BEE

a C++ library for event analysis in HERA-B

Started by C. Borgmeier and I. Siccama,
continued by T. Glebe

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BEE

BEE provides a basic set of event reconstruction and physics analysis functionality.

1 BEE

Initialize non-library projects.

Names

extern const PkgIni **BEESteer** — *Global object which holds XCVS information for **BEE** project.*

extern const PkgIni **ARTESteer** — *Global object which holds XCVS information for **ARTE** project.*

extern const PkgIni **CERNSteer** — *Global object which holds XCVS information for **CERN** project.*

extern const PkgIni **DocSteer** — *Global object which holds XCVS information for **doc** project.*

extern const PkgIni **GCombinerSteer** — *Global object which holds XCVS information for **gcombiner** project.*

extern const PkgIni **GRelationSteer** — *Global object which holds XCVS information for **grelation** project.*

extern const PkgIni **InterfacesSteer** — *Global object which holds XCVS information for **interfaces** project.*

extern const PkgIni

SMatrixSteer	*Global object which holds XCVS information for **smatrix** project.*

Author: T. Glebe

2 Clue

The BEE event classes.

Names

— Global Utility Functions —

const ThreeVector
WireDirection (const Wire& rhs)
return unit vector of Wire direction

const Point3D
Propagate (const RecoSegment& rs, float z)
calculate impact point at z

const double
distance (const ThreeVector& r1,
const ThreeVector& m1,
const ThreeVector& r2,
const ThreeVector& m2)
dist between two rays (unsigned)

const double
distance (const RecoSegment& rseg,
const Wire& wire)
distance between RecoSegment and Wire

const double
distance (const Wire& wire,
const RecoSegment& rseg)
distance between RecoSegment and Wire

2.1 class **PkgIni** *Initialization of BEE package* 9

extern const PkgIni
ClueSteer *Global CLUE object which holds XCVS information.*

2.2 class **ROOTini** *Class to check whether the ROOT system is initialized* . . . 10

2.3 class **RsegC** : public TObject

HERA-B component id 10

2.4 class **RecoSegment** : public TObject, public TrackIf
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2.5 class **RecoTrack** : public RecoSegment
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2.6 class **RecoVertex** : public TObject, public VertexIf
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2.7 class **VDS_Track** : public RecoSegment
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2.8 class **RICH_Track** : public RecoSegment
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2.9 class **OTR_SpacePoint** : public RecoSegment
Space point in outer tracker . 28

2.10 class **MuonTrack** : public RecoSegment
Track in MUON detector 29

2.11 class **TrackClones** : public TObject
Clone class 30

2.12 class **EcalHit** : public TObject, public TrackIf
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2.13 class **MC_Track** : public TObject, public TrackIf
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2.14 class **MC_Vertex** : public TObject, public VertexIf
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2.18 class **Topp** : public TObject, public ToppIf
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Clue provides the classes which are needed for the event structure plus basic classes which are needed for analyzation. The project was started by C. Borgmeier and I. Siccama.

Author: T. Glebe

2.1 class **PkgIni**

Initialization of BEE package

Public Members

— Constructors —

	PkgIni ()	*for ROOT backward compatibility*
	PkgIni (const char* nam, const char* vers, const char* dat)	
	~**PkgIni** ()	

— Access methods —

const char* const	**version** () const	*get string with version number*
const char* const	**name** () const	*get string with package name*
const char* const	**date** () const	*get birthday & time of package version*
const bool	**debug** ()	*toggle debug flag*
bool	**isDebug** () const	*return debug flag*

— Expert functions —

std::ostream&	**print** (std::ostream& os) const	*used by operator<<()*

Class to hold the XCVS information of a BEE package. Each project should create a global PkgIni object which is initialized with the prjects XCVS information.

Author: T. Glebe

2.2

class **ROOTini**

Class to check whether the ROOT system is initialized

Public Members

ROOTini ()

Class to check whether the ROOT system is initialized. If not, initialize it.

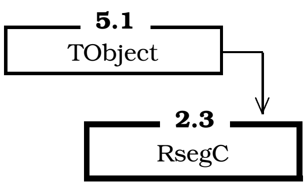
Author: T. Glebe

2.3

class **RsegC** : public TObject

HERA-B component id

Inheritance



Public Members

	— Constructors —	
	RsegC ()	
	RsegC (const unsigned int rhs)	
	~**RsegC** ()	
RsegC&	**operator=** (const RsegC& rhs)	
	— Access methods —	
unsigned int	**cmp** () const	*return bit pattern*
bool	**vxd** () const	*bit 0 (0x1): Vertex Detector*
bool	**patt** () const	*bit 1 (0x2): Pattern Tracker*
bool	**magt** () const	*bit 2 (0x4): Magnet Tracker*
bool	**muon** () const	*bit 3 (0x8): Muon Detector*
bool	**ecal** () const	*bit 4 (0x10): Ecal*
bool	**tar** () const	*bit 5 (0x20): Target Constraint*
bool	**trit** () const	*bit 6 (0x40): Trigger Tracker, betw RICH and ECAL*
bool	**bit7** () const	*bit 7 (0x80): not assigned yet*
bool	**slte** () const	*bit 8 (0x100): match SLT trigger tracks*
bool	**sltmu** () const	*bit 9 (0x200): match SLT trigger tracks*
bool	**bit10** () const	*bit 10 (0x400): not assigned yet*
bool	**bit11** () const	*bit 11 (0x800): not assigned yet*
bool	**bit12** () const	*bit 12 (0x1000): not assigned yet*
bool	**bit13** () const	*bit 13 (0x2000): not assigned yet*
bool	**bit14** () const	*bit 14 (0x4000): not assigned yet*
bool	**bit15** () const	*bit 15 (0x8000): not assigned yet*

bool	**bit16** () const	*bit 16 (0x10000): not assigned yet*
bool	**bit17** () const	*bit 17 (0x20000): not assigned yet*
bool	**bit18** () const	*bit 18 (0x40000): Match SVD-PC (marple RSEG only)*
bool	**bit19** () const	*bit 19 (0x80000): not assigned yet*
bool	**clonerm** () const	*bit 20 (0x100000): Used by Cloneremove.C*
bool	**bit21** () const	*bit 21 (0x200000): not assigned yet*
bool	**bit22** () const	*bit 22 (0x400000): not assigned yet*
bool	**bit23** () const	*bit 23 (0x800000): not assigned yet*
bool	**slt** () const	*bit 24 (0x1000000): SLT seeded segment*
bool	**trd** () const	*bit 25 (0x2000000): TRD straw device type*
bool	**rich** () const	*bit 26 (0x4000000): Cherenkov Counter device type*
bool	**ptc** () const	*bit 27 (0x8000000): HiPT Chamber device type*
bool	**msg** () const	*bit 28 (0x10000000): MSGC device type*
bool	**wch** () const	*bit 29 (0x20000000): honeycomb wire chamber device type*
bool	**sil** () const	*bit 30 (0x40000000): silicon strip device type*
bool	**bitsign** () const	*bit 31 (0x80000000): Kill bit, set if segment is deleted*

— Operators —

bool **operator==** (unsigned int rhs) const

bool **operator!=** (unsigned int rhs) const

const RsegC&

operator—= (const unsigned int rhs)

const RsegC&
operator&= (const unsigned int rhs)

— Expert functions —

std::ostream&
print (std::ostream& os) const

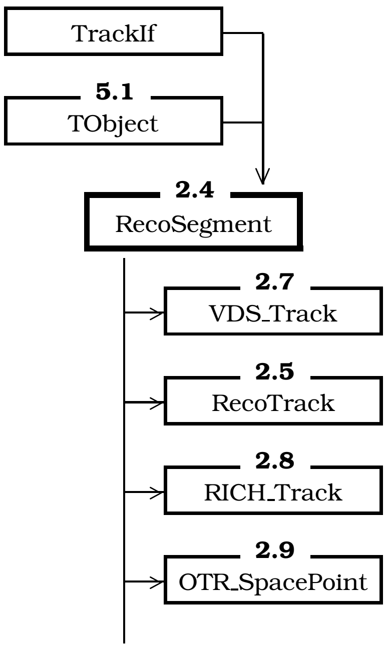
Author: T. Glebe

2.4

class **RecoSegment** : public TObject, public TrackIf

Reconstructed track class

Inheritance



2.10
MuonTrack

Public Members

— Constructors —

RecoSegment ()

RecoSegment (const RecoSegment& rhs)

˜**RecoSegment** ()

const RecoSegment&
operator= (const RecoSegment& rhs)

— ARTE only functions —

template <class T> void
convert (T rtra) *fill RecoSegment from RSEG or RTRA*

RecoSegment (const ArtePointer<RTRA>& r)
create object from RTRA table

RecoSegment (const ArtePointer<RSEG>& r)
create object from RSEG table

ArtePointer <RTRA>
rtra () const *return RTRA pointer*

void **set_rtra** (const ArtePointer<RTRA>& rtra)
set RTRA pointer

unsigned int
rtra () const *not available in ARTE*

— Operators —

bool **operator==** (const TrackIf& rhs) const
compare TrackIf pointers

bool **operator==** (const RecoSegment& rhs) const
compare Rtra value

bool **operator**< (const RecoSegment& rhs) const
compare Rtra value

— TrackIf methods —

float **x** () const *x of track*

float **y** () const *y of track*

float **x** (float z) const *linear extrapolation of x to z*

float	**y** (float z) const	*linear extrapolation of y to z*
float	**z** () const	*z of track*
float	**zorig** () const	*in case of propagation: z before propagation*
float	**tx** () const	*dx/dz slope of track (t_x)*
float	**ty** () const	*dy/dz slope of track (t_y)*
float	**p** () const	*momentum of track (p)*
float	**pt** () const	*transverse Track momentum* $p_t = p \cdot \sqrt{(t_x^2 + t_y^2)/(t_x^2 + t_y^2 + 1)}$
float	**pz** () const	*momentum along z:* $p/\sqrt{t_x^2 + t_y^2 + 1}$
float	**chi2** () const	*χ^2 of track fit*
unsigned	short int **ndf** () const	*degrees of freedom*
float	**phi** () const	*azimuthal angle ϕ [deg]*
float	**theta** () const	*polar angle $\theta = \cos^{-1}(e_z)$ [deg]*
float	**eta** () const	*rapidity $\eta = -\log\tan(\theta/2.)$ rapidity*
int	**charge** () const	*particle charge: -1 for neg. +1 for pos. & neutrals*
virtual float	**energy** (double mass = 0.) const	$E = \sqrt{m^2 + p^2}$
float	**xf** (double mass = 0.) const	$x_f = (p_z - E(m) \cdot \sqrt{1 - \frac{2m_p}{920GeV/c + m_p}})/m_p$, m_p *= Proton mass,* m *= Particle mass*
float	**rap** (double mass = 0.) const	*Rapidity* $y = \frac{1}{2}\ln(\frac{E+p_z}{E-p_z})$
	— Access methods —	
float	**trprob** () const	*upper tail prob. of track χ^2*
void	**set_chi2** (const float chi2)	*set χ^2*
void	**set_nf** (const UShort_t nf)	

