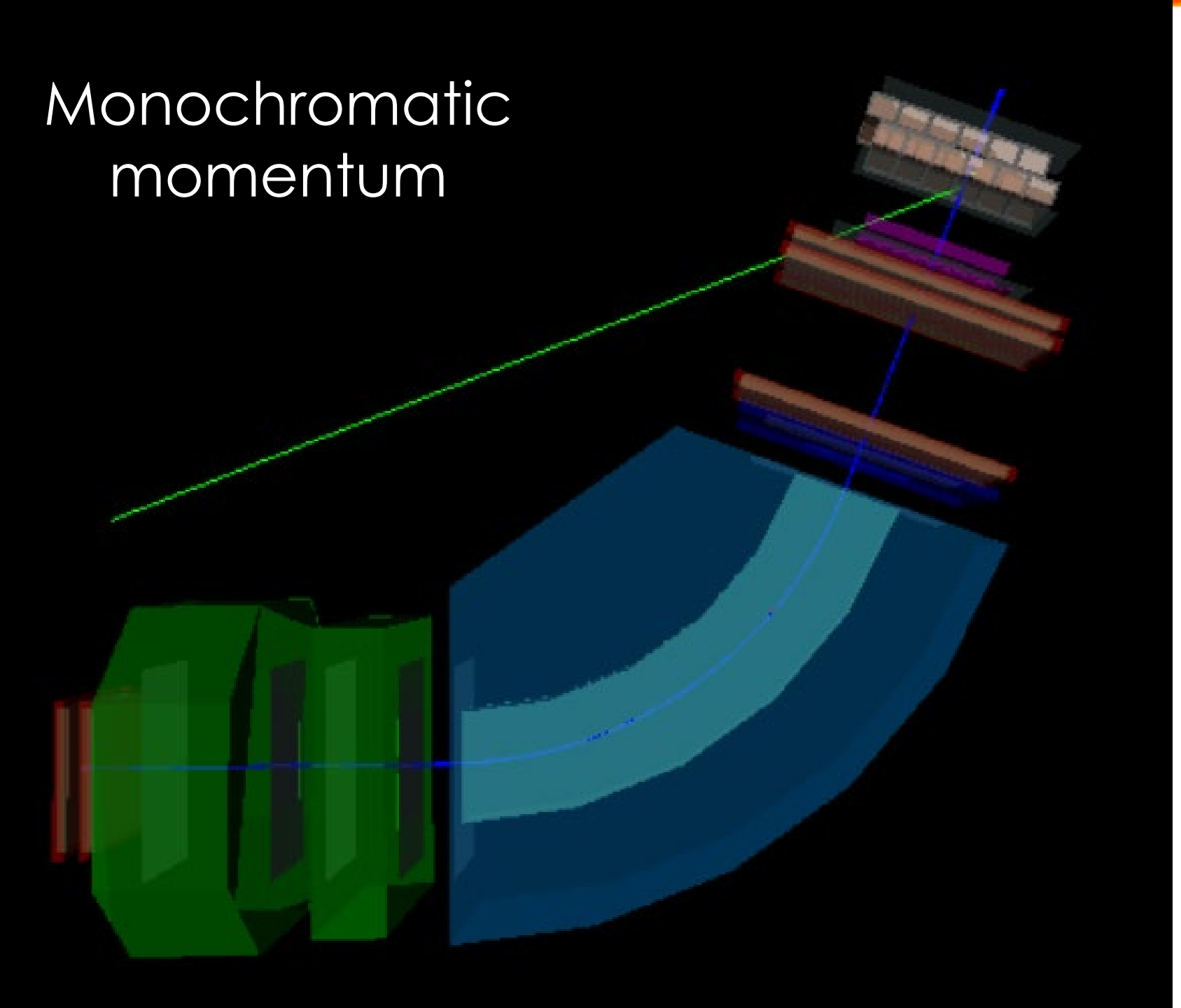
1. **kekcc: /home/had/gogami/git/s2s_MFmap**
2. **hyperdragon11: /data5/outdat5/s2s/dragon/s2s_MFmap**

-rw-r--r-- 1 gogami had_sks 26M 2月 18 23:46 **sts-all_2500A_20mm-mesh.dat**
-rw-r--r-- 1 gogami had_sks 203M 2月 18 23:46 **sts-all_2500A_10mm-mesh.dat**
-rw-r--r-- 1 gogami had_sks 3.2G 2月 18 23:46 **sts-all_2500A_4mm-mesh.dat**

