



Wire-Cell ProtoDUNE Local Meeting

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1. Study on PDHD Memory Consumption Issue

Different `clock_speed`s

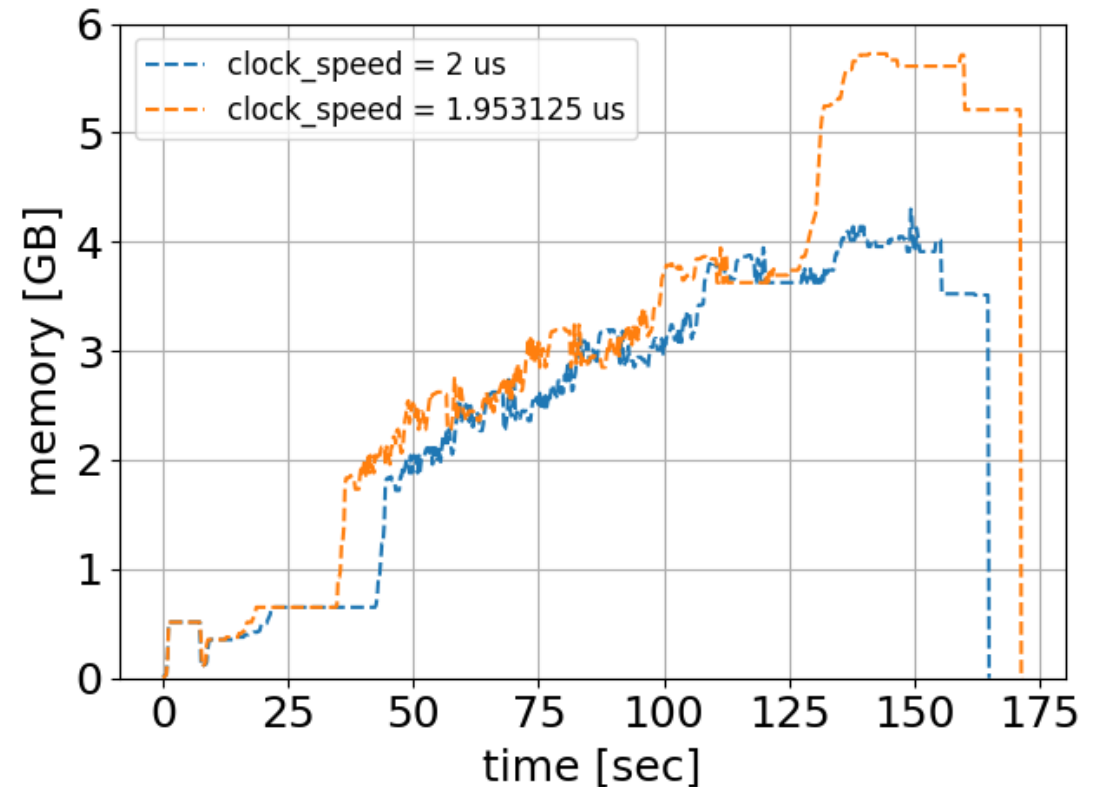
The .fcl file loads different `clock_speed` values depending on the dunesw version

