Subject:
Fwd: Some information on matching datamodels
From:
Andrea Ferrero <andrea.ferrero@cern.ch>
Date:
5/8/25, 9:35 AM
To:
"alice-mft-matching (for alice mft matching crew)" <alice-mft-matching@cern.ch>, "alice-dimuon (Dimuon)" <alice-dimuon@cern.ch>, Kacper Jurek <kacperjur@student.agh.edu.pl>, "kaugust@student.agh.edu.pl" <kaugust@student.agh.edu.pl>, Jacek Kitowski <kito@agh.edu.pl>, Witold Dzwinel <dzwinel@agh.edu.pl>, Sahil Upadhyaya <sahil.upadhyaya@cern.ch>, Jacek Tomasz Otwinowski <jacek.tomasz.otwinowski@cern.ch>

Dear Maurice,

Thanks a lot, this is super-useful!

I am adding the Krakow colleagues in the loop, since they are not yet part of the matching mailing list (I will add them later today if they have no objections).

Cheers,
Andrea

Begin forwarded message:

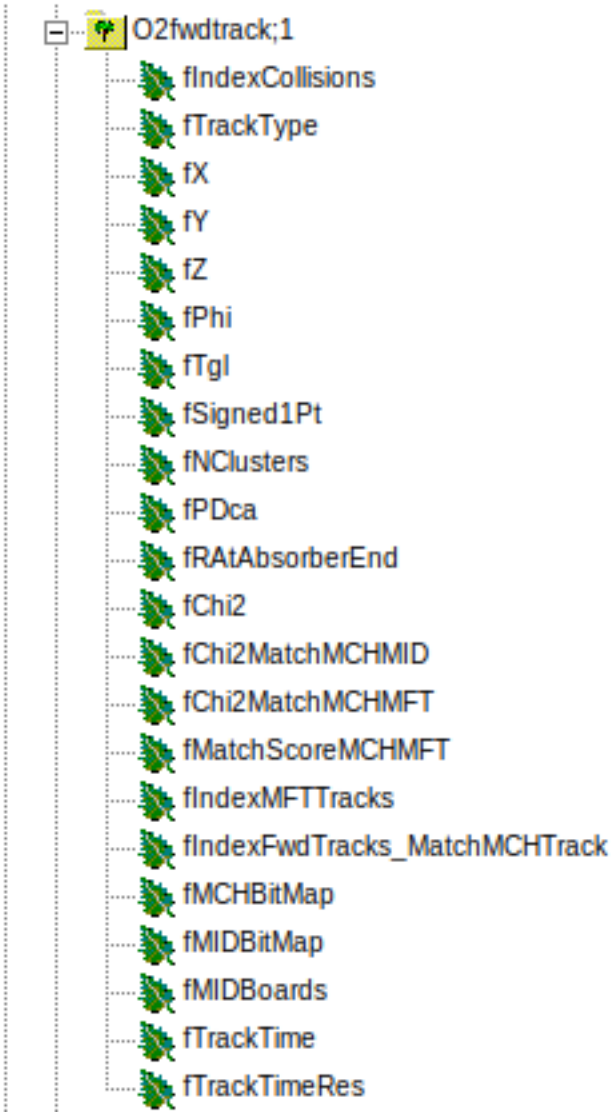
From: Maurice Coquet <maurice.louis.coquet@cern.ch>
Subject: Some information on matching datamodels
Date: 7 May 2025 at 21:24:28 CEST
To: "alice-mft-matching (for alice mft matching crew)" <alice-mft-matching@cern.ch>, <alice-dimuon@cern.ch>

Dear all,

Please fine below an updated version of the information on datamodel that I circulated a few months ago:

We are using the AOD files which are the output of the reconstruction. You can find some recent ones which were produced in a special reconstruction pass of the pp ref run dedicated to matching studies: https://alimonitor.cern.ch/prod/jobs.jsp?t=31720.

The first main table is the fwdtrack one:



An important point about this table is that it contains at the same time standalone tracks which we want to match (MCH-MID tracks), **as well as already matched tracks** (MFT-MCH-MID tracks), for which a first matching attempt was already performed during the reconstruction. What we are trying to do is to see how this matching could be improved at analysis level, using information which is stored inside the AO2Ds.

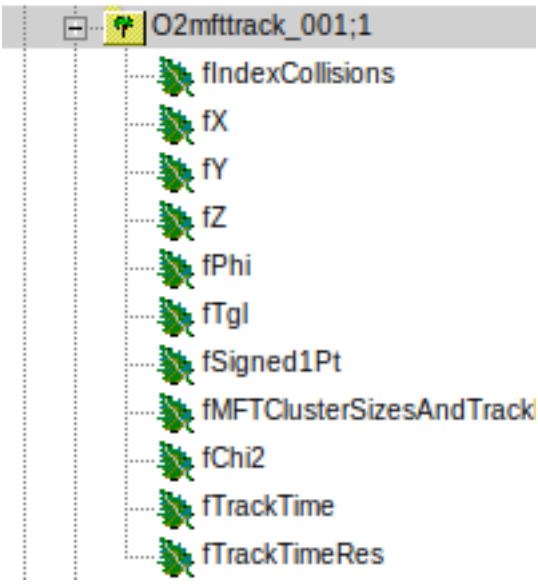
There you see different branches. I explain the main ones:

- fIndexCollisions: Index pointing to the collision to which the track is associated
- fTrackType: 0 -> this is an MFT-MCH-MID matched track, 2-> this is an MFT-MCH track, 3-> this is an MCH-MID track, 4-> this is an MCH track. Note that in AO2Ds, the MCH-MID tracks are first written in AO2Ds before the matching with MFT. Then after the matching is done, the matched muons are also written. This means that you should have roughly the same number of type=0 tracks than type=3 tracks. (similary for type=2 and type=4).
- fX, fY, fZ, fPhi, fTgl, fSigned1Pt : these are the kinematic properties of the track (X,Y,Z,phi,tan(lambda),q/pt) (I attach to the mail a document explaining

in more details these coordinates). An important point is that these are the parameters of the track **evaluated at the plane of the detector closest** to the interaction point. So for MCH-MID tracks, those are the variables of the track at the first MCH plane, while for MFT-MCH-MID tracks, these are the variables at the first MFT plane.

