



HPS Update

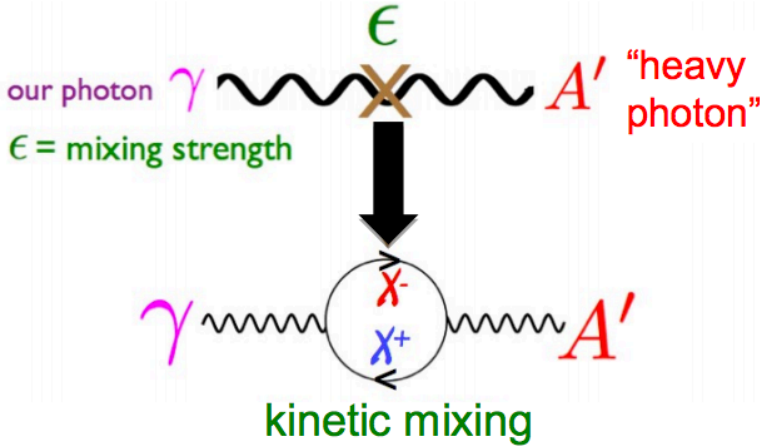
Holly Szumila-Vance
CLAS Collaboration Meeting

June 16, 2016



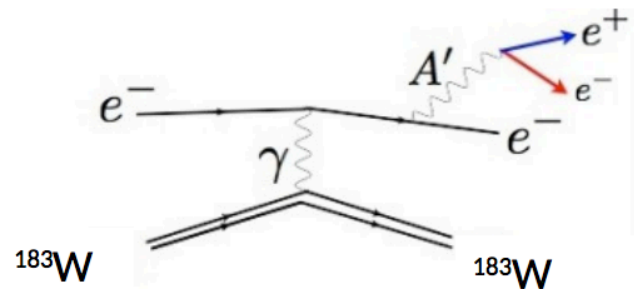
Motivation

Additional U(1) symmetry in nature
 -> new gauge boson!



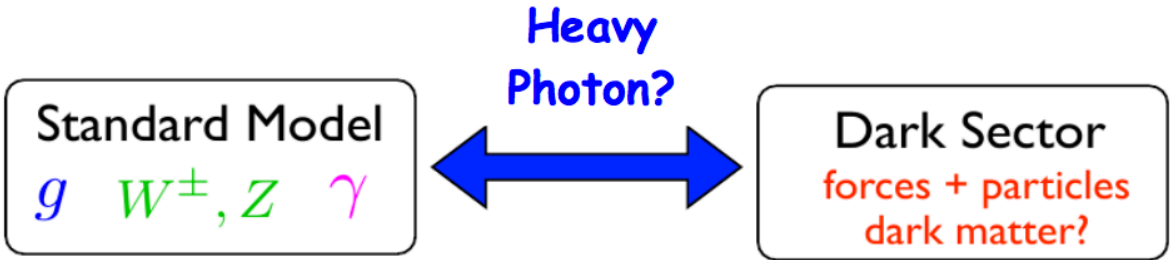
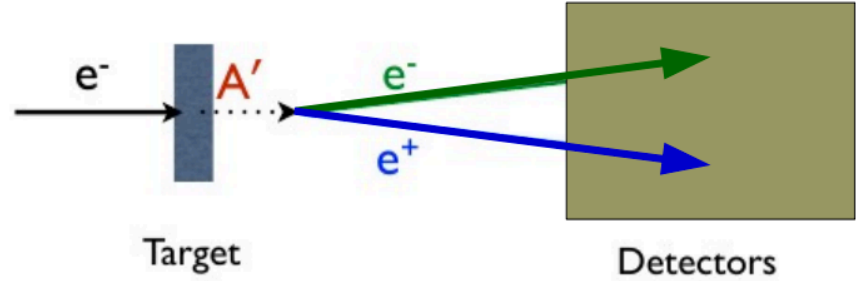
Kinetic mixing could be the leading interaction between the Standard Model and Dark Sector!

Experimental Signature



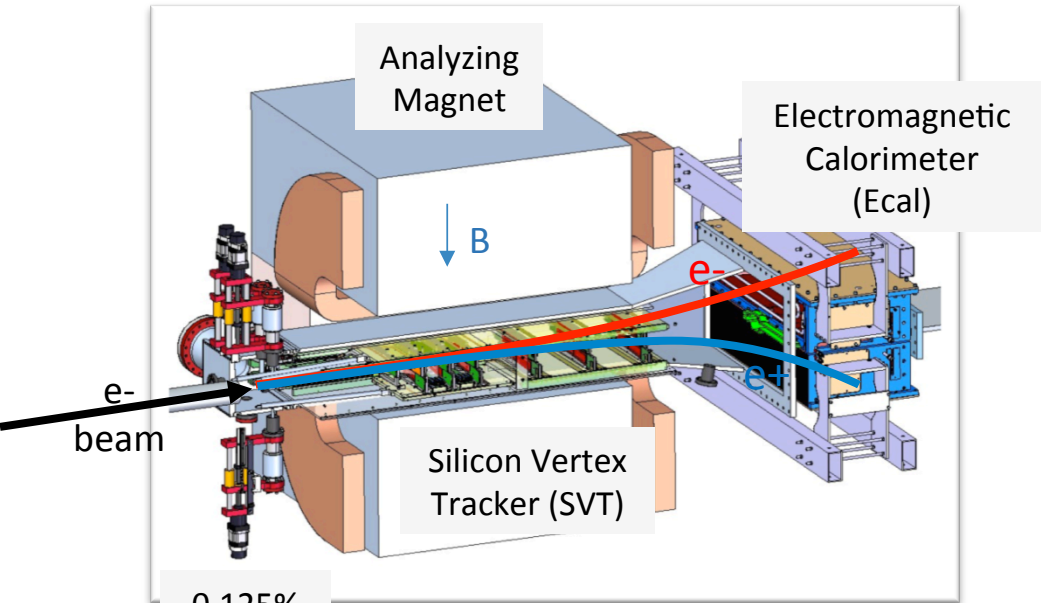
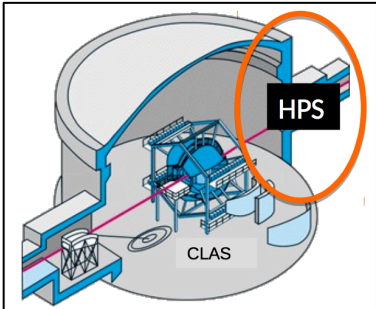
$$e^- + {}^{183}\text{W} \rightarrow A' + X \rightarrow e^+ + e^- + X$$

