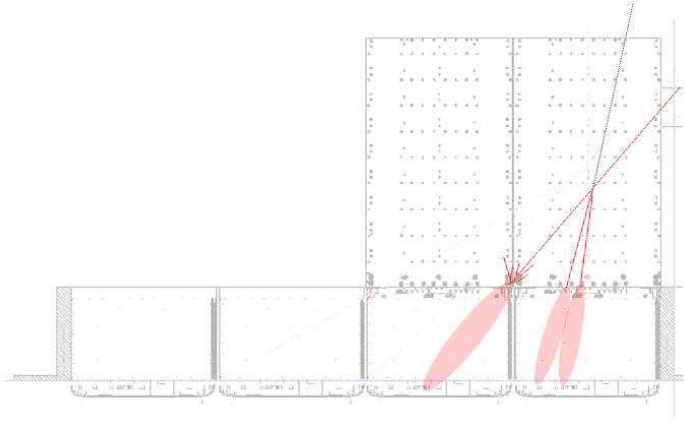
GLAST CERN 2006 Beamtest



Tkr Hits for MIPs : **FRED**

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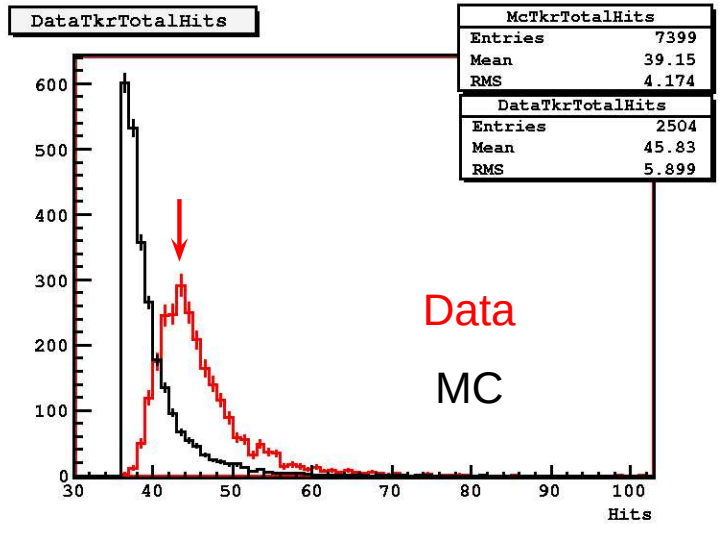
December 6th, 2006