- clock_speed = 2.0 us
- clock_speed = 1.953125 us

```
local params = base {
  daq: super.daq {
    tick: 1.0/std.extVar('clock_speed') * wc.us,
  },
};
```

```
local wcls_input = {
  adc_digits: g.pnode({
    type: 'wclsRawFrameSource',
    name: '',
    data: {
      art_tag: raw_input_label,
      frame_tags: ['orig'], // this is a WCT designator
      //nticks: params.daq.nticks,
      // nticks: nsample,

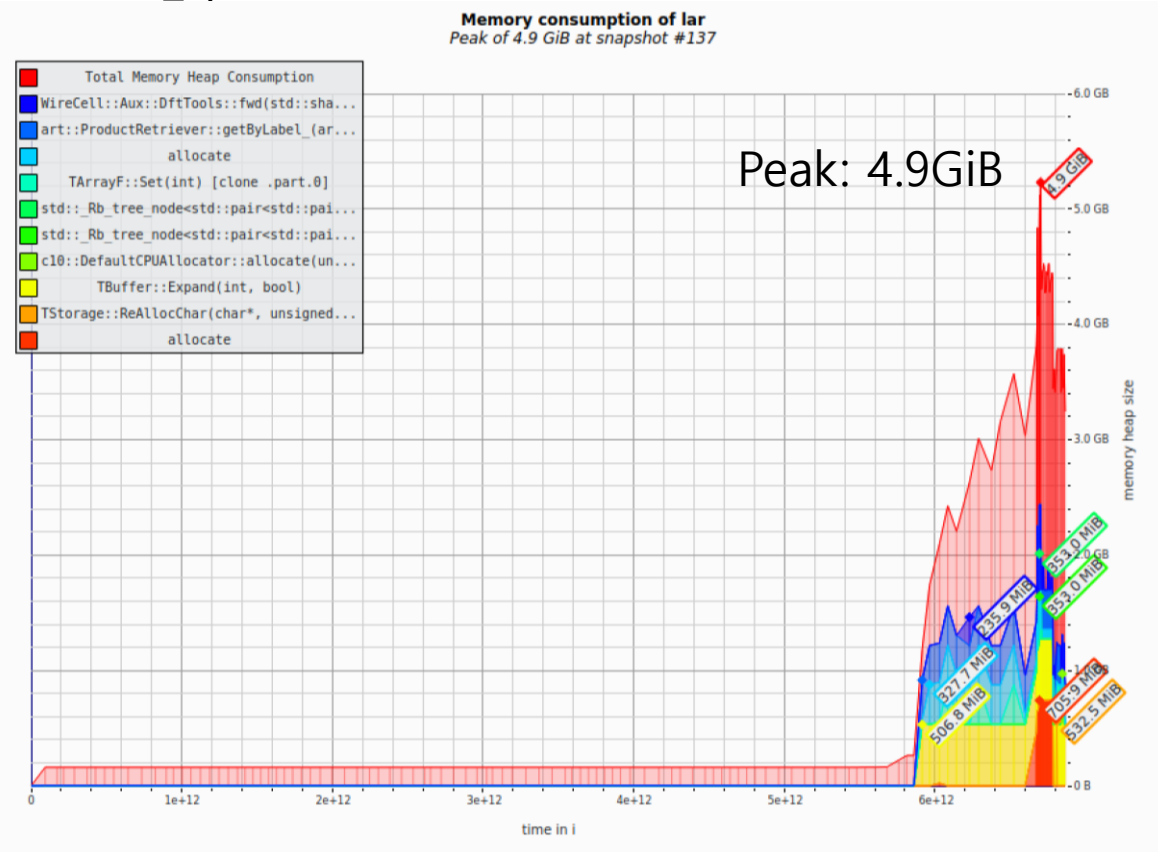
      // -----03.07.2026-----
      // tick: params.daq.tick, //original setting
      //tick: 1.0/2.0*wc.us,
      tick: 1.0/1.953125*wc.us,
    },
  },
```



