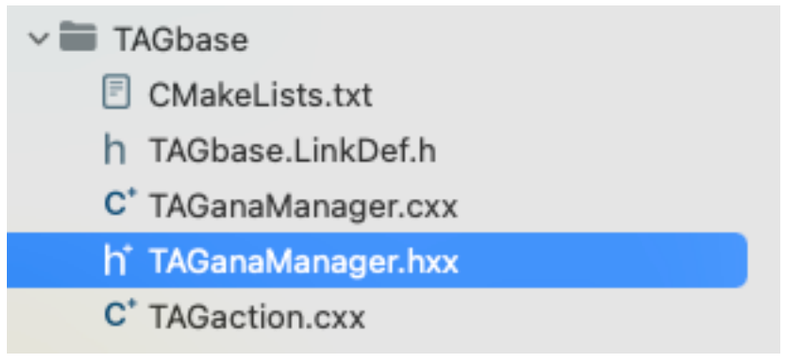
Analysis Framework

New Classes

- Analysis folder:
  - Folder added:

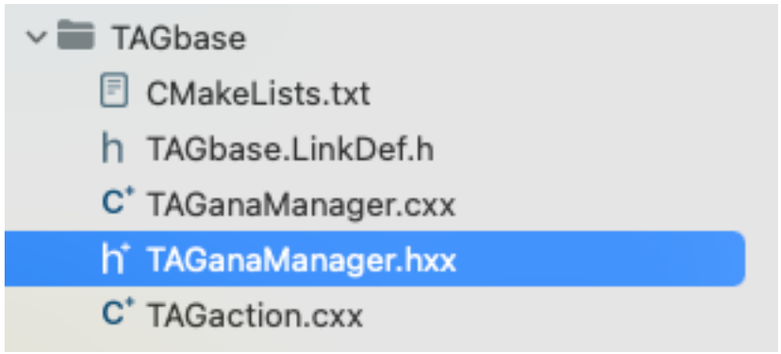
- Library folder:
  - New analysis manager class:



- Base class for analysis: TANAactBaseNtu
- Example of analysis class: TANAactNtuMass
- Master class managing analysis: GlobalAna

Analysis Manager

- Library folder:
  - New analysis manager class:




```
class TAGanaManager : public TAGparTools {

protected:
   TString    fkDefaultName; ///< default analysis file

   /*!
    \struct AnalysisParameter_t
    \brief  Analysis parameters
    */
   struct GlbAnaParameter_t : public  TObject {
      Bool_t     MassResoFlag;            ///< Mass resolution  flag
      Bool_t     PtResoFlag;              ///< Momentum resolution  flag
      Bool_t     EfficiencyFlag;          ///< Efficiency studies  flag
   };

   GlbAnaParameter_t fAnalysisParameter; ///< analysis parameters
```

- ./config/expname/TANAdetector.cfg

```
// -+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
// -+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+
//
// This is a Configuration File for FOOT analysis
//
// Campaign GSI2021
//
// -+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
// Parameters for Analysis
// -+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+-+--+-+-+-+
MassReso:     1
PtReso:       0
Efficiency:   0
```

➡ File only on GSI2021 and CNAO2023

➡ Name of the different analysis modules

➡ Could add as many needed

Analysis Class (i)

- Base analysis class: TANAactBaseNtu

```
class TANAactBaseNtu : public TAGaction {

public:
   explicit  TANAactBaseNtu(const char* name         = 0,
                            TAGdataDsc* p_irntutrack = 0,
                            TAGparaDsc* p_geomap     = 0);

   virtual ~TANAactBaseNtu();

   // Create histograms
   virtual  void    CreateHistogram() { return;      }

   // Action
   virtual  Bool_t  Action()          { return true; }


private:
   TAGdataDsc*     fpNtuTrack;           ///< input global tracks
   TAGgeoTrafo*    fpFootGeo;            ///< First geometry transformer
   TAGparaDsc*     fpGeoMapG;            ///< geometry para dsc

   Float_t         fBeamEnergyTarget;    ///< Beam energy at target
   Float_t         fBeamEnergy;          ///< Beam energy
   Float_t         fBeamA;               ///< Beam atomic mass
   Float_t         fBeamZ;               ///< Beam atomic number
...
}
```