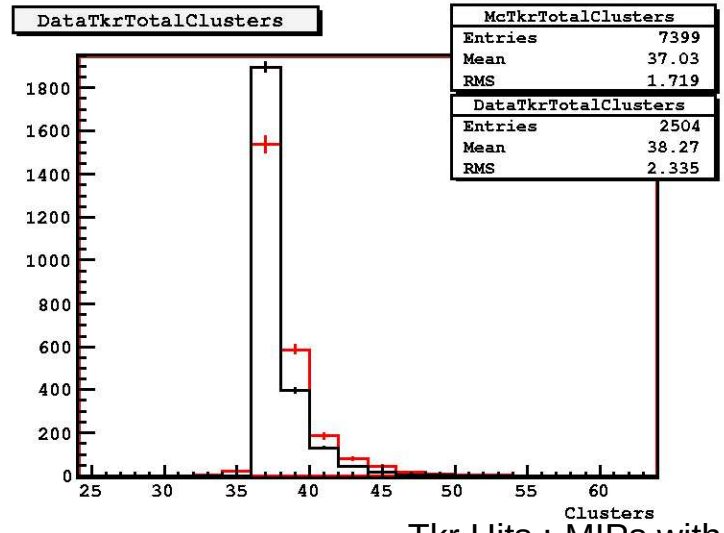
Data and MC

- Proton $6GeV/c$: 3300001423 (PS)
- MC - 184 : G4 cuts 10μ in tkr 70μ in CAL

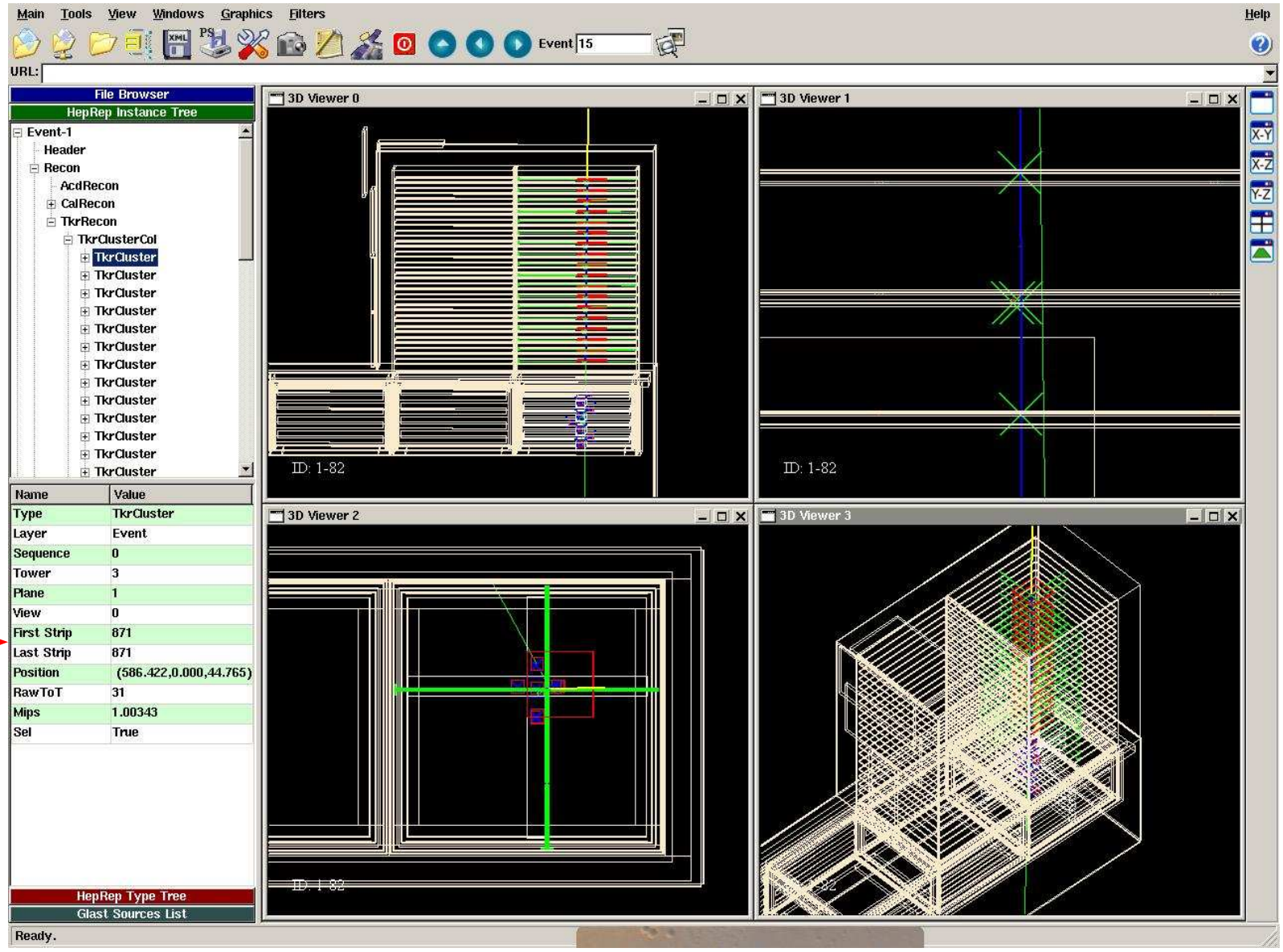
CUTS

- × 1Hit per plane for Tkr Top & Bottom Layers
- × TkrNumTracks==1 & TkrTotalHits[3]>=36 hits
- × $\Delta_{time} >= 1ms$
- × Abs(dataVtxZDir)>0.999 for run 752)