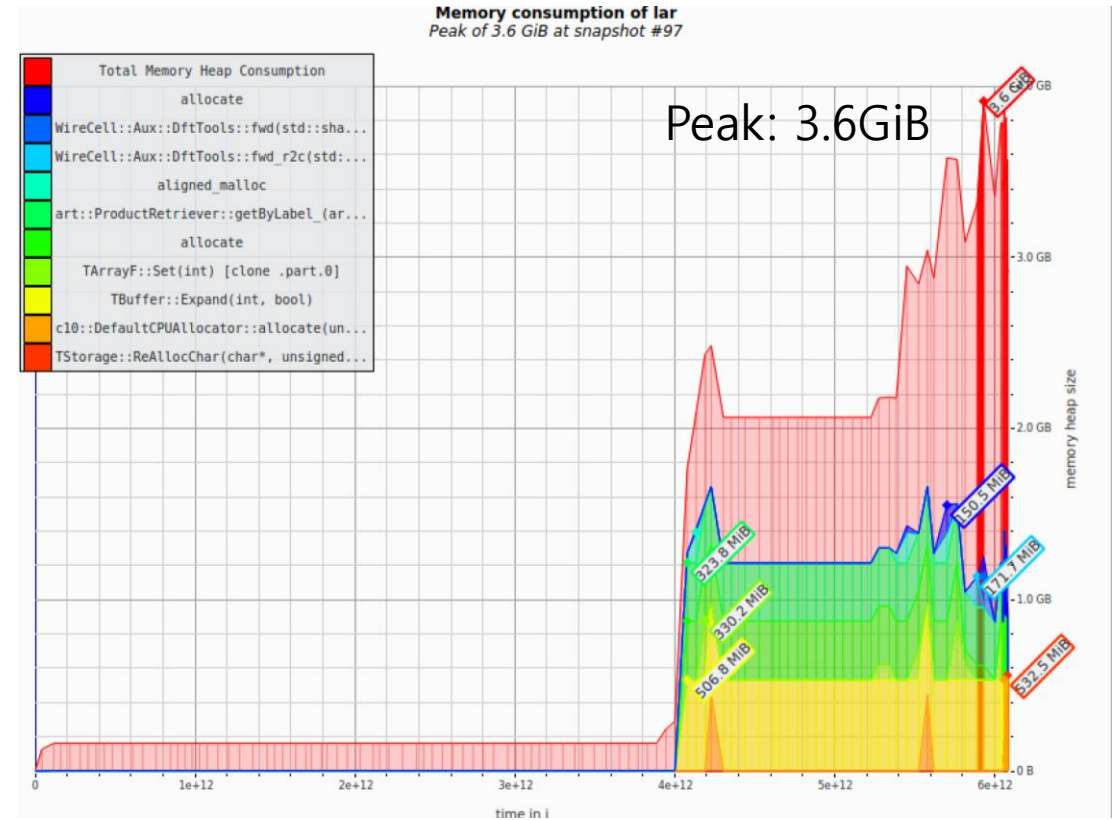
1. Study on PDHD Memory Consumption Issue

Different `clock_speed`s

- `clock_speed = 1.953125 us`



- `clock_speed = 2.0 us`



Run with `--time-unit=I` (# of Instructions executed)`

1. Study on PDHD Memory Consumption Issue

Different `clock_speed`s

- clock_speed = 1.953125 us
Total allocate : ~ 3.85 GiB (11 times)

- clock_speed = 2.0 us
Total allocate : ~ 2.94 GiB (7 times)

```

4.9 GiB: Snapshot #137 (peak)
  1.8 GiB: allocate (new_allocator.h:137)
  705.9 MiB: allocate (new_allocator.h:137)
  506.8 MiB: TStorage::ReAllocChar(char*, unsigned long, unsigned
  353.0 MiB: allocate (new_allocator.h:137)
  353.0 MiB: allocate (new_allocator.h:137)
  323.8 MiB: allocate (new_allocator.h:137)
  202.8 MiB: allocate (new_allocator.h:137)
  171.7 MiB: aligned_malloc (Memory.h:216)
  139.1 MiB: in 23181 places, all below massif's threshold (0.10%)
  81.9 MiB: allocate (new_allocator.h:137)
  81.9 MiB: aligned_malloc (Memory.h:216)
  20.1 MiB: c10::alloc_cpu(unsigned long) (in /cvmfs/larsoft.opensci...
  14.9 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::M...
  14.8 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::M...
  14.8 MiB: allocate (new_allocator.h:137)
  14.2 MiB: operator new [] (TObject.h:182)
  13.5 MiB: c10::Dispatcher::findOrRegisterName_(c10::OperatorNa...
  11.6 MiB: TStorage::ObjectAlloc(unsigned long) (TStorage.cxx:334)
  11.0 MiB: _M_construct<char*> (basic_string.tcc:225)
  9.6 MiB: llvm::WritableMemoryBuffer::getNewUninitMemBuffer(un...
  8.1 MiB: torch::jit::Node::allocNewInstance(torch::jit::Graph*) (in /c...
  6.7 MiB: allocate (new_allocator.h:137)
  6.4 MiB: std::vector<c10::Argument, std::allocator<c10::Argumen...
  6.3 MiB: llvm::SmallVectorBase<unsigned int>::grow_pod(void*, u...
  5.9 MiB: allocate (new_allocator.h:137)
  5.8 MiB: allocate (new_allocator.h:137)
  5.6 MiB: clang::ModuleMap::findOrCreateModule(llvm::StringRef, c...
  5.3 MiB: torch::jit::Graph::create(c10::Symbol, unsigned long) (in /...
  
