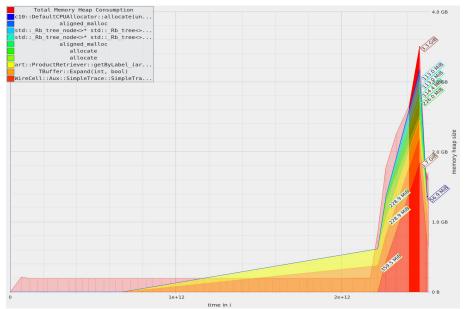


# Status report on **DNNROI sigproc**

Hokyeong Nam Chung-Ang University

## **Memory Profiling - Valgrind**

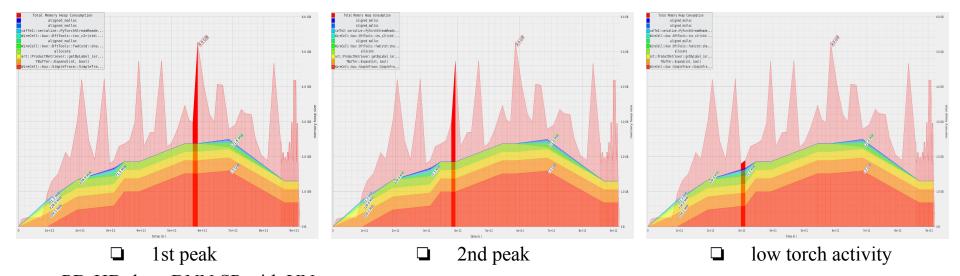


3.3 GiB: Snapshot #48 (peak) 1.7 GiB: allocate (new allocator.h:137) 1.7 GiB: allocate (alloc traits.h:464) 1.7 GiB: M allocate (stl vector.h:378) 1.7 GiB: M create storage (stl vector.h:395) 1.7 GiB: Vector base (stl vector.h:332) 1.7 GiB: vector (stl vector.h:598) 1.7 GiB: WireCell::Aux::SimpleTrace::SimpleTrace(int, int, std::vector<> const&) (SimpleTrace.cxx:8) > 972.7 MiB: WireCell::SigProc::OmnibusSigProc::save data(std::vector<>&, std::vector<> &, int, std::vector<> const&, std::vector<>&, std::vector<> &, std::vector<> const&, std::vector<> &, std::vector<> const&, std::vec 440.5 MiB: WireCell::SigProc::OmnibusSigProc::save mproi(std::vector<>&, std::vector<>&, int, std::multimap<> const&) (OmnibusSigProc.cxx:763) 228.9 MiB: WireCell::SigProc::OmnibusSigProc::save\_roi(std::vector<>&. std::vector<>&. int. std::vector<>&) (OmnibusSigProc.cxx:612) 109.9 MiB: Construct<> (stl construct.h:119) 359.5 MiB: TStorage::ReAllocChar(char\*, unsigned long, unsigned long) (TStorage.cxx:283) 359.5 MiB: TBuffer::Expand(int, bool) (TBuffer.cxx:242) 240.9 MiB: R InitializeReadBasketBuffer (TBasket.cxx:418) 240.9 MiB: TBasket::ReadBasketBuffers(long long, int, TFile\*) (TBasket.cxx:585) 240.9 MiB: TBranch::GetBasketImpl(int, TBuffer\*) (TBranch.cxx:1268) 240.9 MiB: TBranch::GetBasketAndFirst(TBasket\*&, long long&, TBuffer\*) (TBranch.cxx:1390) 240.9 MiB: TBranch::GetEntry(long long, int) (TBranch.cxx:1662) 240.9 MiB: TBranchElement::GetEntry(long long, int) (TBranchElement.cxx:2785) 240.9 MiB: TBranchElement::GetEntry(long long, int) (TBranchElement.cxx:2729) > 240.9 MiB: art::input::getEntry(TBranch\*, long long) (getEntry.cc:17) 118.5 MiB: R InitializeReadBasketBuffer (TBasket.cxx:418) 260.6 MiB: in 22537 places, all below massif's threshold (1.00%) > 228.9 MiB: allocate (new allocator.h:137) 226.0 MiB: allocate (new allocator.h:137) > 114.4 MiB: aligned malloc (Memory.h:216) 113.0 MiB: allocate (new allocator.h:137) 113.0 MiB: allocate (new allocator.h:137) 57.2 MiB: aligned malloc (Memory.h:216) 57.2 MiB: allocate (new allocator.h:137)

