PRS-μ, CMS week

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Muon reco in ORCA 8 & usage of DST objects

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Outline

- Usage of DST objects:,
  - Which algorithm are available,
  - How to access to reconstructed muons,
  - Which information are available,
- Actual performances,
- Future,

Usage of DST objects

From ORCA 7_7_0 DST are available and written in ORCA

- Purpose: have reconstructed objects persistent in DB for easy retrieving and usage
- Rec Objects (aka Analysis Obj, or Physics Obj) are meant to be used directly by final user (analyst) to perform physics analysis
- Track, vertices, electron, **muons**, . . .
- First prototype prepared for DC04 production
- large effort on technical side!
- Persistency uses COBRA/POOL to write RecObj directly to DB
- Automatic and easy access to all event related information within the same framework

How to access a reconstructor

Only one interface supported, common to **all** DST objects
Easy access to reconstructed muons

```
RecCollection<RecMuon>
  theCollection(
    RecQuery("<Name of Reconstructor>"));
for (RecCollection<RecMuon>::const_iterator
  it=theCollection.begin();
  it!=theCollection.end(); ++it)
    cout << "RecMuon: " << (**it) << endl;
```

<**Name of Reconstructor**> can be any of the previous slide

How to access a reconstructor (II)

- Not the full story: more sophisticated access are available:
  - An algorithm can have components (e.g. L3 reco has L2 reco);
  - Can have parameters (such as χ^2 cuts, p_t threshold, etc..), as well as its components;
  - Algorithms have version;
  - User can define any of this in its `RecQuery`, in order to perform a reconstruction according to his/her wishes;
  - Parameters are also configurable via usual `.orcarc`
- A standard set of components and parameter is defined for any algorithm (as in previous slide example);

How to access a reconstructor (III)

- In DST, reconstruction with standard components and parameters is written
- If user just ask that, simply read the stored result (very fast!!!)
- If user changes something, the reconstruction is redone, following user specification:
  - Need access to input data for reconstruction (namely Digis)
  - Obviously slower!

More information on RecQuery, parameters setting and components

PRSμ, 10/2/2004, Norbert Muon persistent object

RPROM, 15/3/2004, Teddy RecCollections

Muon reconstructor

Which reconstructors are available for Muons:

L2MuonReconstructor for HLT: uses muon only

L3MuonReconstructor for HLT: uses muon and Tk

StandAloneMuonReconstructor for off-line: uses only Muon detector, internal seeds from DT-CSC segments.

GlobalMuonReconstructor for off-line analysis: uses Muon and tracker.

What information are available

- A reconstructed muon is more than just a track
- Dedicated description `RecMuon`: fully documented on ORCA Reference Manual
  - State at innermost and outermost detector used
  - State at closest approach to vertex in the transverse plane (can be void)
  - State constrained at beam spot (can be void)
  - Charge
  - Muon only track (if present)
  - Tracker only track (if present)
  - χ^2, NDoF, ...
  - Isolation (set to -999 for cited algorithms, see after)

Isolation

- Access **exactly as above**, name of the algo changes
- Output again a `RecMuon`, but with isolation info filled
- `float RecMuon::isolation()`
- Several isolation algorithms are available

L2MuonCaloIsolator for HLT: uses calo

L3MuonTrackerIsolator for HLT: uses Tk (technicality: uses global/unconditioned reconstruction instead of regional/conditioned as before – will be fixed asap)

MuonCaloEtIsolator for offline: return the $\sum E_t$

MuonCaloEffIsolator return discriminating parameter $[0, 1]$;

MuonTrackerPtIsolator return the $\sum p_t$

MuonTrackerEffIsolator as above

Information not (yet) available

- Individual RecHits used for muon fit not stored (yet)
  - Not possible to refit the muon track, and/or remove some of the RecHits
  - Foreseen and prototype under development: not enough time to put into DC04
- All RecHits (also not used), to eventually add to the muon track, or for tracker track matching
  - Once track RecHits will be writable, all can be: must decide which we want to store
- Track seed: every reconstruction start from a seed, which is a component of the algo. Foreseen to save the seed together with the track

We expect feedback from all users accessing and using RecMuon from DST produced during DC04: what is present now is a first prototype, to be improved by user experience

