New Track Event Model HowTo

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** List of packages available*

** How to get started*

- praticalities

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List of Packages

Available in CVS

-> be aware that some repackaging is to be made (c.f. yesterday)

- Event/
  - TrackEvent
- Trg/
  - TrgConverters
- Kernel/
  - LHCbKernel
  - LHCbInterfaces
- Tr/
  - TrackFitEvent
  - TrackExtrapolators
  - TrackProjectors
  - TrackTools
  - TrackFitter
  - TrackIdealPR
  - TrConverters
  - TrackPython

(about 70 files adapted / invented … more to come …)

How to get started?

Practicalities

- Packages of new event model not yet part of official LHCb sofware releases
  - *Exceptions: Kernel/Xxx, Event/TrackEvent*
  - *To be done (very) soon*
- Need to getpack each package required in user code
- Code is evolving / being modified, improved, etc.
  - *expect need for regular "getpack's"*

Finding information

- Doxygen documentation of "at-present" classes and algorithms

  Regularly updated at

  http://cern.ch/eduardo.rodrigues/lhcb/tracking/event_model
- CVS repository is the place to check for latest versions
- Jose and myself are always happy to answer questions/doubts/…

How to get started?

Requirements files

```
// if access needed to Tracks
        use   TrackEvent   v*   Event
// if access needed to XxxMeasurements
        use   TrackFitEvent  v*   Tr
// for using general tools, extrapolators, …
        use   TrackExtrapolators   v*   Tr
        use  TrackTools    v*   Tr
```

Guidelines

Tracks

- Base class for tracks
- Other track classes may inherit from it, say internally in pattern recognition algorithms, if really needed
  - *Should be avoided as much as possible …*
  - *Additional features may be introduced in the base class, instead?*
- Main source of information (see later)
  - *No need to go through the states as in old event model*
  - *"physics state" for getting p, pt, …, in many practical cases*

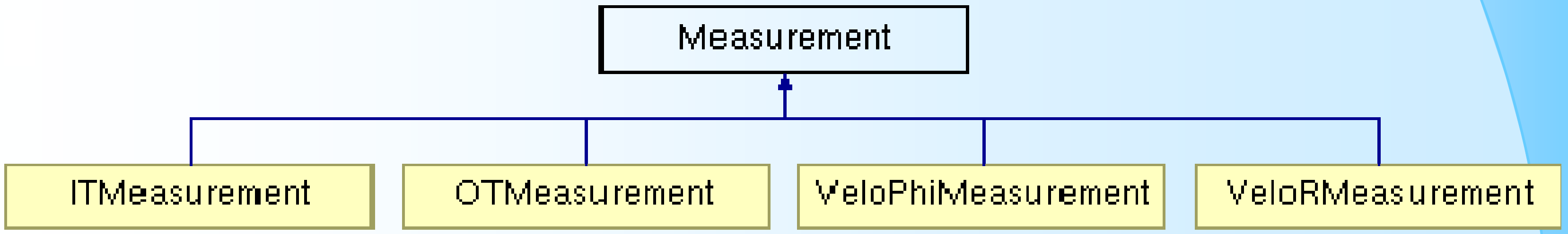
States

- Internal representation of the track, at different positions
- Not need in most cases
  - *The extrapolators do the job for you (see later)*

Guidelines

Measurements

- **Used mainly in fitting code**
- **Internal, not stored on DST**
- **Can be (re)produced from the LHCbIDs, stored on the DST**
- **Dedicated measurements for each sub-detector (e.g. OTMeasurement) are dealt with by the dedicated projectors (see later)**
  - ***User is encouraged to use the base class Measurement, together with the TrackMasterProjector***