Protons with FRED (MC-184)



Events : Data 1423

run 1423 - Event 9			
plane	X(view0)	Y(view1)	Comments
34/35	772	892	
33/32	772	893	
30/31	772-773	895	2 strips
29/28	772	895-896	2 strips
26/27	772	897	
25/24	773	898	
22/23	773	899	
21/20	773	900	
18/19	773	900-901	2 strips
17/16	773	901-902	2 strips
14/15	773	903	
13/12	773	904	
10/11	773	905	
9/8	773-774	906	2 strips
6/7	773-774	907	2 strips
5/4	773	908-909	2 strips
2/3	773-774	909	2 strips
1/0	773	910	
36 Clusters - 44 Hits			

run 1423 - Event 18			
plane	X(view0)	Y(view1)	Comments
34/35	834	850	
33/32	835-836	851	2 strips
30/31	859/837	931/851	2 clusters
29/28	838	852	
26/27	839-840	852	2 strips
25/24	841	853	
22/23	842	854	
21/20	843	855	
18/19	844	855	
17/16	846	855-856	2 strips
14/15	847	856	
13/12	848-849	857	2 strips
10/11	850	857	
9/8	851-852	858	2 strips
6/7	853-854	859	2 strips
5/4	856	860	
2/3	858	861	
1/0	859	862	
38 Clusters - 44 Hits			

run 1423 - Event 2098			
plane	X(view0)	Y(view1)	Comments
34/35	847	833	
33/32	848	833	
30/31	849	834	
29/28	850-851	834	2 strips
26/27	852/837-838	834/830-831	lots of stuff
25/24	853	835	
22/23	854	835	
21/20	855	836	
18/19	855-856	836	2 strips
17/16	856-857	837	2 strips
14/15	858	837	
13/12	859	838	
10/11	860	838-839	2 strips
9/8	858-859-860-861	839	4 strips
6/7	862	840	
5/4	863	840	
2/3	863	841	
1/0	864	841	
38 Clusters - 47 Hits			

- Many clusters with 2 strips
- sometimes 2 clusters, *more or less* close one to each other ($\Delta L < 1cm$).
- higher probability of 2 strip cluster when the proton is drifting from a strip to the following one ?

Events : MC-184

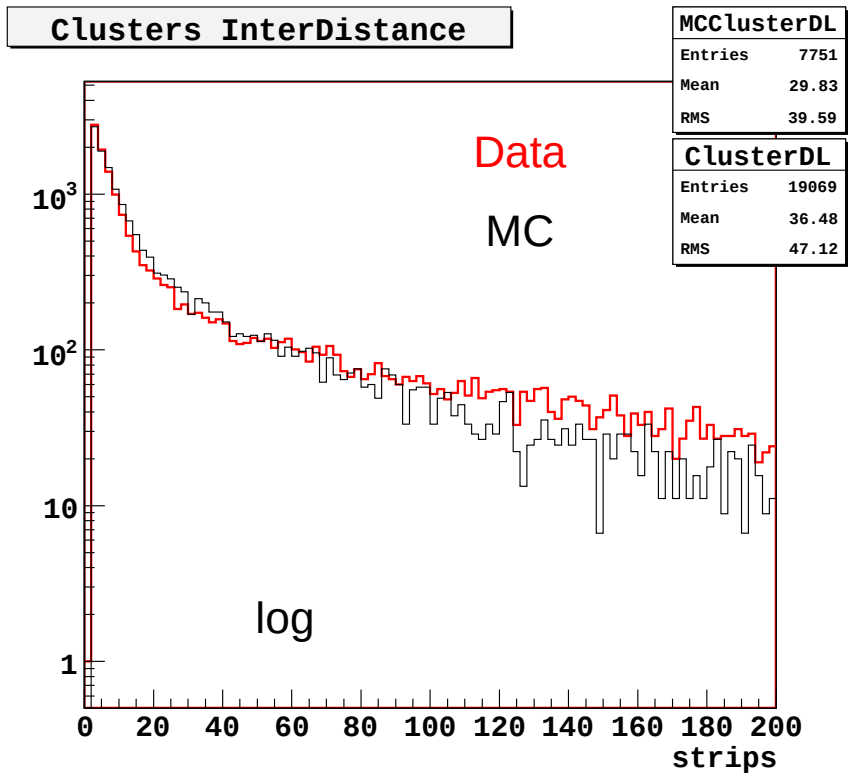
MC 184 - Event 5			
plane	X(view0)	Y(view1)	Comments
34/35	823	785	
33/32	821	785	
30/31	820	785	
29/28	818	784	
26/27	817	784	
25/24	815	783	
22/23	813	783	
21/20	812	782	
18/19	810	782	
17/16	809	782	
14/15	807	781	
13/12	806	780	
10/11	804	779-780	2 strips
9/8	803	779	
6/7	801	779	
5/4	800	778	
2/3	798	777	
1/0	797	776	
36 Clusters - 37 Hits			

