UrQMD (Fortran) calls ROOT (C++)

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Status

◦ Generally successful (but with some cases to be determined / developed)
  ◦ Define C++ functions, and let them called by Fortran at proper locations
  ◦ Define C++ extern struct to link Fortran quantities (commons)

◦ Location: ui:/ustcfs/HICUser/fsi/urqmd

◦ Original UrQMD: /ustcfs/HICUser/fsi/urqmd/urqmd
  ◦ Change: pythia6409.f −> pytahi6428.f (final pythia6), GNUmakefile updated
  ◦ Change: new gfortran option -std=legacy in mk/Linux.mk

◦ New Fortran & C++ codes: /ustcfs/HICUser/fsi/urqmd/curqmd
  ◦ c_*.f, curqmd.[cxx,h], GNUmakefile, run.sh

What to store (UrqmdDst)

column#		contents
0		"E" (only in ⚬○16)
1	√	# of collisions
2	√	# of elastic collisions
3	√	# of inelastic collisions
4	√	# of Pauli-blocked collisions
5	√	# of decays
6	√	# of produced *hard* baryon resonances
7	√	# of produced *soft* baryon resonances
8	√	# of baryon resonances produced via a decay of another resonance

⚬○13	⚬○14	⚬○15	⚬○16		contents
			1		ind: index of particle (see CTOption(56))
1	1	2	1		t: time of particle
2	2	3	2	√	r_x: x coordinate
3	3	4	3	√	r_y: y coordinate
4	4	5	4	√	r_z: z coordinate
5	5	6	5		E: energy of particle
6	6	7	6	√	p_x: x momentum component
7	7	8	7	√	p_y: y momentum component
8	8	9	8	√	p_z: z momentum component
9	9	10	9	√	m: mass of particle
10	10	11	10	√	ityp: particle-ID
11	11	12	11	√	iso3: $2 \cdot I_3$ (see Section 1.2)
12	12	13	12	√	ch : charge of particle
13	13	14	13	√	parent collision number (see Table 10)
14	14	15	14	√	N_{coll} number of collisions
		16			S : strangeness
15	15		15	√	parent process type (see Table 11)
	17				history information (debugging only)
16				√	t^{fr} : freeze-out time of particle
17				√	r_x^{fr} : freeze-out x coordinate
18				√	r_y^{fr} : freeze-out y coordinate
19				√	r_z^{fr} : freeze-out z coordinate
20					E^{fr} : freeze-out energy of particle
21				√	p_x^{fr} : freeze-out momentum x component
22				√	p_y^{fr} : freeze-out momentum y component
23				√	p_z^{fr} : freeze-out momentum z component
	16*			√	τ_{dec} decay time of particle
	17*			√	τ_{form} formation time of particle
	18*			√	R_σ cross section reduction factor
	19*			√	unique particle number (not ID!)
			16*	√	$ityp_1^{old}$: particle-ID of parent particle # 1
			17*	√	$ityp_2^{old}$: particle-ID of parent particle # 2

○ Entry for each time step of events (few)

○ Additional branch

  ○ b

  ○ time: event level (instead of track level)

  ○ Npart: Aproject + Atarget − #(pptype%100==0)

  ○ Ntracks

  ○ spin

  ○ iso3_old1 & iso3_old2

What to store (UrqmdCollisionDst)

column#		format	contents
1	√	(i8)	number of ingoing particles N_{in}
2	√	(i8)	number of outgoing particles N_{out}
3	√	(i4)	process ID (see Table 11)
4	√	(i7)	collision/entry counter
5	√	(f8.3)	collision time t_{coll} in fm/c
6	√	(e12.4)	center of mass energy of the collision $\sqrt{s}$ in GeV
7	√	(e12.4)	total cross-section of the collision σ_{tot} in mbarn
8	√	(e12.4)	partial cross-section of the actual sub-process σ_i in mbarn
9	√	(e12.4)	Baryon density at collision point ρ_B in units of ρ_0

- Not created or stored if storeCollision = false

- Entry for each collision of events (many)
- Additional branch
  - b
  - Ntracks
  - spin
  - iso3_old1 & iso3_old2

