

# Latest news on **SGV** - a fast detector simulation

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Outline:

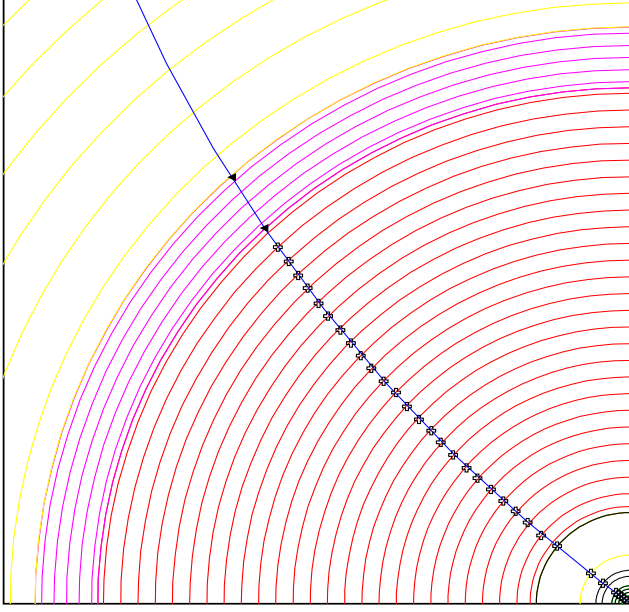
- Reminder of the features of **SGV**
- **New version: 2.32**
- **New features:** Simple event display, Non-zero angle between beams, z-dependent errors, interface to BDK and BDKRC, space-points...
- **Near future:** ZVTOP, dE/dx, interference between tracks, ...
- **Conclusion**

# How does it work?

**SGV** is a machine to calculate covariance matrices

## Tracking:

- Follow track-helix through the detector, to find what layers are hit by the particle.



- From this, calculate covariance matrix at perigee, including effects of material, measurement errors and extrapolation. NB: this is exactly what Your track fit does!
- Smear perigee parameters accordingly, with Choleski decomposition (takes all correlations into account)
- Information on hit-pattern accessible to analysis. Co-ordinates of hits accessible.

## Calorimeters:

- Follow particle to intersection with **calorimeters**
- Decide **how the detectors will act**: MIP, EM-shower, hadronic shower, below threshold, etc.
- Simulate response from **parameters**.
- **Merge** close showers
- Easy to **plug in** other (more sophisticated) shower-simulation

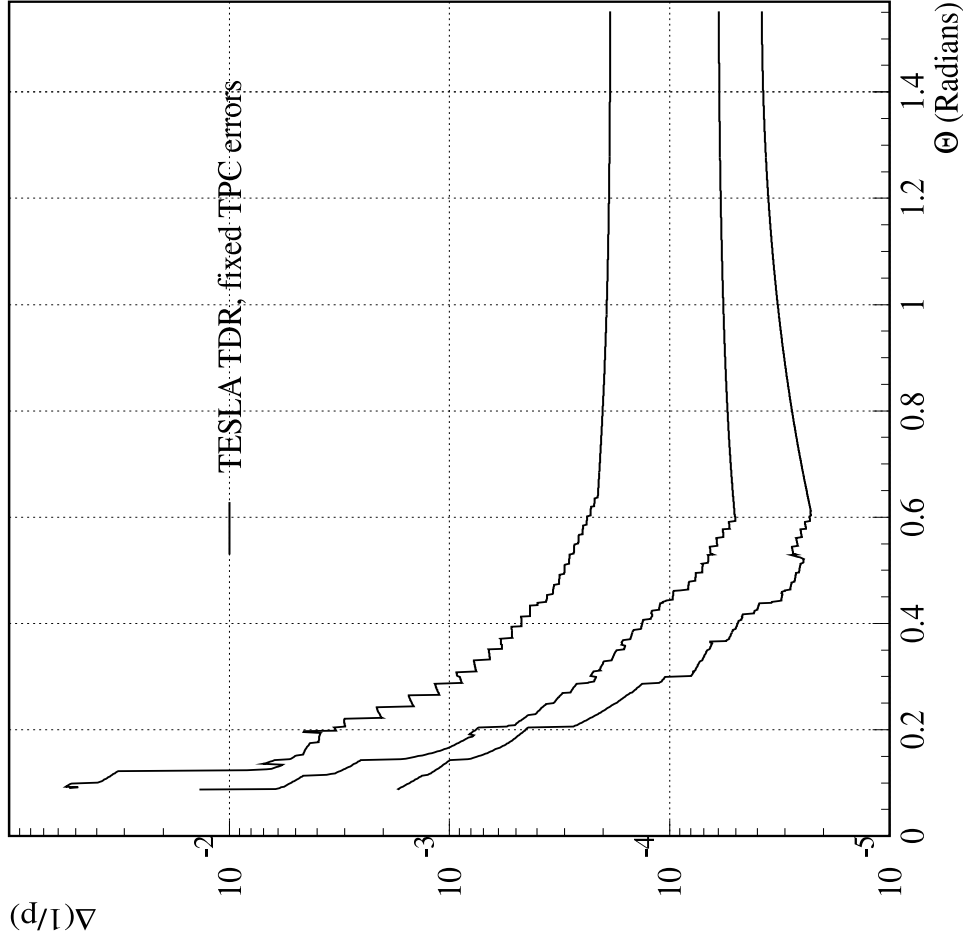
## Other stuff:

- **EM-interactions** in detector material simulated
- Plug-ins for **particle identification**, track-finding **efficiencies**,...
- **Scintillators** and **Taggers**
- Simple **Event-display**.
- **Hit coordinates** at selected detector layers.
- Beams with **non-zero crossing-angle**.
- Interfaces to **many generators** (PYTHIA, JETSET, SUSYGEN, BDKRC, ...)
- **Tools for analysis** included (Jet-finding, shape-variables, impact parameters, flavour-tagging (ZVTOP) ....)

# New release: 2.32

- 2.32 (Nov. 21, 2003) :
- **z-dependent point-errors** for long-drift detectors.
- **Simple event display:**
  - Routine called (ZAPLEV) by user produces **ASCII** file with track information
  - **PAW kumacs** to plot in arbitrary projection, different colouring schemes, track selection, object selection, ...
  - **Non-zero crossing-angles** of incoming beams.
- Hit-coordinates.
- Interfaces to **generators of weighted events** (BDK, BDKRC)
- Some new utility routines.
- A number of **bug-fixes**.

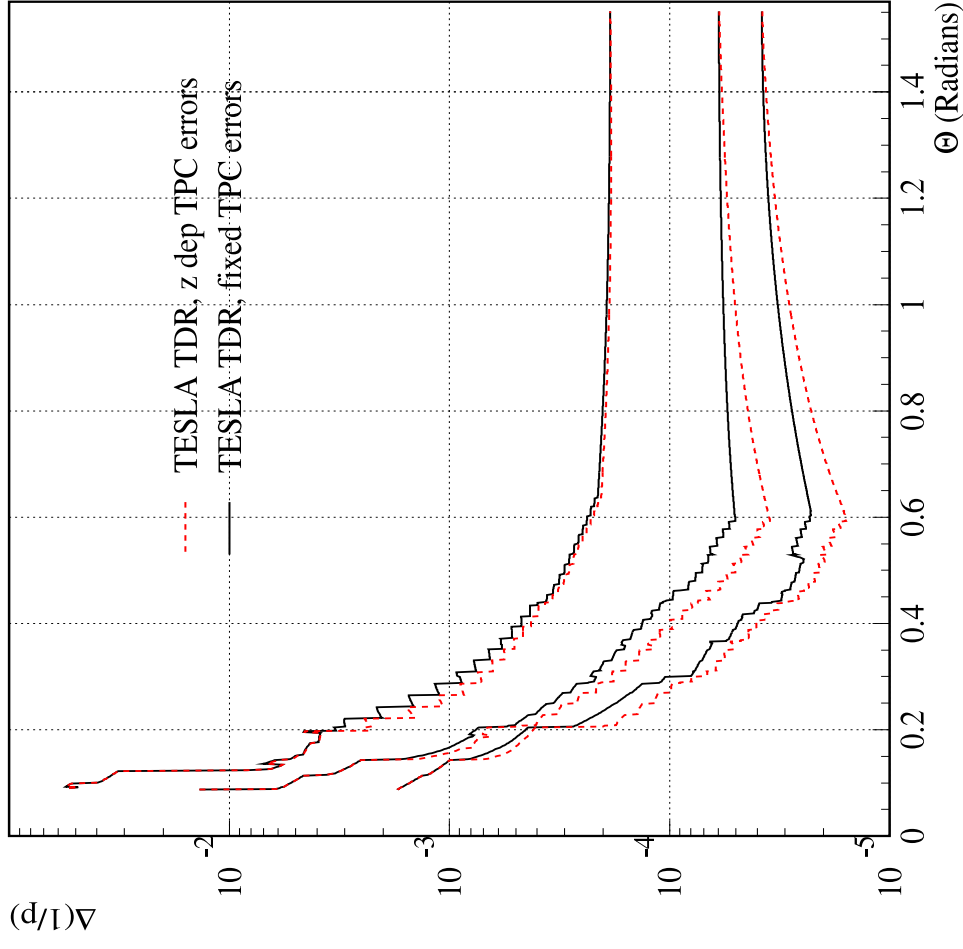
# Effect of z-dependent errors



• dp/p vs  $\theta$ , at different p.

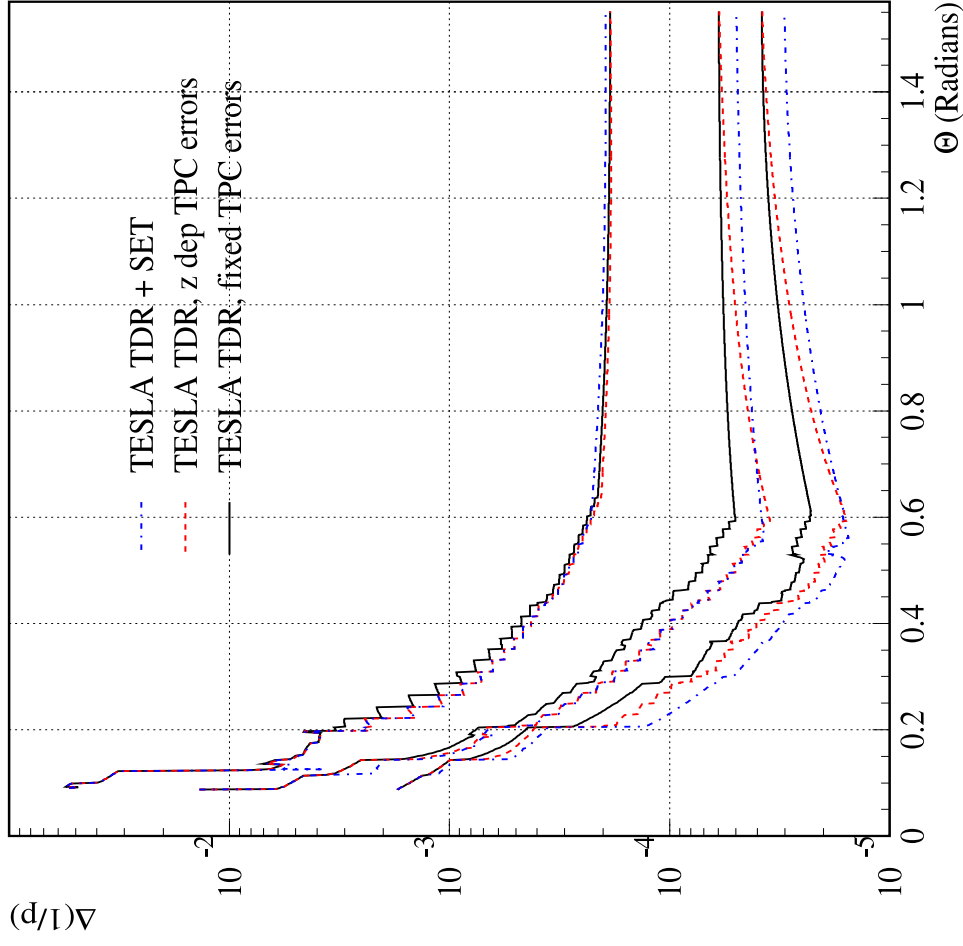
• TDR without z-dependent errors

# Effect of z-dependent errors



- dp/p vs  $\theta$ , at different p.
- TDR with & without z-dependent errors.

