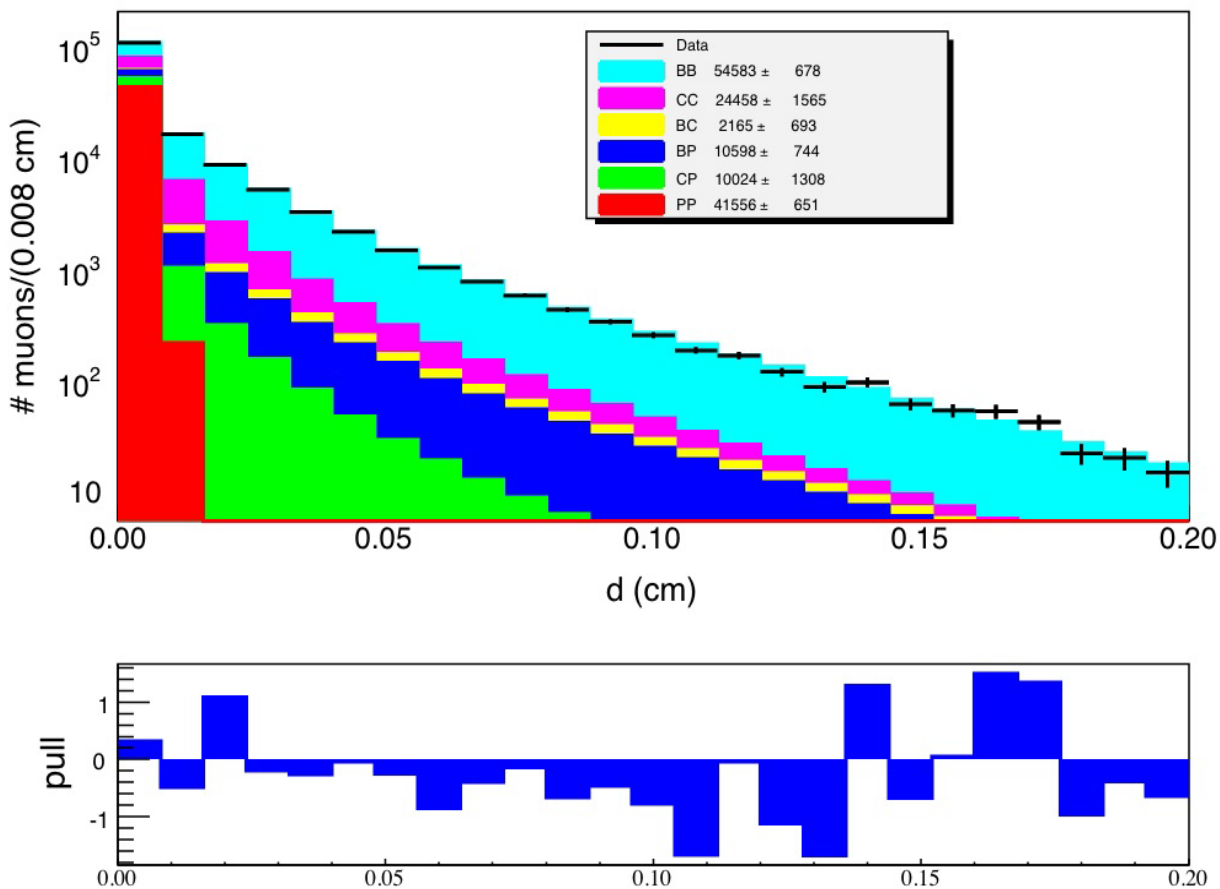
A visual inspection vs a measurement

- We understand that our is a difficult analysis
- Otherwise, anybody else could have done it
- That said, it would be nice if collaborators tried to understand what has been done rather than been scared the living daylights out of them
- At the present time, there is a Dick behind every corner scaring you

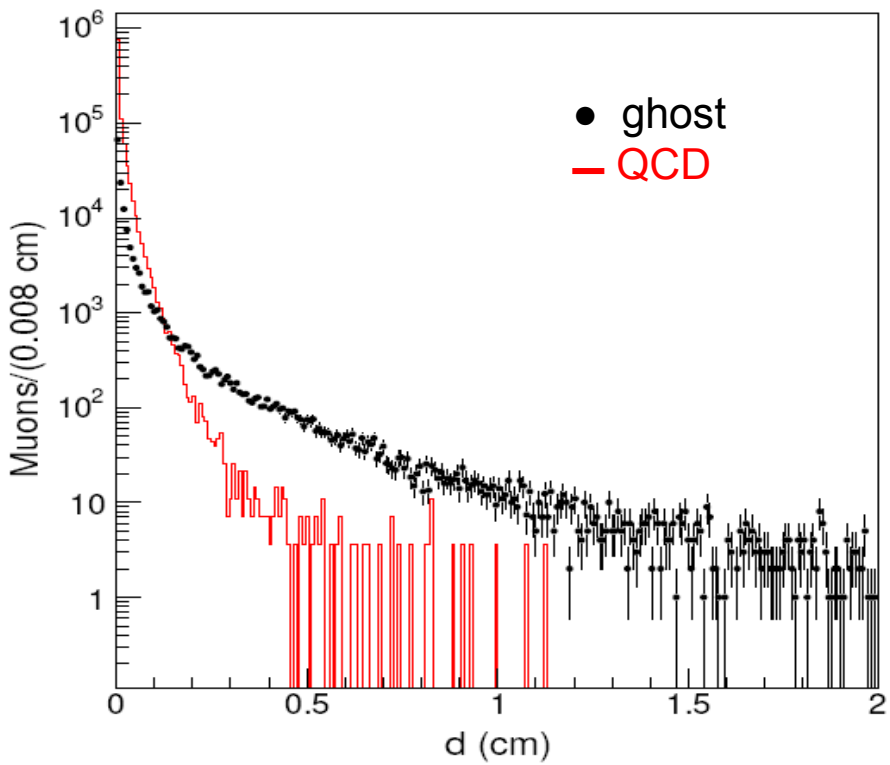
We don’t start with a visual inspection



bb cross section measurement – it requires that two muons originated inside the beam pipe – 96% of the SM processes simulated or considered in Run I do that

