HepMC Visual
- an interactive browser for HepMC records

Sebastian Böser

sboeser@hep.ucl.ac.uk

1st Annual ARTEMIS Meeting

27th September, 2007

Motivation

HepMC event records are rather large:

- ~100 vertices, ~1000 particles for ATLAS
  - ➔ difficult to navigate with HepMC print
    - ➔ make an interactive browser for HepMC events

Goals:

- Interactive
- Show (relevant) parts of the event
- ATLAS independent library
  - ➔ can be used with any program that uses HepMC
- Interface to interactive Athena

```
GenEvent: #5083 ID=1030121 SignalProcessGenVertex Barcode: 0
 Current Memory Usage: 4 events, 2524 vertices, 8834 particles.
 Entries this event: 322 vertices, 1050 particles.
 RndmState(0)=
 Wgts(3)=1 1 1
 EventScale -1 [energy]          alphaQCD=-1     alphaQED=-1
                                   GenParticle Legend
        Barcode   PDG ID      ( Px,       Py,       Pz,     E ) Stat  Deca
Vertex:       -3 ID:    0 (X,cT)=-2.77e-03,-4.45e-03,-7.79e+01,+0.00e+00
 I: 1          3       -1 +1.13e+03,+1.03e+03,+1.36e+06,+1.36e+06   3
 O:14          5       21 +1.71e+05,+2.81e+05,+6.70e+05,+7.46e+05   3
              56       21 -2.65e+03,-4.33e+03,+3.15e+03,+5.98e+03   2
              57       21 -3.45e+03,-7.00e+03,+3.40e+03,+8.51e+03   2
              58       21 -2.31e+04,-4.05e+04,+2.13e+04,+5.13e+04   2
              59       21 -1.22e+05,-2.18e+05,+1.17e+05,+2.76e+05   2
              92       -3 +2.39e+02,-3.70e+02,+5.22e+04,+5.22e+04   2
              94       21 -4.21e+03,+6.23e+03,+6.26e+03,+9.79e+03   2
              95       21 -9.08e+02,+2.41e+03,+1.57e+03,+3.02e+03   2
             124       21 +4.12e+02,-1.93e+02,+1.09e+04,+1.09e+04   2
             125       -1 -6.64e+02,+8.50e+02,+3.61e+05,+3.61e+05   2
             127        4 -3.24e+03,-3.27e+03,+3.34e+03,+5.88e+03   2
             136        3 -1.40e+02,-5.00e+02,+3.73e+03,+3.79e+03   2
             137       21 +9.41e+01,-8.28e+02,+5.41e+02,+9.94e+02   2
             138       -4 -2.35e+03,-5.03e+03,+7.69e+03,+9.61e+03   2
Vertex:       -4 ID:    0 (X,cT)=-2.77e-03,-4.45e-03,-7.79e+01,+0.00e+00
 I: 1          4       21 +5.51e+02,-2.50e+03,-6.09e+05,+6.09e+05   3
 O: 9          6       21 +1.88e+02,+1.91e+03,-5.52e+05,+5.52e+05   3
             30       21 +2.72e+02,-2.30e+02,-5.83e+03,+5.84e+03   2
             31       21 +8.35e+02,-5.88e+02,-7.76e+03,+7.82e+03   2
             32       21 -2.08e+02,-3.68e+03,-3.54e+04,+3.56e+04   2
             33       21 -4.96e+01,+5.93e+01,-1.66e+03,+1.66e+03   2
             34       21 -2.74e+02,-2.26e+02,-5.45e+03,+5.46e+03   2
             35       21 -1.57e+02,-6.59e+01,-7.78e+01,+1.87e+02   2
             36       21 -9.01e+01,-3.39e+02,-3.88e+02,+5.24e+02   2
             37       21 -4.24e+01,+1.06e+02,+8.11e+02,+8.19e+02   2
Vertex:       -5 ID:    0 (X,cT)=-2.77e-03,-4.45e-03,-7.79e+01,+0.00e+00
 I: 2          5       21 +1.71e+05,+2.81e+05,+6.70e+05,+7.46e+05   3
               6       21 +1.88e+02,+1.91e+03,-5.52e+05,+5.52e+05   3
 O: 3          7        6 +6.37e+04,+2.31e+05,-2.60e+04,+2.99e+05   3
               8       -6 -3.61e+04,-2.48e+05,+3.81e+05,+4.89e+05   3
               9       25 +1.43e+05,+2.99e+05,-9.16e+04,+3.65e+05   3
Vertex:       -6 ID:    0 (X,cT)=-2.77e-03,-4.45e-03,-7.79e+01,+0.00e+00
 I: 1          7        6 +6.37e+04,+2.31e+05,-2.60e+04,+2.99e+05   3
 O: 9         10       24 +3.46e+04,+1.10e+05,-8.22e+04,+1.62e+05   3
             11        5 +2.92e+04,+1.21e+05,+5.61e+04,+1.37e+05   3
             21       24 +3.46e+04,+1.10e+05,-8.22e+04,+1.62e+05   2
            140       21 -7.20e+01,+1.15e+02,+4.87e+01,+1.44e+02   2
```


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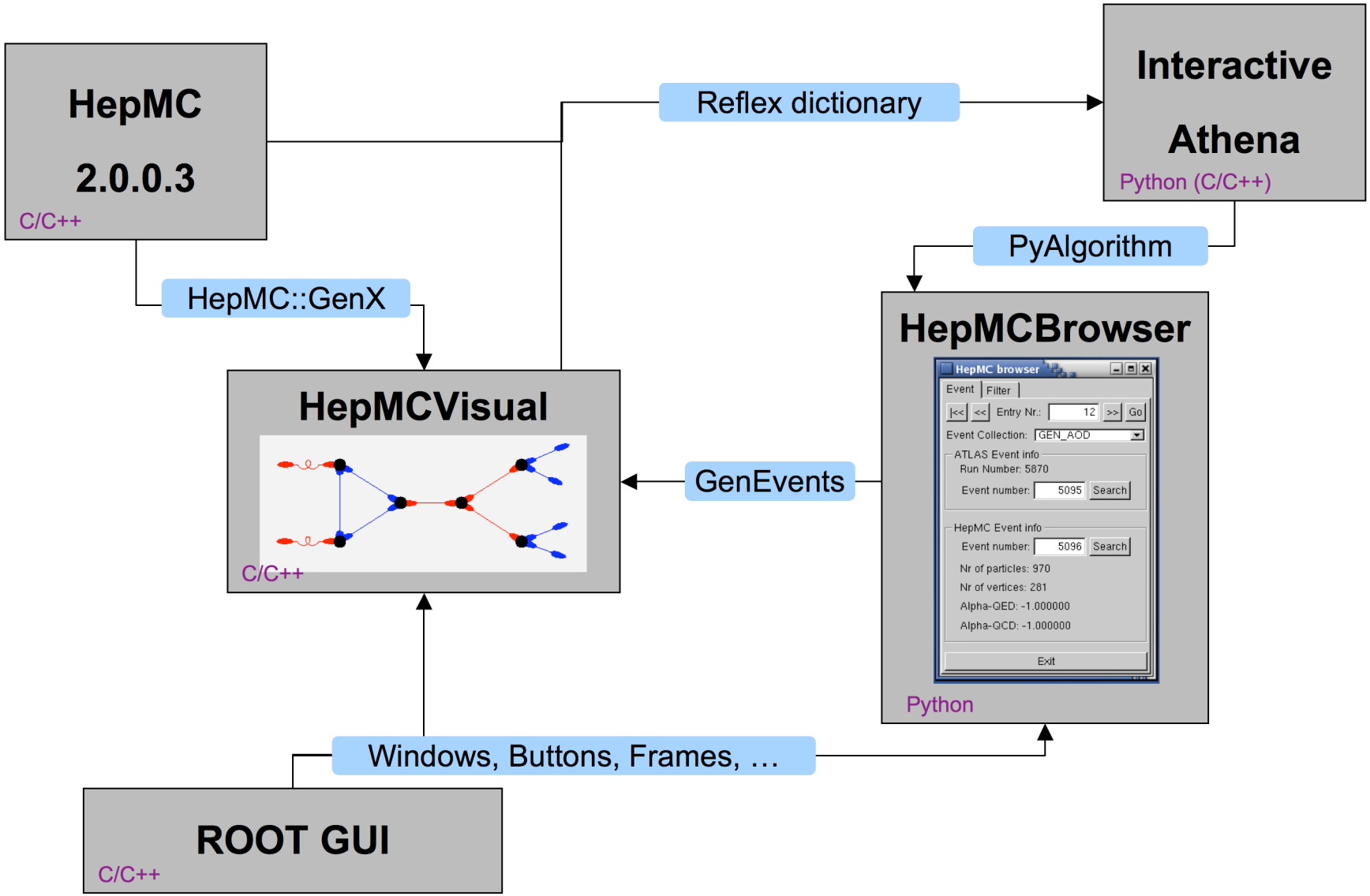
General layout



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HepMC Visual

Visual classes:

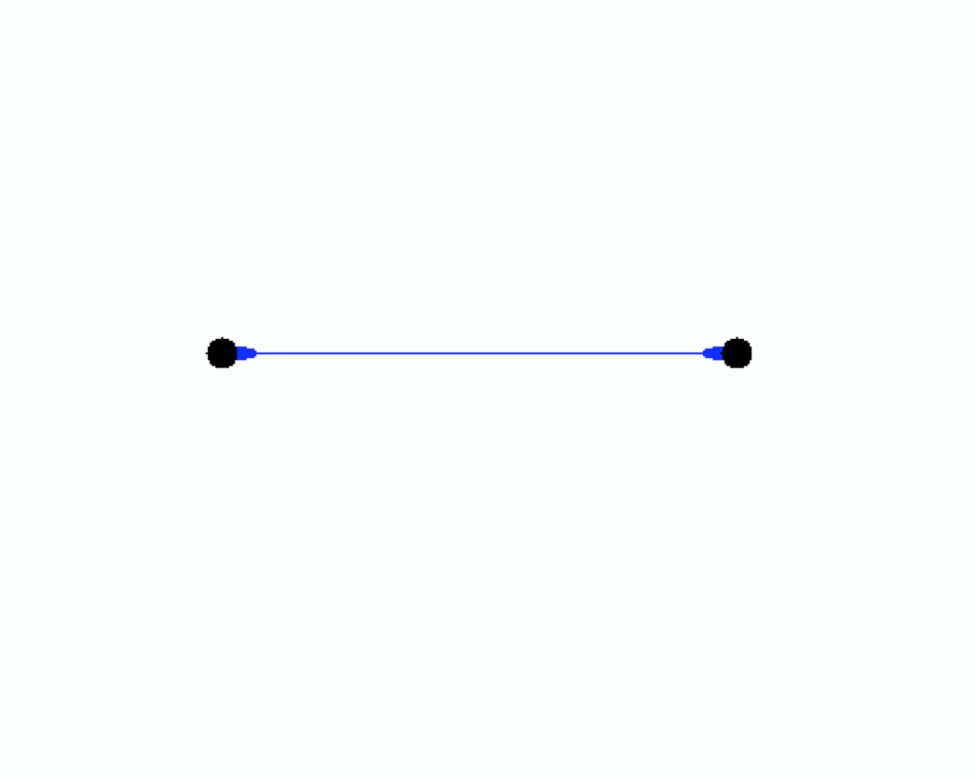
- added to namespace `HepMC`
- can be drawn on any canvas

VisualParticle:

- derives from `GenParticle`

VisualVertex:

- derives from `GenVertex`
- owns `GenParticles` or `VisualParticles`
- knows its position on the screen



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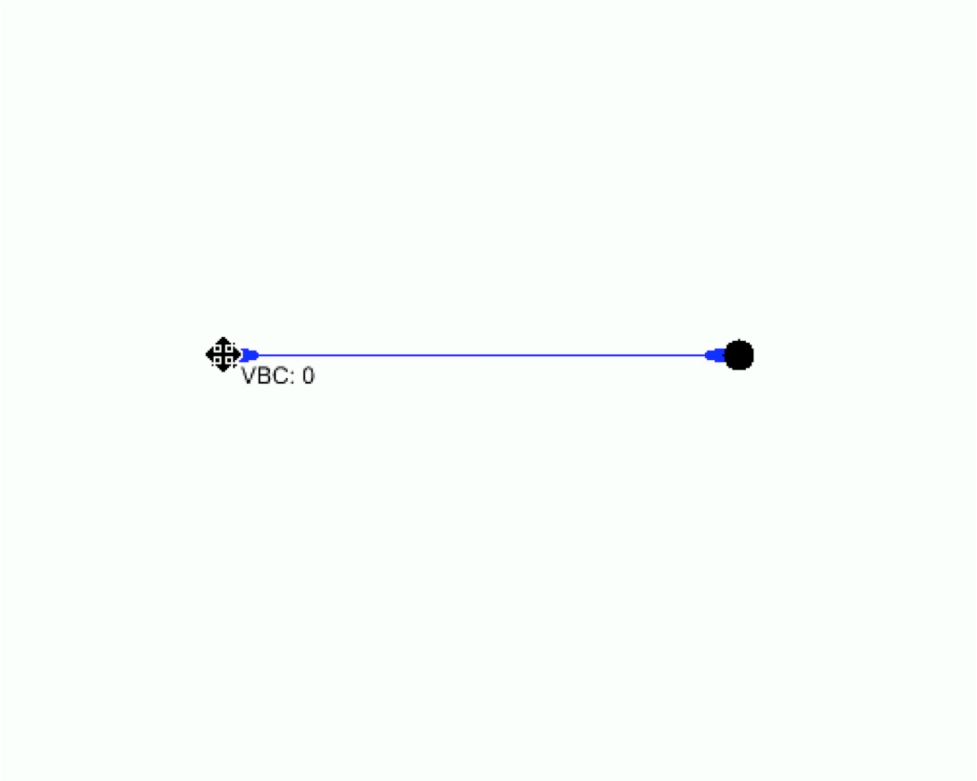

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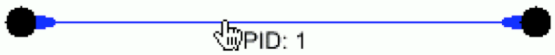

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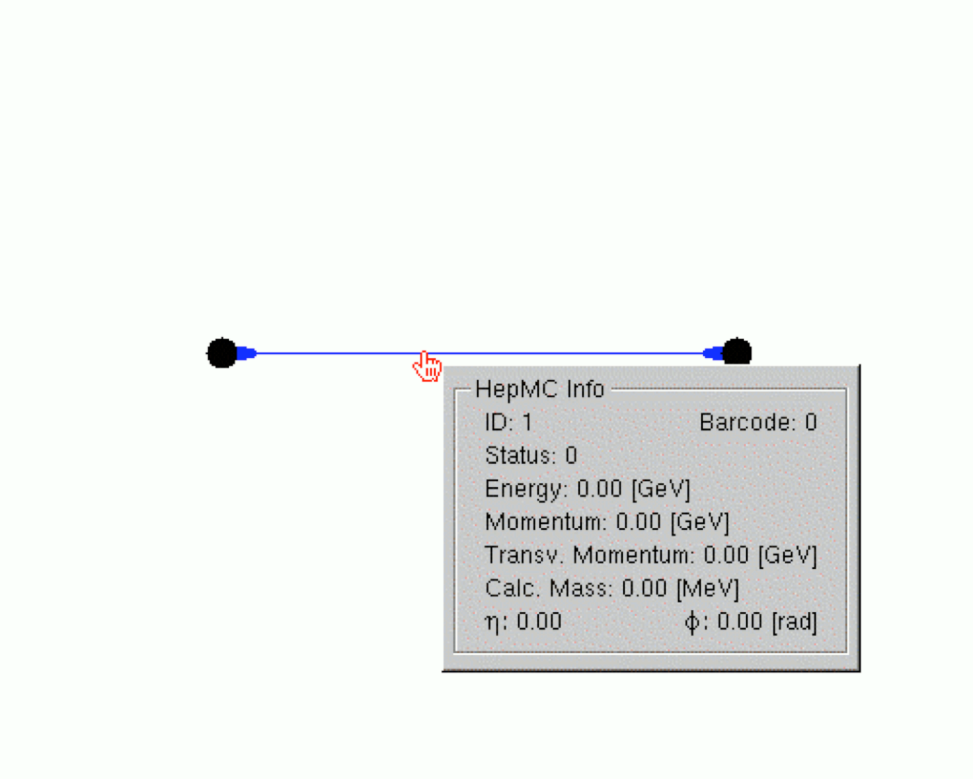

