

CALIBRATION & ANALYSIS PLANS

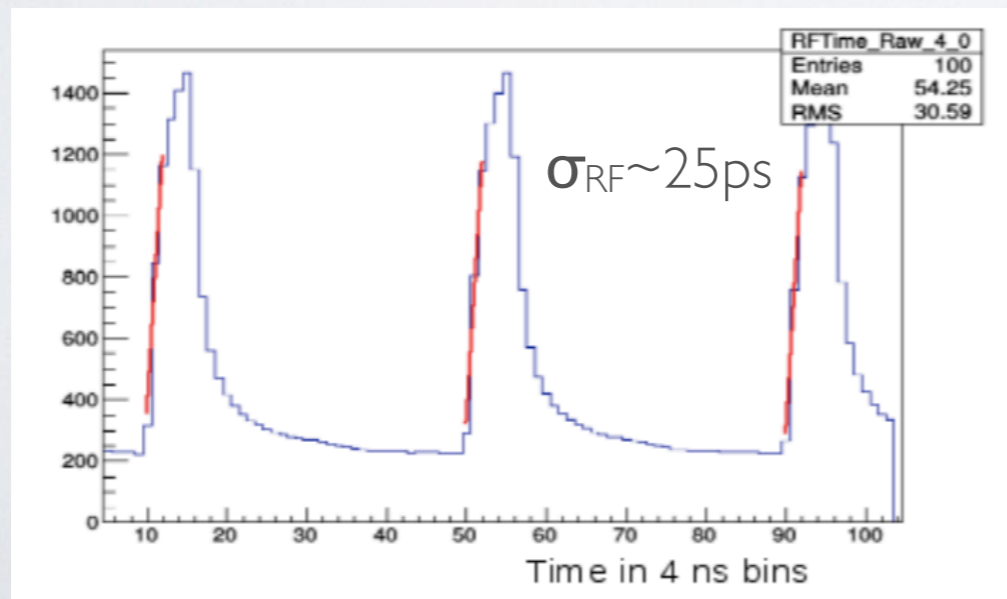
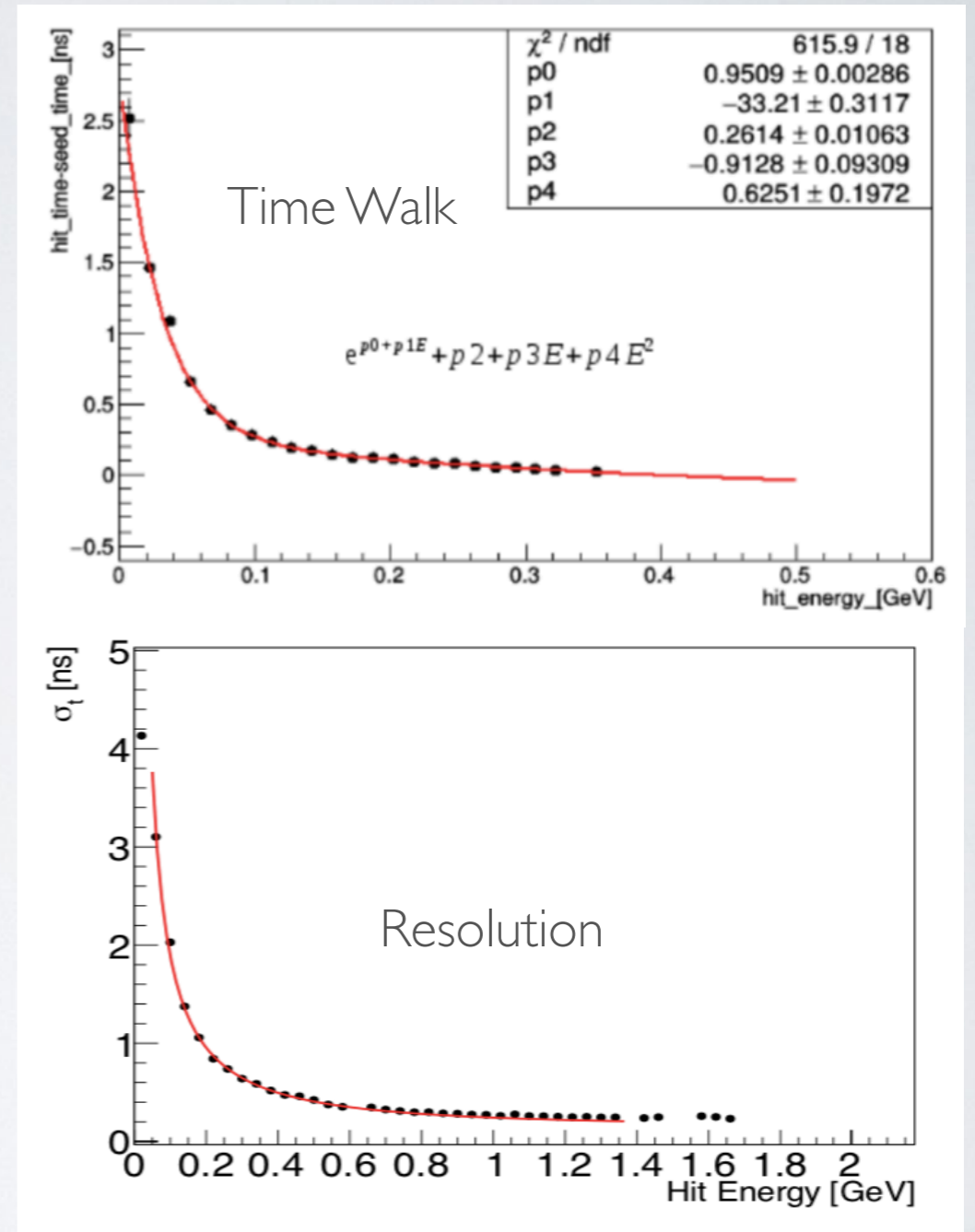
N. Baltzell
HPS Collaboration Meeting
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ALIGNMENT