13	14	15	16	contents
			1	ind: index of particle (see CTOption(56))
1	1	2	1	t: time of particle
2	2	3	2 √	r_x: x coordinate
3	3	4	3 √	r_y: y coordinate
4	4	5	4 √	r_z: z coordinate
5	5	6	5	E: energy of particle
6	6	7	6 √	p_x: x momentum component
7	7	8	7 √	p_y: y momentum component
8	8	9	8 √	p_z: z momentum component
9	9	10	9 √	m: mass of particle
10	10	11	10 √	ityp: particle-ID
11	11	12	11 √	iso3: $2 \cdot I_3$ (see Section 1.2)
12	12	13	12 √	ch : charge of particle
13	13	14	13 √	parent collision number (see Table 10)
14	14	15	14 √	N_{coll} number of collisions
		16		S : strangeness
15	15	17	15 √	parent process type (see Table 11)
	17			history information (debugging only)
16				t^{fr} : freeze-out time of particle
17				r_x^{fr} : freeze-out x coordinate
18				r_y^{fr} : freeze-out y coordinate
19				r_z^{fr} : freeze-out z coordinate
20				E^{fr} : freeze-out energy of particle
21				p_x^{fr} : freeze-out momentum x component
22				p_y^{fr} : freeze-out momentum y component
23				p_z^{fr} : freeze-out momentum z component
	16*			τ_{dec} decay time of particle
	17*			τ_{form} formation time of particle
	18*			R_σ cross section reduction factor
	19*		√	unique particle number (not ID!)
			16* √	$ityp_1^{old}$: particle-ID of parent particle # 1
			17* √	$ityp_2^{old}$: particle-ID of parent particle # 2

What is new

◦ Can store spin, iso3_old

◦ Can store parent information (iType_old, iso3_old) during final output

◦ Can store f13 information @ each time step (original f13 only stores final)

◦ Can set quiet output to command screen

◦ Can skip empty event (Ncoll + Ndecays == 0)

◦ Can set random seed event-by-event

How to store parent information

- Integer (4 bytes): origin (origin definition)
  - = ppType + 100*(# scatters) + 1000*(|iType_old1| + 1000*|iType_old2|)
  - 0 <= ppType < 100, 0 <= |iType_old| < 1000
  - No iso3_old or sign of iType_old

```
if ( (itypt(1).eq.ityp(inew(i))).and.
     (iso3t(1).eq.iso3(inew(i))) ) then
   origin(inew(i))=origint(1)+100
   uid(inew(i))=uidt(1)
elseif ( (itypt(2).eq.ityp(inew(i))).and.
         (iso3t(2).eq.iso3(inew(i))) ) then
   origin(inew(i))=origint(2)+100
   uid(inew(i))=uidt(2)
```

ityp	nucleon	ityp	delta	ityp	lambda	ityp	sigma	ityp	xi	ityp	omega
1	N_{938}	17	Δ_{1232}	27	Λ_{1116}	40	Σ_{1192}	49	Ξ_{1317}	55	Ω_{1672}
2	N_{1440}	18	Δ_{1600}	28	Λ_{1405}	41	Σ_{1385}	50	Ξ_{1530}		
3	N_{1520}	19	Δ_{1620}	29	Λ_{1520}	42	Σ_{1660}	51	Ξ_{1690}		
4	N_{1535}	20	Δ_{1700}	30	Λ_{1600}	43	Σ_{1670}	52	Ξ_{1820}		
5	N_{1650}	21	Δ_{1900}	31	Λ_{1670}	44	Σ_{1775}	53	Ξ_{1950}		
6	N_{1675}	22	Δ_{1905}	32	Λ_{1690}	45	Σ_{1790}	54	Ξ_{2025}		
7	N_{1680}	23	Δ_{1910}	33	Λ_{1800}	46	Σ_{1915}				
8	N_{1700}	24	Δ_{1920}	34	Λ_{1810}	47	Σ_{1940}				
9	N_{1710}	25	Δ_{1930}	35	Λ_{1820}	48	Σ_{2030}				
10	N_{1720}	26	Δ_{1950}	36	Λ_{1830}						
11	N_{1900}			37	Λ_{1890}						
12	N_{1990}			38	Λ_{2100}						
13	N_{2080}			39	Λ_{2110}						
14	N_{2190}										
15	N_{2200}										
16	N_{2250}										

