BeamDet README

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1 Requirements

In order to perform BeamDet diagnostics you should add BeamDet parts in ascending order of Z-coordinate of part in sim_digi.C:

```
ERBeamDetSetup* setupBeamDet = ERBeamDetSetup::Instance();
setupBeamDet->SetXmlParametersFile(paramFileBeamDet);

setupBeamDet->AddToF("ToF1", BeamDetPosZToF - BeamDetLToF);
setupBeamDet->AddToF("ToF2", BeamDetPosZToF);
setupBeamDet->AddMWPC("MWPC1", BeamDetPosZ1MWPC);
setupBeamDet->SetMWPCnumberingInvOrderX();
setupBeamDet->AddMWPC("MWPC2", BeamDetPosZ2MWPC);
setupBeamDet->SetMWPCnumberingInvOrderX();

ERBeamDet* beamdet= new ERBeamDet("ERBeamDet", kTRUE,verbose);
run->AddModule(beamdet);

ERBeamDetDigitizer* beamDetDigitizer = new ERBeamDetDigitizer(verbose);
run->AddTask(beamDetDigitizer);
```

In reco.C in case of ^{8}He beam:

```
Int_t verbose = 1; //standard log print
ERBeamDetTrackFinder* trackFinder = new ERBeamDetTrackFinder(verbose);
trackFinder->SetTargetVolume("target3HVol");
run->AddTask(trackFinder);

TString ionName = "8He";
ERBeamDetPID* beamdetPid = new ERBeamDetPID(verbose);
beamdetPid->SetBoxPID(0., 1000., 0., 1000.);
beamdetPid->SetProbabilityThreshold(0);
beamdetPid->SetIonMass(7482.5396);
beamdetPid->SetPID(1000020080);
run->AddTask(beamdetPid);
```

2 BeamDet diagnostics

Run sim_digi.C and reco.C to obtain sim_digi.root and reco.root. Run beamdet_precision.C.

Beam parameters in this example: ^{8}He, $E = 21.5A \cdot MeV$, standard deviation of ion momentum is 4% of full momentum, $\theta = 1°$, $\sigma(\theta) = 0.004\frac{180}{\pi}°$, φ range is $(0; 45)°$. Spreading of both x and y coordinates of the beam on target ($z = 0$ cm) is from 0.7 to 0.8 cm, further they are reconstructed to the beam start position ($z = -1600$ cm) along momentum vector.

Comparison of coordinates of the beam on target is shown in Fig.1.

