

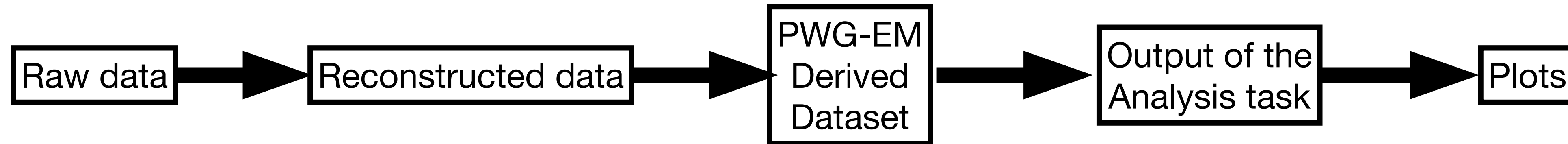
Hands-on session

Dilepton O2Physics framework

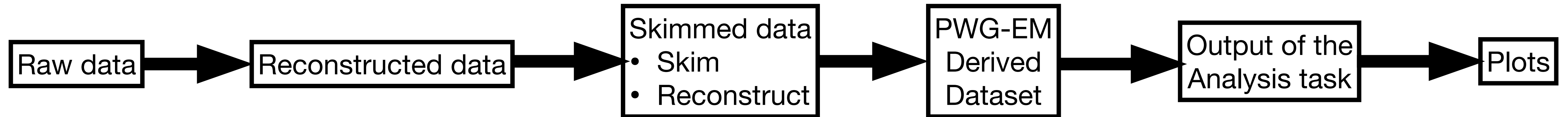
Raphaelle Bailhache (Frankfurt)
13.11.2025

Analysis steps

Minimum-bias data:

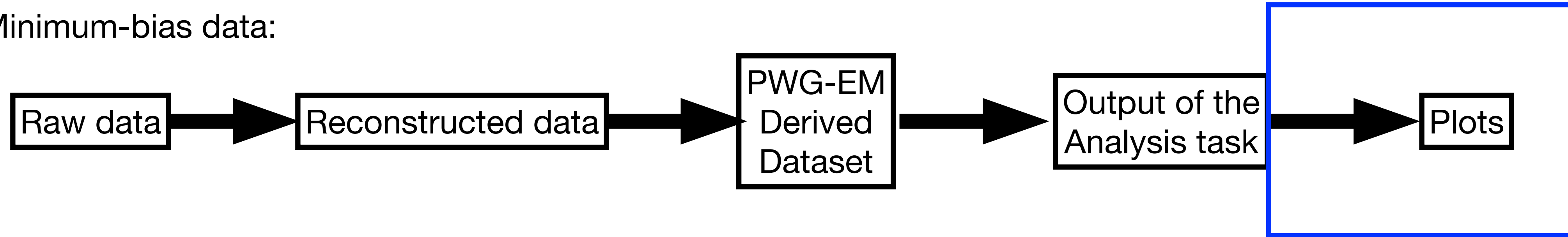


Triggered data:

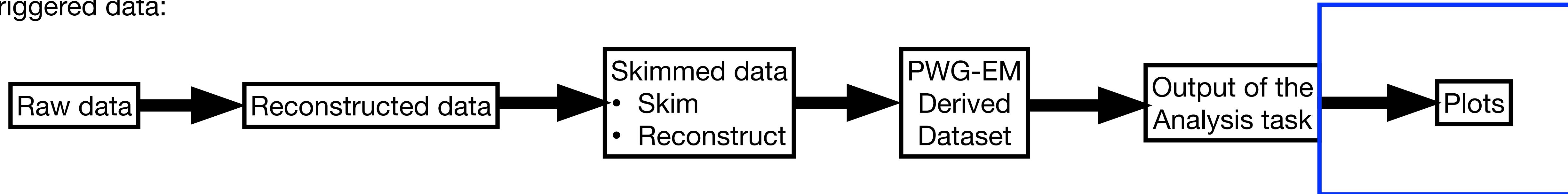


Analysis steps

Minimum-bias data:



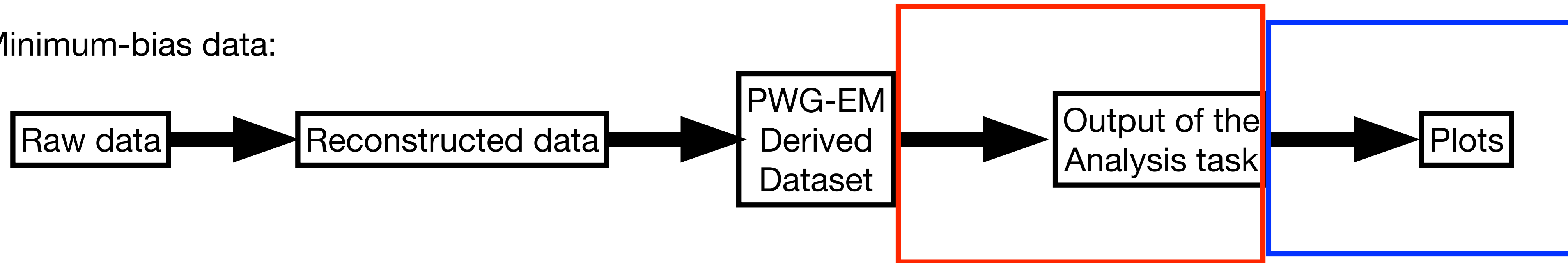
Triggered data:



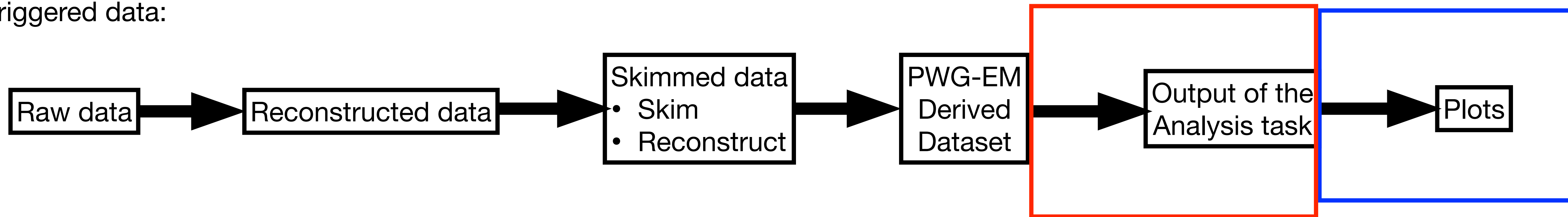
Done locally on your computer
with some macros/scripts

Analysis steps

Minimum-bias data:



Triggered data:



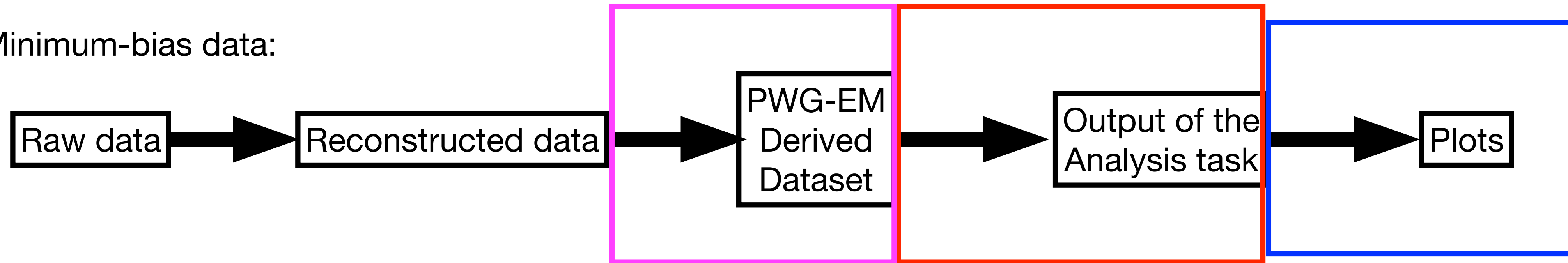
Done locally on your computer
with some macros/scripts

**Hyperloop analysis trains
possible two times a day:**

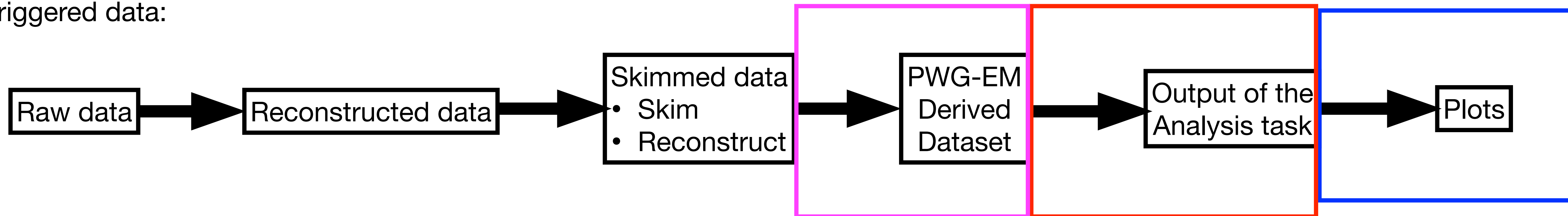
- Run different analysis tasks (single lepton, dilepton, MC/data)
- Changing analysis cuts