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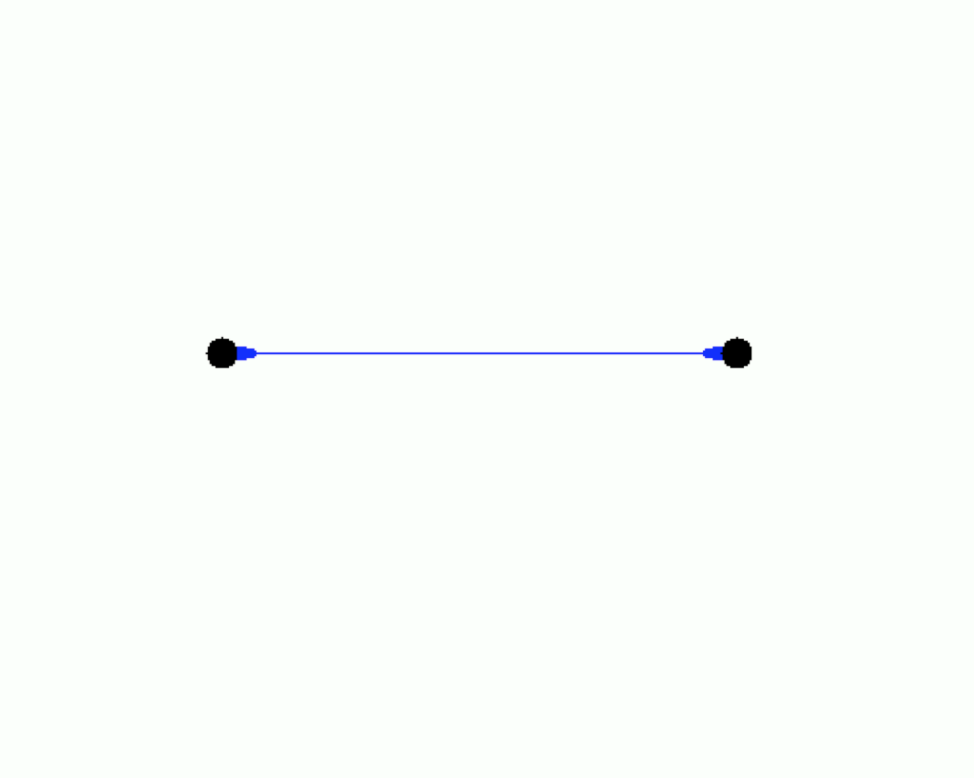

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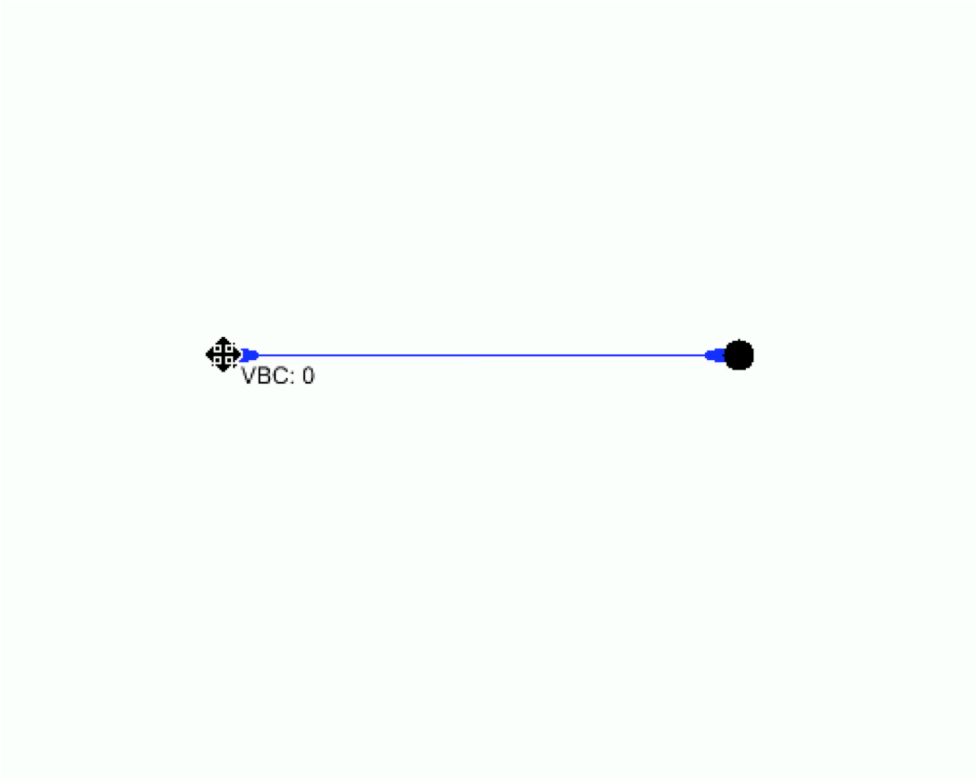

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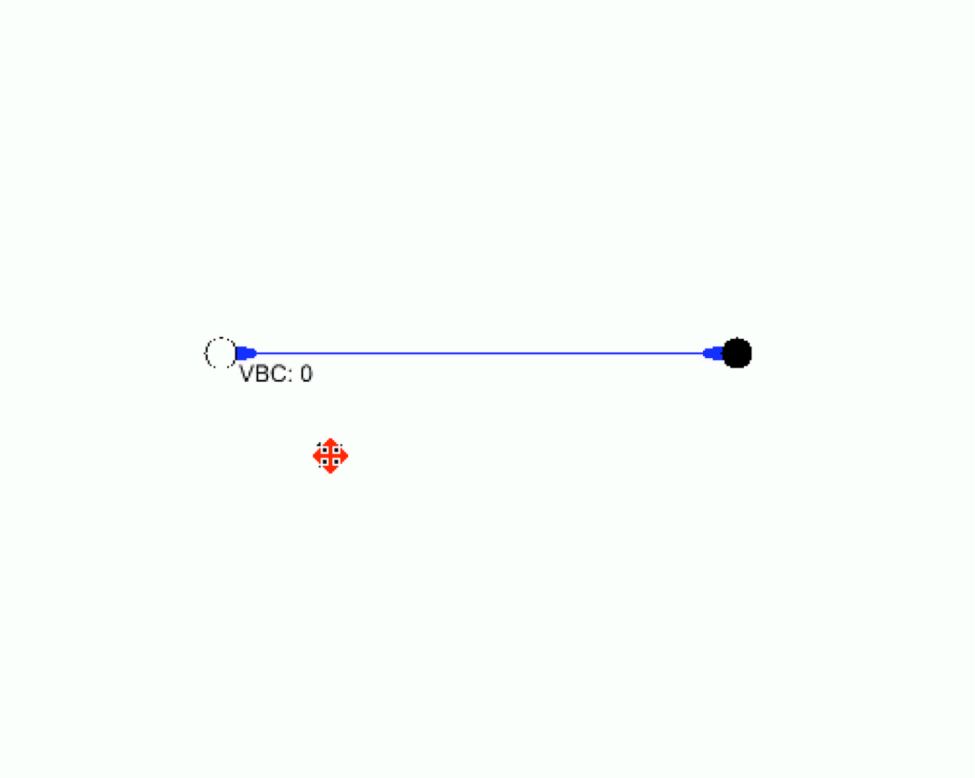

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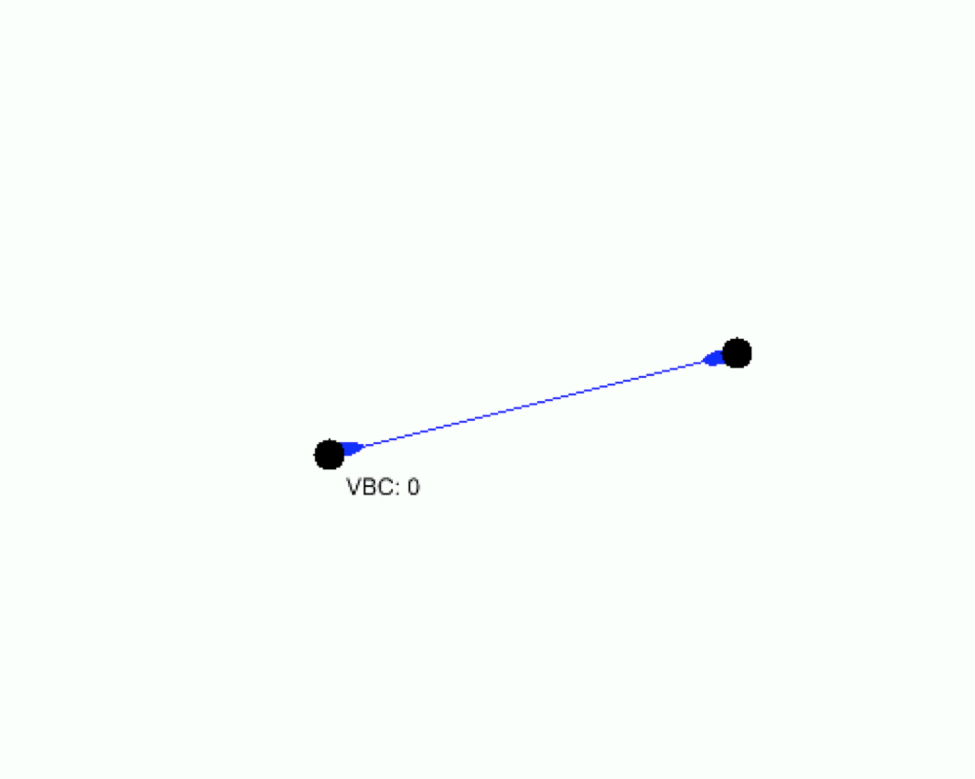

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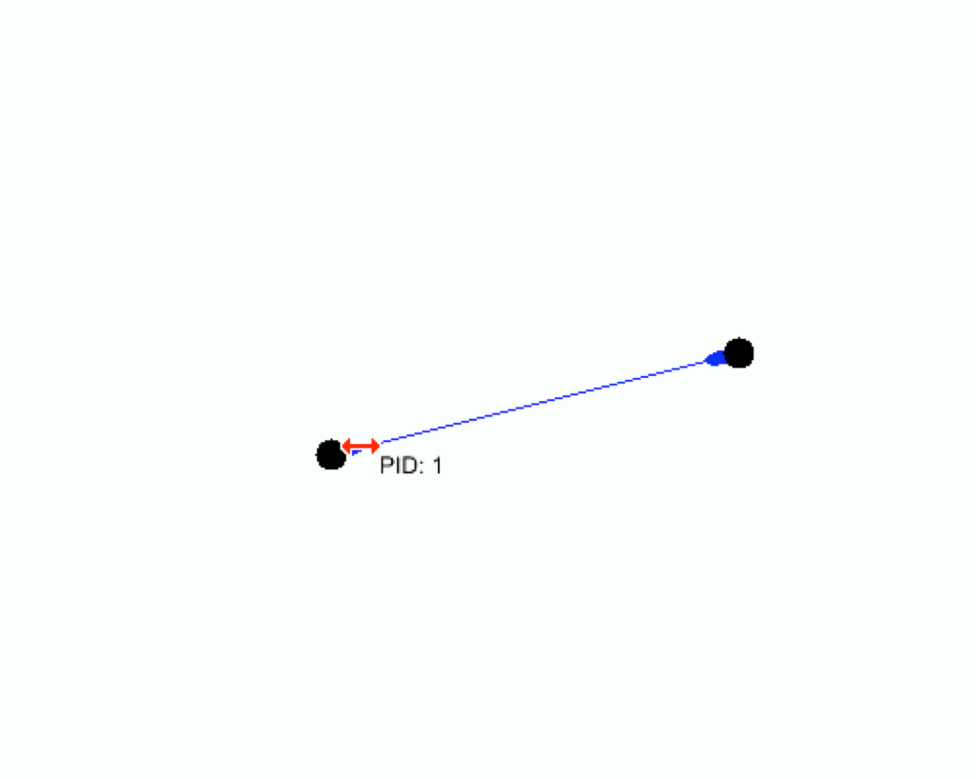

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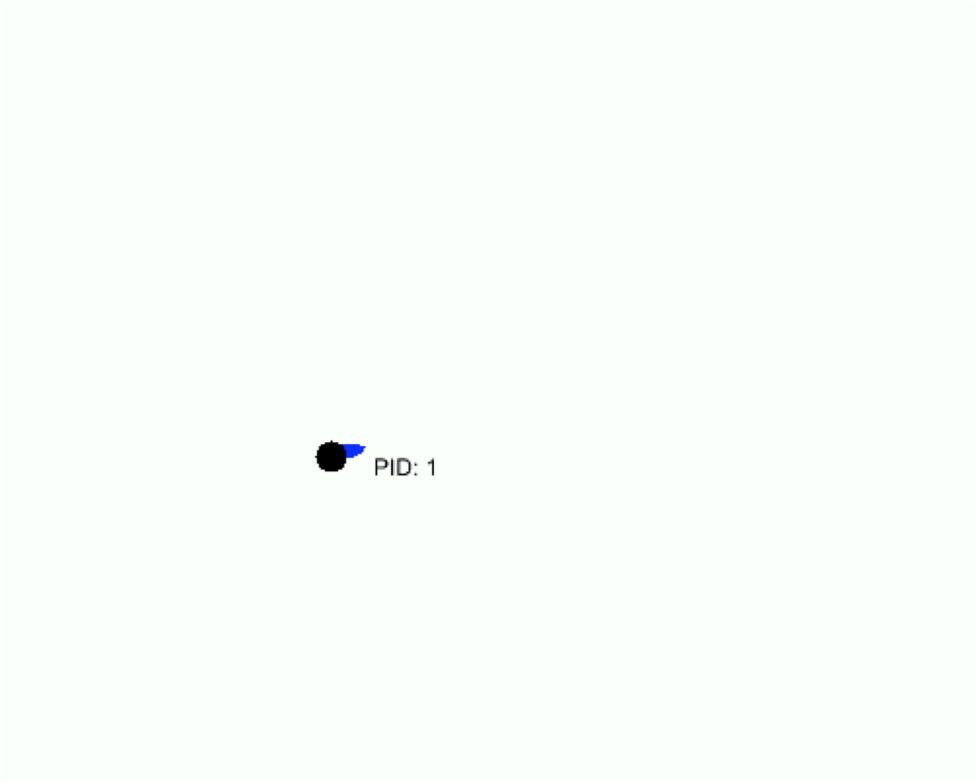