Follow up of the measurement

- There is a large world of processes with muons generated outside the beam pipe



We use tracks with loose SVX requirements to compare to run I measurements

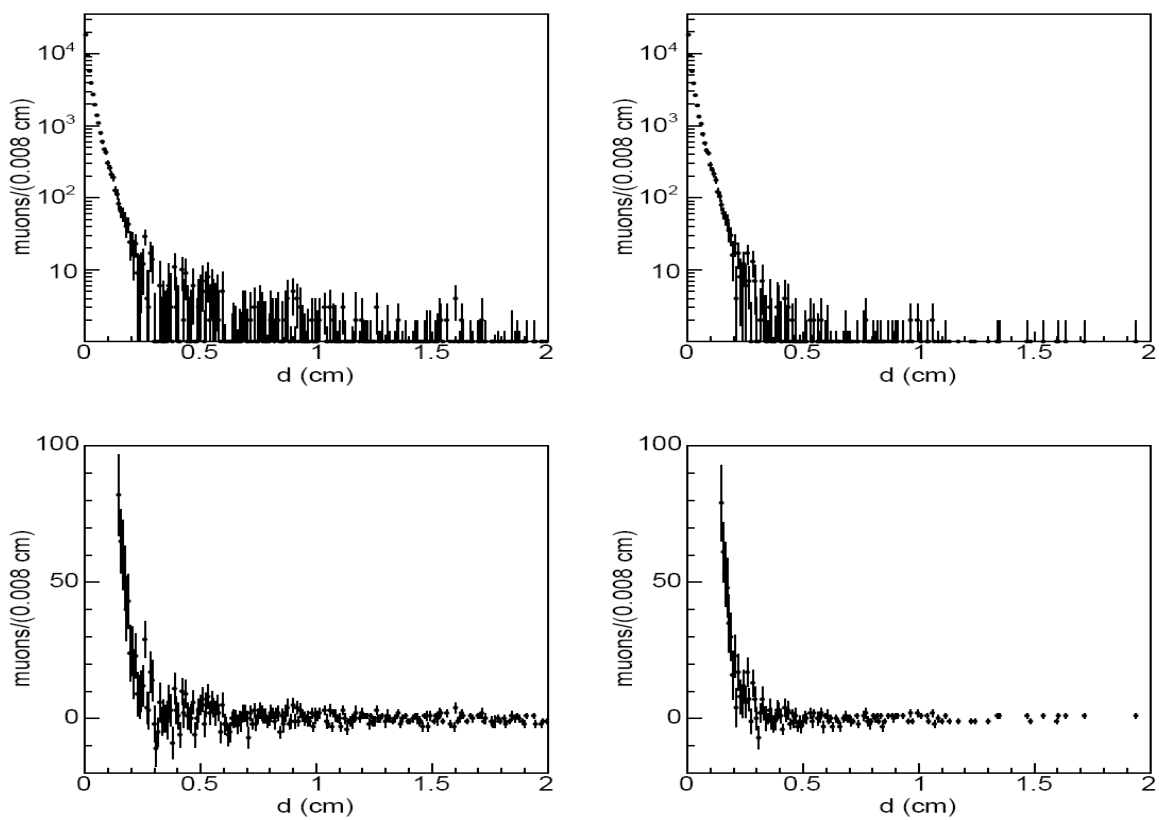
A large fraction of these events, maybe all, are due to IFD of pions and kaons, K0S and hyperons decays

The lifetime measured using the d tail is 12 ps and not that of KOS, K, pion, or hyperon

Without requiring for a muon, there are 100 times more tracks coming from these processes and they have to be seen in jet data

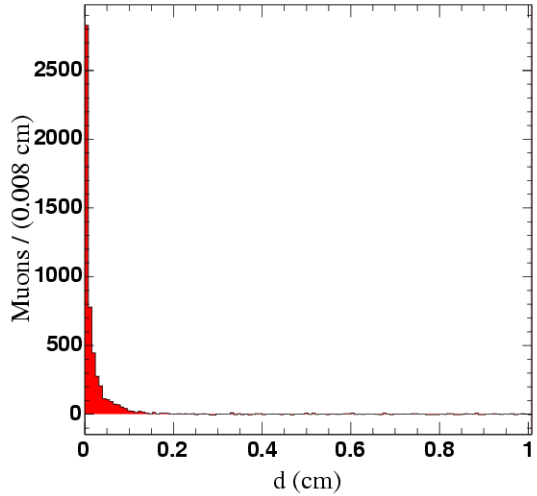
Swift boat veteran

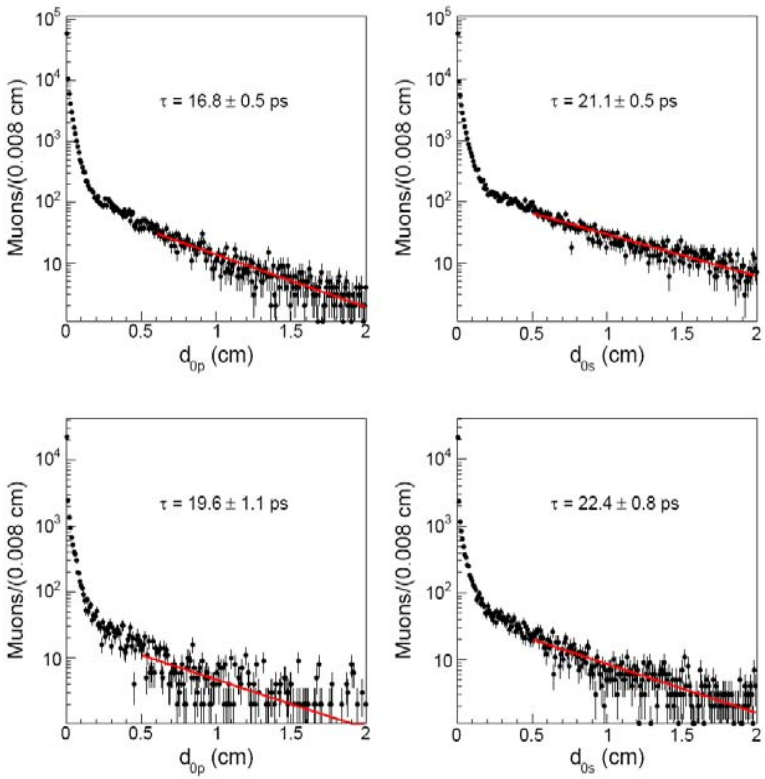
- We agree with Pasha' findings at this stage – another friend lost in the jungle
- And then we kiss him goodbye and start our measurement that is much more subtle
- Release any SVX requirements that bias the impact parameter distribution
- If initial muons come with a D^0 meson, the IP does not have tail – it is not a detector effect