Analysis steps

Minimum-bias data:



Triggered data:



**Hyperloop trains
(ran by you or conveners)**

- Produce PWG-EM dataset
- Looser cuts as in the analysis
- Need to be redone if information missing/wrong in PWG-EM data format

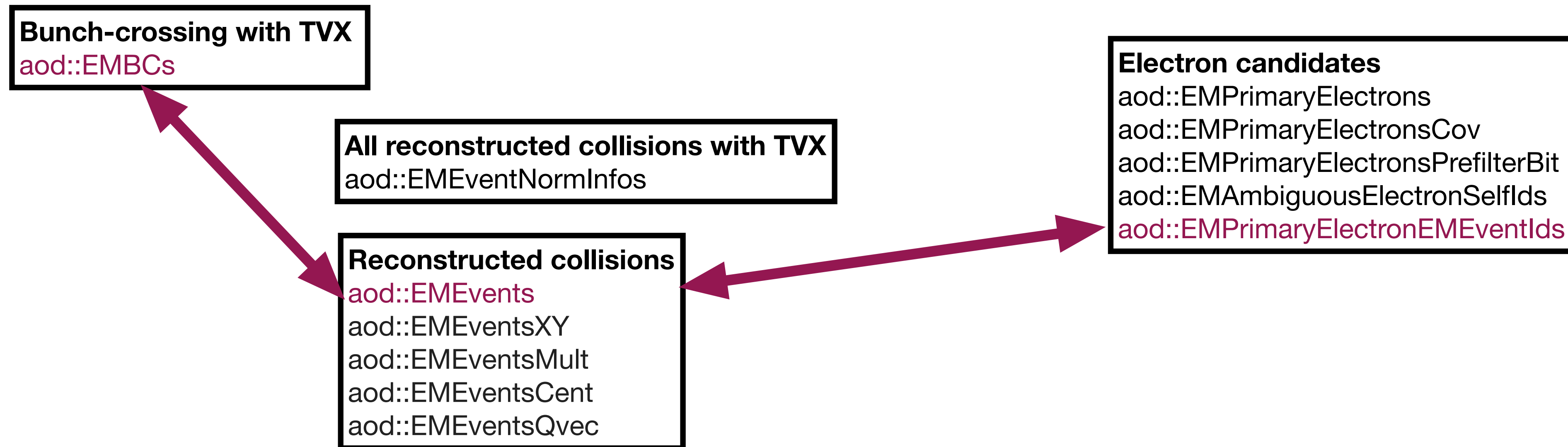
**Done locally on your computer
with some macros/scripts**

**Hyperloop analysis trains
possible two times a day:**

- Run different analysis tasks (single lepton, dilepton, MC/data)
- Changing analysis cuts