HOMOLOGIZING MF INFORMATION

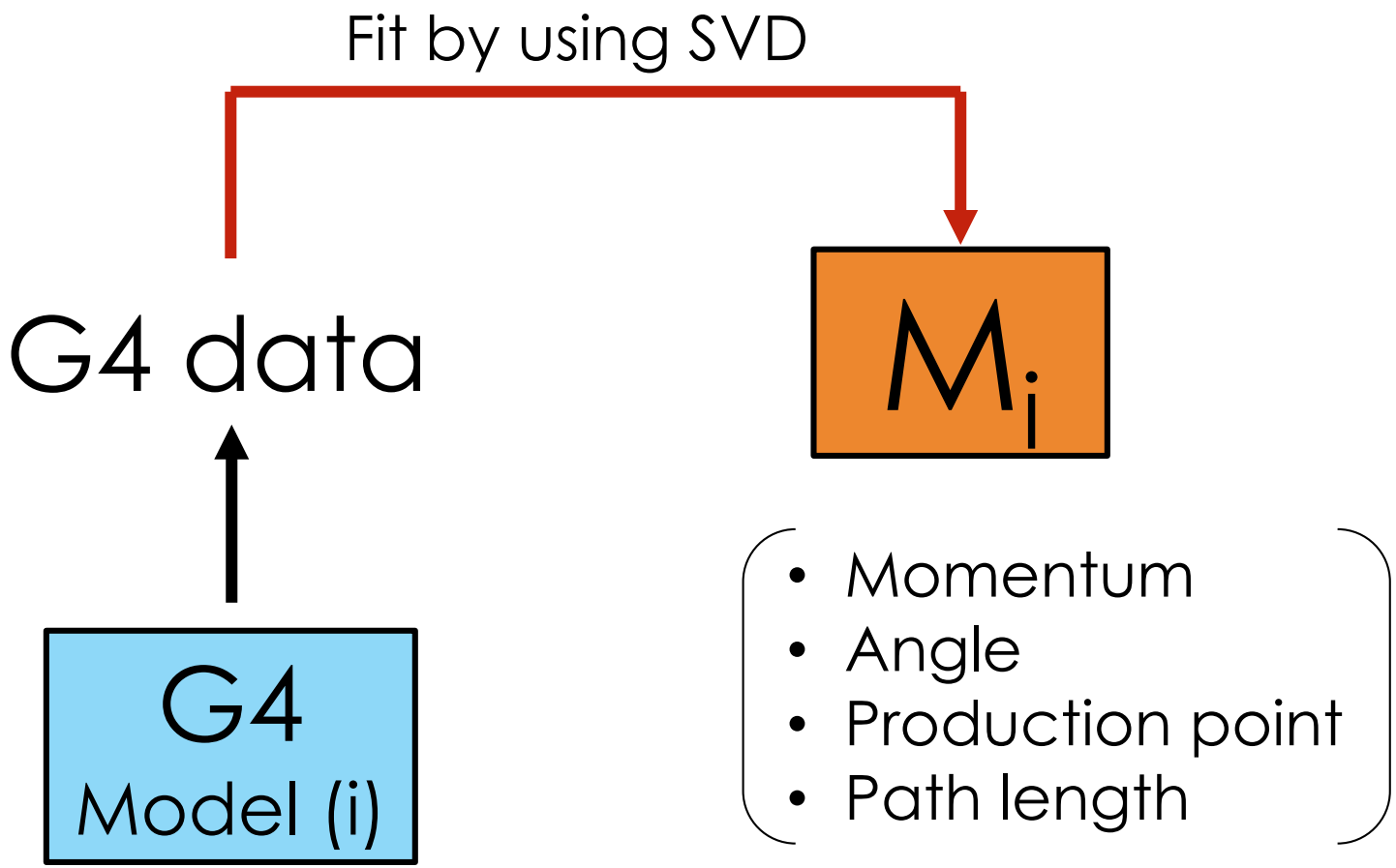


Monochromatic momentum



Direct implementation works (no separation / rotation)