$A' \rightarrow$ Standard Model particles

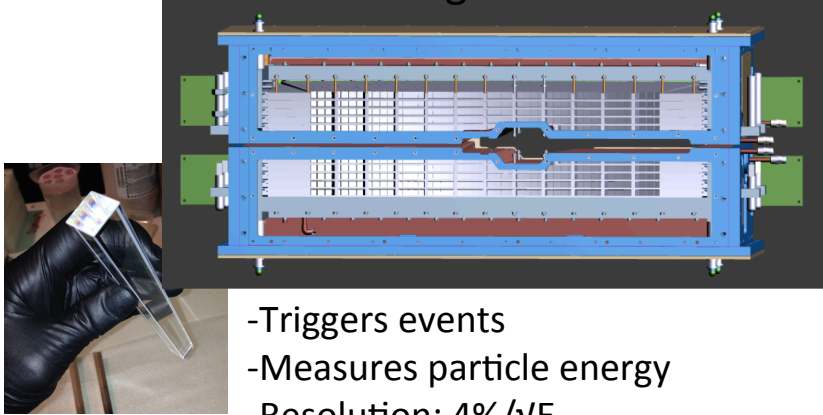


Experimental Setup

Searching for the Heavy Photon using a blinded analysis (10% of the data)



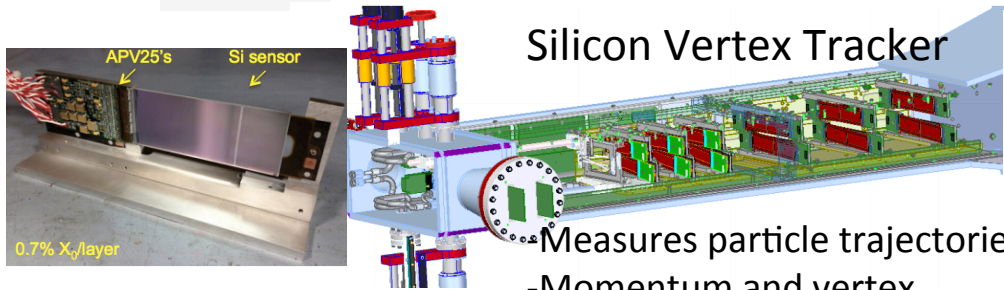
Electromagnetic Calorimeter



- Triggers events
- Measures particle energy
- Resolution: 4%/VE

SVT active area 0.5 mm from beam!

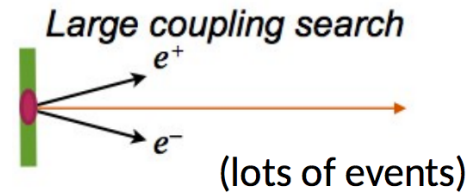
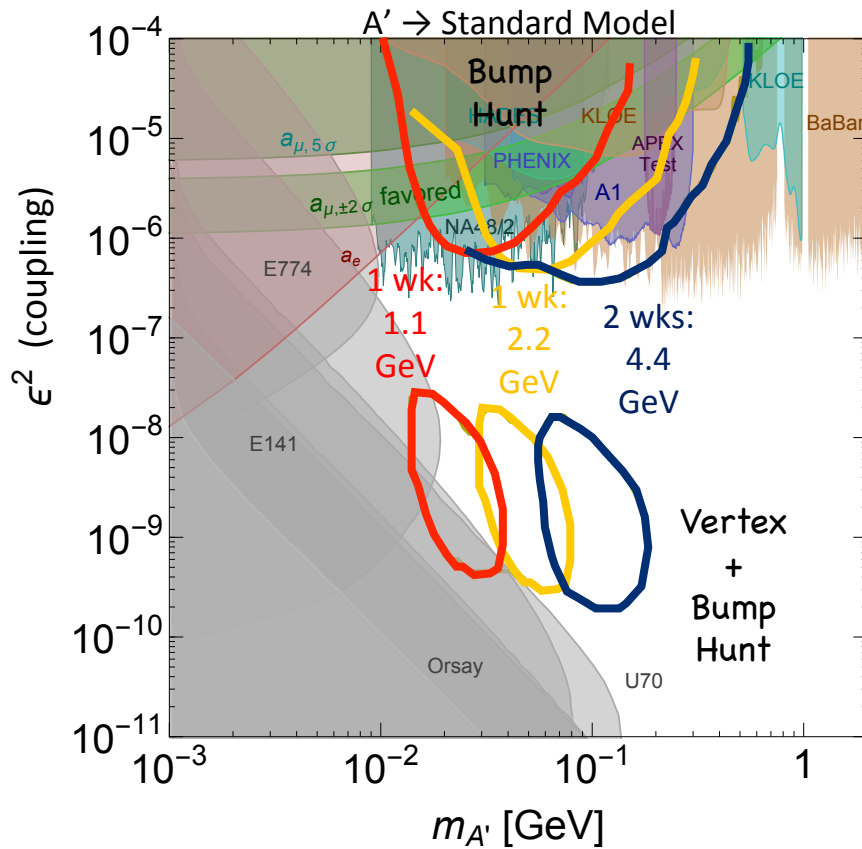
Layer	1	2	3	4	5	6
z position from target [cm]	10	20	30	50	70	90
Stereo angle [mrad]	100	100	100	50	50	50
Non-bend plane resolution [μm]	≈ 6	≈ 6	≈ 6	≈ 6	≈ 6	≈ 6
Bend-plane resolution [μm]	≈ 60	≈ 60	≈ 60	≈ 120	≈ 120	≈ 120



Silicon Vertex Tracker

- Measures particle trajectories
- Momentum and vertex

HPS Proposed Reach



Runs status to date:

Spring 2015: Engineering Run

1.05 GeV, 50 nA

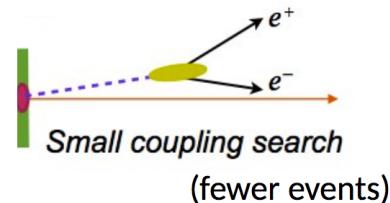
Achieved ~ 1.6 of 7 proposed days (SVT at 0.5 mm)

~ 1 of 7 proposed days (SVT at 1.5 mm)