# Effect of z-dependent errors



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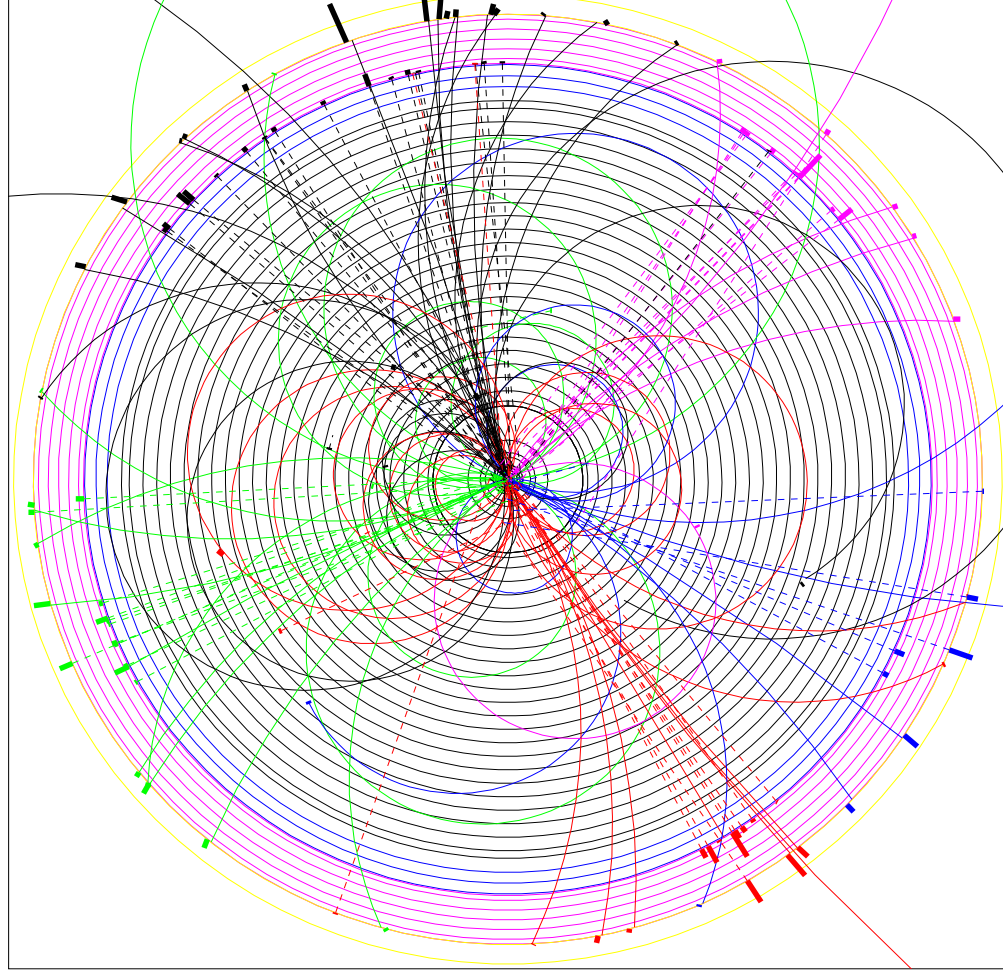
• The same, for TDR+SET and SiFCH.

# *Event display: $t\bar{t}$ event at 500 GeV*

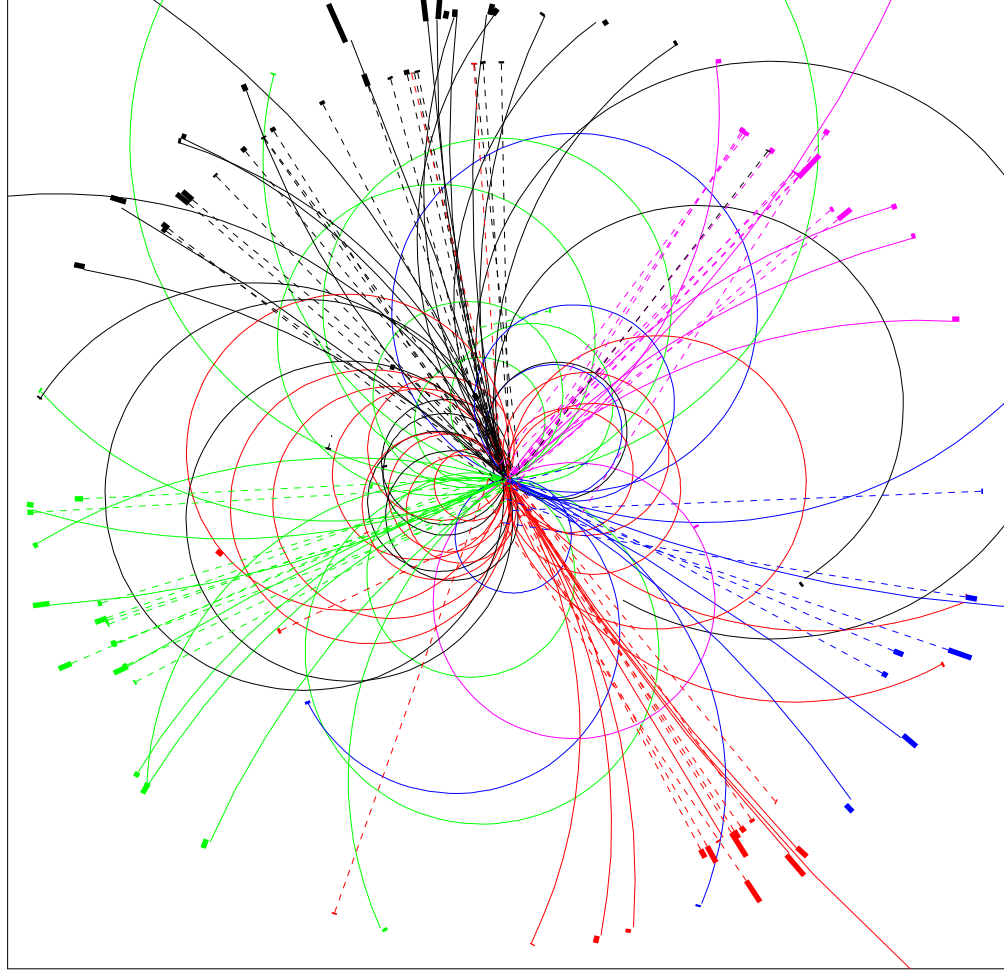
- $t\bar{t}$  event.
- 5 reconstructed jets, colour-coded
- Solid lines: charged, dashed lines: neutrals, bars: calorimeter deposit.
- Following slides:
  - Rotation of event.
  - Zoom.
  - Different attribute settings.