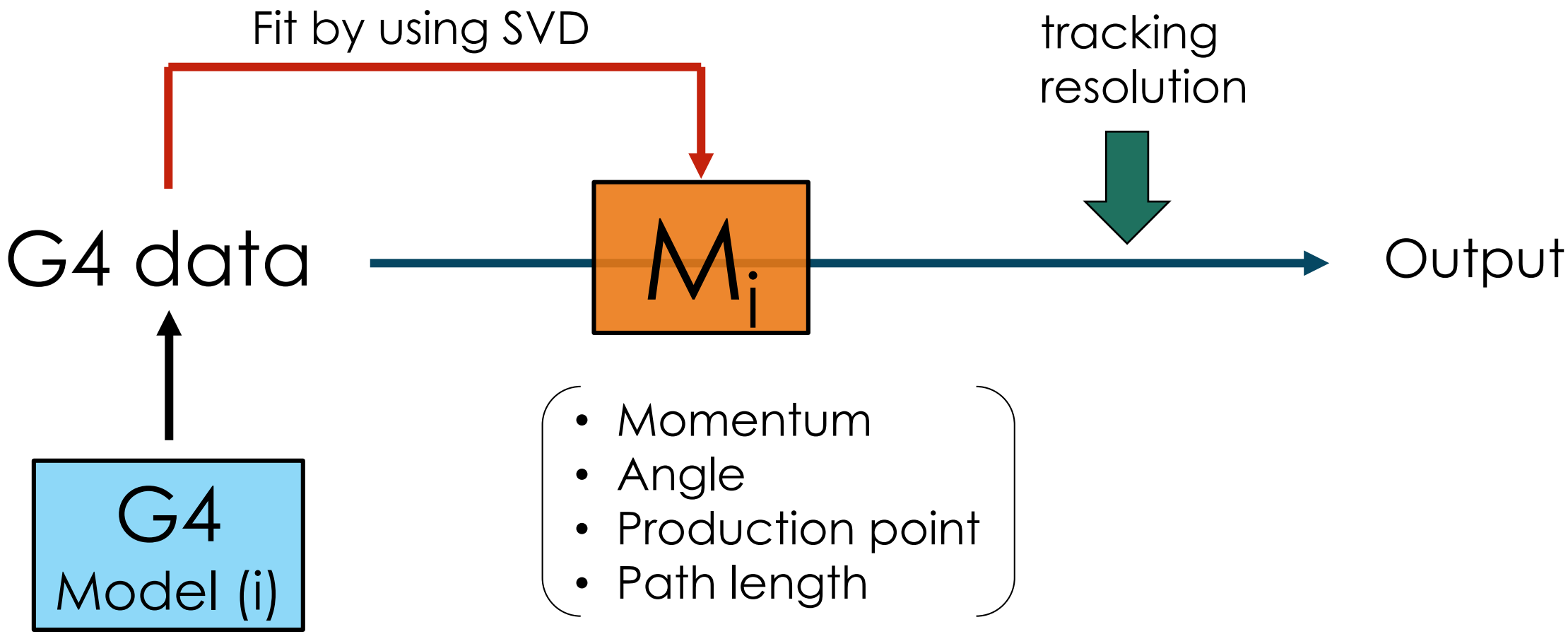
HOW TO USE BACKWARD TRANSFER MATRIX



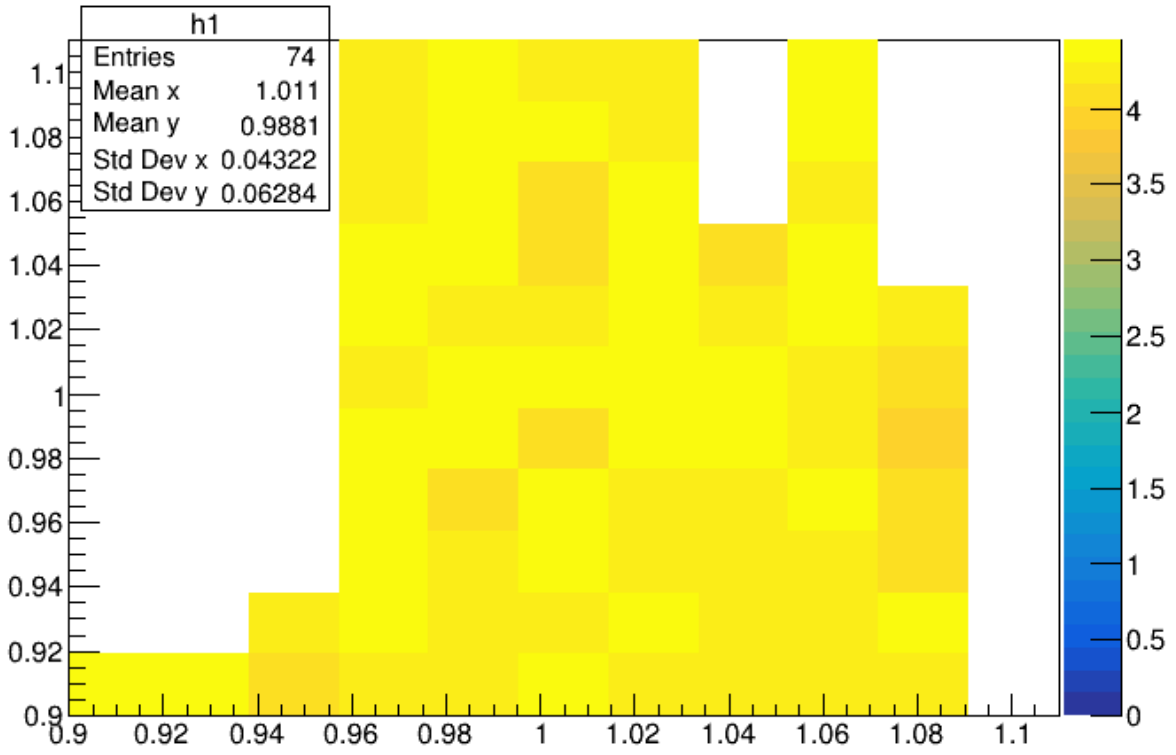
Note:

$M_{\mathrm{BTM}} \neq M^{-1}_{\mathrm{forward}}$

HOW TO USE BACKWARD TRANSFER MATRIX



Q SCAN (E94)