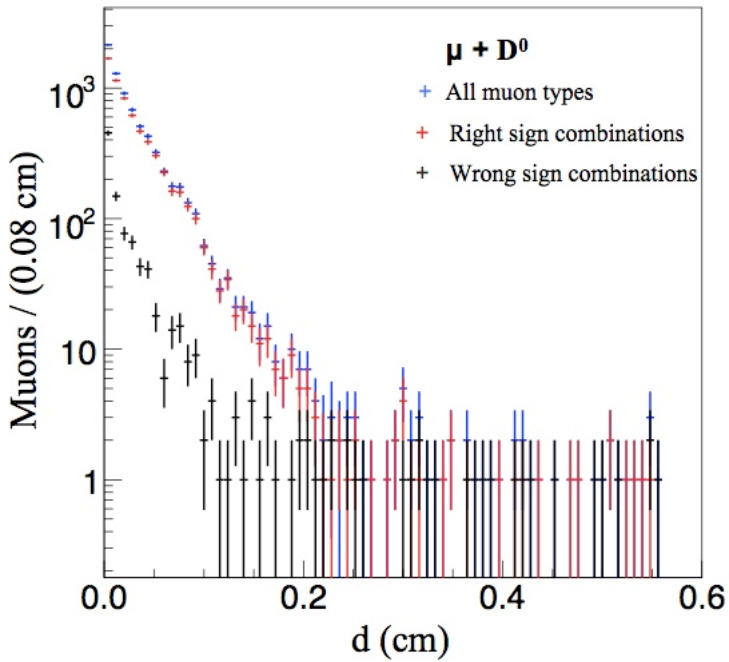


The game starts investigating additional muons

- A fraction of the ghost events has an anomalously high multiplicity of muons
- The additional muons are used to measure a lifetime of 21 ps
- Additional muon in QCD events do not have any d tail







second swift boat : muon selection and fakes

- Initial muons are CMUP with $p_T > 3$ GeV/c
- Dx (CMU) < 30 cm
- The fake probability per track is derived using D^0 from D* from B hadrons and yields approximately 0.002 fakes/event
- The fraction of fakes depends on the signal
- In the bb xsec paper, the fake rate was verified by selecting also muons with $\chi^2 > 9$ and refitting the impact parameter distribution – result:
- bbbar has about 1% fakes
- ccbar has 14% fakes – signal 2 times smaller and the number of events without a second c is 4 times larger
- b – prompt has 100% fakes – no signal
- the fakes from the IP fits are consistent with 0.002 fakes/event

Muon selection and fakes

- Initial muons are CMUP with $p_T > 3$ GeV/c
- Dx (CMU) < 30 cm
- The fake probability per track is derived using D^0 from D* from B hadrons and yields approximately 0.002 fakes/event
- The fraction of fakes depends on the signal
- In the bb xsec paper, the fake rate was verified by selecting also muons with $\chi^2 > 9$ and refitting the impact parameter distribution – result:
- bbbar has about 1% fakes
- ccbar has 14% fakes – signal 2 times smaller and the number of events without a second c is 4 times larger
- b – prompt has 100% fakes – no signal
- the fakes from the IP fits are consistent with 0.002 fakes/event

Additional muons

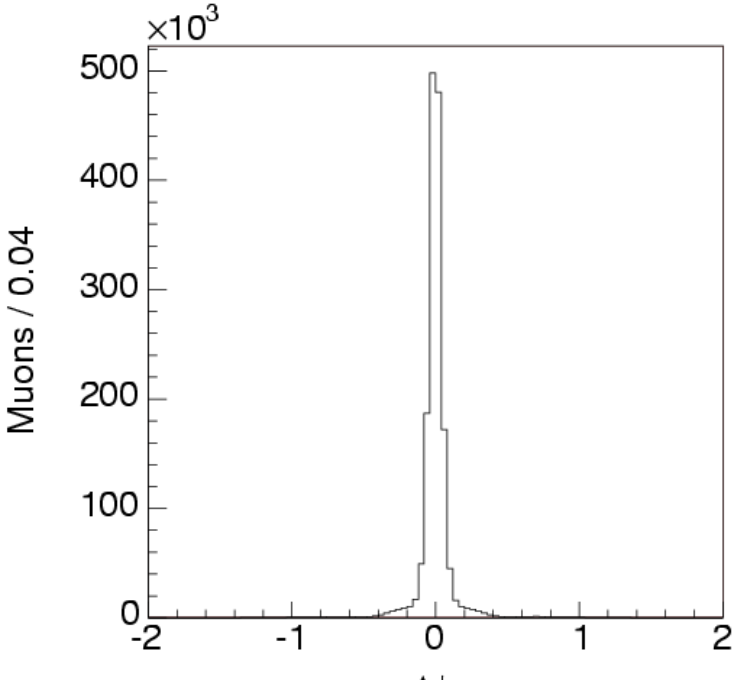
- Use CMU+CMX+CMP muons with p_T>2 GeV/c and $|\eta|$< 1.1
- Dx < 30, 30, and 40 cm, respectively
- We want to maximize efficiency (83%)
- Fake prediction is based on D^0 from D* from B hadrons using a fake probability per track
- This fake probability does not depend on the number of tracks surrounding the pion or kaon . Tested for an average of 2.6 additional tracks that is also the average number of tracks in ghost events
- Since we use both charm and mu-SVT triggers and we retain the trigger info, we verified that the fake probability does not depend on the SVX requirements
- A fake probability per track has been used since 1990 anytime we search for soft muons – usually derived using jet data – The coherence effects alleged now by some people have been never observed.
- We have been the first to use the large sample of D^0 available in Run II to construct a fake probability per track, now also the top group (Tony,Lucio) does this
- Cdf 9038 verifies that this probability per track describes the fakes observed in many jet data sets
- The top soft muon tagger is more sophisticated, but the efficiency is approximately 40%

Swift boat veteran

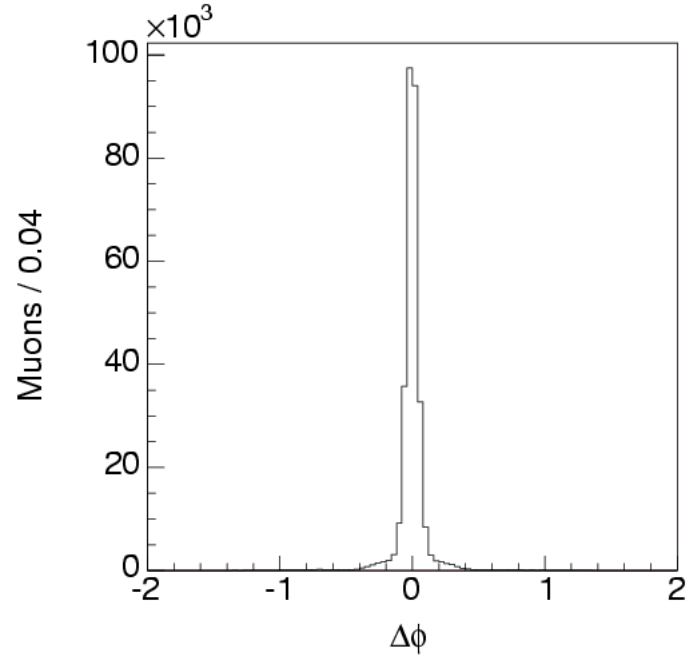
- We use as control sample events in which both muons pass the tight SVX requirements. One half of these events are bbbar and ccbar jets. There is no doubt that we can predict the data. The predicted fakes are 5%/event, the signal 2.1% , and the ratio signal to background is 1 to 2.5
- In ghost events, we predict that the fakes per event are 7% and the signal is measured to be 9.4%
- How could the 5% fakes in QCD rise to 16.4 % in ghost events when all distributions such as dx, chi2, and dphi look the same for QCD and ghost events – all in the analysis web page