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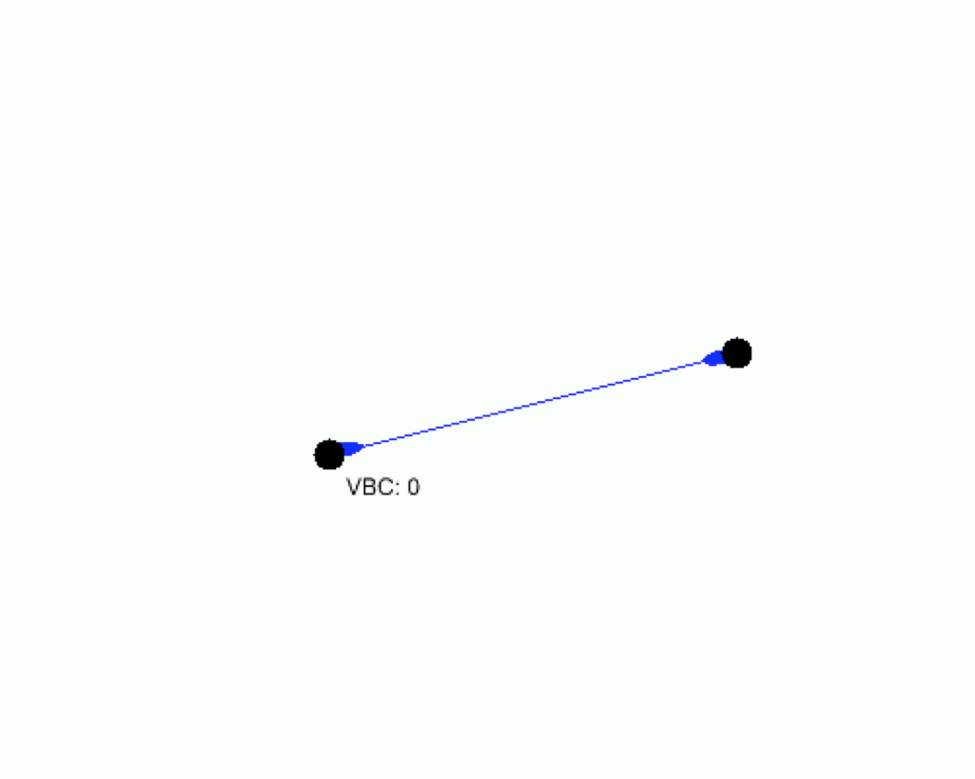

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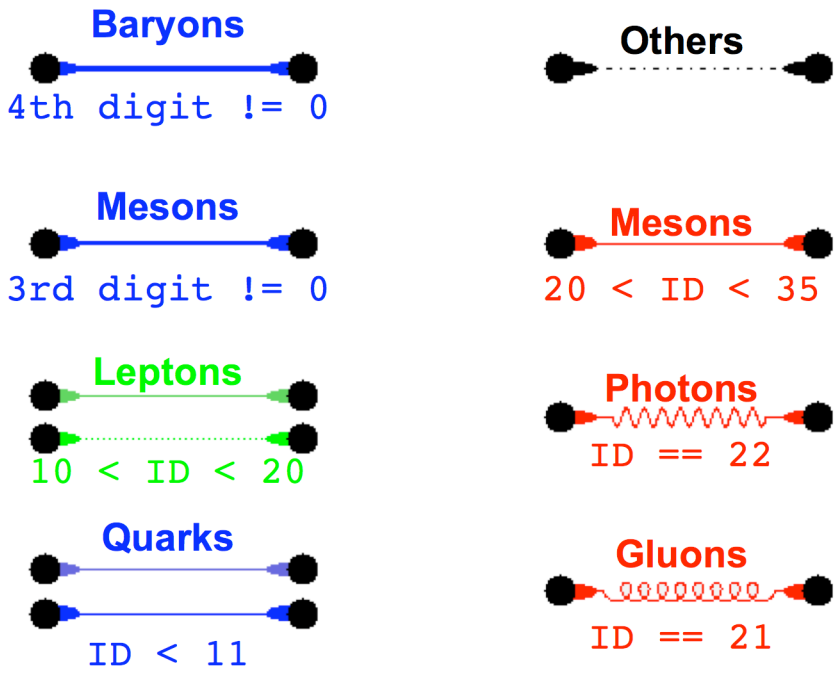
PDG Particle Information

HepMC:

- does not provide own particle listings
- can load PDG particle tables

HepMCVisual:

- use generic particle classification scheme
  - ➔ based on PDG standard
- line style/colour from class
- link to PDG table for name



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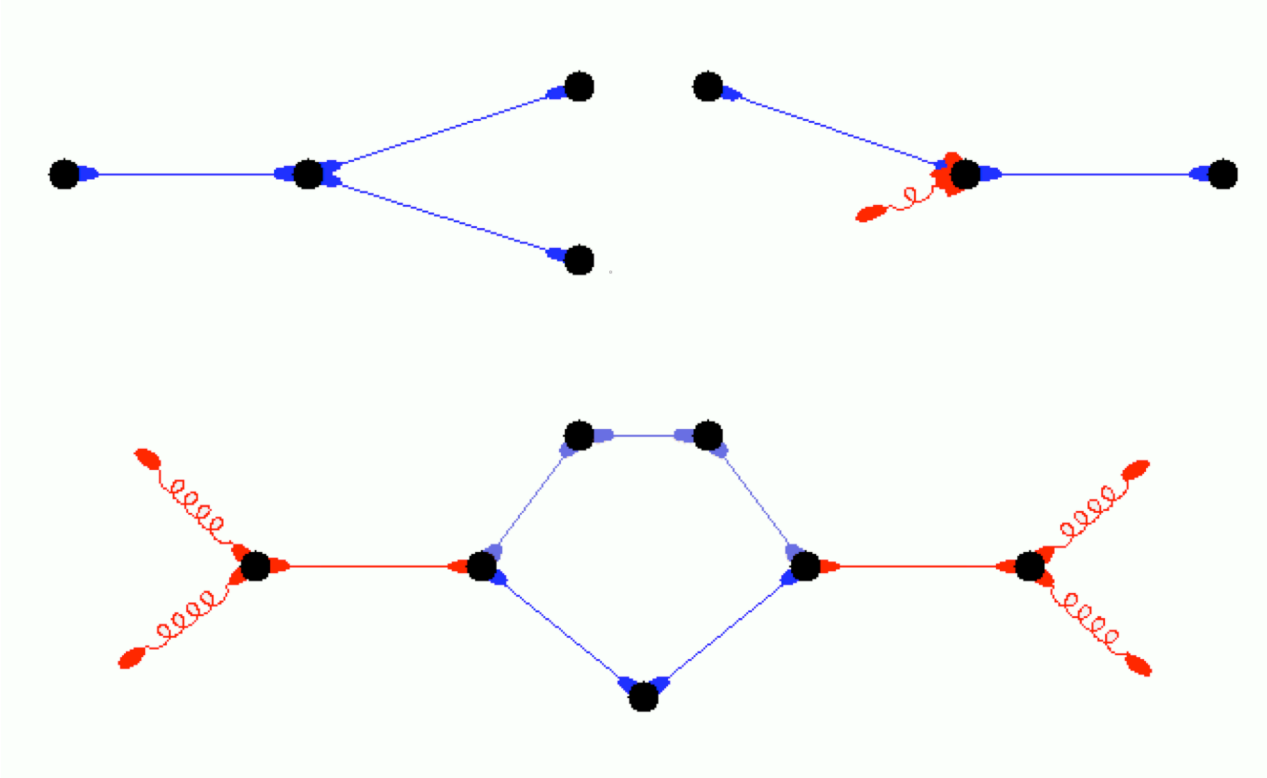
Navigating more complex events



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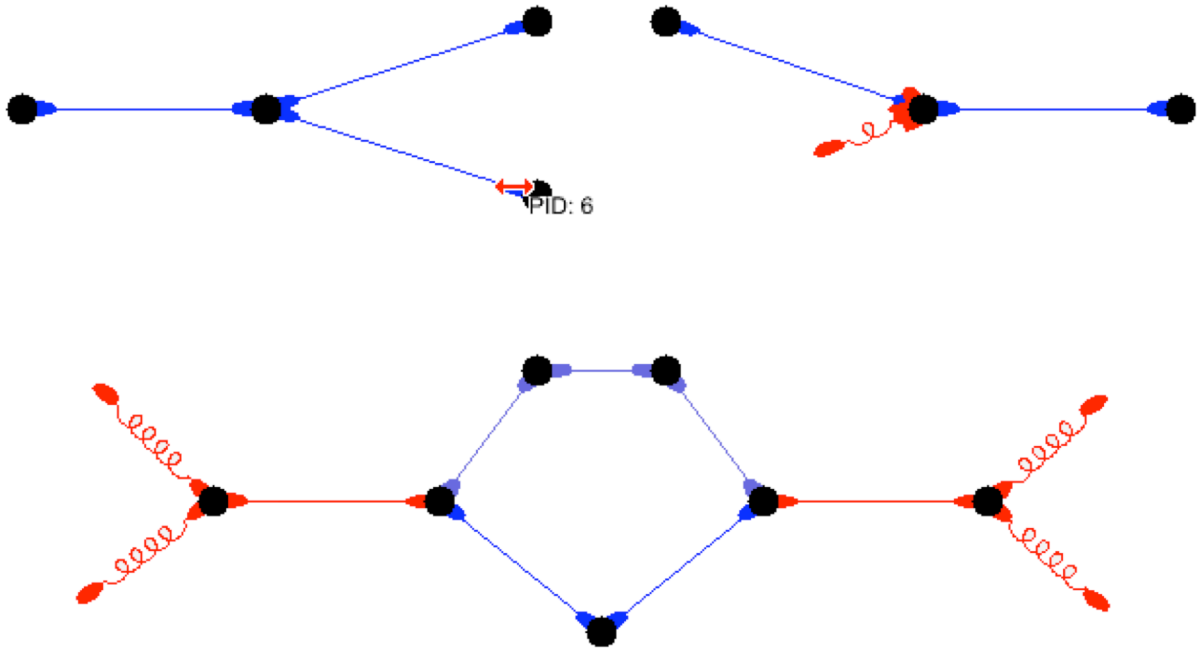

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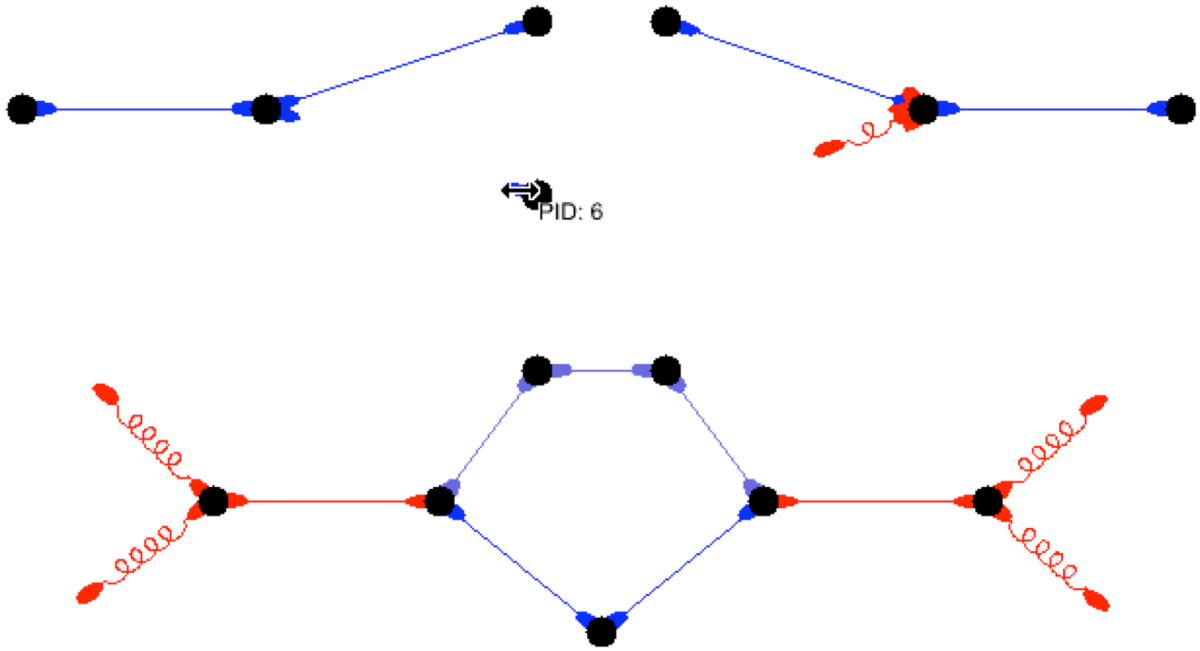

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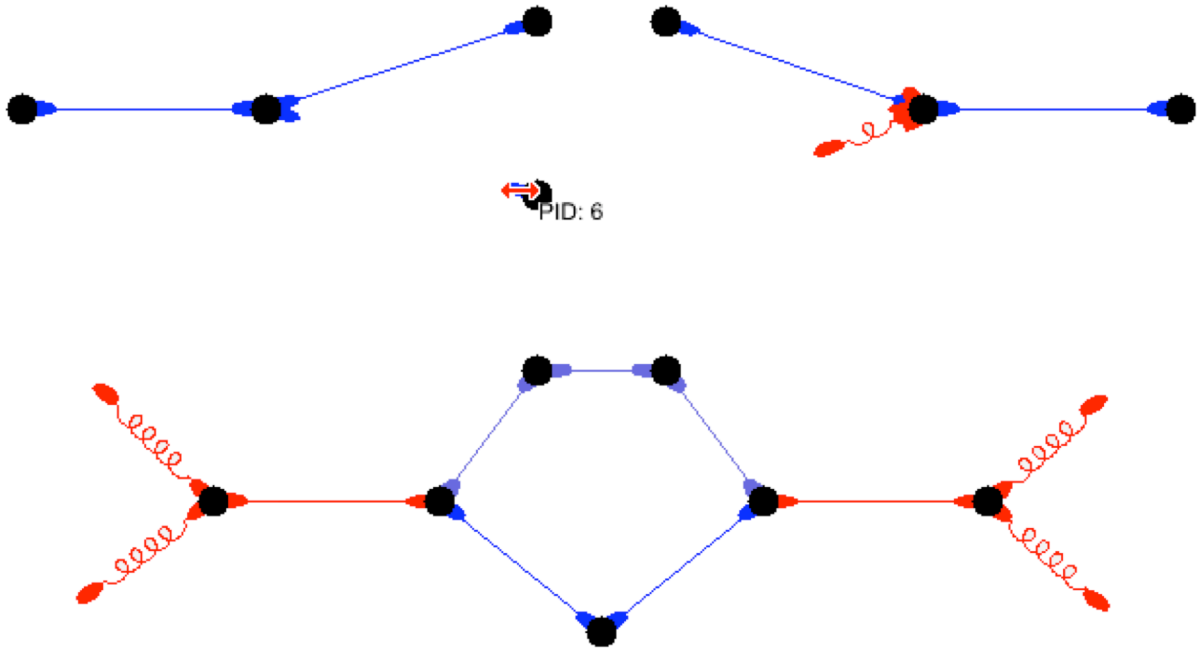

