

General notes:

Units:

- Coordinate unit is centimetre
- Momentum unit is GeV/c
- Energy unit is GeV
- Time unit is second
- Length unit is centimetre

If the unit is different this is noted in the text.

Geometry:

Each detector and its modules have a unique code (ModuleID, DetectorID, SubDetectorID). This unique string code (TGeo-path) of the point at which the particle interacted consists of detectors ID and its parts ID, starting from the outermost (cave) and ending with the innermost. ModuleID can be found in spddata/SpdDetectorList.h or in an appendix1. Detector ID is the string identifier where the particle is in. It is equivalent to the TGeo-path converted to a digit (only the active part). The numbering of parts of the installation is from 1.

Links to the described functions are in the form of I.1. Where I is the number of a branch in the list, 1 is the function number of this branch.

FILE: **run_tor.root**
Object type: **TTree**
Object name: **"cbmsim"**

LIST OF BRANCHES:

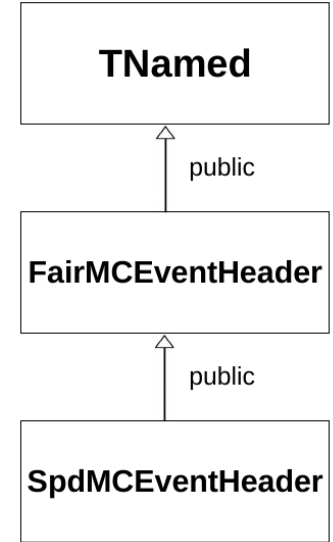
Branch number	Branch name	Notes
I.	"MCEventHeader."	Due to the partial filling or emptiness, some branches are not described in this text.
II.	"SpdMCTrack"	
III.	"SpdTSTBPoint"	
IV.	"SpdEcalTBPoint"	
V.	"SpdRsTBPoint"	
VI.	"SpdTSTECPoint"	
VII.	"SpdEcalTECPoint"	
VIII.	"SpdRsTECPoint"	
IX.	"SpdItsPoint"	
X.	"GeoTracks"	

I. TBranch "MCEventHeader"

Branch name: "MCEventHeader."
Object: SpdMCEventHeader

SpdMCEventHeader :: public FairMCEventHeader :: public TNamed

To print information: **Print** (int opt). By default, opt = 0.



SpdMCEventHeader

	Description	How to get	Type	
1	Unique run identifier	GetRunID()	UInt_t	*
2	MC event unique number (branch event number) ¹	GetEventID()	UInt_t	*
3	X coordinate of the primary vertex	GetX()	Double_t	*
4	Y coordinate of the primary vertex	GetY()	Double_t	*
5	Z coordinate of the primary vertex	GetZ()	Double_t	*
6	Event time	GetT()	Double_t	*
7	Number of primary vertex tracks	GetNPrim()	Int_t	*
8	Get array of SpdPrimGenData	GetPrimGenDataList()	TObjArray*	**
9	Get entries in array of SpdPrimGenData	GetNPrimGenData()	Int_t	**
10	Get list of parameters of generator with the specified position (index) in SpdPrimGenDataList	GetGenData(Int_t index)	SpdPrimGenData*	**
11	Get list of parameters of the specified generator	GetGenData(TString generator)	SpdPrimGenData*	**
12	Get list of parameters of basic generator ("SpdPrimaryGenerator"). SpdPrimGenDataList position of this generator is 0	GetPrimData(TString type)	SpdPrimGenData*	**
13	Decayer parameters	GetDecayerData()	SpdPrimGenData*	**
14	Impact parameter [fm] (if relevant)	GetB()	Double_t	*
15	Flag whether variables are filled ²	IsSet()	Bool_t	*
16	Rotation around x-axis (beam tilt) [rad]	GetRotX()	Double_t	*
17	Rotation around y-axis (beam tilt) [rad]	GetRotY()	Double_t	*
18	Rotation around z-axis (event plane) [rad]	GetRotZ()	Double_t	*