		set degrees of freedom
float	**pinv** () const	*inverse momentum of track*
float	**px** () const	$t_x \cdot p_z$
float	**py** () const	$t_y \cdot p_z$
RsegC	**cmp** () const	*Component id*
int	**isRICH** () const	*is RICH component id set?*
int	**isOTR** () const	*is OTR component id set?*
int	**isVDS** () const	*is VDS component id set?*
int	**isECAL** () const	*is ECAL component id set?*
void	**set_x** (const float x)	*set x parameter*
void	**set_y** (const float y)	*set y parameter*
void	**set_z** (const float z)	*set z parameter*
void	**set_tx** (const float tx)	*set t_x parameter*
void	**set_ty** (const float ty)	*set t_y parameter*
void	**set_p** (const float p)	*set momentum p*
float	**cov_x** (double dz=0.) const	*get* $\sigma_x^2\|_{z+dz}$
float	**cov_x_y** (double dz=0.) const	*get* $\sigma_x \times \sigma_y\|_{z+dz}$
float	**cov_y** (double dz=0.) const	*get* $\sigma_y^2\|_{z+dz}$
float	**cov_x_tx** (double dz=0.) const	*get* $\sigma_x \times \sigma_{t_x}\|_{z+dz}$
float	**cov_y_tx** (double dz=0.) const	*get* $\sigma_y \times \sigma_{t_x}\|_{z+dz}$
float	**cov_tx** () const	*get* $\sigma_{t_x}^2$
float	**cov_x_ty** (double dz=0.) const	*get* $\sigma_x \times \sigma_{t_x}\|_{z+dz}$
float	**cov_y_ty** (double dz=0.) const	

		get $\sigma_y \times \sigma_{t_y}\|_{z+dz}$
float	**cov_tx_ty** () const	*get* $\sigma_{t_x} \times \sigma_{t_y}$
float	**cov_ty** () const	*get* $\sigma_{t_y}^2$
float	**cov_x_p** (double dz=0.) const	*get* $\sigma_x \times \sigma_p\|_{z+dz}$
float	**cov_y_p** (double dz=0.) const	*get* $\sigma_y \times \sigma_p\|_{z+dz}$
float	**cov_tx_p** () const	*get* $\sigma_{t_x} \times \sigma_p$
float	**cov_ty_p** () const	*get* $\sigma_{t_y} \times \sigma_p$
float	**cov_p** () const	*get* σ_p^2
void	**set_cov_x** (const float c)	*set* σ_x^2
void	**set_cov_x_y** (const float c)	*set* $\sigma_x \times \sigma_y$
void	**set_cov_y** (const float c)	*set* σ_y^2
void	**set_cov_x_tx** (const float c)	*set* $\sigma_x \times \sigma_{t_x}$
void	**set_cov_y_tx** (const float c)	*set* $\sigma_y \times \sigma_{t_x}$
void	**set_cov_tx** (const float c)	*set* $\sigma_{t_x}^2$
void	**set_cov_x_ty** (const float c)	*set* $\sigma_x \times \sigma_{t_x}$
void	**set_cov_y_ty** (const float c)	*set* $\sigma_y \times \sigma_{t_y}$
void	**set_cov_tx_ty** (const float c)	*set* $\sigma_{t_x} \times \sigma_{t_y}$
void	**set_cov_ty** (const float c)	*set* $\sigma_{t_y}^2$
void	**set_cov_x_p** (const float c)	*set* $\sigma_x \times \sigma_p$
void	**set_cov_y_p** (const float c)	*set* $\sigma_y \times \sigma_p$
void	**set_cov_tx_p** (const float c)	

set $\sigma_{t_x} \times \sigma_p$

void **set_cov_ty_p** (const float c)
set $\sigma_{t_y} \times \sigma_p$

void **set_cov_p** (const float c)
set σ_p^2

— Expert functions —

void **collect** (vector<TrackIf*>& c) const
collect pointers

void **propagate** (const double zz)
propagate track to z

void **sPinvToP** () $\sigma(Q/p) \rightarrow \sigma(p)$

void **sPToPinv** () $\sigma(p) \rightarrow \sigma(Q/p)$

SVector <double, 3>
xvec () const $\vec{x} = (x,\ y,\ z)$

SVector <double, 3>
tvec () const $\vec{t} = (t_x,\ t_y,\ 1)$

SVector <double, 3>
evec () const $\vec{e} = (e_x,\ e_y,\ ez)$ *unit vector along* $\vec{p}$

SVector <double, 3>
pvec () const $\vec{p} = (p_x,\ p_y,\ p_z)$

bool **FillCINV** () *fill COV_ matrix and compute inverse cov. matrix*

const SMatrix <double, 5> &
COV () const *return covariance matrix **Cov***

const SMatrix <double, 5> &
CINV () const *return inverse covariance matrix* $\boldsymbol{Cov}^{-1}$

virtual bool
isValid () const *is track valid?*

bool **PrepareForVertexing** ()
Prepare reconstructed track for vertexing with SVertex package: propagate track parameters and errors to $z = 0$, *fill inverse covariance matrix*

virtual void

valid () *mark track as valid*

virtual void
invalid () *mark track as invalid*

std::ostream&
print (std::ostream&) const
used by operator<<()

std::ostream&
print_cov (std::ostream&) const
print covariance matrix

— GRelation relations —

GRelationList <SPatternMatch>
pmatch *RecoTrack → PatternMatch*

const GRelationList <SPatternMatch> &
Pmatch () const

GRelationList <SPatternMatch> &
Pmatch ()

GRelationList <SPatternMatch> &
container (const SPatternMatch& p)

void **Print** (Option_t *option="")
only available in ROOT

Reconstructed track class. In contrast to `ARTE`, the momentum covariance matrix elements are computed with the momentum p and not with Q/p. The reason is that they enter in this way into the vertexing (Vt based vertexing codes). The transformation $cov_{ij}(Q/p) \rightarrow cov_{ij}(p)$ is done before writing the `BEE` files in the `ARTE` project `cluearte`. The `RecoSegment` memberfunctions `sPinvToP()` and `sPtoPinv()` do the appropriate transformation in the respective direction.

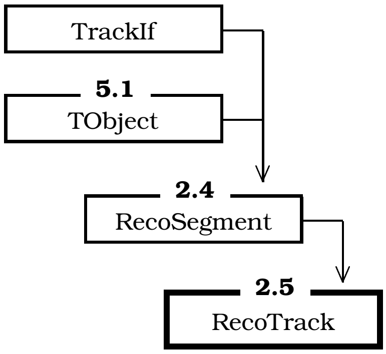
Author: C. Borgmeier, T. Glebe

2.5

class **RecoTrack** : public RecoSegment

reconstructed track class

Inheritance



Public Members

	— Constructors —	
	RecoTrack ()	
	RecoTrack (const RecoTrack& rt)	
	~**RecoTrack** ()	
	RecoTrack (const ArtePointer<RTRA>& rtra, double mass = 0)	*not available in ROOT*
	RecoTrack (const ArtePointer<RSEG>& rseg)	*not available in ROOT*
const RecoTrack&	**operator=** (const RecoTrack& rhs)	
	— Access methods —	
int	**pid** () const	*particle identification flag*
void	**set_pid** (int pid)	*set particle identification flag*
float	**le** () const	*global likelihood of electron hypothesis*
float	**lmu** () const	*global likelihood of muon hypothesis*
float	**lpi** () const	*global likelihood of pion hypothesis*
float	**lk** () const	*global likelihood of kaon hypothesis*

float	**lp** () const	*global likelihood of proton hypothesis*
int	**hsi** () const	*number of hits in the SVD*
int	**hin** () const	*number of hits in the inner tracker*
int	**hou** () const	*number of hits in the outer tracker*
int	**hri** () const	*number of hits in the RICH*
int	**hca** () const	*number of hits in the calorimeter*
int	**htr** () const	*number of hits in the TRD*
int	**hmu** () const	*number of hits in the muon chambers*
int	**fit** () const	*fit flag*
float	**mass** () const	*particle mass* m
void	**set_mass** (const float newMass)	*set particle mass* m
float	**energy** (double mass = 0.) const	$E = \sqrt{m^2 + p^2}$
float	**ebrems** () const	*possible Bremsstrahlung correction*
void	**set_ebrems** (const float ener)	*set bremsstrahlungs energy*
void	**ebrems_recovery** ()	*perform bremsstrahlungs recovery*
float	**cer** () const	*Cerenkov angle of associated RICH ring*
int	**mommask** () const	

Momentum determination flag:
1: estimated by REFIT on all hits assigned,
2: estimated by REFIT with rejection of hits in magnet,
3: estimated in VDS-ECAL match,
4: obtained during magnet tracking,
5: target constrain of OTR-PC segment,
6: PC-kick in the magnet is used for estimation,
7: estimated in VDS-RICH match,
8: estimated in VDS-PC match,
9: assigned by CATS for VDS segment

const ArtePointer <Topp>
topp () const *link to Topp table*

void **set_topp** (const ArtePointer<Topp>& topp)
set link to Topp table

— Expert functions —

std::ostream&
print (std::ostream& os) const
used by operator<<()

void **print_all** (std::ostream& os) const
print all available information

void **printMC** () const *print related MC tracks*

— CLUE relations —

ClueRelationList <MC_Track>
mtrack *RecoTrack ↔ MC_Track relation*

const ClueRelationList <MC_Track> &
mTrack () const

ClueRelationList <MC_Track> &
mTrack ()

ClueRelationList <MC_Track> &
container (const ArtePointer<MC_Track>& p)

ClueRelationList <TrackClones>

clones *RecoTrack ↔ TrackClones*

const ClueRelationList <TrackClones> &
Clones () const

ClueRelationList <TrackClones> &
Clones ()

ClueRelationList <TrackClones> &
container (const ArtePointer<TrackClones>& p)

ClueRelationList <RecoVertex>
rvertex *RecoTrack ↔ RecoVertex*

const ClueRelationList <RecoVertex> &
rVertex () const

ClueRelationList <RecoVertex> &
rVertex ()

ClueRelationList <RecoVertex> &
container (const ArtePointer<RecoVertex>& p)

ClueRelationList <EcalHit>
ehit *RecoTrack ↔ EcalHit*

const ClueRelationList <EcalHit> &
Ehit () const

ClueRelationList <EcalHit> &
Ehit ()