Table 1: Baryon-itypes used in **UrQMD**. Antibaryons carry a negative sign.

ityp	0^{-+}	ityp	1^{--}	ityp	0^{++}	ityp	1^{++}	ityp	charmed
101	π	104	ρ	111	a_0	114	a_1	133	D
106	K	108	K^*	110	K_0^*	113	K_1^*	134	D^*
102	η	103	ω	105	f_0	115	f_1	135	J/Ψ
107	η'	109	ϕ	112	f_0^*	116	f_1'	136	χ_c
ityp	1^{+-}	ityp	2^{++}	ityp	$(1^{--})^*$	ityp	$(1^{--})^{**}$	137	Ψ'
122	b_1	118	a_2	126	ρ_{1450}	130	ρ_{1700}	138	D_s
121	K_1	117	K_2^*	125	K_{1410}^*	129	K_{1680}^*	139	D_s^*
123	h_1	119	f_2	127	ω_{1420}	131	ω_{1662}		
124	h_1'	120	f_2'	128	ϕ_{1680}	132	ϕ_{1900}		

- ppType = origin%100
- # scatters = origin/100%10

```
    2       1  10    318    3.486  0.1665E+01  0.1983E+02  0.1983E+02  0.5118E+00
714  0.34855015E+01 -0.31837811E+01  0.30769649E+01 -0.22947721E+01  0.62539188E+00 -0.15451485E+00  0.31808005E+00 -0.49701232E+00  0.13800000E+00         101 -2 -1     277    1  0        1001015
233  0.34855015E+01 -0.26863519E+01  0.33516045E+01 -0.23172907E+01  0.44498825E+01  0.47432728E+00 -0.64771840E+00 -0.42751707E+01  0.93800002E+00           1  1  1     267    4  0        1017030
233  0.34855015E+01 -0.29350665E+01  0.32142847E+01 -0.23060314E+01  0.50752743E+01  0.31981242E+00 -0.32963835E+00 -0.47721830E+01  0.16654542E+01           4 -1  0     318    5  0        1101010
```

How to store parent information

- Integer (4 bytes): origin (new definition)
  - = ppType + 100*(# scatters) + 1000*((iso3_old1+3)+7*(t_iType_old1+100)) + 1400000*((iso3_old2+3)+7*(t_iType_old2+100))
  - $0 <=$ ppType < 100, $0 <=$ iso3_old+3 $<= 6$
  - t_iType_old = iType_old; if(>=100) −=40; if(<=−100) +=40
    - $0 <=$ t_iType_old+100 < 200
  - origin $< 1.96e9$ (4-byte integer max ~ 2.1e9)

  - !!!Also affect *.txt output

  - ppType = origin%100
  - # scatters = origin/100%10
  - If ppType does not contain # scatters, can be stored 1-byte

```
ppType = origin%1000;
if(origin<1000)
    iType_old1 = iso3_old1 = iType_old2 = iso3_old2 = 0;
else{
    iso3_old1 = origin/1000%7-3;
    iType_old1 = origin/7000%200-100;
    if(iType_old1>=60)
        iType_old1 += 40;
    if(iType_old1<=-60)
        iType_old1 -= 40;
    if(origin<1400000)
        iType_old2 = iso3_old2 = 0;
    else{
        iso3_old2 = origin/1400000%7-3;
        iType_old2 = origin/9800000-100;
        if(iType_old2>=60)
            iType_old2 += 40;
        if(iType_old2<=-60)
            iType_old2 -= 40;
    }
}
```

