

b-baryons in Mokka

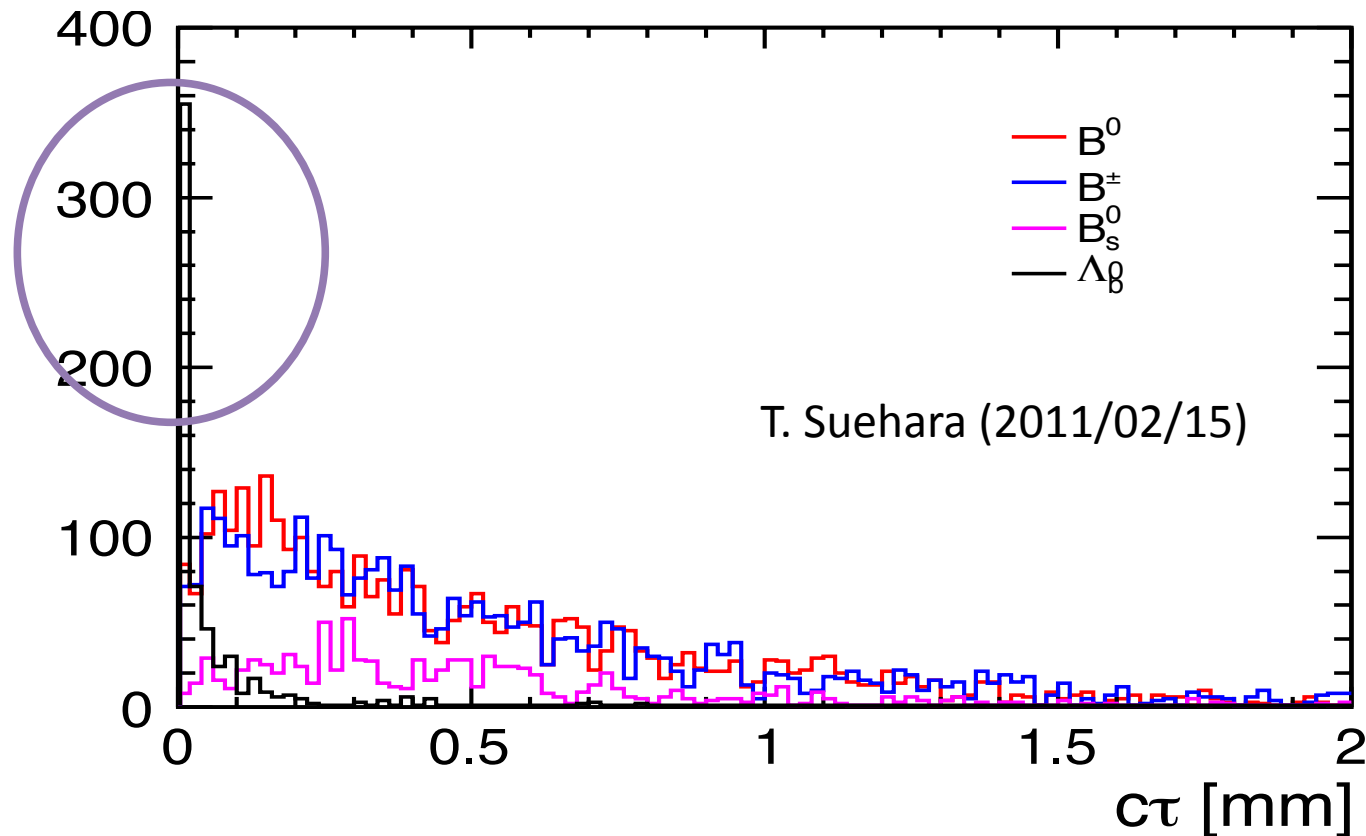
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b-baryon problem in Mokka

- problem: b-baryons don't fly in Mokka/G₄
 - this is a **big problem!** since ~10% of b-jets contain b-baryons, b-tagging performance is severely penalized

DST01-06_ppr004_bb_w11803_500_ILD_00_LCP_ep+1.0_em-1.0_Slac_SM_0001.slcio



treating generator information

- another (unrelated) problem which confused people:
decay vertex information from the event generator was previously **ignored** by Mokka/G₄
 - **this was fixed** in the latest Mokka release
 - ... **BUT NOT FOR B-BARYONS!**

STDHEP	#	parent	PDG	V_X	V_Y	V_Z
	1	n/a	5122	0.	0.	0.
	2	1	4122	73.43	219.06	-3.67
	3	1	-211	73.43	219.06	-3.67
	4	1	223	73.43	219.06	-3.67
	5	2	-11	73.84	220.52	-3.69
	6	2	12	73.84	220.52	-3.69
MCParticles	#	parent	PDG	V_X	V_Y	V_Z
	1	n/a	5122	0.	0.	0.
	2	1	4122	0.	0.	0.
	3	1	-211	0.	0.	0.
	4	1	223	0.	0.	0.
	5	2	-11	0.41	1.56	-0.02
	6	2	12	0.41	1.56	-0.02

c-baryons are simulated properly but b-baryons were not !!

problem & solution

- **the problem:** Mokka/G4 doesn't know that b-baryons are physical particles so it ignores their flight length (see below)
- **the solution:** add **b-baryons** the list of particles via a text file containing a list of particle properties (name, PDG#, width, lifetime)
 - following same strategy as SLIC code
- **BONUS:** can add quasi-stable SUSY particles in the same framework

```
Idle> /particle/list
```

```
      B+,          B-,          B0,          Bs0
      D+,          D-,          D0,          Ds+
      Ds-,          GenericIon,      He3,          J/psi
      N(1440)+,      N(1440)0,      N(1520)+,      N(1520)0
      N(1535)+,      N(1535)0,      N(1650)+,      N(1650)0
      N(1675)+,      N(1675)0,      N(1680)+,      N(1680)0
      N(1700)+,      N(1700)0,      N(1710)+,      N(1710)0
```