Spring 2016: Physics Run

2.3 GeV, 200 nA

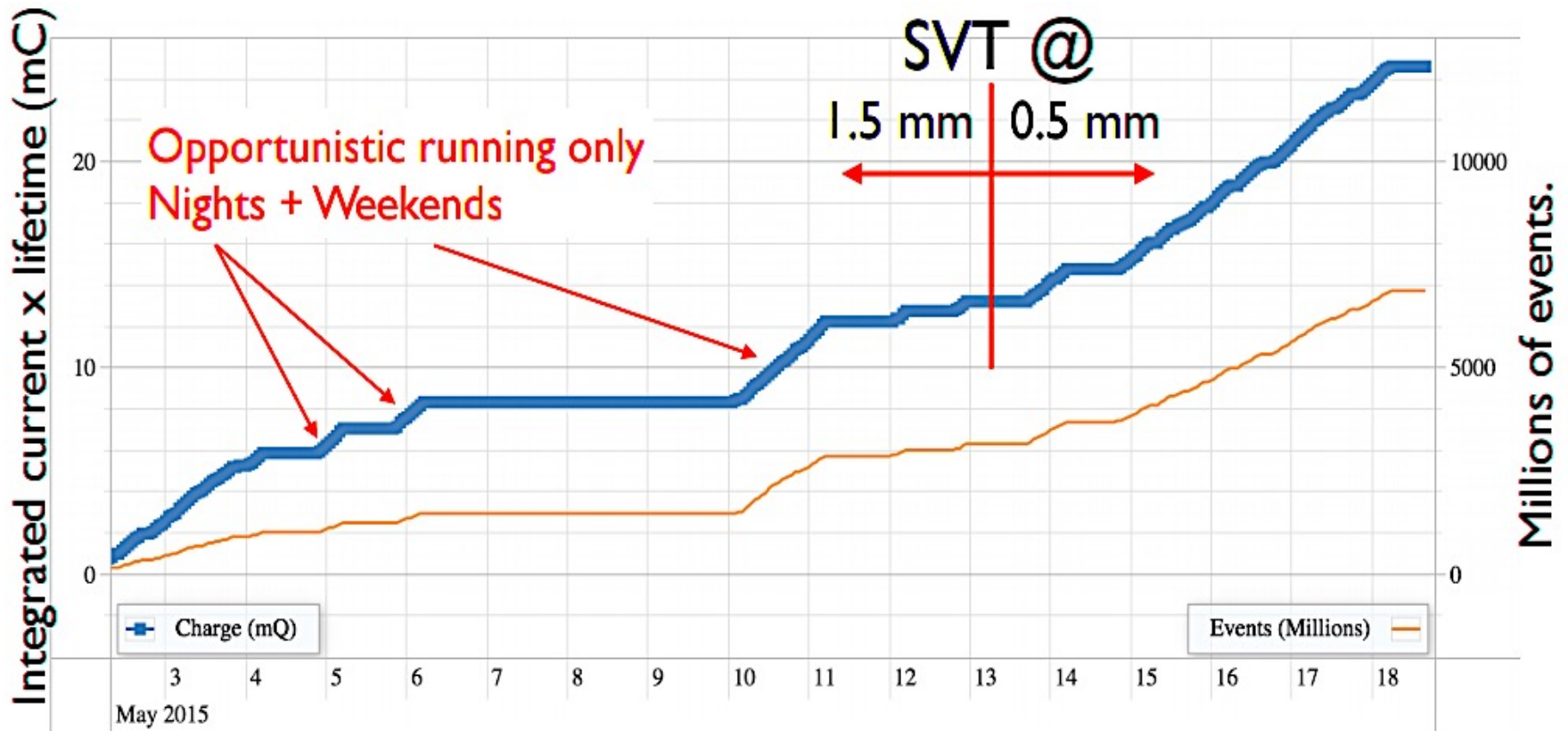
Achieved ~ 5 of 7 proposed days (SVT at 0.5 mm)



2015 Run Results

Goal: 30 mC

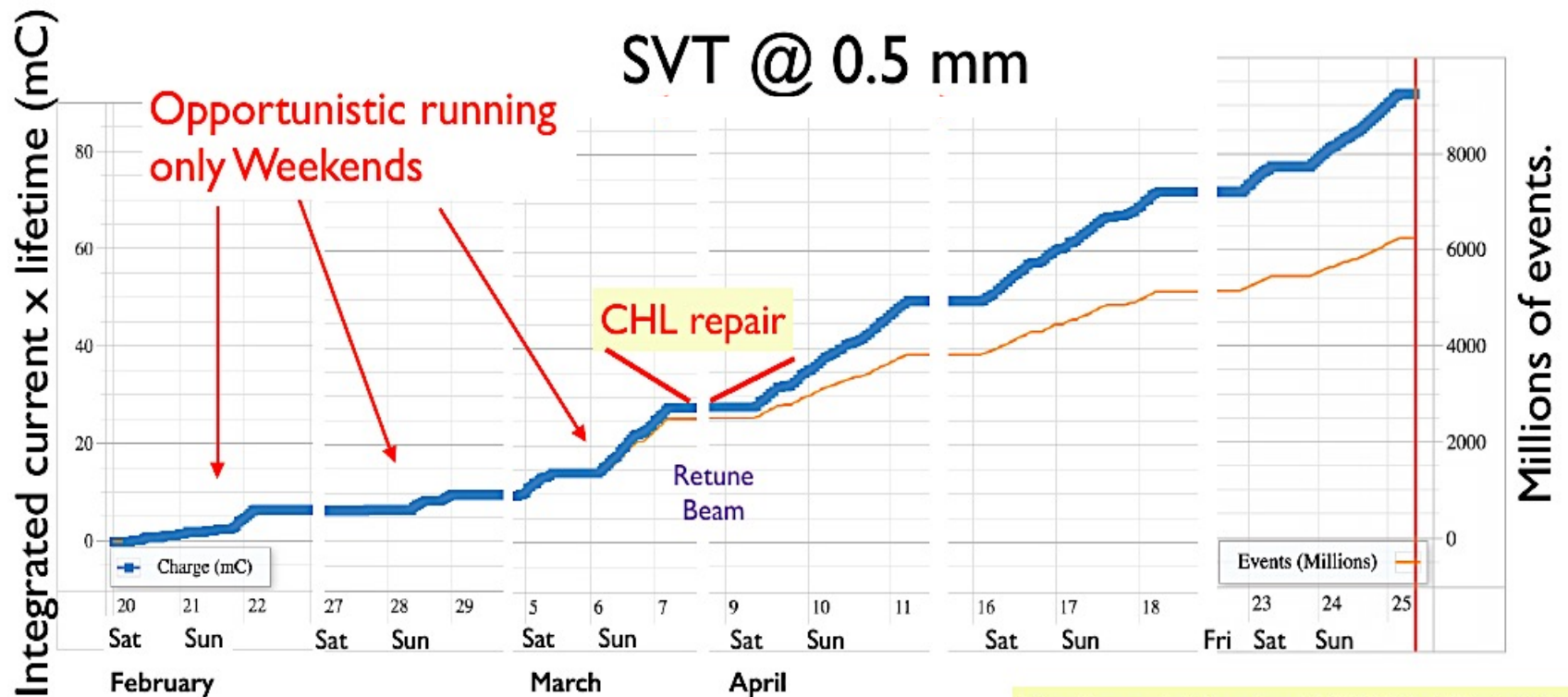
Achieved: 10 mC with SVT at ± 1.5 mm, 10 mC with SVT at ± 0.5 mm