Measurement

ITMeasurement

OTMeasurement

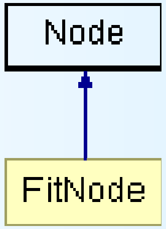
VeloPhiMeasurement

VeloRMeasurement

Guidelines

Nodes

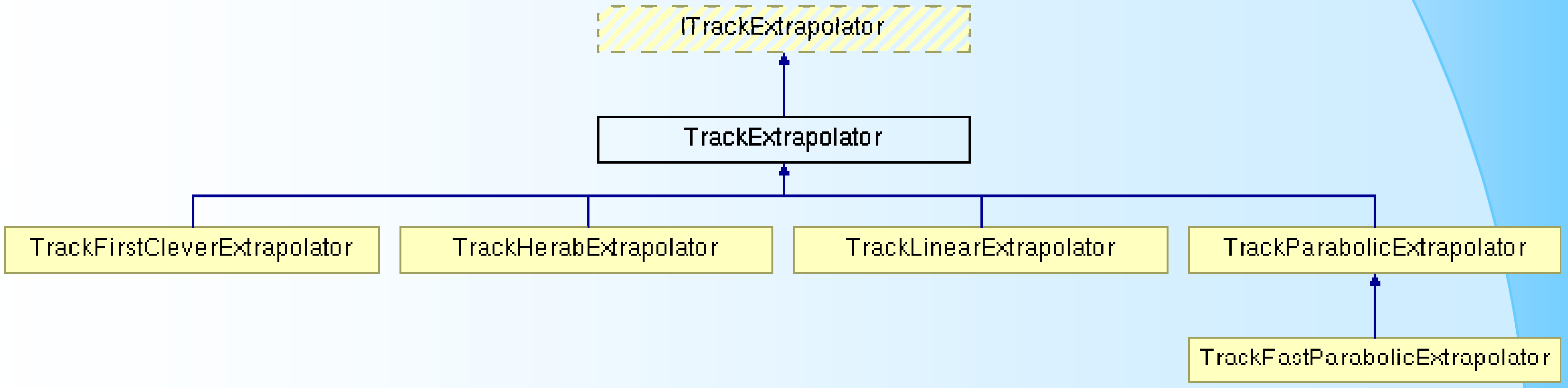
- Only stored in the tracks during fitting
- Not stored on DST
- Store the connection / relation between a State and a Measurement



Guidelines

Extrapolators

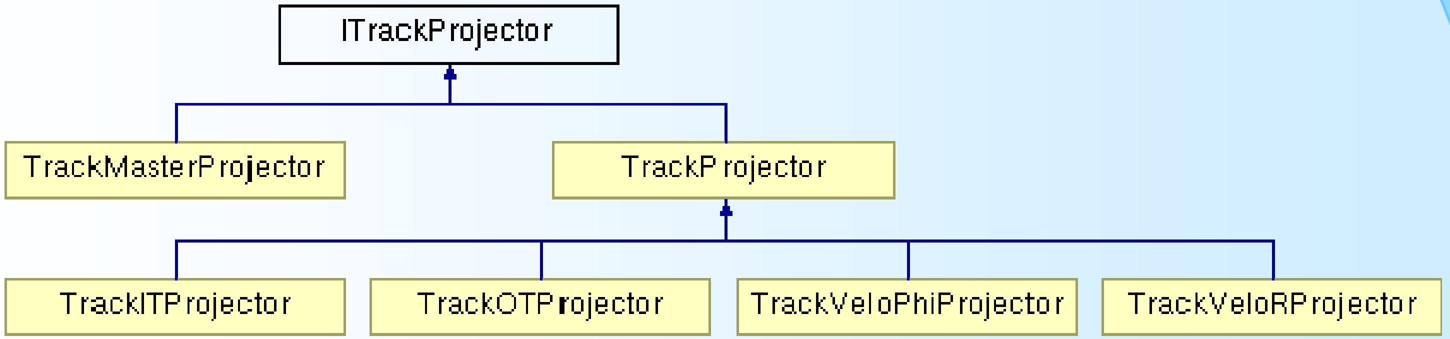
- **A variety of extrapolators, adapted and extended from the old model**
- **Useful for getting track info at a certain position (z, plane)**
- **User passes a track as an argument; it gets a state**
    - ***Makes available: position, momentum, covariance matrix, etc.***
- **TrackMasterExtrapolator delegates the work**


