# LPAIR++

0.1

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# Contents

# 1 Todo List

**Global GamGam::GamGam (const unsigned int ndim_, int nOpt_, double x_[])**

Figure out how this *nOpt_* parameter is affecting the final cross-section computation and events generation

# 2 Hierarchical Index

## 2.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:



# 3 Data Structure Index

## 3.1 Data Structures

Here are the data structures with brief descriptions:

# 4 Data Structure Documentation

## 4.1 Event Class Reference

Kinematic information on the particles in the event.

### Public Member Functions

- void Dump ()
- Particle * GetByRole (int role_)
- int SetParticle (Particle *part_)
- void Store (std::ofstream *, double weight_=1.)
- void StoreLHERecord (std::ofstream *of_, const double weight_=1.)

  *Stores the LHE block for this event.*

### 4.1.1 Detailed Description

Class containing all the information on the in- and outgoing particles' kinematics

### 4.1.2 Member Function Documentation

#### 4.1.2.1 void Event::Dump ( )

Dumps all the known information on every Particle object contained in this Event container in the output stream

#### 4.1.2.2 Particle* Event::GetByRole ( int *role_* )

Returns the pointer to the Particle object corresponding to a certain role in the process kinematics

**Parameters**

| | |
|---|---|
| *role_* | The role the particle has to play in the process |

**Returns**

A pointer to the requested Particle object

#### 4.1.2.3 int Event::SetParticle ( Particle * *part_* )

Sets the information on one particle in the process

**Parameters**

| | |
|---|---|
| *part_* | The Particle object to insert or modify in the event |

**Returns**

- 1 if a new Particle object has been inserted in the event
- 0 if an existing Particle object has been modified
- -1 if the requested role to edit is undefined or incorrect

#### 4.1.2.4 void Event::Store ( std::ofstream *, double *weight_* = 1. )

Stores in a file (raw format) all the kinematics on the outgoing leptons

**Parameters**

| | |
|---|---|
| *weight_* | The weight of the event |

#### 4.1.2.5 void Event::StoreLHERecord ( std::ofstream * *of_*, const double *weight_* = 1. )

Stores in a LHE format (a XML-style) all the information on the particles composing this event

**Parameters**

| | |
|---|---|
| *of_* | The file stream on which the event record has to be saved |
| *weight_* | The weight of the event |

The documentation for this class was generated from the following file:

- include/event.h

## 4.2 GamGam Class Reference

Computes the matrix element for a $\gamma\gamma \to \ell^+\ell^-$ process.

### Public Member Functions

- GamGam (const unsigned int ndim_, int nOpt_, double x_[])
  *Class constructor.*
- void ComputeSqS ()
  *Computes $\sqrt{s}$ for the system.*
- double ComputeXsec (int nm_=1)
  *Computes the process' cross section.*
- Particle * GetParticle (int role_)
  *Get a particle given its role in the process.*
- double GetT1 ()
- void GetT1extrema (double &t1min_, double &t1max_)
- double GetT2 ()
- void GetT2extrema (double &t2min_, double &t2max_)
- bool IsKinematicsDefined ()
  *Is the system's kinematics well defined?*
- void SetCuts (GamGamKinematics cuts_)
  *Sets the list of kinematic cuts to apply on the outgoing particles' final state.*
- bool SetIncomingKinematics (int part_, double momentum_[3], int pdgId_)
  *Sets the momentum and PDG id for the incoming particles.*
- bool SetIncomingKinematics (Particle ip1_, Particle ip2_)
  *Sets the momentum and PDG id for the incoming particles.*
- bool SetOutgoingParticles (int part_, int pdgId_)
  *Sets the PDG id for the outgoing particles.*

### 4.2.1 Detailed Description

Full class of methods and objects to compute the full analytic matrix element [2] for the $\gamma\gamma \to \ell^+\ell^-$ process according to a set of kinematic constraints provided for the incoming and outgoing particles (the GamGamKinematics object).

#### 4.2.2 Constructor & Destructor Documentation

##### 4.2.2.1 GamGam::GamGam ( const unsigned int *ndim_*, int *nOpt_*, double *x_[]* )

Sets the mandatory parameters used in the methods computing the kinematics and the cross-section of this phase space point.

