The tracking

Present situation

Short term actions

Long term actions

FUTURE

GeanE Status

The Crash See thread *Bugs, Fixes, Releases: genfit/geane*

Problem: after the update to the new external packages it happens often this kind of crash when running `geane`

```
event 307

 *** Break *** floating point exception
Using host libthread_db library "/lib/tls/libthread_db.so.1".
Attaching to program: /proc/27679/exe, process 27679
[Thread debugging using libthread_db enabled]
[New Thread -1208822080 (LWP 27679)]
0x00a8d7a2 in _dl_sysinfo_int80 () from /lib/ld-linux.so.2
                                        ...
#10 0x081b6fe5 in xmm55_ (a=0x8601f20, b=0x8601fe8, c=0x8601fe8)
    at matx55/xmm55.F:42
#11 0x08267fca in trprfn_ (x1=0x85d32d8, p1=0x85d32e4, h1=0x85d32f0,
    x2=0x85d3314, p2=0x85d3320, h2=0x85d332c, ch=@0x85d3350, xl=@0x84528ec,
    r=0xbfe2523c, mvar=@0xbfe25290, iflag=@0xbfe25298, itran=@0xbfe25294,
    ierr=@0xbfe2529c) at erpremc/trprfn.F:376
#12 0x08260e82 in erprop_ () at erdecks/erprop.F:76
#13 0x08263d65 in ertrch_ () at erdecks/ertrch.F:429
#14 0x08264cd1 in ertrgo_ () at erdecks/ertrgo.F:249
#15 0x0826221d in ertrak_ (x1=0xc9623f0, p1=0xc9623fc, x2=0xc962364,
    p2=0xc962370, ipa=@0xbfe25a04, chopt=@0xfe296a8, _chopt=2)
    at erdecks/ertrak.F:242
                                        ...
#16 0x08341e7f in TGeant3::Ertrak (this=0xfa13a10, x1=0xc9623f0,
    p1=0xc9623fc, x2=0xc962364, p2=0xc962370, ipa=6, chopt=0xfe296a8 "LE")
    at TGeant3/TGeant3.cxx:5402
#17 0x047924a8 in FairGeanePro::FindPCA (...
```

But `xmm55.F` does only a multiplication of two 5 X 5 matrices!

The Crash - investigation

1 set: 10000 events (5 files of 2000 μ^- each), **p** 1 GeV/c, ϕ [0 , 360], θ[20 , 140]
2 set: 10000 events (5 files of 2000 μ^- each), **p** 1 GeV/c, ϕ [-45 , 45], θ [25.5 , 26.5],

TESTS

- Magnetic field:
  - some IFIELD = 0
  - some FIELDM ≠ 20 kG

  ← To be changed but not relevant

- Double to single precision ← The problem is not here

- Memory problem ← The problem is not here

- Compiler: ← Test Succesfull! No crash with g77
  - tried compiling with g77

- Difference old/new geant3: ← Test Succesfull! No crash with old ertrch.F
  - ertrch.F changes

The “real” error turns out to be in routine `erpremc/trprfn.F` that performs:

```
* *** ERROR PROPAGATION ALONG A PARTICLE TRAJECTORY IN A MAGNETIC FIELD
*         ROUTINE ASSUMES THAT IN THE INTERVAL (X1,X2) THE QUANTITIES 1/P
*         AND (HX,HY,HZ) ARE CONSTANT.
```

```
* *** CHECK WHETHER H*ALFA/P IS TOO DIFFERENT AT X1 AND X2
*
*
      IF(HA2.NE.0.) THEN
         GAM=(H2(1)*T2(1)+H2(2)*T2(2)+H2(3)*T2(3))/HA2
      ELSE
         GAM=(H1(1)*T1(1)+H1(2)*T1(2)+H1(3)*T1(3))/HA1
      ENDIF
*
      ALFA2=1.-GAM**2
*
      DH2=(H1(1)*PM1-H2(1)*PM2)**2+
     1    (H1(2)*PM1-H2(2)*PM2)**2+
     1    (H1(3)*PM1-H2(3)*PM2)**2
      IF(DH2*ALFA2.GT.DELHP6**2) GO TO 903
```

At a certain point there is a check whether the curvature of the track inside the step is too big

`ALFA2` = $\sin^2$ of the angle between the `P` and `H` field vectors

`DH2` is proportional to `H/P` → `1/R`

```
903 IERR=3
C     IF(INIT.NE.0) GO TO 30
*     WRITE (LOUT, 998) DH2,ALFA2,XL
  998 FORMAT('0',' *** S/R TRPROP   DELTA(H*ALFA/
     1,'EXCEEDS TOLERANCE    '/'0',3E12.5//' ***
',///)
      INIT=1
      GO TO 30
```

the GO TO 903 leads us here, where the message

*** Error in subr. TRPROP 3 called bysubr. ERPROP***

is printed out, and then we go back into the code via GO TO 30

```
 IF(DH2*ALFA2.GT.DELHP6**2) GO TO 903
*
* *** DEFINE AVERAGE MAGNETIC FIELD AND GRADIENT
*
      PM12=(PM1+PM2)*0.5
      P12=1./(2.*PM12)
      HN(1)=(H1(1)*PM1+H2(1)*PM2)*P12*CH*CFACT8
      HN(2)=(H1(2)*PM1+H2(2)*PM2)*P12*CH*CFACT8
      HN(3)=(H1(3)*PM1+H2(3)*PM2)*P12*CH*CFACT8
     ** skip **
     PAV = .5*(PA1+PA2)
      Q = - HM/PAV
      THETA = Q*XL
      SINT = SIN(THETA)
      COST = COS(THETA)
      … and other variables
    ** skip **
```