- Alignment has been a bit of a bottleneck in the past
 - in part because it needs to be finalized before large-scale simulation, and because methods to extract it and sensitivity to was not initially well-understood
 - the primary calibration item to get shored up as soon as possible
- SVT
 - vertex and mass resolution
 - probably the most intensive and important (for stock HPS physics) part of all HPS detector calibrations
 - Norman spoke about status yesterday
- ECAL
 - simulation trigger acceptance and matching with tracks
 - in the past we've aligned ECAL based on SVT, with simple methods but no final prescription
 - for new explorations with neutrals it may become more important
- Beam
 - position and angles at HPS target
 - used as a vertexing constraint, and in extraction of SVT alignment parameters
 - important to get right for data-MC comparisons
 - we should try to do better about actively tracking/extracting it through the run and during pass0
- Fieldmaps
 - need updating or re-alignment based on different 2019 survey positions?

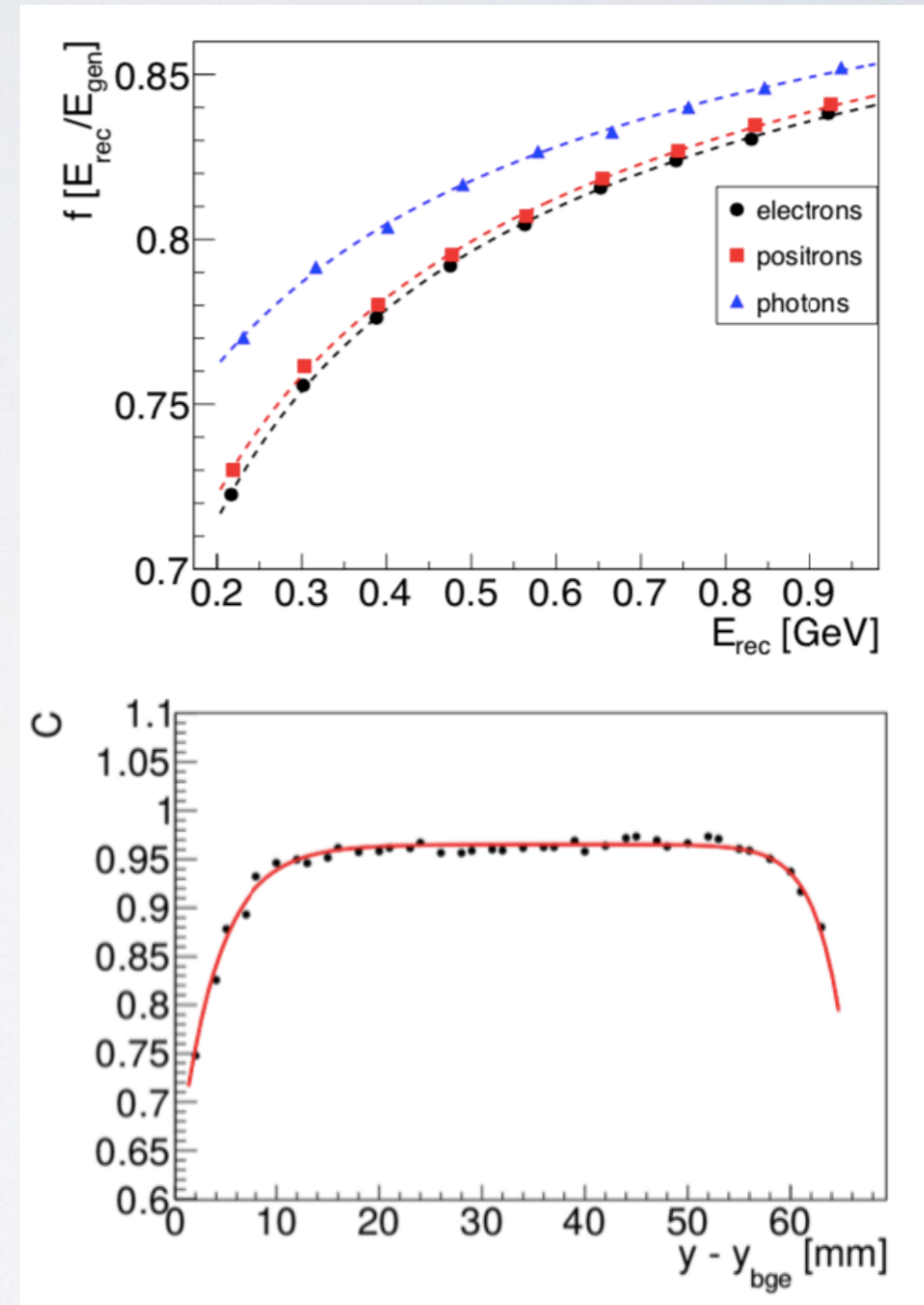
ECAL TIMING

- Starts with CEBAF RF time reference (500 MHz)
- Time Offsets (per channel)
- Time Walk (global)
 - Linear leading edge and full pulse fitting significantly reduce time walk relative to leading edge-threshold timing, but not to zero
- Aside from a new hardware crate/slot for the RF signal, we shouldn't expect significant/any changes here since the last run
 - except for one global time shift, if we don't get it quite right online in order to put pulses at same place in window as in 2016, just to simplify analysis cuts