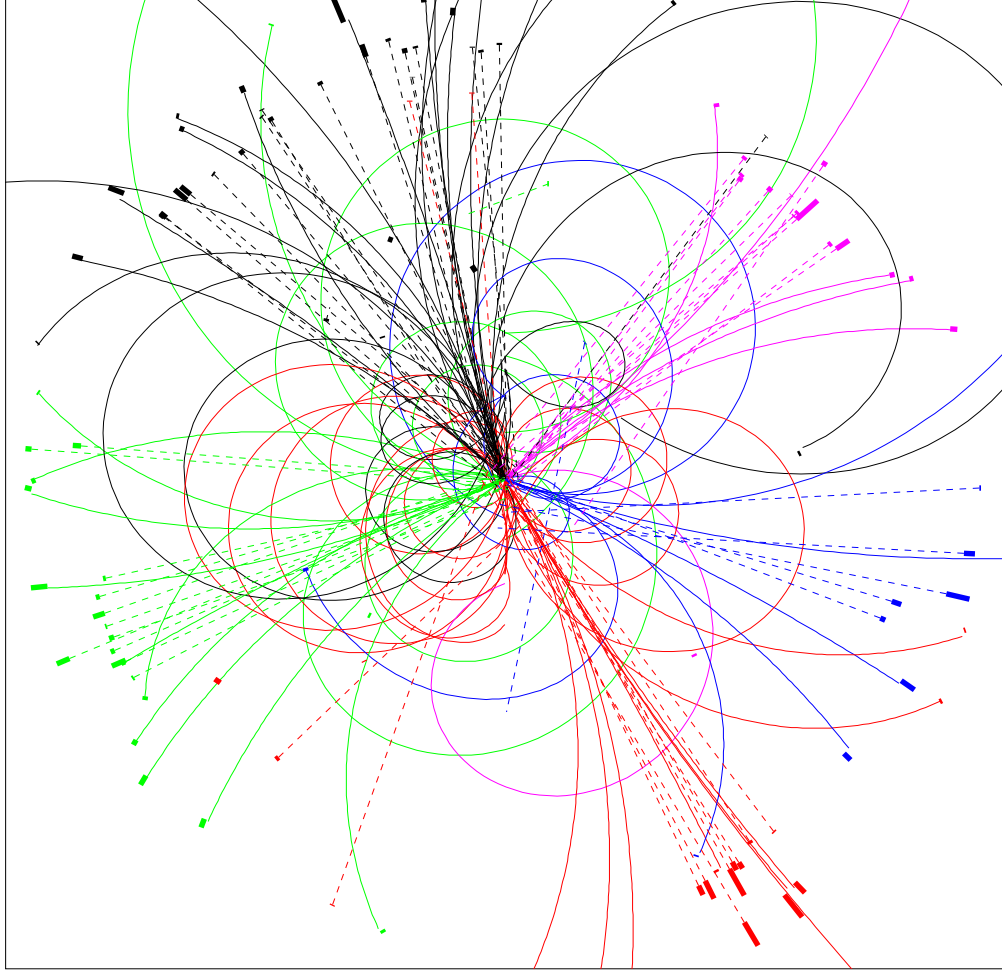
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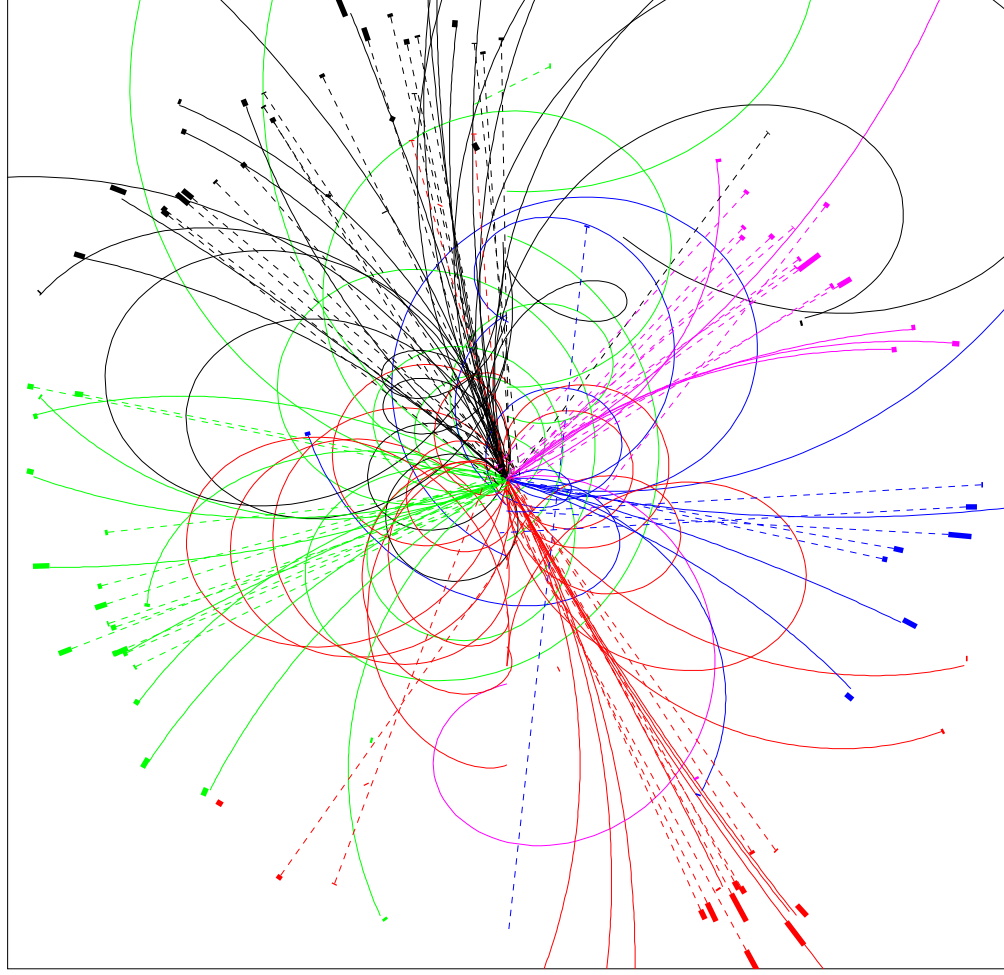
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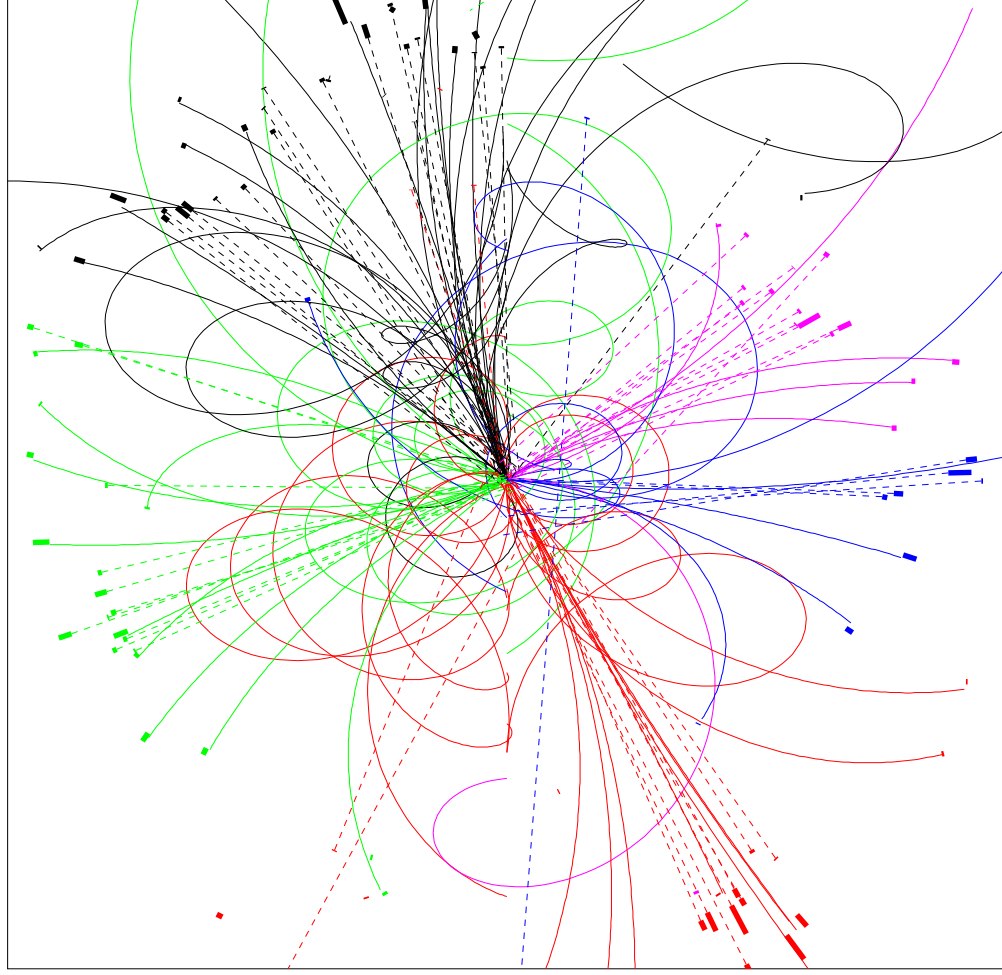
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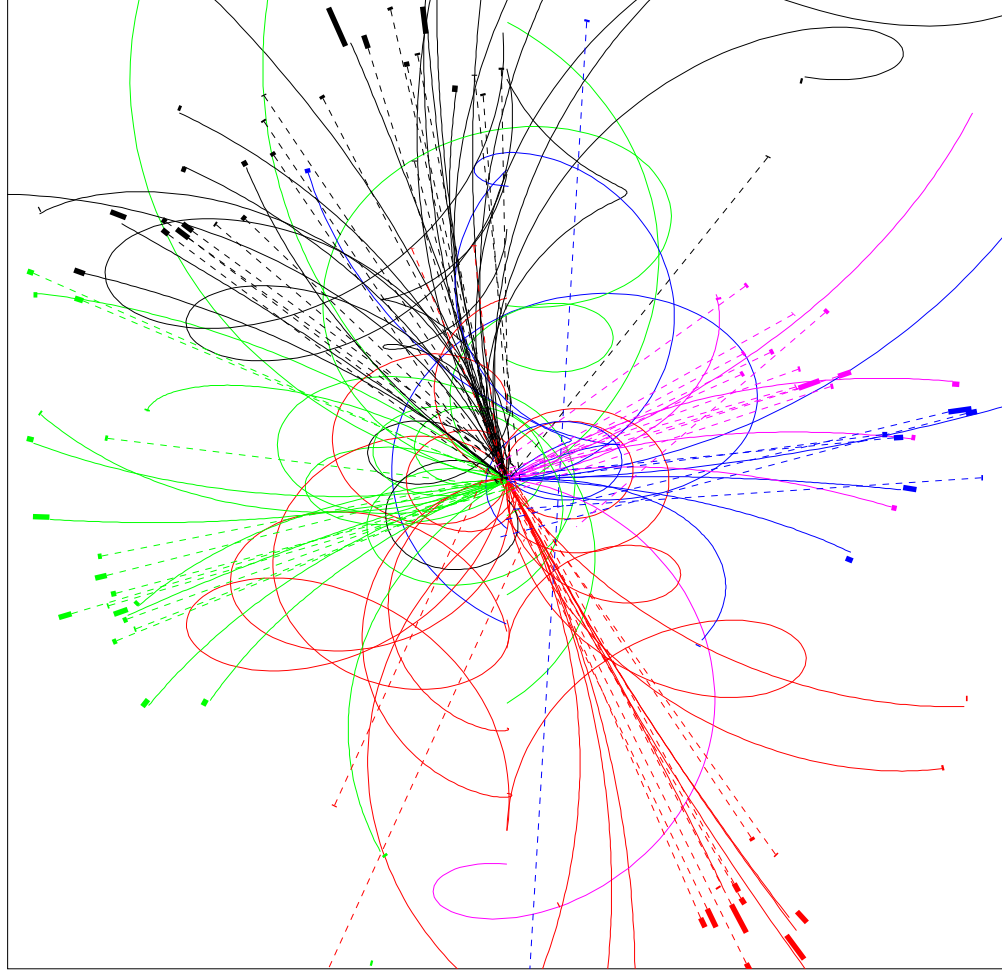
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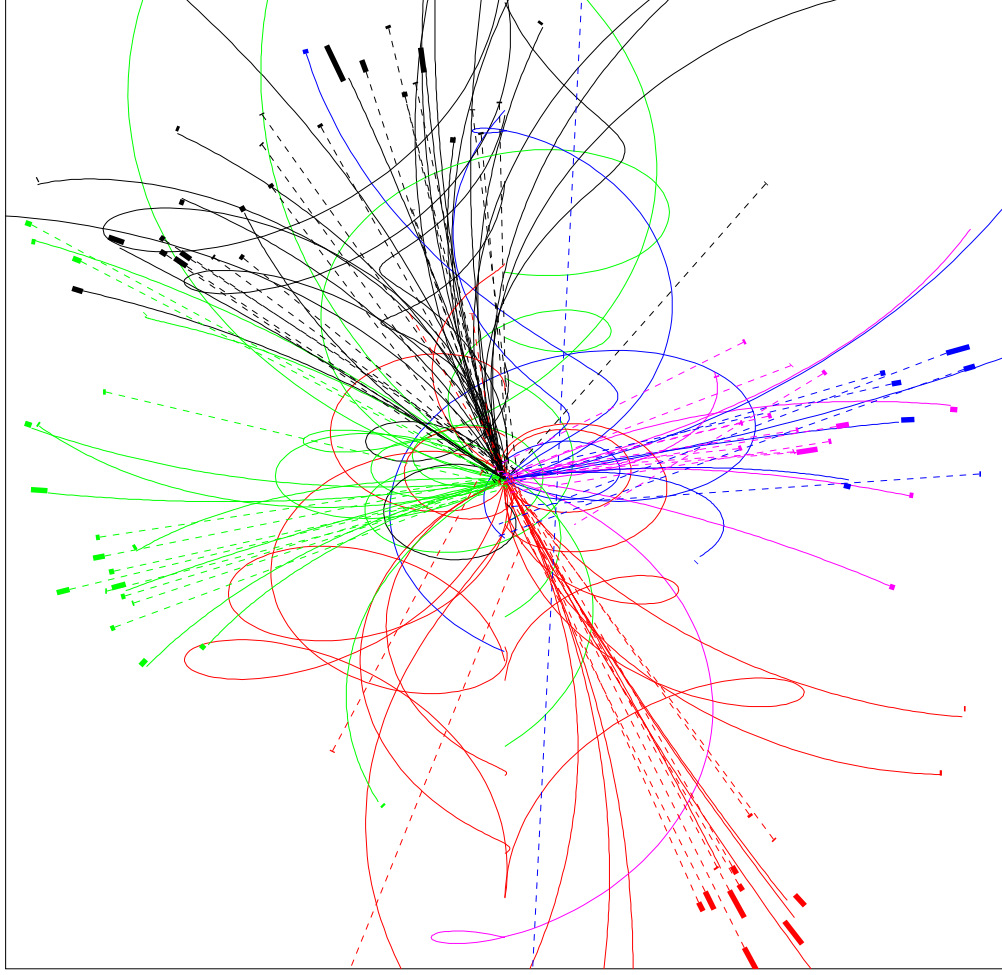
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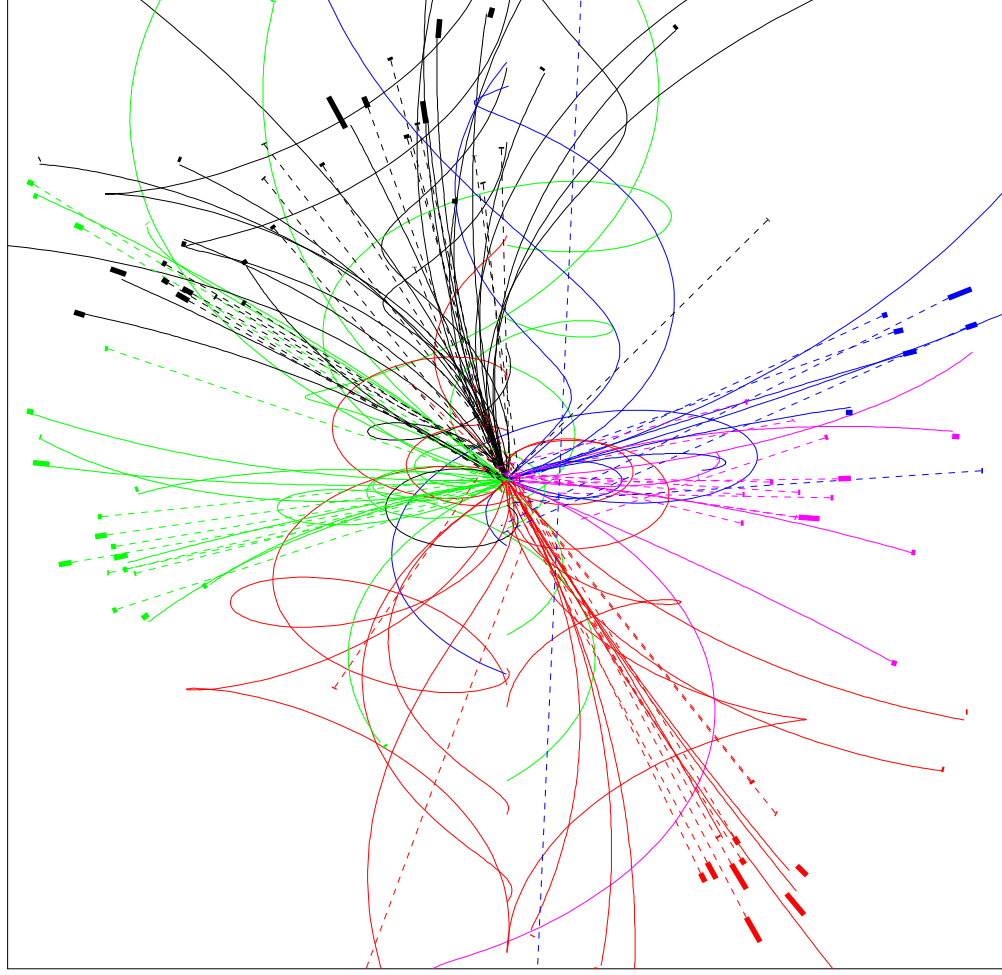
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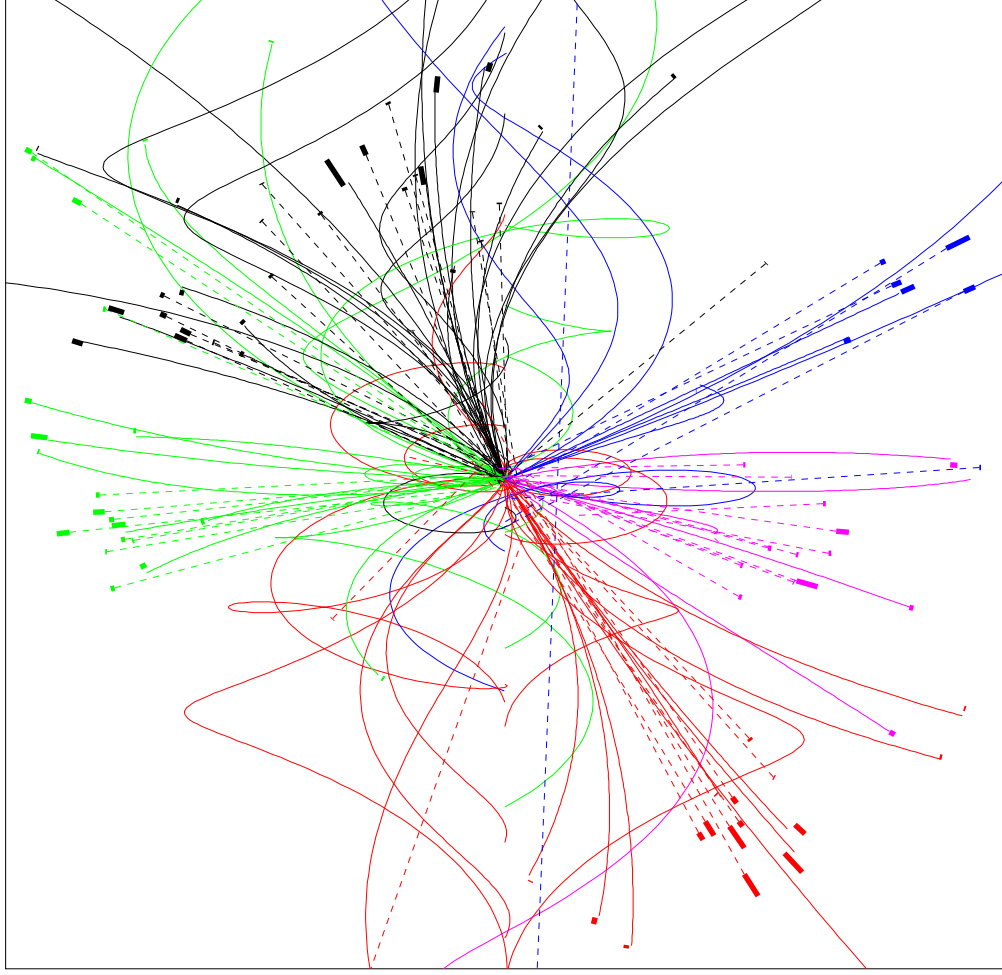