From Mokka command prompt: b-baryons (e.g. Lambda_b) were not present in this list.

implementation

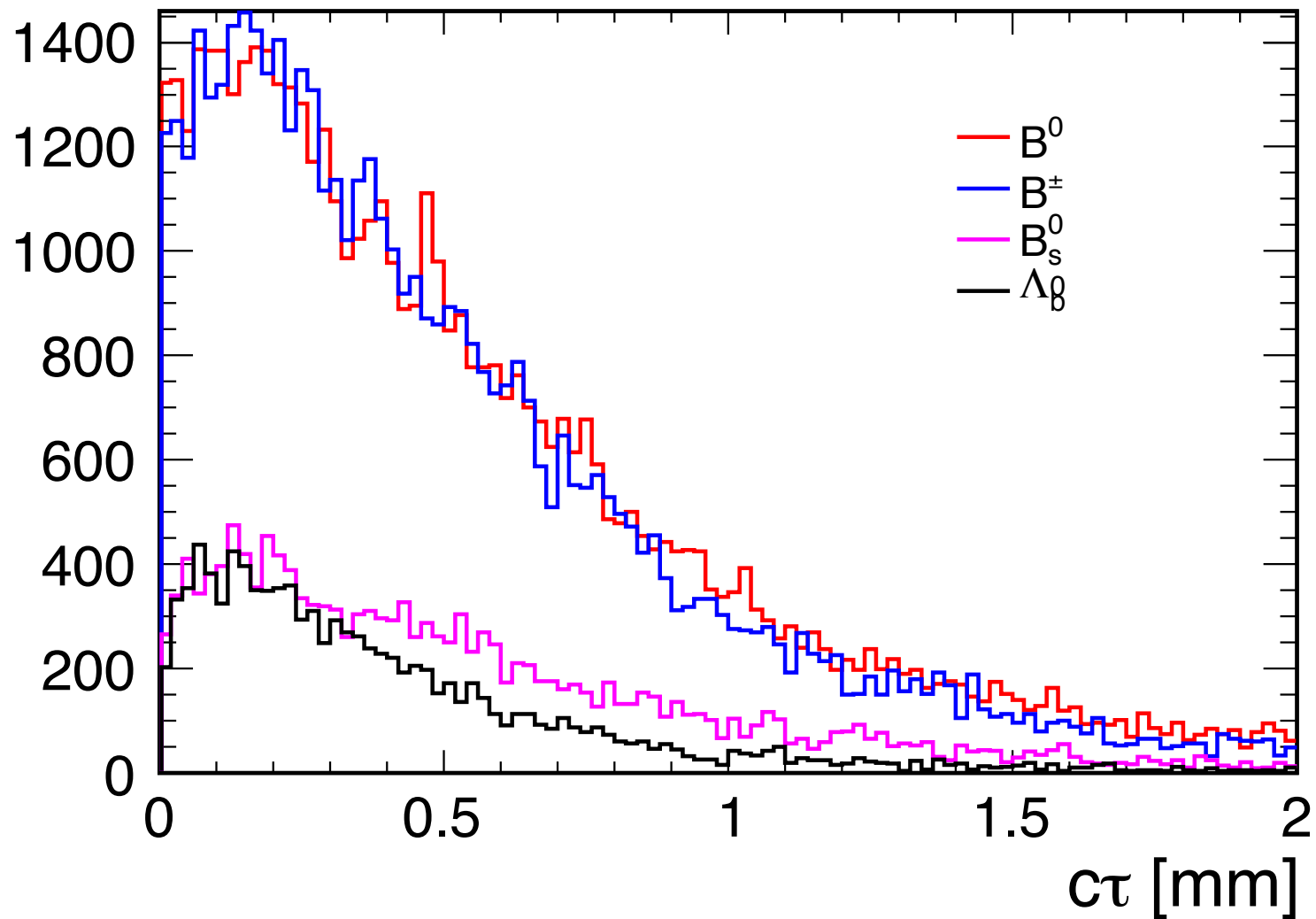
- a Mokka patch was prepared over the weekend.
- a new class “ExtraParticles” has been created (inheriting from “G4VPhysicsConstructor”)
 - implements ConstructParticle() method which reads in a text file (particle.tbl) and adds any unknown particles into the G4ParticleTable
 - implements ConstructProcess() method which defines ionization and multiple scattering for the new particles
 - instantiated after the nominal physics list is created

From **particle.tbl**

<PDG>	<name>	<3*charge>	<mass>	<width>	<lifetime>
5122	Lambda_b^0	0	5.64100	0.00000	3.42000E-01
-5122	Lambda_b~^0	0	5.64100	0.00000	3.42000E-01
5132	Xi_b^-	-3	5.84000	0.00000	3.87000E-01
-5132	Xi_b~^+	3	5.84000	0.00000	3.87000E-01
5142	Xi_bc^0	0	7.00575	0.00000	3.87000E-01
-5142	Xi_bc~^0	0	7.00575	0.00000	3.87000E-01

the result

w16466_01 with new Mokka



Lambda_b decay is now properly treated by Mokka/G4 !!

summary

- the b-baryon problem in Mokka has been fixed with a patch
- it now reads a text file “particle.tbl” which specifies the particle lifetime
- we are now working with Gabriel Musat to finalize it into a Mokka release