ClueRelationList <EcalHit> &
container (const ArtePointer<EcalHit>& p)

void **RelStreamer** (TBuffer& R__b,
const Version_t& StreamVersion)
only availabe in ROOT: call Streamer of relation container

void **Print** (Option_t* o="")
only available in ROOT

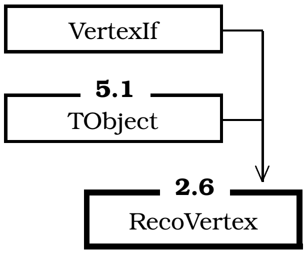
Author: C. Borgmeier, T. Glebe

2.6

class **RecoVertex** : public TObject, public VertexIf

Reconstructed vertex

Inheritance



Public Members

— Constructors —

	RecoVertex ()	*default constructor*
	RecoVertex (const RecoVertex& rhs)	*copy constructor*
	˜**RecoVertex** ()	*destructor*
	RecoVertex (const ArtePointer<RVER>& rver)	*from ArtePointer*
const RecoVertex&	**operator=** (const RecoVertex& rhs)	

— Operators —

bool	**operator**< (const RecoVertex& rhs) const	$z_1 < z_2$

— VertexIf access methods —

float	**vx** () const	x *of vertex*
float	**vy** () const	y *of vertex*
float	**vz** () const	z *of vertex*
float	**chi2** () const	χ^2 *of vertex fit*
unsigned short int	**ndf** () const	*degrees of freedom of vertex fit*
float	**prob** () const	*probability of the vertex fit*
unsigned short int		

	ntracks () const	*no of tracks in vertex*
const TrackIf*	**track** (unsigned int i) const	*returns pointer to track in vertex (slow access via relation!)*
const TrackIf*&	**track** (unsigned int i)	*returns null pointer + prints warning*
float	**vtx_cov_x** () const	σ_x^2 *of vertex*
float	**vtx_cov_y** () const	σ_y^2 *of vertex*
float	**vtx_cov_z** () const	σ_z^2 *of vertex*
	— Access methods —	
bool	**valid** () const	*is vertex valid?*
void	**invalid** ()	*mark vertex as invalid*
void	**set_valid** ()	*mark vertex as valid*
float	**xerr** () const	*error in* x
float	**yerr** () const	*error in* y
float	**zerr** () const	*error in* z
float	**mass** () const	*invariant mass in vertex*
SVector <double, 3>	**vpos** () const	$\vec{v} = (x,\ y,\ z)$
const SMatrix <double, 3> &	**VCOV** () const	*vertex cov. matrix*
std::ostream&	**print** (std::ostream& os) const	*used by operator<<()*
std::ostream&	**print_cov** (std::ostream& os) const	*print covariance matrix*
void	**set_chi2** (float chi)	
void	**set_ndf** (int nd)	
void	**set_mass** (float ms)	

float **vtx_cov_x_y** () const
$\sigma_x \times \sigma_y$ of vertex

float **vtx_cov_x_z** () const
$\sigma_x \times \sigma_z$ of vertex

float **vtx_cov_y_z** () const
$\sigma_y \times \sigma_z$ of vertex

void **set_vtx_cov_x** (const float c)
set σ_x^2 of vertex

void **set_vtx_cov_x_y** (const float c)
set $\sigma_x \times \sigma_y$ of vertex

void **set_vtx_cov_y** (const float c)
set σ_y^2 of vertex

void **set_vtx_cov_x_z** (const float c)
set $\sigma_x \times \sigma_z$ of vertex

void **set_vtx_cov_y_z** (const float c)
set $\sigma_y \times \sigma_z$ of vertex

void **set_vtx_cov_z** (const float c)
set σ_z^2 of vertex

void **set_xyz** (const float x, const float y, const float z)
set vertex position

— CLUE relations —

ClueRelationList <RecoTrack>
out *RecoVertex ↔ RecoTrack (relations to outgoing tracks)*

const ClueRelationList <RecoTrack> &
Out () const

ClueRelationList <RecoTrack> &
Out ()

ClueRelationList <RecoTrack> &
container (const ArtePointer<RecoTrack>& p)

void **RelStreamer** (TBuffer& R__b, const Version_t& StreamVersion)
only availabe in ROOT: call Streamer of relation container

void **Clear** (Option_t *option="")
only available in ROOT

void **Print** (Option_t *option="")

only available in ROOT

void **Paint** (Option_t *option="")
only available in ROOT

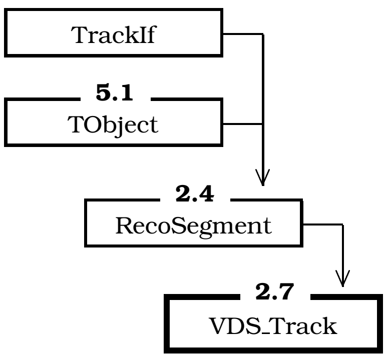
Author: C. Borgmeier, T. Glebe

2.7

class **VDS_Track** : public RecoSegment

Track in vertex detector

Inheritance



Public Members

VDS_Track ()

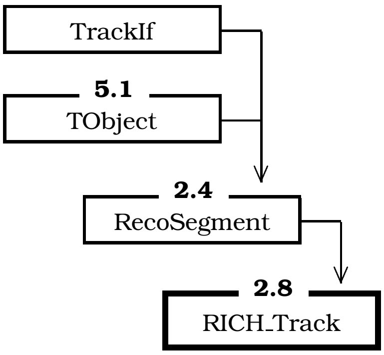
VDS_Track (const ArtePointer<RSEG>& rseg)

Author: C. Borgmeier, T. Glebe

2.8 class **RICH_Track** : public RecoSegment

Track in RICH detector

Inheritance



Public Members

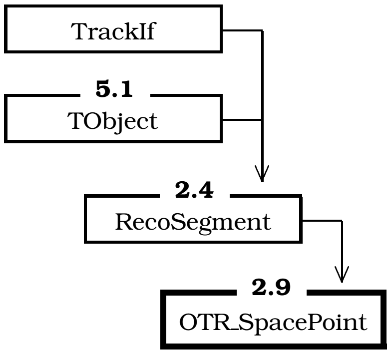
	RICH_Track ()
	RICH_Track (const ArtePointer<RSEG>& rseg)
float	**radius**
float	**signalPhotons**
float	**backgndPhotons**
float	**fraction**

Author: C. Borgmeier, T. Glebe

2.9 class **OTR_SpacePoint** : public RecoSegment

Space point in outer tracker

Inheritance



Public Members

OTR_SpacePoint ()

OTR_SpacePoint (const ArtePointer<RSEG>& rseg)

int **nHits**

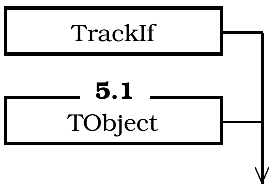
Author: C. Borgmeier, T. Glebe

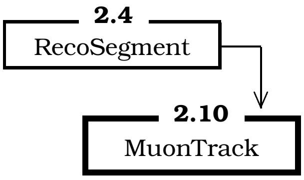
2.10

class **MuonTrack** : public RecoSegment

Track in MUON detector

Inheritance





Public Members

MuonTrack ()

MuonTrack (const ArtePointer<RSEG>& rseg)

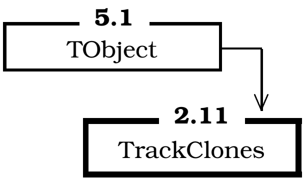
Author: C. Borgmeier, T. Glebe

2.11

class **TrackClones** : public TObject

Clone class

Inheritance



Public Members

— Constructors —

TrackClones ()

TrackClones (const TrackClones& rhs)

TrackClones (const RsegC& t)

~**TrackClones** ()

const TrackClones&

operator= (const TrackClones& rhs)

— Access methods —

RsegC **type** () const *type corresponds to rseg->cmp; type of incompatibility*

— CLUE relations —

ClueRelationList <RecoTrack>
rtrack *TrackClones ↔ RecoTrack*

const ClueRelationList <RecoTrack> &
rTrack () const

ClueRelationList <RecoTrack> &
rTrack ()

ClueRelationList <RecoTrack> &
container (const ArtePointer<RecoTrack>& p)

void **RelStreamer** (TBuffer& R__b,
const Version_t& StreamVersion)
only availabe in ROOT: call Streamer of relation container

Class for tracks sharing segments.

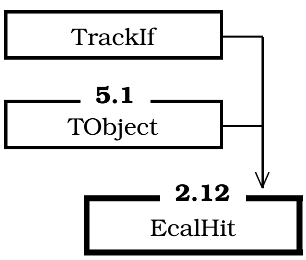
Author: C. Borgmeier, T. Glebe

2.12

class **EcalHit** : public TObject, public TrackIf

Photon candidates found by ECAL

Inheritance



Public Members

	— Constructors —	
	EcalHit ()	
	EcalHit (const ArtePointer<RCCL>& rccl)	*only available with ARTE*
	EcalHit (const EcalHit& rhs)	
	~**EcalHit** ()	
EcalHit&	**operator=** (const EcalHit& rhs)	
	— TrackIf methods —	
float	**x** () const	x *position of cluster*
float	**y** () const	y *position of cluster*
float	**z** () const	z *position of cluster*
float	**x** (float z) const	*Track* x *position at* z
float	**y** (float z) const	*Track* y *position at* z
float	**tx** () const	t_x *of cluster calculated from point* x_0
float	**ty** () const	t_y *of cluster calculated from point* x_0
float	**p** () const	*Photon track momentum* $\|\vec{p}\| = E_{cluster}$
float	**pt** () const	*transverse Photon track momentum* $p_t = p \cdot \sqrt{(t_x^2 + t_y^2)/(t_x^2 + t_y^2 + 1)}$
float	**pz** () const	*Photon track momentum along* z, $p_z = p/\sqrt{t_x^2 + t_y^2 + 1}$
float	**phi** () const	*azimuthal angle* ϕ *[deg]*
float	**theta** () const	*polar angle* $\theta = \cos^{-1}(e_z)$ *[deg]*
float	**eta** () const	*pseudorapidity* $\eta = -\log\tan(\theta/2.)$
int	**charge** () const	*Photon charge: 0*
float	**energy** (double rm = 0.) const	*Ecal cluster energy* $E_{cluster}$ *(rm argument has no effect)*
float	**xf** (double rm = 0.) const	