2016 Run Results

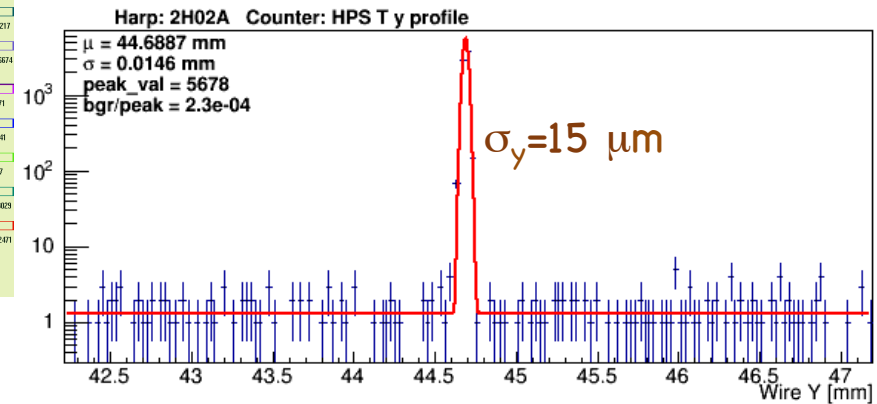
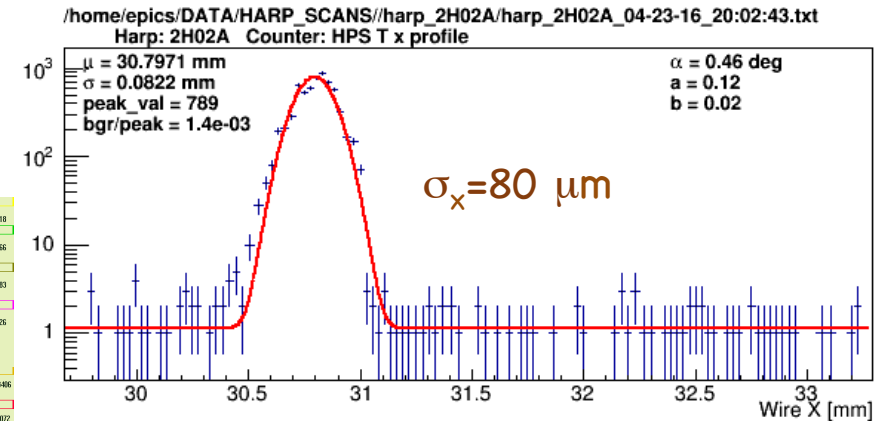
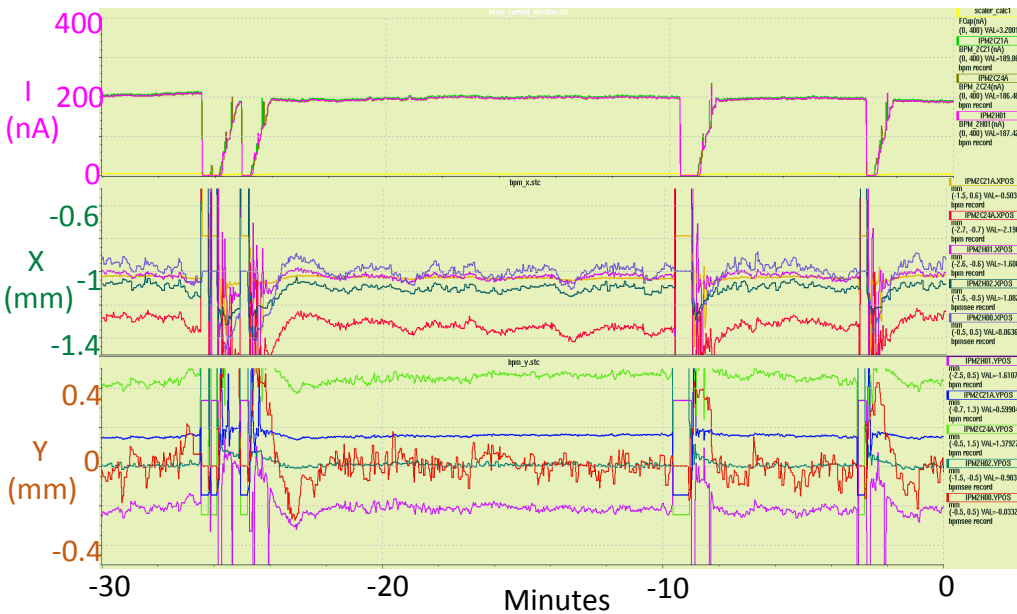
Goal: 120 mC