Additional muon composition

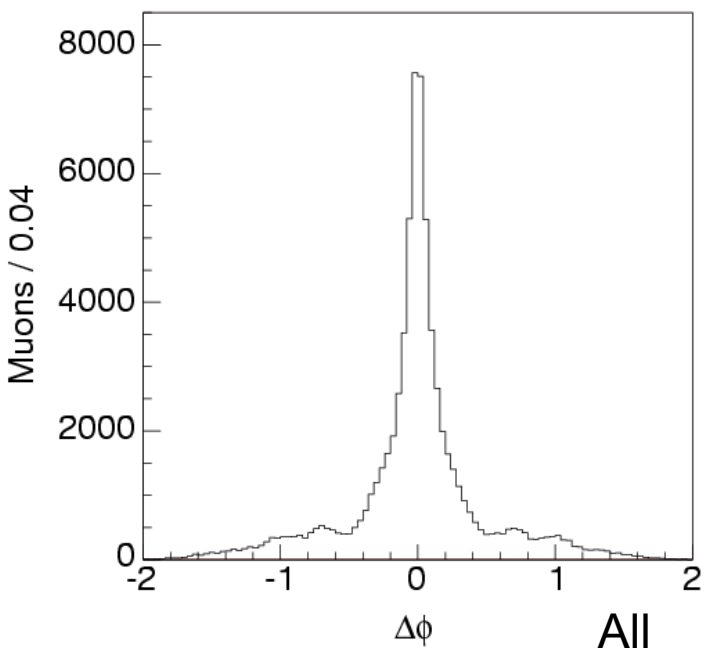
	CMU	CMP	CMUP	CMX
QCD	53%	26%	17%	4%
Ghost	60%	24%	14%	2%