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8	N_{1700}	24	Δ_{1920}	34	Λ_{1810}	47	Σ_{1940}				
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102	η	103	ω	105	f_0	115	f_1	135	J/Ψ
107	η'	109	ϕ	112	f_0^*	116	f_1'	136	χ_c
ityp	1^{+-}	**ityp**	2^{++}	**ityp**	$(1^{--})^*$	**ityp**	$(1^{--})^{**}$	137	Ψ'
122	b_1	118	a_2	126	ρ_{1450}	130	ρ_{1700}	138	D_s
121	K_1	117	K_2^*	125	K_{1410}^*	129	K_{1680}^*	139	D_s^*
123	h_1	119	f_2	127	ω_{1420}	131	ω_{1662}		
124	h_1'	120	f_2'	128	ϕ_{1680}	132	ϕ_{1900}		

How to set seed for random generator

○ Random seed generator

  ○ iseed is actual seed when used

    ○ Changed after each use

  ○ ranseed is seed of iseed

  ○ 1. set ranseed < 0

  ○ 2. if < 0, set ranseed by time

    ○ if different from old

  ○ 3. set iseed = −ranseed

  ○ 4. modify iseed (extra if < 0)

```fortran
        subroutine sseed(ranseed)
c
c       reset the random number generato
c
ccccccccccccccccccccccccccccccccccccccccccccccccccc

        implicit none

        real*8 dummy, ran2
        integer iseed, ranseed, oldseed, time, timeseed
        common /seed/iseed,oldseed

        if (ranseed.le.0) then
            timeseed = abs(time())
            if (timeseed.eq.oldseed) return
            ranseed = timeseed
        endif
        oldseed = ranseed
        iseed = -ranseed
        dummy = ran2(iseed)

        return
        end
```

```fortran
        function ran2(idum)
c
c Long period (>2E18) random number generator of L'Ecuyer with
c Bays-Durham shuffle and added safeguards. Returns a uniform random
c deviate between 0.0 and 1.0 (exclusive of the endpoint values).
c Call with idum a negative integer to initialize; thereafter, do
c not alter idum between successive deviates in a sequence. RNMX
c should approximate the largest floating value that is less than 1.
c
C  (C) Copr. 1986-92 Numerical Recipes Software.
c
ccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc

        implicit none

        integer idum,IM1,IM2,IMM1,IA1,IA2,IQ1,IQ2,IR1,IR2,NTAB,NDIV
        real*8 ran2,AM,EPS,RNMX

        parameter (IM1=2147483563,IM2=2147483399,AM=1.0D0/IM1,IMM1=IM1-1,
     $      IA1=40014,IA2=40692,IQ1=53668,IQ2=52774,IR1=12211,IR2=3791,
     $      NTAB=32,NDIV=1+IMM1/NTAB,EPS=1.0D0-16,RNMX=1.0D0-EPS)
        integer idum2, j, k, iv(NTAB), iy
        save iv, iy, idum2
        data idum2/123456789/, iv/NTAB*0/, iy/0/

        if (idum.le.0) then
            idum=max(-idum,1)
            idum2=idum
            do 11 j=NTAB+8,1,-1
                k=idum/IQ1
                idum=IA1*(idum-k*IQ1)-k*IR1
                if (idum.lt.0) idum=idum+IM1
                if (j.le.NTAB) iv(j)=idum
11          continue
            iy=iv(1)
        endif
        k=idum/IQ1
        idum=IA1*(idum-k*IQ1)-k*IR1
        if (idum.lt.0) idum=idum+IM1
        k=idum/IQ2
        idum2=IA2*(idum2-k*IQ2)-k*IR2
        if (idum2.lt.0) idum2=idum2+IM2
        j=1+iy/NDIV
        iy=iv(j)-idum2
        iv(j)=idum
        if (iy.lt.1) iy=iy+IMM1
        ran2=min(AM*iy,RNMX)

        return
        end
```

```fortran
c       initialize random number generator
c       call auto-seed generator only for first event and if no seed was fixed
        if(.not.firstseed.and.(.not.fixedseed)) then
            ranseed=-(1*abs(ranseed))
            call sseed(ranseed)
        else
            firstseed=.false.
        endif
```

If .not.fixedseed, it can reset seed from time almost each event
If fixedseed, it use only one random sequence (follows last event)

How to set seed for random generator

- Set seed for gRandom by random_device
  - True random number if supported by compiler
- Set c_use_external_seed = true

- Set ranseed uniformly in [-2147483648, 2147483647]
  - Not finalized yet
  - Set ranseed only positive?
  - Add effect of time?