Achieved: 92.5 mC on target, 6.3×10^9 events (77% of proposed running)

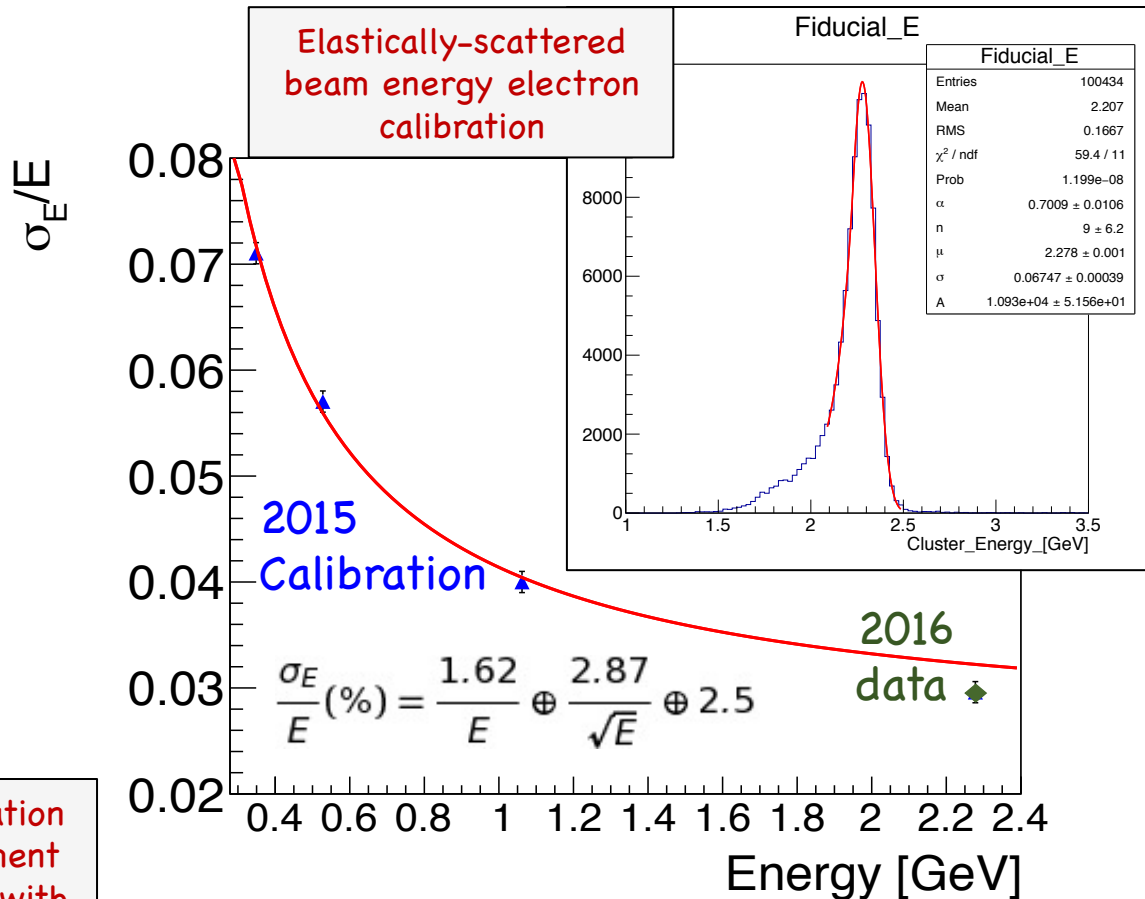
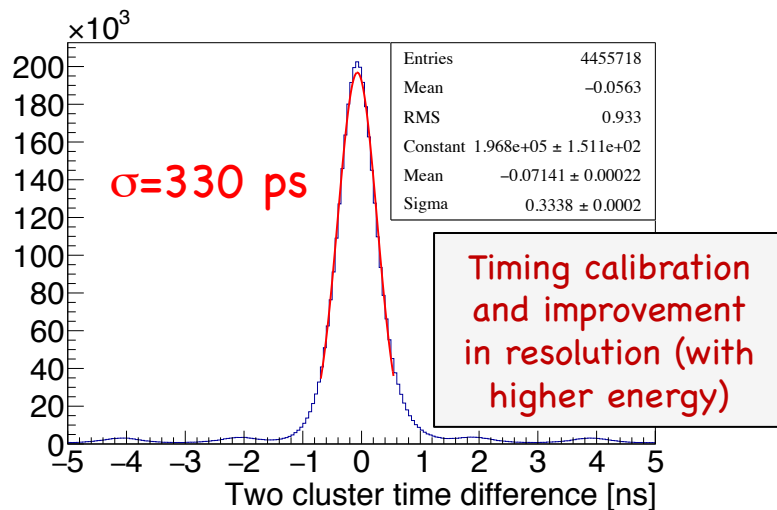
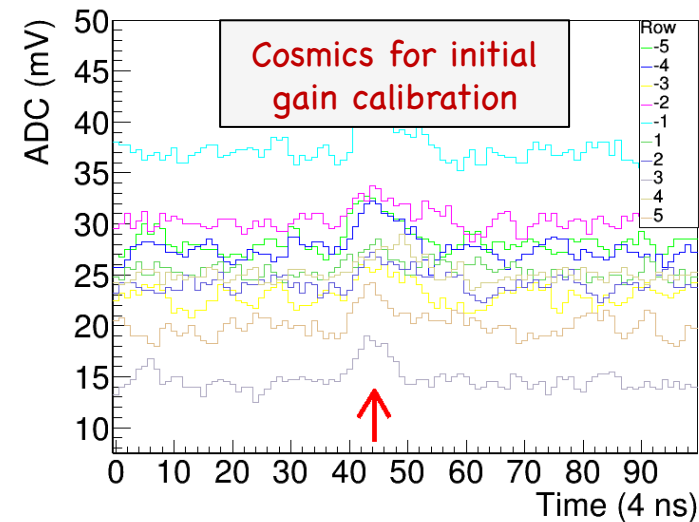