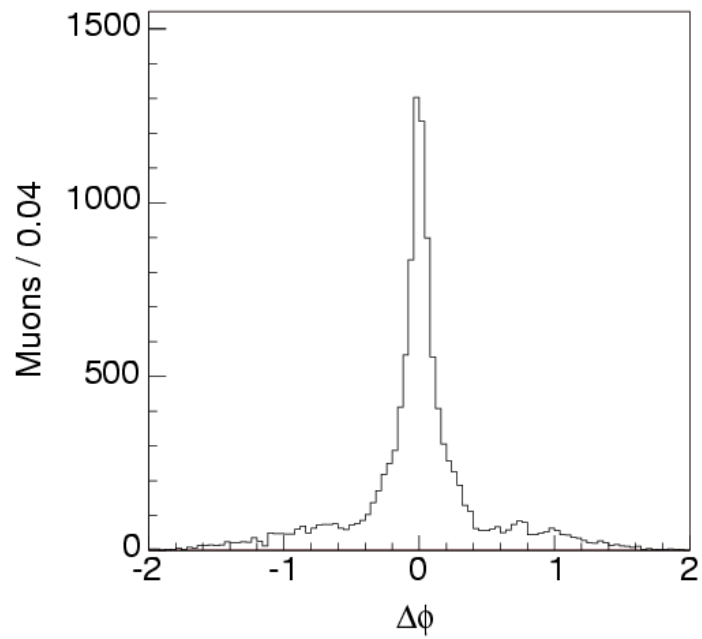
initial



QCD



additional



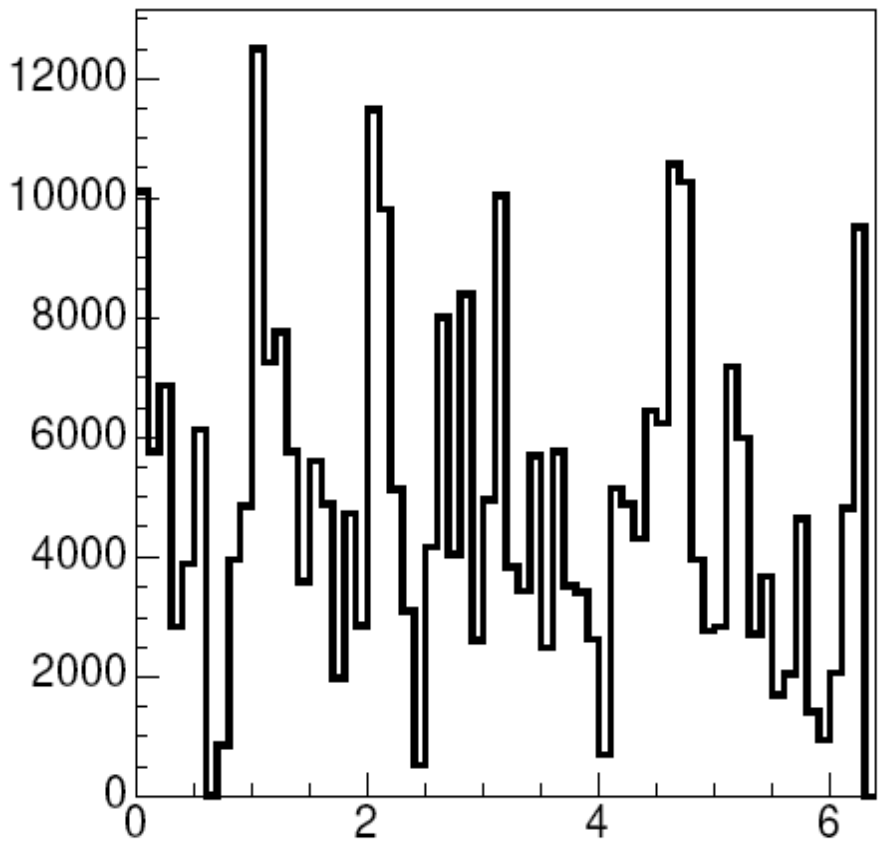
All

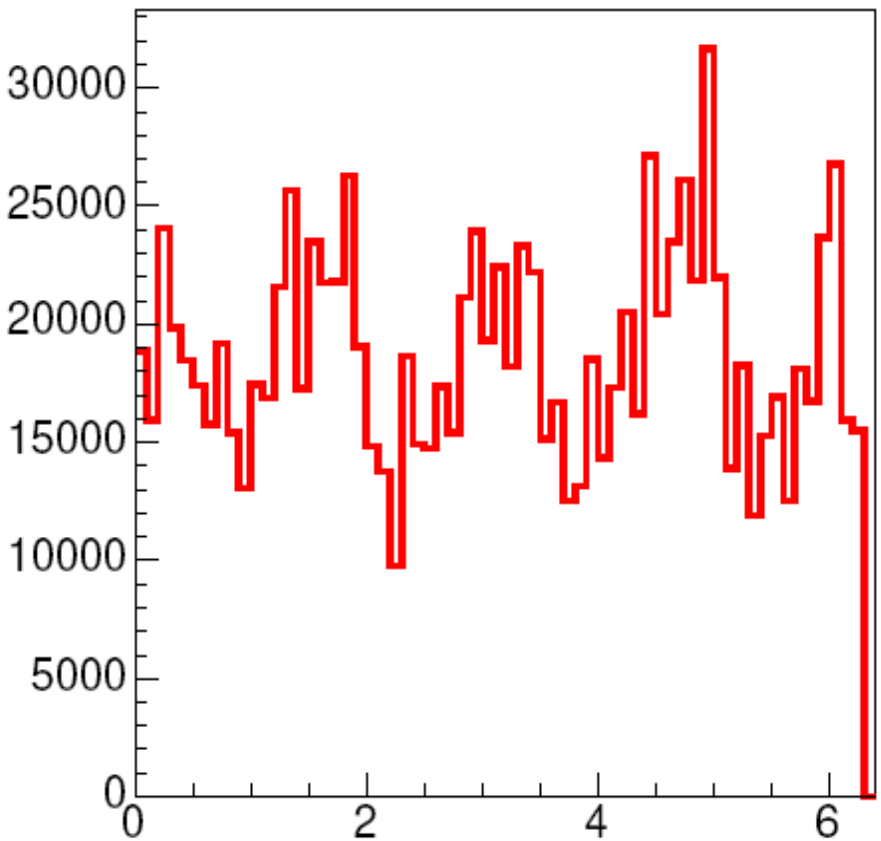
Checks

- Use CMUP only – the acceptance is reduced to 20%
- The fake rate is negligible as verified in the bb xs measurement
- The ratio of additional muon in ghost events remains 4 times larger than in QCD events
- Redone the study with χ^2 smaller than 9 and 4. The salient feature of the multiplicity distribution in ghost are unchanged

Q&A

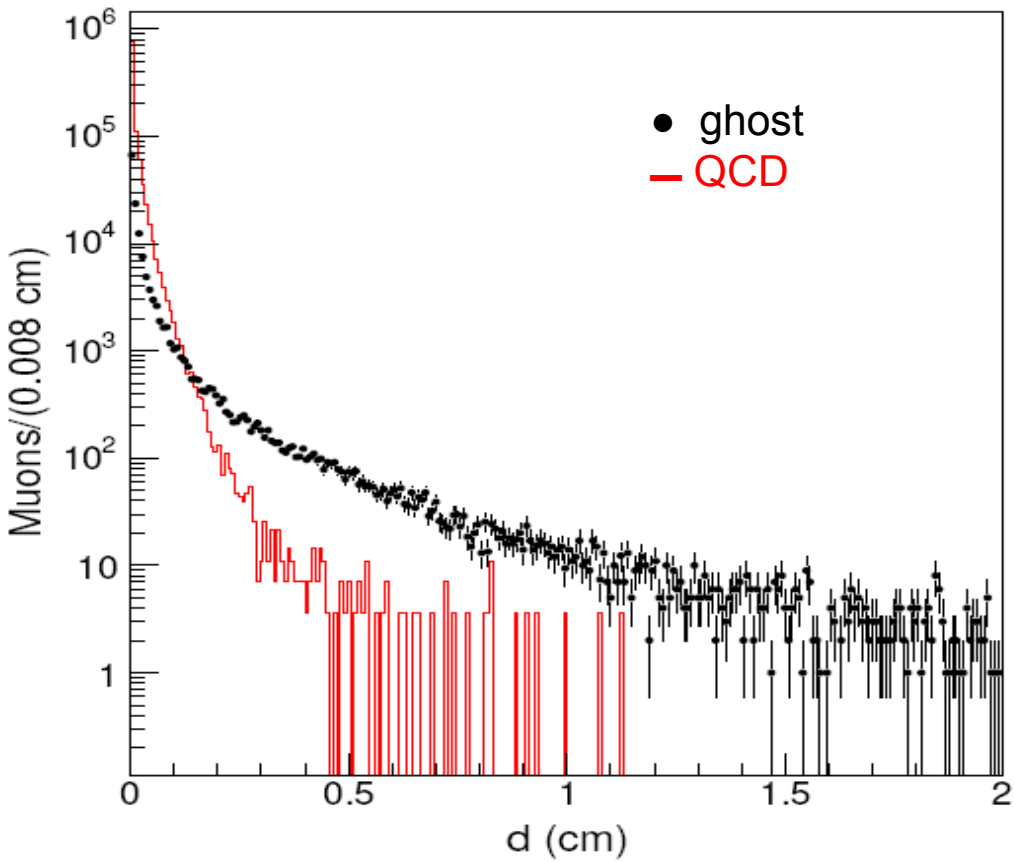
- Most of them on the web page by now – generally generated by misunderstanding





Loose SVX selection

- It is used only to compare to Run I analyses – don't see the relevance of the SVX hit pattern discussion