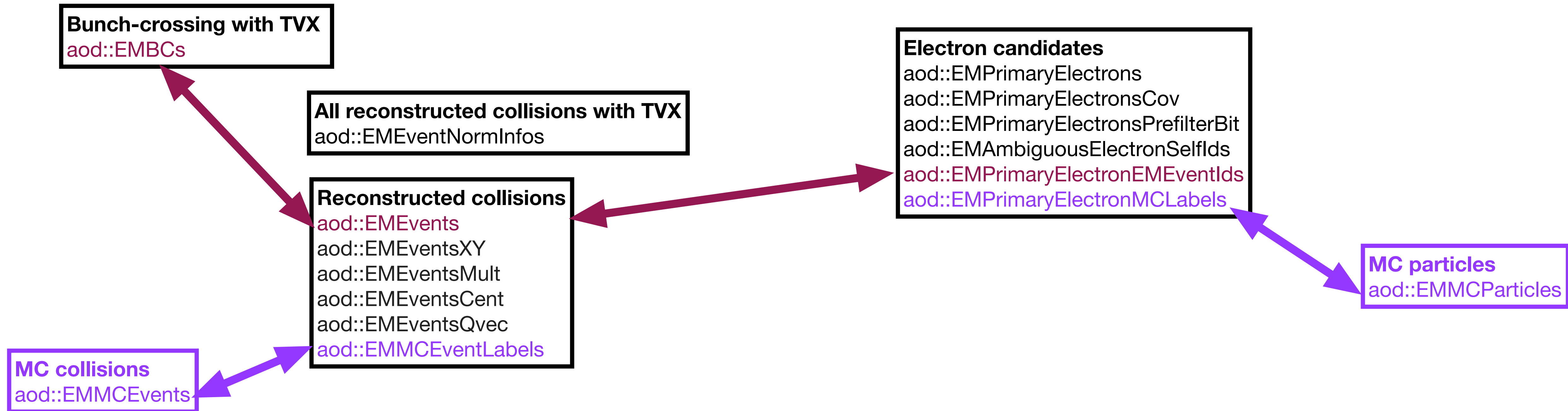
EM data format

- Define in O2Physics/PWGEM/Dilepton/DataModel
- Some tables (small amount):



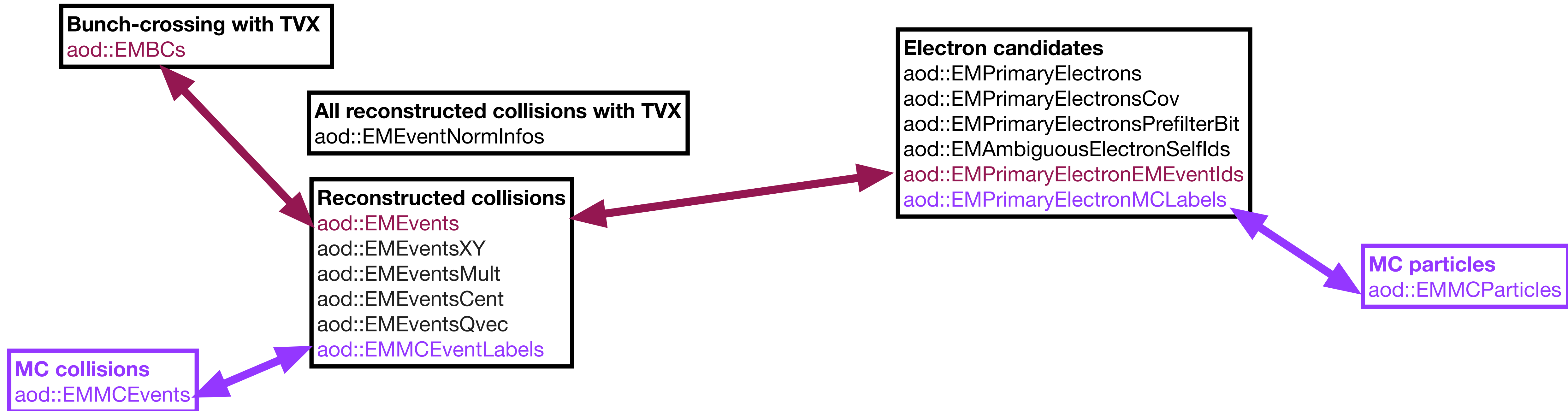
EM data format

- Define in O2Physics/PWGEM/Dilepton/DataModel
- Some tables (small amount):



EM data format

- Define in O2Physics/PWGEM/Dilepton/DataModel
- Some tables (small amount):



- Still changing relatively frequently: aod::EMEvents_003, EMPrimaryElectrons_005 (current versions)
 - **You may need converters running on older PWG-EM derived data for your analysis**
See in O2Physics/PWGEM/Dilepton/Tasks/Converters in O2Physics
See on hyperloop Service Analysis / Service Wagons EM / *Converter*

Example: production of dielectron derived data

Train to produce EM_LHC23_PbPb_pass5_Dielectron_PIDTPCNN:

My Analyses

All Analyses

Dashboard

AliHyperloop

Train Submission

Train Runs

Datasets

DPG Runlists

?