Algo performances

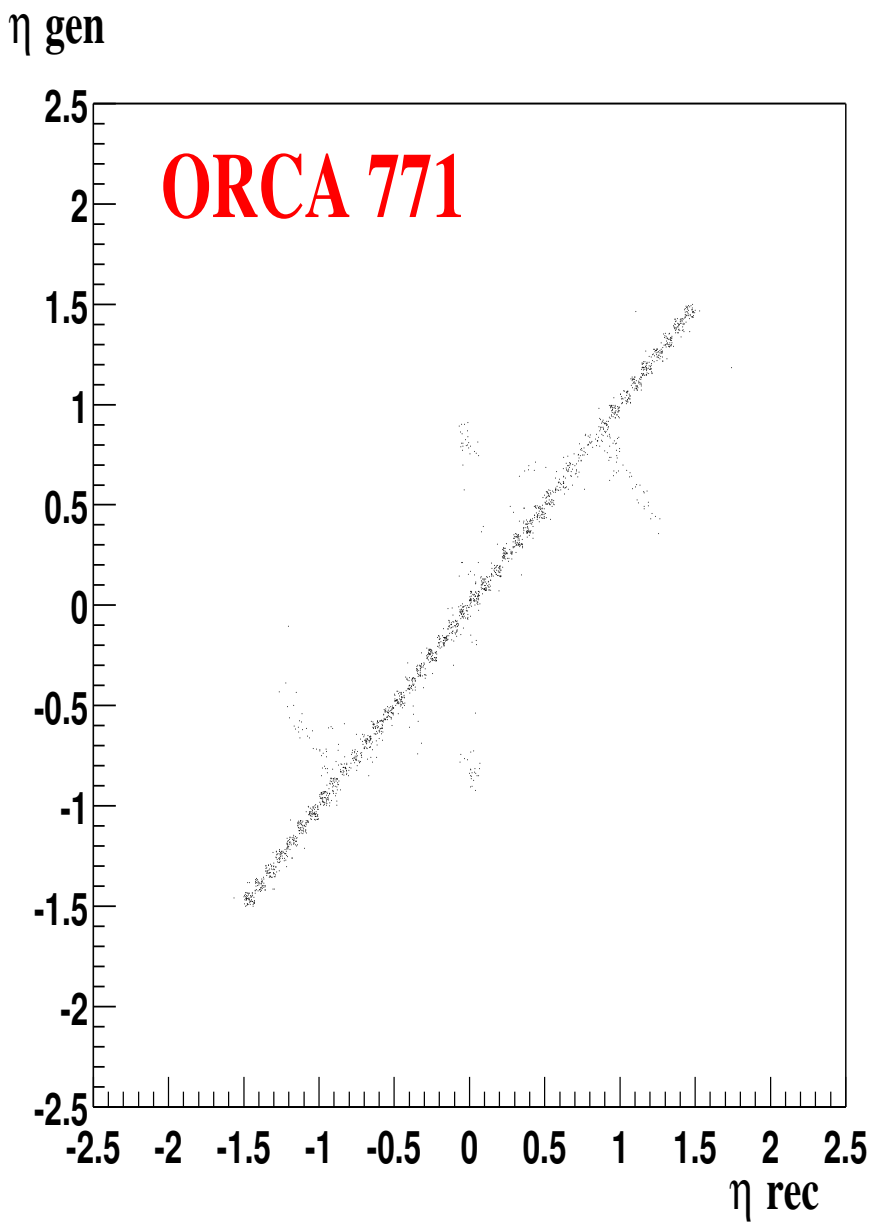
- Large effort to technically write persistently reconstruction object on DST in time for DC04
- Limited effort to improve the algorithms due to overload of key people
- Result: we do write RecMuon, but the reconstruction algorithms need more work to be improved and optimized!
- We already know some weakness on actual off-line reconstruction
  - Most problematic part is the Seed generation: shows inefficiency in the overlap region, not clear how well suited for di-muon events;
  - Known problem in reconstructing high energy muons: problem in case of hard showering;