- PD-HD data, DNN SP with MobileNetV2
- The peak memory recorded is 3.3 GiB
- Almost half of the memory ( $\sim$ 1.7 GiB) is due to:
  - WireCell::SigProc::OmnibusSigProc::save\_data (972 MiB out of 1.7 GiB)
  - WireCell::SigProc::OmnibusSigProc::save\_mproi (440 MiB out of 1.7 GiB)

do\_not\_mp\_protect\_tradtional is set to true

## **Memory Profiling - Valgrind**



- PD-HD data, DNN SP with UNet
- The peak memory recorded is 4.9 GiB
- Not like a MobileNet result, the total cost graph has several peaks
- Almost half of the memory (~2.5 GiB) is allocated to libtorch\_cpu.so around the peak
- Another major contributions are from:
  - WireCell::SigProc::OmnibusSigProc::save\_data (853 MiB out of 1.4 GiB)
  - WireCell::SigProc::OmnibusSigProc::save\_mproi (343 MiB out of 1.4 GiB)

## **Memory Profiling - Valgrind**

### 2.5 GiB: c10::alloc cpu(unsigned long) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2 1 1b/Linux64bit+3.10-2.17-e26/lib/libc10.so) 25 GB: Citraloc cyulunisped long lin (confarestruperscience) diognostics (blood N2 1 Julious Aid+1 10 2 11 42 Kilo (Bct Uso) 25 GB: Citraloc (CAUDE (a) CRAIC Confare (a) Confarestrupe 565.9 MiB: allocate (new allocatorh:137) v 2.5 GB: c10::DefaultCPUAllocator::allocate(unsigned long) const (in (cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2\_1\_b)Linux64bit+3.10-2.17-e26/lib(libc10.so) \* 2.3 GB: c10::StorageImpl::StorageImpl:(c10::StorageImpl::use\_byte\_size\_t, c10::Symint const&, c10::Allocator\*, bool) (in [cvmfs/larsoft.opensciencegrid.org)products/ ▼ 565.9 MiB: allocate (alloc traits h:464 2.3 GB: CD: StorageImpl:StorageImpl: Description: StorageImpl: use byte size t, cD::Sprint coretis, cD::Alborator; bod] (in pomis/arsoft operacience; of only products/laturchy2.1 Explanability 3.14.2.17-23/fb/fatorchy2.1. 2.3 GiB: at:/TensorBase at::detail:: empty\_generic<>(c10::ArrayRef<>, c10::Allocator\*, c10::DispatchKeySet, c10::ScalarType, c10::optional<>) (in /cvmfs/larsoft.org) \* 23 GB st:TensorBase st:detail: empty generic > (c10:AmarifeFc), c10:Albostor\*, c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:optimal > ) (in jointsfarsoft operation conductsifictord in 1 Tubulous Albostory (c10:Dispatchle/Set, c10:ScalarType, c10:Dispatchle/Set, c10:S 2.3 GiB: at::detail::empty\_generic(c10::ArrayRef<>, c10::Allocator\*, c10::DispatchKeySet, c10::ScalarType, c10::optional<>) (in |cvmfs|larsoft.opensciencegrid ▼ 565.9 MiB: M allocate (stl vector.h:378 2.3 GiB: at::detail::empty cpu(c10::ArrayRef<>, c10::ScalarType, bool, c10::optional<>) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2 1 1b/Lin \* 23 GB at statal: empty generic(10: Arrayllet <> , c.10: Alocator\*, c.10: Dispatch VerSet, c.10: ScalarType, c.10: ordinal <> ) (in ) (umfs]arsult coenscience and unproducts (laturally 2.1.1 biblious 4bit + 3.10-2.11-e2 ▼ 565.9 MiB: M create storage (st) vector.h:395 2.3 GiB: at::detail::empty\_cpu(c10::ArrayRef<>, c10::optional<>, c10::optional \* 23 GBt at: detail: empty coulct0: ArrayRef<>, c10: Scalarilpe, bool, c10: reburel<>) (in (rums larget represence and organized bloomby 2.1 bb Linux Abb + 3.10 2.17 + 25 fb) (bloomby 2.10 - 2.00 - 2.1 GiB: at::native::empty coulc10::ArrayRef<>, c10::optional<>, c10::optional • 2.3 GB. abdetail:empty cpu(cD:AmayRef<>, cD:optional<>, cD:optional<>, cD:optional<>, cD:optional<>, cD:optional<>, cD:optional<>) in journal@aractiverscience.jrid optional ▼ 565.9 MiB: Vector base (stl vector.h:332) 2.1 GiB: c10::impl::wrap kernel functor unboxed <>::call(c10::OperatorKernel\*, c10::DispatchKeySet, c10::ArrayRef<>, c10::optional<>, c10::optional 2.1 GB: at:native:empty gov[cl/chmayRef<>, cl/ccc/comal<>, cl/ccc/cmal<>, cl/ccc/cmal<>, cl/ccc/cmal<>, cl/ccc/cmal<>) (in |cmfs|asset operations) products (introducts) 2.1 GiB: at:: ops::empty memory format::redispatch/c10::DispatchKeySet, c10::ArrayRef<>, c10::optional<>, c10::optional<>, c10::optional 565.9 MiB: vector (st) vector.h:5981 2.1 GiB: c10::impl::wrap kernel functor unboxed <>::call/c10::OperatorKernel\*, c10::DispatchKeySet, c10::ArrayRef<>, c10::optional<>, c 2.1.68: cl0:impl:imax lemel fundur unbowed <a href="c:color:color:alicult/Coentrollemel">cl0::Osoatorlemel</a>; cl0::obrael 565.9 MiB: WireCell::Aux::SimpleTrace::SimpleTrace(int, int, std::vector<> const&) (SimpleTrace.cox:8) 2.1 GiB: at:: ops::empty memory format::call(c10::ArrayRef<>, c10::optional<>, c10::optional<>, c10::optional<>, c10::optional<>, c10::optional<> \* 2.1 GR. st. ous:endo menos fomat:refssatch(cl):Dispatch(enset.cl):AmayRefo.cl):notional-o.c 2.1 GiB: at::emotv(c10::ArravRef<>, c10::TensorOptions, c10::optional<>) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v/s/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.opensciencegrid.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/products/larsoft.org/product \* 2.1 GB: CIC implantay lemel functor unboxed <a href="https://cic.org/cic.org/linearing/cic.org/cic.o \* 357.6 Mile: WireCell:SinProc::OmnibusSinProc::save data/std::vector<>&.std::vector<>&.int.std::vector<> const&.std::vector<>&.std:: cxx11:: 2.1 GiB: at::native::(anonymous namespace)::compute\_columns2d(at::Tensor const&, c10::ArrayRef<>, c10::ArrayRef<>, c10::ArrayRef > 2.1 GBt at: ous:endy memory formatical ICD: ArrayRefox, c.Ut:outional (>, c.Ut:outional (>, c.Ut:outional (>), c.Ut:outional 2.1 GiB: at::native::slow\_conv2d forward out\_cou(at::Tensor const&, at::Tensor const&, c10::ArrayRef<>, c10::optional<> const + 93.0 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.:cox:1669) > 245.4 MB: at:rietal:empty coulcili:Arra/Ref<>, cilo:TensorOptions consts) (in journis/arsoft.openscienceprid org/products/laborch/V2\_1 lb\_Linux/Abit+3.10.2.17-2.6 fib/fibtorch couss) 2.1 GiB: at::native::slow\_conv2d forward\_cpu(at::Tensor\_const&, at::Tensor\_const&, c10::ArrayRef<>>, c10::optional<> const 117.2 MB: at:native:resize bytes cut(cl0:StorageImpl\*, unsigned long) (in journ's larsoft