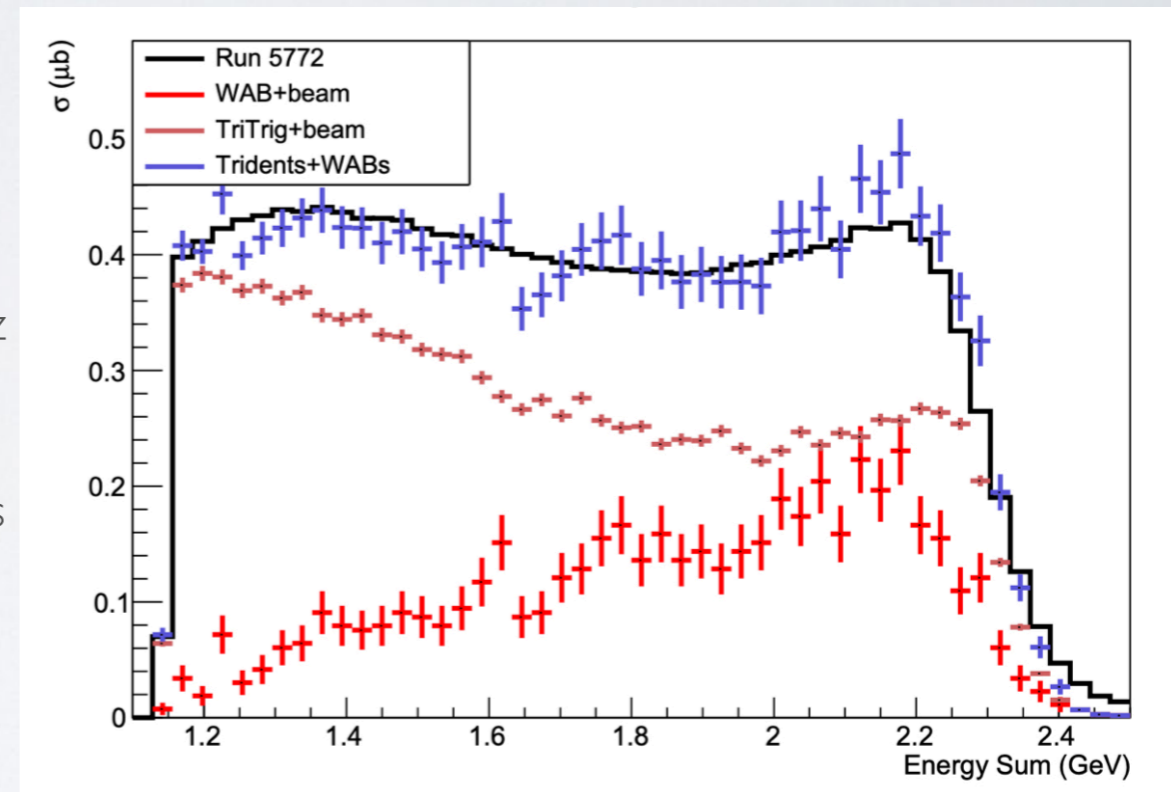
ECAL ENERGY

- Gains (per-channel)
 - calibrated based on full-energy electrons
 - iterative procedure, not push-button, will require some attention, and probably some software work to re-establish it
- Shower loss corrections (global)
 - charge-dependent portion due to geometric effects
 - edge corrections
 - some aspects partially scale with E/B but will definitely need revisiting