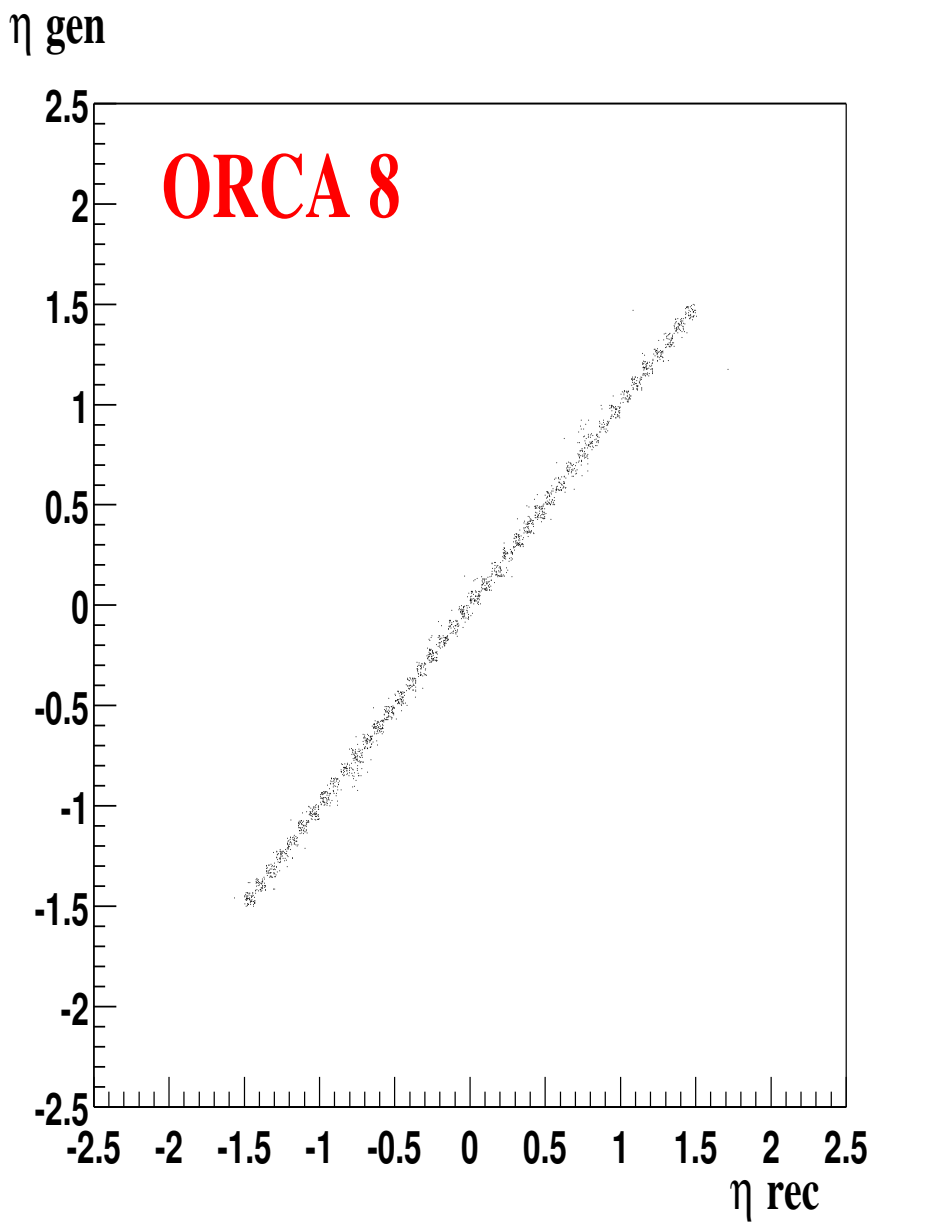
Algo performances (II)

With respect to ORCA 771 several fixes and improvements (within the really tight schedule):