2016 Run: Beam

- 2.3 GeV beam at 200 nA
- 4 μ m W target

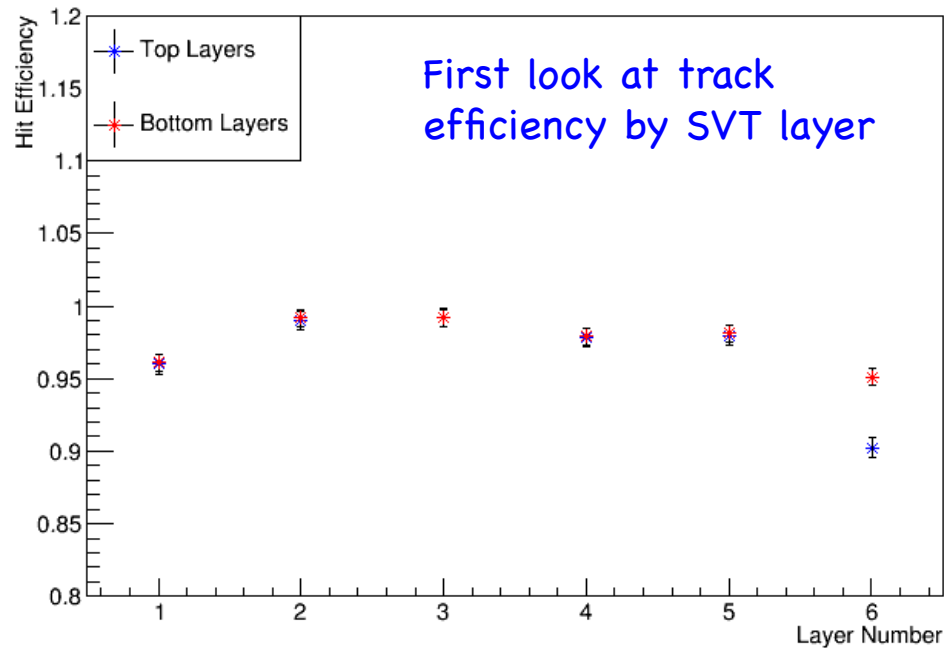


2016 Run: Ecal Performance

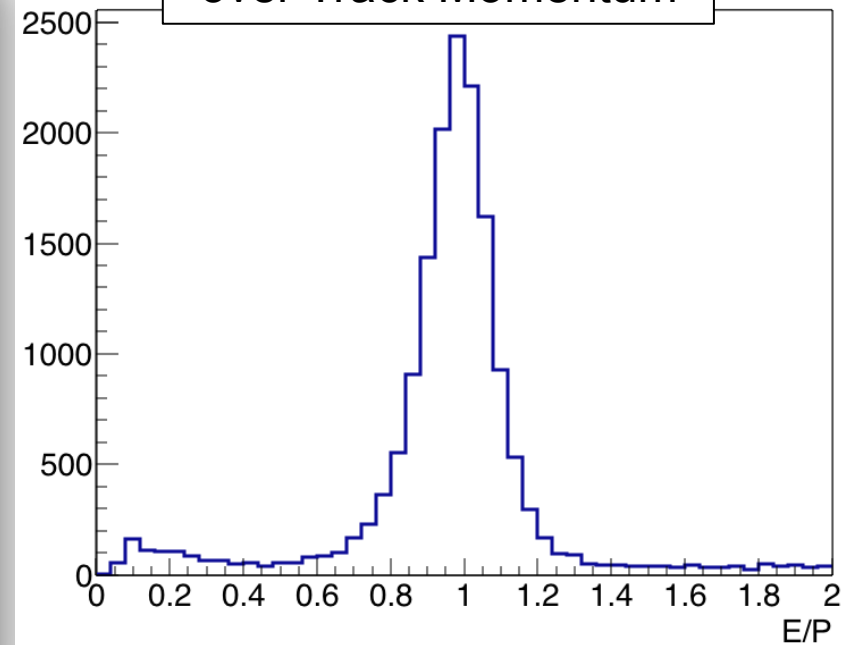


2016 Run: SVT Performance

Hit Efficiency for Layers 1-6

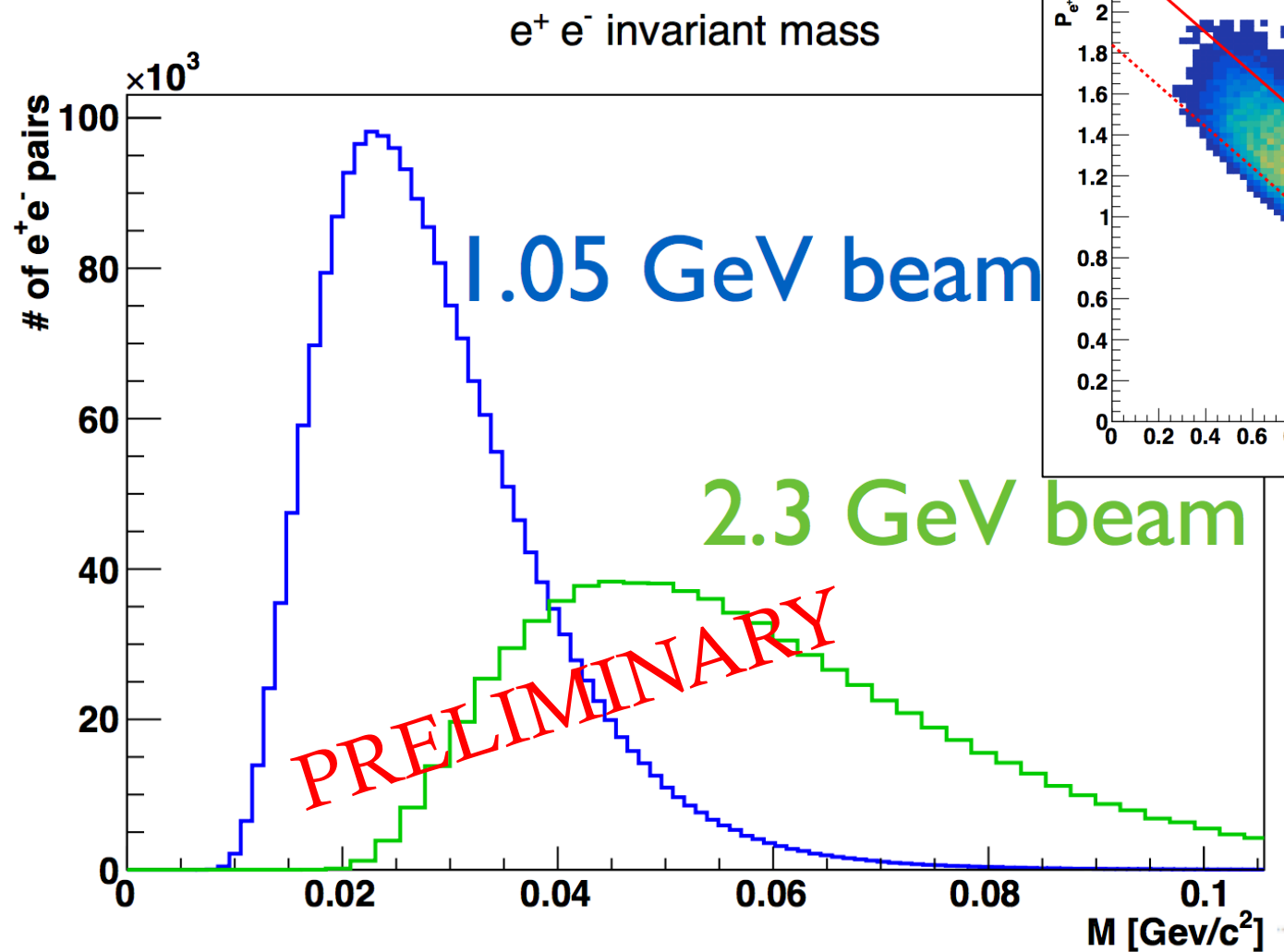


Ecal Cluster Energy over Track Momentum

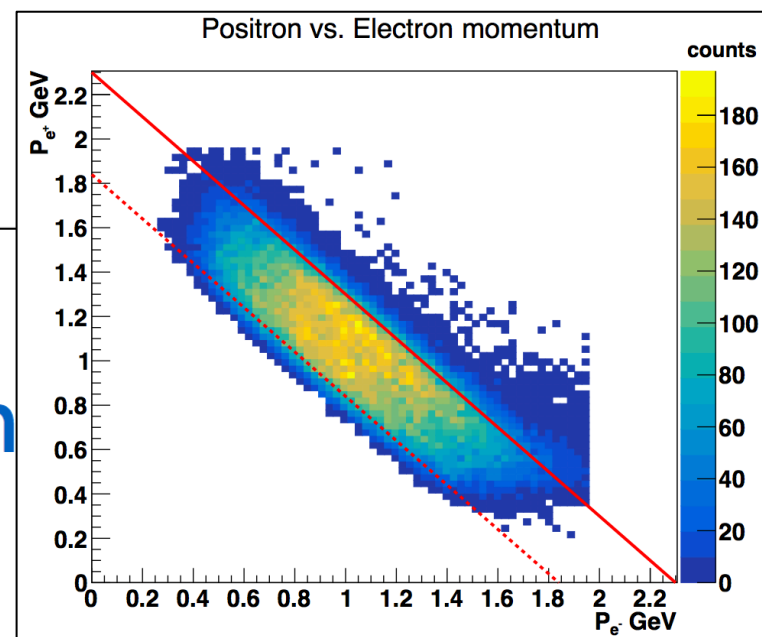


E/P for Elastic Events