```

```

3.6 GiB: Snapshot #97 (peak)
  1.9 GiB: allocate (new_allocator.h:137)
  506.8 MiB: TStorage::ReAllocChar(char*, unsigned long, unsigned long) (...
  323.8 MiB: allocate (new_allocator.h:137)
  171.7 MiB: aligned_malloc (Memory.h:216)
  126.6 MiB: in 23178 places, all below massif's threshold (0.10%)
  108.4 MiB: allocate (new_allocator.h:137)
  107.5 MiB: aligned_malloc (Memory.h:216)
  81.9 MiB: allocate (new_allocator.h:137)
  56.3 MiB: aligned_malloc (Memory.h:216)
  53.7 MiB: aligned_malloc (Memory.h:216)
  53.7 MiB: aligned_malloc (Memory.h:216)
  26.9 MiB: aligned_malloc (Memory.h:216)
  20.1 MiB: c10::alloc_cpu(unsigned long) (in /cvmfs/larsoft.opensciencegr...
  14.9 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::ModuleF...
  14.8 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::ModuleF...
  14.2 MiB: operator new [] (TObject.h:182)
  13.5 MiB: c10::Dispatcher::findOrRegisterName_(c10::OperatorName co...
  11.6 MiB: TStorage::ObjectAlloc(unsigned long) (TStorage.cxx:334)
  11.0 MiB: _M_construct<char*> (basic_string.tcc:225)
  9.6 MiB: llvm::WritableMemoryBuffer::getNewUninitMemBuffer(unsigned...
  8.1 MiB: torch::jit::Node::allocNewInstance(torch::jit::Graph*) (in /cvmfs/l...
  6.7 MiB: allocate (new_allocator.h:137)
  6.5 MiB: allocate (new_allocator.h:137)
  6.4 MiB: std::vector<c10::Argument, std::allocator<c10::Argument> >:...
  6.3 MiB: llvm::SmallVectorBase<unsigned int>::grow_pod(void*, unsign...
  5.8 MiB: allocate (new_allocator.h:137)
  5.6 MiB: clang::ModuleMap::findOrCreateModule(llvm::StringRef, clang:...
  5.3 MiB: torch::jit::Graph::create(c10::Symbol, unsigned long) (in /cvmfs/l...
  4.4 MiB: std::_cxx11::basic_string<char, std::char_traits<char>, std::all...
  4.2 MiB: std::any::Manager_external<std::_cxx11::basic_string<char, s...
  3.9 MiB: torch::jit::Node::addOutput() (in /cvmfs/larsoft.opensciencegrid...
  
```

```

705.9 MiB: WireCell::SigProc::ROI_refinement::MP2ROI(int, std::shared_ptr<WireCell::IAnodePlane>, std::shared_ptr<
  705.9 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared_ptr<WireCell::IFrame const> const&, std::s
  705.9 MiB: WireCell::IFunctionNode<WireCell::IFrame, WireCell::IFrame>::operator()(boost::any const&, boost
  