- Contains the global track container, target/beam and FOOT geometry
- Histograms creation and action method are virtual

Analysis Class (ii)

- Analysis class template: TANAactNtuMass

```
class TANAactNtuMass : public TANAactBaseNtu {

public:
   explicit  TANAactNtuMass(const char* name         = 0,
                            TAGdataDsc* p_irntutrack = 0,
                            TAGparaDsc* p_geomap     = 0);

   virtual ~TANAactNtuMass();

   // Create histograms
   void    CreateHistogram();

   // Action
   Bool_t  Action();

   ClassDef(TANAactNtuMass, 0)
};
```

- Inherits from base class
- Could add as much containers and descriptors needed
- Will save automatically the created histograms
  (not foreseen saving in a tree, but could be done by passing the tree of TAGactTreeWriter as argument)

Global Analysis Class (i)

- Global analysis class: GlobalAna

```
class GlobalAna : public TNamed // using TNamed for the in/out files
{
public:
   // default constructor
   GlobalAna(TString expName, Int_t runNumber, TString fileNameIn, TString fileNameout, Bool_t isMC = false);

   // default destructor
   virtual ~GlobalAna();

   // Read parameters
   void ReadParFiles();

   // Create raw action
   virtual void CreateAnaAction();

   // Add required items
   virtual void AddRequiredItem();

   // Set histogram directory
   virtual void SetHistogramDir();

   // Loop events
   virtual void LoopEvent(Int_t nEvents);

   // Begin loop
   virtual void BeforeEventLoop();
```

```
    // End loop
   virtual void AfterEventLoop();

   // Open File Out
   virtual void OpenFileOut();

   // Close File Out
   virtual void CloseFileOut();

   // Create L0 branch in tree
   virtual void SetTreeBranches();

   // Goto Event
   virtual Bool_t GoEvent(Int_t iEvent);
```

➡ Base on the structure of BaseReco class

Global Analysis Class (ii)

- Global analysis class: GlobalAna

```
//_____________________________________________________________
//! Read parameters files
void GlobalAna::ReadParFiles()
{
   Int_t Z_beam = 0;
   Int_t A_beam = 0;
   TString ion_name;
   Float_t kinE_beam = 0.;

   // Read Trafo file
   TString parFileName = fCampManager->GetCurGeoFile(FootBaseName("TAGgeoTrafo"), fRunNumber);
   fpFootGeo->FromFile(parFileName);

. . .

   // initialise par files for start counter
   if (TAGrecoManager::GetPar()->IncludeST() || TAGrecoManager::GetPar()->IncludeTW() || TAGrecoManager::GetPar()->IncludeCA()) {
      fpParGeoSt = new TAGparaDsc(new TASTparGeo());
      TASTparGeo* parGeo = (TASTparGeo*)fpParGeoSt->Object();
      TString parFileName = fCampManager->GetCurGeoFile(FootBaseName("TASTparGeo"), fRunNumber);
      parGeo->FromFile(parFileName.Data());

      fpParConfSt = new TAGparaDsc(new TASTparConf());
      TASTparConf* parConf = (TASTparConf*)fpParConfSt->Object();
      parFileName = fCampManager->GetCurConfFile(FootBaseName("TASTparGeo"), fRunNumber);
      parConf->FromFile(parFileName.Data());
   }

. . .
```

➡ Read all geomaps/config files for all included detectors

Global Analysis Class (iii)

- Global analysis class: GlobalAna

```
//_____________________________________________________________
//! Set L0 tree branches for reading back
void GlobalAna::SetTreeBranches()
{
   const Char_t* name = FootActionDscName("TAGactTreeReader");
   fActEvtReader = new TAGactTreeReader(name);

   if (TAGrecoManager::GetPar()->IncludeST()) {
      fpNtuHitSt   = new TAGdataDsc(new TASTntuHit());
      fActEvtReader->SetupBranch(fpNtuHitSt);

      if (fFlagMC) {
         fpNtuMcSt   = new TAGdataDsc(FootDataDscMcName(kST), new TAMCntuHit());
         fActEvtReader->SetupBranch(fpNtuMcSt, FootBranchMcName(kST));
      }
   }

  if (TAGrecoManager::GetPar()->IncludeBM()) {
      fpNtuTrackBm = new TAGdataDsc(new TABMntuTrack());
      fActEvtReader->SetupBranch(fpNtuTrackBm);
      if (fFlagMC) {
         fpNtuMcBm   = new TAGdataDsc(FootDataDscMcName(kBM), new TAMCntuHit());
         fActEvtReader->SetupBranch(fpNtuMcBm, FootBranchMcName(kBM));
      }
   }
. . .
}
```