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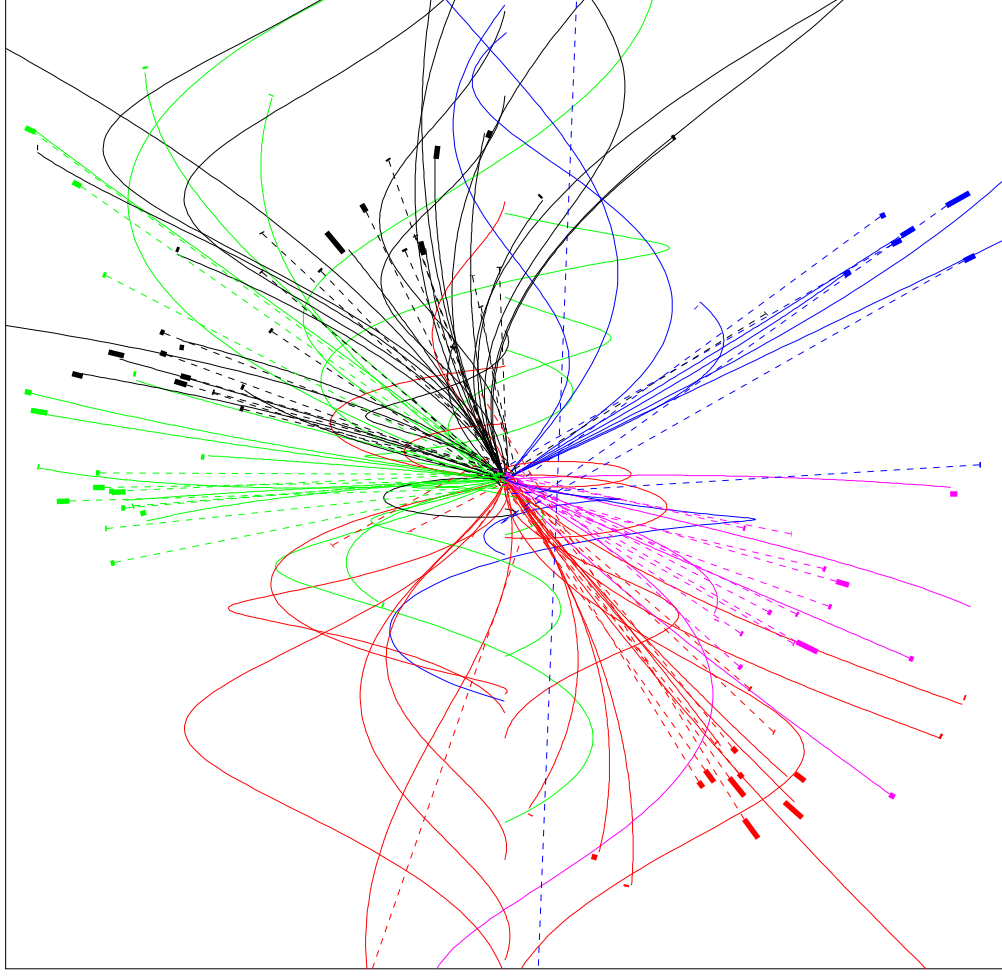




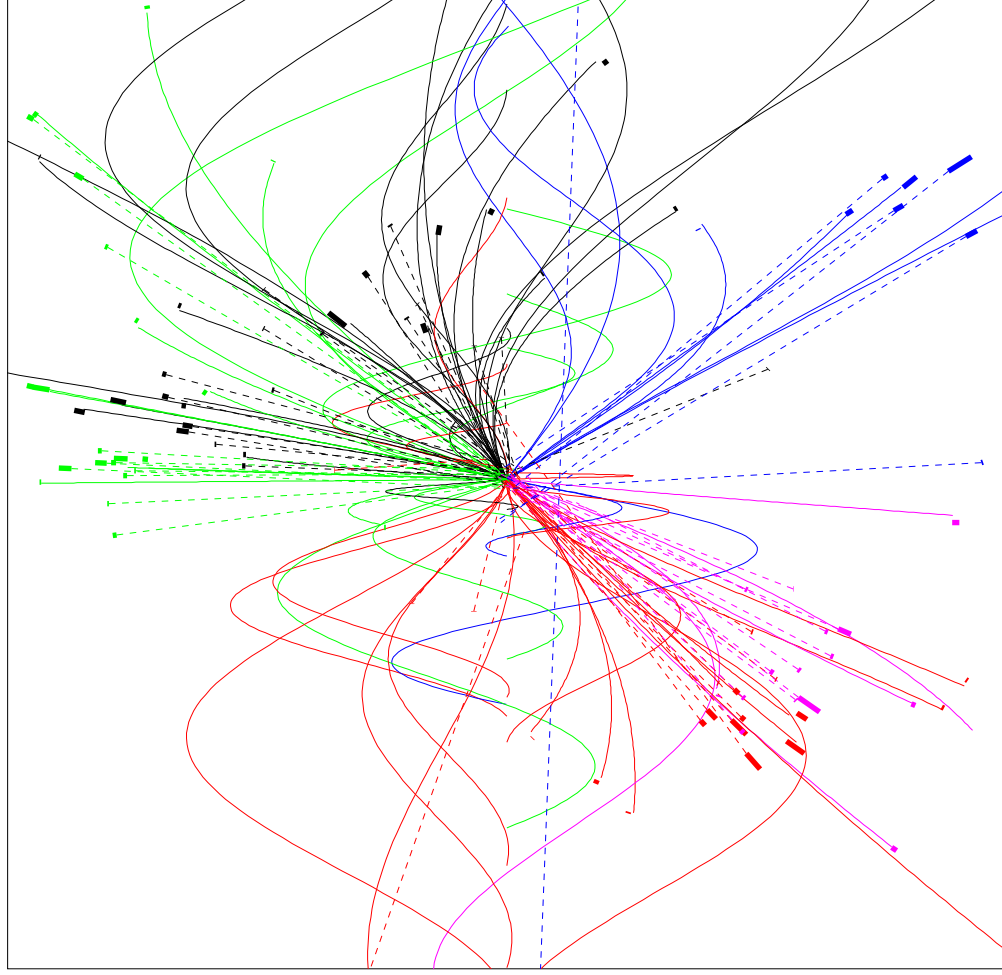
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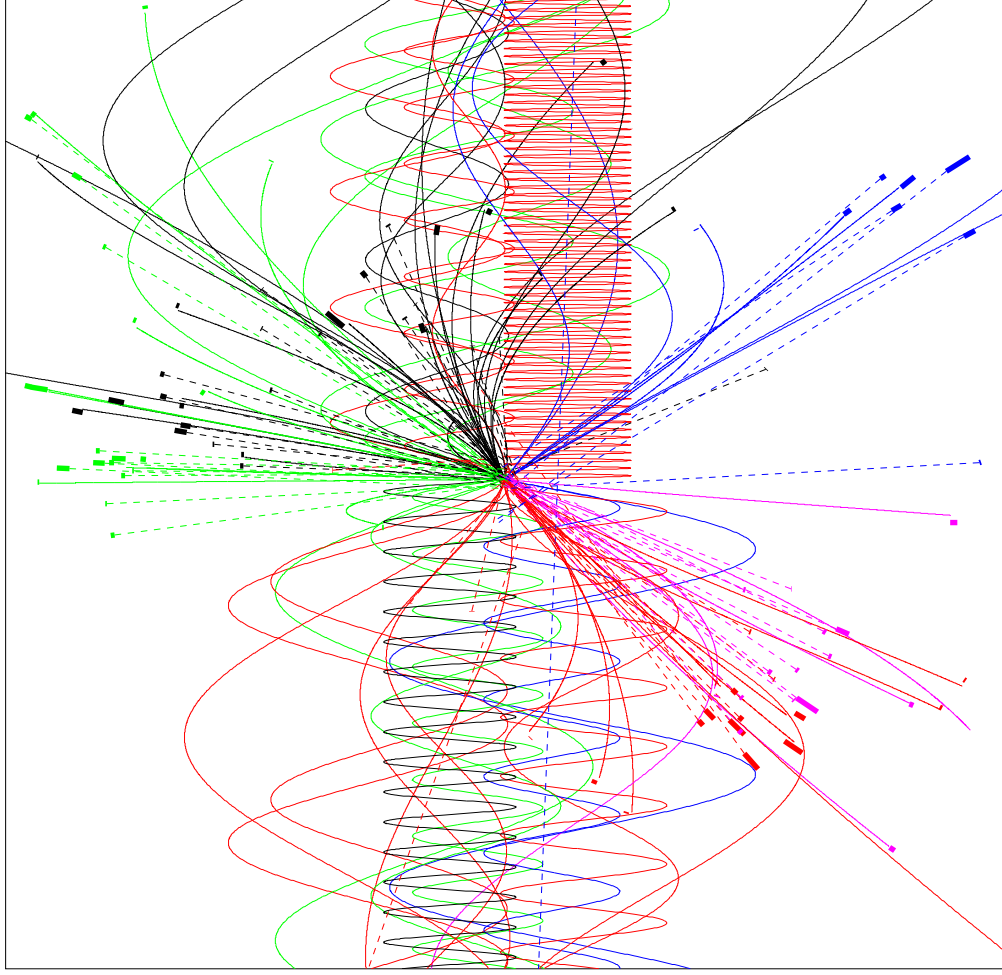
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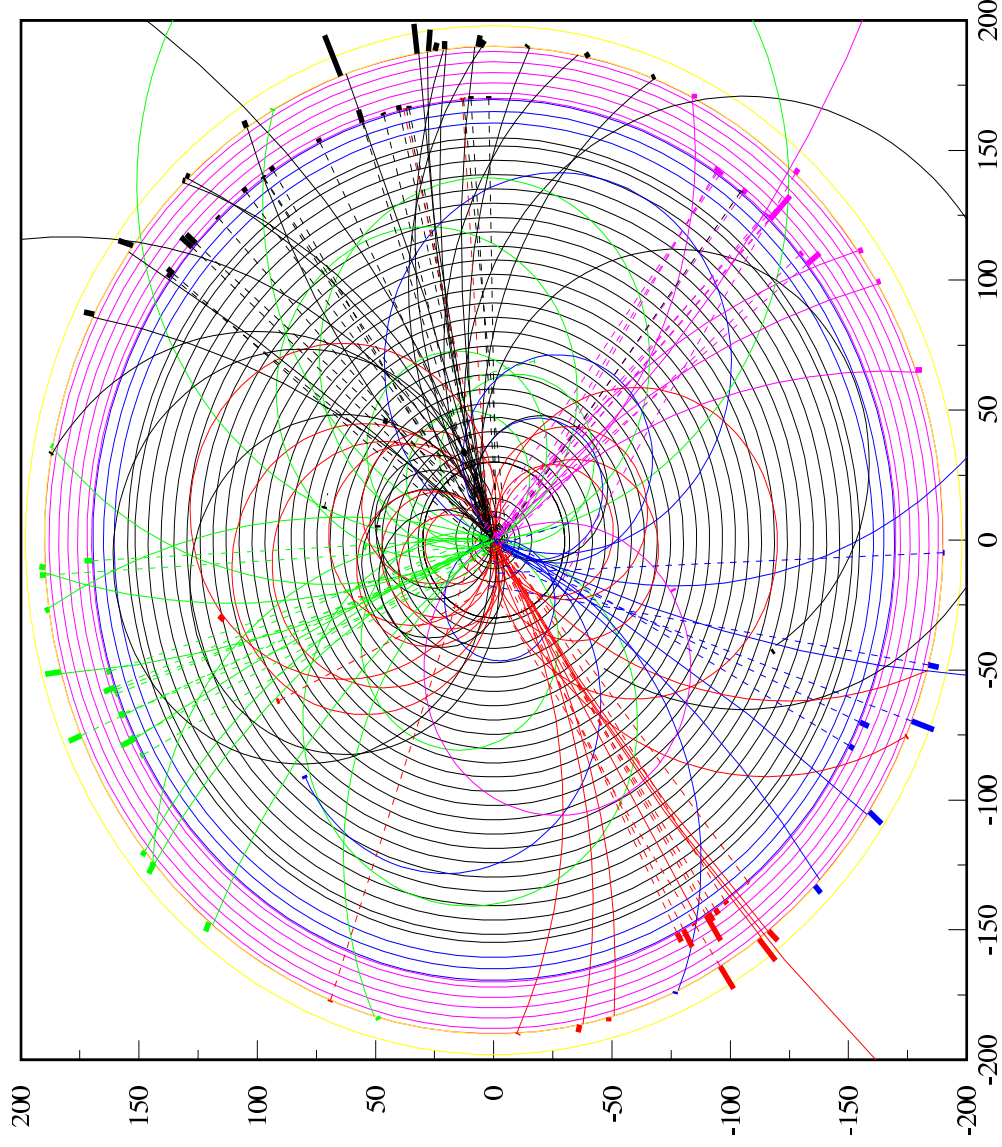
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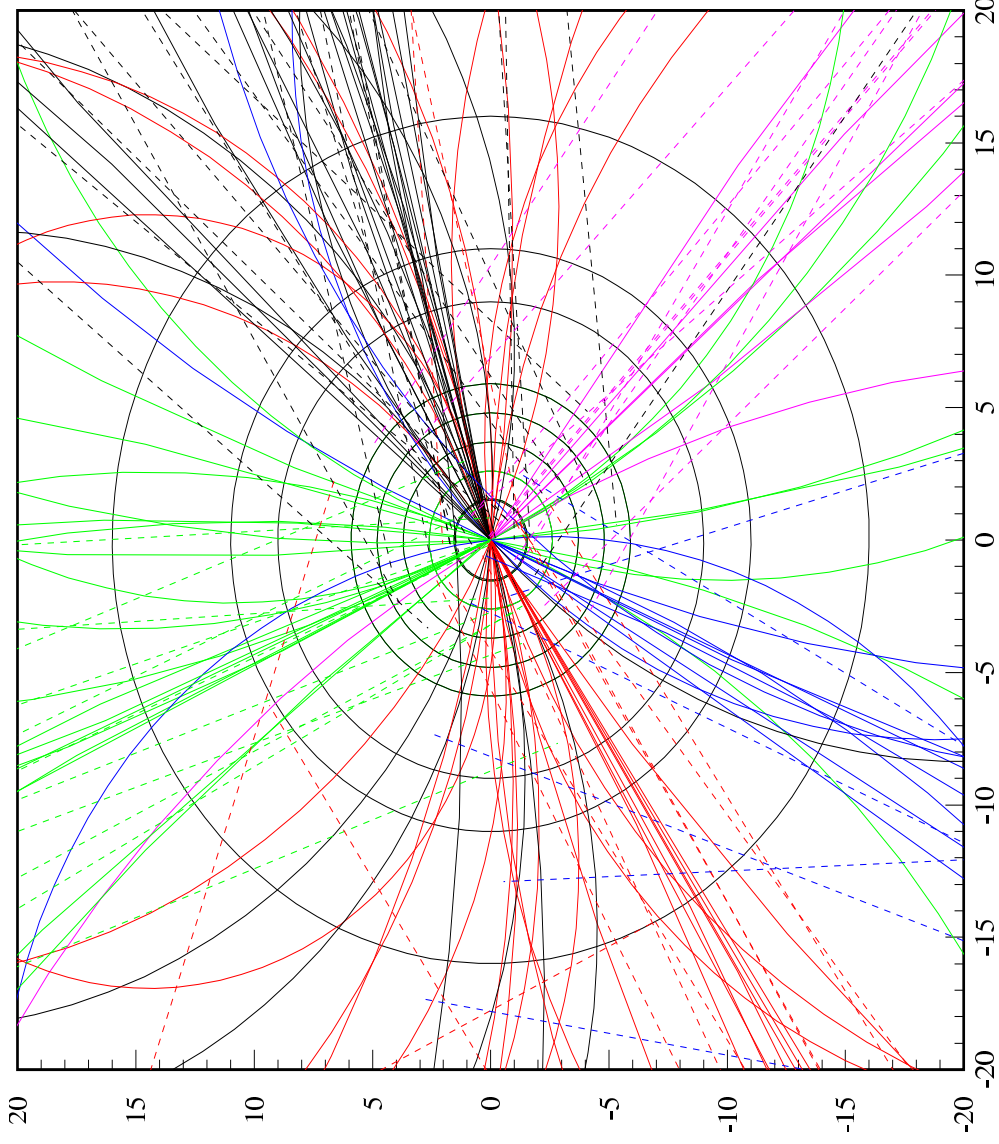
# *Event display: tt event at 500 GeV*