* - functions of FairMCEventHeader

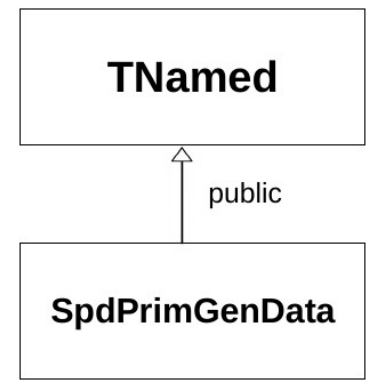
** - functions of SpdMCEventHeader

¹ Numbering starts from 1

² Not used now

SpdPrimGenData³

SpdPrimGenData : public TNamed



	Description	How to get	Type
1	Unique Generator id	GetGenIndex()	Int_t
2	Set of seeds of primary generator	GetGenSeeds()	std::vector<UInt_t>&
3	Vertex particles list	GetParticles()	TClonesArray*
4	Return the particle at i-th position in vertex particles list	GetParticle(int i)	TParticle*
5	Parameters and triggers	GetParameters()	SpdBaseParSet*
6	Return number of seeds of the primary generator	GetNGenSeeds()	Int_t
7	Return the number of particles in the vertex particles list	GetNParticles()	Int_t

³ References to functions of this class will begin with Ia (f.e Ia(1) is GetGenIndex())

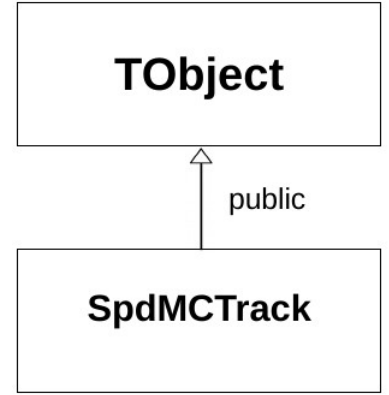
II. TBranch "SpdMCTrack"

Object type inside the branch: **TClonesArray**
Object type: **SpdMCTrack**

SpdMCTrack : public **TObject**

To print information of class: **Print**(Track_number)

Data:



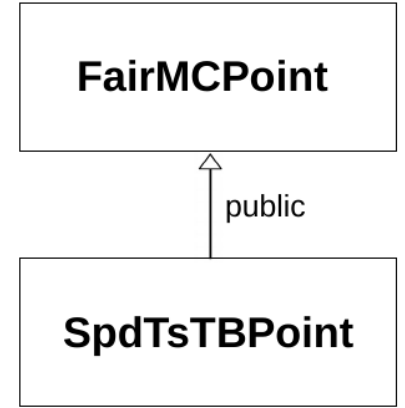
	Description	How to get	Type
1	Particle (track) number position inside the array	-	Int_t
2	First mother particle number (-1 for primaries)	GetMotherId()	Int_t
3	First mother particle number (-1 for primaries)	GetFirstMotherId()	Int_t
4	Particle number in the MCEventHeader primary data list (-1 for secondaries) (see I.(8))	GetSecondMotherId()	Int_t
5	Particle code (PDG number) (cm. http://pdg.lbl.gov/2019/mcdata/mc_particle_id_contents.html)	GetPdgCode()	Int_t
6	Start vertex module unique number (ModuleID)	GetStartModule()	Int_t
7	Start vertex initial physical process (VMC physics process codes) unique number (It is possible to view the list of processes and their IDs follow the link https://root.cern/doc/v610/TMCProcess_8h.html or in an appendix2	GetStartProcess()	Int_t
8	Start vertex node name (full TGeo-path). It is unique string code that displays the full path	GetStartNodeName()	TString
9	Coordinate X of start vertex in global CS ⁴	GetStartX()	Double_t
10	Coordinate Y of start vertex in global CS	GetStartY()	Double_t
11	Coordinate Z of start vertex in global CS	GetStartZ()	Double_t
12	All components of coordinate of start vertex in global CS	GetStartVertex()	TVector3
13	Momentum X-component at start vertex	GetPx()	Double_t
14	Momentum Y-component at start vertex	GetPy()	Double_t
15	Momentum Z-component at start vertex	GetPz()	Double_t
16	All components of momentum at start vertex	GetMomentum()	TVector3
17	Total number of stored points for the particle track	GetTotalPoints()	Int_t
18	Total number of points in this module	GetNPoints(DetectorId modId)	Int_t