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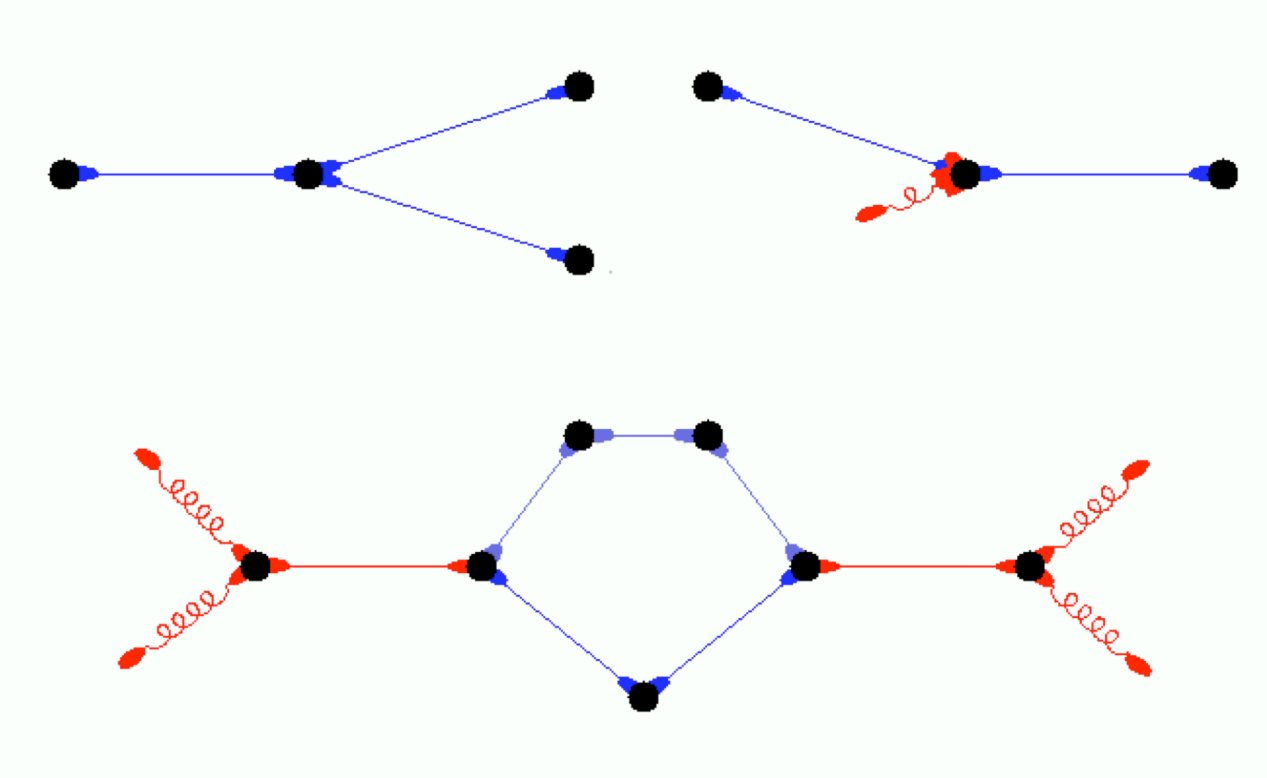

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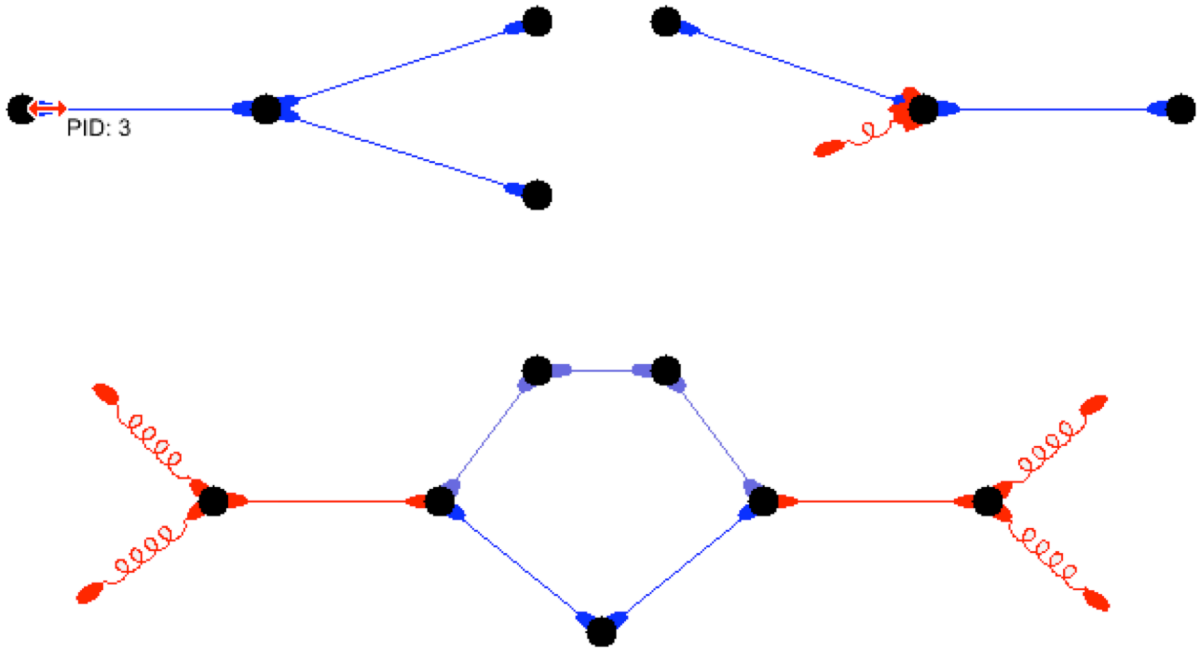

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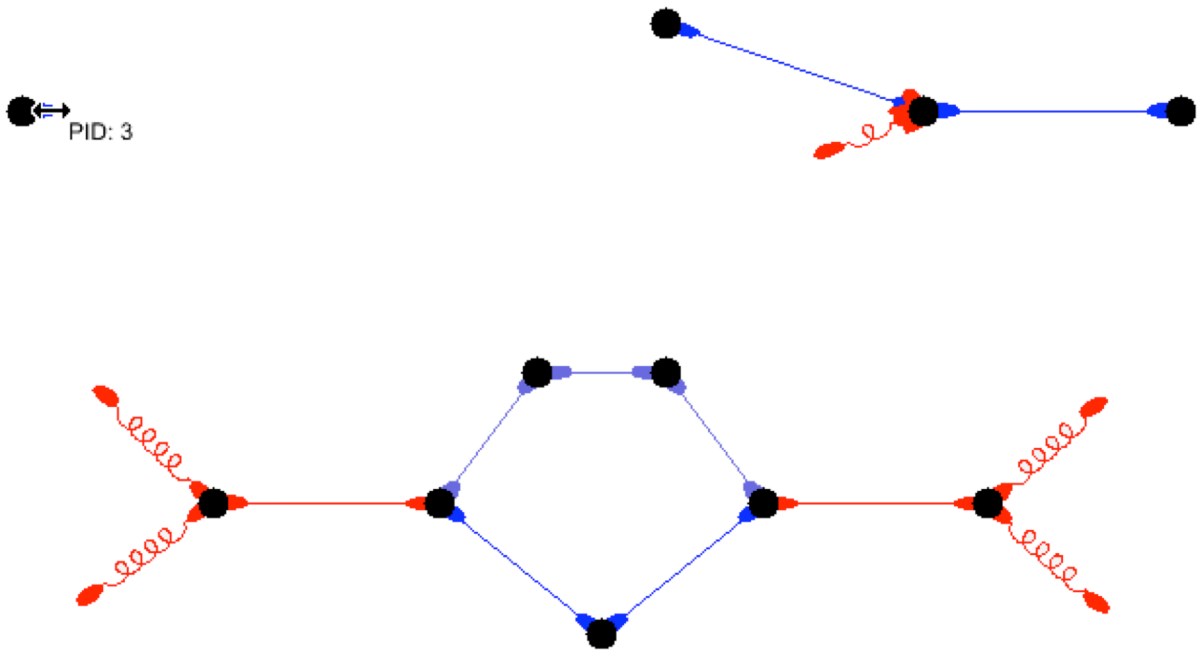

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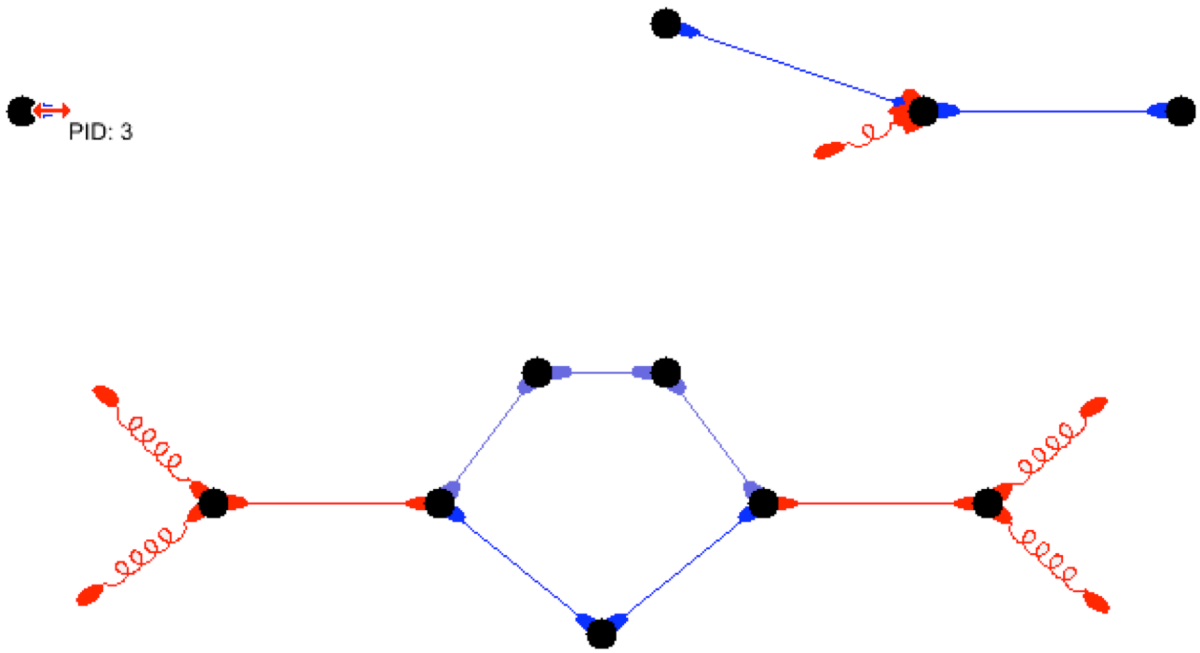

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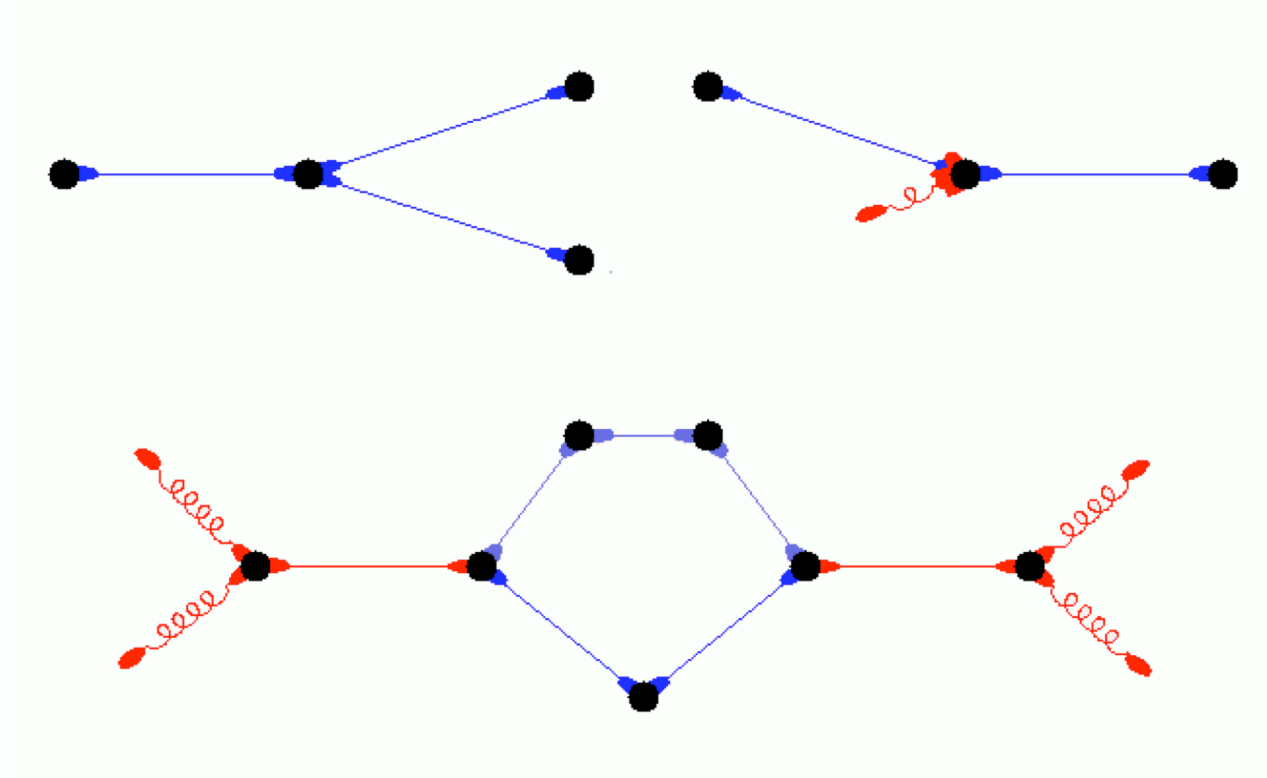

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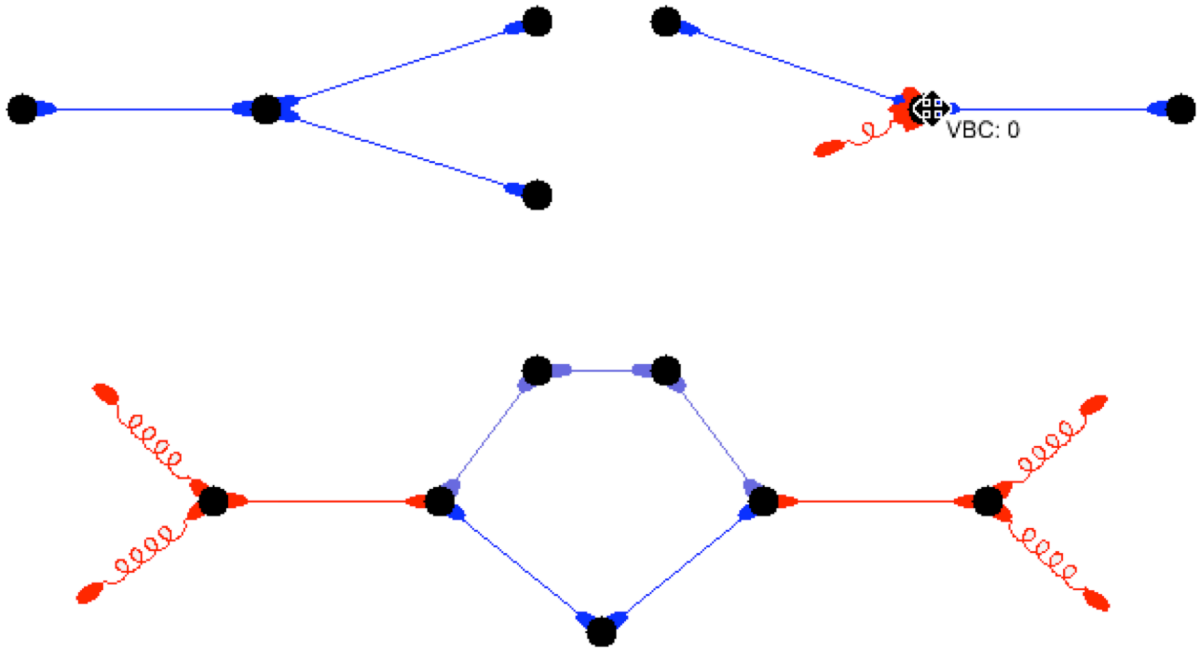