GO TO 903 statement skips this part of the code, where some variables (in green) are filled up with a value.

RECALL

```
903 IERR=3
C     IF(INIT.NE.0) GO TO 30
*     WRITE (LOUT, 998) DH2,ALFA2,XL
  998 FORMAT('0',' *** S/R TRPROP
DELTA(H*ALFA/P)',5X
     1,'EXCEEDS TOLERANCE    '/'0',3E12.5//'
**********    ',///)
      INIT=1
      GO TO 30
```

```
* *** COMPLETE TRANSFORMATION MATRIX BETWEEN ERRORS AT X1 AND X2
* *** FIELD GRADIENT PERPENDICULAR TO TRACK IS PRESENTLY NOT
* *** TAKEN INTO ACCOUNT
*
   30 CONTINUE
      QP   =Q *PAV
      ANV = -(HN(1)*U2(1)+HN(2)*U2(2)                )
      ANU =   (HN(1)*V2(1)+HN(2)*V2(2)+HN(3)*V2(3))
      OMCOST = 1.-COST
      TMSINT = THETA-SINT
     …
```

Here some variables not filled are used: all of them keep the previous step value, except for Q (…conflict with ZEBRA ??)

Why the crash?

The crash results related to the changes in `ertrch.F`:
they let the case

```
IF(DH2*ALFA2.GT.DELHP6**2) GO TO 903
```

be more frequent , probably because a change in the stepping has been made
In old GeanE this condition never (or very rarely) happens and some compilers did not detect it

This explains why the error remained undetected up to now

Conclusions (on the crash)

1. The changes in ertrch.F of the last GeanE version sometimes allow too big steps
   This must be corrected

2. Too big steps activate a wrong procedure in the old GeanE.
   Perhaps this condition in trprfn.F could happen also without the changed ertrch.F under some conditions (e. g. low momenta, very inhomogeneous magnetic field)
   This has been fixed just now by us by skipping the step

Possible solutions

At present, we propose:

1. **to fix the media_pnd.geo file (m.f. map must be read in each medium!!)**

2. **get rid of the new ertrch.F routine and go back to the old one**
   - **to correct the new GeanE (with a skip of the step updating) to avoid crashes**

There is another possibility

get rid of the 'E' (exact) option in the propagation.
In non-exact case the `trprop.F` routine substitutes the `trprfn.F` one without bugs.

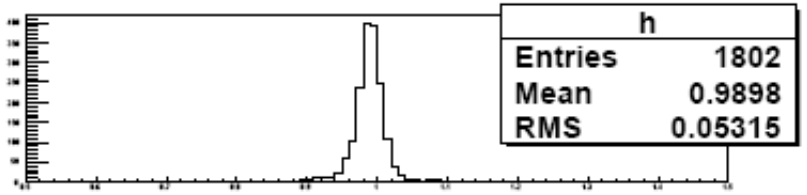
Tests have been performed on the same set of events where we saw the crash and **all the simulations ended without crashing**

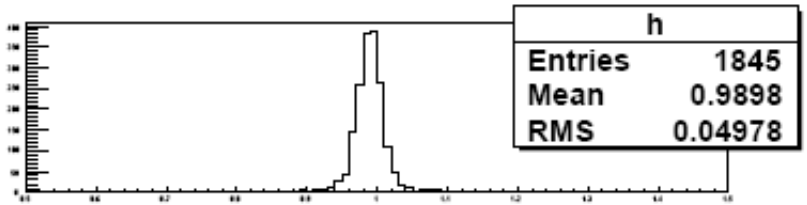
In the meanwhile:

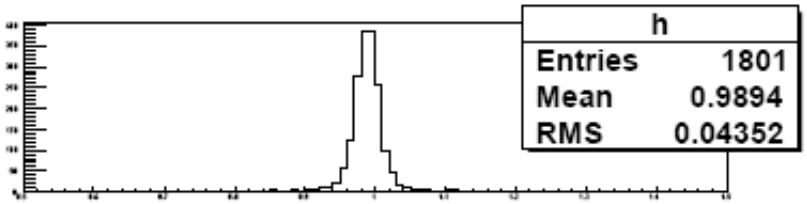
- the `ertrch.F` has to be checked and fixed where needed
- we will investigate a more robust patch, for `trprfn.F`

