



6. Manipulating data: Vertexing



Geometrical Vertex Fitter

Performs an unconstrained fit of a vertex given any number of particles. If any of the input particles is a resonance, it uses the daughters.

Interface: `IVertexFitter`

```
StatusCode fitVertex( const ParticleVector&, Vertex& );  
StatusCode fitVertex( Particle&, Particle&, Vertex& );  
StatusCode fitVertex( Particle&, Particle&, Particle&,  
                    Vertex&);
```

Concrete Class: `UnconstVertexFitter`

Equations in LHC-B/TN/95-01.

The Vertex type is set to "Decay".

Number of degrees of freedom is $2N-3$.



Geometrical Vertex Fitter (cont)

Usage:

(iMuMinus **and** iMuPlus **are** ParticleVector::iterator **objects.**)

```
Vertex MuMuVertex;  
StatusCode scMuMuVertex = vertexFitter()->  
    fitVertex(*(iMuMinus),*(iMuPlus), MuMuVertex);
```

Or put all the input particles in one ParticleVector:

```
ParticleVector vMuComb;  
vMuComb.push_back(*iMuMinus);  
vMuComb.push_back(*iMuPlus);  
Vertex MuMuVertex;  
StatusCode scMuMuVertex = vertexFitter()->  
    fitVertex(vMuComb,MuMuVertex);
```



Particle Stuffer

Fills a (composite) Particle object given a particle ID and a vertex that has been previously filled by following the links to the particles that originated the vertex.

Interface - IParticleStuffer

```
StatusCode fillParticle(const Vertex&, Particle&,  
    const ParticleID& );
```

Concrete Class - ParticleStuffer

calculates the mother particle attributes by combining the ones from the products of the vertex.

- **four-momentum** → sum of the daughter's four-momentum
- **mass()** (and its error) → obtained from the four-momentum.
- **particle ID** → given as input



- **PointOnTrack()** (and its error) → vertex position.
- **four-momentum - point correlation error** → zero for the moment.
- **isResonance()** → set to 1 if $\tau < 10^{-15}$ s

Usage:

Assuming that `MuMuVertex` is a `Vertex` object that has already been filled

```
Particle candJpsi;
ParticleProperty* partProp = ppSvc->find( "J/psi(1S)" );
m_jpsiID = (*partProp).jetsetID();
ParticleID jpsiPID( m_jpsiID );
StatusCode scStuff = particleStuffer()->
    fillParticle( MuMuVertex, candJpsi, jpsiPID);
```



Mass constrained Vertex Fitter

Particles are constrained to cross one point in space and their invariant mass is constrained to the PDG value of a given decaying particle.

Interface: `IMassVertexFitter`

```
StatusCode fitWithMass(const std::string&,
    const ParticleVector&, Vertex&, Particle&);
StatusCode fitWithMass(const std::string&,
    Particle&, Particle&, Vertex&, Particle&);
StatusCode fitWithMass(const std::string&,
    Particle&, Particle&, Particle&, Vertex&, Particle&);
```

An object `Vertex` and an object `Particle` are returned with all their parameters set.



Mass constrained Vertex Fitter (cont)

Concrete Class: LagrangeMassVertexFitter
Equations in LHCb Phys Note 98-051.

☞ **Fits up to four particles. If any input particle is a resonance with $\Gamma < 1$ MeV, it uses the daughters to fit.**

- **composite particle's 4-momentum → sum of the modified daughter particles**
- **mass() method → PDG value.**
- **The original parameters of the daughter particles are not modified.**
- **The Vertex type → "DecayWithMass"**
- **Number of degrees of freedom → N**



Mass constrained Vertex Fitter (cont)

Usage:

```
StatusCode scLagFit = massVertexFitter()->  
    fitWithMass("J/psi(1S)", *(*iMuMinus), *(*iMuPlus),  
                jpsiVtx, jpsi);
```

Or put all the input particles in one ParticleVector as in the Geometrical Vertex Fitter