		Feynman Variable $x_F = \frac{E+p_z}{(E+p_z)_{max}}$
float	**rap** (double rm = 0.) const	*Rapidity* $y = \frac{1}{2}\ln(\frac{E+p_z}{E-p_z})$
SVector <double, 3>	**xvec** () const	$\vec{x} = (x,\ y,\ z)$
SVector <double, 3>	**tvec** () const	$\vec{t} = (t_x,\ t_y,\ 1)$
SVector <double, 3>	**evec** () const	$\vec{e} = (e_x,\ e_y,\ ez)$ *unit vector along* $\vec{p}$
SVector <double, 3>	**pvec** () const	$\vec{p} = (p_x,\ p_y,\ p_z)$
bool	**isValid** () const	*is ECAL cluster valid?*
const SMatrix <double, 5> &	**COV** () const	*return 0 matrix*
const SMatrix <double, 5> &	**CINV** () const	*return 0 matrix*
float	**cov_x** (double dz=0.) const	*get* $\sigma_x^2\|_{z+dz}$
float	**cov_y** (double dz=0.) const	*get* $\sigma_y^2\|_{z+dz}$
float	**cov_tx** () const	*get* $\sigma_{t_x}^2 = \sigma_x^2/(z-z_0)^2$
float	**cov_ty** () const	*get* $\sigma_{t_y}^2 = \sigma_y^2/(z-z_0)^2$
float	**cov_p** () const	*get* σ_E^2
void	**propagate** (const double dz)	*propagate track + errors*
	— dummy functions —	
float	**chi2** () const	*always return 0*
unsigned short int	**ndf** () const	*always return 0*
	— EcalHit access functions —	
float	**zorig** () const	*return Z before propagation*
float	**cov_x_tx** (double dz=0.) const	*get* $\sigma_x \times \sigma_{t_x}\|_{z+dz}$
float	**cov_y_ty** (double dz=0.) const	

get $\sigma_y \times \sigma_{t_y}|_{z+dz}$

— Operators —

bool	**operator==** (const TrackIf& rhs) const	*comparison between Track objects*

— Expert methods —

void	**valid** ()	*mark cluster as valid*
void	**invalid** ()	*mark cluster as invalid*
void	**collect** (vector<TrackIf*>& c) const	*collect TrackIf pointers*
std::ostream&	**print** (std::ostream&) const	*used by operator<<()*

— EcalHit Access methods —

unsigned int	**width** () const	*width of cluster*
float	**x_c** () const	x_c*: cluster* x
float	**y_c** () const	y_c*: cluster* y
float	**z_c** () const	z_c*: cluster* z
float	**px** () const	$t_x \cdot p_z$
float	**py** () const	$t_y \cdot p_z$
float	**Ez** () const	$E/\sqrt{t_x^2 + t_y^2 + 1}$
float	**Et** () const	$E \cdot \sqrt{(t_x^2 + t_y^2)/(t_x^2 + t_y^2 + 1)}$
SVector <double, 3>	**xc_vec** () const	$\vec{x} = (x_c,\ y_c,\ z_c)$
SVector <double, 3>	**Evec** () const	$\vec{E} = (E_x,\ E_y,\ E_z)$
void	**calc_track** (const SVector<double, 3>& x0)	*calc track parameters & cov. matrix using photon origin* $\vec{x}_0$
bool	**calc_CINV** ()	*calculate inverse cov. matrix*

— CLUE relations —

ClueRelationList <RecoTrack>	**rtrack**	*EcalHit* $\leftrightarrow$ *RecoTrack*

const ClueRelationList <RecoTrack> &

rTrack () const

ClueRelationList <RecoTrack> &
rTrack ()

ClueRelationList <RecoTrack> &
container (const ArtePointer<RecoTrack>& p)

void **RelStreamer** (TBuffer& R__b,
const Version_t& StreamVersion)
only availabe in ROOT: call Streamer of relation container

— ROOT only functions —

void **Print** (Option_t * = "")

void **Paint** (Option_t *option)

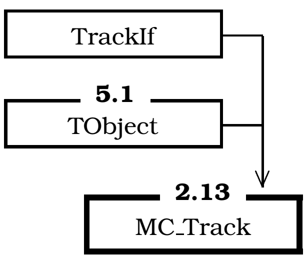
Author: T. Glebe

2.13

class **MC_Track** : public TObject, public TrackIf

Monte Carlo Track

Inheritance



Public Members

— Constructors —

MC_Track ()

MC_Track (const MC_Track& rhs)

MC_Track (const ArtePointer<MTRA>& t)
constructor reading from ARTE table

~**MC_Track** ()

MC_Track&
operator= (const MC_Track&)

— TrackIf Access methods —

float	**x** () const	*Track x position*
float	**y** () const	*Track y position*
float	**x** (float z) const	*Track x position at z*
float	**y** (float z) const	*Track y position at z*
float	**z** () const	*Track z position*
float	**tx** () const	*Track slope t_x*
float	**ty** () const	*Track slope t_y*
float	**p** () const	*Track momentum p*
float	**pt** () const	*transverse Track momentum p_t ($\perp$ to z)*
float	**pz** () const	*Track momentum along z*
float	**chi2** () const	*dummy function: returns 0*
unsigned short int	**ndf** () const	*dummy function: returns 0*
float	**phi** () const	*azimuthal angle ϕ [deg]*
float	**theta** () const	*polar angle $\theta = \cos^{-1}(e_z)$ [deg]*
float	**eta** () const	*pseudorapidity $\eta = -\log\tan(\theta/2.)$*
int	**charge** () const	*track charge*
float	**energy** (double rm = 0.) const	*track energy $E = \sqrt{m^2+p^2}$, rm is ignored*
float	**xf** (double rm = 0.) const	*Feynman Variable $x_F = \frac{E+p_z}{(E+p_z)_{max}}$, rm is ignored*
float	**rap** (double rm = 0.) const	

		Rapidity $y = \frac{1}{2}\ln(\frac{E+p_z}{E-p_z})$, *rm is ignored*
SVector <double, 3>	**xvec** () const	$\vec{x} = (x,\ y,\ z)$
SVector <double, 3>	**tvec** () const	$\vec{t} = (t_x,\ t_y,\ 1)$
SVector <double, 3>	**evec** () const	$\vec{e} = (e_x,\ e_y,\ ez)$ *unit vector along* $\vec{p}$
SVector <double, 3>	**pvec** () const	$\vec{p} = (p_x,\ p_y,\ p_z)$
const SMatrix <double, 5> &	**COV** () const	*dummy function: returns zero matrix*
const SMatrix <double, 5> &	**CINV** () const	*dummy function: returns zero matrix*
float	**cov_x** (double dz=0.) const	*dummy function: return 0*
float	**cov_y** (double dz=0.) const	*dummy function: return 0*
float	**cov_tx** () const	*dummy function: return 0*
float	**cov_ty** () const	*dummy function: return 0*
float	**cov_p** () const	*dummy function: return 0*
bool	**isValid** () const	*dummy function: always return true*
	— Operators —	
bool	**operator==** (const TrackIf& rhs) const	*comparison between Track objects*
bool	**operator==** (const GTopp& rhs) const	*compare with GTOPP*
	— Expert methods —	
void	**valid** ()	*dummy function: do nothing*
void	**invalid** ()	*dummy function: do nothing*
void	**collect** (vector<TrackIf*>& c) const	

collect TrackIf pointers

void **propagate** (const double dz)
dummy function: do nothing

std::ostream&
print (std::ostream&) const
used by operator<<()

— Access methods —

float **mass** () const *return topp mass m*

const char* const
name () const *return topp name*

unsigned int
flag () const *MC flag: 0: just created; not yet processed*
1: expected to decay according to QMTRA_LENG
2: decayed resonance or electromagnetic decay (production vertex = decay vertex)
3: decay with non-zero track length
4: track ends in a electromagnetic or hadronic interaction
5: track leaves the detector volume
6: track stops inside detector volume
7: track curls up inside detector volume
8: track stopped by user

const ToppIf&
topp () const *link to Topp table*

const ArtePointer <MC_Vertex>
bVertex () const *pointer to begin vertex*

void **set_bVertex** (const ArtePointer<MC_Vertex>& p)
set pointer to begin vertex

const ArtePointer <MC_Track>
mother () const *pointer to begin vertex*

void **set_mother** (const ArtePointer<MC_Track>& t) *set pointer to begin vertex*

2.13.1 void **print_decay** (unsigned int level, char opt = ' ', const ArtePointer<MC_Track> mtra = 0, unsigned int lvl=0) const
print MC decay chain 40

unsigned int
outsize () const *no of outgoing tracks*

— CLUE relations —

ClueRelationList <RecoTrack>
rtrack *MC_Track ↔ RecoTrack relation*

const ClueRelationList <RecoTrack> &
rTrack () const

ClueRelationList <RecoTrack> &
rTrack ()

ClueRelationList <RecoTrack> &
container (const ArtePointer<RecoTrack>& p)

ClueRelationList <MC_Vertex>
endVtx *MC_Track ↔ MC_Vertex relation (end vertices)*

const ClueRelationList <MC_Vertex> &
EndVtx () const

ClueRelationList <MC_Vertex> &
EndVtx ()

ClueRelationList <MC_Vertex> &
container (const ArtePointer<MC_Vertex>& p)

ClueRelationList <MC_Track>
endTrack *MC_Track ↔ MC_Track relation (outgoing tracks)*

const ClueRelationList <MC_Track> &
EndTrack () const

ClueRelationList <MC_Track> &
EndTrack ()

ClueRelationList <MC_Track> &
container (const ArtePointer<MC_Track>& p)

— ROOT only functions —

void **RelStreamer** (TBuffer& R__b, const Version_t& StreamVersion)
call Streamer of relation container

void **Print** (Option_t *option="")

2.13.2 virtual void **Paint** (Option_t *option="")
Do not call this function directly, use Draw() instead . . . 41

Monte Carlo Track. In case of prompt decays (e.g. $\phi \rightarrow \mathrm{K}^{+} + \mathrm{K}^{-}$) no begin- or end-vertices exist in ARTE (to reduce event size). Therefore we need in addition to begin- and end-vertex relations relations to mother- and outgoing tracks. In case of decays which have a travel distance this introduces some redundancy: the mother & outgoing tracks can be accessed either directly or via the begin- and end-vertices.

Author: C. Borgmeier, T. Glebe

2.13.1

void **print_decay** (unsigned int level, char opt = ' ', const ArtePointer<MC_Track> mtra = 0, unsigned int lvl=0) const

print MC decay chain

print MC decay chain. Options for additional information: f: print track flag m: print ArtePointer<MC_Track> r: print ArtePointer<RecoTrack> (matches to reconstructed tracks)

2.13.2

virtual void **Paint** (Option_t *option="")

Do not call this function directly, use Draw() instead

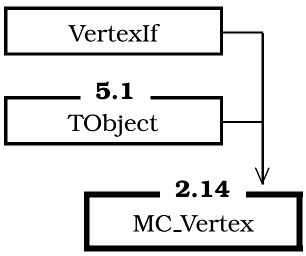
Do not call this function directly, use Draw() instead. Before you can draw, create a TView.