```

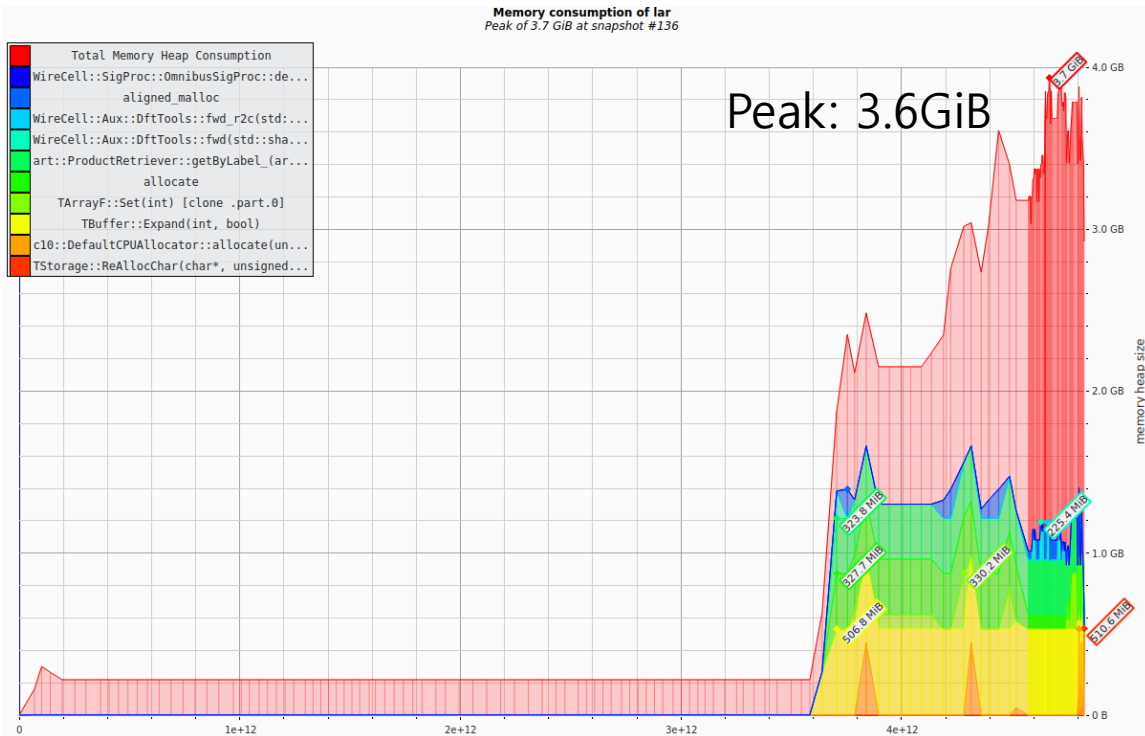
```

108.4 MiB: WireCell::SigProc::ROI_refinement::MP2ROI(int, std::shared_ptr<WireCell::IAnodePlane>, std:
  108.4 MiB: WireCell::SigProc::OmnibusSigProc::operator()(std::shared_ptr<WireCell::IFrame const> c
  108.4 MiB: WireCell::IFunctionNode<WireCell::IFrame, WireCell::IFrame>::operator()(boost::any co
  
```

1. Study on PDHD Memory Consumption Issue

Different `clock_speed`s

- `clock_speed = 1.7 us`



- Increasing of # of ticks -> Increasing memory?
- For 1.7us, no memory increasing