III. TBranch "SpdTsTBPoint"

Object type inside the branch: **TClonesArray**
Object "SpdTsTBPoints": **SpdTsTBPoint**

SpdTsTBPoint : public **FairMCPoint**
To print information of class: **Print** (Option_t* opt)

Data:



	Description	How to get	Type
1	MC event unique number (= I.(2) -1) ⁵	GetEventID()	Int_t
2	Particle (track) number position inside the array	GetTrackID()	Int_t
3	Module unique identifier (ModuleID = kSpdTsTB)	GetDetectorID()	Int_t
4	Detector unique number (DetectorID)	GetDetectorTID()	Long_t
5	Full track length (length from vertex to this detector)	GetLength()	Double_t
6	Trajectory segment length inside this detector	GetSegmentLength()	Double_t
7	X-coordinate of track at entrance of the detector	GetXIn()	Double_t
8	Y-coordinate of track at entrance of the detector	GetYIn()	Double_t
9	Z-coordinate of track at entrance of the detector	GetZIn()	Double_t
10	All components of coordinate of track at entrance of the	GetPositionIn(Double_t*)	void
11	detector	GetPositionIn(TVector3&)	void
12	Time since event start at entrance of the detector	GetTimeIn()	Double_t
13	Momentum X-component at entrance of the detector	GetPxIn()	Double_t
14	Momentum Y-component at entrance of the detector	GetPyIn()	Double_t
15	Momentum Z-component at entrance of the detector	GetPzIn()	Double_t
16	All components of momentum at entrance of the detector	GetMomentumIn(TVector3&)	void
17	X-coordinate of track at exit of the detector	GetXOut()	Double_t
18	Y-coordinate of track at exit of the detector	GetYOut()	Double_t
19	Z-coordinate of track at exit of the detector	GetZOut()	Double_t
20	All components of coordinate of track at exit of the detector	GetPositionOut(Double_t*)	void
21	Time since event start at exit of the detector	GetTimeOut()	Double_t
22	Momentum X-components at exit of the detector	GetPxOut()	Double_t
23	Momentum Y-components at exit of the detector	GetPyOut()	Double_t
24	Momentum Z-components at exit of the detector	GetPzOut()	Double_t
25	All components of momentum at exit of the detector	GetMomentumOut(TVector3&)	void
26	Energy deposit (total energy for this detector)	GetEnergyLoss()	Double_t

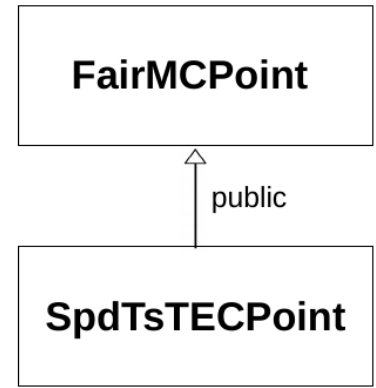
⁵ In I.(2) numbering starts from 1, in III.(1) numbering starts from 0.

VI. TBranch "SpdTsTECPoint"

Object type inside the branch: **TClonesArray**
Object "SpdTsTECPoints": **SpdTsTECPoint**

SpdTsTECPoint : public FairMCPoint
To print information of class: **Print** (Option_t* opt)

Data:



	Description	How to get	Type
1	MC event unique number (= L(2) -1)	GetEventID()	Int_t
2	Particle (track) number position inside the array	GetTrackID()	Int_t
3	Module unique identifier (ModuleID = kTsTEC)	GetDetectorID()	Int_t
4	Detector unique number (DetectorID)	GetDetectorTID()	Long_t
5	Full track length (length from vertex to this detector)	GetLength()	Double_t
6	Trajectory segment length inside this detector	GetSegmentLength()	Double_t
7	X-coordinate of track at entrance of the detector	GetXIn()	Double_t
8	Y-coordinate of track at entrance of the detector	GetYIn()	Double_t
9	Z-coordinate of track at entrance of the detector	GetZIn()	Double_t
10	All components of coordinate of track at entrance of the	GetPositionIn(Double_t*)	void
11	detector	GetPositionIn(TVector3&)	void
12	Time since event start at entrance of the detector	GetTimeIn()	Double_t
13	Momentum X-component at entrance of the detector	GetPxIn()	Double_t
14	Momentum Y-component at entrance of the detector	GetPyIn()	Double_t
15	Momentum Z-component at entrance of the detector	GetPzIn()	Double_t
16	All components of momentum at entrance of the detector	GetMomentumIn(TVector3&)	void
17	X-coordinate of track at exit of the detector	GetXOut()	Double_t
18	Y-coordinate of track at exit of the detector	GetYOut()	Double_t
19	Z-coordinate of track at exit of the detector	GetZOut()	Double_t
20	All components of coordinate of track at exit of the detector	GetPositionOut(Double_t*)	void
21	Time since event start at exit of the detector	GetTimeOut()	Double_t
22	Momentum X-components at exit of the detector	GetPxOut()	Double_t
23	Momentum Y-components at exit of the detector	GetPyOut()	Double_t
24	Momentum Z-components at exit of the detector	GetPzOut()	Double_t
25	All components of momentum at exit of the detector	GetMomentumOut(TVector3&)	void
26	Energy deposit (total energy for this detector)	GetEnergyLoss()	Double_t

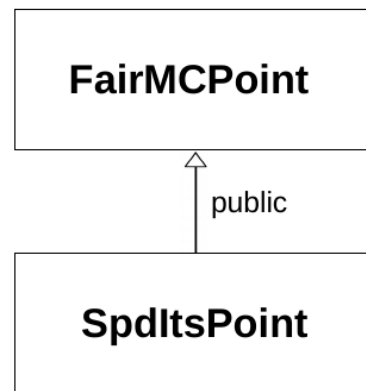
IX. TBranch "SpdItsPoint"

Object type inside the branch: **TClonesArray**
Object "SpdItsPoints": **SpdItsPoint**

SpdItsPoint : public **FairMCPoint**

To print information use **Print** (Option_t* opt) or **PrintVData()**

Data:



	Description	How to get	Type
1	MC event unique number	GetEventID()	Int_t
2	Particle (track) number position inside the array of MCTrack	GetTrackID()	Int_t
3	Module unique number (ModuleID = kSpdIts)	GetDetectorID()	Int_t
4	Detector unique number (DetectorID)	GetNodeId()	Int_t
5	X -coordinate of track at entrance of the detector	GetX()	Double_t
6	Y -coordinate of track at entrance of the detector	GetY()	Double_t
7	Z -coordinate of track at entrance of the detector	GetZ()	Double_t
8	X -coordinate of track position at exit of the detector	GetXOut()	Double_t
9	Y -coordinate of track position at exit of the detector	GetYOut()	Double_t
10	Z -coordinate of track position at exit of the detector	GetZOut()	Double_t
11	Time at entrance of the detector	GetTime()	Double_t
12	Track length since creation	GetLength()	Double_t
13	Momentum X-component of track at entrance of the detector	GetPx()	Double_t
14	Momentum Y-component of track at entrance of the detector	GetPy()	Double_t
15	Momentum Z-component of track at entrance of the detector	GetPz()	Double_t
16	Momentum X-component at exit of the detector	GetPxOut()	Double_t
17	Momentum Y-component at exit of the detector	GetPyOut()	Double_t
18	Momentum Z-component at exit of the detector	GetPzOut()	Double_t
19	Energy deposit (total energy in all Vid (sum of Ved))	GetEnergyLoss()	Double_t
20	List of channels through which the particle passed (SubDetectorID)	GetVid()	std::vector<Int_t>
21	List of channels through which the particle passed (SubDetectorID)	GetVid(vector<Int_t>&)	void
22	Array of energy release in channels	GetVed()	std::vector<Double_t>
23	Array of energy release in channels	GetVed(vector<Double_t>&)	void