Q2 strength factor

Q1 strength factor

20 → 4-mm mesh MF map

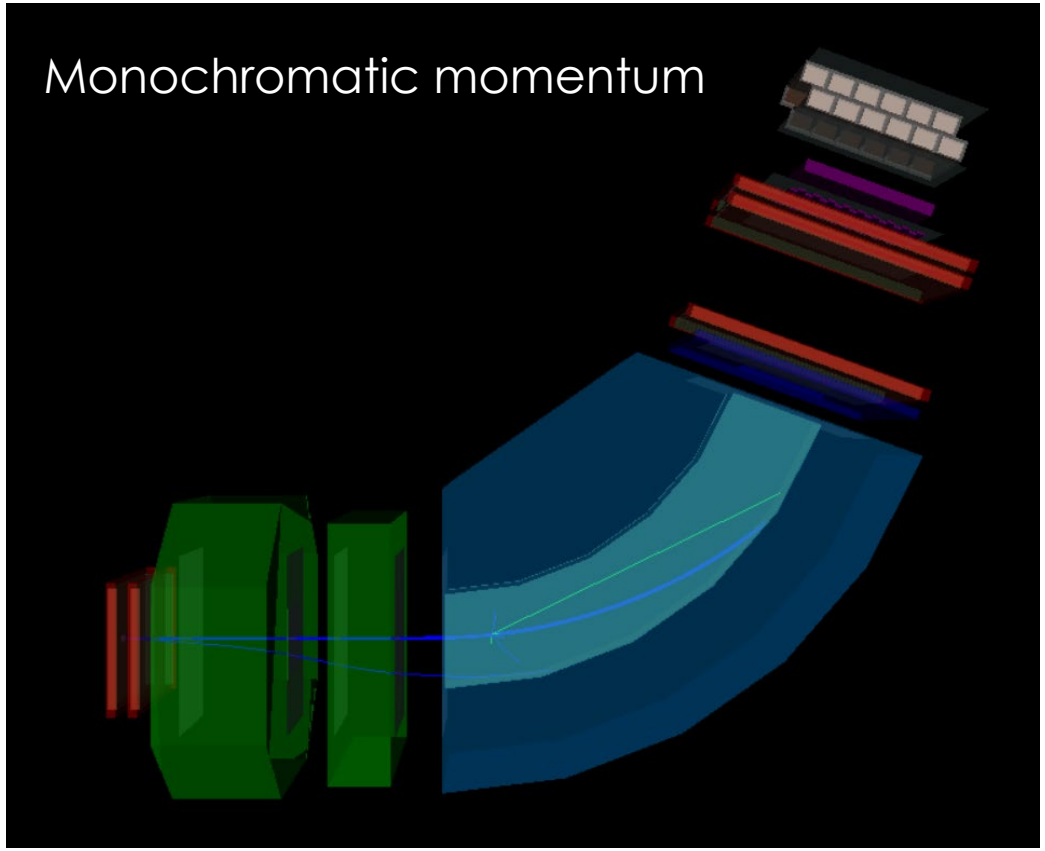
➔ The resolution got better

➔ But, optical features are not seen yet.