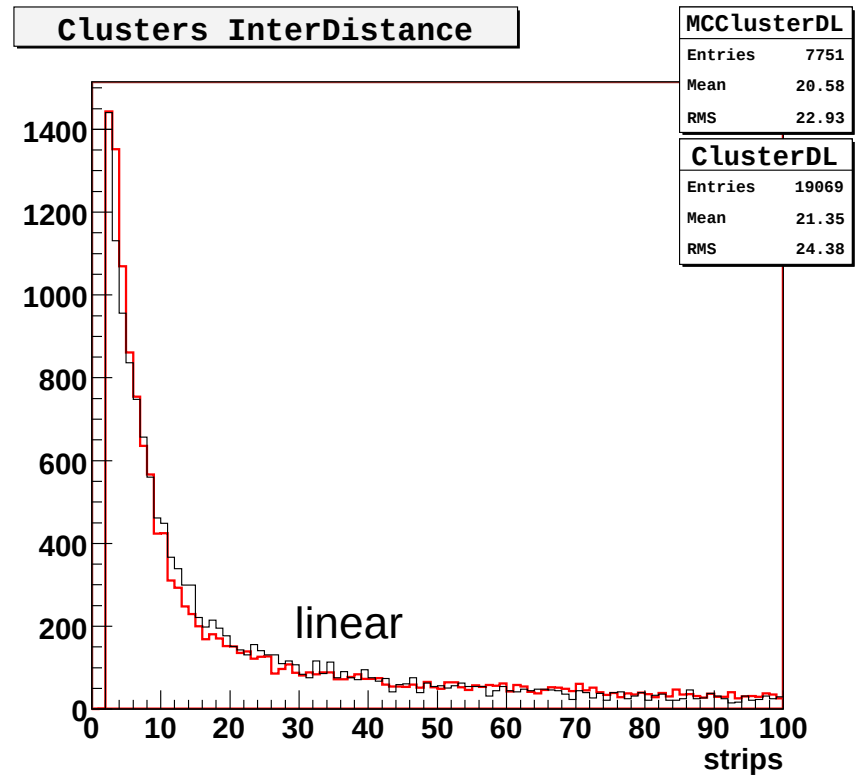
MC 184 - Event 5			
plane	X(view0)	Y(view1)	Comments
34/35	894	927	
33/32	893	927	
30/31	892	927	
29/28	891	928	
26/27	889	928	
25/24	888	928	
22/23	886	928	
21/20	885-886	929/919-920	2 clusters
18/19	884	929	
17/16	882	930	
14/15	881	930	
13/12	880	930	
10/11	878	931	
9/8	877	931-932	2 strips
6/7	870-871/875	931	2 clusters
5/4	874	932	
2/3	872	932	
1/0	871		
38 Clusters - 42 Hits			

MC 184 - Event 5			
plane	X(view0)	Y(view1)	Comments
34/35	735	726	
33/32	734	725	
30/31	732	725	
29/28	731	737-738/724	2 clusters
26/27	729	723-724	2 strips
25/24	728	722	
22/23	726	721-722	2 strips
21/20	725	720	
18/19	724	720	
17/16	722	719	
14/15	721	718	
13/12	719	717	
10/11	718	715-716-717	3 strips
9/8	716	716	
6/7	714	715	
5/4	712	714/698-699	2 clusters
2/3	711	713	
1/0	709	712	
38 Clusters - 42 Hits			

- some clusters with 2 strips
- sometimes 2 clusters, **close** one to each other (few strips).
- higher probability of 2 strip cluster when the proton is drifting from a strip to the following one ?

