

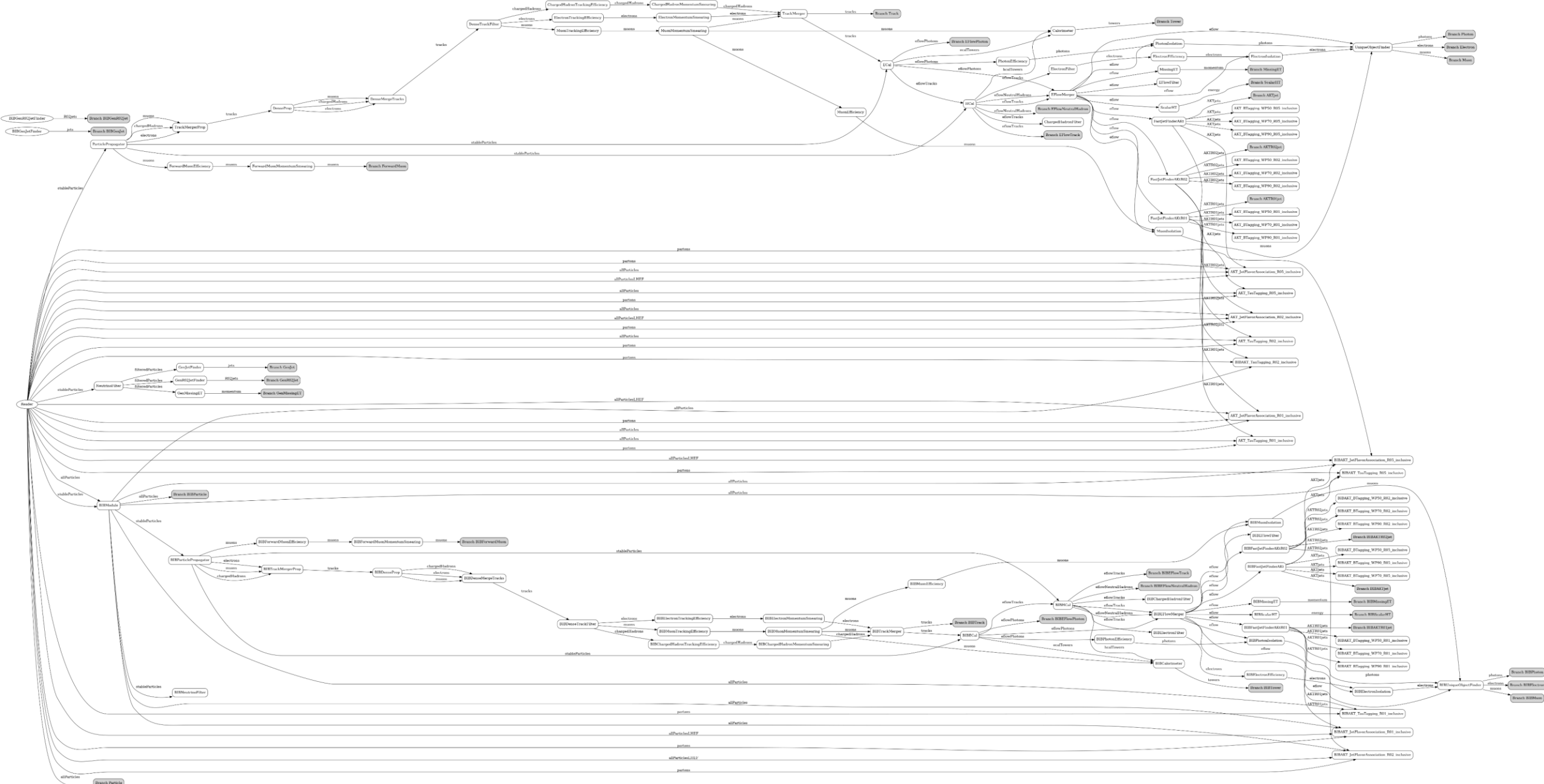


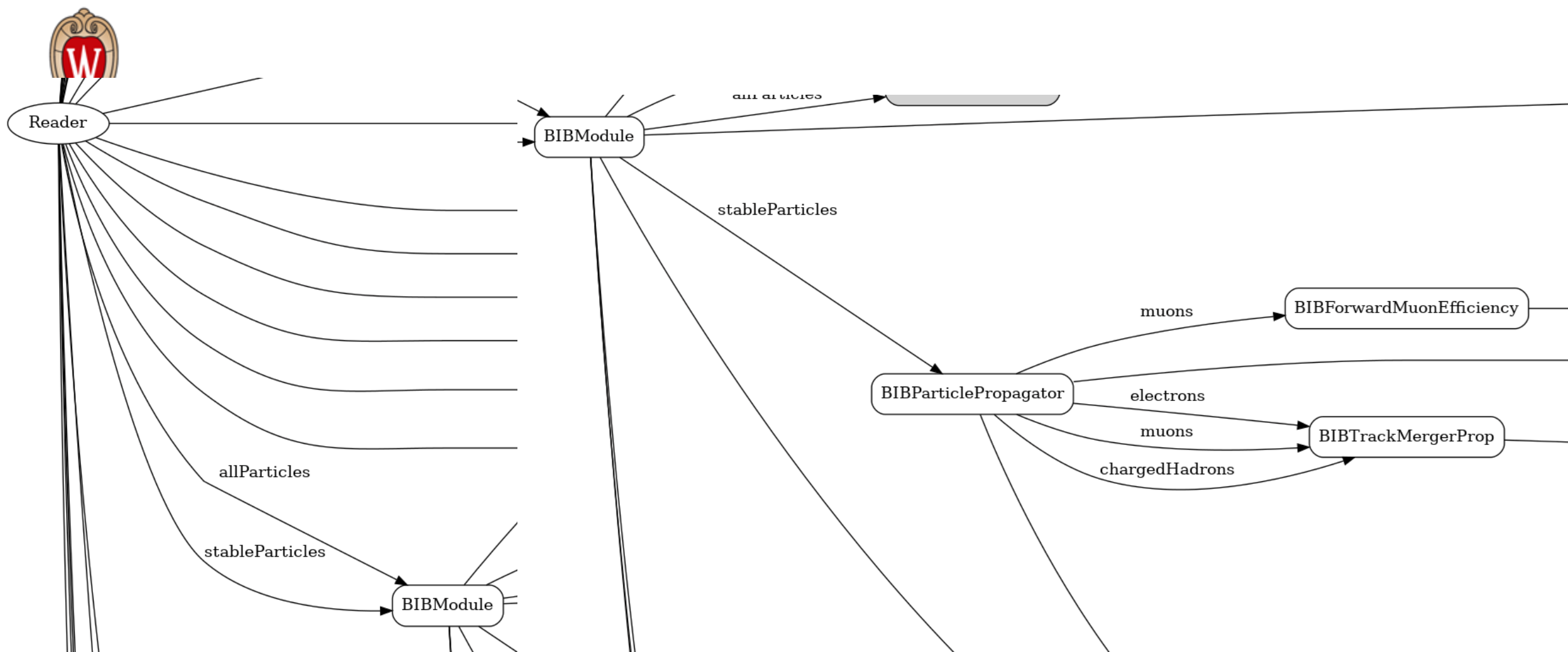
Measuring the Higgs Self-coupling Using the Muon Collider