**Parameters**

| | |
|---|---|
| *ndim_* | The number of dimensions of the point in the phase space |
| *nOpt_* | Optimisation??? |
| *x_[]* | The (*ndim_*)-dimensional point in the phase space on which the kinematics and the cross-section are computed |

**Todo** Figure out how this *nOpt_* parameter is affecting the final cross-section computation and events generation

#### 4.2.3 Member Function Documentation

##### 4.2.3.1 void GamGam::ComputeSqS ( )

Computes the centre of mass energy for the system, according to the incoming particles' kinematics

##### 4.2.3.2 double GamGam::ComputeXsec ( int *nm_* = 1 )

Computes the cross-section for the $\gamma\gamma \to \ell^+\ell^-$ process with the given kinematics

**Returns**

$\frac{\mathrm{d}\sigma}{\mathrm{d}\mathbf{x}}(\gamma\gamma \to \ell^+\ell^-)$, the differential cross-section for the given point in the phase space.

##### 4.2.3.3 Particle* GamGam::GetParticle ( int *role_* )

**Parameters**

| | |
|---|---|
| *role_* | An integer denoting the particle's role in the selected production process |

##### 4.2.3.4 double GamGam::GetT1 ( ) [inline]

Returns the value for the first photon virtuality

**Returns**

$t_1$, the first photon virtuality

##### 4.2.3.5 void GamGam::GetT1extrema ( double & *t1min_*, double & *t1max_* ) [inline]

Returns the two limit values for the first photon virtuality

**Parameters**

| | |
|---|---|
| *t1min_* | The minimal value for $t_1$ |
| *t1max_* | The maximal value for $t_1$ |

##### 4.2.3.6 double GamGam::GetT2 ( ) [inline]

Returns the value for the second photon virtuality

**Returns**

$t_2$, the second photon virtuality

#### 4.2.3.7 void GamGam::GetT2extrema ( double & *t2min_*, double & *t2max_* ) [inline]

Returns the two limit values for the second photon virtuality

**Parameters**

| | |
|---|---|
| *t2min_* | The minimal value for $t_2$ |
| *t2max_* | The maximal value for $t_2$ |

#### 4.2.3.8 bool GamGam::IsKinematicsDefined ( ) [inline]

Is the system's kinematics well defined and compatible with the process ? This check is mandatory to perform the (*_ndim*)-dimensional point's cross-section computation.

**Returns**

A boolean stating if the input kinematics and the final states are well defined

#### 4.2.3.9 void GamGam::SetCuts ( GamGamKinematics *cuts_* )

**Parameters**

| | |
|---|---|
| *cuts_* | The Cuts object containing the kinematic parameters |

#### 4.2.3.10 bool GamGam::SetIncomingKinematics ( int *part_*, double *momentum_[3]*, int *pdgId_* )

Specifies the incoming particles' kinematics as well as their properties (role in the process and code according to the PDG convention)

**Parameters**

| | |
|---|---|
| *part_* | Role of the particle in the process |
| *momentum_[]* | 3-momentum of the particle |
| *pdgId_* | Particle ID according to the PDG convention |

**Returns**

True if the kinematics was correctly set for the given particle role

#### 4.2.3.11 bool GamGam::SetIncomingKinematics ( Particle *ip1_*, Particle *ip2_* )

Specifies the incoming particles' kinematics as well as their properties using two Particle objects.

**Parameters**

| | |
|---|---|
| *ip1_* | Information on the first incoming particle |
| *ip2_* | Information on the second incoming particle |

#### 4.2.3.12 bool GamGam::SetOutgoingParticles ( int *part_*, int *pdgId_* )

**Parameters**

| | |
|---|---|
| *part_* | Role of the particle in the process |
| *pdgId_* | Particle ID according to the PDG convention |

The documentation for this class was generated from the following file:

- include/gamgam.h

## 4.3 GamGamKinematics Class Reference

List of kinematic cuts to apply on the central and outgoing phase space.