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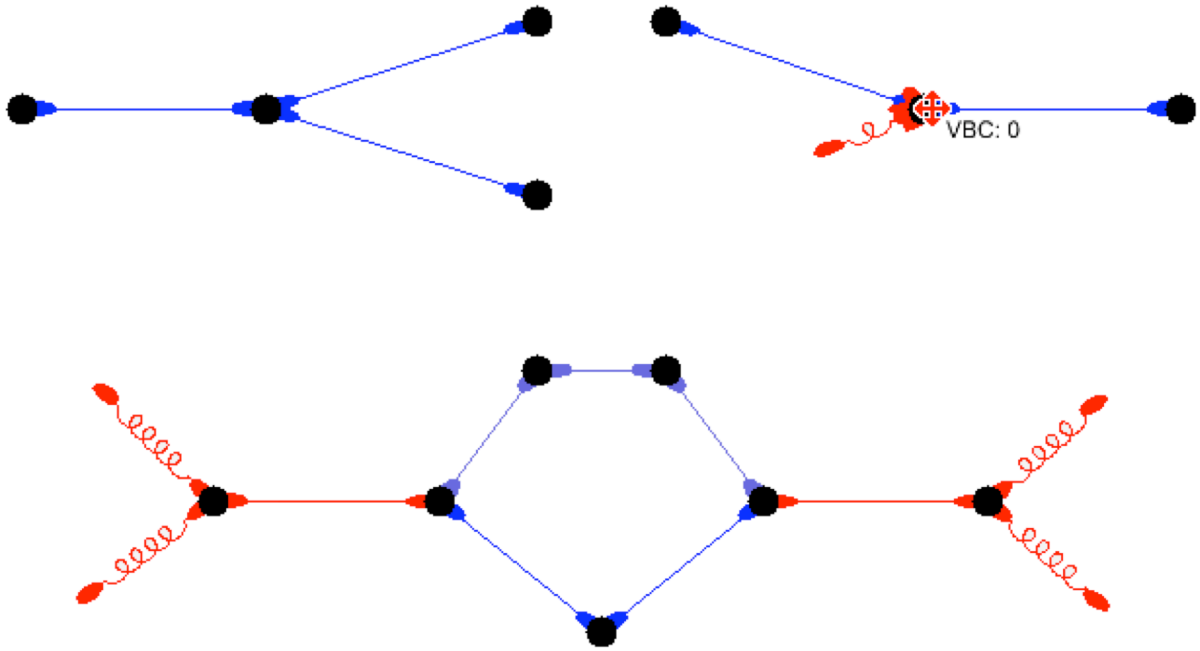

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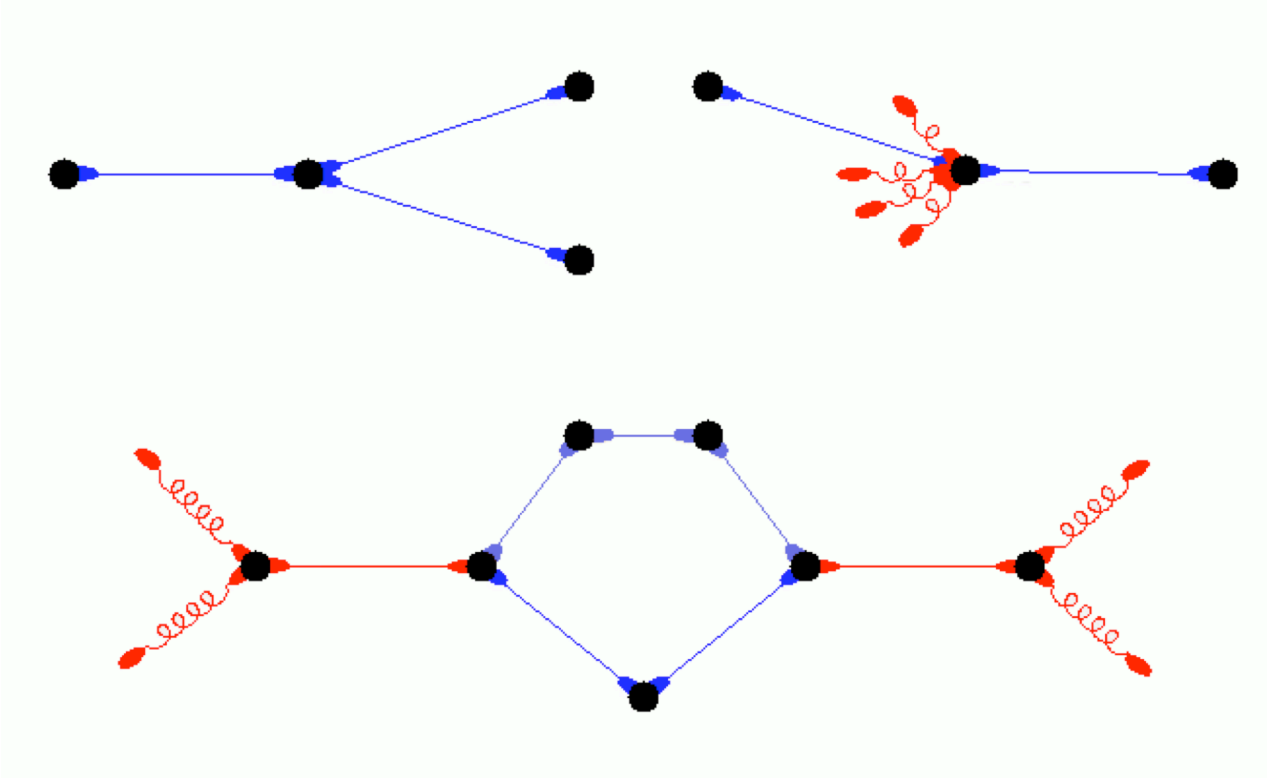

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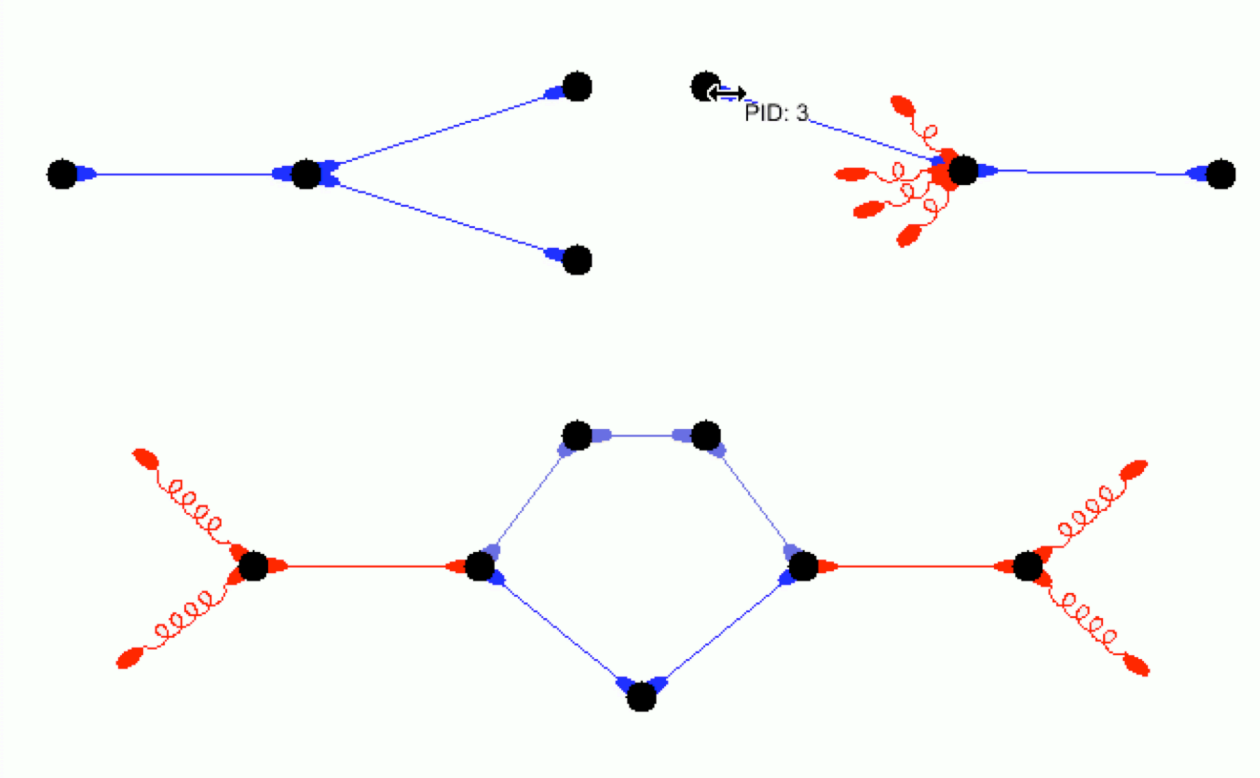

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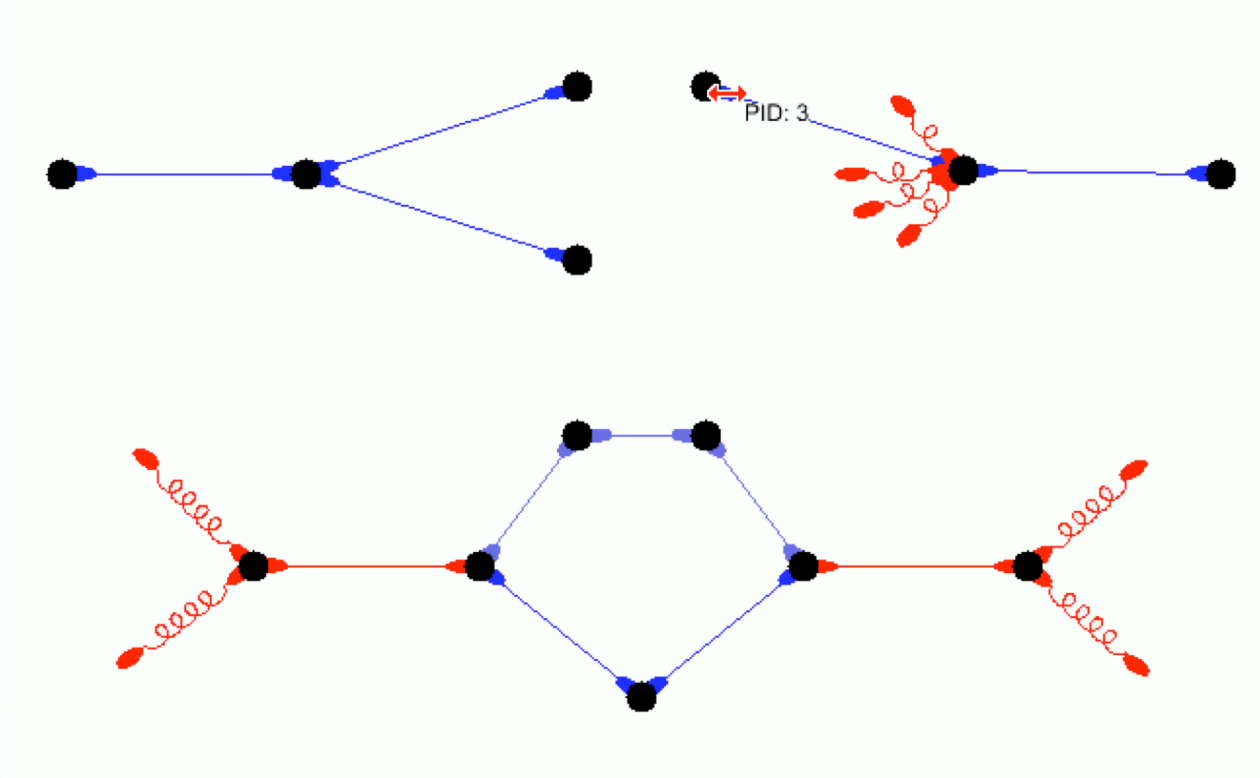

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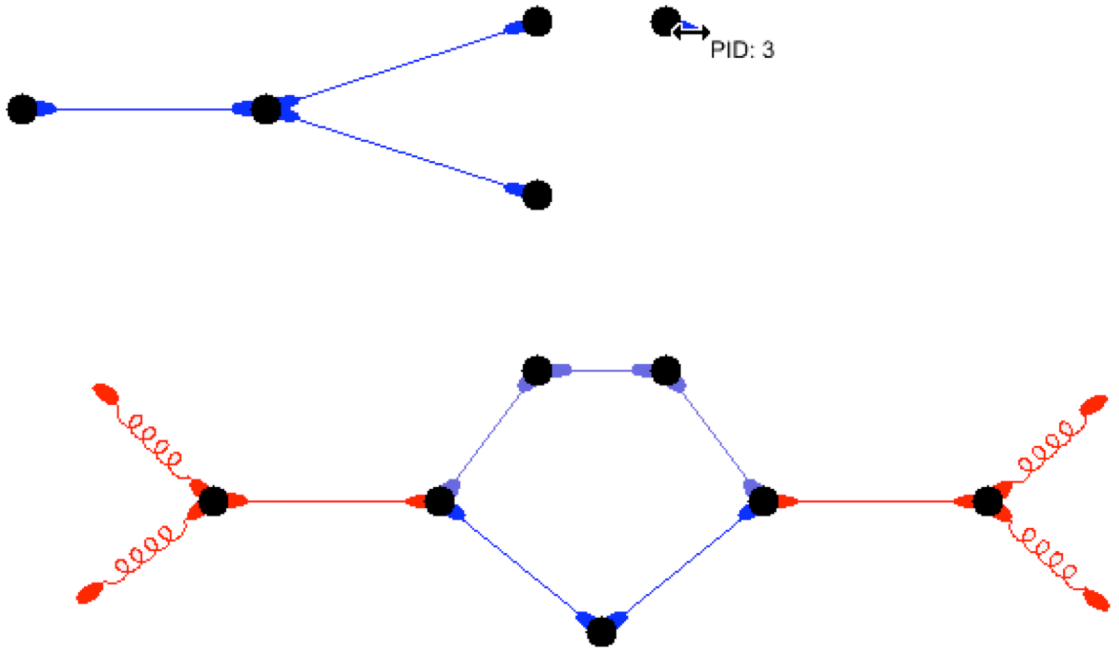