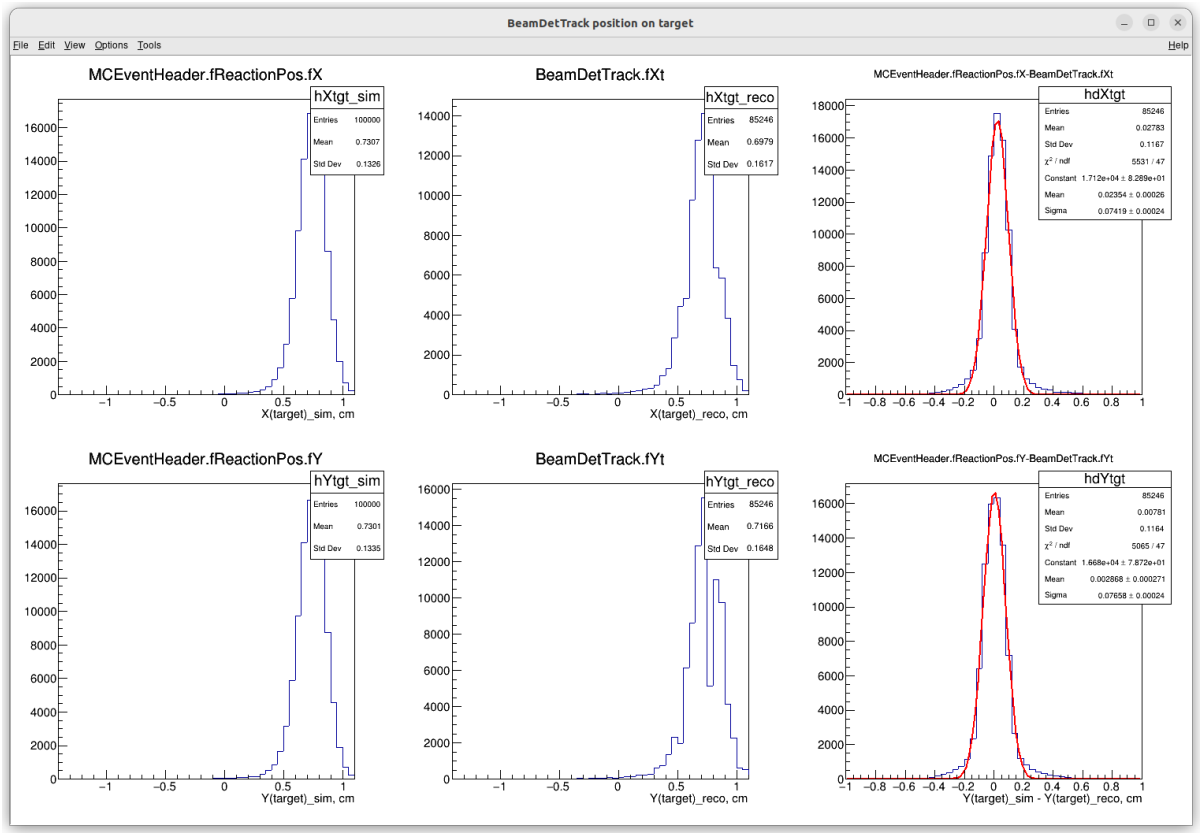

Figure 1: Difference between simulated (EventHeader) and reconstructed (BeamDetTrack) coordinates of ^{8}He beam on target. First row is x-coordinate, second row is y-coordinate. From left to right: simulated coordinate, reconstructed coordinate, their difference. Reconstruction accuracy: mean bias is $\langle \Delta x \rangle = 0.002354 \pm 0.00026$ cm, $\langle \Delta y \rangle = 0.002868 \pm 0.000271$ cm; standard deviation is $\sigma(\Delta x) = 0.07419 \pm 0.00024$ cm, $\sigma(\Delta y) = 0.07658 \pm 0.00024$ cm.

Comparison of unit vector coordinates of the beam on target is shown in Fig.2

Comparison of beam energy on target is shown in Fig.3.