### Data Fields

- double emax

  *Maximal energy of the central two-photons system.*
- double emin

  *Minimal energy of the central two-photons system.*
- int kinematics

  *Type of kinematics to consider for the phase space.*
- int mode

  *Sets of cuts to apply on the final phase space.*
- double ptmax

  *Maximal transverse momentum of the single outgoing leptons.*
- double ptmin

  *Minimal transverse momentum of the single outgoing leptons.*
- double q2max

  *The maximal value of $Q^2$.*
- double q2min

  *The minimal value of $Q^2$.*
- double thetamax

  *Maximal polar ( $\theta_{\max}$) angle of the outgoing leptons, expressed in degrees.*
- double thetamin

  *Minimal polar ( $\theta_{\min}$) angle of the outgoing leptons, expressed in degrees.*
- double wmax

  *The maximal $s$ on which the cross section is integrated. If negative, the maximal energy available to the system (hence, $s = (\sqrt{s})^2$) is provided.*
- double wmin

  *The minimal $s$ on which the cross section is integrated.*

### 4.3.1 Field Documentation

#### 4.3.1.1 int GamGamKinematics::kinematics

Type of kinematics to consider for the process. Can either be :

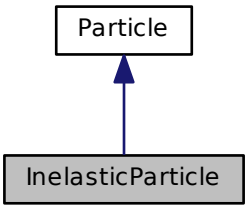
- 0 for the electron-electron elastic case
- 1 for the proton-proton elastic case
- 2 for the proton-proton single-dissociative (or inelastic) case
- 3 for the proton-proton double-dissociative case

The documentation for this class was generated from the following file:

- include/gamgam.h

## 4.4 InelasticParticle Class Reference

Inheritance diagram for InelasticParticle:




### Public Member Functions

- void AddDaughter (Particle *part_)
  *Specify a decay product for this particle.*
- void E (double E_)
  *Sets the particle's energy.*
- Particle * GetDaughter (const unsigned int num_=0)
  *Gets a daughter from this particle, labelled by its identifier in this particle's daughters list.*
- std::string GetLHEline (bool revert_=false)
- Particle * GetMother ()
  *Gets the mother particle from which this particle arises.*
- void Hadronise ()
  *Hadronises the particle using Pythia.*
- double M ()
  *Gets the particle's mass.*
- double M2 ()
  *Gets the particle's squared mass.*
- unsigned int NumDaughters ()
  *Gets the number of daughter particles arising from this one.*
- bool P (double px_, double py_, double pz_)
  *Sets the 3-momentum associated to the particle.*
- bool P (double px_, double py_, double pz_, double E_)
  *Sets the 4-momentum associated to the particle.*
- bool P (double p_[3], double E_)
  *Sets the 4-momentum associated to the particle.*
- void SetMother (Particle *part_)
  *Sets the mother particle (from which this particle arises)*

### Data Fields

- double eta
  *Pseudo-rapidity.*
- bool isValid
  *Is this particle a valid particle which can be used for kinematic computations ?*

- double p

  *Norm of the 3-momentum, in GeV/c.*
- int pdgId

  *Particle Data Group integer identifier.*
- double pt

  *Transverse momentum, in GeV/c.*
- double px

  *Momentum along the $x$-axis in GeV/c.*
- double py

  *Momentum along the $y$-axis in GeV/c.*
- double pz

  *Momentum along the $z$-axis in GeV/c.*
- int role

  *Role in the considered process.*
- int status

  *Particle status.*

#### 4.4.1 Detailed Description

Class containing the information on a particle supposed to decay or fragment in the process

#### 4.4.2 Member Function Documentation

##### 4.4.2.1 void Particle::AddDaughter ( Particle * *part_* ) [inherited]

**Parameters**

| | |
|---|---|
| *part_* | The Particle object in which this particle will desintegrate or convert |

##### 4.4.2.2 void Particle::E ( double *E_* ) [inline], [inherited]

**Parameters**

| | |
|---|---|
| *E_* | Energy, in GeV |

##### 4.4.2.3 Particle* Particle::GetDaughter ( const unsigned int *num_* = 0 ) [inherited]

**Returns**

A Particle object containing all the kinematic information related to this daughter particle

##### 4.4.2.4 std::string Particle::GetLHEline ( bool *revert_* = false ) [inherited]

Returns a string containing all the particle's kinematics as expressed in the Les Houches format

**Parameters**

| | |
|---|---|
| *revert_* | Is the event symmetric ? If set to true, the third component of the momentum is reverted. |

**Returns**

The LHE line associated to the particle, and containing the particle's history (mother/daughters), its kinematics, and its status

#### 4.4.2.5 void InelasticParticle::Hadronise ( )

Hadronises the particle with Pythia, and builds the shower (list of Particle objects) embedded in this object

#### 4.4.2.6 double Particle::M ( ) [inline], [inherited]

Gets the particle's mass in GeV/c $^2$.