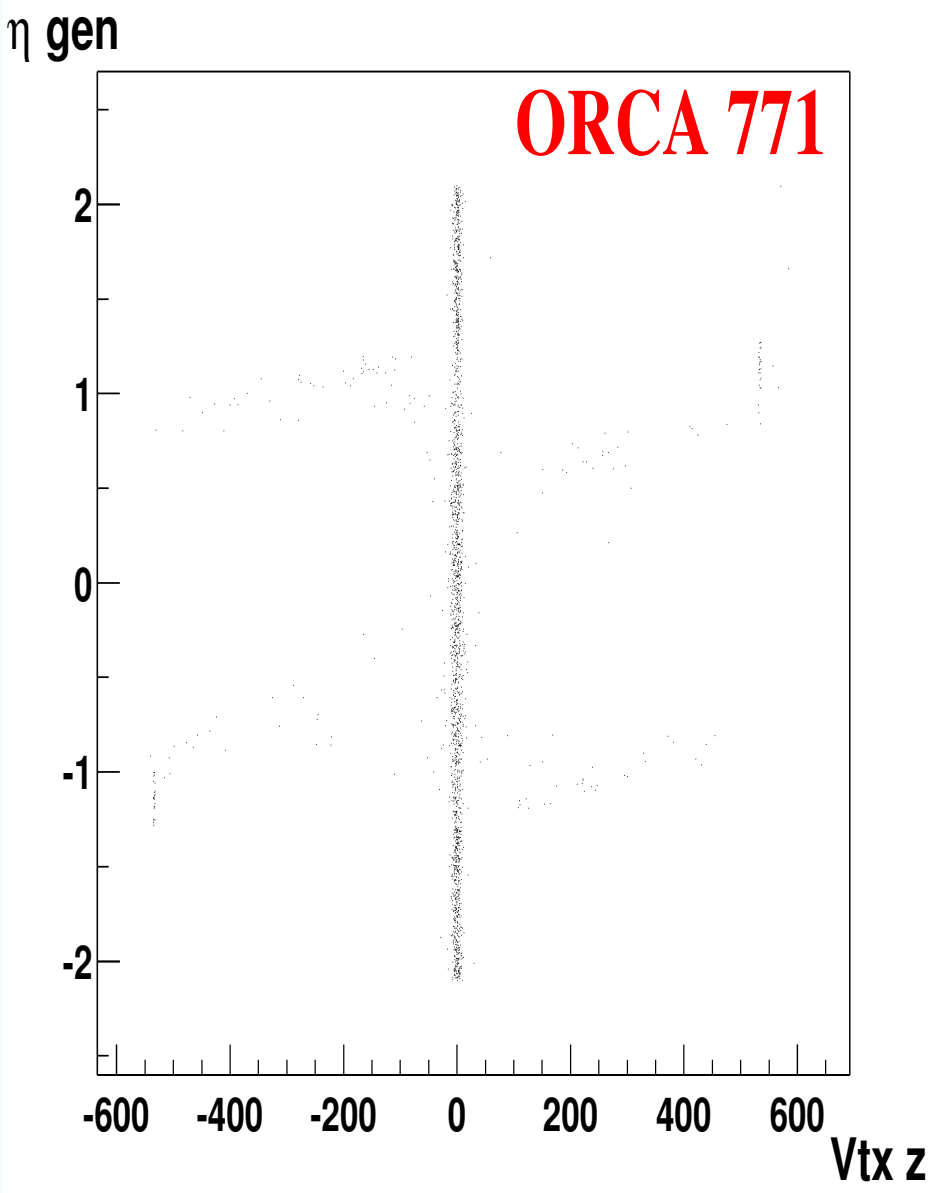
- Seed Generation: for all seed (DT and CSC) uses segment position for η assignment, and not direction.
- Accept more seeds to start the pattern recognition: previously only the "nominal" best was used. Increases efficiency in particular on overlap region: could increase ghost rate (not yet tested on large sample) ...
- Bug fix on DT segment orientation for particular pattern;
- Crash reported to **savannah** by *Ivan Belotelov*: for very crowded DT chamber ($\mathcal{O}(100)$ hits) segment reco could crashes for huge combinatorics. If $N_hits > 200$ give up. Should think to something smarter in such cases, maybe a center-of-weight clusterizer...
- Result in better quality of StandAlone muons and so in higher efficiency for Global Reconstructor
- clearly more work to be done