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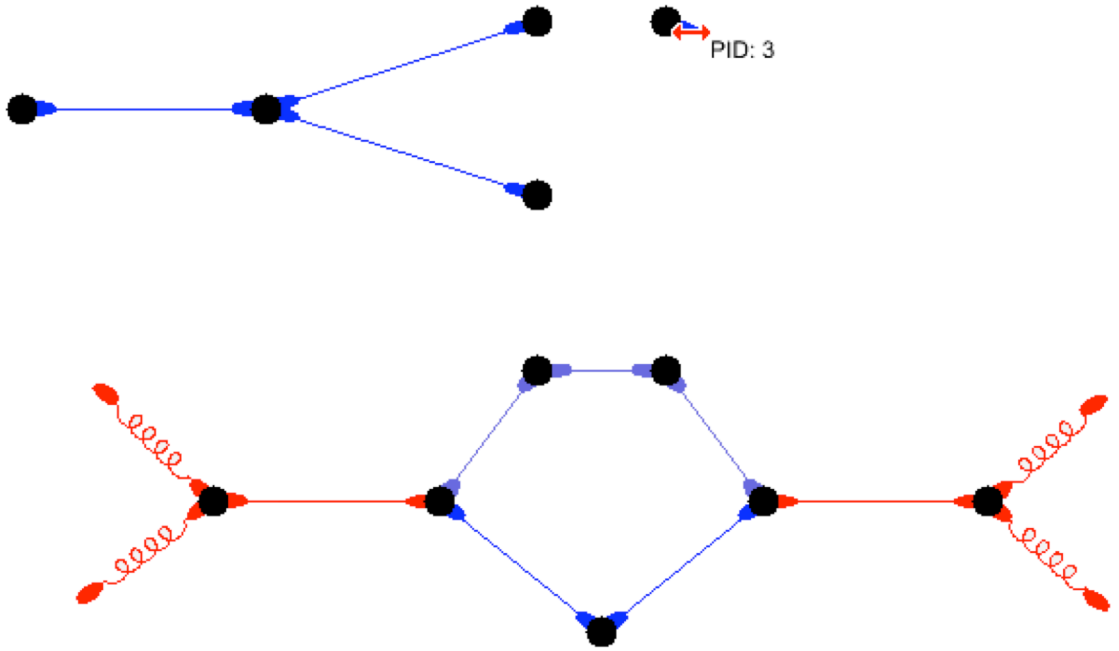

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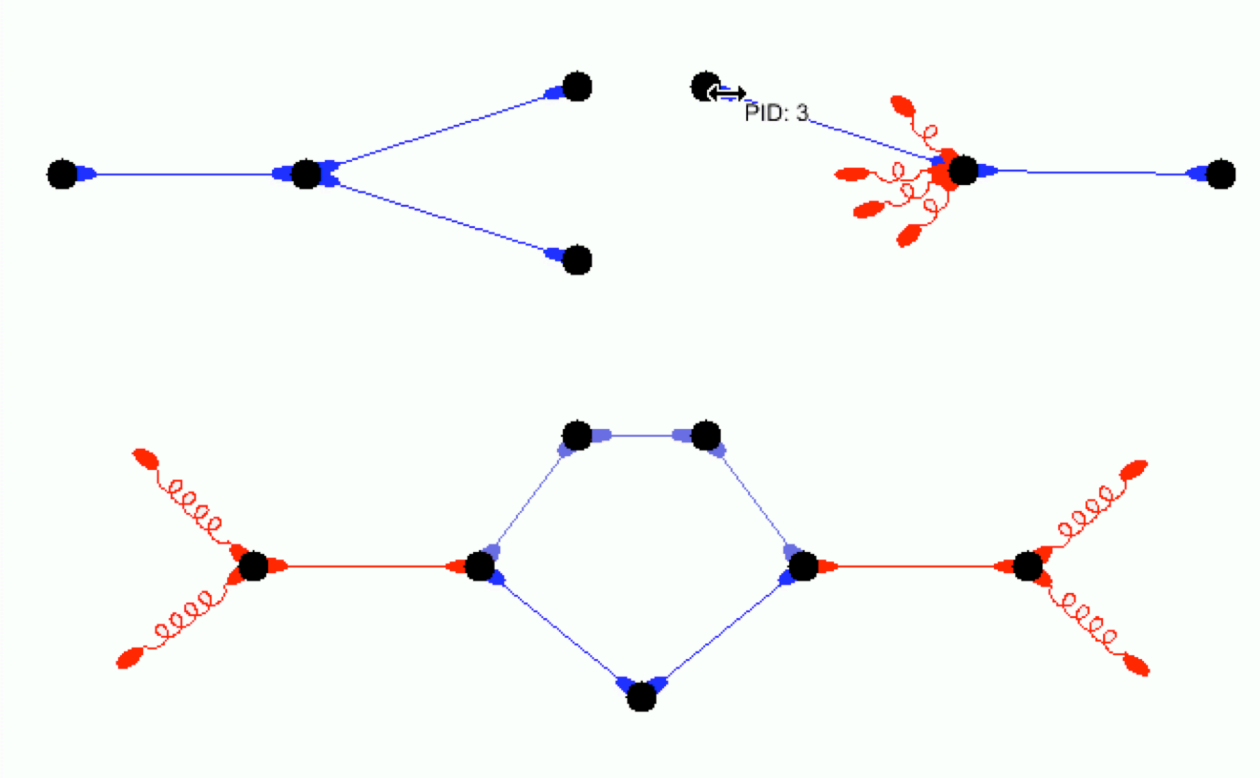

Everything done with left mouse button (use on every TCanvas, use on Mac)

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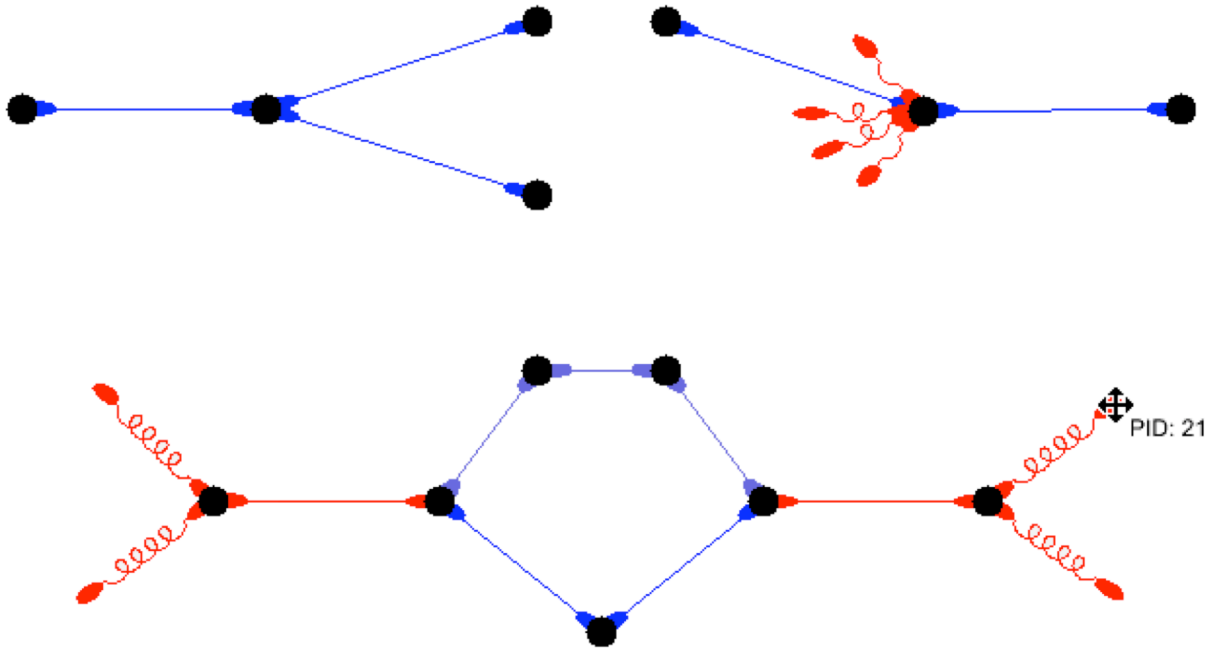

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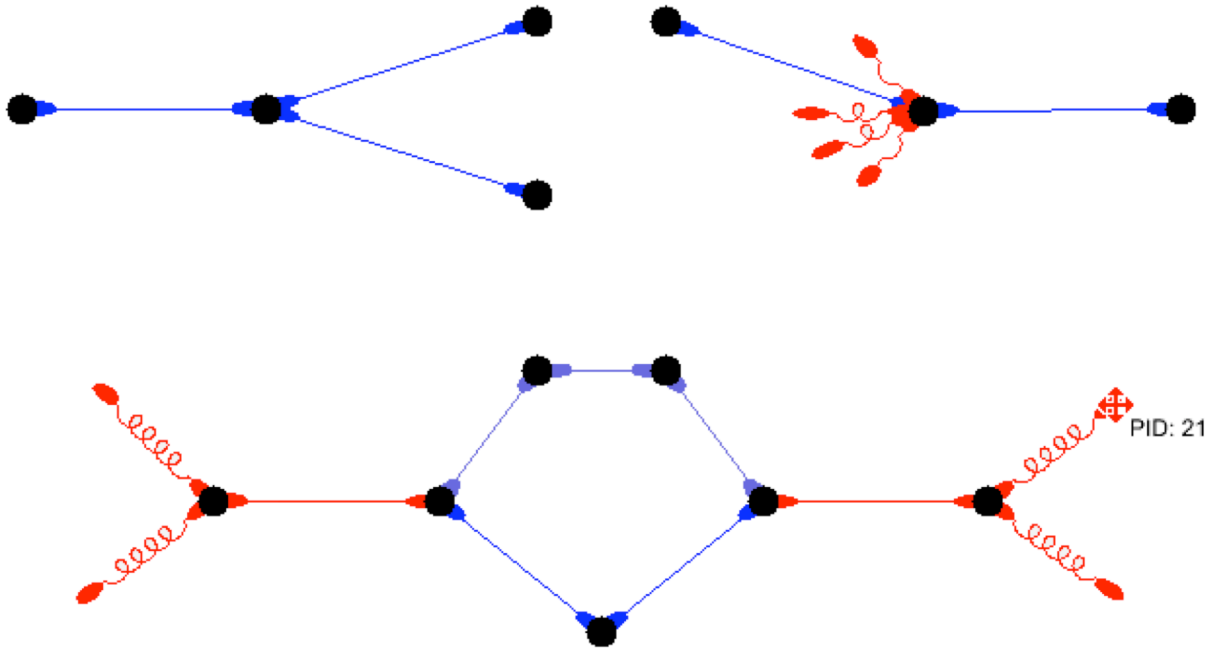

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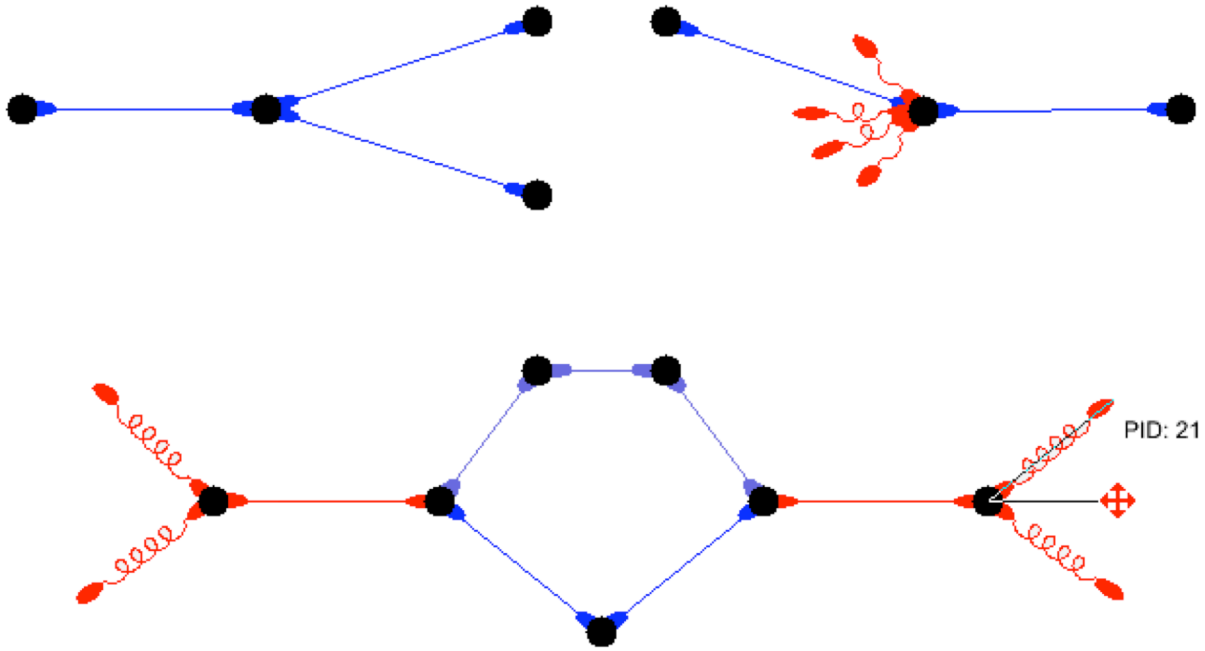

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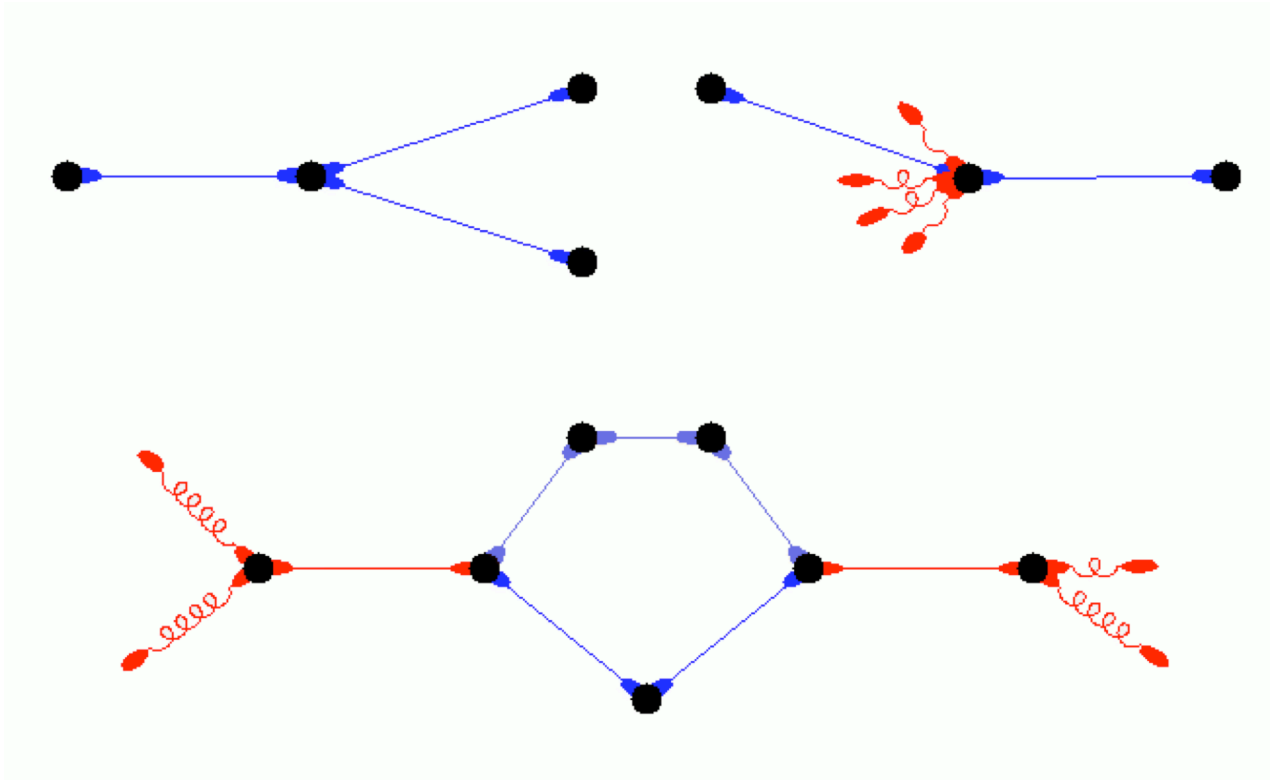