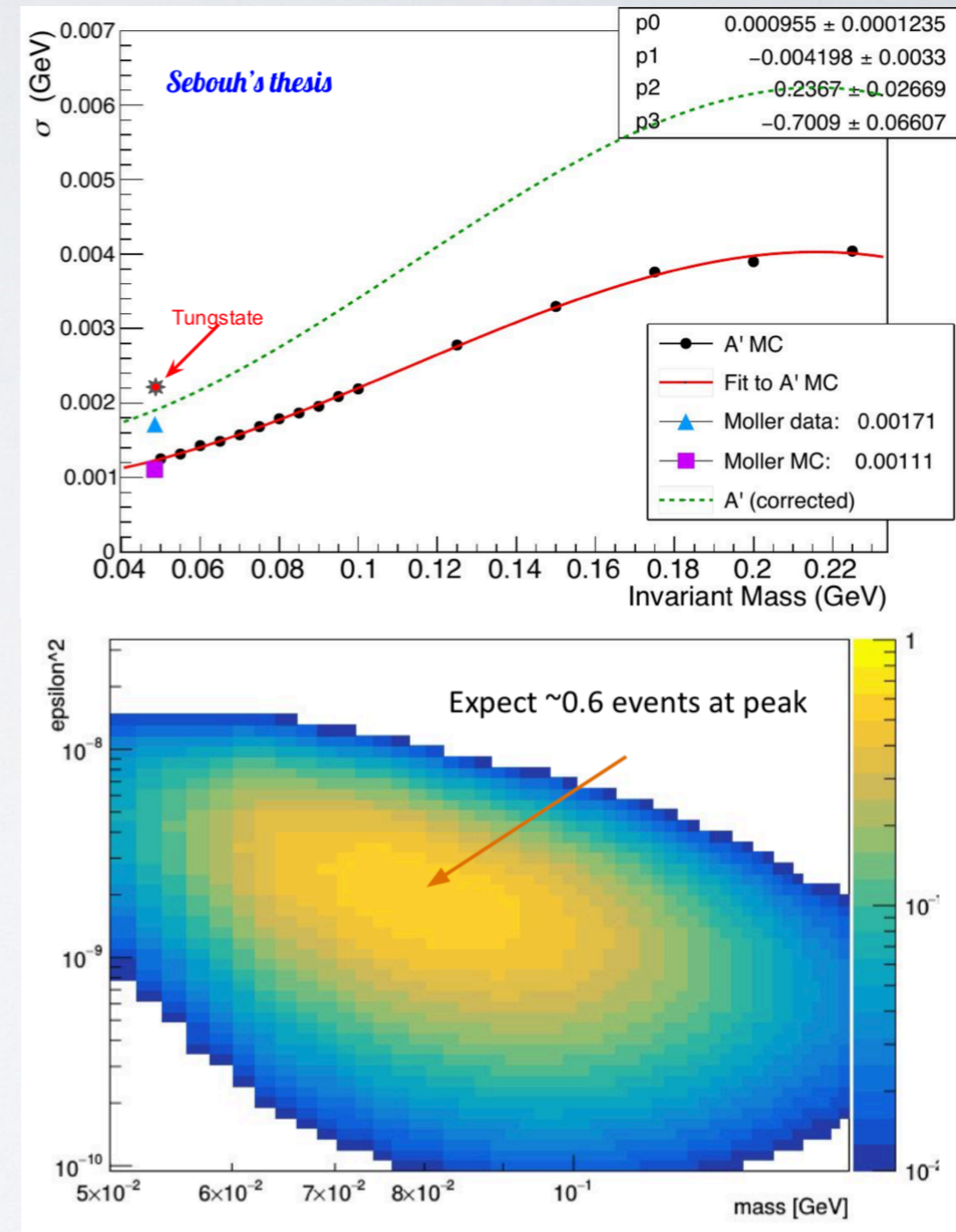
SIMULATION

- We've come a long way
 - getting all the important background contributions included, normalized properly, with correct kinematics generation for HPS phase-space, was a big hurdle we shouldn't have to readdress
 - now generally in great agreement with what we see in the data, *except for a global normalization error of $\sim 10\%$*
 - and it's a critical input for the radiative-fraction for A' limits
- We still will need special measures for studying rare effects (e.g. high- z contributions)
 - very large MC samples is not impossible (even as JLab resources will be more for data processing)
 - MC campaigns at SLAC have been tested and in use (there were some technical challenges to overcome)
 - ideas to run on OSG, not yet fully explored
 - new biasing techniques available with hps-sim are starting to be reality, e.g. heavy scatterers, converted WABs
 - other ideas yet to be pursued include event-mixing, ...