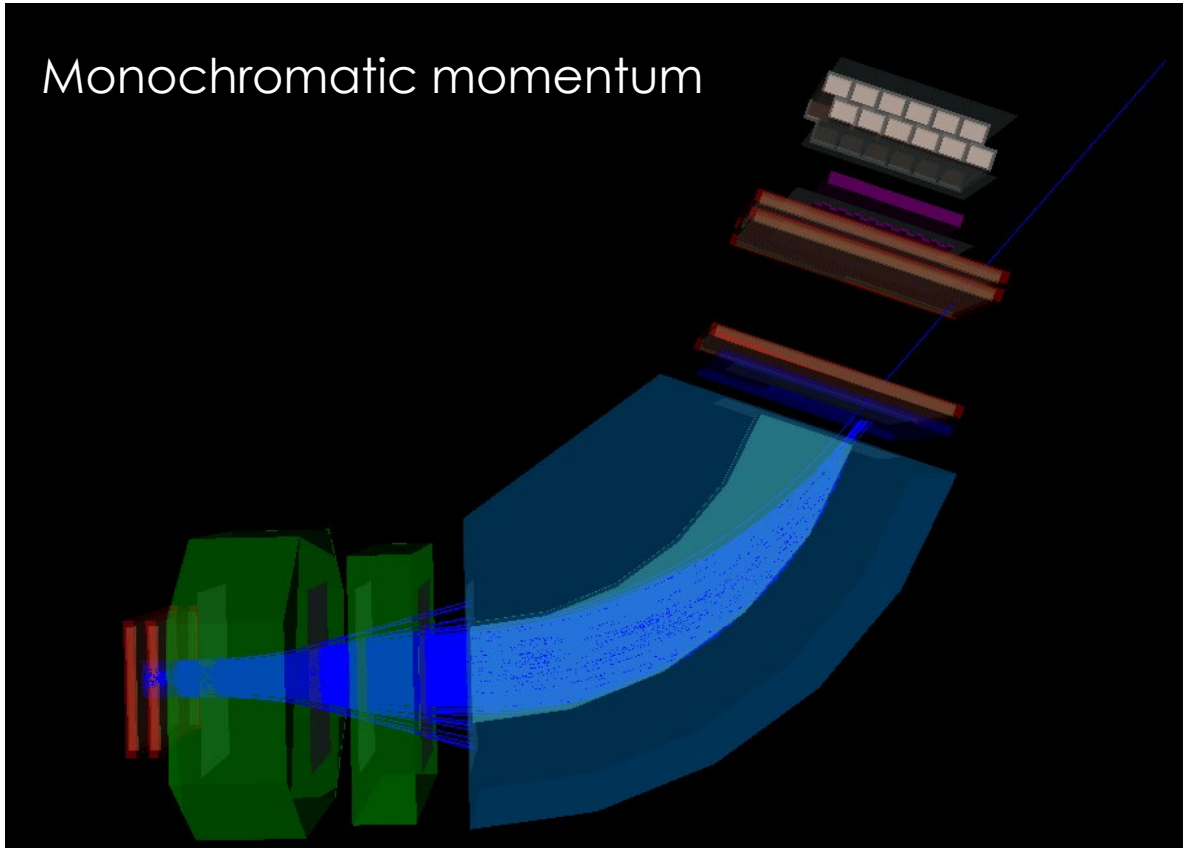
To do next

Make the mesh size finer (TOSCA / MF map)

Beam hit on S-2S D at p = 1.05 GEV/c (E94)



Point generation



50 mm (Gaus), 25 (Gaus) , 5 (uniform)

PARTICLE-MASS RECONSTRUCTION

$$m^2 = p^2 \left(\frac{1}{\beta^2} - 1 \right)$$

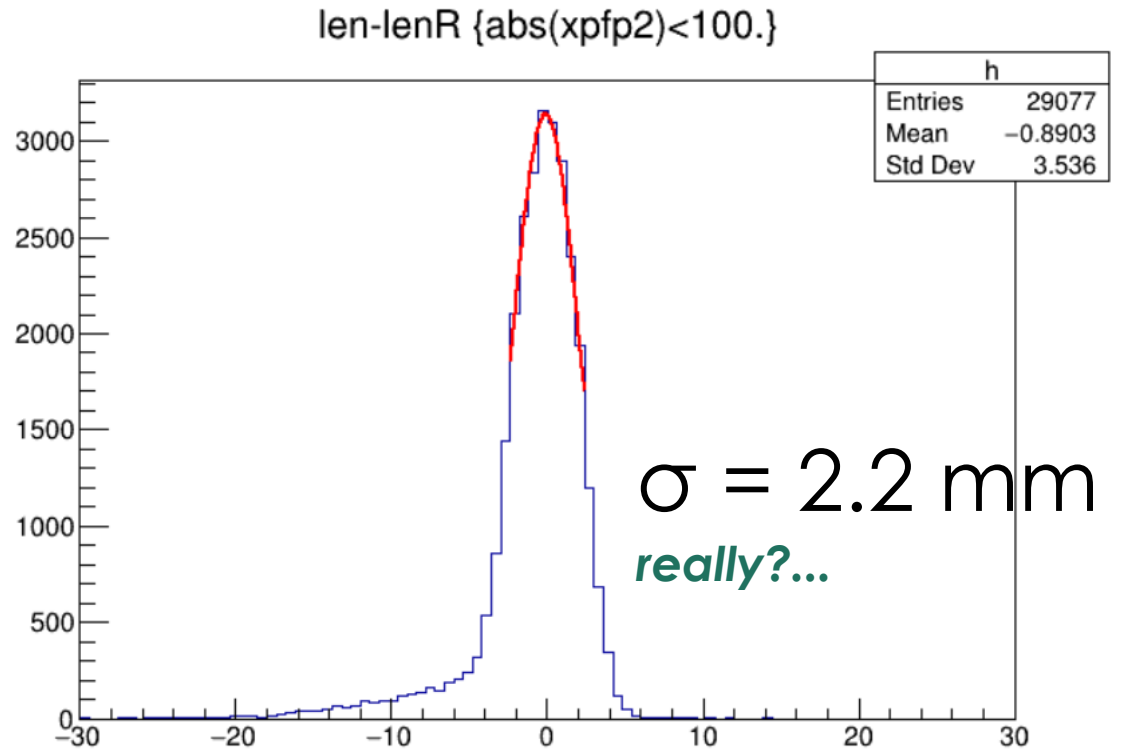
p_{recon}

PL_{recon} & TOF

PATH-LENGTH RESOLUTION

- **3rd order polynomial (364 parameters)**
- **Assumed resolution:**

```
double xtreso  = 0.20; // x at target (mm)
double ytreso  = 0.20; // y at target (mm)
double xreso  = 0.10; // FP x (mm)
double yreso  = 0.20; // FP y (mm)
double xreso2  = 0.10; // Q entrance x (mm)
double yreso2  = 0.20; // Q entrance y (mm)
double xpreso  = 0.5e-3; // FP x'
double ypreso  = 0.5e-3; // FP y'
double xpreso2 = 0.5e-3; // Q entrance x'
double ypreso2 = 0.5e-3; // Q entrance y'
```