Appendix 1

Detector ID (active)

kSpdEcalTB	0	Electromagnetic calorimeter, barrel, toroidal magnet
kSpdEcalTEC	1	Electromagnetic calorimeter, endcaps, toroidal magnet
kSpdTSTB	2	Tracking system barrel, toroidal magnet
kSpdTSTEC	3	Tracking system endcaps, toroidal magnet
kSpdRsTB	4	Range system barrel, toroidal magnet
kSpdRsTEC	5	Range system endcaps, toroidal magnet
kSpdEcalSB	6	Electromagnetic calorimeter, barrel, solenoidal magnet
kSpdEcalSEC	7	Electromagnetic calorimeter, endcaps, solenoidal magnet
kSpdTSTB	8	Tracking system barrel, solenoidal magnet
kSpdTSTEC	9	Tracking system endcaps, solenoidal magnet
kSpdRsSB	10	Range system barrel, solenoidal magnet
kSpdRsSEC	11	Range system endcaps, solenoidal magnet
kSpdIts	12	Inner Tracking System
kTestDetector	17	Detector for testing
kSTOPHERE	18	How many announced detectors

Detector ID (passive)

kSpdUndefined	-1000	
kSpdHybMagnet	-9	Hybrid magnet coils
kSpdPipe	-8	Beam pipe
kSpdSolFrame	-7	Setup elements for solenoidal geometry
kSpdSolBasket	-6	Setup elements for solenoidal geometry
kSpdSolMagnet	-5	Solenoidal magnet coils
kSpdTorFrame	-4	Setup elements for toroidal geometry
kSpdTorBasket	-3	Setup elements for toroidal geometry
kSpdTorMagnet	-2	Toroidal magnet coils
kSpdTop	-1	Top volume

Appendix 2

VMC physics process codes

Enumerator	Enumerator	Process
kPPPrimary	0	Primary interaction
kPMultipleScattering	1	Multiple scattering
kPEnergyLoss	2	Continuous energy loss
kPMagneticFieldL	3	Bending in mag. field
kPDecay	4	Particle decay
kPPair	5	Photon pair production or muon direct pair production
kPCompton	6	Compton scattering
kPPhotoelectric	7	Photoelectric effect
kPBrem	8	Bremsstrahlung
kPDeltaRay	9	Delta-ray production
kPAnnihilation	10	Positron annihilation
kPAnnihilationRest	11	Positron annihilation at rest
kPAnnihilationFlight	12	Positron annihilation in flight
kPHadronic	13	Hadronic interaction
kPEvaporation	14	Nuclear evaporation
kPNuclearFission	15	Nuclear fission
kPNuclearAbsorption	16	Nuclear absorption
kPPbarAnnihilation	17	Antiproton annihilation
kPNbarAnnihilation	18	Antineutron annihilation
kPNCapture	19	Neutron capture
kPHElasti	20	Hadronic elastic scattering
kPHIElastic	21	Hadronic elastic incoherent scattering
kPHCElastic	22	Hadronic elastic coherent scattering
kPHInelastic	23	Hadronic inelastic scattering
kPPhotonInelastic	24	Photon inelastic scattering

kPMuonNuclear	25	Muon nuclear interaction
kPElectronNuclear	26	Electron nuclear interaction
kPPositronNuclear	27	Positron nuclear interaction
kPTOFlimit	28	Exceeded time of flight cut
kPPhotoFission	29	Nuclear photofission
kPRayleigh	30	Rayleigh scattering
kPNull	31	No mechanism is active, usually at the entrance of a new volume
kPStop	32	Particle has fallen below energy threshold and tracking stops
kPLightAbsorption	33	Cerenkov photon absorption
kPLightDetection	34	Optical photon detection (absorption + photoelectron production)
kPLightScattering	35	Cerenkov photon reflection/refraction
kStepMax	36	Step limited by STEMAX
kPCerenkov	37	Cerenkov photon generation
kPFeedBackPhoton	38	Feed back photon in RICH -- ALICE specific
kPLightReflection	39	Cerenkov photon reflection
kPLightRefraction	40	Cerenkov photon refraction or dichroic mirror transmission
kPSynchrotron	41	Synchrotron radiation generation
kPScintillation	42	Scintillation
kPTransportation	43	Transportation
kPNoProcess	44	Unknown process
kPCoulombScattering	45	Single Coulomb scattering
kPPhotoNuclear	46	Photo nuclear interaction
kPUserDefined	47	User defined process
kPLightWLShifting	48	Optical photon wavelength shifting