operacience and comproducts (laborative 2.1 lb)Linus Abit + 3.10-2.17-e26 (b) (laboration course) 2.1 GIB: c10::impl::wrap kernel functor unboxed <>::call(c10::OperatorKernel\*, c10::DispatchKeySet, at::Tensor const& > 71.5 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared.ptr<> const&, std::shared.ptr<>&) (OmnibusSigProc::oc::1678) > 245.4 MiB: at::detail::empty\_cpu(c10::ArrayRef<>, c10::TensorOptions const&) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2\_1\_tb/Linuxl > 51.3 Milk caffe2:serialize:PyTordiStreamReader:qetRecord(std: cxx11:tesic stimp<> consta) in (confisiarisut operaciencegrid anglorobuts/filtrot/p2 1 lb(cinud4bit+3.10-2.17-e26/fb)fobtord quusal \* 117.2 MiB: at::native::resize\_bytes\_cpu(c10::StorageImpl\*, unsigned long) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2\_1\_1b/Linux64bit+3.10-2.17-e26/l > 57.2 MB: WireCell::SioProc::OmnibusSioProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSioProc.cox:1822) 952.1 ViB: alocate (new allocator fr:137) > 117.2 MiB: c10::TensorImpl\* at::native:: resize impl <>(c10::TensorImpl\*, c10::ArrayRef<>, c10::OptionalArrayRef<>, bool) (in Jovmfs/larsoft.opensciencegrid.org) 952.1 MiB: allocate (alloc traits.h:464) > 57.2 MiB: WireCell::SigProc::OmnibusSigProc::operator()/std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.cox:1800) > 51.3 MiB: caffe2::serialize::PyTorchStreamReader::getRecord(std:: cxx11::basic string<> const&) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2 1 1b/Lin 952.1 MiB: M allocate (stl vector.h:378) 1.4 GiB: allocate (new allocator.h:137) > 57.2 MiB: WireCell::SigProc::OmnibusSigProc::operator()/std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.cox:1814) 952.1 MiB: M create storage (stl vector.h:395) 1.4 GiB: allocate (alloc traits.h:464) > 21.5 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.coc:1693) 1.4 GiB: M allocate (stl vector.h:378 952.1 MiB: Vector base (stl vector h:332) ▼ 1.4 GiB: M create storage (stl vector.h:395) 952.1 MiB: vector (stl vector h:598) 114.4 MiB: WireCell::SioProc::OmnibusSioProc::save moroi(std::vector > 6. std::vector > 6. int. std::multimao >> const6) (OmnibusSioProc::coc763 1.4 GiB: Vector base (stl vector.h:332) 952.1 MB: WireCel::Aux:SimpleTrace:SimpleTraceInt. int. std::vector<> const&) | SimpleTrace.cox3| 1.4 GiB: vector (stl vector.h:598) → 57.2 MiB: WireCell::SiaProc::OmnibusSiaProc::save roi(std::vector > 6, std::vector > 6, int. std::vector > 6) (OmnibusSiaProc.cocc612) \* 5722 MB: WineCell-SurProc-OmnitusSurProcessive data(std:webtor ⇔ 6, std:webtor ⇔ 6, int. std:webtor ⇔ constá, std:webtor ⇔ 6, std:: cxcl1:rbasic string ⇒ constá, bobl (OmnibusSurProc.cxc512) 1.4 GiB: WireCell::Aux::SimpleTrace::SimpleTrace(int. int. std::vector<> const&) (SimpleTrace.cxx:8) > 114.4 MB: WreCel:SigProc:OmnbusSigProc:operator()(std:shared.ptr > consté, std:shared.ptr > 6/ (OmnbusSigProc.coc:1022) 36.6 MiB: Construct<> (stl construct.h:119) 858.3 MiB: WireCell::SigProc::OmnibusSigProc::save\_data(std::vector<>&, std::vector<>&, int, std::vector<> const&, std::vector<>&, std:: cxx11::b > 171.7 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared ptr<> const&, std::shared ptr<>&) (OmnibusSigProc.cxx:1822) > 114.4 MB: WreCel:SuProc:OmnibusSuProc:operator()(std:shared ptr > consté, std:shared ptr > 6) (OmnibusSuProc:coc:1669) 359.5 MiB: TStorage::ReAllocChar(char\*, unsigned long, unsigned long) (TStorage.cxx:283) > 171.7 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.cxx:1669) → 114.4 MB: WreCel:SigProc:OmnibusSigProc:operator()/std:shared.ptr<> consti, std:shared.ptr<>6//>6/ (OmnibusSigProc.cor.1800) 171.7 MiB: WireCell::SioProc::OmnibusSioProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSioProc.cxx:1800) 228.9 MiB: allocate (new allocator.h:137) > 114.4 MB: WireCel:SupProc:OmnibusSupProc:operator()/std:shared.ptr > constit, std:shared.ptr > 6/ | OmnibusSupProc.coc.1814) > 171.7 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.cxx:1814) > 71.5 WB: WireCell:SupProc:OrmibusSupProc:operator()(std::shared ptr<> const6, std::shared ptr<>6| (OrmibusSupProc.oox.1678) 228.9 MiB: allocate (new allocator.h:137) 107.3 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared ptr<> const&, std::shared ptr<>&) (OmnibusSigProc.:cxx:1678) > 64.4 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared\_ptr<> const&, std::shared\_ptr<>&) (OmnibusSigProc.:cxx:1693) 42.9 MiR: in 1 place, below massiffs threshold (1.00%) 207.8 MiB: in 22540 places, all below massif's threshold (1.00%) 343.3 MiB: WireCell::SigProc::OmnibusSigProc::save mproi[std::vector<>&, std::vector<>&, int, std::multimap<> const&) (OmnibusSigProc.:coc:763) > 228.9 MiB: WireCell:SigProc:OmnibusSigProc:save mpmi(std:vector>6, std:vector>6, int, std:multimap<> const6) (OmnibusSigProc.coc:763) 171.7 MiB: WireCell::SigProc::OmnibusSigProc::save\_roi(std::vector<>&, std::vector<>&, int. std::vector<>&) (OmnibusSigProc.:xxx:612) 114.4 MB: WineCell-SinProc:OmnibusSinProc:save milistri-vector-o-6, std:vector-o-6, int. std:vector-o-6 i/OmnibusSinProc.com(12) 71.5 MiB: aligned malloc (Memory.h:216) > 73.2 MiB: Construct<> (stl construct.h:119) 36.6 MB: in 1 place, below massifs threshold |1.00%| 359.5 MiB: TStorage::ReAllocChar(char\*, unsigned long, unsigned long) (TStorage.cxx:283) 53.6 MiB: aligned malloc (Memory:h:216) 359.5 MB: TStorage: ReAllocChar(char\*, unsigned long, unsigned long) [TStorage.cox 283] > 359.5 MiB: TBuffer::Expand(int. bool) (TBuffer.cxx:242) 228.9 MB: allocate (new allocatoch: 137) 51.3 MB: c10::alloc cpu(unsigned long) (in /cvmfs/larsoft.opensciencegrid.org/products/libtorch/v2 1 1b/Linux64bit+3.10-2.17-e26/lib/libc10.so) > 228.9 MiB: allocate (new allocator.h:137) > 228.9 MiB: allocate (new allocator.h:137) 228.9 MR: allocate (new allocatoch: 137) 35.8 MiB: aligned malloc (Memory.h:216) 220.9 MiB: in 22544 places, all below massifs threshold (1.00% 2nd peak low torch activity 1st peak