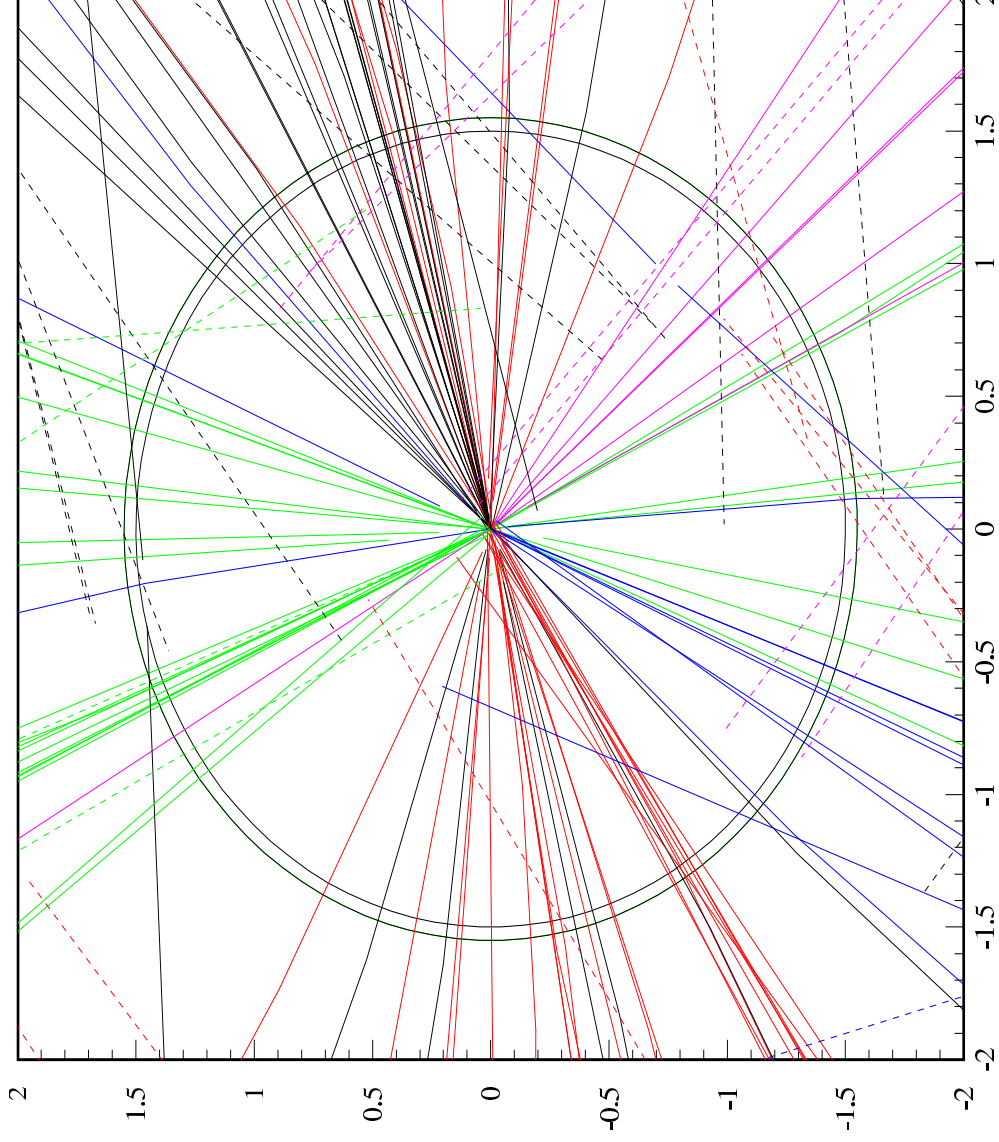
# Event display: $t\bar{t}$ event at 500 GeV



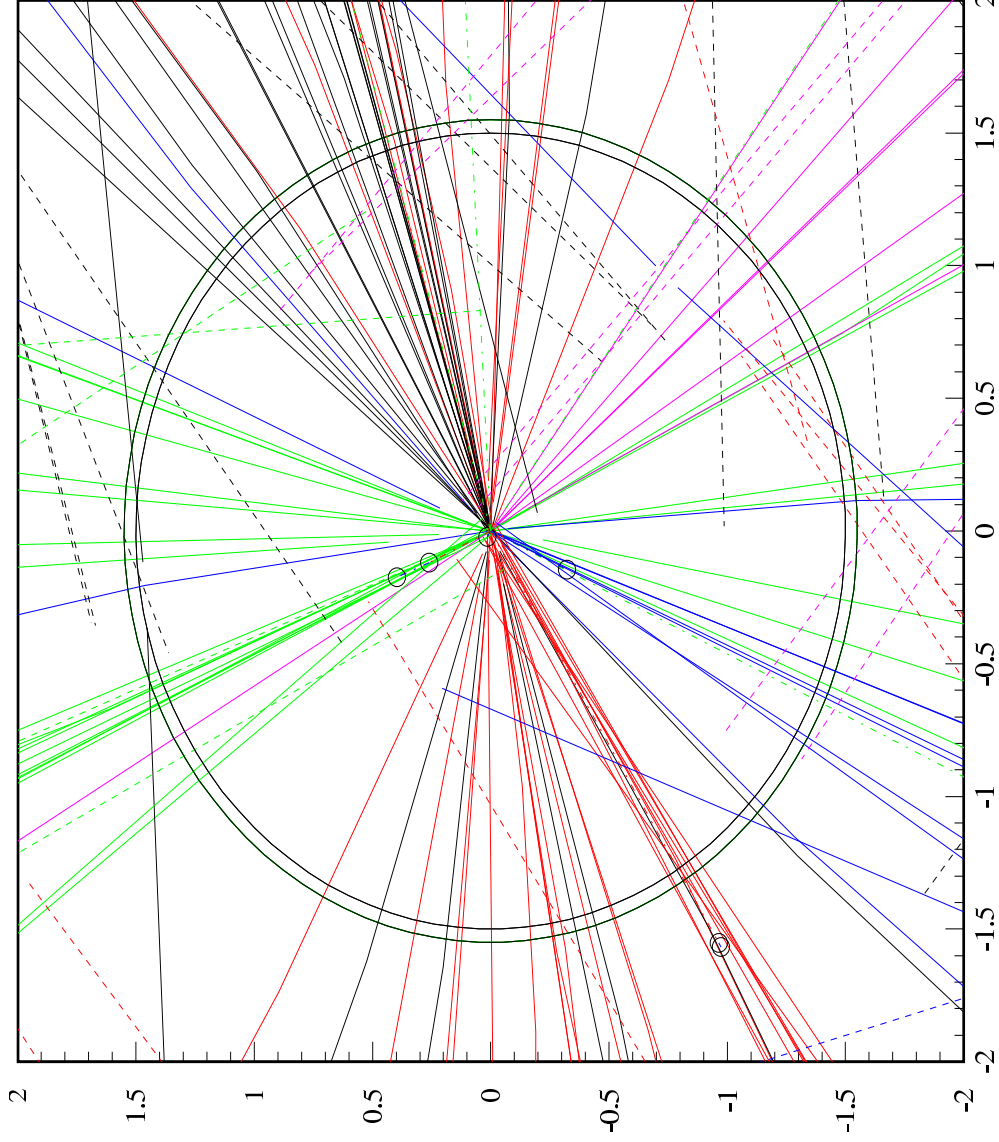
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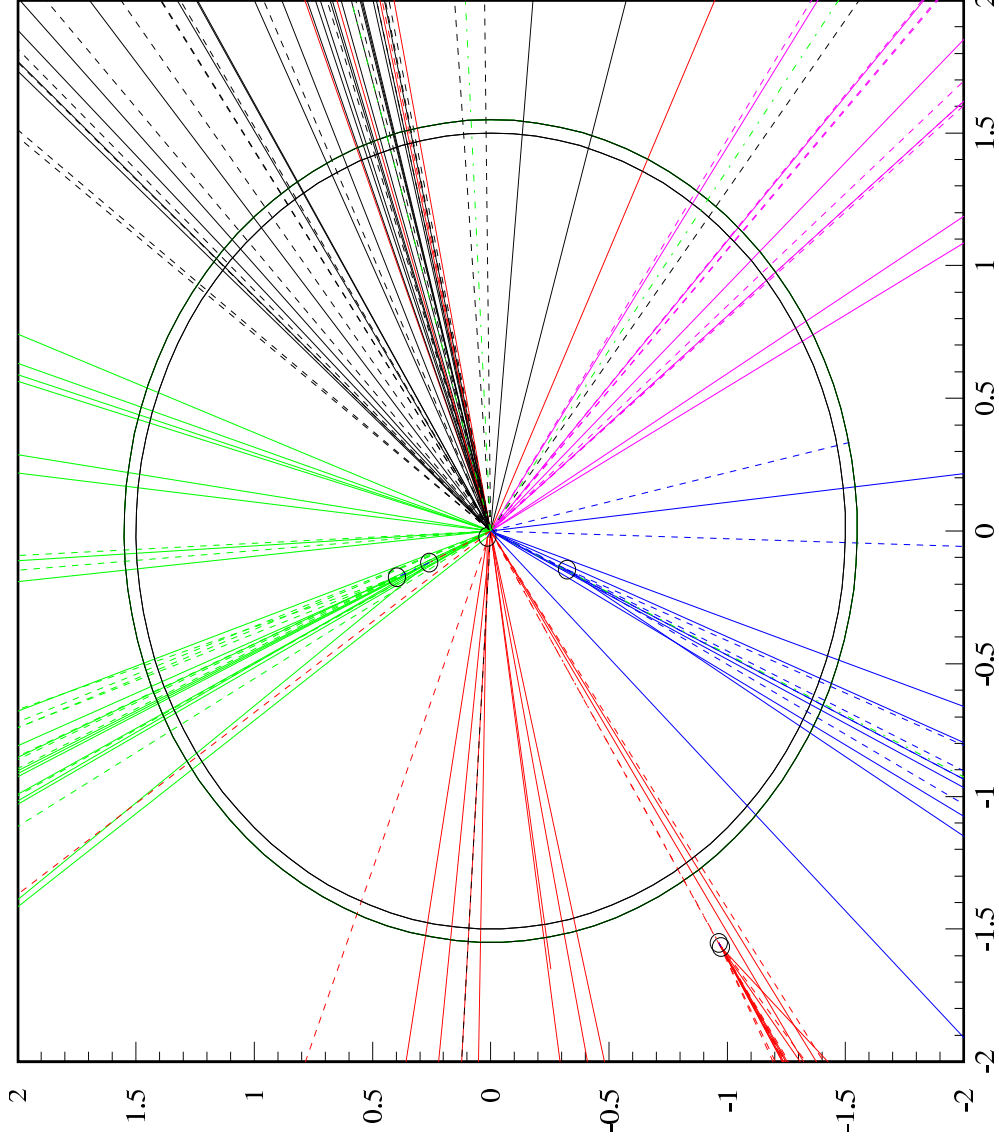