9

Train Run 522829

General

Derived data

Test

Submitted jobs

Grid statistics

Performance comparison

Wagon resources

Package tag

Dataset

Operator

Test status

Target

Train status

Approved by

Train created

Train submitting

All jobs submitted

Train finished

Train duration

Needed resources

Emissions

Job status

Per-run merging

O2Physics::daily-20251007-0000-1

LHC23_PbPb_pass5

dsekihat

Done (output) (browse)

Speedscope

Grid - 2 core

Done

PWG-EM

09 October 2025 at 17:02:07 CEST (based on short train [519811](#))

10 October 2025 at 03:05:25 CEST by agautam

10 October 2025 at 03:26:09 CEST

11 October 2025 at 04:40:18 CEST

1d 1h

10y 197d (wall time), 3.6 TB (output size)

562 kgCO2eq

Total: 44322, Done: 43285, Active: 0, Wait: 0, Error: 1037

Done: 92, Running: 0, Pending: 0, Skipped: 0, Failed: 0

Delete

[See dependent datasets](#)

Settings

☒ slow train

☒ standard derived data

☐ pipelining

☐ automatic submission

Wagons (as of 07/10/25, 14:01 CEST)

createEMEventDielectron_PIDTPCNN_Qvector (dsekihat) [PWGEM-29](#)

EMEventSelection_Dielectron [PWGEM-29](#)

filterEOI_Dummy [PWGEM-29](#)

skimmerPrimaryElectron [PWGEM-29](#)

CorrectedFT0

eventSelectionService

multCentTable

PIDTOFGeneralPurpose_Run3

PIDTPC.Service-NeuralNetwork

Comments

Submitted: Approved by PWG-EM

agautam @ 10/10/25, 03:05 CEST

Example: production of dielectron derived data

- A lot of tasks running to obtain and write the derived PWG-EM data
- **Core wagons:**
 - Defined on hyperloop in Services Analyses / Core Service Wagons
 - Handled by experts (outside of PWG-EM)
 - Some examples:
 - Track2CollisionAssociatorITSOnlyReq → track-to-collision reassociation also done for ITS only tracks
 - PIDTPCService-NeuralNetwork → TPC signals ($n\sigma_e^{\text{TPC}}$..) in the derived data obtained with NN
 - qVectorTable → Calibrated Q Vector
 - **You/convener: need to check that these are the good ones (latest calibrations)**
- **EM wagons:**
 - **You/convener: need to check that selection criteria are looser than those you want in your analysis**

Example: production of dielectron derived data

EM wagons: in O2Physics/PWGEM/Dilepton/TableProducer/

- **o2-analysis-em-event-selection:** eventSelection.cxx
→ **You/convener: need to check the event cuts here.**
- **o2-analysis-skimmer-primary-electron:** skimmerPrimaryElectron.cxx
 - skimmer-primary-electron: produce aod::EMPrimaryElectrons...
 - **You/convener: need to check the selection criteria and if TTCA was used here**
 - prefilter-primary-electron: produce aod::EMPrimaryElectronsPrefilterBit
 - **You/convener: need to check the definition of this prefilter here if you used it in your analysis**
- **o2-analysis-em-filter-eoi:** filterEoi.cxx
→ **You/convener: if not dummy, need “ProcessNorm” in your analysis**
- **o2-analysis-em-create-emevent-dilepton:** createEMEventDilepton.cxx
 - create-emevent-dilepton: produce aod::EMBCs, aod::EMEventNormInfos, aod::EMEvents...
 - associate-dilepton-to-emevent: produce aod::EMPrimaryElectronEMEventIds

Example: production of dielectron derived data

Train to produce EM_LHC23_PbPb_pass5_Dielectron_PIDTPCNN:

My AnalysesAll AnalysesDashboard

AliHyperloop

Train SubmissionTrain RunsDatasetsDPG Runlists?9

Train Run 522829

General

Derived data

Test

Submitted jobs

Grid statistics

Performance comparison

Wagon resources

Max DF size:100000000

Max derived file size:0

Wagon	Origin	Binding	Description	Version
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMEventsCent	EMEVENTCENT	0
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMEventsMult	EMEVENTMULT	0
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMEventsQvec	EMEVENTQVEC	0
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMPrimaryElectronEMEventIds	PRMELMEVENTID	0
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMEvents_003	EMEVENT	3
skimmerPrimaryElectron	AOD	EMAmbiguousElectronSelfIds	EMAMBELSELFID	0
skimmerPrimaryElectron	AOD	EMPrimaryElectronsPrefilterBit	PRMELPFB	0
createEMEventDielectron_PIDTPCNN_Qvector	AOD	EMBCs	EMBC	0
skimmerPrimaryElectron	AOD	EMPrimaryElectrons_005	EMPRIMARYEL	5

Be careful: the derived data (train number) may change, although the name of the dataset did not

Let's have a short loop together on hyperloop

Main part: analysis tasks on derived data

Analysis tasks: in O2Physics/PWGEM/Dilepton/Tasks/

- **Single lepton analyses**
 - singleElectronQC.cxx or singleMuonQC.cxx
 - singleElectronQCMC.cxx or singleMuonQCMC.cxx
- **Dilepton analyses**
 - dielectron.cxx or dimuon.cxx
 - dielectronMC.cxx or dimuonMC.cxx

Your turn...

