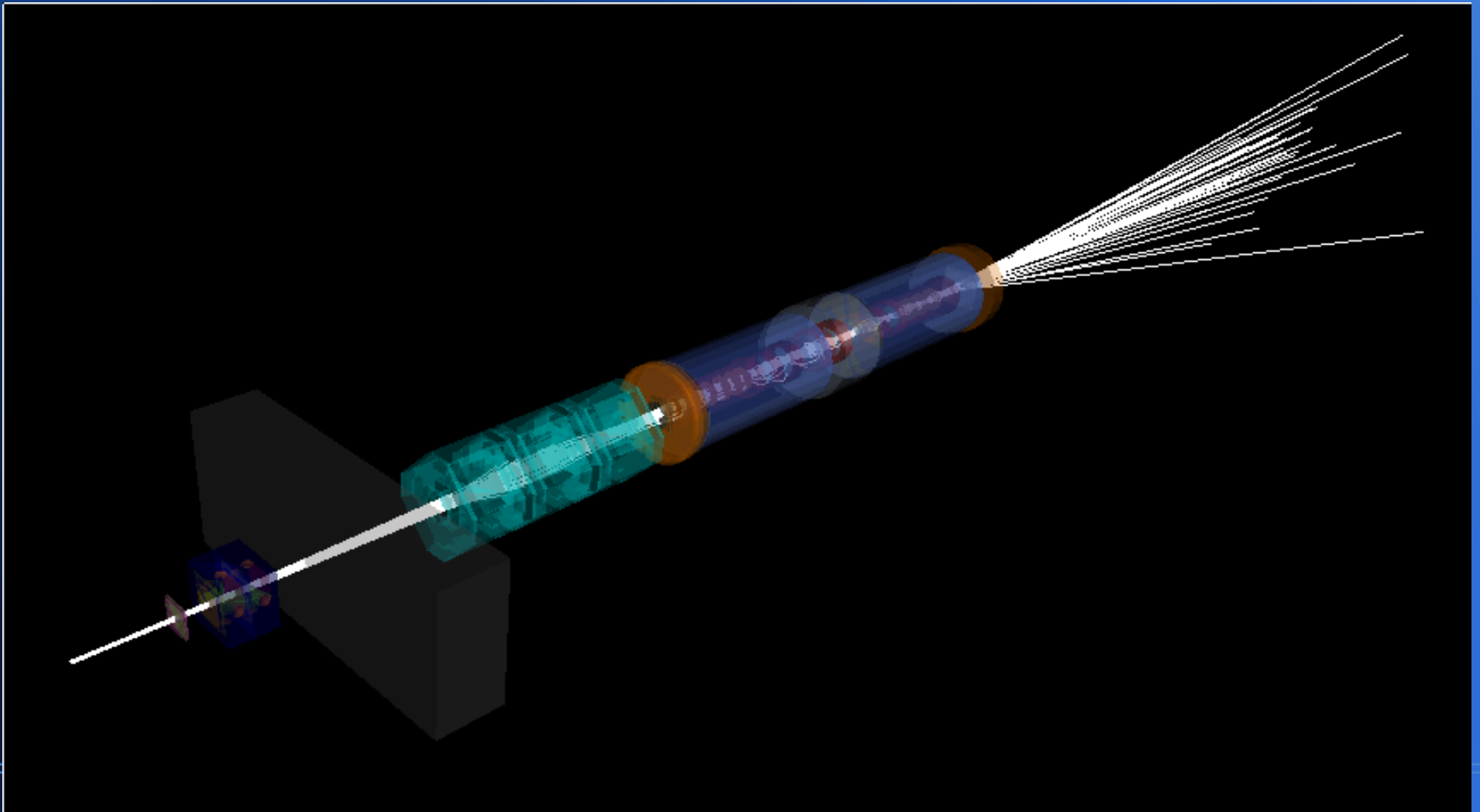


# Global Reconstruction of Step 4

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# Step 4 Simulation



# Beam Configuration

```
beam = {"particle_generator":"binomial", "binomial_n":500, "binomial_p":1,
  "random_seed":2,
  "definitions":[
    ##### MUONS #####
    {
      "reference":simulation_reference_particle,
      "random_seed_algorithm":"incrementing_random", "weight":100.,
      "transverse":{"
        "transverse_mode":"twiss",
        "beta_x":1000., "alpha_x":0.0, "emittance_x":0.1,
        "beta_y":1000., "alpha_y":0.0, "emittance_y":0.1
      },
      "longitudinal":{"longitudinal_mode":"uniform_time",
        "momentum_variable":"p",
        "sigma_p":25., "t_start":-1.e6, "t_end":+1.e6},
      "coupling":{"coupling_mode":"none"}
    }
  ]
}
```

# Reconstruction Input Notes

- Trigger time is unknown. Times relative to beam creation time.
- Tracker times are not synched with TOF times, so they are treated as unknowns (set to 0).
- Tracker energy/momenta are smeared MC since helical reconstruction is not available yet.
- Energy in TOF are unknown, so they are treated as unknowns (set to ref. particle E)

# Momentum Smearing

```
ThreeVector momentum;
const SciFiClusterPArray clusters = (*scifi_space_point)->get_channels();
for (SciFiClusterPArray::const_iterator cluster = clusters.begin();
     cluster != clusters.end();
     ++cluster) {
    ThreeVector true_momentum = (*cluster)->get_true_momentum();
    momentum += true_momentum;
}
if (clusters.size() > 0) {
    momentum /= clusters.size();
}
momentum.setX(momentum.x() + ::CLHEP::RandGauss::shoot(0., 3.));
momentum.setY(momentum.y() + ::CLHEP::RandGauss::shoot(0., 3.));
momentum.setZ(momentum.z() + ::CLHEP::RandGauss::shoot(0., 20.));
...
const GlobalDS::PID particle_id = GlobalDS::PID(reference_pgparticle.pid);
const double beta = Beta(particle_id, momentum.mag());
const double energy = momentum.mag() / beta;
```