**Returns**

The particle's mass

#### 4.4.2.7 bool Particle::P ( double *px_*, double *py_*, double *pz_* ) [inline], [inherited]

**Parameters**

| | |
|---|---|
| *px_* | Momentum along the $x$-axis, in GeV/c |
| *py_* | Momentum along the $y$-axis, in GeV/c |
| *pz_* | Momentum along the $z$-axis, in GeV/c |

Here is the call graph for this function:

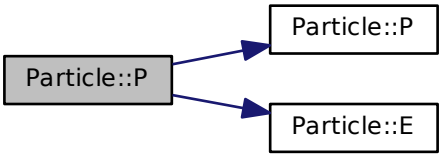

#### 4.4.2.8 bool Particle::P ( double *px_*, double *py_*, double *pz_*, double *E_* ) [inline], [inherited]

Sets the 4-momentum associated to the particle, and computes its (invariant) mass.

**Parameters**

| | |
|---|---|
| *px_* | Momentum along the $x$-axis, in GeV/c |
| *py_* | Momentum along the $y$-axis, in GeV/c |
| *pz_* | Momentum along the $z$-axis, in GeV/c |
| *E_* | Energy, in GeV |

Here is the call graph for this function:




#### 4.4.2.9 bool Particle::P ( double *p_[3]*, double *E_* ) [inherited]

**Parameters**

| | |
|---|---|
| *p_* | 3-momentum |
| *E_* | Energy, in GeV |

#### 4.4.2.10 void Particle::SetMother ( Particle * *part_* ) [inline], [inherited]

**Parameters**

| | |
|---|---|
| *part_* | A Particle object containing all the information on the mother particle |

### 4.4.3 Field Documentation

#### 4.4.3.1 int Particle::status [inherited]

Codes 1-10 correspond to currently existing partons/particles, and larger codes contain partons/particles which no longer exist, or other kinds of event information

The documentation for this class was generated from the following file:

- include/inelastic.h

## 4.5 InputParameters Class Reference

List of input parameters used to start and run the simulation job.

### Public Member Functions

- void Dump ()

  *Dumps the input parameters in the console.*
- bool ReadConfigFile (std::string inFile_)

  *Reads content from config file to load the variables.*
- void SetEtaRange (double etamin_, double etamax_)

  *Sets the pseudo-rapidity range for the produced leptons.*
- bool StoreConfigFile (std::string outFile_)

  *Stores the full run configuration to an external config file.*

### Data Fields

- bool debug
  *Do we need control plots all along the process?*
- std::ofstream * file
  *The file in which to store the events generation's output.*
- bool generation
  *Are we generating events ? (true) or are we only computing the cross-section ? (false)*
- int gpdf
  *PDFLIB group to use.*
- double in1p
  *First incoming particle's momentum (in GeV/c)*
- double in2p
  *Second incoming particle's momentum (in GeV/c)*
- int itvg
  *Maximal number of iterations to perform by VEGAS.*
- double maxenergy
  *Maximal energy of the outgoing leptons.*
- int maxgen
  *Maximal number of events to generate in this run.*
- double maxmx
  *Maximal $M_X$ of the outgoing proton remnants.*
- double maxpt
  *Maximal $p_T$ of the outgoing leptons.*
- double maxtheta
  *Maximal polar angle $\theta$ of the outgoing leptons.*
- int mcut
  *Set of cuts to apply on the outgoing leptons.*
- double minenergy
  *Minimal energy of the outgoing leptons.*
- double minmx
  *Minimal $M_X$ of the outgoing proton remnants.*
- double minpt
  *Minimal $p_T$ of the outgoing leptons.*
- double mintheta
  *Minimal polar angle $\theta$ of the outgoing leptons.*
- int ngen
  *Number of events already generated in this run.*
- int ntreat
  *Maximal number of TREAT calls.*
- int p1mod
  *First particle's mode.*
- int p2mod
  *Second particle's mode.*
- int pair
  *PDG id of the outgoing leptons.*
- int qpdf
  *Number of quarks.*
- int spdf
  *PDFLIB set to use.*
- bool store
  *Are the events generated in this run to be stored in the output file ?*
- bool symmetrise
  *Control plots objects.*

#### 4.5.1 Detailed Description

**Note**

The default parameters are derived from GMUINI in LPAIR

#### 4.5.2 Member Function Documentation

##### 4.5.2.1 bool InputParameters::ReadConfigFile ( std::string *inFile_* )

Reads the list of parameters to be used in this cross-section computation/events generation from an external input card.