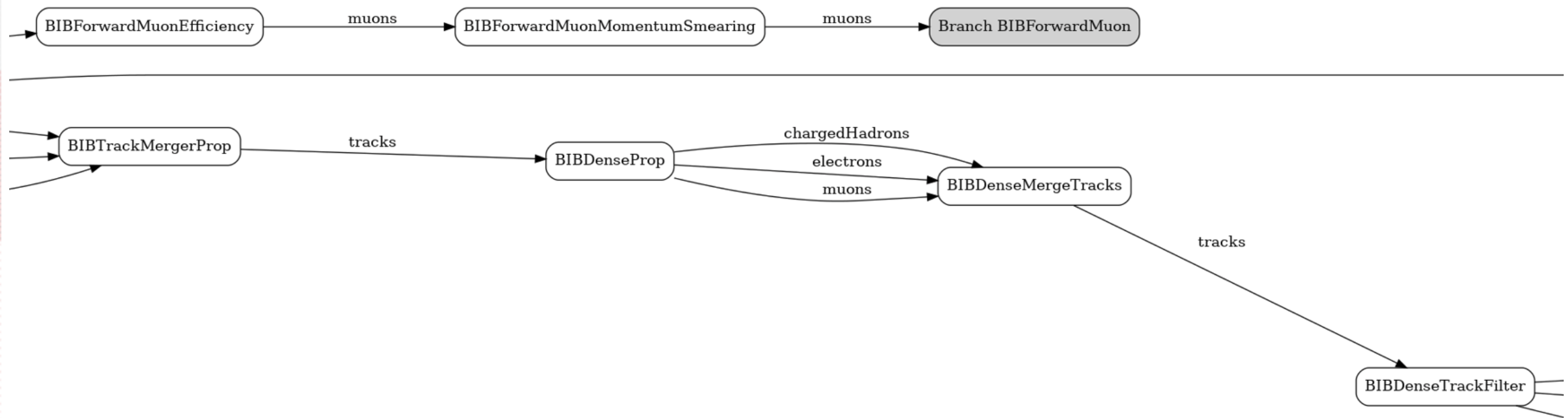
Kenny Jia

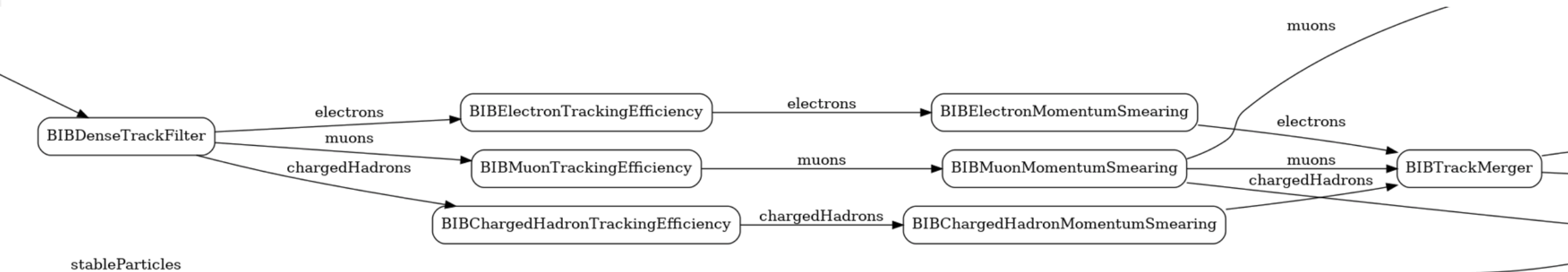
Mar 6th, 2023

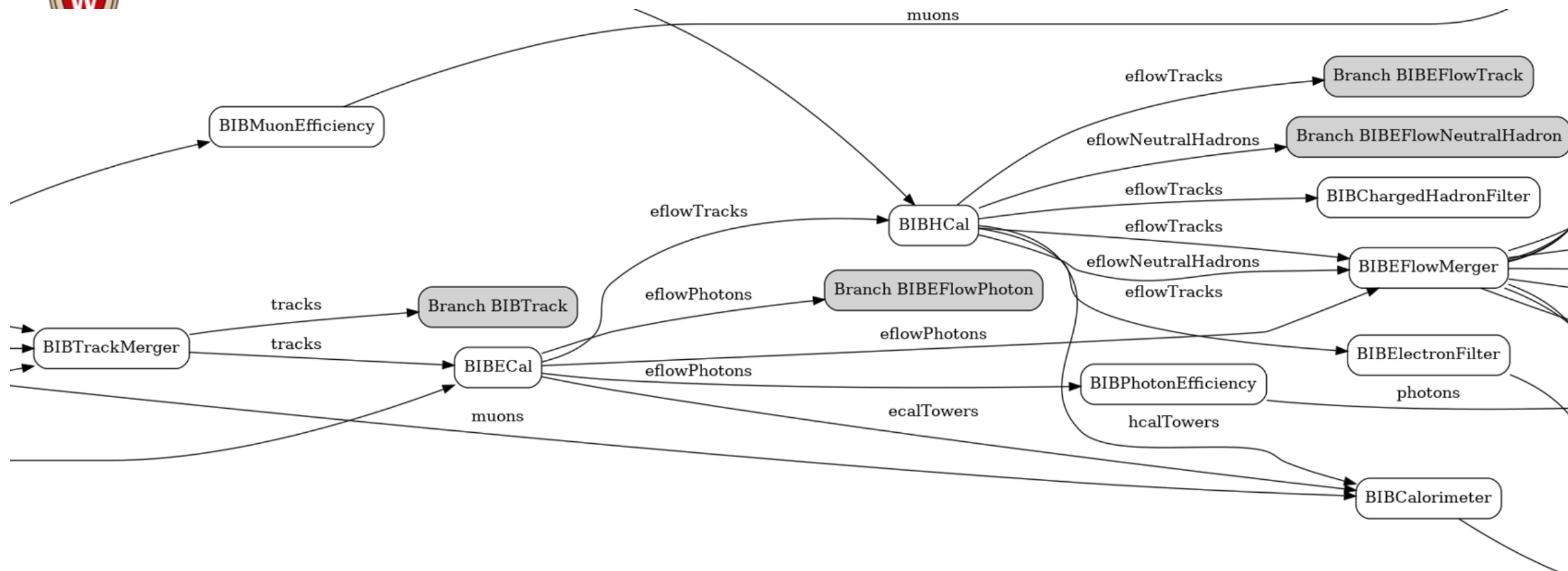














ExportArray

```
// create output arrays
```

```
fOutputArray = ExportArray(GetString("OutputArray", "stableParticles"));
```

```
fNeutralOutputArray = ExportArray(GetString("NeutralOutputArray", "neutralParticles"));
```

```
fChargedHadronOutputArray = ExportArray(GetString("ChargedHadronOutputArray", "chargedHadrons"));
```

```
fElectronOutputArray = ExportArray(GetString("ElectronOutputArray", "electrons"));
```

```
fMuonOutputArray = ExportArray(GetString("MuonOutputArray", "muons"));
```



```
TObjArray *DelphesModule::ExportArray(const char *name)
{
    TObjArray *array;
    if(!fExportFolder)
    {
        fExportFolder = NewFolder("Export");
    }

    array = GetFactory()->NewPermanentArray();
    array->SetName(name);
    fExportFolder->Add(array);

    return array;
}
```



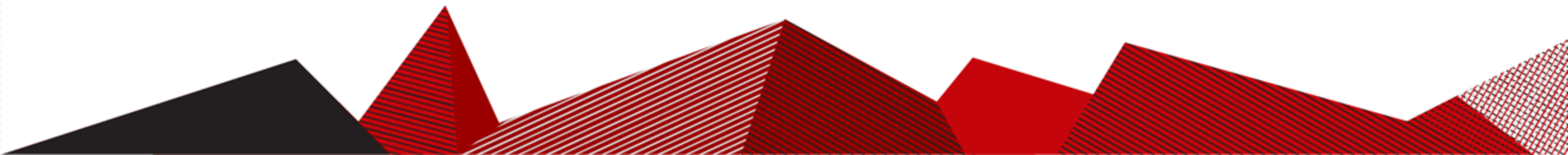
Memory use of BIBModule

- 40GiB for 10^7 BIB particles, why using so many memory?
 - Delphes are modular programming framework.
 - Save output TObjArrays for each module in each event and delete after each event