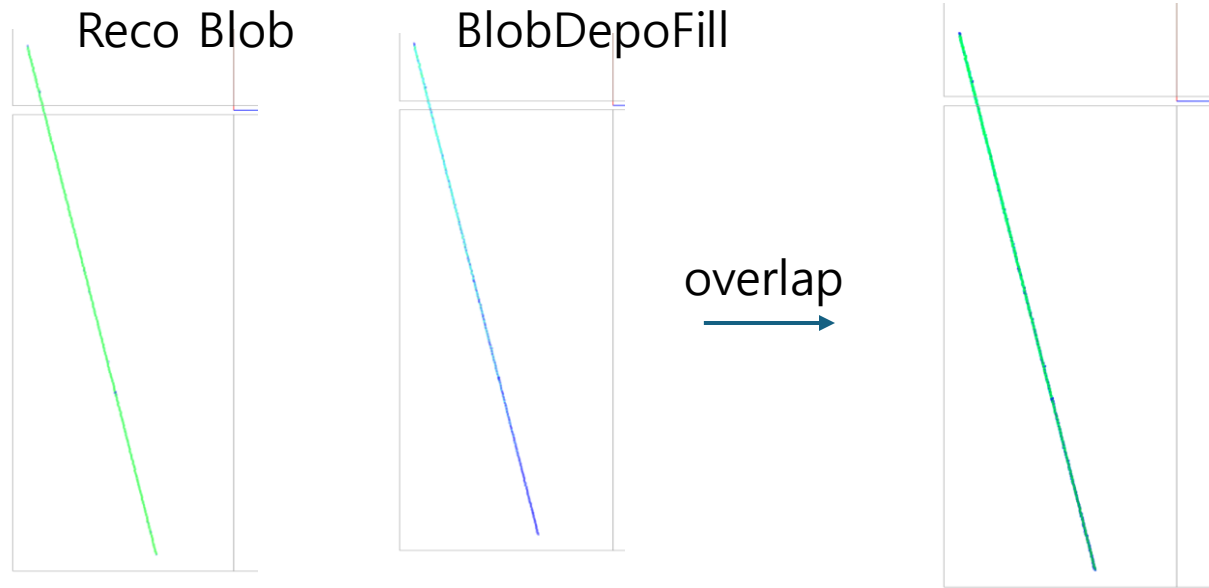
```

3.7 GiB: Snapshot #136 (peak)
▶ 1.9 GiB: allocate (new_allocator.h:137)
▶ 506.8 MiB: TStorage::ReAllocChar(char*, unsigned long, unsigned long) (TStorage.cxx:283)
▶ 323.8 MiB: allocate (new_allocator.h:137)
▶ 171.7 MiB: aligned_malloc (Memory.h:216)
▶ 131.3 MiB: allocate (new_allocator.h:137)
▶ 126.1 MiB: in 23178 places, all below massif's threshold (0.10%)
▶ 107.5 MiB: aligned_malloc (Memory.h:216)
▶ 81.9 MiB: allocate (new_allocator.h:137)
▶ 56.3 MiB: aligned_malloc (Memory.h:216)
▶ 53.7 MiB: aligned_malloc (Memory.h:216)
▶ 53.7 MiB: aligned_malloc (Memory.h:216)
▶ 26.9 MiB: aligned_malloc (Memory.h:216)
▶ 20.1 MiB: c10::alloc_cpu(unsigned long) (in /cvmfs/larsoft.opensciencegrid.org/products/li...
▶ 14.9 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::ModuleFile&, unsigned int...
▶ 14.8 MiB: clang::ASTReader::ReadASTBlock(clang::serialization::ModuleFile&, unsigned int...
▶ 14.2 MiB: operator new [] (TObject.h:182)
▶ 13.5 MiB: c10::Dispatcher::findOrRegisterName_(c10::OperatorName const&) (in /cvmfs/l...
▶ 11.6 MiB: TStorage::ObjectAlloc(unsigned long) (TStorage.cxx:334)
▶ 11.0 MiB: _M_construct<char*> (basic_string.tcc:225)
▶ 9.6 MiB: llvmlib::WritableMemoryBuffer::getNewUninitMemBuffer(unsigned long, llvmlib::Twine...
▶ 8.1 MiB: torch::jit::Node::allocNewInstance(torch::jit::Graph*) (in /cvmfs/larsoft.openscienc...
▶ 6.7 MiB: allocate (new_allocator.h:137)
▶ 6.5 MiB: allocate (new_allocator.h:137)
▶ 6.4 MiB: std::vector<c10::Argument, std::allocator<c10::Argument> >::reserve(unsigned...
▶ 6.3 MiB: llvmlib::SmallVectorBase<unsigned int>::grow_pod(void*, unsigned long, unsigned...
▶ 5.8 MiB: allocate (new_allocator.h:137)
▶ 5.6 MiB: clang::ModuleMap::findOrCreateModule(llvmlib::StringRef, clang::Module*, bool, bo...
▶ 5.3 MiB: torch::jit::Graph::create(c10::Symbol, unsigned long) (in /cvmfs/larsoft.openscienc...
▶ 4.4 MiB: std::_cxx11::basic_string<char, std::char_traits<char>, std::allocator<char> >::...
▶ 4.2 MiB: std::any::Manager_external<std::_cxx11::basic_string<char, std::char_traits<c...
▶ 3.9 MiB: torch::jit::Node::addOutput() (in /cvmfs/larsoft.opensciencegrid.org/products/libt...
    
```


2. Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

PDVD : track sim



```
blob_depo_fill(anode, name, drift_speed=params.lar.drift_speed) :: g.pnode({
  type: "BlobDepoFill",
  name: "blobdepo-filler-%s"%name,
  data: {
    // fixme, breaks detector independence
    speed: drift_speed, //1.56*wc.mm/wc.us,
    // fixme, as does this
    time_offset: 360.6833*wc.us, //314*wc.us,
  }
}, nin=2, nout=1, uses=anodes),
```