2.14

class **MC_Vertex** : public TObject, public VertexIf

Monte Carlo Vertex

Inheritance



Public Members

MC_Vertex ()

MC_Vertex (const MC_Vertex& rhs)

MC_Vertex (const ArtePointer<MVER>& mv)
only available in ARTE

~**MC_Vertex** ()

MC_Vertex&
operator= (const MC_Vertex&)

std::ostream&
print (std::ostream&) const
used by operator<<()

— VertexIf access methods —

float	**vx** () const	x *of vertex*
float	**vy** () const	y *of vertex*
float	**vz** () const	z *of vertex*

float **chi2** () const *dummy function: return 0*

unsigned short int
ndf () const *dummy function: return 0*

float **prob** () const *dummy function: return 1*

unsigned short int
ntracks () const *no of tracks in vertex*

const TrackIf*
track (unsigned int i) const
returns pointer to track in vertex (slow access via relation!)

const TrackIf*&
track (unsigned int i)
returns null pointer + prints warning

SVector <double, 3>
vpos () const $\vec{x} = (x,\ y,\ z)$

const SMatrix <double, 3> &
VCOV () const *dummy function: return zero matrix*

float **vtx_cov_x** () const
dummy function: return 0

float **vtx_cov_y** () const
dummy function: return 0

float **vtx_cov_z** () const
dummy function: return 0

— Access methods —

const ArtePointer <MC_Track>
mother () const *return pointer to mother track*

void **set_mother** (const ArtePointer<MC_Track>& p)
set pointer to mother track

— CLUE relations —

ClueRelationList <MC_Track>
out *MC_Vertex ↔ MC_Track (relations to outgoing tracks)*

const ClueRelationList <MC_Track> &
Out () const

ClueRelationList <MC_Track> &

Out ()

ClueRelationList <MC_Track> &
container (const ArtePointer<MC_Track>& p)

void **RelStreamer** (TBuffer& R__b, const Version_t& StreamVersion)
only availabe in ROOT: call Streamer of relation container

void **Print** (Option_t *option="")
only available in ROOT

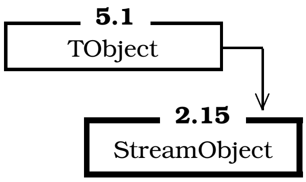
void **Paint** (Option_t *option="")
only available in ROOT

Author: C. Borgmeier, T. Glebe

2.15 class **StreamObject** : public TObject

write/read ROOT files

Inheritance



Public Members

StreamObject ()

StreamObject (RtEvent*)

Helper class to write and read CLUE events from/to ROOT files.

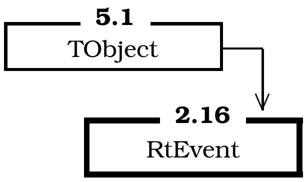
Author: C. Borgmeier, T. Glebe

2.16

class **RtEvent** : public TObject

event class

Inheritance



Public Members

		— Constructors —		
		RtEvent ()		
	virtual	~**RtEvent** ()		
		— Access methods —		
	long int	**unixtime** () const	*seconds since 1.1.70 0:00 somewhere in the U.S.*	
	int	**evt** () const	*event number*	
	int	**run** () const	*run number*	
2.16.1	int	**exp** () const	*experiment number*	47
	float	**vfld** () const	*version of the mag field MC and reco*	
	int	**flagdst** () const	*event classification flag from/to DST*	
	int	**dbmajor** () const	*major key for constants on data base*	
	int	**dbminor** () const	*minor key for constants on data base*	

	int	**flag** () const	*event classification flag from/to EDIR if no EDIR: same as flagdst*	
	unsigned int	**bx** () const	*bx number from DIHD*	
2.16.2	int	**tcode** () const	*Trigger code*	47
	float	**ir** () const	*Interaction rate*	
	float	**bg** () const	*Background rate*	
	float	**rad0** () const	*Cherenkov radius for* $\beta = 1$	
	int	**hvds** () const	*Hits in VDS*	
	int	**hwch** () const	*Hits in wire chambers*	
	int	**hmsg** () const	*Hits in MSG microstrip chambers*	
	int	**hptc** () const	*Hits in PTC chambers (pi-pi trigger)*	
	int	**hrich** () const	*Hits in Cerenkov counter*	
	int	**htrd** () const	*Hits in forward TRD*	
	int	**hcal** () const	*Hits in electromagnetic calorimeter*	
	int	**hmuo** () const	*Hits in muon outer chambers*	
	int	**hmux** () const	*Hits in muon central chambers*	

GClonesArray <Topp*> *
topp () const *get Topp table pointer*

GClonesArray <RecoTrack*> *
tracks () const *get RecoTrack table pointer*

GClonesArray <VDS_Track*> *
vds () const

GClonesArray <OTR_SpacePoint*> *
otr () const

GClonesArray <RICH_Track*> *
rich () const

GClonesArray <EcalHit*> *
ecal () const

GClonesArray <MuonTrack*> *

muon () const

GClonesArray <RecoVertex*> *
vertices () const

GClonesArray <Wire*> *
wires () const

GClonesArray <TrackClones*> *
clones () const

GClonesArray <MC_Track*> *
mcTracks () const

GClonesArray <MC_Vertex*> *
mcVertices () const

— Event algorithms —

bool **prepareRecoTracksforVertexing** ()
Prepare reconstructed tracks for vertexing with SVertex package: transform $\sigma^2(1/p) \rightarrow \sigma^2(p)$, *propagate RecoTracks to* $z = 0$, *fill inverse covariance matrix*

— Expert functions —

std::ostream&
print (std::ostream& os) const
used in operator<<()

bool **FillTopp** () *fill Topp table from ARTE TOPP*

bool **FillHeader** () *fill event header from ARTE EVHD, DIHD*

void **unlock** () *initialize objects contained in GClonesArrays*

— ROOT only functions —

void **Clear** (Option_t * = ””)

void **Delete** (Option_t * = ””)

void **Print** (Option_t *options=””)

void	**Clear** ()	*replacement of ROOT Clear()*
void	**Delete** ()	*replacement of ROOT Delete()*
vector <float>	**user**	*user space for ROOT file*
void	**StreamUser** (TBuffer &R__b)	*only availabe in ROOT*

Holds information of ARTE in C++ objects. The Track lists can also be accessed via the ARTE table interface.

Author: C. Borgmeier, T. Glebe

2.16.1

int **exp** () const

experiment number

experiment number.
exp > 0: real data
exp < 0: Monte Carlo; specifies the lab:
-1: DESY HH
-2: DESY Zeuthen
...: not yet specified

2.16.2

int **tcode** () const

Trigger code

Trigger code.
0: (FLT) FLT trigger
2: (VME) Standalone trigger
4: (LEMO1) ECAL Internal LED calibration

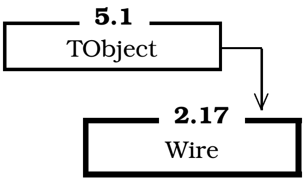
5: (LEMO2) Front Panel trigger for test
6: (LEMO3) Front Panel trigger for test
7: (LEMO4) Front Panel trigger for test
8: FLT + RANDOM
9: (RANDOM) Random trigger
10: VME + RANDOM
12: LEMO1 + RANDOM
13: LEMO2 + RANDOM
14: LEMO3 + RANDOM
15: LEMO4 + RANDOM

2.17

class **Wire** : public TObject

Target wire class

Inheritance



Public Members

— Constructors —

Wire ()

Wire (const ArtePointer<GTAR>& wire)
only available in ARTE

Wire (const ArtePointer<RTAR>& wire)
only available in ARTE

Wire (const Wire& rhs)

~**Wire** ()

— Access methods —

float **x** () const *x of wire center*

float	**y** () const	*y of wire center*
float	**z** () const	*z of wire center*
float	**dx** () const	*size in x-direction*
float	**dy** () const	*size in y-direction*
float	**dz** () const	*size in z-direction*
SVector <double, 3>	**xvec** () const	*position vector* $\vec{x} = (x,\ y,\ z)$
SVector <double, 3>	**dxvec** () const	*size vector* $\vec{dx} = (dx,\ dy,\ dz)$
SVector <double, 3>	**dvec** () const	*direction vector* $\vec{d} = (1,\ 0,\ 0)$ *or* $\vec{d} = (0,\ 1,\ 0)$

— Expert functions —

std::ostream&	**print** (std::ostream&) const	*used by operator<<()*

— ROOT only functions —

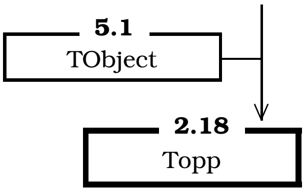
void	**Print** (Option_t *options="")
void	**Paint** (Option_t *option="")

Author: T. Glebe

2.18 class **Topp** : public TObject, public ToppIf

TOPP table entry

Inheritance



Public Members

— Constructors —

Topp ()

Topp (const ArtePointer<TOPP>& topp)
only available with ARTE

const Topp&
operator= (const ArtePointer<TOPP>& topp)

— ToppIf Access methods —

const char* const	**name** () const	*particle name*
float	**mass** () const	*mass*
float	**wid** () const	*width*
float	**trbw** () const	*truncate Breit-Wigner at mass - trbw*
float	**life** () const	*life time*
int	**chrg** () const	*3 * charge*
bool	**valid** () const	*Do we represent a valid Topp entry?*
const ToppIf&	**anti** () const	*get anti particle*
int	**lund** () const	*LUND code*

— Access Methods —

int	**colo** () const	*colour information: 0 = colour singlet; 2 = gluon; 1 = quark or anti-diquark; -1 = anti-quark or diquark*
int	**deca** () const	*Lund decay flag (0 = no decay)*
int	**gean** () const	*GEANT code*

const ArtePointer <Topp>

anti_ptr () const *anti-particle row number*

void **set_anti** (const ArtePointer<Topp>& topp) *set anti-particle row number*

— Operators —

bool **operator==** (const ToppIf& rhs) const

— Expert functions —

std::ostream& **print** (std::ostream&) const *used by operator<<()*

— ROOT only functions —

void **Print** (Option_t *option="")

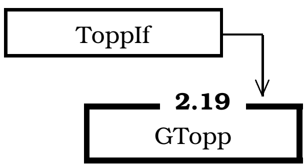
Author: C. Borgmeier, T. Glebe

2.19

class **GTopp** : public ToppIf

Representation of a Topp table entry

Inheritance



Public Members

— Constructors —

GTopp ()

GTopp (const GTopp& rhs)

GTopp (const char* name)