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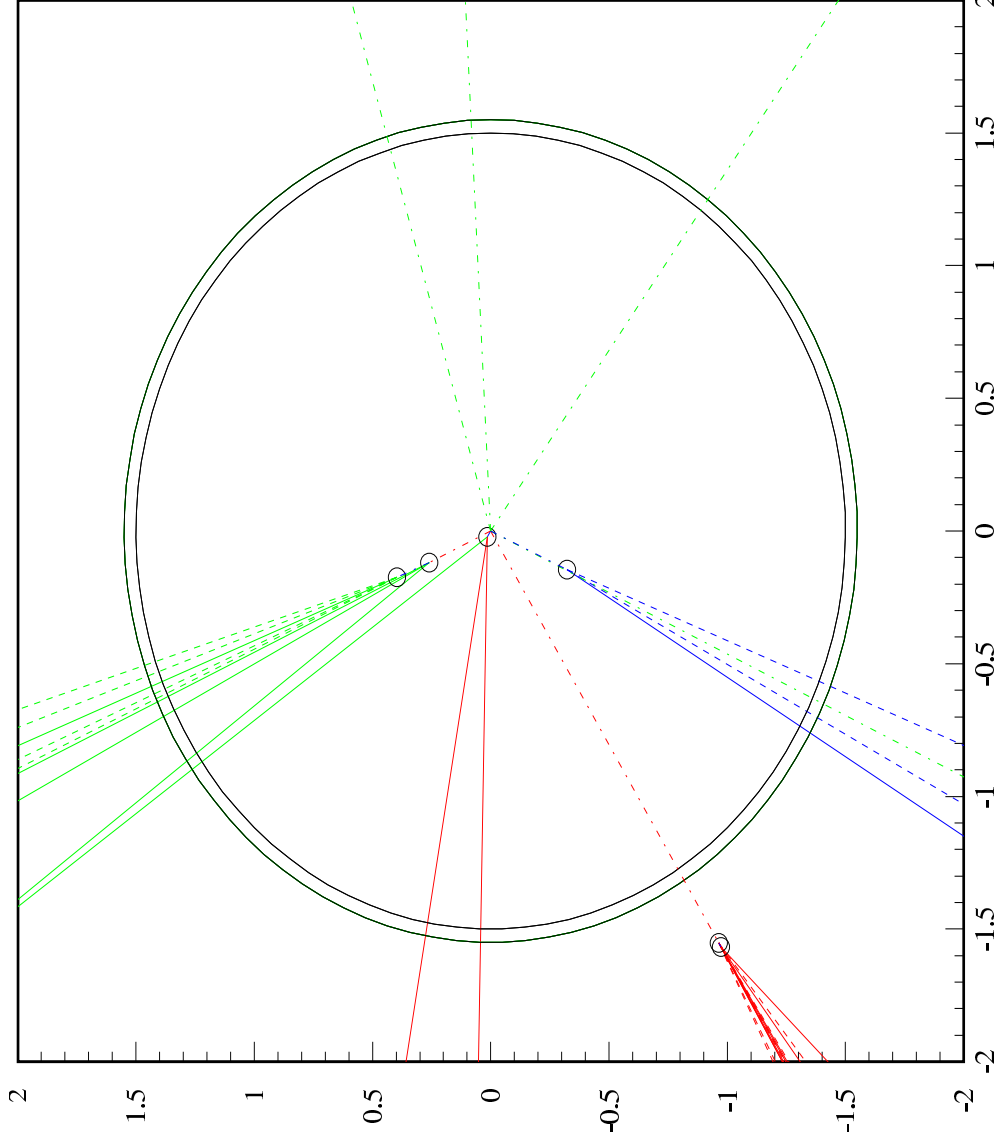