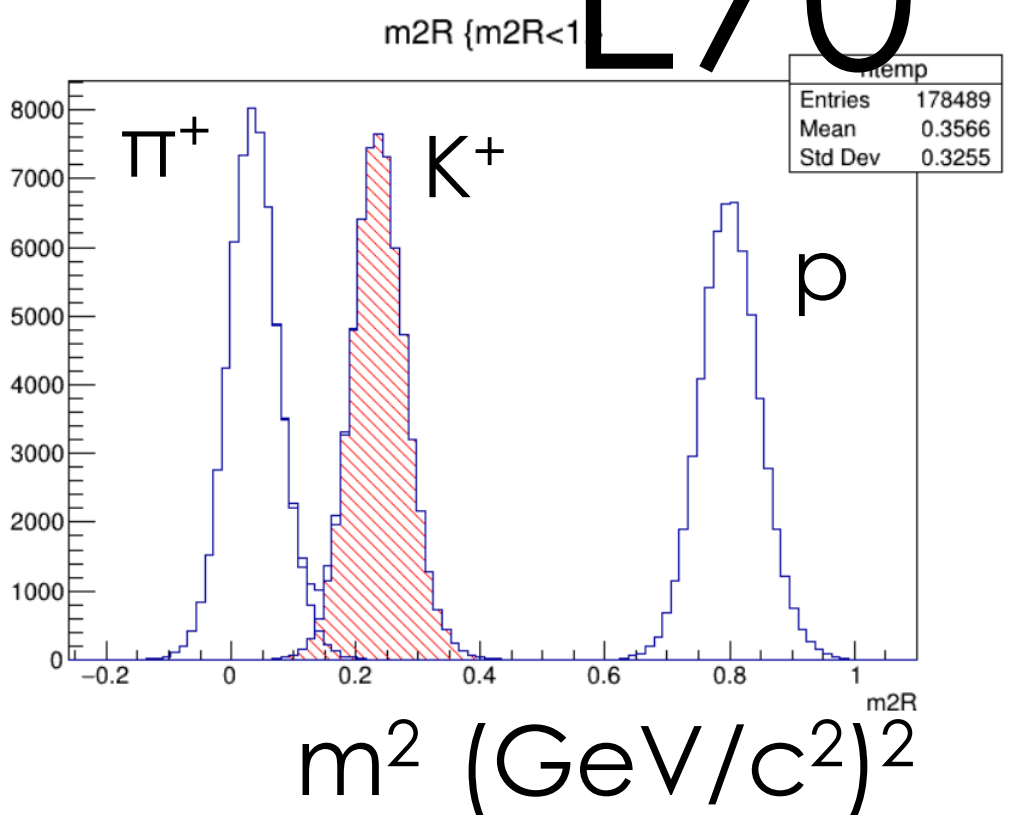


Path length resolution (mm)