	GTopp (const char* name, int chrg)	
virtual	~**GTopp** ()	
	— ToppIf access methods —	
const char* const	**name** () const	*particle name*
float	**mass** () const	*mass*
float	**wid** () const	*width*
float	**trbw** () const	*truncate Breit-Wigner at mass - trbw*
float	**life** () const	*life time*
int	**chrg** () const	*3 * charge*
const ToppIf&	**anti** () const	*access to anti-particle*
int	**lund** () const	*LUND code*
	— Access methods —	
const ToppIf&	**topp** () const	*topp table pointer*
bool	**valid** () const	*Do we represent a valid Topp entry?*
	— Factory functions —	
SP_sp	**swith** (const SProperty<TrackIf, bool>& rhs) const	*create a SPattern object*
PMC_sp	**createPattern** () const	
PMC_sp	**with** (const SProperty<TrackIf, bool>& rhs) const	
template <unsigned int NTR> typename DP_trait <NTR> ::DPMC_sp	**decaysTo** (const SPatternExpression<NTR>& rhs) const	*create a SDecayPatternMatch-Container object*
	— Operators —	
bool	**operator==** (const ToppIf& rhs) const	
bool	**operator==** (const GTopp& rhs) const	
bool	**operator!=** (const GTopp& rhs) const	

bool **operator**< (const GTopp& rhs) const

— Expert functions —

void **set_topp** (const ArtePointer<Topp>& topp)
set topp table pointer

void **set_anti** (const GTopp& anti)
set link to anti GTopp object

std::ostream&
print (std::ostream& os) const
used by operator<<()

3 Gate

Names

extern const PkgIni **GateSteer** *Global Gate object which holds XCVS information.*

3.1 template <class T> class **GClonesArray** : public TClonesArray *Array of similar objects.* 54

3.2 template <class T> class **GObjArray** : public TObjArray *Array of different objects.* ... 56

3.3 template <class T> class **GObjArrayIterator** : public TObject *GObjectArray Iterator class* . 58

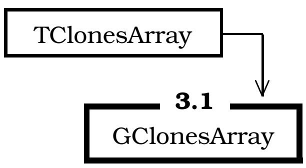
3.4 template <class T> class **ConstGObjArrayIterator** : public TObject *ConstGObjectArray Iterator class* 59

STL like ROOT containers

3.1 template <class T> class **GClonesArray** : public TClonesArray

Array of similar objects.

Inheritance



Public Members

— Constructors —

GClonesArray ()

GClonesArray (unsigned int newsize)

GClonesArray (const GClonesArray<T>& rhs)

~**GClonesArray** ()

GClonesArray <T> &
operator= (const GClonesArray<T>& rhs)

— Access methods —

iterator **begin** ()

iterator **end** ()

const_iterator
begin () const

const_iterator
end () const

inline size_type
size () const

inline bool
empty () const

T **push_back** (T obj)

inline void
pop_back ()

inline void
erase (iterator position)

void **erase** (iterator p1, iterator p2)

inline T& **GetAt** (int idx)

inline const value_type
operator[] (int idx) const

void **set** (int idx, T v)

void **print** (std::ostream& os) const
used by operator<<()

void **saveObjects** (GClonesArray<T>& newArray) const

void **copyObjectsFrom** (const GObjArray<T>& oldArray)

inline void
Print (Option_t* ="")

GClonesArray is a template wrapper for the ROOT TClonesArray class. This class is only available in ROOT. Outside ROOT, GClonesArray is typedef'd to a STL vector.

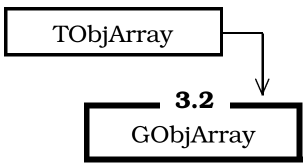
Author: C. Borgmeier

3.2

template <class T> class **GObjArray** : public TObjArray

Array of different objects.

Inheritance



Public Members

— Constructors —

GObjArray ()

GObjArray (const GObjArray<T>& rhs)

~**GObjArray** ()

GObjArray <T> &
operator= (const GObjArray<T>& rhs)

— Access methods —

iterator **begin** ()

inline iterator

end ()

const_iterator
begin () const

inline const_iterator
end () const

inline size_type
size () const

inline bool
empty () const

inline void
push_back (value_type obj)

inline void
pop_back ()

inline void
erase (iterator position)

void **erase** (iterator p1, iterator p2)

inline void
clear ()

inline const value_type
operator[] (int idx) const

inline value_type
GetAt (int idx)

inline const value_type
GetAt (int idx) const

inline void
set (int idx, value_type v)

void **print** (std::ostream& os) const
used by operator<<()

void **Print** (Option_t* ="")

void **saveObjects** (GObjArray<T>& newArray) const

GObjArray is a template wrapper for the ROOT TObjArray class. This class is only available in ROOT. Outside ROOT, GObjarray is typedef'd to a STL vector.

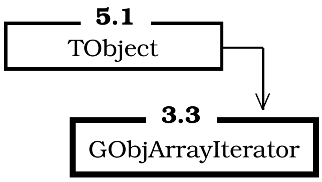
Author: C. Borgmeier

3.3

template <class T> class GObjArrayIterator : public TObject

GObjectArray Iterator class

Inheritance



Public Members

— Constructors —

GObjArrayIterator ()

GObjArrayIterator (TObjArray& array, Int_t idx)

GObjArrayIterator (const GObjArrayIterator<T>& rhs)

const GObjArrayIterator <T> & **operator=** (const GObjArrayIterator<T>& rhs)

— Operators —

T **operator*** ()

const T **operator*** () const

GObjArrayIterator <T> & **operator++** ()

GObjArrayIterator <T> **operator++** (int)

GObjArrayIterator <T> & **operator–** ()

GObjArrayIterator <T>

operator– (int)

GObjArrayIterator <T>
operator+ (int i) const

inline bool
operator!= (const ConstGObjArrayIterator<T>& rhs) const

inline bool
operator== (const GObjArrayIterator<T>& rhs) const

inline bool
operator< (const GObjArrayIterator<T>& rhs) const

— Expert functions —

void **Print** (Option_t* o="")

void **print** (std::ostream& os) const

Protected Members

void **increment** ()

inline void
decrement ()

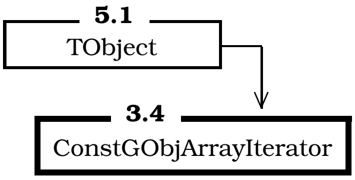
Author: C. Borgmeier, T. Glebe

3.4

template <class T> class **ConstGObjArrayIterator** : public TObject

ConstGObjectArray Iterator class

Inheritance



Public Members

— Constructors —

ConstGObjArrayIterator ()

ConstGObjArrayIterator (const ConstGObjArrayIterator<T>& rhs)

ConstGObjArrayIterator (const GObjArrayIterator<T>& rhs)

ConstGObjArrayIterator (const TObjArray& array, Int_t idx)
this would better be protected.

— Operators —

const ConstGObjArrayIterator <T> &
operator= (const ConstGObjArrayIterator<T>& rhs)

const ConstGObjArrayIterator <T> &
operator= (const GObjArrayIterator<T>& rhs)

T **operator*** ()

const T **operator*** () const

ConstGObjArrayIterator <T> &
operator++ ()

ConstGObjArrayIterator <T>
operator++ (int)

ConstGObjArrayIterator <T> &
operator– ()

ConstGObjArrayIterator <T>

operator-- (int)

ConstGObjArrayIterator <T>
operator+ (int i) const

int **operator!=** (const ConstGObjArrayIterator<T>& rhs) const

int **operator==** (const ConstGObjArrayIterator<T>& rhs) const

inline bool
operator< (const GObjArrayIterator<T>& rhs) const

void **print** (std::ostream& os) const

Protected Members

inline void
increment ()

inline void
decrement ()

Author: C. Borgmeier, T. Glebe

4 Geometry

Point/Vector classes

Names

extern const PkgIni **GeomSteer** *Global Geom object which holds XCVS information.*

4.1 namespace CLUE class **ThreeVector** : public TVector3 *ROOT based implementation* 62

4.2 namespace CLUE class **ThreeVector** : public TObject, public Hep3Vector *CLHEP implementation* 64

4.3 namespace CLUE class **Point3D** : public ThreeVector *ROOT based implementation* 65

4.4 namespace CLUE class **Point3D** : public TObject, public HepPoint3D *CLHEP implementation* 67

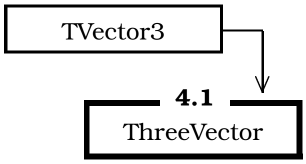
4.5 namespace CLUE class **LorentzVector** : public TLorentzVector *ROOT based implementation* 68

4.6 namespace CLUE class **LorentzVector** : public HepLorentzVector *CLHEP implementation* 70

4.1 namespace CLUE class **ThreeVector** : public TVector3

ROOT based implementation

Inheritance



Public Members

— Constructors —

ThreeVector ()

ThreeVector (const ThreeVector& rhs)

ThreeVector (const TVector3& rhs)

ThreeVector (const double x, const double y, const double z)

const ThreeVector&
operator= (const ThreeVector& rhs)

— Access methods —

inline double
x () const — *X() can be used, too*

inline double
y () const — *Y() can be used, too*

inline double
z () const — *Z() can be used, too*

inline void
set_x (const double x) — *set x-component in cartesian coordinates*

inline void
set_y (const double y) — *set y-component in cartesian coordinates*

inline void
set_z (const double z) — *set z-component in cartesian coordinates*

inline ThreeVector

unit () const — *Unit vector parallel to this.*

virtual void
Paint (Option_t *option="")
only available in ROOT

ThreeVector - ROOT based implementation for usage with ROOT. For documentation of TVector3 member functions see the ROOT reference manual.

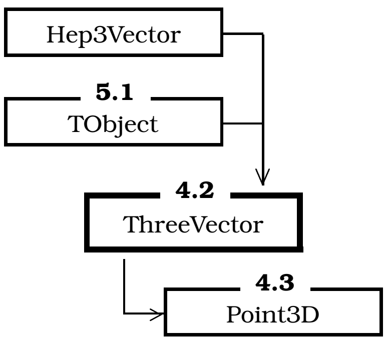
Author: T. Glebe

4.2

namespace CLUE class **ThreeVector** : public TObject, public Hep3Vector

CLHEP implementation

Inheritance



Public Members

— Constructors —

ThreeVector ()

ThreeVector (const ThreeVector& rhs)

ThreeVector (const Hep3Vector& rhs)

ThreeVector (const double x, const double y, const double z)

— Access methods —

inline double
X () const — *x() can be used, too*

inline double
Y () const — *y() can be used, too*

inline double
Z () const — *z() can be used, too*

inline void
set_x (const double x)
set x-component in cartesian coordinates

inline void
set_y (const double y)
set y-component in cartesian coordinates

inline void
set_z (const double z)
set z-component in cartesian coordinates

ThreeVector - CLHEP based implementation for usage outside ROOT. For documentation of Hep3Vector member functions see CLHEP documentation.