Clusters on the same plane





- At first look : similar distributions for MC and Data

→ cluster are very likely produced by the same kind of process

- in details : Data distribution shows more clusters close one to each other and more clusters far on from each other

Observations

- Events have the same *shape* in Data and MC, however...
- Wider clusters : most probable to find a cluster with 2 strips in data than in MC
- More clusters : most probable to see 2 clusters on the same plane in data than in MC
  - additionnal cluster is close to the one on the track
  - correlation X/Y planes and/or successive planes ?
- drifting from one strip to another, from one plane to the next one, seems to increase the probability of having more strips/clusters

Ideas :

→ Hardware problem ? (requires a lot of imagination !)

→ Charge sharing underestimated ? (by such a big factor ?)

→ Production of low energy electrons (δ_{rays})(hypothesis of my September 7th slides...)

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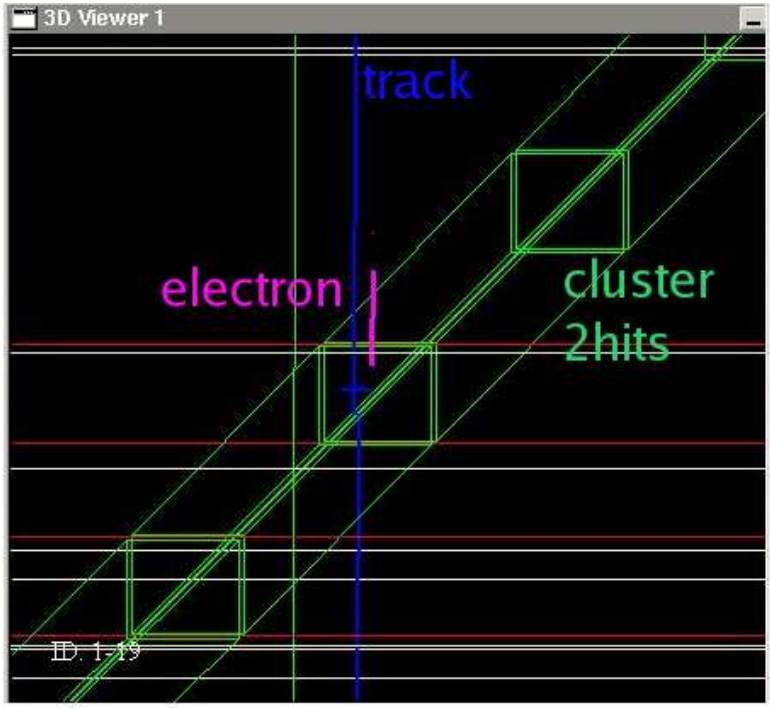
$\Rightarrow$ **Use FRED on the MC to see how low energy electrons produce these hits/clusters.**