 - For flexibility, they store every type of physic objects (particle, jet, track, tower) in a single class called “candidate”, which has >100 attributes. Some of the attribute are array, TLorentzVector, std::vector of floats. Result in a huge waste of memory!
 - Some of the modules classifies particles and store them into TObjArrays for later use. This also increase the memory use.
 - Assume each attribute use 4 Byte, we can not handle $10^7 * 100 * 4 * >10$ TObjArray= > 40 GiB memory use.



How to solve this problem

- What if put we simulate BIB eflow instead in one module?
 - During merging, you still need a 10^7 entries TObjArray which still too much memory.
 - Only possible way is to merge bins by bins, but it would take days for 100 events.
- Work with less particles:





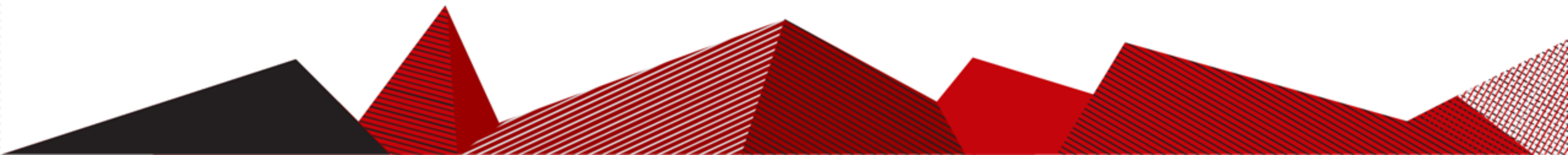
10^6 BIB particle

- Memory wise we can handle 10^6 BIB particles in both login machine and on nodes of the cluster, $\sim 10\text{GiB}$. 1000 job where each job has 100 events and each event with 10^6 BIB is okay. Study of BIB effect on MuCol di-Higgs after some mitigation strategy that cut 90% of BIB out.
- Each job takes >3 hours to run.



Bug solve

- Add random seed to random generator
- Number of bins of histograms increase
- Definition of theta? $(-\pi/2, \pi/2) \rightarrow (0, \pi)$





Next step

- Decide number of BIB particle use
- Compare with full simulation