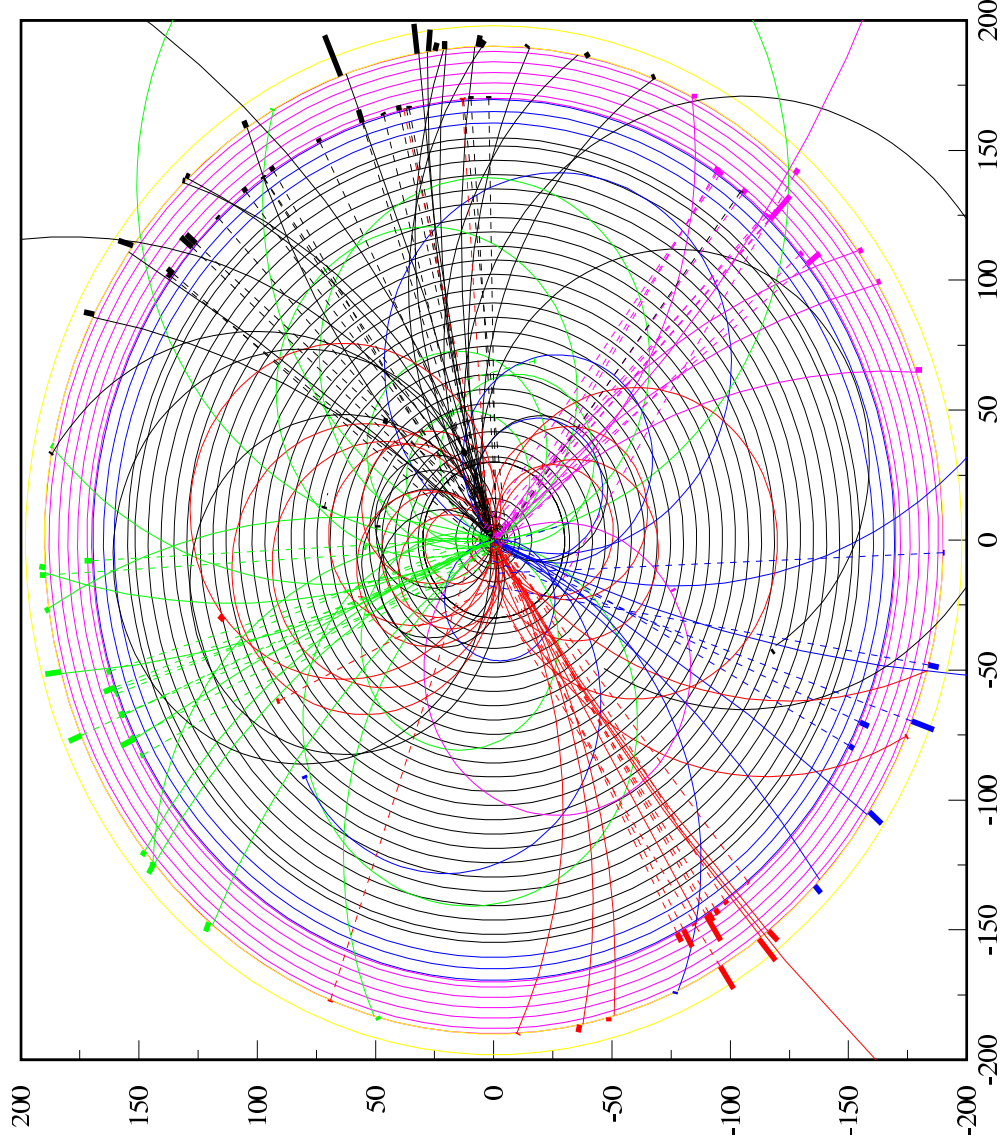
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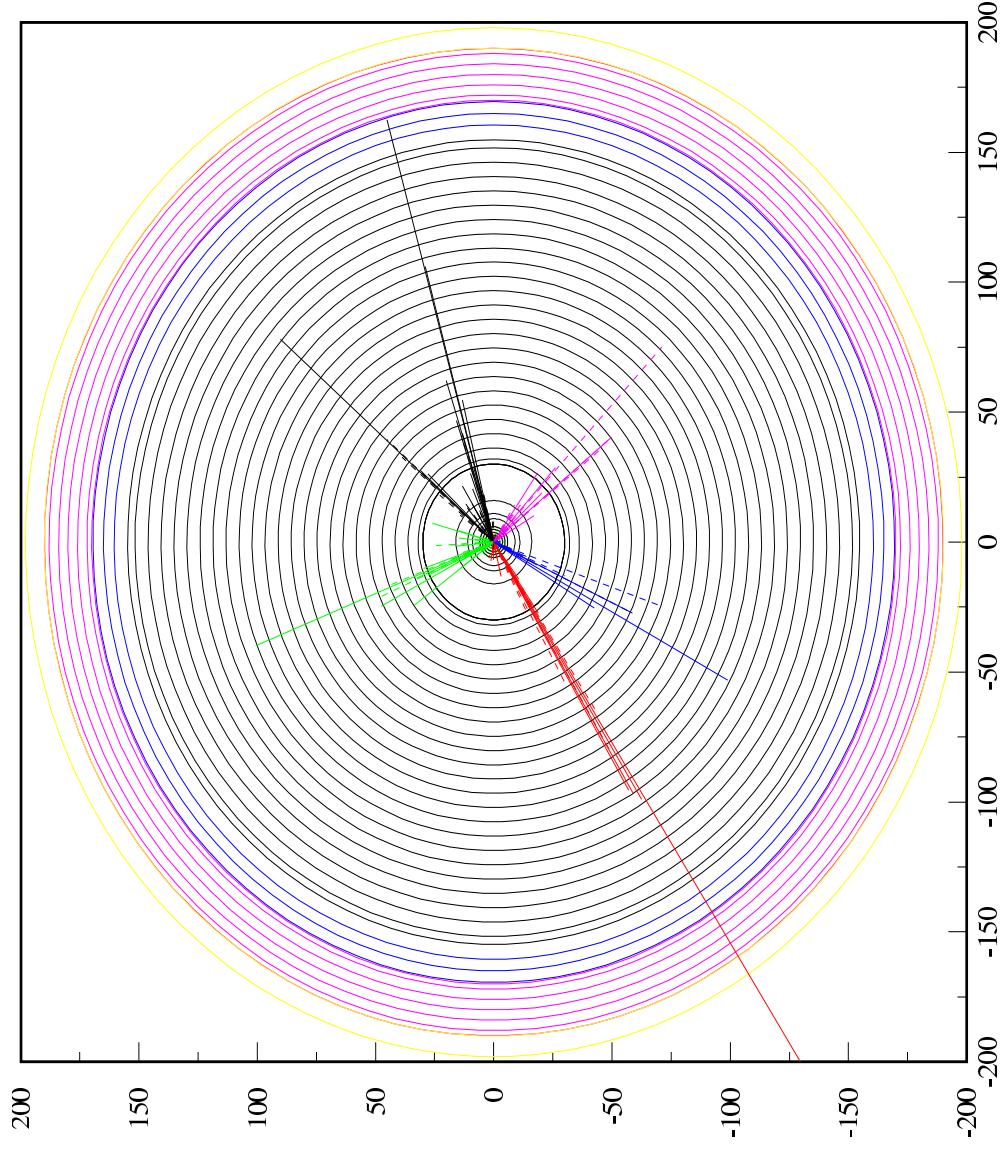
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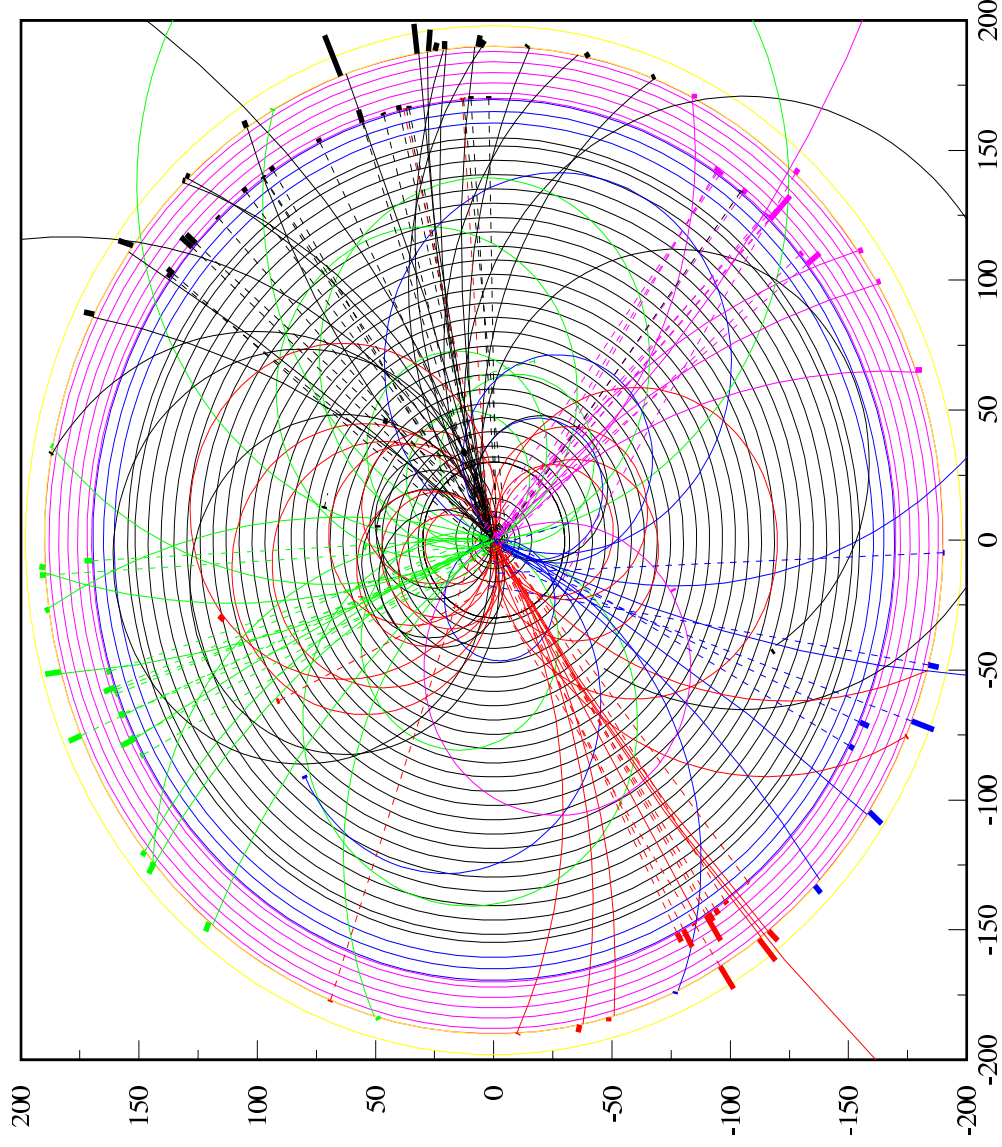
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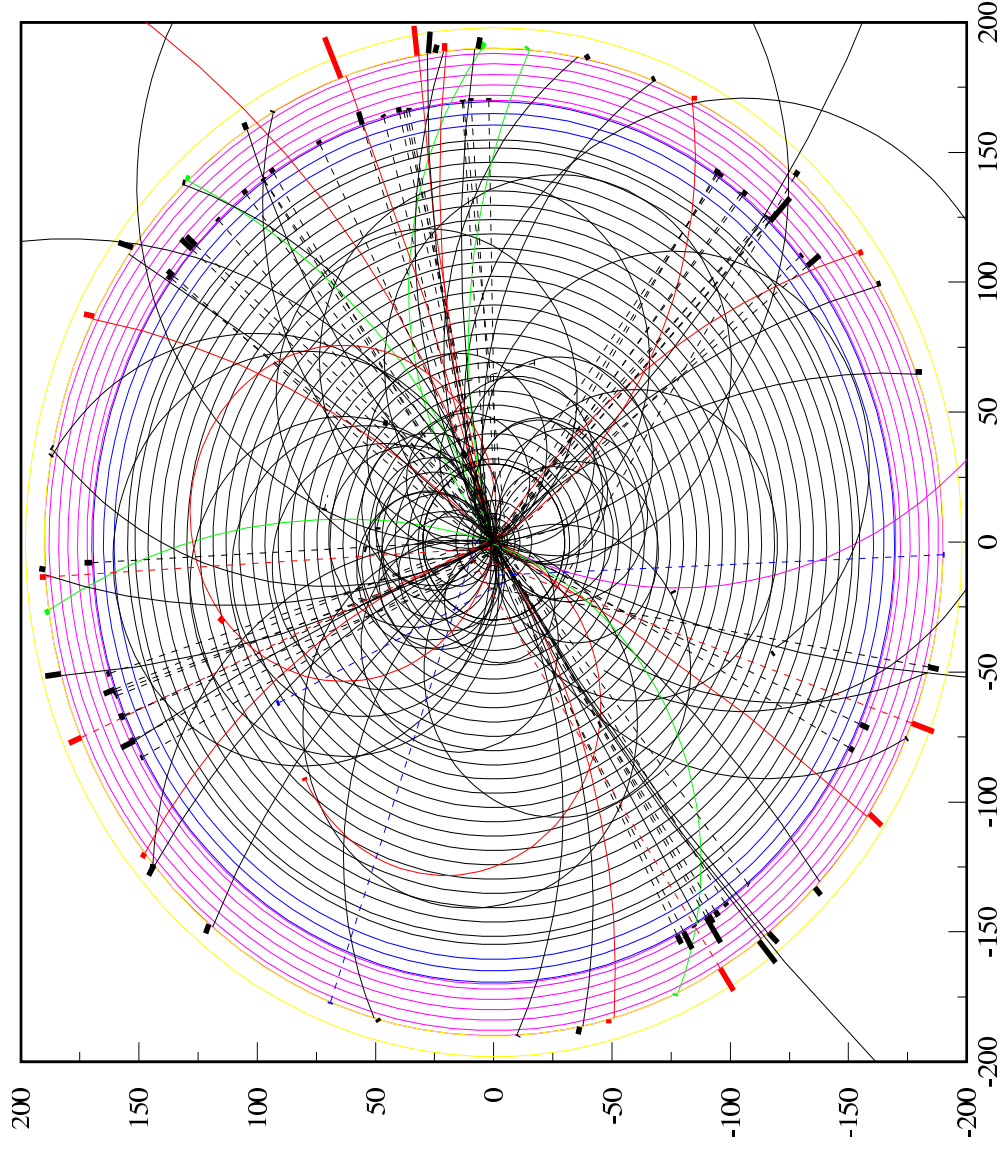
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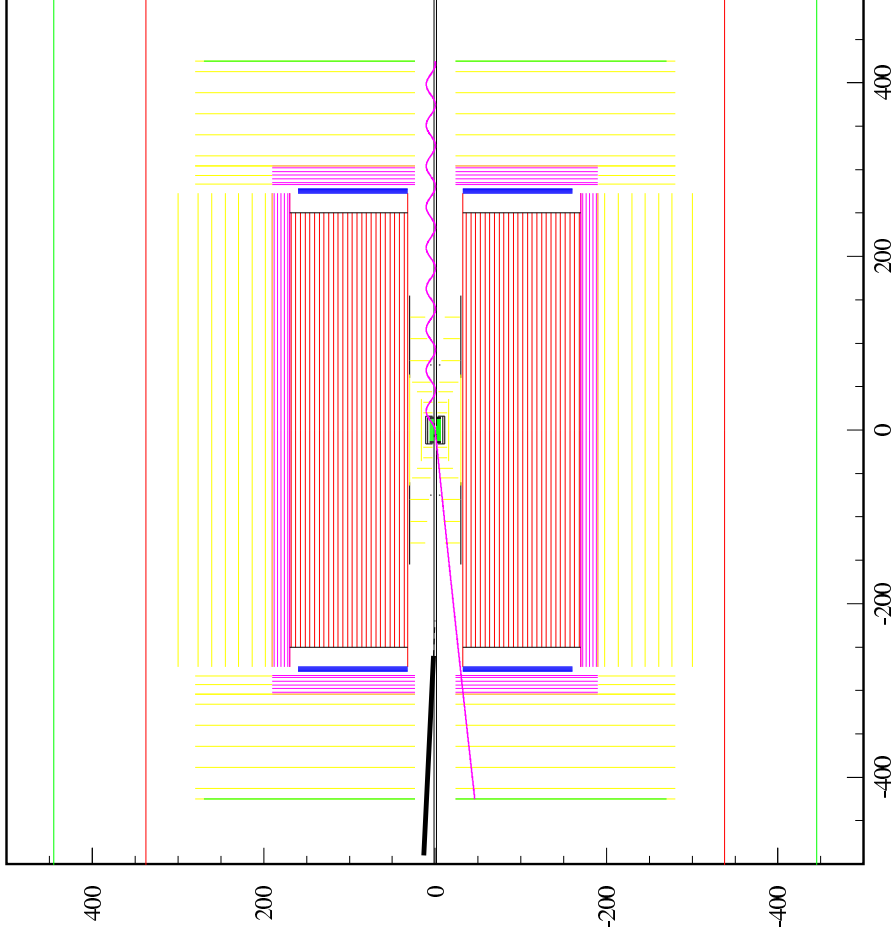
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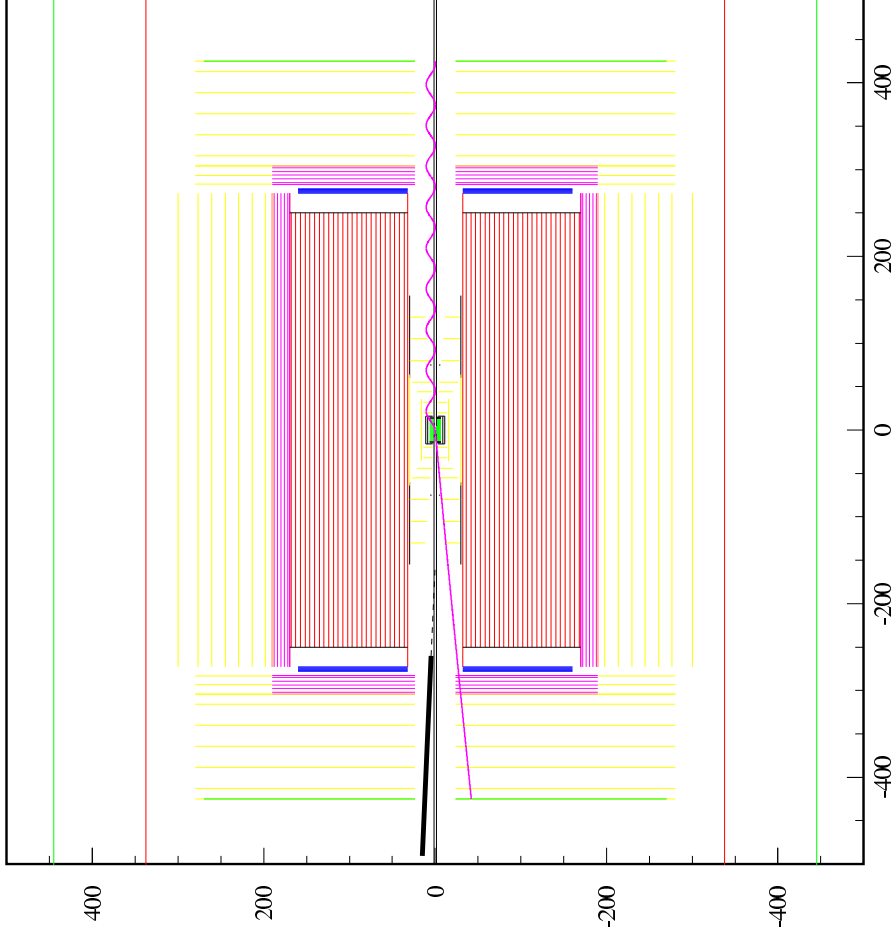