MC-184 : Event 5



Particle

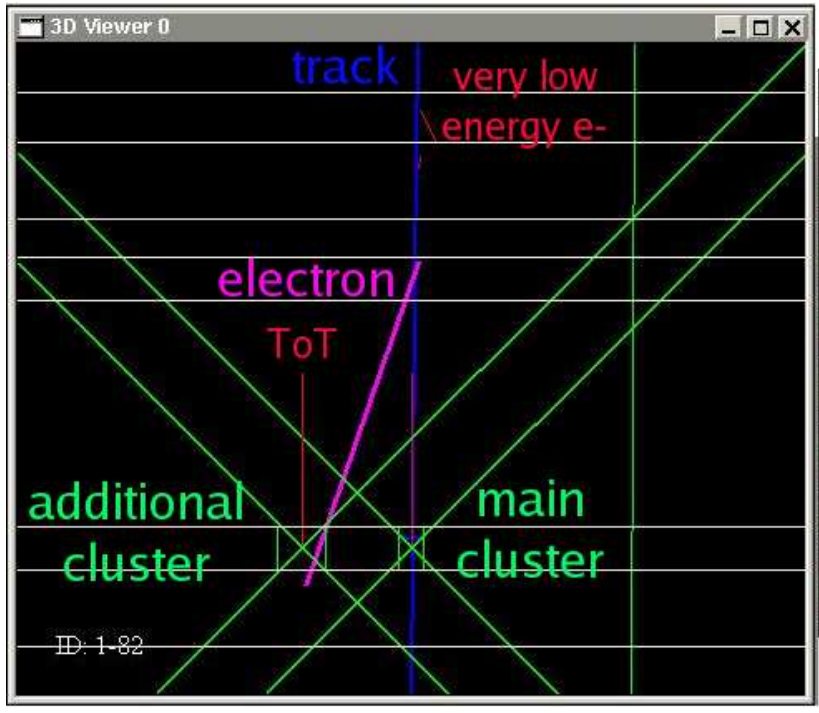
Name	Value
Type	Particle
DrawAs	Line
Layer	Event
Name	e-
Ei	0.850335
Eo	0
Initial Position	(571.234,3.873,208.849)
Final Position	(570.766,3.865,208.452)
Direction	(-0.36682,0.63610,-0.67884)
Proc	hIoni
PDG	11
Status Low	0001 0100 0000 0000
Charge	neg
Color	red
NumDaughters	0
Sel	True

Cluster

Name	Value
Type	TkrCluster
Layer	Event
Sequence	11
Tower	3
Plane	11
View	1
First Strip	779
Last Strip	780
Position	(561.750,3.810,208.265)
RawToT	149
Mips	4.61612
Sel	True

- Low energy electrons produced by 'ionization' can turn on a strip aside the one in which the proton passes, thus producing a 2 hits cluster.

MC-184 : Event 15



Particle

Name	Value
Type	Particle
DrawAs	Line
Layer	Event
Name	e-
Ei	1.03614
Eo	0
Initial Position	(587.406,38.329,142.219)
Final Position	(586.339,38.940,139.186)
Direction	(-0.53705,0.45569,-0.7098
Proc	hIoni
PDG	11
Status Low	0001 0100 0000 0000
Charge	neg
Color	red
NumDaughters	0
Sel	True

Clusters

Name	Value
Type	TkrCluster
Layer	Event
Sequence	6
Tower	3
Plane	6
View	0
First Strip	870
Last Strip	871
Position	(586.308,0.000,139.538)
RawToT	106
Mips	3.17321
Sel	True

Name	Value
Type	TkrCluster
Layer	Event
Sequence	7
Tower	3
Plane	6
View	0
First Strip	875
Last Strip	875
Position	(587.334,0.000,139.538)
RawToT	106
Mips	3.17321
Sel	True

- Low energy electrons produced by 'ionization' can even create their own cluster which size can be more than 1.

Conclusions

- In the MC, additionnal hits and additional clusters (with respect to a perfect *mip*) are due to Δ_{rays}
- This hit production depends upon : the number, the creation point, the energy and the direction of the created electrons.
- We see more hits and more clusters in the data, but it looks like they come from the same process as events have the same *shape*.
- Very likely this process is **underestimated** in our MC

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- In the MC, additionnal hits and additional clusters (with respect to a perfect *mip*) are due to Δ_{rays}
- This hit production depends upon : the number, the creation point, the energy and the direction of the created electrons.
- We see more hits and more clusters in the data, but it looks like they come from the same process as events have the same *shape*.
- Very likely this process is **underestimated** in our MC
  - Material properties?
  - Discriminator thresholds ?
  - G4 electron production/propagation process ?
  - G4 configuration in BTR

Further work

- Review our use of G4 ionization processeses
- Use the MC to study Δ_{ray} production in the Tracker
  - How many do we have ? How many do we need ?
  - Production point : in which material ?
  - Energy spectrum
  - Angular spectrum
- Consequences on the electromagnetic showers ?