No Fiducial Cuts to Ecal

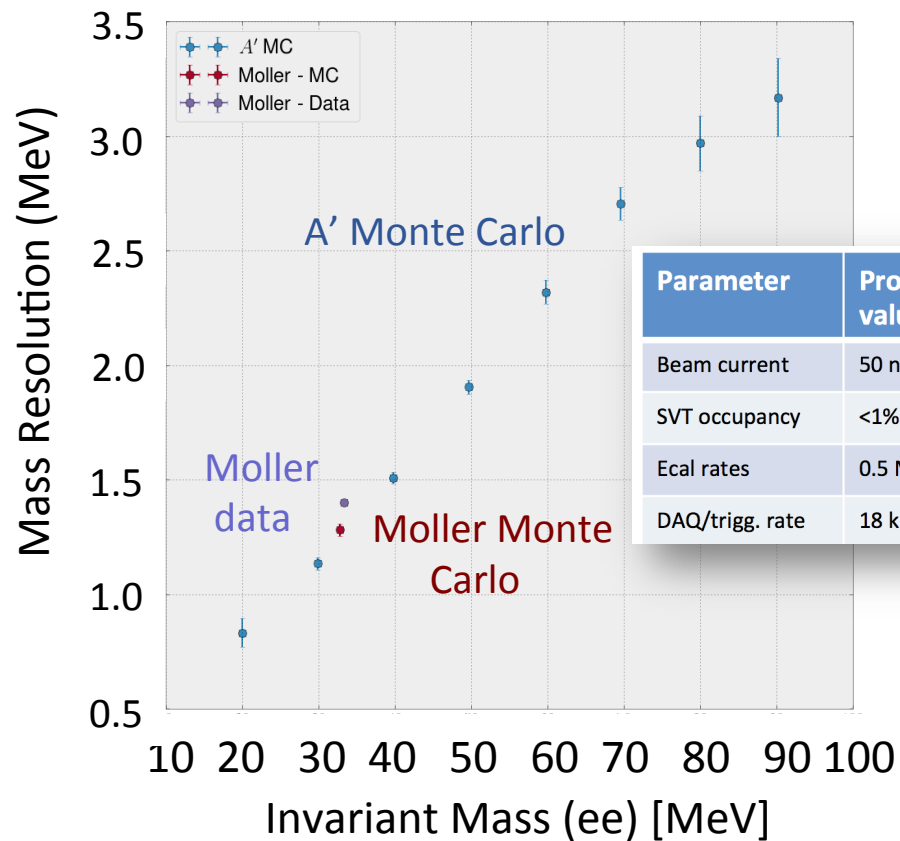
Invariant Mass



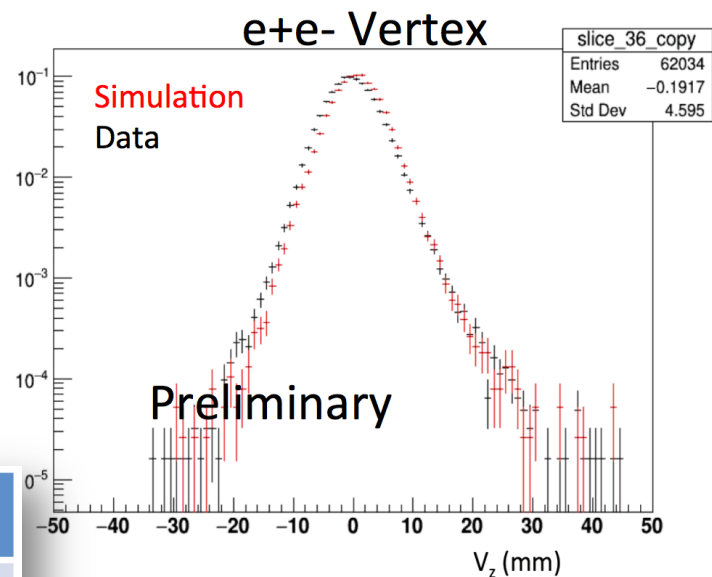
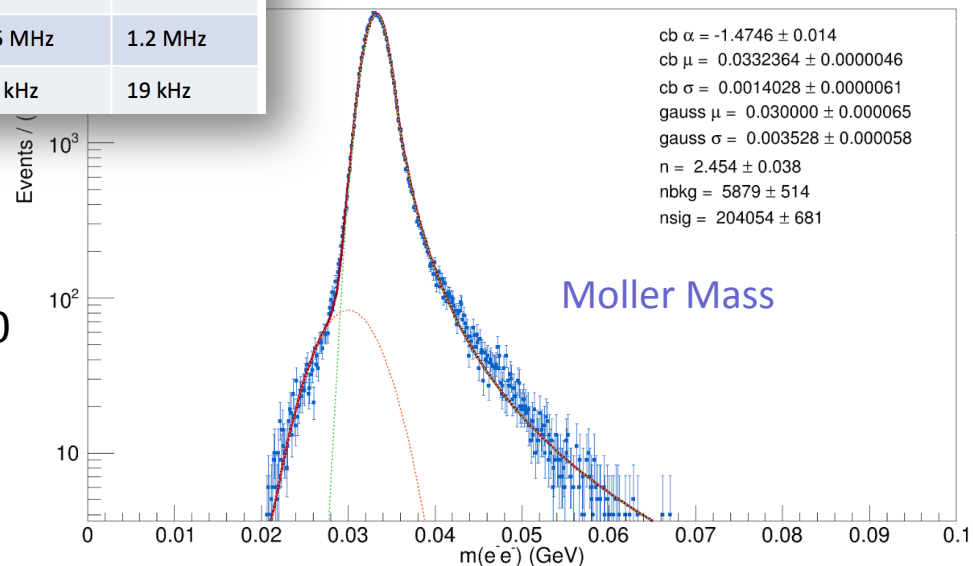
Radiative Cut



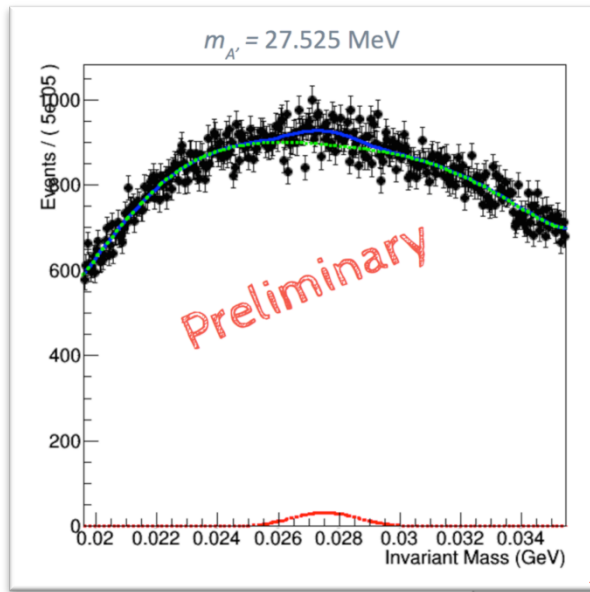
2015 Analysis



Parameter	Proposal value	Measured value
Beam current	50 nA	50 nA
SVT occupancy	<1%	1%
Ecal rates	0.5 MHz	1.2 MHz
DAQ/trigg. rate	18 kHz	19 kHz