## Writing LArSoft Module

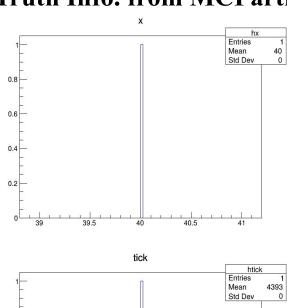
```
// Geometry & services
      auto const* geom
                              = lar::providerFrom<geo::Geometry>();
      auto const* wireReadout = &art::ServiceHandle<geo::WireReadout>()->Get();
                              = art::ServiceHandle<detinfo::DetectorPropertiesService>()->DataFor(e);
      auto const& dprop
     // Convert to geo::Point t for TPC lookup
     geo::Point t mcpos(fX, fY, fZ);
     // Determine TPC containing position
     geo::TPCID tpcid = geom->FindTPCAtPosition(mcpos);
       mf::LogWarning("ShowerAna") << "MC position outside any TPC: ("
125
                                     << fX << "," << fY << "," << fZ << ")":
        return;
     fTPCID = tpcid.TPC;
     // Map X to tick and position to wire channel for planes 0, 1, 2
     for (unsigned int plane = 0; plane < 3; ++plane) {</pre>
       geo::PlaneID pid(tpcid, plane);
       float tick = dprop.ConvertXToTicks(fX, pid.Plane, pid.TPC, pid.Cryostat);
        int channel = std::lround(wireReadout->Plane(pid).WireCoordinate(mcpos));
136
137
        if (plane == 0) { fTick0 = tick; fChannel0 = channel; }
       if (plane == 1) { fTick1 = tick; fChannel1 = channel;
       if (plane == 2) { fTick2 = tick; fChannel2 = channel; }
142
     // Fill tree
      fTree->Fill();
```

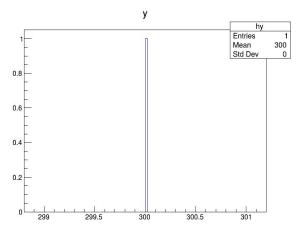
- Succeed to get x, y, z positions of primary electron generated from particle gun
- Currently under updates to include momentum, direction, TPC id, PDG id

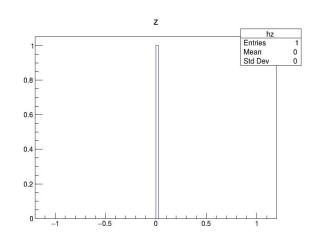
Can access under my local larsoft development environment

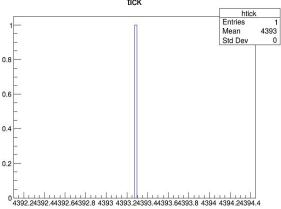
```
Apptainer> lar --print-available-modules | grep ShowerAna 402. ShowerAna analyzer /exp/dune/app/users/hnam/2024tutorial/srcs/protoduneana/protoduneana/TutorialExamples/ShowerAna_module.cc
```

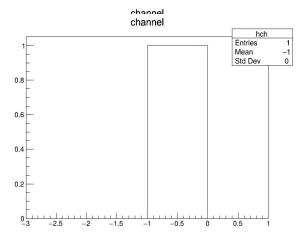
### Truth Info. from MCParticle

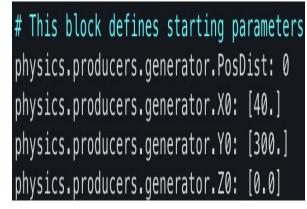












## Back Up