<https://www.phy.bnl.gov/twister/bee/set/7eab4e64-8fa7-43d5-8b0f-3f58e40d7fef/event/0/>

- For PDVD, boh reco blob and BlobDepoFill have charge

```
"q": [13492.494, 14543.514, 14121.116, 2216.187, 16508.152, 13127.55, 15838.063, 16368.572, 14723.5963.067, 14832.087, 13957.008, 15548.359, 15283.725, 16516.104, 15763.198, 14104.935, 15434.196, 759, 15780.503, 12700.822, 14977.85, 14611.481, 15518.079, 13882.846, 14685.924, 15824.111, 15065.607.123, 15041.694, 13211.856, 14265.848, 16112.316, 14323.741, 15042.518, 16546.168, 16167.526,
```

```
"q": [9090.95, 0.0, 6578.456, 0.0, 8776.368, 0.0, 0.0, 10281.951, 10557.898, 0.0, 9972.835, 3335.962, 136.821, 0.0, 1989859.546, 7527.239, 0.0, 593.775, 7617.111, 0.0, 10021.493, 0.0, 0.0, 11637.681, 0.0, 11873.171, 11105.037, 0.0, 3595.360515.288, 0.0, 10398.631, 0.0, 7576.247, 0.0, 0.0, 4191.364, 0.0, 6616.562, 0.0, 8588.111, 0.0, 9874.841, 0.0, 10002.82359, 0.0, 1463.194, 0.0, 11903.642, 11683.088, 0.0, 8343.749, 0.0, 0.0, 7091.705, 9229.479, 10314.313, 0.0, 0.0, 10585.784.525, 0.0, 213.194, 0.0, 257.054, 0.0, 9998.6, 0.0, 9733.907, 0.0, 0.0, 6817.027, 0.0, 8246.033, 0.0, 10599.194, 0.0, 1196.524, 6159.936, 0.0, 0.0, 8497.627, 0.0, 9953.587, 0.0, 10615.896, 0.0, 10042.529, 0.0, 7034.571, 0.0, 0.0, 0.0, 0.0,
```


2. Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

Solve problem in PDHD

- Apply similar approach which hokyeong did in Signal Processing
- Or just find some time offset value

Simple performance evaluation about charge in PDVD

Backup

2. Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

Metrics

- Two metrics for 3D Imaging performance evaluations in the **Blob level**

$$\text{Purity} = \frac{\text{Number of blobs with non-zero true charge}}{\text{Total number of reconstructed blobs}}$$

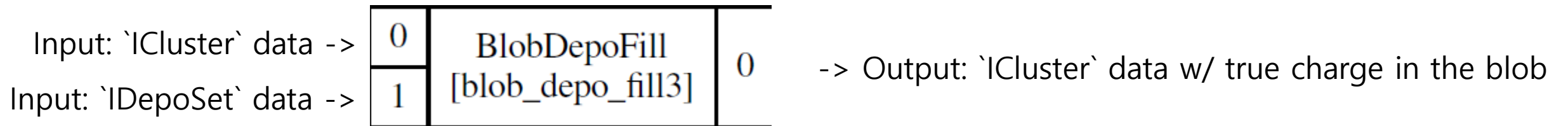
$$\text{Efficiency} = \frac{\text{Total true charge in blob}}{\text{Total true charge}}$$

BlobDepoFill

(<https://github.com/WireCell/wire-cell-toolkit/blob/18a8a5c06c8f8001e8dea5e3a577570ee473b79b/img/src/BlobDepoFill.cxx#L2>)

- Replace charges of reco blob with true charges in the blobs
- This node only replace the charge info, not position info, giving the position of reco blob