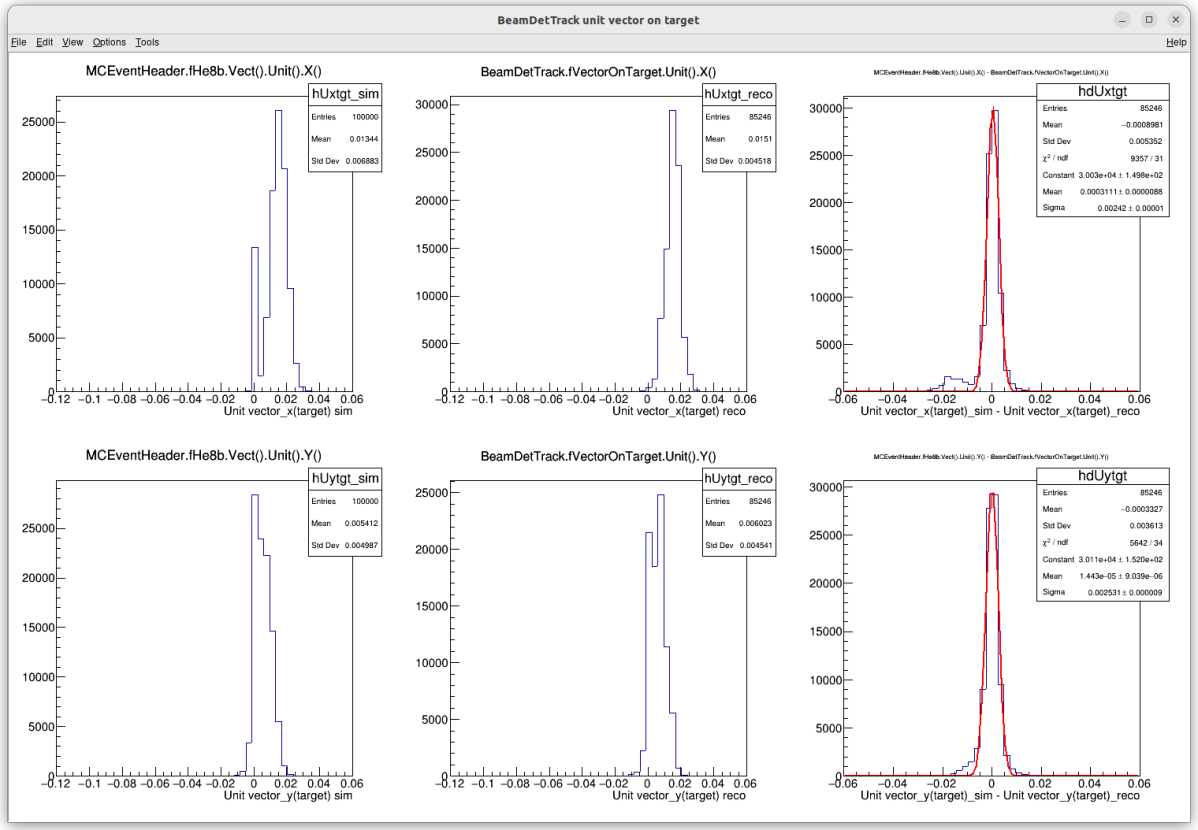

Figure 2: Difference between simulated (EventHeader) and reconstructed (BeamDetTrack) components of unit vector of the ^{8}He beam direction. First row is x component, second row is y component. From left to right: simulated component, reconstructed component, their difference. Reconstruction accuracy: mean bias is $\langle \Delta x \rangle = 3 \cdot 10^{-4} \pm 8.8 \cdot 10^{-6}$, $\langle \Delta y \rangle = 1.443 \cdot 10^{-5} \pm 9.039 \cdot 10^{-6}$; standard deviation is $\sigma(\Delta x) = 0.00242 \pm 10^{-5}$, $\sigma(\Delta y) = 0.002531 \pm 9 \cdot 10^{-6}$.

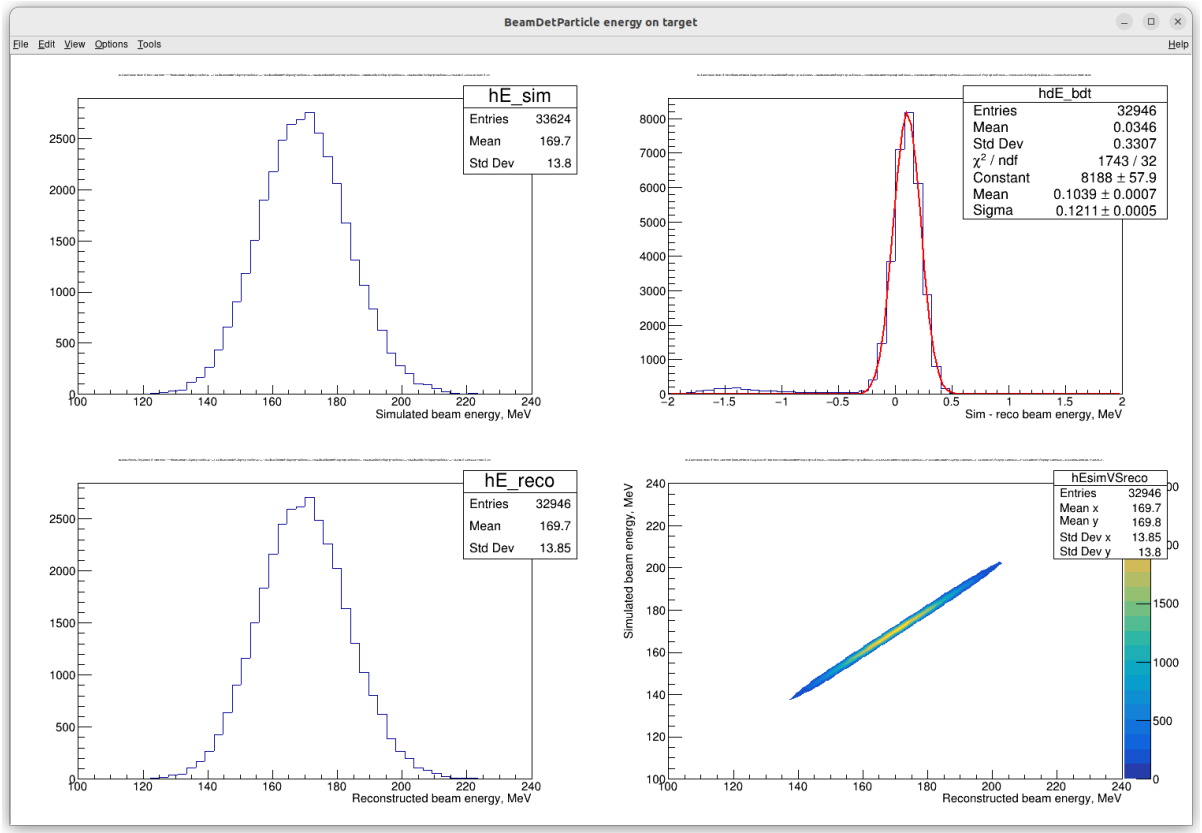

Figure 3: Difference between simulated (EventHeader) and reconstructed (BeamDetParticle) energy of the ^{8}He beam on target. First column up is simulated energy of the beam, down - reconstructed energy. Second column up is difference between simulated and reconstructed energy of the beam, down - is two-dimensional chart with reconstructed energy on the x-axis and simulated energy on the y-axis. Reconstruction accuracy: mean bias is $\langle \Delta E \rangle = 0.1039 \pm 0.0007$ MeV, standard deviation is $\sigma(\Delta E) = 0.1211 \pm 0.0005$ MeV.