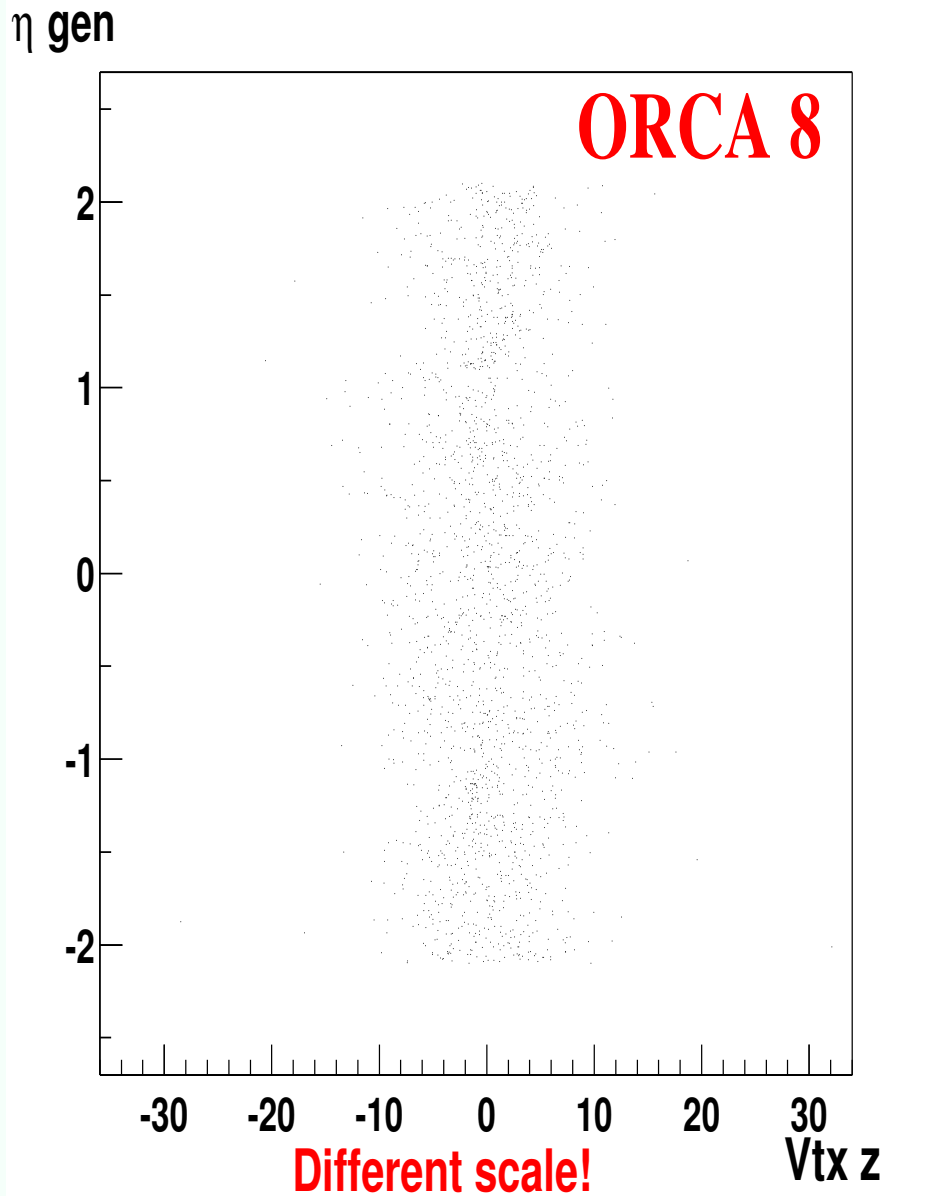
η gen vs rec ORCA 771 and 8



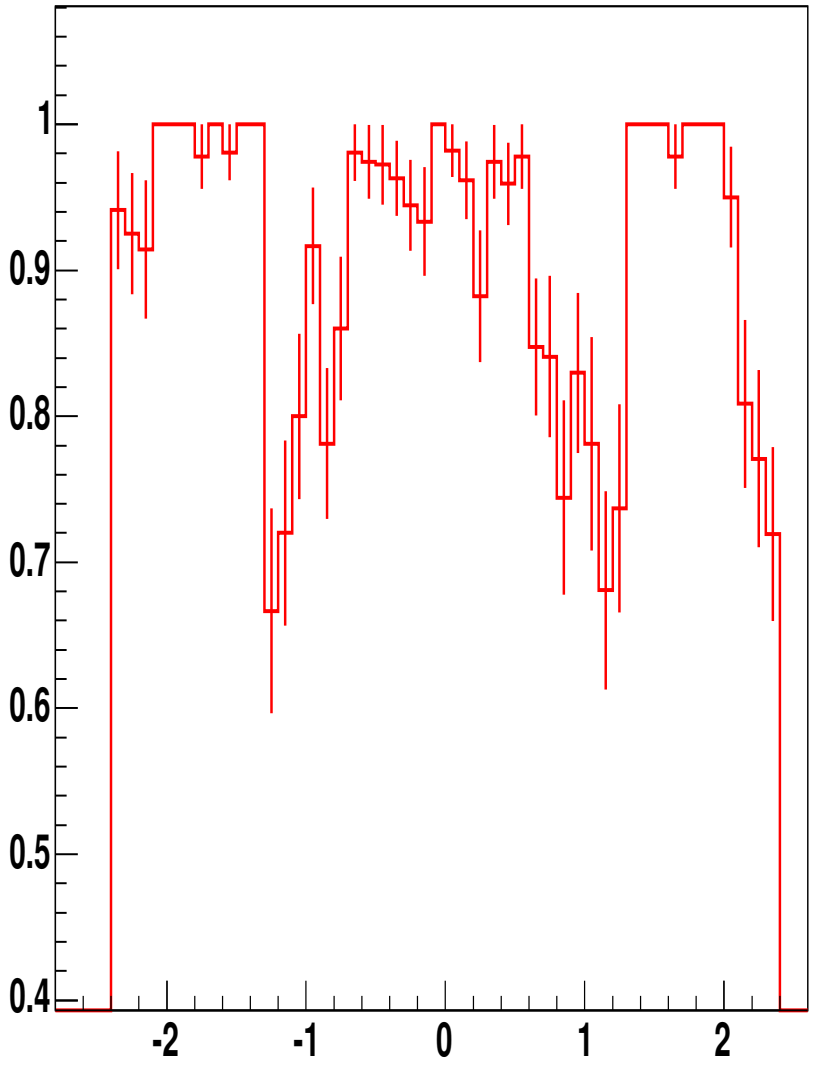


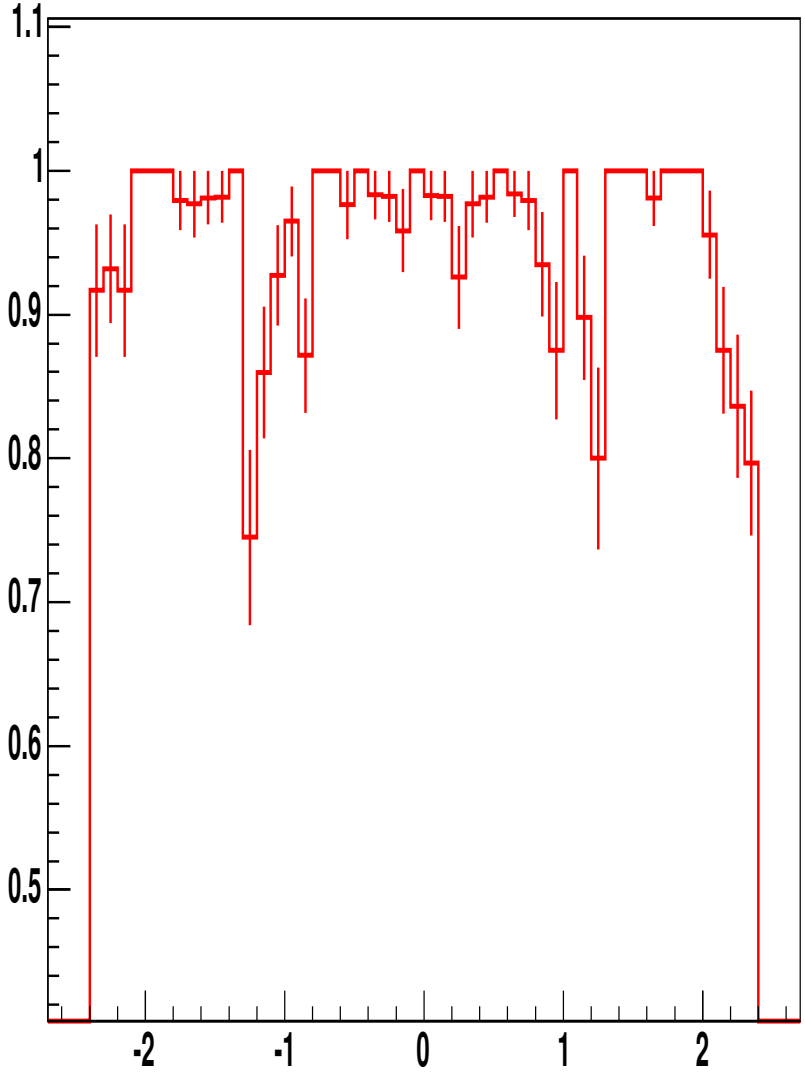
z at IP ORCA 771 and 8





ϵ Global reco ORCA 771 and 8





Conclusion and future

- First version of DST usable by users/analysts with reconstructed objects
- Reconstructed muon with and without isolation available for public use
- Easy and fast access: user analysis are really doable without much user expertize
- Need feedback from user on RecMuon access! Do user need more, different infos ...
- Reconstruction algorithm still in development: some weak points identified, need work to find solutions
- Need user feedback also here, improved algorithms and smart ideas are even more welcomed!
- For new user: follow ORCA tutorial, new series will start this week (DST foreseen on 2/4, Muon on 15/04)