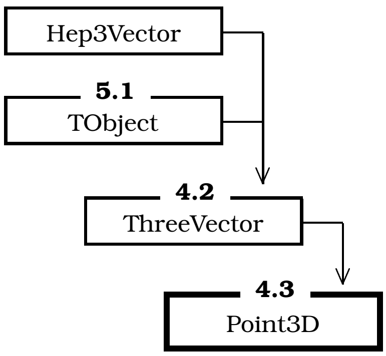
Author: C. Borgmeier

4.3

namespace CLUE class **Point3D** : public ThreeVector

ROOT based implementation

Inheritance



Public Members

— Constructors —

Point3D ()

Point3D (const Point3D& rhs)

Point3D (const ThreeVector& rhs)

Point3D (const TVector3& rhs)

Point3D (const double x, const double y, const double z)

const Point3D& **operator=** (const Point3D& rhs)

Point3D - ROOT based implementation for use with ROOT For member functions see ThreeVector documentation.

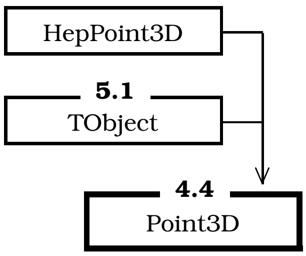
Author: T. Glebe

4.4

namespace CLUE class **Point3D** : public TObject, public HepPoint3D

CLHEP implementation

Inheritance



Public Members

— Constructors —

Point3D ()

Point3D (const Point3D& rhs)

Point3D (const HepPoint3D& rhs)

Point3D (const double x, const double y, const double z)

const Point3D&
operator= (const Point3D& rhs)

— Access methods —

inline double
X () const *x() can be used, too*

inline double
Y () const *y() can be used, too*

inline double
Z () const *z() can be used, too*

inline void
set_x (const double x)
set x-component in cartesian coordinates

inline void

set_y (const double y)
set y-component in cartesian coordinates

inline void
set_z (const double z)
set z-component in cartesian coordinates

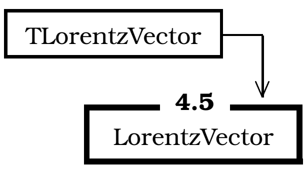
Point3D - CLHEP based implementation for use outside ROOT For HepPoint3D member functions see CLHEP documentation.

Author: C. Borgmeier

4.5 namespace CLUE class **LorentzVector** : public TLorentzVector

ROOT based implementation

Inheritance



Public Members

— Constructors —

LorentzVector ()

LorentzVector (const LorentzVector& rhs)

LorentzVector (const TLorentzVector& rhs)

LorentzVector (const ThreeVector& rhs, double E)

LorentzVector (const double px,
const double py,
const double pz,
const double E)

const LorentzVector&
operator= (const LorentzVector& rhs)

— Access methods —

inline ThreeVector
vect () const *get spatial component*

inline double
e () const *get 4th component (energy)*

inline double
mag () const *Invariant mass. If mag2() is negative then -sqrt(-mag2()) is returned.*

inline double
mag2 () const *Invariant mass squared.*

inline double
rapidity () const *Returns the rapidity, i.e.* $0.5 \cdot \ln((E + p_z)/(E - p_z))$

inline double
pseudoRapidity () const
Returns the pseudo-rapidity, i.e. $-\ln(\tan(\theta/2))$

— Operators —

inline LorentzVector
operator+ (const LorentzVector &rhs) const

inline LorentzVector
operator- (const LorentzVector &rhs) const

LorentzVector - ROOT based implementation for usage with ROOT. For documentation of TLorentzVector member functions see the ROOT reference manual.

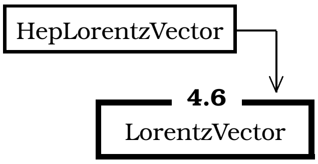
Author: T. Glebe

4.6

namespace CLUE class **LorentzVector** : public HepLorentzVector

CLHEP implementation

Inheritance



Public Members

— Constructors —

LorentzVector ()

LorentzVector (const LorentzVector& rhs)

LorentzVector (const HepLorentzVector& rhs)

LorentzVector (const Hep3Vector& rhs,
double E)

LorentzVector (const double px,
const double py,
const double pz,
const double E)

const LorentzVector&
operator= (const LorentzVector& rhs)

LorentzVector - CLHEP based implementation for usage without ROOT. For documentation of HepLorentzVector member functions see CLHEP documentation

Author: T. Glebe

5 ARTE

The C++ Arte Table interface

Names

5.1 class **TObject** *Dummy base class* 73

— typedef's from ROOT Rtypes.h —

typedef char
Char_t

typedef unsigned char
UChar_t

typedef short
Short_t

typedef unsigned short
UShort_t

typedef int
Int_t

typedef unsigned int
UInt_t

typedef int
Seek_t

typedef long
Long_t

typedef unsigned long
ULong_t

typedef float
Float_t

typedef double
Double_t

typedef char
Text_t

typedef unsigned char
Bool_t

typedef unsigned char

Byte_t

typedef short
Version_t

typedef const char
Option_t

typedef int
Ssiz_t

typedef float
Real_t

typedef void
(*VoidFuncPtr_t) ()

5.2 class **ArtePointerBase**
Base class for ArtePointers .. 75

5.3 class **ArteLink** *single link class* 77

5.4 class **ArteVector** : public ArteLink
Link vector 78

5.5 template <class T> class
ArteRelVector : public ArteVector
Arte Relation Vector 78

5.6 template <class T> class
ArtePointer : public ArtePointerBase
Arte pointer class 79

5.7 template <class Relation, class Result> class
ArteRelationPointer : public ArtePointerBase
Arte Relation Pointer 81

5.8 template <class Relation, class Result> class
ArteInvOneRelationPointer : public ArteRelation-Pointer<Relation, Result>
ArteInvOneRelationPointer .. 82

5.9 template <class Relation, class Result> class
ArteManRelationPointer : public ArteRelation-Pointer<Relation, Result>
ArteManRelationPointer 83

5.10 template <class Relation, class Result> class

ArteInvManRelationPointer : public ArteRelation-Pointer<Relation, Result>
ArteInvManRelationPointer .. 83

5.11 template <class Result> class **ArteRelationIterator** : public ArtePointerBase
ArteRelationIterator 84

5.12 template <class T> class **ArteTableIterator** : public TObject
Arte Table Iterator class 86

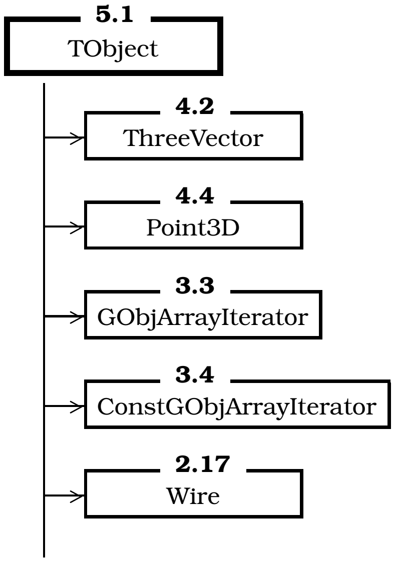
5.13 template <class T> class **ArteTable** : public TObject
Arte Table class 88

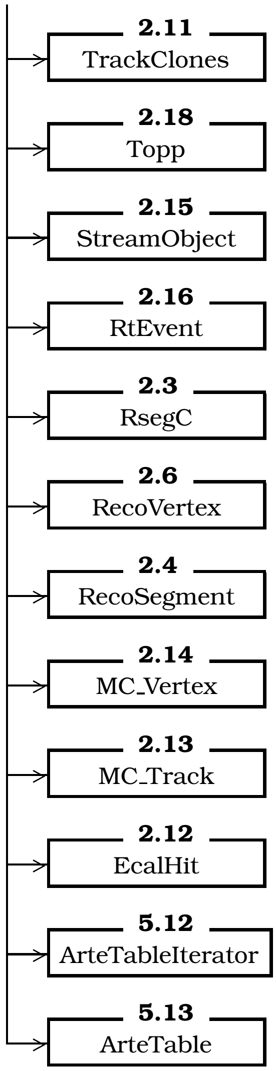
5.1

class **TObject**

Dummy base class

Inheritance





Public Members

	TObject ()
TObject*	**Clone** (void)

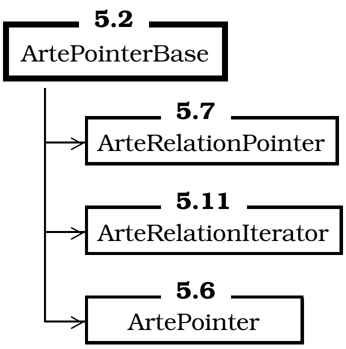
TObject is the base class for all classes which should be integrated into ROOT RTTI. For sake of clean code, a dummy base class is used in case no ROOT is present.

Author: T. Glebe

5.2 class **ArtePointerBase**

Base class for ArtePointers

Inheritance



Public Members

— Constructors —

ArtePointerBase ()

ArtePointerBase (UShort_t i)

ArtePointerBase (const ArtePointerBase& rhs)

const ArtePointerBase&
operator= (const ArtePointerBase& rhs)

— Access methods —

inline UShort_t
index () const

inline void
setInt (const UShort_t index)

inline bool

null () const

— Operators —

inline bool
operator< (const ArtePointerBase& rhs) const

inline bool
operator> (const ArtePointerBase& rhs) const

inline int **operator+** (const ArtePointerBase& rhs) const

inline int **operator-** (const ArtePointerBase& rhs) const

inline bool
operator== (const ArtePointerBase& rhs) const

inline bool
operator!= (const ArtePointerBase& rhs) const

inline ArtePointerBase&
operator++ ()

inline ArtePointerBase&
operator– ()

inline ArtePointerBase
operator++ (int)

inline ArtePointerBase
operator– (int)

— Expert functions —

inline void
print (std::ostream& os) const
used by operator<<()

Protected Members

inline UShort_t&
indexReference ()
Returns the private data.

inline void
increment ()

inline void
decrement ()

const ArtePointerBase&

operator+= (int offset)

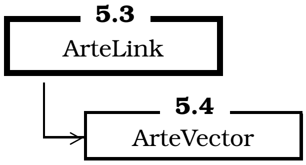
const ArtePointerBase&
operator-= (int offset)

Author: C. Borgmeier, T. Glebe

5.3 class **ArteLink**

single link class

Inheritance



Public Members

inline int&
getRef ()

inline int&
getInt ()

inline int operator
() () — *only available in ARTE compatibility mode*

inline void*&
getVec ()