- **Using your own installation (recommended)**
 - `mkdir -p emtutorial2025 && cd emtutorial2025`
 - The tutorial is working with O2Physics from 19.11.2025 and from 08.11.2025 (different instructions explained)
- **Using lxplus**
 - `ssh -X <your cern account>@lxplus.cern.ch`
 - `$ /cvmfs/alice.cern.ch/bin/alienv enter VO_ALICE@O2Physics::daily-20251108-0000-1`
 - `$ alien-token-init <your cern account>`
 - `$ cd /eos/user/r/rbailhac; with your account`
 - `$ mkdir -p your/emtutorial2025 && cd your/emtutorial2025`
- Take the file `o2tutorial_20251113.tgz` attached on today's indigo page
or `alien_cp alien:///alice/cern.ch/user/r/rbailhac/tutorial/o2tutorial_20251113.tgz file://.`
- `tar -xf o2tutorial_20251113.tgz`

Your turn...

- **CommandLines/command.txt: the command lines to follow, open first this file.**
- Directory structures:
 - config: json file to run on data or MC
 - MC: where to run the command lines for MC
 - Macros: macros to make some plots after running on MC data
 - Datapp: where to run the command lines for pp data
 - DataPbPb: where to run the command lines for Pb—Pb data
 - OutputFiles: some output files in case you do not manage to run (examples of what you should get)
 - Solution: solution of the final exercise (see next slides)

Exercise

To be run on your own computer

Add pair pt as z axis to the histogram dielectron/Pair/same/uls/hMvsPhiV

- Look where the histogram is defined
 - Go first to O2Physics/PWGEM/Dilepton/Tasks/dielectron.cxx
 - Then to O2Physics/PWGEM/Dilepton/Core/Dilepton.h

```
548 // pair info
549 const AxisSpec axis_mass{ConfMllBins, mass_axis_title};
550 const AxisSpec axis_pt{ConfPtllBins, pair_pt_axis_title};
551 const AxisSpec axis_dca{ConfDCA1Bins, pair_dca_axis_title};
552 const AxisSpec axis_y{ConfYllBins, pair_y_axis_title};
553
554 if (cfgAnalysisType == static_cast<int>(o2::aod::pwgem::dilepton::utils::pairutil::DileptonAnalysisType::kQC)) {
555     fRegistry.add("Pair/same/uls/hs", "dilepton", kTHnSparseD, {axis_mass, axis_pt, axis_dca, axis_y}, true);
556     fRegistry.add("Pair/same/uls/hDeltaEtaDeltaPhi", "#Delta#eta-#Delta#varphi between 2 tracks;#Delta#varphi (rad.);#Delta#eta;", kTH2D, {{180, -M_PI, M_PI}, {400, -2, +2}}, true);
557
558     if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
559         fRegistry.add("Pair/same/uls/hMvsPhiV", "m_{ee} vs. #varphi_{V};#varphi_{V} (rad.);m_{ee} (GeV/c^{2})", kTH2D, {{90, 0, M_PI}, {100, 0.0f, 1.0f}}, true); // phiv is only for dielectron
560         fRegistry.add("Pair/same/uls/hMvsUpAng", "m_{ee} vs. angle between 2 tracks;#omega (rad.);m_{ee} (GeV/c^{2})", kTH2D, {{90, 0, M_PI}, {100, 0.0f, 1.0f}}, true);
561         fRegistry.add("Pair/same/uls/hDCA1vsDCA2", "DCA of leg1 vs. DCA of leg2;DCA1(#sigma);DCA2 (#sigma)", kTH2D, {{100, 0, 10.0}, {100, 0, 10}}, true);
562     }
563     fRegistry.addClone("Pair/same/uls/", "Pair/same/lsp/");
564     fRegistry.addClone("Pair/same/uls/", "Pair/same/lsm/");
565     fRegistry.addClone("Pair/same/", "Pair/mix/");
566 } else if (cfgAnalysisType == static_cast<int>(o2::aod::pwgem::dilepton::utils::pairutil::DileptonAnalysisType::kUPC)) {
567     const AxisSpec axis_aco{10, 0, 1.f, "#alpha = 1 - #frac{#varphi_{l^{+}} - #varphi_{l^{-}}}{#pi}";
568     const AxisSpec axis_asym_pt{10, 0, 1.f, "A = #frac{|p_{T,l^{+}} - p_{T,l^{-}}|}{|p_{T,l^{+}} + p_{T,l^{-}}|}";
569     const AxisSpec axis_dphi_e_ee{18, 0, M_PI, "#Delta#varphi = #varphi_{l} - #varphi_{ll} (rad.)";
570
```