**Parameters**

| | |
|---|---|
| *inFile_* | Name of the configuration file to load |

##### 4.5.2.2 void InputParameters::SetEtaRange ( double *etamin_*, double *etamax_* )

Defines the range to cover in pseudo-rapidity for the outgoing leptons produced in this process. This method converts this range into a range in $\theta$, the polar angle.

**Parameters**

| | |
|---|---|
| *etamin_* | The minimal value of $\eta$ for the outgoing leptons |
| *etamax_* | The maximal value of $\eta$ for the outgoing leptons |

##### 4.5.2.3 bool InputParameters::StoreConfigFile ( std::string *outFile_* )

**Parameters**

| | |
|---|---|
| *outFile_* | Name of the configuration file to create |

#### 4.5.3 Field Documentation

##### 4.5.3.1 bool InputParameters::debug

Enables or disables the production of control plots for several kinematic quantities in this process

##### 4.5.3.2 double InputParameters::maxmx

Maximal mass of the outgoing proton remnants, $M_X$, in GeV/c $^2$.

##### 4.5.3.3 double InputParameters::maxpt

Maximal transverse momentum cut to apply on the outgoing lepton(s)

##### 4.5.3.4 int InputParameters::mcut

Set of cuts to apply on the outgoing leptons in order to restrain the available kinematic phase space :

- 0 - No cuts at all (for the total cross section)
- 1 - Vermaserens' hypothetical detector cuts : for both leptons,
  - $\frac{|p_z|}{|\mathbf{p}|} \leq 0.75$ and $p_T \geq 1$ GeV/c, or
  - $0.75 < \frac{|p_z|}{|\mathbf{p}|} \leq 0.95$ and $p_z > 1$ GeV/c,
- 2 - Cuts on both the outgoing leptons, according to the provided cuts parameters

- 3 - Cuts on at least one outgoing lepton, according to the provided cut parameters

#### 4.5.3.5 double InputParameters::minmx

Minimal mass of the outgoing proton remnants, $M_X$, in GeV/c $^2$.

#### 4.5.3.6 double InputParameters::minpt

Minimal transverse momentum cut to apply on the outgoing lepton(s)

#### 4.5.3.7 int InputParameters::ntreat

**Note**

Is it correctly implemented ?

#### 4.5.3.8 int InputParameters::p1mod

The first incoming particle type and kind of interaction :

- 1 - electron,
- 2 - proton elastic,
- 3 - proton inelastic without parton treatment,
- 4 - proton inelastic in parton model

**Note**

Was named PMOD in ILPAIR

#### 4.5.3.9 int InputParameters::p2mod

**Note**

Was named EMOD in ILPAIR

#### 4.5.3.10 int InputParameters::pair

The particle code of produced leptons, as defined by the PDG convention :

- 11 - for $e^+e^-$ pairs
- 13 - for $\mu^+\mu^-$ pairs
- 15 - for $\tau^+\tau^-$ pairs

#### 4.5.3.11 bool InputParameters::symmetrise

List of Gnuplot objects which can be used to produce control plots all along the cross-section determination and events generation process

**Note**

Maximum number of these can be raised in the utils.h file, but pay attention to the memory load since these Gnuplot objects are still under development!

The documentation for this class was generated from the following file:

- include/utils.h

## 4.6 MCGen Class Reference

Core of the Monte-Carlo generator.

### Public Member Functions

- MCGen (InputParameters ip_)
  *Class constructor.*
- void ComputeXsection (double *, double *)
- InputParameters GetInputParameters ()
  *Returns the set of parameters used to setup the phase space to integrate.*

### 4.6.1 Detailed Description

This object represents the core of this Monte Carlo generator, with its allowance to generate the events (using the embedded Vegas object) and to study the phase space in term of the variation of resulting cross section while scanning the various parameters (point **x** in the DIM-dimensional phase space).

The phase space is constrained using the InputParameters object given as an argument to the constructor, and the differential cross-sections for each value of the array **x** are computed in the f-function defined outside (but populated inside) this object.