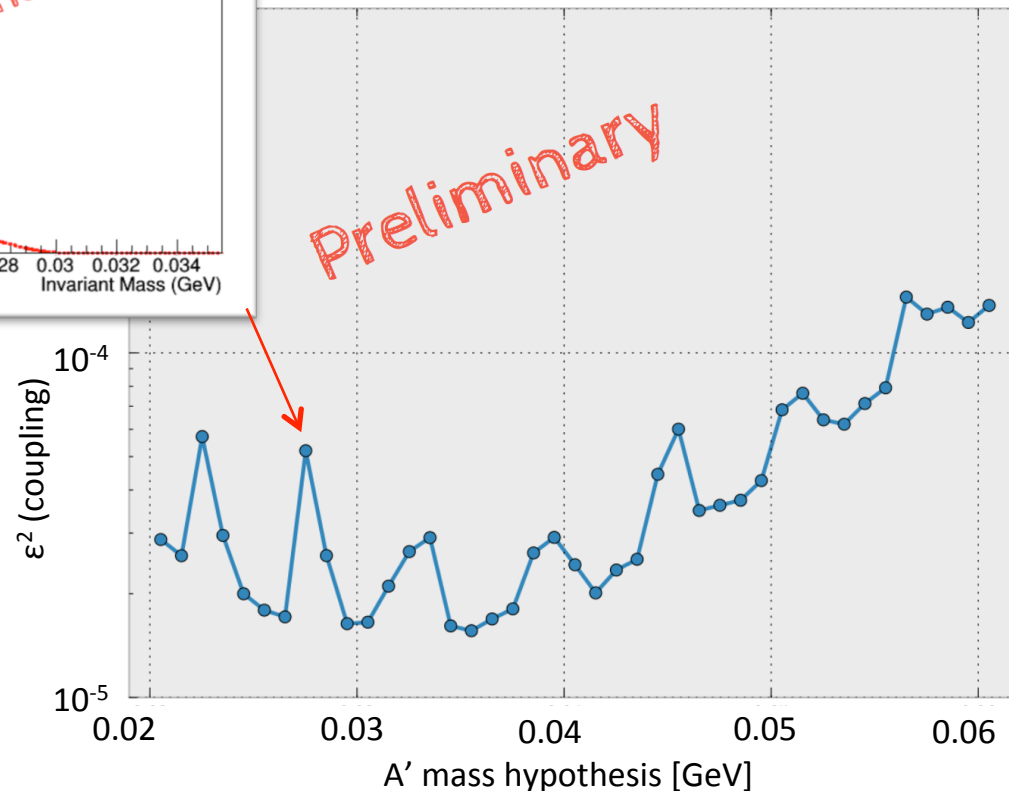


2015 Run: Bump Hunt



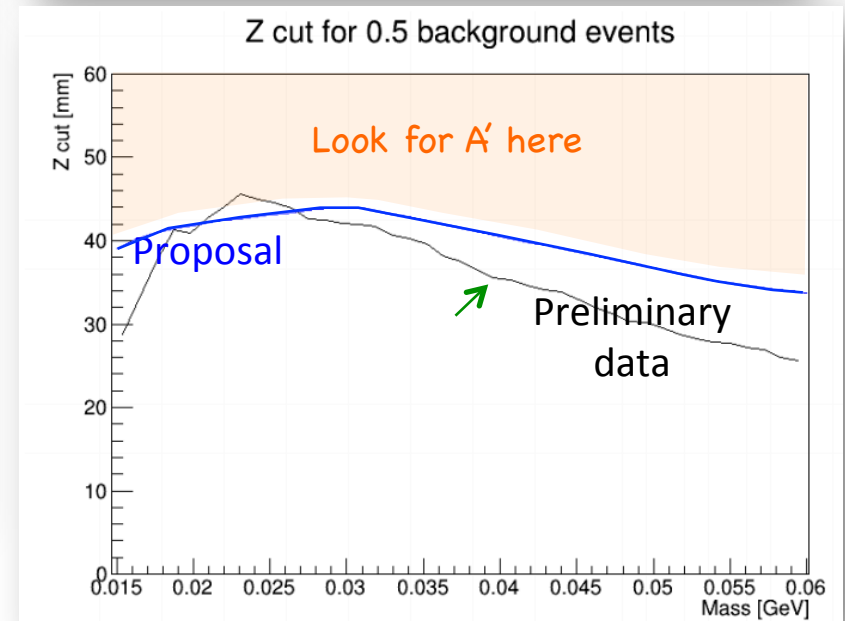
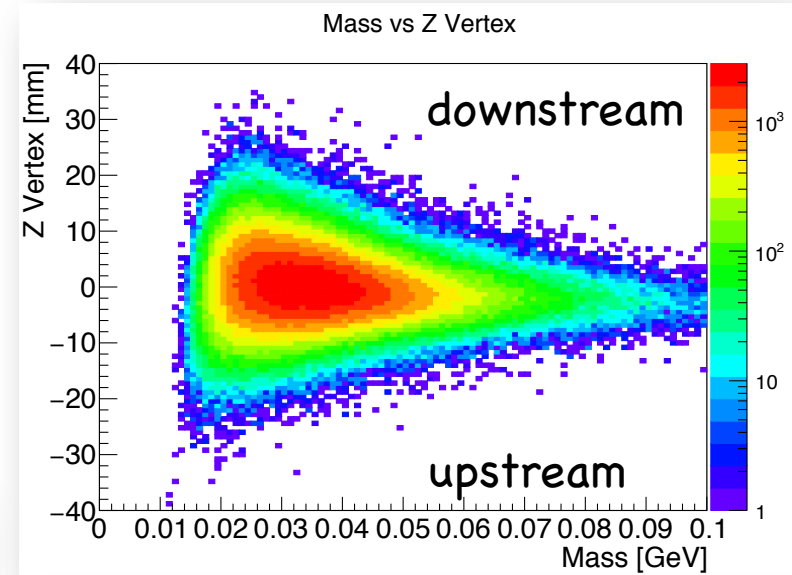
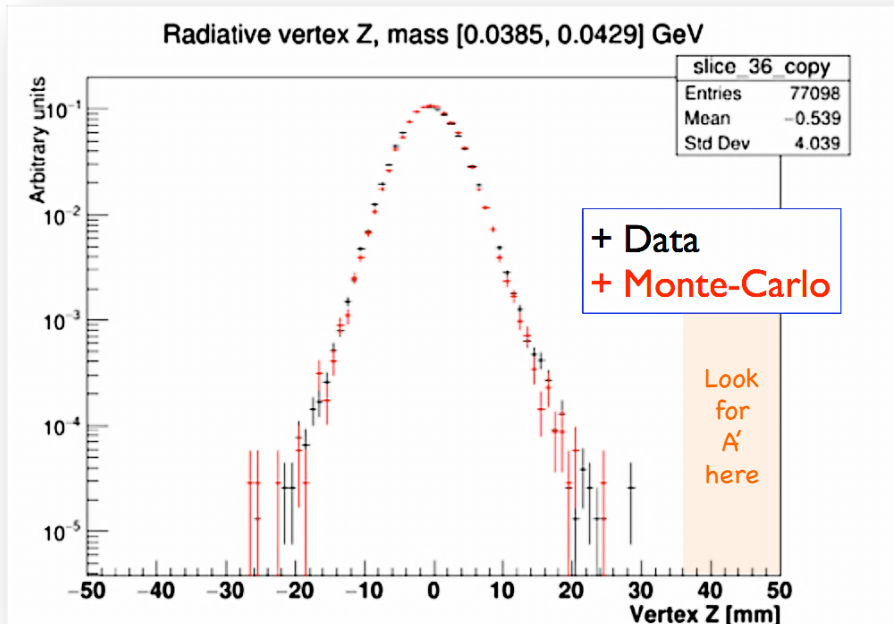
- 10% of 2015 data, SVT at 0.5 mm
- Conservative cuts
- Fits 7th order polynomial background + A' peak

- Fix A' “peak” width, moving “peak” across spectrum to determine upper limits



2015 Run: Vertex search

- Search for long-lived A' with separated vertex



Summary

- Successful running at 2.3 GeV in the spring of 2016
- 1st PhD thesis complete, Omar Moreno of UCSC, on the bump hunt limits (10%)
 - 4 more theses on 2015 data
 - 3 theses on 2016 data
- NIM papers underway
- Blind data analysis using 10% of 2015 data
 - Bump hunt analysis nearly complete
 - Vertex cut analysis well advanced
 - This summer:
 - Fix cuts
 - Unblind data (100%)