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Subject: Bug fixed in PndKinFitter read-in covariance matrix

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Dear all,

I just found a bug in RhoKinFitter::ReadMatrix(), when the original cov matrix is re-arranged from (X, Y, Z, Px, Py, Pz, E) basis to (Px, Py, Pz, E, X, Y, Z).

For example, the original cov matrix of a photon in (X, Y, Z, Px, Py, Pz, E) is

	0	1	2	3	4	5	6	
0	0.2111	0.008221	-0.02881	0.0002914	1.135e-05	-3.977e-05	0	
1	0.008221	0.2217	0.02912	1.135e-05	0.0003061	4.02e-05	0	
2	-0.02881	0.02912	0.008063	-3.977e-05	4.02e-05	1.113e-05	0	
3	0.0002914	1.135e-05	-3.977e-05	3.203e-06	-2.683e-06	1.97e-05	2.013e-05	
4	1.135e-05	0.0003061	4.02e-05	-2.683e-06	3.022e-06	-1.897e-05	-1.939e-05	
5	-3.977e-05	4.02e-05	1.113e-05	1.97e-05	-1.897e-05	0.0001393	0.000142	
6	0	0	0	2.013e-05	-1.939e-05	0.000142	0.0001447	

but the re-arranged one in (Px, Py, Pz, E, X, Y, Z) is

	0	1	2	3	4	5	6	
0	3.203e-06	-2.683e-06	1.97e-05	2.013e-05	1.135e-05	-3.977e-05	0	
1	-2.683e-06	3.022e-06	-1.897e-05	-1.939e-05	0.0003061	4.02e-05	0	
2	1.97e-05	-1.897e-05	0.0001393	0.000142	4.02e-05	1.113e-05	0	
3	2.013e-05	-1.939e-05	0.000142	0.0001447	0	0	0	
4	0.0002914	1.135e-05	-3.977e-05	0	0.2111	0.008221	-0.02881	
5	1.135e-05	0.0003061	4.02e-05	0	0.008221	0.2217	0.02912	
6	-3.977e-05	4.02e-05	1.113e-05	0	-0.02881	0.02912	0.008063	

One can notice that some elements in the new cov matrix are wrongly filled, eg. the new (0,4) should be equal to the old (3,0)=0.0002914 rather than 1.135e-05. Since the new cov matrix is not symmetric, the whole fitting procedure will be badly influenced. This is caused by a bug in the code:

```
272 //Change to px,py,pz,E,x,y,z
273 for(int i=0; i<7; i++) {
274     for(int j=0; j<7; j++) {
275         if(i>=3) {
276             if(j>=3) {
277                 p4Cov[i-3][j-3] = p3Cov[i][j];
278             } else { p4Cov[i-3][j+3] = p3Cov[i][j]; }
279         } else {
280             if(j>=3) {
281                 p4Cov[i+4][j-3] = p3Cov[i][j];
282             } else { p4Cov[i+4][j+4] = p3Cov[i][j]; }
283         }
284     }
}
```

285 }

.

The line #278,

Quote:  $p4Cov[i-3][j+3] = p3Cov[i][j]$  should be  $p4Cov[i-3][j+4] = p3Cov[i][j]$ .

I've studied the pull distributions of before & after fixing, combining with another bug fixed in this fitter recently (trk 29480), with my Ds semileptonic decay chain. The result shows several issues regarding to the covariance matrix itself and the fitter, and seems may evoke a long and detailed discussion. For a more efficient and direct communication, I would prefer to present the plots in the upcoming software meeting on 4th Oct..

BTW, the fixed code is attached. (No right to commit... )

Best regards,

Lu

### File Attachments

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1) [RhoKinFitter.cxx](#), downloaded 603 times

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