Exercise

To be run on your own computer

Add pair pt as z axis to the histogram dielectron/Pair/same/uls/hMvsPhiV

- Implement
 - Definition

```
const AxisSpec axis_pt{ConfPtllBins, pair_pt_axis_title};
const AxisSpec axis_dca{ConfDCAllBins, pair_dca_axis_title};
const AxisSpec axis_y{ConfYllBins, pair_y_axis_title};

if (cfgAnalysisType == static_cast<int>(o2::aod::pwgem::dilepton::utils::pairutil::DileptonAnalysisType::kQC)) {
    fRegistry.add("Pair/same/uls/hs", "dilepton", kTHnSparseD, {axis_mass, axis_pt, axis_dca, axis_y}, true);
    fRegistry.add("Pair/same/uls/hDeltaEtaDeltaPhi", "#Delta#eta-#Delta#varphi between 2 tracks;#Delta#varphi (rad.);#Delta#eta;", kTH2D, {{180, -M_PI, M_PI}, {400, -2, +2}}, true);

    if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
        fRegistry.add("Pair/same/uls/hMvsPhiV", "m_{ee} vs. #varphi_{V} vs p_{T,ee};#varphi_{V} (rad.);m_{ee} (GeV/c^{2});p_{T,ee} (GeV/c)", kTH3D, {{90, 0, M_PI}, {100, 0.0f, 1.0f}, {50, 0.0f, 5.0f}}, true); // phiv is only for dielectron
        fRegistry.add("Pair/same/uls/hMvsOpAng", "m_{ee} vs. angle between 2 tracks;#omega (rad.);m_{ee} (GeV/c^{2})", kTH2D, {{90, 0, M_PI}, {100, 0.0f, 1.0f}}, true);
        fRegistry.add("Pair/same/uls/hDCA1vsDCA2", "DCA of leg1 vs. DCA of leg2;DCA1(#sigma);DCA2 (#sigma)", kTH2D, {{100, 0, 10.0}, {100, 0, 10}}, true);
    }
    fRegistry.addClone("Pair/same/uls/", "Pair/same/lsp/");
    fRegistry.addClone("Pair/same/uls/", "Pair/same/lsmm/");
    fRegistry.addClone("Pair/same/", "Pair/mix/");
} else if (cfgAnalysisType == static_cast<int>(o2::aod::pwgem::dilepton::utils::pairutil::DileptonAnalysisType::kUPC)) {
    const AxisSpec axis_aco{10, 0, 1.f, "#alpha = 1 - #frac{#varphi_{l^{+}} - #varphi_{l^{-}}}{#pi}"};
    const AxisSpec axis_asym_pt{10, 0, 1.f, "A = #frac{|p_{T,l^{+}} - p_{T,l^{-}}|}{|p_{T,l^{+}} + p_{T,l^{-}}|}"};
    const AxisSpec axis_dphi_e_ee{18, 0, M_PI, "#Delta#varphi = #varphi_{l} - #varphi_{ll} (rad.)"};

    std::string frameName = "CS";
    if (cfgPolarizationFrame == 0) {
        frameName = "CS";
    } else if (cfgPolarizationFrame == 1) {
```