# Simulated Data Residuals (t)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	1.12702	0.182519			
TOF1	0.435904	6.0761			
TOF2	0.194586	5.56516			
Tracker 0 Station 1	-37.6025	1.76166	Tracker 1 Station 1	-61.8843	3.314328
Tracker 0 Station 2	-39.0835	1.98121	Tracker 1 Station 2	-60.4444	3.17363
Tracker 0 Station 3	-40.3373	2.1213	Tracker 1 Station 3	-59.2114	3.08545
Tracker 0 Station 4	-41.4041	2.30315	Tracker 1 Station 4	-58.1628	2.9778
Tracker 0 Station 5	-42.2373	2.38699	Tracker 1 Station 5	-57.2901	2.85464

# Reconstructed Data Residuals (t)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	0.6533	1.451			
TOF1	-0.9104	5.549			
TOF2	-3.939	5.508			
Tracker 0 Station 1	-0.4752	1.068	Tracker 1 Station 1	-6.417	3.018
Tracker 0 Station 2	-0.6059	1.286	Tracker 1 Station 2	-4.239	3.262
Tracker 0 Station 3	-0.7068	1.374	Tracker 1 Station 3	-2.019	3.249
Tracker 0 Station 4	-0.8068	1.565	Tracker 1 Station 4	0.1844	3.285
Tracker 0 Station 5	-0.8722	1.608	Tracker 1 Station 5	2.4033	3.321

# Simulated Data Residuals (E)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	9.71005	23.4726			
TOF1	27.1273	25.764			
TOF2	60.8007	26.6398			
Tracker 0 Station 1	1.26785	15.5205	Tracker 1 Station 1	1.36235	16.8664
Tracker 0 Station 2	1.73136	16.578	Tracker 1 Station 2	1.66112	16.0996
Tracker 0 Station 3	0.288747	16.0525	Tracker 1 Station 3	-0.34348	16.4793
Tracker 0 Station 4	-0.340856	16.6211	Tracker 1 Station 4	0.753887	15.7502
Tracker 0 Station 5	0.169632	16.2036	Tracker 1 Station 5	-1.44594	14.7462



# Reconstructed Data Residuals (E)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	18.51	58.72			
TOF1	23.34	43.87			
TOF2	32.90	44.05			
Tracker 0 Station 1	16.15	41.28	Tracker 1 Station 1	19.02	40.97
Tracker 0 Station 2	16.20	41.32	Tracker 1 Station 2	18.44	41.30
Tracker 0 Station 3	16.24	41.44	Tracker 1 Station 3	17.28	41.42
Tracker 0 Station 4	16.34	41.48	Tracker 1 Station 4	16.27	41.49
Tracker 0 Station 5	16.42	41.61	Tracker 1 Station 5	15.04	41.35

# Simulated Data Residuals (x)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	-0.28	21.48			
TOF1	-1.39	40.90			
TOF2	-2.10	60.02			
Tracker 0 Station 1	-1.43	36.78	Tracker 1 Station 1	-2.64	23.24
Tracker 0 Station 2	-8.46	50.40	Tracker 1 Station 2	1.89	26.93
Tracker 0 Station 3	-2.35	47.64	Tracker 1 Station 3	0.00645	.322
Tracker 0 Station 4	-3.68	49.38	Tracker 1 Station 4	-1.88	26.95
Tracker 0 Station 5	-3.57	45.87	Tracker 1 Station 5	2.76	23.13

# Reconstructed Data Residuals (x)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	0.7201	23.54			
TOF1	-4.244	32.03			
TOF2	-2.227	46.21			
Tracker 0 Station 1	-0.7334	19.90	Tracker 1 Station 1	-2.850	25.72
Tracker 0 Station 2	-4.752	34.16	Tracker 1 Station 2	0.4533	22.13
Tracker 0 Station 3	-1.017	24.00	Tracker 1 Station 3	-1.304	20.88
Tracker 0 Station 4	-2.149	28.00	Tracker 1 Station 4	-1.508	24.98
Tracker 0 Station 5	-2.370	32.71	Tracker 1 Station 5	-0.3581	27.53

# Simulated Data Residuals (Px)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	0.1341	1.255			
TOF1	0.6576	10.18			
TOF2	-0.9616	9.276			
Tracker 0 Station 1	0.02363	3.159	Tracker 1 Station 1	0.1056	22.81
Tracker 0 Station 2	-0.04714	3.385	Tracker 1 Station 2	-0.1447	32.61
Tracker 0 Station 3	-0.2382	4.002	Tracker 1 Station 3	0.0968	3.129
Tracker 0 Station 4	0.1066	3.363	Tracker 1 Station 4	.01327	32.34
Tracker 0 Station 5	-0.1203	3.449	Tracker 1 Station 5	-0.241	22.51

# Reconstructed Data Residuals (Px)

Detector	Mean	RMS	Detector	Mean	RMS
TOF0	0.2052	1.955			
TOF1	0.8547	10.93			
TOF2	-0.9767	9.594			
Tracker 0 Station 1	-0.03225	21.77	Tracker 1 Station 1	0.9796	23.88
Tracker 0 Station 2	-0.6217	17.24	Tracker 1 Station 2	-1.728	21.07
Tracker 0 Station 3	1.140	21.18	Tracker 1 Station 3	1.595	13.54
Tracker 0 Station 4	-0.8380	22.36	Tracker 1 Station 4	-1.080	23.25
Tracker 0 Station 5	-0.1153	20.28	Tracker 1 Station 5	0.6581	23.93