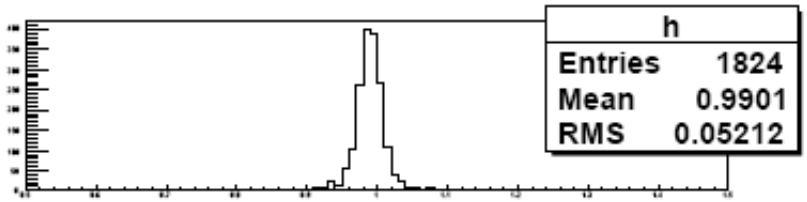
Momenta reconstructed on the first MVD plane (with Kalman)

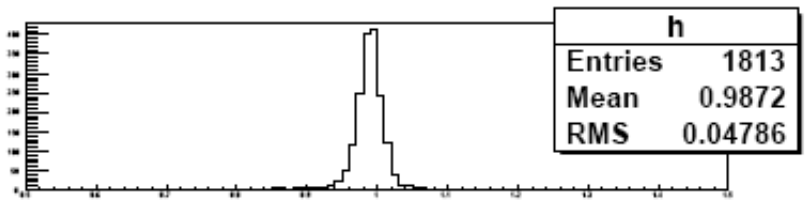
Old GEanE without correction



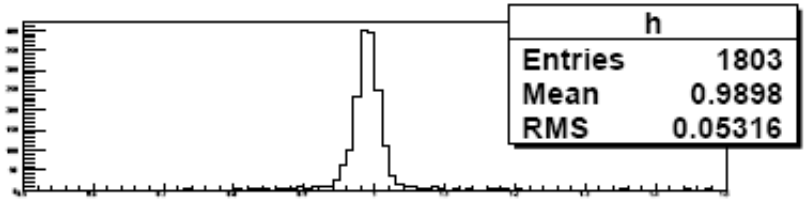


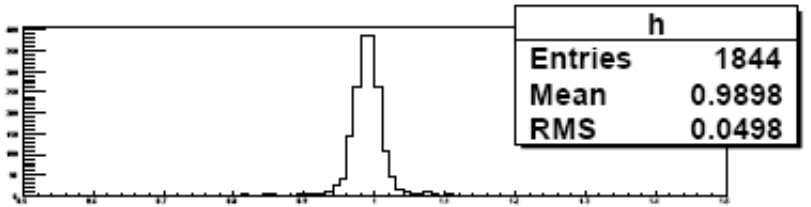


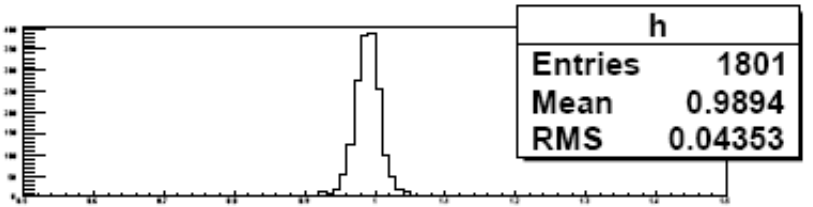


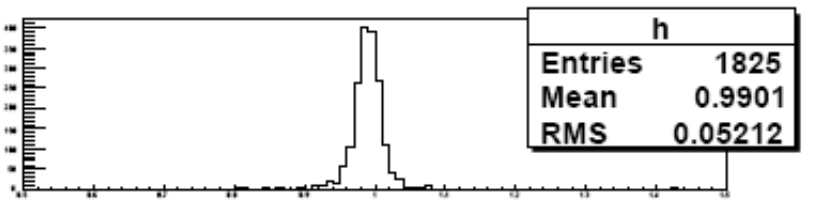


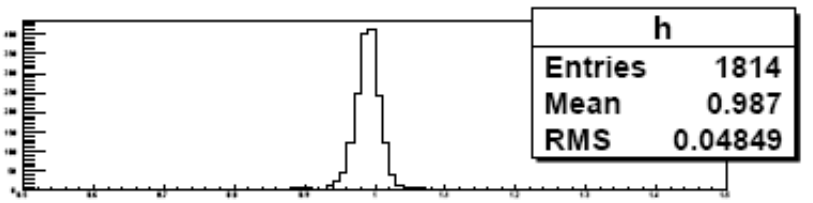
New GeanE with correction











GeanE: TO DO list

BUG FIXES AND THINGS TO BE ADDED (Lia and A.R.):

- **Fix bug to prevent crash in xmm55**
- Some comments needed to explain the functions (e.g. in the helix (SC) from/to parabola (SD) contructors sometimes the transformation is not possible and it must be explained) (improve the failure procedure)
- `PropagateToLength(0)` must be fixed to propagate to track length = 0
- Add the option 'O' to perform the tracking only of the mean values without the errors
- Add the covariance matrix in MARS (6X6) in `FairTrackParH`

- **Check the tracking along the z axis**

- **Investigate the failure when propagating to virtual detector planes**

- **Check tracking of low momentum particles**