This f-function embeds a GamGam object which defines all the methods to obtain this differential cross-section as well as the in- and outgoing kinematics associated to each particle.

#### Author

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#### Date

February 2013

### 4.6.2 Constructor & Destructor Documentation

#### 4.6.2.1 MCGen::MCGen ( InputParameters *ip_* )

Sets the number of dimensions on which to perform the integration, according to the set of input parameters given as an argument and propagated to the whole object

#### Parameters

| | |
|---|---|
| *ip_* | List of input parameters defining the phase space on which to perform the integration |

### 4.6.3 Member Function Documentation

#### 4.6.3.1 void MCGen::ComputeXsection ( double *, double * )

Computes the cross-section for the run defined by this object. This returns the cross-section as well as the absolute error computed along.

#### 4.6.3.2 InputParameters MCGen::GetInputParameters ( ) [inline]

#### Returns

The InputParameter object embedded in this class

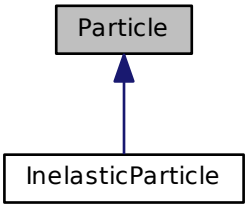
The documentation for this class was generated from the following file:

- include/mcgen.h

## 4.7 Particle Class Reference

Kinematics of one particle.

Inheritance diagram for Particle:




### Public Member Functions

- void AddDaughter (Particle *part_)
  *Specify a decay product for this particle.*
- void E (double E_)
  *Sets the particle's energy.*
- Particle * GetDaughter (const unsigned int num_=0)
  *Gets a daughter from this particle, labelled by its identifier in this particle's daughters list.*
- std::string GetLHEline (bool revert_=false)
- Particle * GetMother ()
  *Gets the mother particle from which this particle arises.*
- double M ()
  *Gets the particle's mass.*
- double M2 ()
  *Gets the particle's squared mass.*
- unsigned int NumDaughters ()
  *Gets the number of daughter particles arising from this one.*
- bool P (double px_, double py_, double pz_)
  *Sets the 3-momentum associated to the particle.*
- bool P (double px_, double py_, double pz_, double E_)
  *Sets the 4-momentum associated to the particle.*
- bool P (double p_[3], double E_)
  *Sets the 4-momentum associated to the particle.*
- void SetMother (Particle *part_)
  *Sets the mother particle (from which this particle arises)*

#### Data Fields

- double eta

  *Pseudo-rapidity.*
- bool isValid

  *Is this particle a valid particle which can be used for kinematic computations ?*
- double p

  *Norm of the 3-momentum, in GeV/c.*
- int pdgId

  *Particle Data Group integer identifier.*
- double pt

  *Transverse momentum, in GeV/c.*
- double px

  *Momentum along the $x$-axis in GeV/c.*
- double py

  *Momentum along the $y$-axis in GeV/c.*
- double pz

  *Momentum along the $z$-axis in GeV/c.*
- int role

  *Role in the considered process.*
- int status

  *Particle status.*

### 4.7.1 Detailed Description

Kinematic information for one particle

### 4.7.2 Member Function Documentation

#### 4.7.2.1 void Particle::AddDaughter ( Particle * *part_* )

**Parameters**

| | |
|---|---|
| *part_* | The Particle object in which this particle will desintegrate or convert |

#### 4.7.2.2 void Particle::E ( double *E_* ) [inline]

**Parameters**

| | |
|---|---|
| *E_* | Energy, in GeV |

#### 4.7.2.3 Particle* Particle::GetDaughter ( const unsigned int *num_* = 0 )

**Returns**

A Particle object containing all the kinematic information related to this daughter particle

#### 4.7.2.4 std::string Particle::GetLHEline ( bool *revert_* = false )

Returns a string containing all the particle's kinematics as expressed in the Les Houches format

**Parameters**

| | |
|---|---|
| *revert_* | Is the event symmetric ? If set to true, the third component of the momentum is reverted. |

**Returns**

The LHE line associated to the particle, and containing the particle's history (mother/daughters), its kinematics, and its status

#### 4.7.2.5 double Particle::M ( ) [inline]

Gets the particle's mass in GeV/c $^2$.