➡ Read all containers (excluded all hits except for ST) for the included detectors

Global Analysis Class (iv)

- Global analysis class: GlobalAna

```
//_____________________________________________________________
//! Create reconstruction actions
void GlobalAna::CreateAnaAction()
{
   // place here your beloved analysis class
   if ((TAGrecoManager::GetPar()->IncludeTOE() || TAGrecoManager::GetPar()->IncludeKalman())) {
      if (fAnaManager->GetAnalysisPar().MassResoFlag)
         fActGlbAna = new TANAactNtuMass("anaActMass", fpNtuGlbTrack, fpParGeoG);
   }
}

//_____________________________________________________________
//! Add required reconstruction actions in list
void GlobalAna::AddRequiredItem()
{
   // Add the required analysis class
   if ((TAGrecoManager::GetPar()->IncludeTOE() || TAGrecoManager::GetPar()->IncludeKalman())) {
      if (fAnaManager->GetAnalysisPar().MassResoFlag)
         gTAGroot->AddRequiredItem("anaActMass");
   }
}
```

- ➡ Create and require the dedicated class analysis when flag is on in the analysis manager
- ➡ Can have more than one analysis module

Global Analysis executable

- Global analysis main: DecoceGlbAnalysis

```
for (int i = 0; i < argc; i++){
     if(strcmp(argv[i],"-out") == 0)   { out =TString(argv[++i]);  }   // Raw file name for output
     if(strcmp(argv[i],"-in")  == 0)   { in = TString(argv[++i]);  }   // Root file in input
     if(strcmp(argv[i],"-exp") == 0)   { exp = TString(argv[++i]); }   // extention for config/geomap files
     if(strcmp(argv[i],"-nev") == 0)   { nTotEv = atoi(argv[++i]); }   // Number of events to be analized
     if(strcmp(argv[i],"-nsk") == 0)   { nSkipEv = atoi(argv[++i]);}   // Number of events to be skip
     if(strcmp(argv[i],"-run") == 0)   { runNb = atoi(argv[++i]);  }   // Run Number
     if(strcmp(argv[i],"-mc")  == 0)   { mc = true;                }   // reco from MC local reco data

  . . .
 }

  TApplication::CreateApplication();

   TAGrecoManager::Instance(exp);
   TAGrecoManager::GetPar()->FromFile();
   TAGrecoManager::GetPar()->Print();

   // check input file exists
   if(in.IsNull() || gSystem->AccessPathName(in.Data())) {
      Error("main()", "Input file does not exist or is null");
      exit(-1);
   }

   GlobalAna* glbAna = new GlobalAna(exp, runNb, in, out, mc);
. . .
}
```

➡ Copy of the DecodeGlb main, take same arguments

```
DecodeGlbAnalysis -in run4287_GlbS_70kEvts_Out.root -out MassAnalysis.root -exp GSI2021 -run 4287
```

Conclusions

- New analysis framework
- A template analysis class

- Need to implement dedicated analysis class and update the analysis manager

- Status of old analysis mains ?

Outlooks

- Many (new) collaborators are used to python
- Looking to interface FOOT with python

- Making a try with some classes of FOOT:
  - TAGanaManager (TAGparTools)
  - Creating a dedicated interface class (PyFOOT.cxx, using boost:python libraries)
  - Updating the CMakeFiles.txt accordingly

```
> python
Python 3.12.2 (main, Feb 20 2024, 04:06:49) [Clang 14.0.0 (clang-1400.0.29.202)] on darwin
Type "help", "copyright", "credits" or "license" for more information.

>>> from PyFOOT import TAGanaManager
>>> b = TAGanaManager("GSI2021")
>>> b.FromFile("")
Info in <UnknownClass::FromFile()>: Open file ./config/GSI2021/TANAdetector.cfg for analysis configuration

Mass resolution flag: 1
Momentum resolution flag: 0
Efficiency studies flag: 0
```

- Still some issues when passing a ROOT class as argument in cstr