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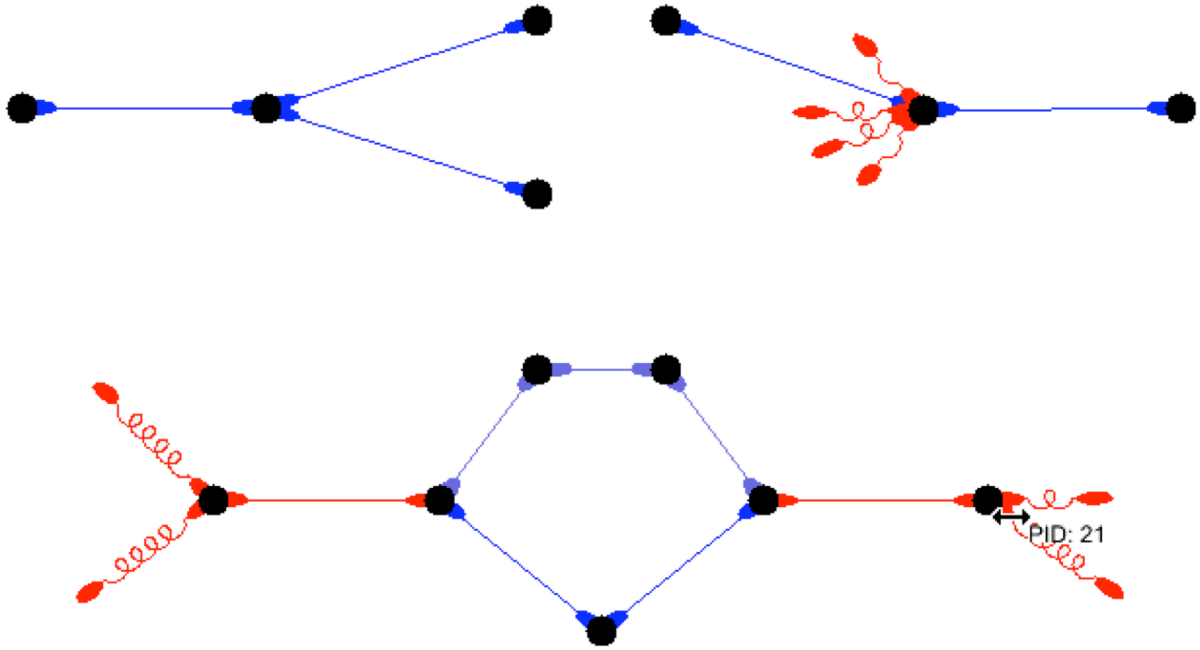

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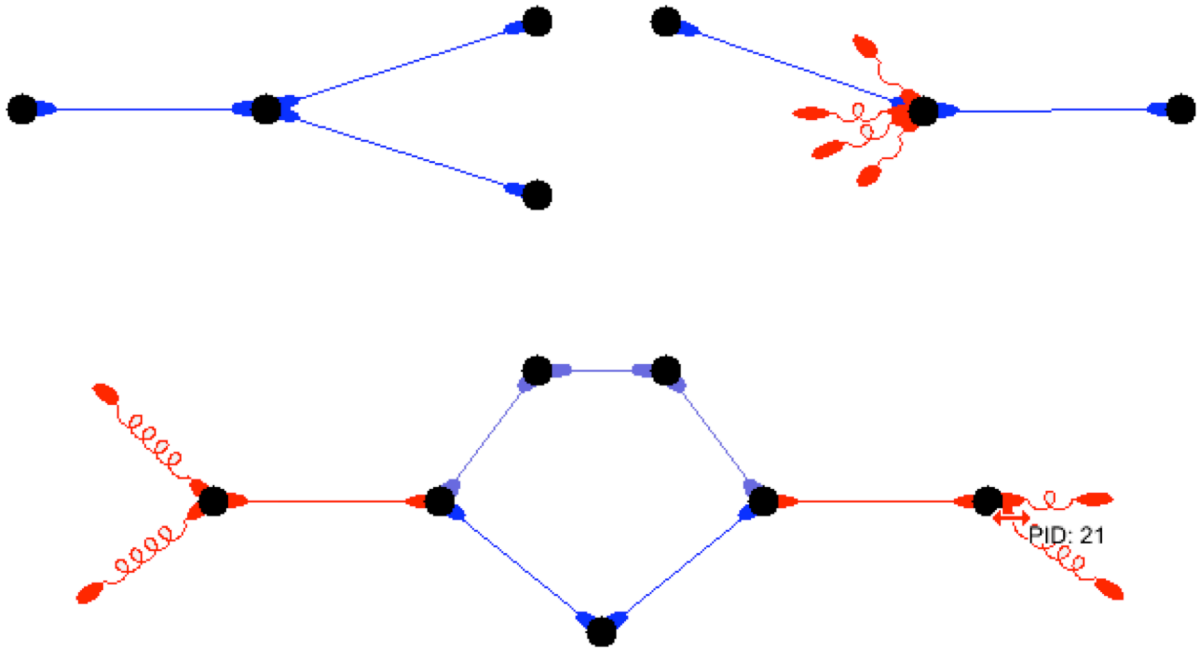

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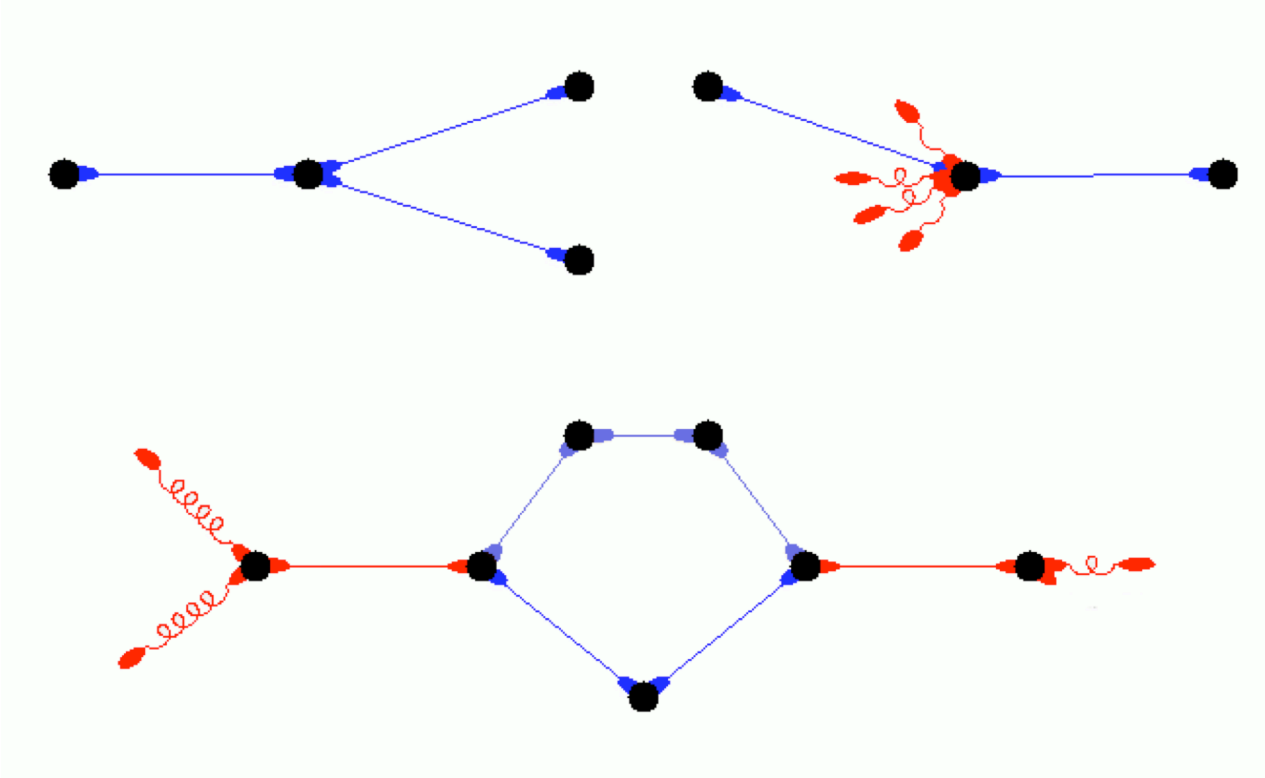

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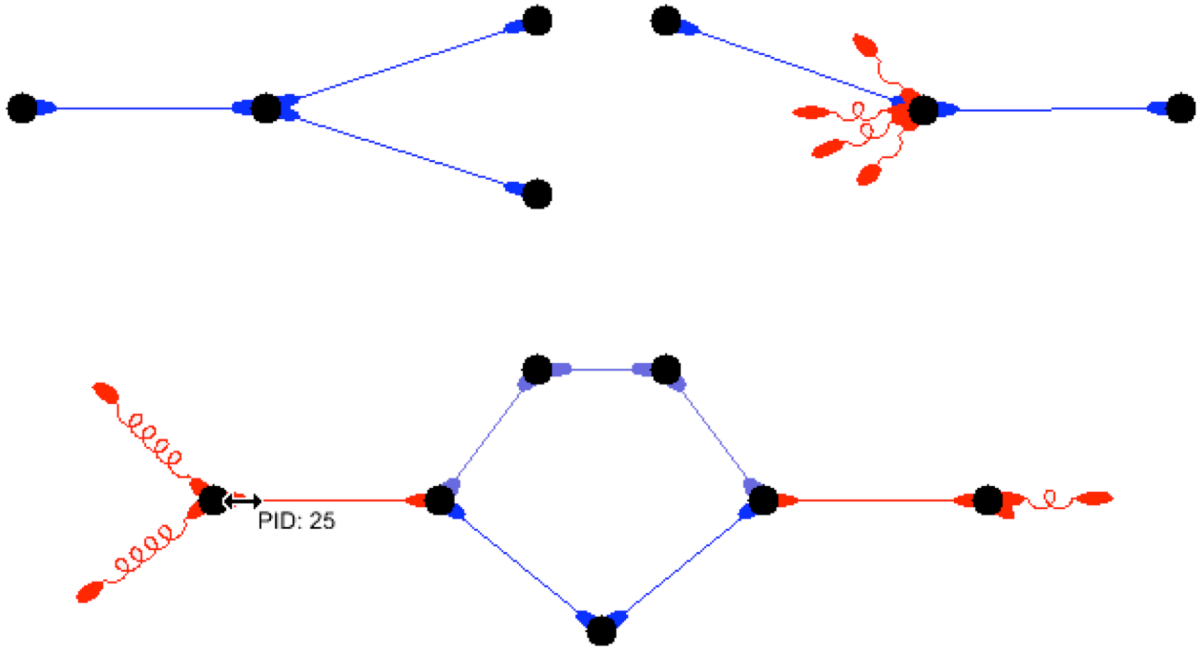

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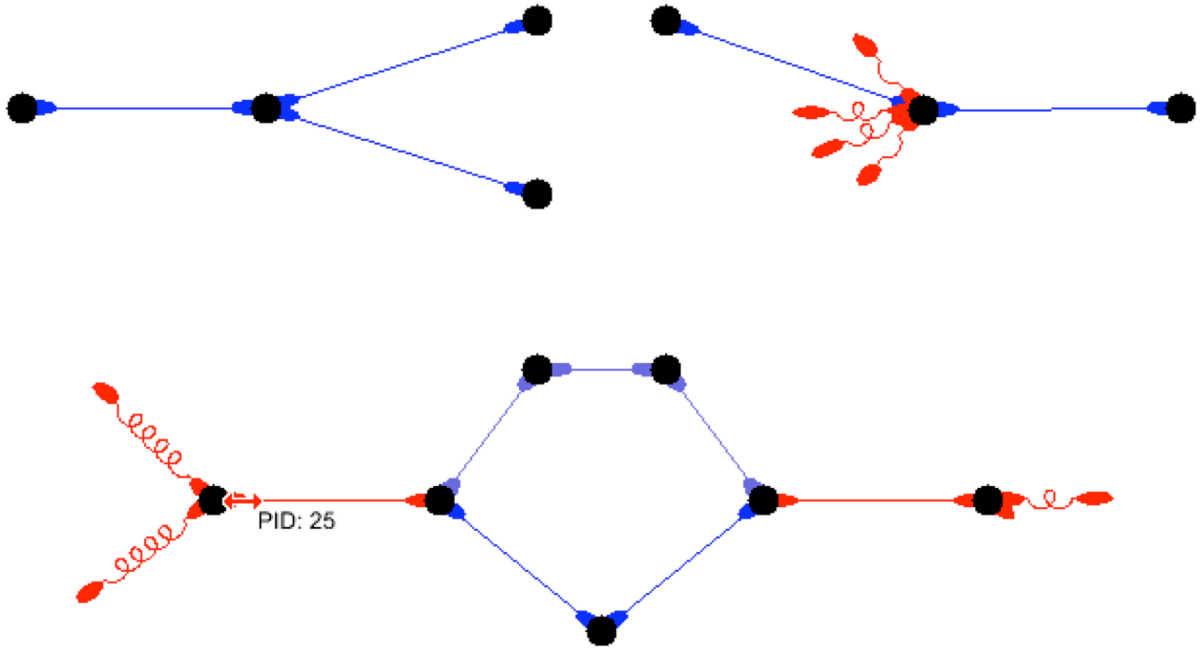

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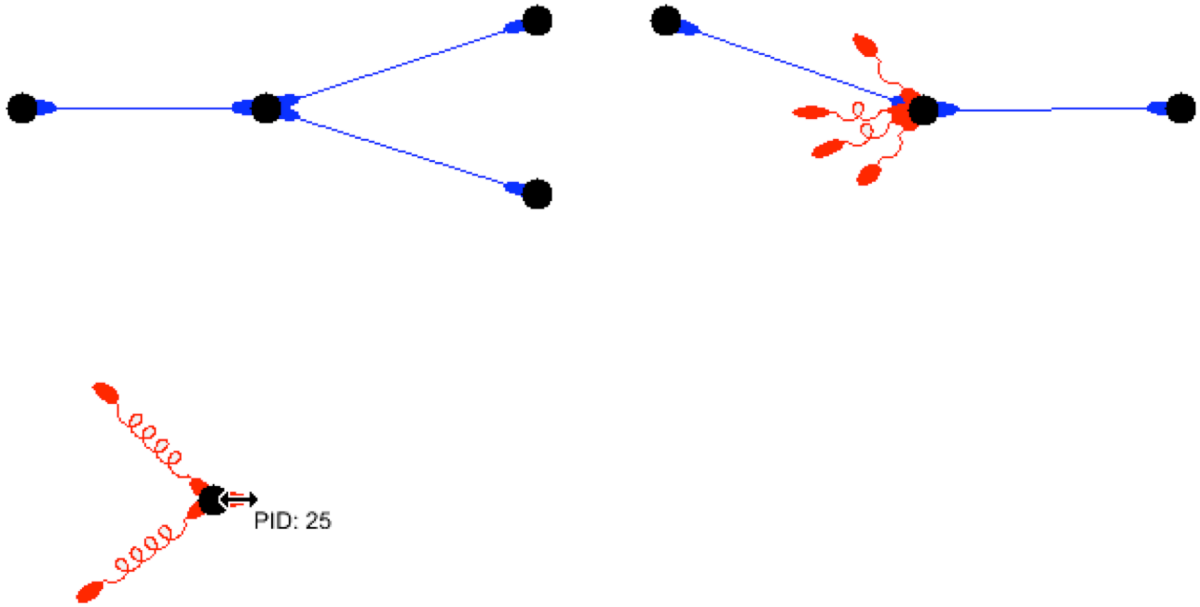