→ BlobDeopFill approach can be used for only evaluating about charge

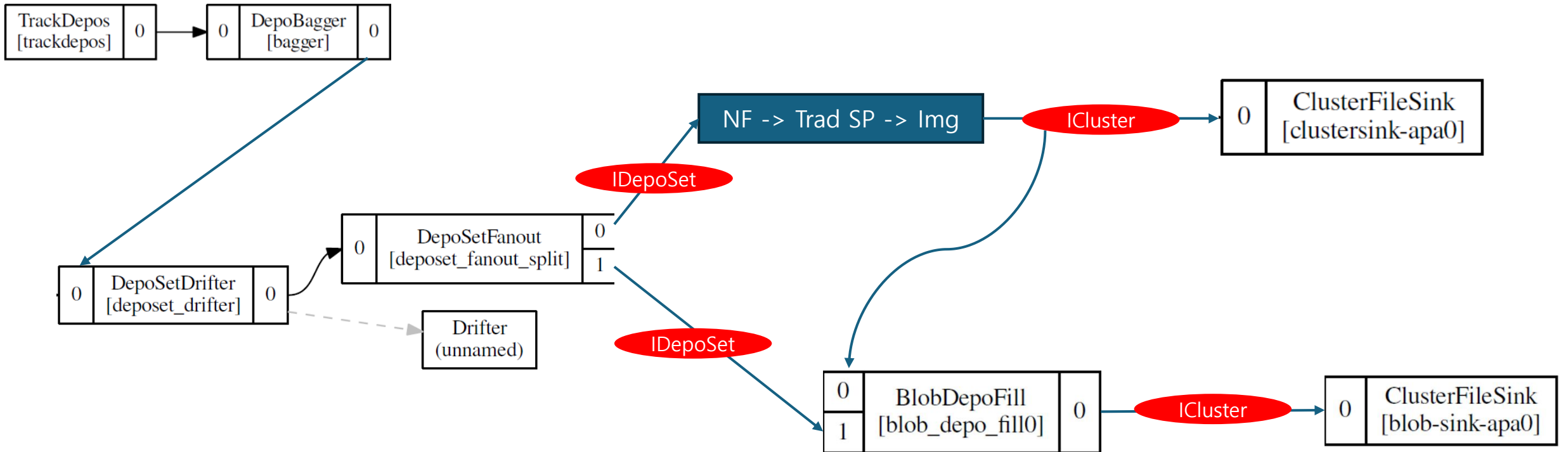


2. Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

New PDHD configuration including BlobDepoFill nodes

- Wire-Cell standalone simulation: NF -> Trad SP -> Img
- Add BlobDepoFill nodes to the conventional img pipeline



2. Wire-Cell 3D Imaging & Clustering

Blob Depo Fill: Adding true info in the conventional pipeline

Previous Jay&Haiwang's study

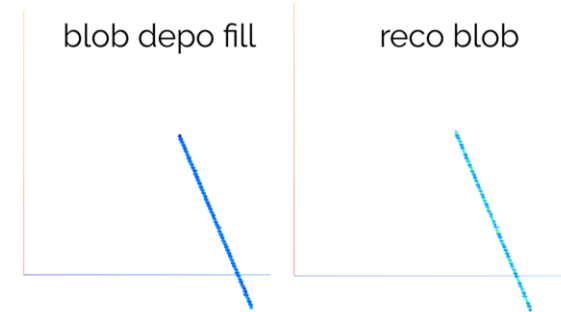
- BlobDepoFill requires some time offsets
- Hard coded now

test with a track with thetaXZ=20

- BEE: <https://www.phy.bnl.gov/twister/bee/set/a6630d3d-2e98-4275-97be-1d05fad3f76c/event/0/>
- color (charge) is different between "block" due to different size filled with the same amount of charge (we think)
- both are aligned well, sharing the same blob

```
local thetaXZ = 20*wc.deg;
local thetaXZ2 = 45*wc.deg;
local thetaXZ3 = 60*wc.deg;

local stubby_bottom = {
  head: wc.point(-50, 50, 50, wc.cm),
  // tail: wc.point(100*(1 + std.tan(thetaXZ)), 100, 100*(1+1), wc.cm),
  tail: wc.point(50*(1 + std.tan(thetaXZ)), 50, 50*(1+1), wc.cm),
};
```



- Investigation of time offsets
- Reproducing and comparing results with those of Jay&Haiwang will help validate my work
- Calculating metrics about charge with respect to different track angles