- Call ran2 to modify iseed

```cpp
std::random_device rd;
gRandom->SetSeed(rd());

c_sets_l_.c_use_external_seed = kTRUE;
```

```cpp
void c_set_seed_(){
    sys_.ranseed = (gRandom->Rndm()-0.5)*4294967296;
    seed_.oldseed = sys_.ranseed;
    seed_.iseed = -sys_.ranseed;
    ran2_(&seed_.iseed);
}
```

```fortran
c      initialize random number generator
c      call auto-seed generator only for first event and if no seed was fixed
       if(c_use_external_seed)then
         if(firstseed)firstseed=.false.
         if(fixedseed)then
           write(6,*)'c_use_external_seed is neglected due to fixedseed'
           c_use_external_seed=.false.
         else
           call c_set_seed
         endif
       elseif(.not.firstseed.and.(.not.fixedseed)) then
         ranseed=-(1*abs(ranseed))
         call sseed(ranseed)
       else
         firstseed=.false.
       endif
```

Other developments

- Parent particle Information in collision output
  - In temporary quantities named t*
  - No spin, or Nin, rho_b values
    - Saved to my defined global quantity
    - Extraction method is the same as other t*

- Now time step tree filled after final particle decays rather than after final time step
  - Unstable particles' decays after all time steps & before the end of event
  - The same as origin output f14

- If CTOption(4)==1, initial information (t==0) is stored in tree
  - The same as origin output f14

Other developments

◦ Pdgid (int) −> mass (float), iType (short), iso3 (char), charge (char)

  ◦ Strange masses of protons

  ◦ Different masses between UrQMD and PDG

  ◦ Some particles in UrQMD has no pdgid in ityp2pdg.f

    ◦ Such as iType = 12, 13, 15, 16

```
c Neutron
    .        1, -1,  2112,
c Proton
    .        1,  1,  2212,
c N*
    .        2, -1, 12112,      2,  1, 12212,
    .        3, -1,  1214,      3,  1,  2124,
    .        4, -1, 22112,      4,  1, 22212,
    .        5, -1, 32112,      5,  1, 32212,
    .        6, -1,  2116,      6,  1,  2216,
    .        7, -1, 12116,      7,  1, 12216,
    .        8, -1, 21214,      8,  1, 22124,
    .        9, -1, 42112,      9,  1, 42212,
    .       10, -1, 31214,     10,  1, 32124,
    .       14, -1,  1218,     14,  1,  2128,
c Delta
    .       17, -3,  1114, 17, -1,  2114, 17, 1,  2214, 17, 3,  2224,
    .       18, -3, 31114, 18, -1, 32114, 18, 1, 32214, 18, 3, 32224,
    .       19, -3,  1112, 19, -1,  1212, 19, 1,  2122, 19, 3,  2222,
    .       20, -3, 11114, 20, -1, 12114, 20, 1, 12214, 20, 3, 12224,
    .       21, -3, 11112, 21, -1, 11212, 21, 1, 12122, 21, 3, 12222,
    .       22, -3,  1116, 22, -1,  1216, 22, 1,  2126, 22, 3,  2226,
    .       23, -3, 21112, 23, -1, 21212, 23, 1, 22122, 23, 3, 22222,
    .       24, -3, 21114, 24, -1, 22114, 24, 1, 22214, 24, 3, 22224,
    .       25, -3, 11116, 25, -1, 11216, 25, 1, 12126, 25, 3, 12226,
    .       26, -3,  1118, 26, -1,  2118, 26, 1,  2218, 26, 3,  2228,
```

```
data baryon_names/
.       'Nukleon',
.       'N(1440)',
.       'N(1520)',
.       'N(1535)',
.       'N(1650)',
.       'N(1675)',
.       'N(1680)',
.       'N(1700)',
.       'N(1710)',
.       'N(1720)',
.       'N(1900)',
.       'N(1990)',
.       'N(2080)',
.       'N(2190)',
.       'N(2220)',
.       'N(2250)',
```

