Dear Ralf, dear rho-developers,
I have a question how to evaluate the error of the momentum, position, theta, phi, distributions using rho candidates and rho lists, and I am wondering if below is the best way how to proceed. For example, if I want to evaluate the pull of quantities like momentum, or theta and phi, I need information about the reco variables (easy), the true value (easy) and the error distributions. I see that in RhoMath/ the information about the covariance error matrix is accessible. So I could write:

```
while (theAnalysis->GetEvent() && i++<nevts)
{
    theAnalysis->FillList(muminus, "MuonAllMinus");
for (j=0;j<muminus.GetLength();++j)
{
    // reco variables
    hmomtrk->Fill(muminus[j]->P());
    hthttrk->Fill(muminus[j]->P4().Theta());
    hphitrk->Fill(muminus[j]->P4().Phi());
    // error matrix : variance
    RhoError tempvar = muminus[j]->Cov7(); //variance of 7 parameters: x,y,z,px,py,pz,E
            double var_px = tempvar(3,3);
            double var_py = tempvar(4,4);
            double var_pz = tempvar(5,5);
            double var_energy = tempvar(6,6);
    }
}
```

This shoud give my access to the variance of $\mathrm{px}, \mathrm{py}, \mathrm{pz}$, energy. Am I correct?
Sqrt() of what I get from here should deliver the error distribution of px, py, pz, E. Now my question is: is this the way to proceed to get the error distirbutions? and what about Theta() and Phi()? Should I combine, then, the information which I obtain, and get the error distribution for the angular variables? or is there a smarter way/funcion implemented to obtain the error distribution of kinematic variables, in pandaroot?

Thank you for your help,
Elisabetta

Hi Elisabetta,

The RhoCandidate stores the 4-momentum and its covariance matrix in the coordinates of ( px , py, pz, e). The covariance is a "RhoError" type, which inherits from TMatrixD. The diagonal elements contain sigma^2 of the corresponding coordinate. If you want to get some error and pull distributions, you can do something like that:

```
for (j=0;j<muplus.GetLength();++j)
{
    TLorentzVector Iv=muplus[j]->P4();
    RhoError IvCov=muplus[j]->P4Cov();
    hpullpx->Fill( ( Iv.Px() - Ivmc.Px() ) / sqrt( IvCov[0][0] ) );
    hpullpy->Fill(( Iv.Py() - Ivmc.Py() ) / sqrt( IvCov[1][1] ) );
    hpullpz->Fill(( Iv.Pz() - Ivmc.Pz() ) / sqrt( IvCov[2][2] ) );
    hpulle->Fill(( (v.E() - Ivmc.E() ) / sqrt( IvCov[3][3] ) );
}
```

If you need the other coordinates, you would have to convert that error matrix to those coordinates.

Cheers
Ralf

## Subject: Re: RhoError class in pandaroot <br> Posted by Elisabetta Prencipe (2) on Tue, 03 Jun 2014 11:12:08 GMT <br> View Forum Message <> Reply to Message

Hi Ralf,
thank you for your reply. So you confirm that for additional (basic) kimenatic variables nothing is already implemented. Then, I will do myself. no problem!
So, instead of $\operatorname{Cov} 7()$, you suggest the use of $\mathrm{P} 4 \operatorname{Cov}()$, where:
$\operatorname{cov}[0] 0]$ is the variance for px
$\operatorname{cov}[1][1]$ is the variance for $p y$
$\operatorname{cov}[2][2]$ is the variance for pz
$\operatorname{cov}[3][3]$ is the variance for $E$
Actually I checked, and I found that if I use Cov7(), and I evaluate $\operatorname{cov}[3][3], \operatorname{cov}[4][4], \operatorname{cov}[5][5]$ and $\operatorname{cov}[6][6]$,
or
if I use P4Cov(), as you suggested, to evaluate the variance of px,py,pz,E respectively, as
indicated in my previous posting, results are identical, as expected. This is the output for the px variance, if I run in my macro $\operatorname{Cov} 7(3,3)$ left side, or $\mathrm{P} 4 \operatorname{Cov}(0,0)$ right side.
$4.7454 \mathrm{e}-05,4.7454 \mathrm{e}-05$
$7.9324 \mathrm{e}-05,7.9324 \mathrm{e}-05$
$0.00021817,0.00021817$
$0.000140595,0.000140595$
$1.7677 \mathrm{e}-05,1.7677 \mathrm{e}-05$
$0.000121126,0.000121126$
$0.000230273,0.000230273$
$0.000486443,0.000486443$
$2.26079 \mathrm{e}-05,2.26079 \mathrm{e}-05$
$1.85428 \mathrm{e}-05,1.85428 \mathrm{e}-05$
$0.000152567,0.000152567$
cheers, Elisabetta