**Returns**

The particle's mass

#### 4.7.2.6 bool Particle::P ( double *px_*, double *py_*, double *pz_* ) [inline]

**Parameters**

| | |
|---|---|
| *px_* | Momentum along the $x$-axis, in GeV/c |
| *py_* | Momentum along the $y$-axis, in GeV/c |
| *pz_* | Momentum along the $z$-axis, in GeV/c |

Here is the call graph for this function:

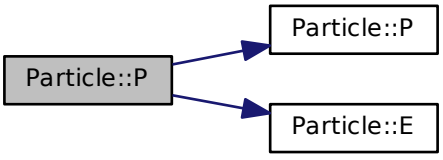

#### 4.7.2.7 bool Particle::P ( double *px_*, double *py_*, double *pz_*, double *E_* ) [inline]

Sets the 4-momentum associated to the particle, and computes its (invariant) mass.

**Parameters**

| | |
|---|---|
| *px_* | Momentum along the $x$-axis, in GeV/c |
| *py_* | Momentum along the $y$-axis, in GeV/c |
| *pz_* | Momentum along the $z$-axis, in GeV/c |
| *E_* | Energy, in GeV |

Here is the call graph for this function:



#### 4.7.2.8 bool Particle::P ( double *p_[3],* double *E_* )

**Parameters**

| | |
|---|---|
| *p_* | 3-momentum |
| *E_* | Energy, in GeV |

#### 4.7.2.9 void Particle::SetMother ( Particle * *part_* ) [inline]

**Parameters**

| | |
|---|---|
| *part_* | A Particle object containing all the information on the mother particle |

### 4.7.3 Field Documentation

#### 4.7.3.1 int Particle::status

Codes 1-10 correspond to currently existing partons/particles, and larger codes contain partons/particles which no longer exist, or other kinds of event information

The documentation for this class was generated from the following file:

- include/particle.h

## 4.8 Vegas Class Reference

Vegas Monte-Carlo integrator instance.

### Public Member Functions

- Vegas (const int dim_, double f_(double *, size_t, void *), InputParameters *inParam_)
- ~Vegas ()

  *Class destructor.*
- int Integrate (double *result_, double *abserr_)

  *Launches the integration of the provided function.*
- int LaunchGeneration ()

  *Launches the generation of events.*
- int MyIntegrate (double *result_, double *abserr_)

### 4.8.1 Constructor & Destructor Documentation

#### 4.8.1.1 Vegas::Vegas ( const int *dim_,* double *f_double *, size_t, void *,* InputParameters * *inParam_* )

Constructs the class by booking the memory and structures for the GSL Vegas integrator. This code from the GNU scientific library is based on the Vegas Monte Carlo integration algorithm developed by P. Lepage. [1]

**Parameters**

| | |
|---|---|
| *dim_* | The number of dimensions on which the function will be integrated |
| *f_* | The function one is required to integrate |
| *inParam_* | A list of parameters to define the phase space on which this integration is performed (embedded in an InputParameters object) |

### 4.8.2 Member Function Documentation

#### 4.8.2.1 int Vegas::Integrate ( double * *result_*, double * *abserr_* )

Launches the Vegas integration of the provided function with the provided input parameters.

**Parameters**

| | |
|---|---|
| *result_* | The cross section as integrated by Vegas for the given phase space restrictions |
| *abserr_* | The error associated to the computed cross section |

#### 4.8.2.2 int Vegas::LaunchGeneration ( )

Launches the Vegas generation of events according to the provided input parameters.

#### 4.8.2.3 int Vegas::MyIntegrate ( double * *result_*, double * *abserr_* )

Vegas algorithm to perform the (_dim)-dimensional Monte Carlo integration of a given function as described in[1]

**Author**

Primary author : G.P. Lepage
This C++ implementation : L. Forthomme

**Date**

September 1976
Reviewed in Apr 1978
FTN5 version 21 Aug 1984
This C++ implementation is from 12 Dec 2013

**Parameters**

| | |
|---|---|
| *result_* | The cross section as integrated by Vegas for the given phase space restrictions |
| *abserr_* | The error associated to the computed cross section |

The documentation for this class was generated from the following file:

- include/vegas.h

## References

[1] G Peter Lepage. A new algorithm for adaptive multidimensional integration. *Journal of Computational Physics*, 27(2):192 – 203, 1978.

[2] J.A.M. Vermaseren. Two-photon processes at very high energies. *Nuclear Physics B*, 229(2):347 – 371, 1983.

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