Wrong name?

ityp	nucleon	ityp	delta	ityp	lambda	ityp	sigma	ityp	xi	ityp	omega
1	N_{938}	17	Δ_{1232}	27	Λ_{1116}	40	Σ_{1192}	49	Ξ_{1317}	55	Ω_{1672}
2	N_{1440}	18	Δ_{1600}	28	Λ_{1405}	41	Σ_{1385}	50	Ξ_{1530}		
3	N_{1520}	19	Δ_{1620}	29	Λ_{1520}	42	Σ_{1660}	51	Ξ_{1690}		
4	N_{1535}	20	Δ_{1700}	30	Λ_{1600}	43	Σ_{1670}	52	Ξ_{1820}		
5	N_{1650}	21	Δ_{1900}	31	Λ_{1670}	44	Σ_{1775}	53	Ξ_{1950}		
6	N_{1675}	22	Δ_{1905}	32	Λ_{1690}	45	Σ_{1790}	54	Ξ_{2025}		
7	N_{1680}	23	Δ_{1910}	33	Λ_{1800}	46	Σ_{1915}				
8	N_{1700}	24	Δ_{1920}	34	Λ_{1810}	47	Σ_{1940}				
9	N_{1710}	25	Δ_{1930}	35	Λ_{1820}	48	Σ_{2030}				
10	N_{1720}	26	Δ_{1950}	36	Λ_{1830}						
11	N_{1900}			37	Λ_{1890}						
12	N_{1990}			38	Λ_{2100}						
13	N_{2080}			39	Λ_{2110}						
14	N_{2190}										
15	N_{2200}										
16	N_{2250}										

Table 1: Baryon-itypes used in **UrQMD**. Antibaryons carry a negative sign.

ityp	0^{-+}	ityp	1^{--}	ityp	0^{++}	ityp	1^{++}	ityp	charmed
101	π	104	ρ	111	a_0	114	a_1	133	D
106	K	108	K^*	110	K_0^*	113	K_1^*	134	D^*
102	η	103	ω	105	f_0	115	f_1	135	J/Ψ
107	η'	109	ϕ	112	f_0^*	116	f_1'	136	χ_c
ityp	1^{+-}	ityp	2^{++}	ityp	$(1^{--})^*$	ityp	$(1^{--})^{**}$	137	Ψ'
122	b_1	118	a_2	126	ρ_{1450}	130	ρ_{1700}	138	D_s
121	K_1	117	K_2^*	125	K_{1410}^*	129	K_{1680}^*	139	D_s^*
123	h_1	119	f_2	127	ω_{1420}	131	ω_{1662}		
124	h_1'	120	f_2'	128	ϕ_{1680}	132	ϕ_{1900}		

What to be determined

- Npart: Aproject + Atarget − #(pptype%100==0)
  - ppType = origin%100
  - # scatters = origin/100%10

  - Some particles only explore scatters, contribute to Npart?

```
    2      2  17    233   1.554  0.5056E+01  0.3978E+02  0.1166E+02  0.8930E+00
362  0.15541405E+01 -0.22213285E+01  0.35829759E+01 -0.71742345E+00  0.17039231E+01 -0.17381395E+00  0.13815719E+01 -0.29078794E+00  0.93800002E+00      1 -1  0      213   1  0        100
233  0.15541405E+01 -0.27680167E+01  0.33953480E+01 -0.60064611E+00  0.85553163E+01  0.20642659E+00  0.13534976E+00 -0.85059975E+01  0.88346555E+00      1  1  1        0   0  0          0
362  0.15541405E+01 -0.22213285E+01  0.35829759E+01 -0.71742345E+00  0.84217759E+01  0.32168377E+00  0.25335456E-01 -0.83631539E+01  0.93800002E+00      1 -1  0      233   2  0        200
233  0.15541405E+01 -0.27680167E+01  0.33953480E+01 -0.60064611E+00  0.18374634E+01 -0.28907113E+00  0.14915862E+01 -0.43363154E+00  0.93800002E+00      1  1  1      233   1  0        100
```