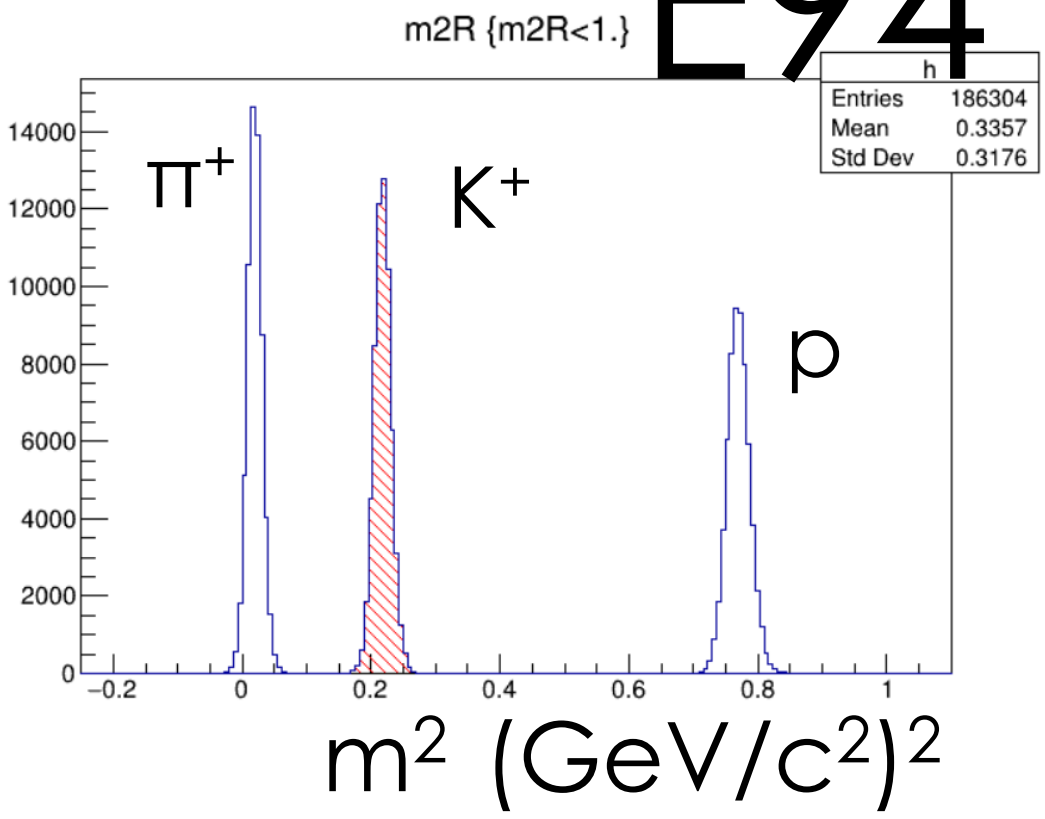
MASS SQUARED

Momentum / path length resolutions ← Gaussian function

E70



E94



PLAY WITH SIMULATION DATA

ROOT files processed by a code "recon_m2.cc":

- nodecay_m2.root (dp/p = 6e-4 FWHM, dL = 2.5 mm)
- nodecay_m2_lenreso-double.root (dp/p = 6e-4 FWHM, dL = 2.5 x 2 mm)
- nodecay_m2_momreso-double.root (dp/p = 6e-4 x2 FWHM, dL = 2.5 mm)

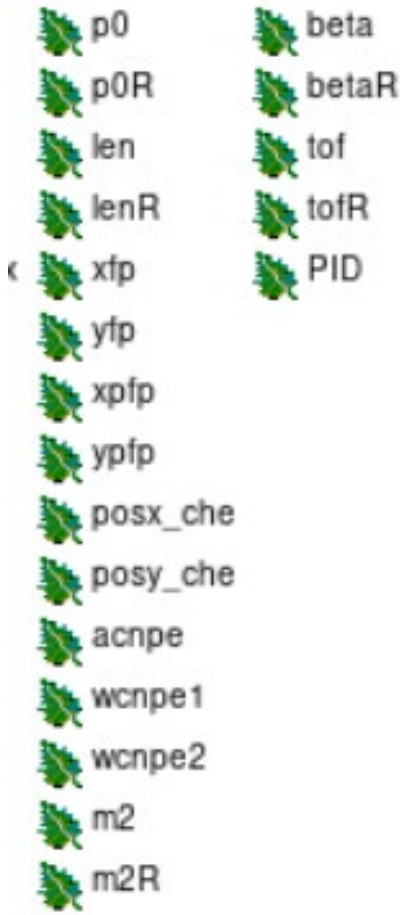
Location of ROOT files (hyperdragon11):

- E70 = /home/dragon/S2S/analysis/out5/forKID_E70
- E94 = /home/dragon/S2S/analysis/out5/forKID

Location of ROOT files (kekcc):