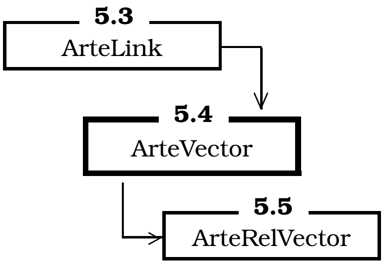
Author: C. Borgmeier

5.4

class **ArteVector** : public ArteLink

Link vector

Inheritance



Public Members

inline const int& operator
() ()

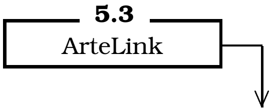
Author: C. Borgmeier

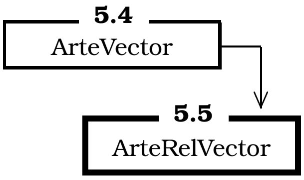
5.5

template <class T> class **ArteRelVector** : public ArteVector

Arte Relation Vector

Inheritance





Public Members

	ArteRelVector ()
	~**ArteRelVector** ()
void	**clear** ()

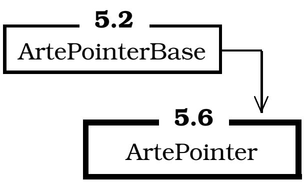
Author: C. Borgmeier

5.6

template <class T> class **ArtePointer** : public ArtePointerBase

Arte pointer class

Inheritance



Public Members

	— Constructors —
	ArtePointer ()
	ArtePointer (const UShort_t index)
explicit	**ArtePointer** (const ArtePointerBase& rhs)

this is a conversion between ArtePointers!!

ArtePointer (const ArtePointer<T>& index)

const self&
operator= (const self& rhs)

— Operators —

inline T& **operator*** () const

inline T* **operator->** () const

inline bool
operator> (const ArtePointer<T>& rhs) const

inline bool
operator< (const ArtePointer<T>& rhs) const

inline int **operator-** (const ArtePointer<T>& rhs) const

inline bool
operator!= (const ArtePointer<T>& rhs) const

inline bool
operator== (const ArtePointer<T>& rhs) const

— ARTE compatibility —

inline ArtePointer <T> &
operator++ ()

inline ArtePointer <T>
operator++ (int)

— ARTE only functions —

inline static unsigned int
nrow () *Returns the number of entries in the corresponding Arte table.*

inline static self
append (const_reference e)

inline static void*
getLink ()

inline static int&
getIntLink ()

inline static ArteLink&
getLinkLink ()

inline static int

ncol () *Return the width of the Arte table.*

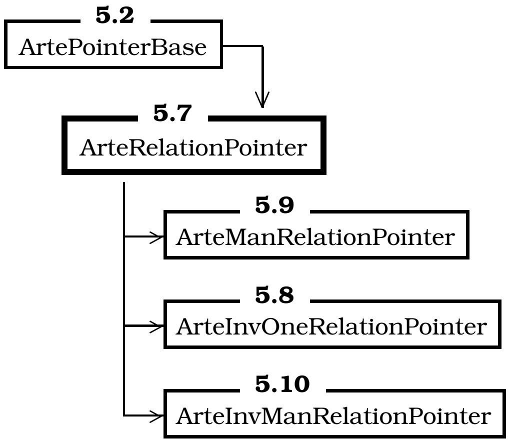
Author: C. Borgmeier, T. Glebe

5.7

template <class Relation, class Result> class **ArteRelationPointer** : public ArtePointerBase

Arte Relation Pointer

Inheritance



Public Members

— Constructors —

ArteRelationPointer ()

ArteRelationPointer (const ArteRelationPointer<Relation, Result>& arg)

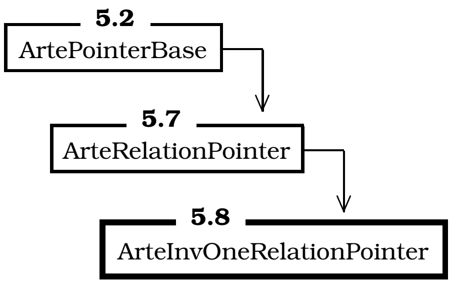
Author: C. Borgmeier

5.8

template <class Relation, class Result> class **ArteInvOneRelationPointer** : public ArteRelationPointer<Relation, Result>

ArteInvOneRelationPointer

Inheritance



Public Members

iterator **begin** () const

iterator **end** () const

inline static ArteRelVector <Relation> & **getLink** ()

inline static ArteRelVector <Relation> & **getLinkLink** () *only in ARTE compat. mode*

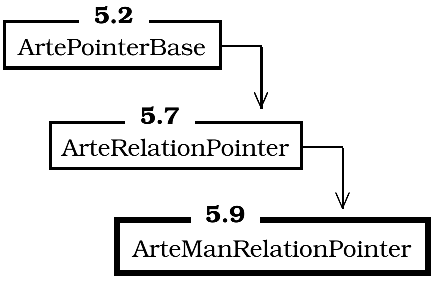
Author: C. Borgmeier

5.9

template <class Relation, class Result> class **ArteManRelationPointer** : public ArteRelationPointer<Relation, Result>

ArteManRelationPointer

Inheritance



Public Members

- iterator **begin** () const
- iterator **end** () const
- inline static ArteRelVector <Relation> & **getLink** ()
- inline static ArteRelVector <Relation> & **getLinkLink** () *only in ARTE compat. mode*

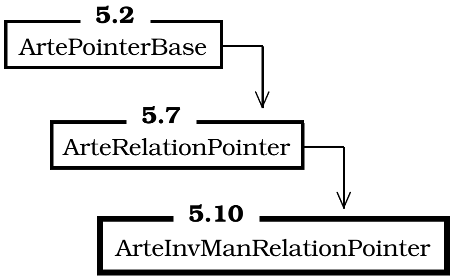
Author: C. Borgmeier

5.10

template <class Relation, class Result> class **ArteInvManRelationPointer** : public ArteRelationPointer<Relation, Result>

ArteInvManRelationPointer

Inheritance



Public Members

iterator **begin** () const

iterator **end** () const

inline static ArteRelVector <Relation> & **getLink** ()

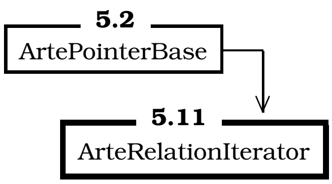
Author: C. Borgmeier

5.11

template <class Result> class **ArteRelationIterator** : public ArtePointerBase

ArteRelationIterator

Inheritance



Public Members

— Constructors —

ArteRelationIterator ()

template <class Relation>
ArteRelationIterator (const ArteInvOneRelationPointer<Relation, Result>& x)

template <class Relation>
ArteRelationIterator (const ArteManRelationPointer<Relation, Result>& x)

template <class Relation>
ArteRelationIterator (const ArteInvManRelationPointer<Relation, Result>& x)

— Relation structures —

struct **ArteOneToManyRelation**

struct **ArteManyToManyRelation**

struct **ArteBackwardsManyToManyRelation**

— Operators —

template <class Relation> const ArteRelationIterator <Result> &
operator= (const ArteInvOneRelationPointer<Relation, Result>& x)

template <class Relation> const ArteRelationIterator <Result> &
operator= (const ArteManRelationPointer<Relation, Result>& x)

template <class Relation> const ArteRelationIterator <Result> &
operator= (const ArteInvManRelationPointer<Relation, Result>& x)

inline ArtePointer <Result>
operator* () const

operator ArtePointer<**Result**> () const *only in ARTE compat. mode*

self& **operator++** ()

self **operator++** (int)

inline bool **operator!=** (const ArteRelationIterator<Result>& rhs)

inline bool **operator==** (const ArteRelationIterator<Result>& rhs)

— ARTE compatibility mode —

inline int **valid** () const

inline void **next** ()

Protected Members

ArtePointer <Result> **lookup** () const

void **followLink** ()

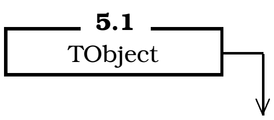
Author: C. Borgmeier, T. Glebe

5.12

template <class T> class **ArteTableIterator** : public TObject

Arte Table Iterator class

Inheritance



5.12 ArteTableIterator

Public Members

— Constructors —

ArteTableIterator ()

ArteTableIterator (const ArtePointer<T>& rhs)

ArteTableIterator (const ArteTableIterator<T>& rhs)

— Operators —

inline ArtePointer <T> &
operator* ()

inline const ArtePointer <T> &
operator* () const

self& **operator++** ()

inline self
operator++ (int)

self& **operator–** ()

inline self
operator– (int)

inline const self&
operator+= (int offset)

inline const self&
operator-= (int offset)

inline bool
operator!= (const ArteTableIterator<T>& rhs) const

inline bool
operator== (const ArteTableIterator<T>& rhs) const

inline bool
operator< (const ArteTableIterator<T>& rhs) const

inline bool

operator> (const ArteTableIterator<T>& rhs) const

inline int **operator-** (const ArteTableIterator<T>& rhs) const

inline ArteTableIterator <T>
operator+ (int rhs) const

inline ArteTableIterator <T>
operator- (int rhs) const

inline void
print (std::ostream& os) const

— Arte compatibility mode —

operator ArtePointer<**T**> () const

inline int **valid** () const

ArtePointer <T>
next ()

inline static unsigned int
nrow ()

inline T* **operator-**> () const

Protected Members

inline unsigned int
index () const *public only in ARTE compat. mode*

ArteTableIterator (unsigned int i)
forbidden constructor

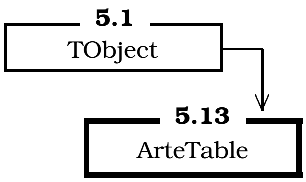
Author: C. Borgmeier, T. Glebe

5.13

template <class T> class **ArteTable** : public TObject

Arte Table class

Inheritance



Public Members

— Constructors —

ArteTable ()

— Access methods —

static std::string
getName () *not available in CINT*

static inline iterator
begin ()

static inline iterator
end ()

static unsigned int
size ()

static ArtePointer <T>
push_back (const T& e)

static ArtePointer <T>
allocate (unsigned int n)

void **print** (std::ostream& os) const

virtual void
Print (Option_t* = "")
only available in ROOT

inline static bool
isArteTable ()

inline static unsigned int
nrow () *only in ARTE compat. mode*

static void*
getLink () *private in Arte compat. mode*

— ARTE only functions —

inline static void

book (int num = 1)

inline static bool
booked ()

inline static void
free ()

inline static void
clear ()

inline static int
ncol () *Return the width of the Arte table*

Author: C. Borgmeier, T. Glebe

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