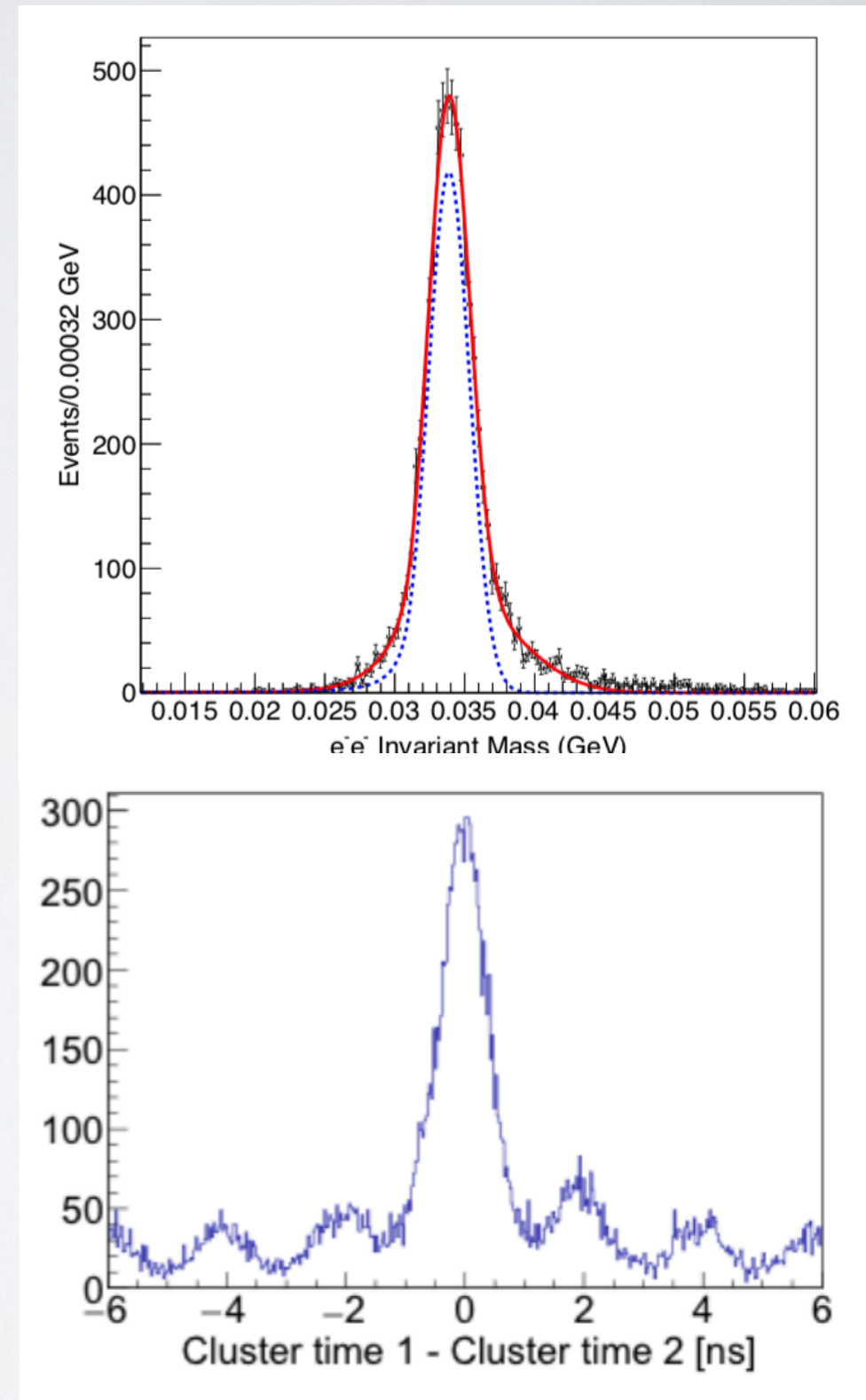
A' SEARCHES

- Event selection for radiative tridents
 - mature, although in continual development looking for possible improvement, key variables for better background rejection
 - symptoms of mis-alignment in data (e.g. beam spot constraint, z-shifts in vertex) is much better understood
- Bump hunt
 - technique and software to do it is mature, maybe can be considered final
 - systematics of fitting, toy generation, UL extraction, are understood and optimized
 - pretty close to plug-n-play (?), after calibrations and MC comparisons check-out
 - although alternative statistical methods have been proposed as improvements
- Detached vertex search
 - extraction technique is mature, results in general agreement with projections
 - *large work has been invested in understanding high-z backgrounds and will continue*
 - isolation cuts, machine-learning