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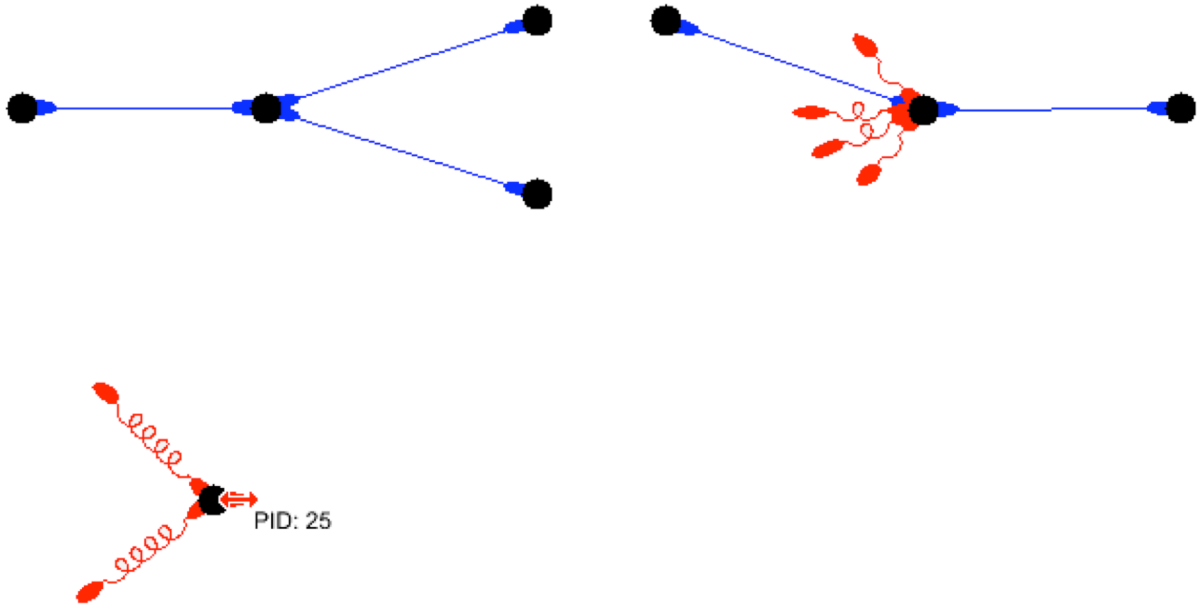

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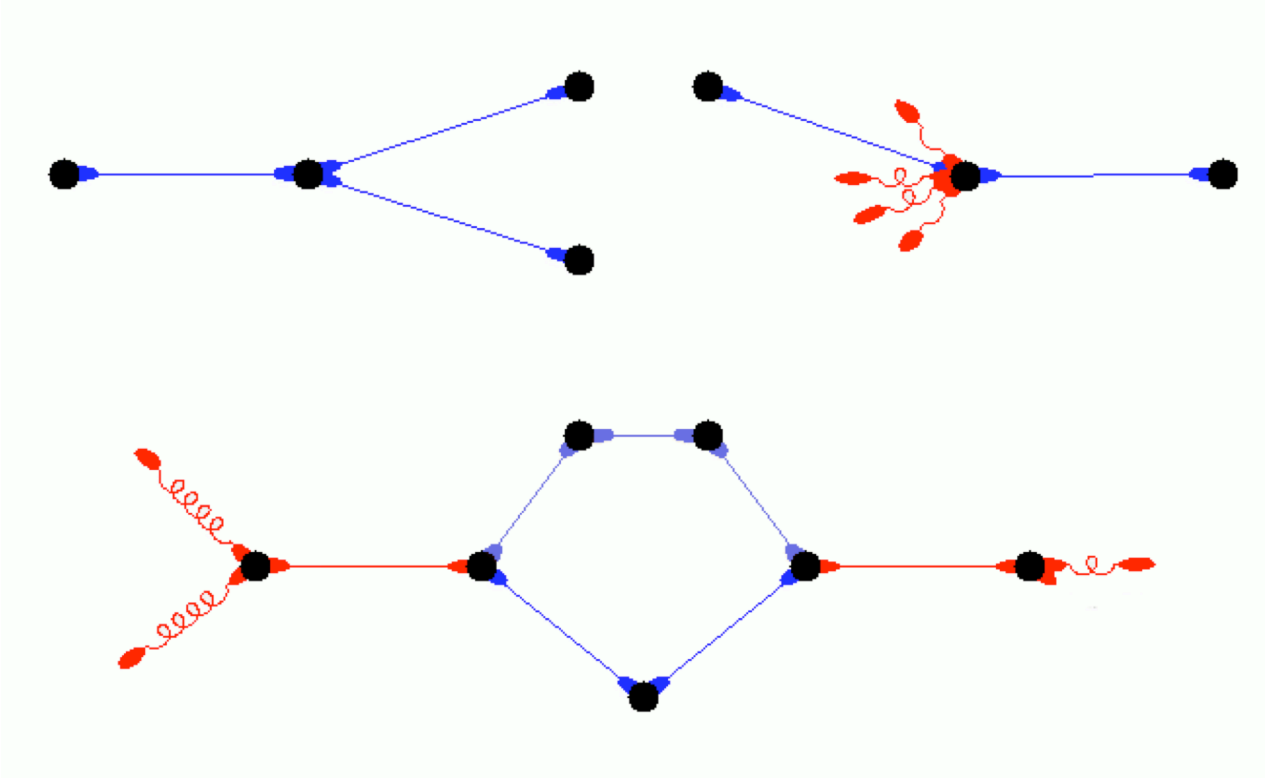

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Interfacing Athena: HepMCBrowser

Interactive Athena:

- PyROOT interface to ROOT
  - ➔ load “ROOT-based” *HepMCVisual* libraries
  - ➔ basic ROOT classes (TCanvas)
  - ➔ ROOT GUI elements (buttons, etc…)

PyAlgorithm:

- python version of Athena Algorithm

```
def execute( self ):
    #Get MC event
    Evt = self.getMCEvent(self.getStoreGateKey())
    #Visualize Event
    VisEvt = HepMC.Visualize(Evt);
    #Draw it
    VisEvt.Draw();
```


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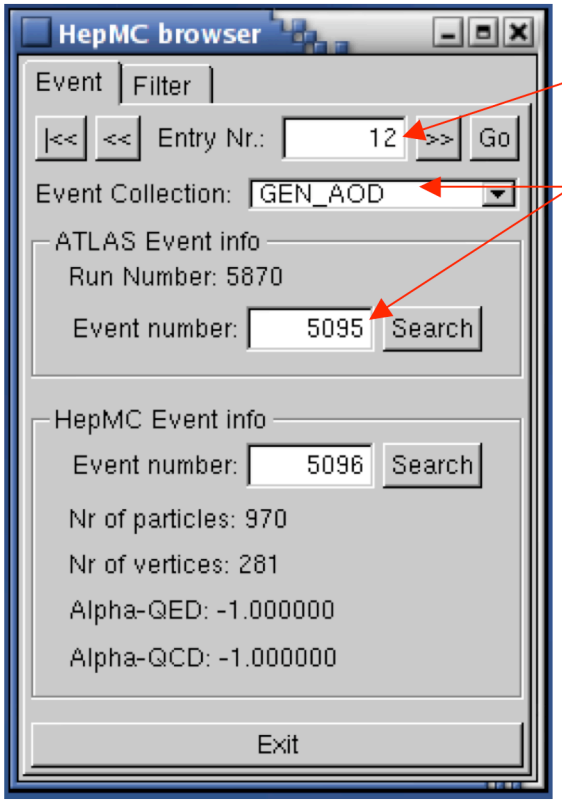
HepMCBrowser: user interface



Search by

- entry number
- event number

Collections

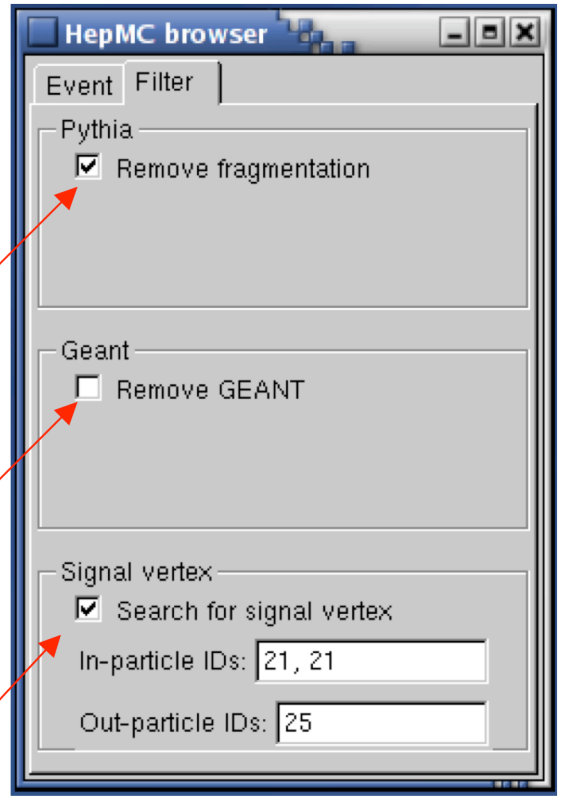
- GEN_AOD
- GEN_EVENT
- TruthEvent

Filter

- Pythia fragmentation
- GEANT particles

Find

- signal vertex



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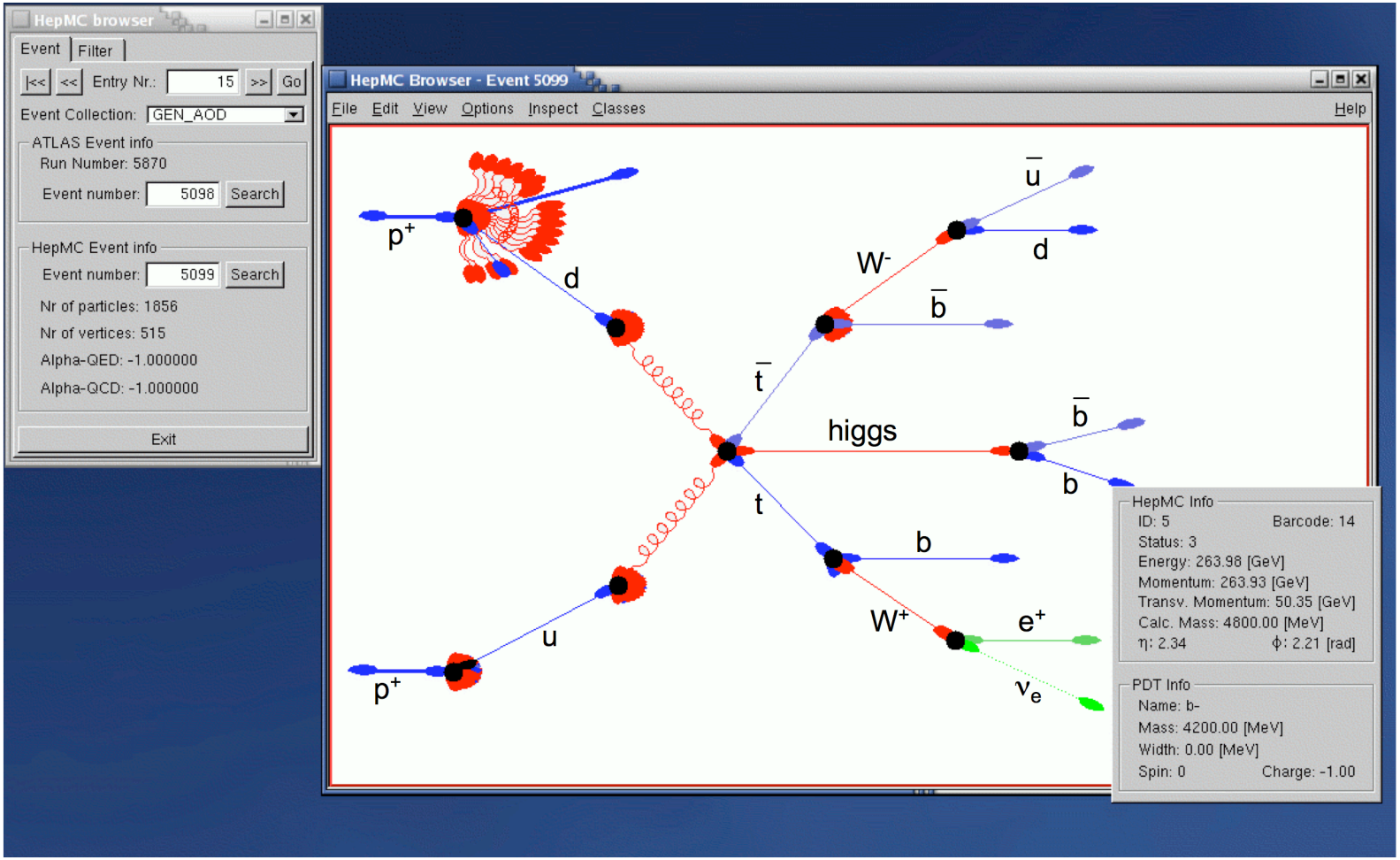
A “real” event



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ToDo List

HepMC Visual:

- advanced Event slimming features
  (by barcode ranges, particle status and IDs, transverse momentum…)
- better handling of “sibblings” (multiple particles between same vertices)
- graphical display of `HepMC::Flow` ?

  ➔ does not seem to be widely used…

HepMC Browser:

- port for Athena 13.0.30

General:

- remove all known and unknown bugs
- write users manual
- get as many test users as possible

Your input is very welcome here!

sboeser@hep.ucl.ac.uk

Hands-on Tutorial: Installation I

Getting the source:

- *HepMCVisual* is a HepForge project:

  `http://projects.hepforge.org/hepmcvisual/`

Requires:

- *HepMC libraries*: version 2.00.00 or larger

  `http://savannah.cern.ch/hepmc/`

- ROOT: version 5.10.00 or larger

  `http://projects.hepforge.org/hepmcvisual/`

Systems:

- Linux / Unix / MacOSX
  ➔ Windows+CygWin theoretically possible, but a bit tricky
- Automatic binding to ATHENA installation not yet supported

sboeser@hep.ucl.ac.uk

Hands-on Tutorial: Installation II

Configuration:

- `./configure`

Options:

`--prefix=`	Do not install to /usr/local/lib
`--with-root=`	Set the path to your ROOT version

Full list:

`--help`	Display all command line options

Compilation:

- `make`
- `sudo make install`

sboeser@hep.ucl.ac.uk

Hands-on Tutorial: Installation III

Compiling examples:

- `cd test`
- Edit `Makefile` if you have used `--prefix, --with-hepmc-*`
- `make basic`
- `make ShowEvents` -- this may take several minutes!

Running examples:

- `./basic`
- `./ShowEvents --pythia --remove-fragmentation`
- `./ShowEvents --herwig --remove-fragmentation`

  ➔ double-click black dot to start

sboeser@hep.ucl.ac.uk