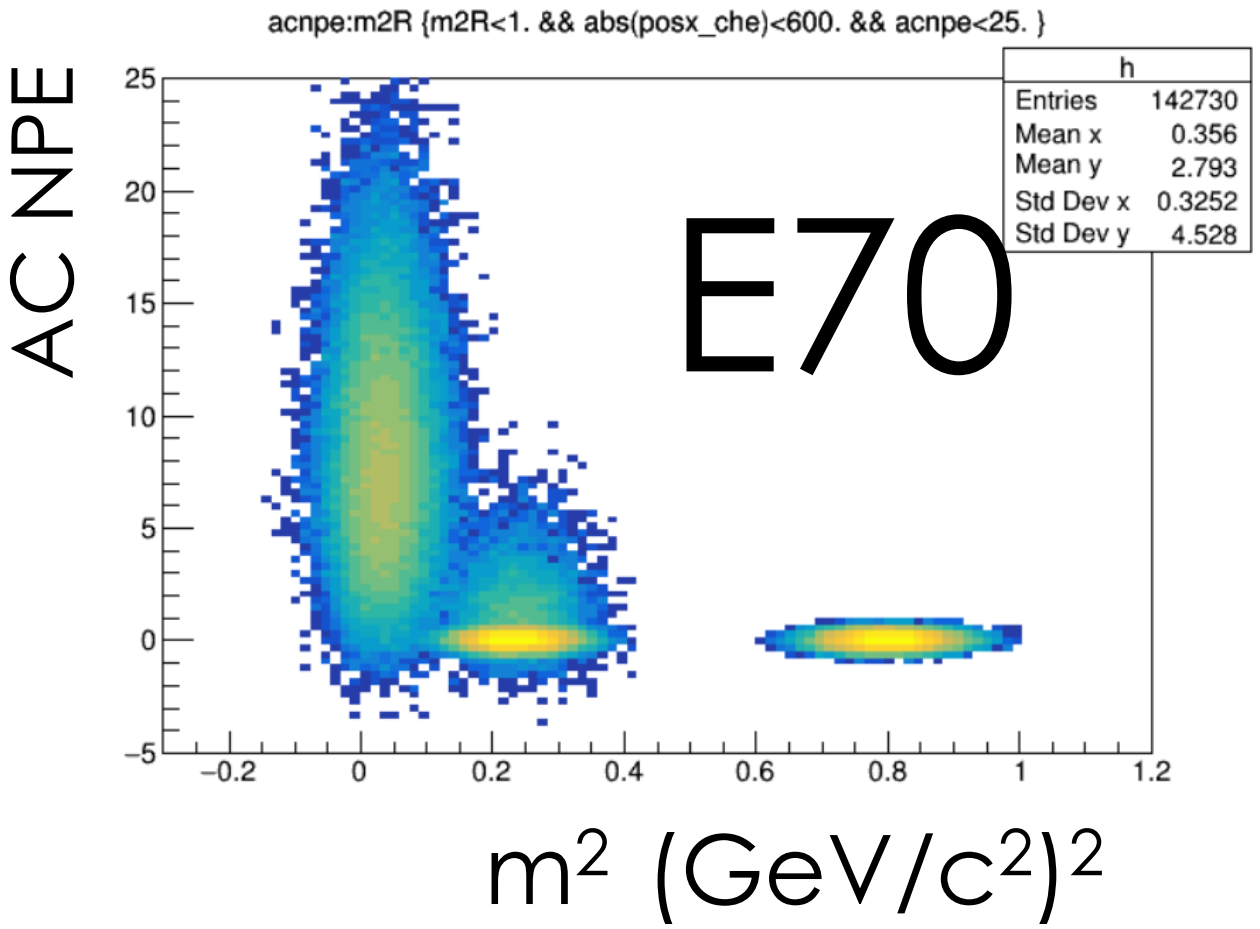
- E70 = /home/had/gogami/git/e94/S2S/analysis/root/forKID_E70
- E94 = /home/had/gogami/git/e94/S2S/analysis/root/forKID

DEFINED VARIABLES IN THE ROOT FILES



PID = 0, 1 and 2 for K^+, π^+, and proton
posx_che = x position right before WC
m2 = mass squared
m2R = mass squared, which took into account TOF and momentum resolutions
tof / tofR = time of flight
p0 / p0R = momentum at target
beta / betaR = velocity factor
len / lenR = path length
acnpe = NPE for AC
wcnpe1[6] = NPE for WC1
wcnpe2[6] = NPE for WC2

QUANTITATIVE STUDY NEEDS TO BE DONE



KID capability can be studied

高橋くん (E70)、渡辺くん (E94) よろしく

SUMMARY

S-2S Geant4 simulation (J-PARC E70 / E94)

1. **Magnetic field map for Geant4**
   - ➢dp/p is improved by changing from 20- to 4-mm mesh size
   - ➢Finer mesh calculation is tried to be performed
2. **Mass squared**
   - ➢Sample ROOT files can be used → play with them

BACKUP

mf_reduce.cc

1. **kekcc: /home/had/gogami/git/s2s_MFmap**
2. **hyperdragon11 (Kyoto Univ.): /data5/outdat5/s2s/dragon/s2s_MFmap**

```
for(int i=0 ; i<n1 ; i++){
  for(int j=0 ; j<n2 ; j++){
    for(int k=0 ; k<n3 ; k++){
      *ifs >> x >> y >> z
           >> Bx >> By >> Bz;

      if(z<=2800.
         && fabs(x)<350.
         && fabs(y)<350.){
        ok = true;
      }
      else if(z>2800.
              && z <= -2.74747*x + 11042.4
              && pow(z-2800.,2.0)+pow(x-3000.,2.0)>=pow(2500.,2.0)
              && pow(z-2800.,2.0)+pow(x-3000.,2.0)<=pow(3500.,2.0)){
        ok = true;
      }
      else if(z > -2.74747 + 11042.4
              && z <= -2.74747*x + 12796.7
              && z >= 0.36397*x + 4368.54
              && z <= 0.36397*x + 5432.71){
        ok = true;
      }
      else ok=false;

      if(ok==true){
        z = z-zoff;
        tnew->Fill();

        *ofs << z << " " << x << " " << y << " "
             << Bz << " " << Bx << " " << By << endl;

      }

    }
  }
}
```

ROOT files for π^+ beam hit study (E94)

hyperdragon11 (Kyoto U.): /data5/outdat5/s2s/dragon/S2S_root_1/pibeam/

- -rwxr-xr--. 1 dragon s2s 273M 2月 23 13:45 **pibeam_center_decayON.root**
- -rwxr-xr--. 1 dragon s2s 172M 2月 23 13:45 **pibeam_center.root**
- -rwxr-xr--. 1 dragon s2s 379M 2月 23 15:40 **pibeam_decayON.root**