ITrackExtrapolator
TrackExtrapolator
TrackFirstCleverExtrapolator
TrackHerabExtrapolator
TrackLinearExtrapolator
TrackParabolicExtrapolator
TrackFastParabolicExtrapolator

Guidelines

Projectors

- Project a state onto a measurement
- TrackOTProjector, VeloRProjector, etc. for dedicated XxxMeasurements
- User does not need to care about the details
  - *TrackMasterProjector figures out which TrackXxxProjector it needs for you*
- Place where “local* (Measurements) and “global” (States) information is brought together
  - *Main part of tracking software where the technical problems related to (mis)alignment are dealt with*



Guidelines

Ideal pattern recognition TrackIdealPR

- **Ideal pattern recognition adapted to work with new model**
- **Main algorithm for testing projectors, extrapolators, fitting, …**
  - ***First users got already their hands dirty with it: Jacopo, Edwin, …?***

HowTo's

Getting general track info

```
// from TrackEvent
#include "Event/Track.h"
#include "Event/TrackKeys.h"
```

```
Tracks* tracksCont = get<Tracks>( "/Event/Rec/Track/Ideal" );

 debug() << "Tracks container contains " << tracksCont -> size()
             << " tracks" << endreq;

 Tracks::const_iterator iTrk;
 for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
   debug()
     << "-> Track  # " << (*iTrk) -> key() << endreq
     << "  * charge               = " << (*iTrk) -> charge() << endreq
     << "  * is Valid             = " << (*iTrk) -> checkFlag( TrackKeys::Valid ) << endreq
     << "  * is Unique            = " << (*iTrk) -> checkFlag( TrackKeys::Unique ) << endreq
     << "  * is of type           = " << (*iTrk) -> type() << endreq
     << "  * is Backward          = " << (*iTrk) -> checkFlag( TrackKeys::Backward ) << endreq
     << "  * # measurements = " << (*iTrk) -> nMeasurements() << endreq;
   // …
 }
```

Tracks flags, history, …

```
// from TrackEvent
#include "Event/TrackKeys.h"
#include "Event/StateKeys.h"
```

```
…
Tracks::const_iterator iTrk;
for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
  debug()
    << "-> Track  # " << (*iTrk) -> key() << endreq
    << "  * from algorithm    = " << (*iTrk) -> history( ) << endreq
    << "  * Kalman fitted?    = " << (*iTrk) -> checkHistoryFit( TrackKeys::Kalman ) << endreq
    << "  * has State at location BegRich1?    = " << (*iTrk) -> hasStateAt( StateKeys::BegRich1 ) << endreq;
 …
   HepPoint3D pos;
   HepVector3D mom;
   HepSymMatrix cov6D;
   // position and momentum of the “physics state” (i.e. the one stored on the DST)
   StatusCode sc = (*iTrk) -> positionAndMomentum( pos, mom, cov );
    …
}
```

Extrapolating a track

```
// from TrackTools
#include “TrackTools/ITrackExtrapolator.h“


…
ITrackExtrapolator*   m_extrapolator;
```

```
 // Retrieve TrackExtrapolator tool
  m_extrapolator = tool<ITrackExtrapolator>( « TrackHerabExtrapolator" );


  …
  Tracks::const_iterator iTrk;
  for ( iTrk = tracksCont->begin(); tracksCont->end() != iTrk; ++iTrk ) {
    …
    double z = 3000.;
    State myState;
    HepPoint3D plane;
// position and momentum of the “physics state” (i.e. the one stored on the DST)
    StatusCode sc = m_extrapolator -> propagate( **iTrk, z, myState );
    if ( sc.isSucess() ) {
      debug() << “ -  state at z = “ << z << “ has slopes “ << myState.slopes() << endreq;
    }
     …
  }
```