- fChi2: this is the Chi2 of the track after the refit. It is different from the chi2 matching score (see below)
- fChi2MatchMCHMFT : this is the chi2 score of the matching between MCH and MID. If the track is not matched with MFT, than it is -1. When the default "chi2 matching" method is used for the matching during the reconstruction, this is the same thing as the matching score
- fIndexMFTTracks : when the track is matched with MFT, this is an index which points to the MFT track used to construct the track, in the MFT track table
- fIndexFwdTracks_MatchMCHTrack : same thing but pointing to MCH tracks, in the same fwdtrack table
- fTrackTime : The timing information attached to the track. This is an important information for MCH-MID tracks, since it is based in this timing information that we can perform a first match between MFT and MCH-MID tracks based on time compatibility. One must be careful : **the time stored in this table is relative to the time of the collision to which the track was associated**
- fTrackTimeRes : this is the timing resolution for each track, which should also be used to determine time compatibility.
- fNClusters : this is the number of clusters which build up each track. Something important to keep in mind: in the case of global muons (MFT-MCH-MID), this variable reflects only the number of clusters of the associated MCH-MID track, i.e. it does not contain the number of clusters from MFT. To get the total number of clusters of a global track, one should add the number of MFT clusters, which can be retrieved as explained below.

Finally, there is the MFT track table :

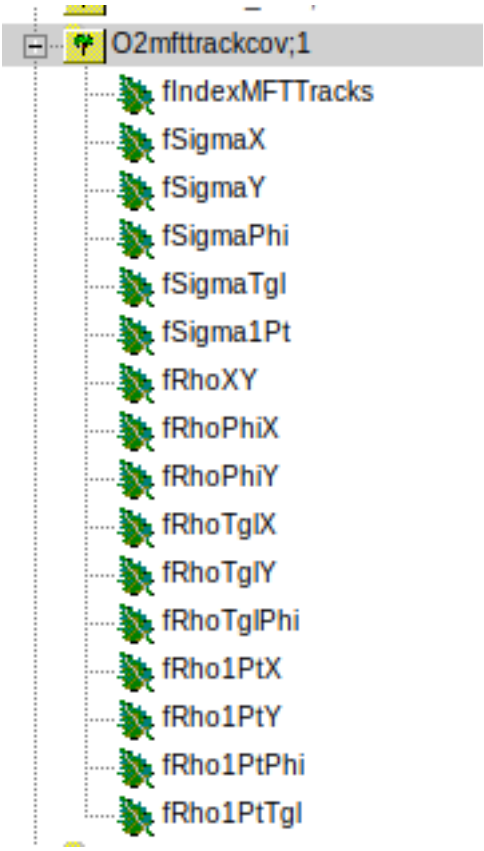


The structure is quite similar to the one of the fwdtrack table, with the different branches having the same meaning. The main differences are that here all the track parameters are all evaluated at the MFT layer closest to the interaction point, and there is also an additional branch "fMFTClusterSizesAndTrackFlags" which encodes several information such as the size of the clusters which made up this MFT track, as well as which tracking algorithm was used.

Cluster information are also available for MCH tracks. They are stored in a separate table called "O2fwdtrkcl". It contains an index pointing to the muon track (in the fwdtrack table) to which a given clusters is associated, and the (X,Y,Z) position of the cluster.

Another table related to forward track is also inside the AOD files : the O2fwdtrackcov table, which contains the covariance matrix of the tracks.

For MFT, the covariance matrices are stored only for tracks which were matched with a muon one to give a global muon (in order to save space).



This table cannot be used as the O2fwdtrackcov table, i.e. it cannot be joined with the track parameters table because they have different sizes. In order to properly access the information, one has to first retrieve the index of the considered MFT track, and retrieve the entry of this covariance table corresponding to this index stored in "fIndexMFTTracks".

Here is also a link to the code which is currently used for the matching at reconstruction level :

https://github.com/AliceO2Group/AliceO2/blob/dev/Detectors/GlobalTracking/src/MatchGlobalFwd.cxx

One important aspect of the matching is the propagation of the tracks at a common matching plane. I am not sure how it will turn out for the ML implementation of the matching, but for the chi2 matching, which is the default in the reconstruction, both the MFT track and the MCH-MID track must be propagated to a common plane (at a fix Z value) so that we can compare the parameters of both tracks. You can see how this done in the matching code : https://github.com/AliceO2Group/AliceO2/blob/dev/Detectors/GlobalTracking/src/MatchGlobalFwd.cxx#L180-L184

In some recent productions, we store not only the best matching candidate, but a given number of best candidates (5 for pp collisions and 20 for PbPb). This is the case for the special pp ref reconstruction mentioned above. One can still use these types of productions in a "normal" way by selecting, for a given muon track, the matching candidate with the best chi^2. This selects the best matching candidates only. One way to do this is shown in the following code of O2 DQ : https://github.com/AliceO2Group/O2Physics/blob/master/PWGDQ/TableProducer/tableMakerMC_withAssoc.cxx#L868-L888

Don't hesitate to contact us if you have any questions.

Bests,

Maurice