Exercise

To be run on your own computer

Add pair pt as z axis to the histogram dielectron/Pair/same/uls/hMvsPhiV

- Implement
 - Definition
 - Filling ULS

```
else if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDimuon) {
    pair_dca = pairDCAQuadSum(fwdDcaXYinSigma(t1), fwdDcaXYinSigma(t2));

    f (cfgAnalysisType == static_cast<int>(o2::aod::pwgem::dilepton::utils::pairutil::DileptonAnalysisType::kQC)) {
        float deta = t1.sign() * v1.Pt() > t2.sign() * v2.Pt() ? v1.Eta() - v2.Eta() : v2.Eta() - v1.Eta();
        float dphi = t1.sign() * v1.Pt() > t2.sign() * v2.Pt() ? v1.Phi() - v2.Phi() : v2.Phi() - v1.Phi();
        o2::math_utils::bringToPMPi(dphi);

        float phiv = o2::aod::pwgem::dilepton::utils::pairutil::getPhivPair(t1.px(), t1.py(), t1.pz(), t2.px(), t2.py(), t2.pz(), t1.sign(), t2.sign(), d_bz);
        float opAng = o2::aod::pwgem::dilepton::utils::pairutil::getOpeningAngle(t1.px(), t1.py(), t1.pz(), t2.px(), t2.py(), t2.pz());

        if (t1.sign() * t2.sign() < 0) { // ULS
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDeltaEtaDeltaPhi"), dphi, deta, weight);
            if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
                fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hMvsPhiV"), phiv, v12.M(), v12.Pt(), weight);
                fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hMvsOpAng"), opAng, v12.M(), weight);
                if (cfgDCAType == 1) {
                    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
                } else if (cfgDCAType == 2) {
                    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaZinSigma(t1), dcaZinSigma(t2), weight);
                }
            }
        } else if (t1.sign() > 0 && t2.sign() > 0) { // LS++
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDeltaEtaDeltaPhi"), dphi, deta, weight);
            if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
                fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsPhiV"), phiv, v12.M(), weight);
                fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsOpAng"), opAng, v12.M(), weight);
                if (cfgDCAType == 1) {
                    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
                }
            }
        }
    }
}
```


Exercise

To be run on your own computer

Add pair pt as z axis to the histogram dielectron/Pair/same/uls/hMvsPhiV

- Implement
 - Definition
 - Filling LS mm

```
if (cfgDCAType == 1) {
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
} else if (cfgDCAType == 2) {
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaZinSigma(t1), dcaZinSigma(t2), weight);
}
}
} else if (t1.sign() > 0 && t2.sign() > 0) { // LS++
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDeltaEtaDeltaPhi"), dphi, deta, weight);
    if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsPhiV"), phiv, v12.M(), v12.Pt(), weight);
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsOpAng"), opAng, v12.M(), weight);
        if (cfgDCAType == 1) {
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
        } else if (cfgDCAType == 2) {
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDCA1vsDCA2"), dcaZinSigma(t1), dcaZinSigma(t2), weight);
        }
    }
} else if (t1.sign() < 0 && t2.sign() < 0) { // LS--
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hDeltaEtaDeltaPhi"), dphi, deta, weight);
    if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hMvsPhiV"), phiv, v12.M(), v12.Pt(), weight);
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hMvsOpAng"), opAng, v12.M(), weight);
        if (cfgDCAType == 1) {
```


Exercise

To be run on your own computer

Add pair pt as z axis to the histogram dielectron/Pair/same/uls/hMvsPhiV

- Implement
 - Definition
 - Filling LS pp

```
if (cfgDCAType == 1) {
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
} else if (cfgDCAType == 2) {
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("uls/hDCA1vsDCA2"), dcaZinSigma(t1), dcaZinSigma(t2), weight);
}
}
} else if (t1.sign() > 0 && t2.sign() > 0) { // LS++
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDeltaEtaDeltaPhi"), dphi, deta, weight);
    if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsPhiV"), phiv, v12.M(), v12.Pt(), weight);
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hMvsOpAng"), opAng, v12.M(), weight);
        if (cfgDCAType == 1) {
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDCA1vsDCA2"), dcaXYinSigma(t1), dcaXYinSigma(t2), weight);
        } else if (cfgDCAType == 2) {
            fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lspp/hDCA1vsDCA2"), dcaZinSigma(t1), dcaZinSigma(t2), weight);
        }
    }
} else if (t1.sign() < 0 && t2.sign() < 0) { // LS--
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hs"), v12.M(), v12.Pt(), pair_dca, v12.Rapidity(), weight);
    fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hDeltaEtaDeltaPhi"), dphi, deta, weight);
    if constexpr (pairtype == o2::aod::pwgem::dilepton::utils::pairutil::DileptonPairType::kDielectron) {
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hMvsPhiV"), phiv, v12.M(), v12.Pt(), weight);
        fRegistry.fill(HIST("Pair/") + HIST(event_pair_types[ev_id]) + HIST("lsmm/hMvsOpAng"), opAng, v12.M(), weight);
        if (cfgDCAType == 1) {
```