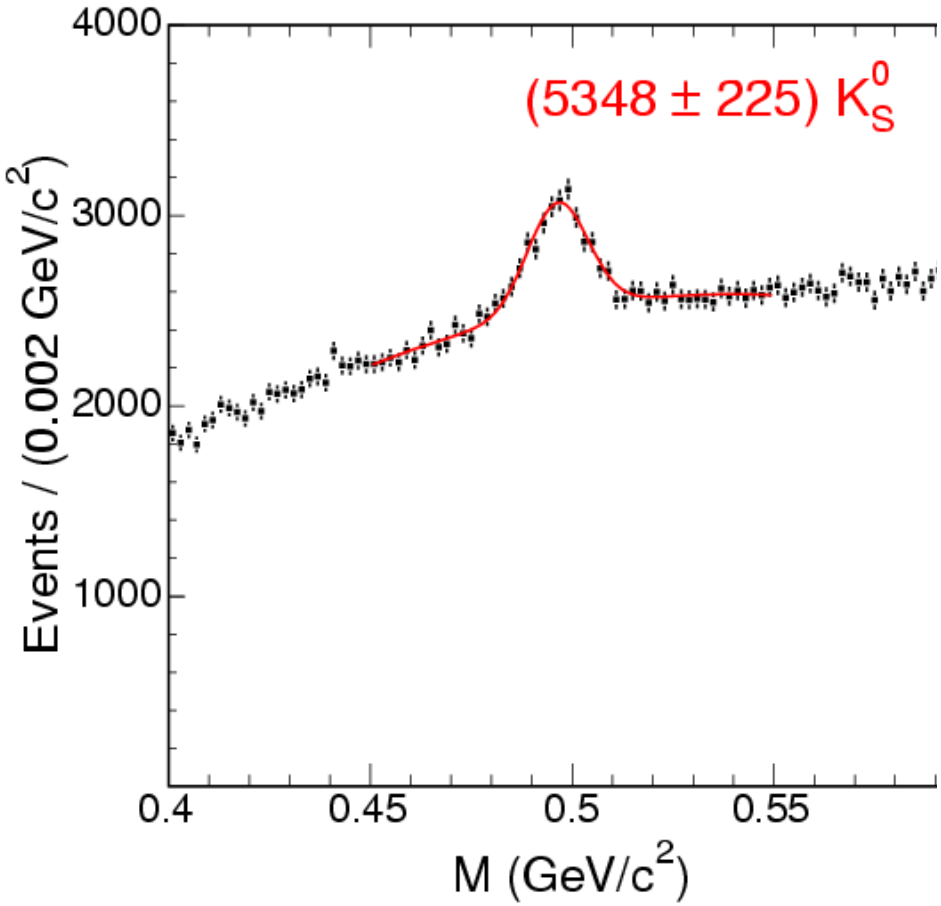
When we show this plot there is no claim of new physics. It shows the IP of the events that affected the Run I measurements. We say that IFD may explain 40% of it and at this stage might explain all of it. We say that secondary interactions may contribute and we added hyperons to make Ari happy

The comment of the week

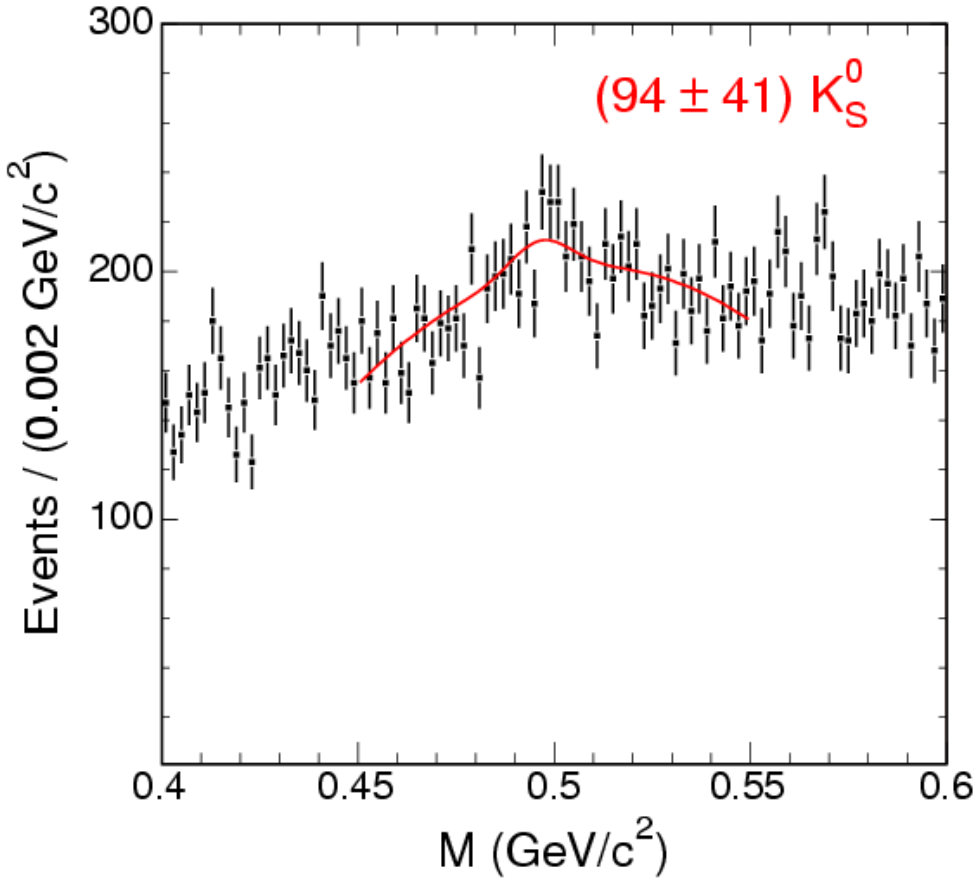
- Todd suggested to look for KOS by pairing initial muons to track – we also extended it to a search for hyperons
- We saw a lot of potential in doing this
- Combine initial muons with opposite sign track with $p_T > 0.5$ Gev/c in a 40^0 cone
- Vertex-constrain and retain pairs with chi2 per NDF smaller than 10
- If we find K0S, the muon is due to punchthrough

Results

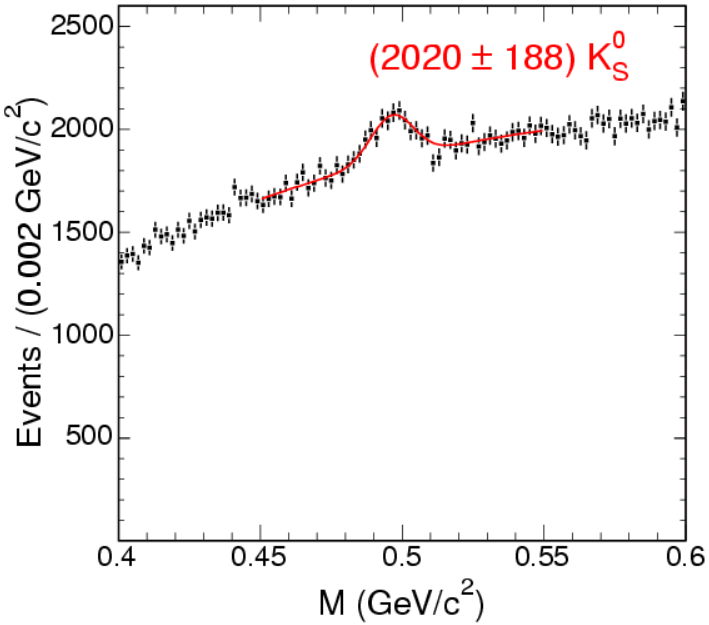
(1.7 ±0.8)% of the KOS survive the request of an additional muon
(0.90 ±0.01)% of the Y survive the same request.
Note that the muon is due to punchthrough