Check

```
root [1] UrqmdCollisionDst->Show(0);
=====> EVENT:0
b               = 13.9877
number          = 1
time            = 0.0746903
sqrts           = 199.043
sigma_total     = 52.0758
sigma_partial   = 10.3074
rho_B           = 14.489
pType           = 17
Nin             = 2
Nout            = 2
Ntracks         = 4
uid             = 73,
                  352, 73, 352
iType           = 1,
                  1, 1, 1
iso3            = 1,
                  -1, 1, -1
charge          = 1,
                  0, 1, 0
spin            = 1,
                  -1, -1, 1
x               = 1.65141,
                  0.385643, 1.65141, 0.385643
y               = 0.0844311,
                  0.0137725, 0.0844311, 0.0137725
z               = 0.0112218,
                  0.0112218, 0.0112218, 0.0112218
px              = 0.0141267,
                  0.0926628, 2.14204, -2.03525
py              = 0.148645,
                  -0.105794, -0.724586, 0.767437
pz              = 98.2774,
                  -100.773, -100.748, 98.2526
m               = 0.917558,
                  0.919356, 0.938, 0.938
Nc              = 0,
                  0, 1, 1
pcNumber        = 0,
                  0, 1, 1
ppType          = 0,
                  0, 100, 100
iType_old1      = 0,
                  0, 0, 0
iso3_old1       = 0,
                  0, 0, 0
iType_old2      = 0,
                  0, 0, 0
iso3_old2       = 0,
                  0, 0, 0
```

```
pvec:ind   r0         rx           ry           rz           p0            px            py            pz            m              ityp 2i3 chg lcl#  nc
     2      2  17       1   0.075  0.1990E+03  0.5208E+02  0.1031E+02  0.1449E+02
    73  0.74690319E-01  0.16514065E+01  0.84431142E-01  0.11221819E-01  0.98281818E+02  0.14126706E-01  0.14864452E+00  0.98277421E+02  0.91755845E+00      1  1  1       0   0 0          0
   352  0.74690319E-01  0.38564307E+00  0.13772507E-01  0.11221819E-01  0.10077680E+03  0.92662766E-01 -0.10579351E+00 -0.10077251E+03  0.91935619E+00      1 -1  0       0   0 0          0
    73  0.74690319E-01  0.16514065E+01  0.84431142E-01  0.11221819E-01  0.10077745E+03  0.21420381E+01 -0.72458558E+00 -0.10074771E+03  0.93800002E+00      1  1  1       1   1 0        100
   352  0.74690319E-01  0.38564307E+00  0.13772507E-01  0.11221819E-01  0.98281171E+02 -0.20352486E+01  0.76743659E+00  0.98252621E+02  0.93800002E+00      1 -1  0       1   1 0        100
```