NEW CHALLENGES @ 4 GEV

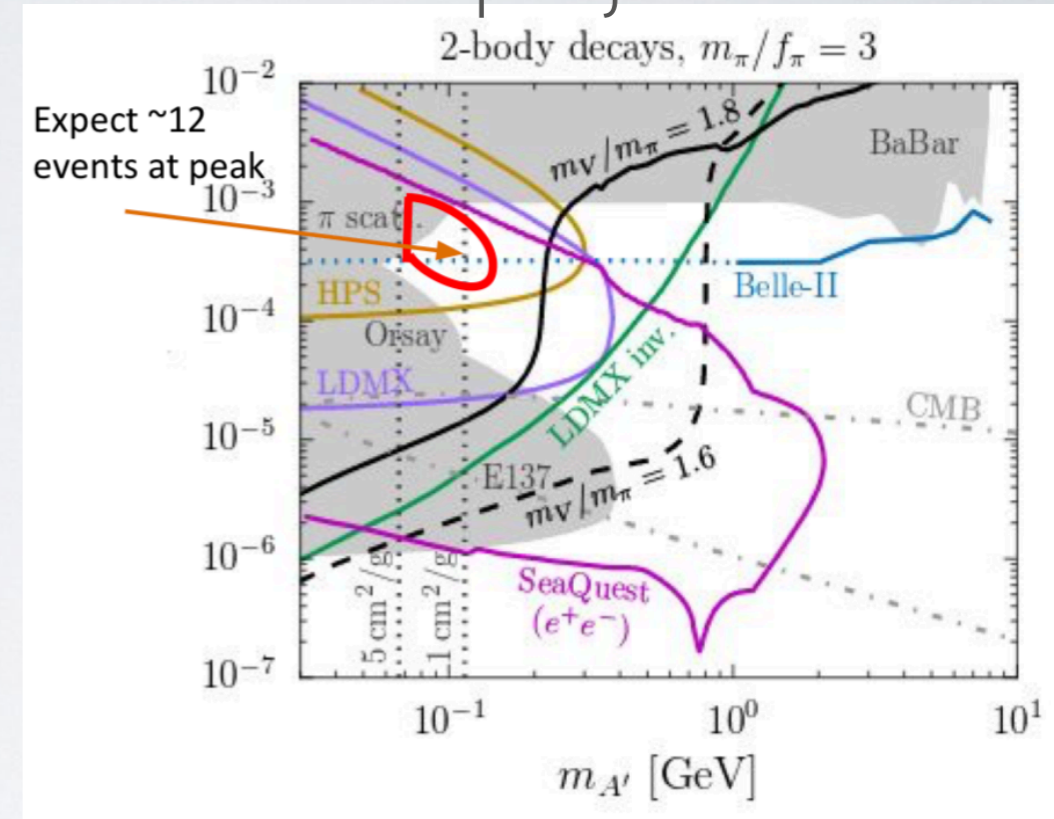
- We expect to lose standard HPS acceptance for Moller electrons
 - used as a mass resolution benchmark for addressing systematic between data and MC, a direct input to A' searches, especially bump-hunt
 - upstream target useful? although that probably brings in other systematics to address
- Single-cluster triggers
 - ECAL time-coincidence not available for accidental removal, more dependent on track timing or other coincidence metrics



NEW PHYSICS @ 4 GEV

- SIMPs
 - analysis is largely the same as A' vertexing, and we have some unexplored reach
- Mesons
 - start to gain sensitivity to $\omega/\rho/\pi^0$ -production?
 - we have pair and (new) 3-cluster triggers, can be explored "parasitically"
- Muons
 - can we learn about HPS's capabilities with mu-mu?
 - trigger on MIPs in the calorimeter, or will the rates be overwhelming?

OLD projections



SUMMARY

- Understanding of the HPS response and collected data far exceeds where we were going into and after the 2015 and 2016 runs
- Most aspects of calibration and analysis are well-understood, with software in place to address them, with some exceptions for new L0
- Need to make sure roles and timelines for the critical pre-"analysis" items, ECAL calibration and SVT/beam alignments, MC requirements, are set and known
- Couple new challenges at 4 GeV, and some new physics to explore