Events with an additional muon

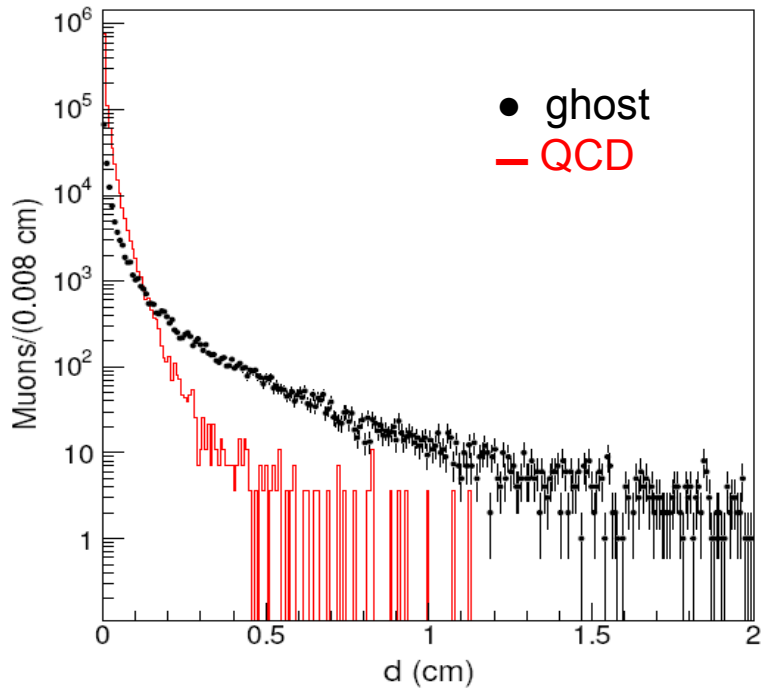


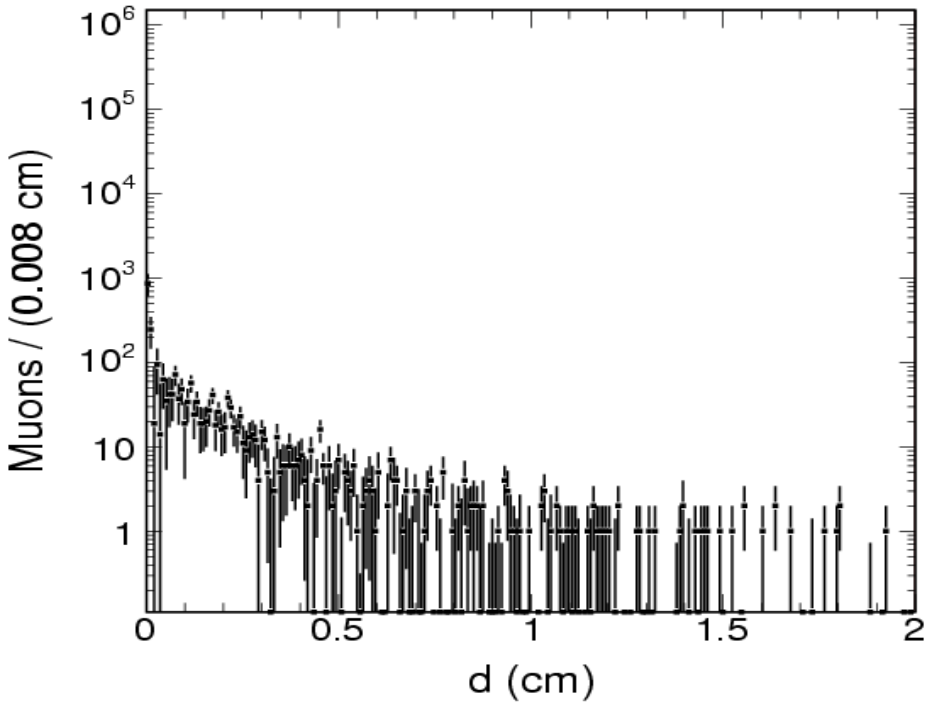
Result



Loose SVX selection

Fitting the tail yields a 12 ps lifetime





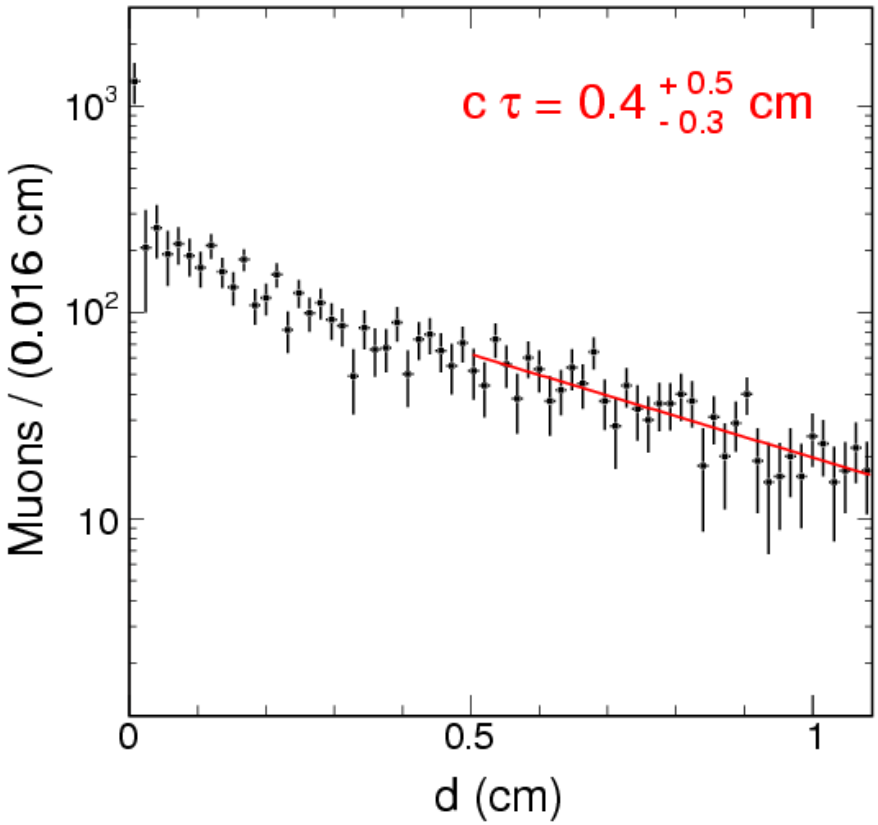
I was surprised

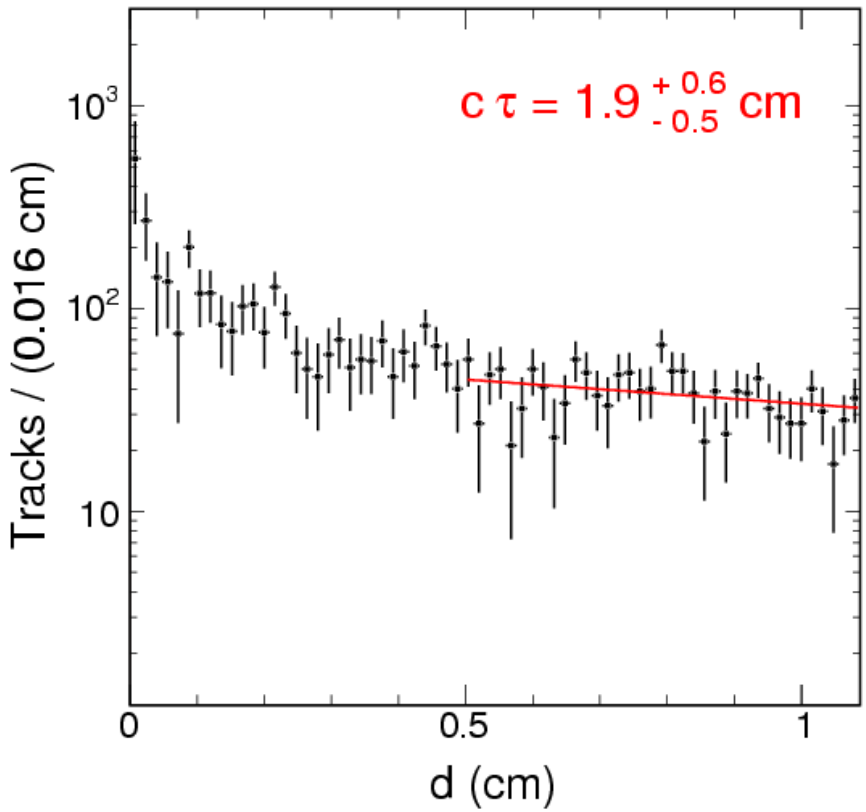
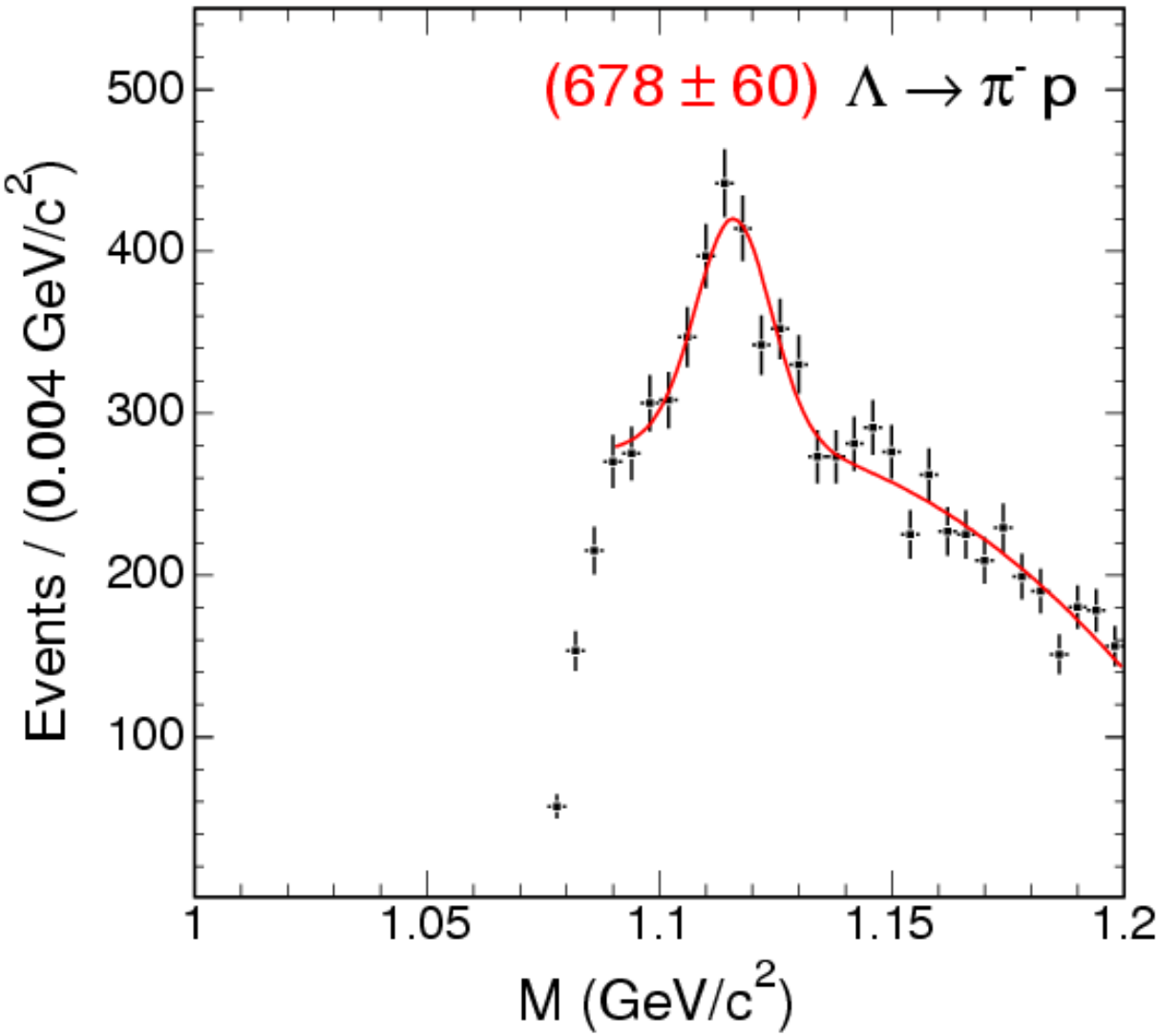
The lifetime measured with the trigger muon is the same as that of ghost events

Any lifetime larger than 10-15 ps produce the same impact parameter distribution for trigger muons

The fact that in ghost events the lifetime ot the initial muon is 85% of that measured with additional muons is due to the fact that the new particle has a 21 ps lifetime

No SVX requirement





More results