Check

```
root [3] UrqmdCollisionDst->Show(3);
=====> EVENT:3
b              = 13.9877
number         = 4
time           = 0.0848807
sqrts          = 61.8361
sigma_total    = 6.74686
sigma_partial  = 5.6639
rho_B          = 9.46934
pType          = 28
Nin            = 2
Nout           = 3
Ntracks        = 5
uid            = 412,
                 400, 418, 419, 420
iType          = 17,
                 113, 17, 101, 108
iso3           = -1,
                 -1, -1, -2, 1
charge         = 0,
                 0, 0, -1, 1
spin           = 1,
                 -2, 3, 0, 2
x              = -1.08297,
                 -0.890353, -1.08297, -0.890353, -0.890353
y              = -0.40725,
                 -0.706899, -0.40725, -0.706899, -0.706899
z              = 0.0215079,
                 0.0219206, 0.0215079, 0.0219206, 0.0219206
px             = -0.227418,
                 -0.399309, -0.227416, -0.283917, -0.115395
py             = 0.106963,
                 -0.120717, 0.106957, -0.311715, 0.191004
pz             = -52.9585,
                 18.0103, -52.9563, 7.31453, 10.6936
m              = 1.20804,
                 1.25213, 1.232, 0.138, 0.88364
Nc             = 1,
                 1, 2, 2, 1
pcNumber       = 3,
                 2, 4, 4, 4
ppType         = 15,
                 15, 28, 28, 28
iType_old1     = 1,
                 1, 17, 17, 17
iso3_old1      = 1,
                 1, -1, -1, -1
iType_old2     = 1,
                 1, 113, 113, 113
iso3_old2      = 1,
                 -1, -1, -1, -1
```

```
     2     3  28    4   0.085  0.6184E+02  0.6747E+01  0.5664E+01  0.9469E+01
412  0.84880709E-01 -0.10829742E+01 -0.40724994E+00  0.21507895E-01  0.52972894E+02 -0.22741829E+00  0.10696294E+00 -0.52958522E+02  0.12080407E+01        17 -1  0       3   1  0      996111015
400  0.84880709E-01 -0.89035344E+00 -0.706899333E+00 0.21920565E-01  0.18058629E+02 -0.39930945E+00 -0.12071740E+00  0.18010336E+02  0.12521293E+01       113 -1  0       2   1 -1      993311015
418  0.84880709E-01 -0.10829742E+01 -0.40724994E+00  0.21507895E-01  0.52971212E+02 -0.22741600E+00  0.10695713E+00 -0.52956287E+02  0.12320000E+01        17 -1  0       4   2  0     1699021028
419  0.84880709E-01 -0.89035344E+00 -0.706899333E+00 0.21920565E-01  0.73279741E+01 -0.28391694E+00 -0.31171549E+00  0.73145324E+01  0.13800000E+00       101 -2 -1       4   2  0     1699021028
420  0.84880709E-01 -0.89035344E+00 -0.706899333E+00 0.21920565E-01  0.10732337E+02 -0.11539479E+00  0.19100390E+00  0.10693570E+02  0.88364039E+00       108  1  1       4   1 -1     1699021028
```

Check

```
root [4] UrqmdCollisionDst->Show(10);
======> EVENT:10
b                = 13.9877
number           = 11
time             = 3.86413
sqrts            = 1.32149
sigma_total      = 0
sigma_partial    = 0
rho_B            = 0.00949667
pType            = 20
Nin              = 1
Nout             = 2
Ntracks          = 3
uid              = 447,
                   462, 463
iType            = 118,
                   101, 104
iso3             = 2,
                   2, 0
charge           = 1,
                   1, 0
spin             = -2,
                   0, 0
x                = -0.446549,
                   -0.446549, -0.446549
y                = -1.2298,
                   -1.2298, -1.2298
z                = -2.79132,
                   -2.79132, -2.79132
px               = 0.242734,
                   0.16513, 0.0776042
py               = -0.285845,
                   -0.169923, -0.115922
pz               = -1.54135,
                   -0.0961053, -1.44524
m                = 1.32149,
                   0.138, 1.0194
Nc               = 1,
                   2, 1
pcNumber         = 6,
                   11, 11
ppType           = 28,
                   20, 20
iType_old1       = 101,
                   118, 118
iso3_old1        = 0,
                   2, 2
iType_old2       = 1,
                   0, 0
iso3_old2        = -1,
                   0, 0
```

```
    1     2 20    11   3.864  0.1321E+01  0.0000E+00  0.0000E+00  0.9497E-02
447  0.38641318E+01 -0.44654879E+00 -0.12298002E+01 -0.27913244E+01  0.20646336E+01  0.24273440E+00 -0.28584481E+00 -0.15413463E+01  0.13214902E+01   118  2  1      6   1  0    993730028
462  0.38641318E+01 -0.44654879E+00 -0.12298002E+01 -0.27913244E+01  0.29055463E+00  0.16513024E+00 -0.16992283E+00 -0.96105291E-01  0.13800000E+00   101  2  1     11   2  0    1251020
463  0.38641318E+01 -0.44654879E+00 -0.12298002E+01 -0.27913244E+01  0.17740790E+01  0.77604157E-01 -0.11592198E+00 -0.14452410E+01  0.10193991E+01   104  0  0     11   1  0    1251020
```