# Crossing-angle (& BDKRC)



- $\gamma\gamma \rightarrow e e \mu \mu$  generated with BDKRC
- Crossing-angle 0 mRad

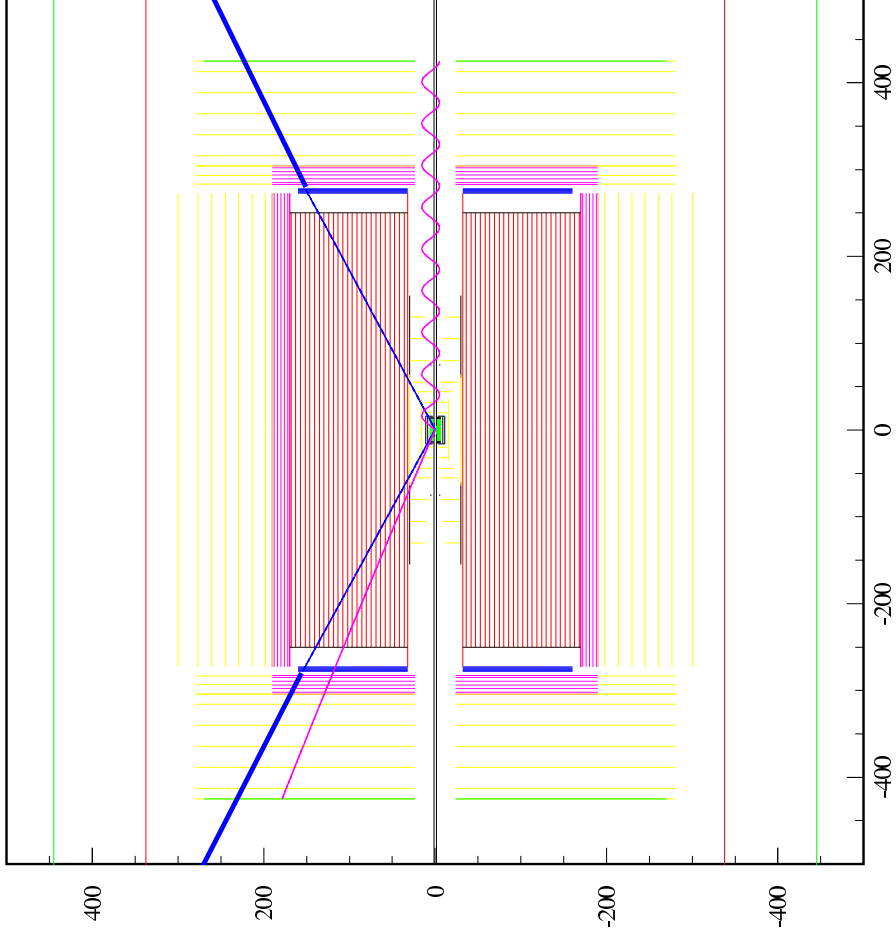
# Crossing-angle (& BDKRC)



- $\gamma\gamma \rightarrow e e \mu \mu$  generated with BDKRC
- Crossing-angle 10 mRad

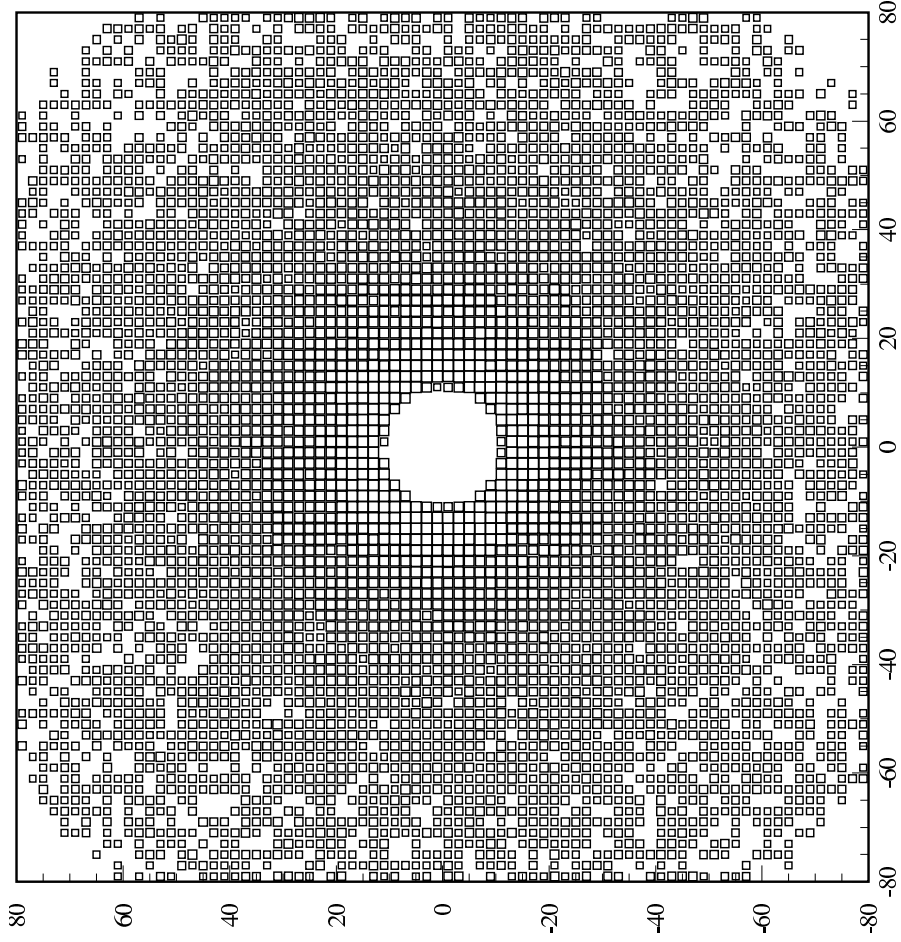


# Crossing-angle (& BDKRC)



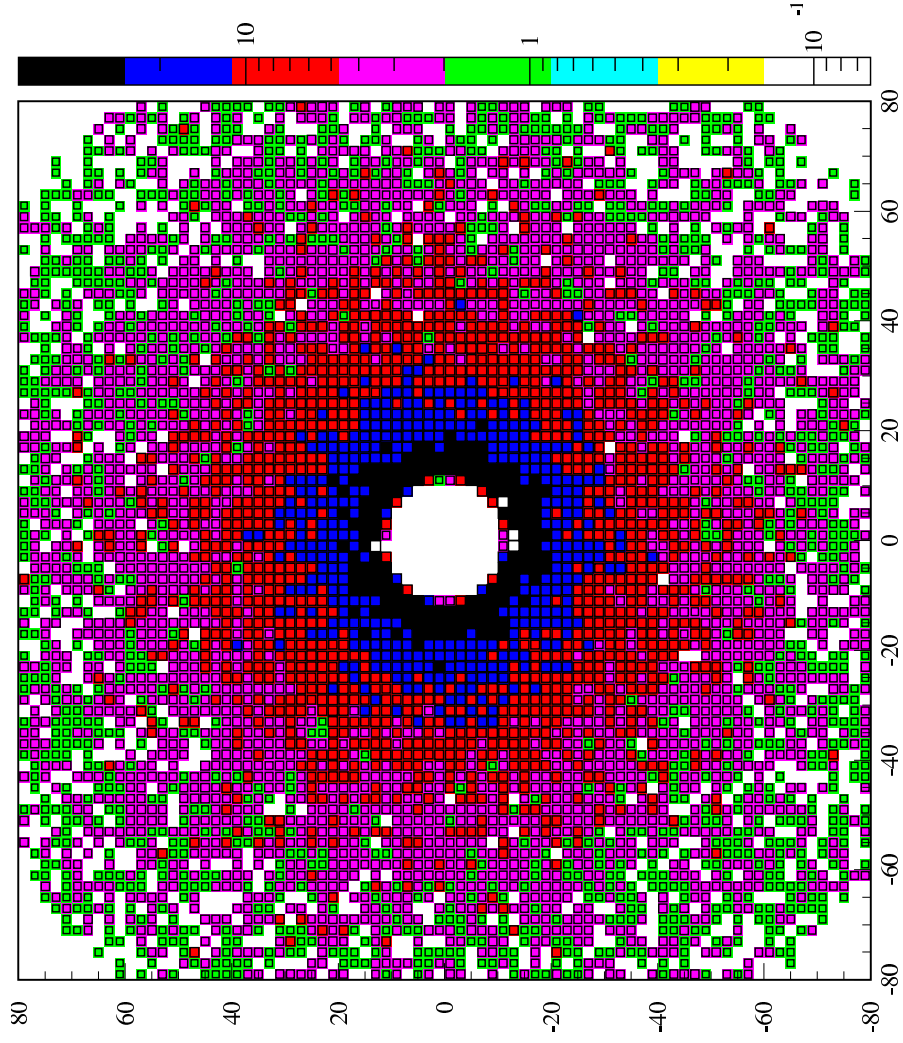
- $\gamma\gamma \rightarrow e e \mu \mu$  generated with BDKRC
- Crossing-angle 500 mRad.

# Crossing-angle and the LCAL



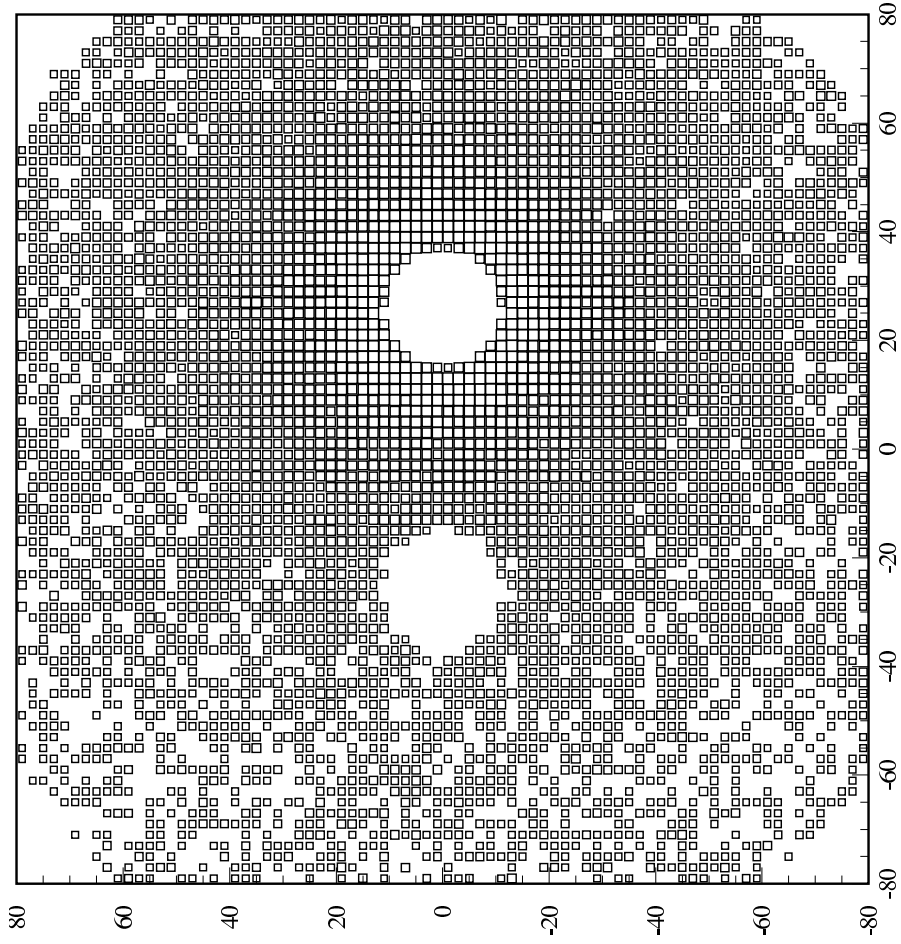
- $\gamma\gamma \rightarrow eeqq$  generated with PYTHIA6
- Crossing-angle 0 mRad.
- Hits in LCAL

# Crossing-angle and the LCAL



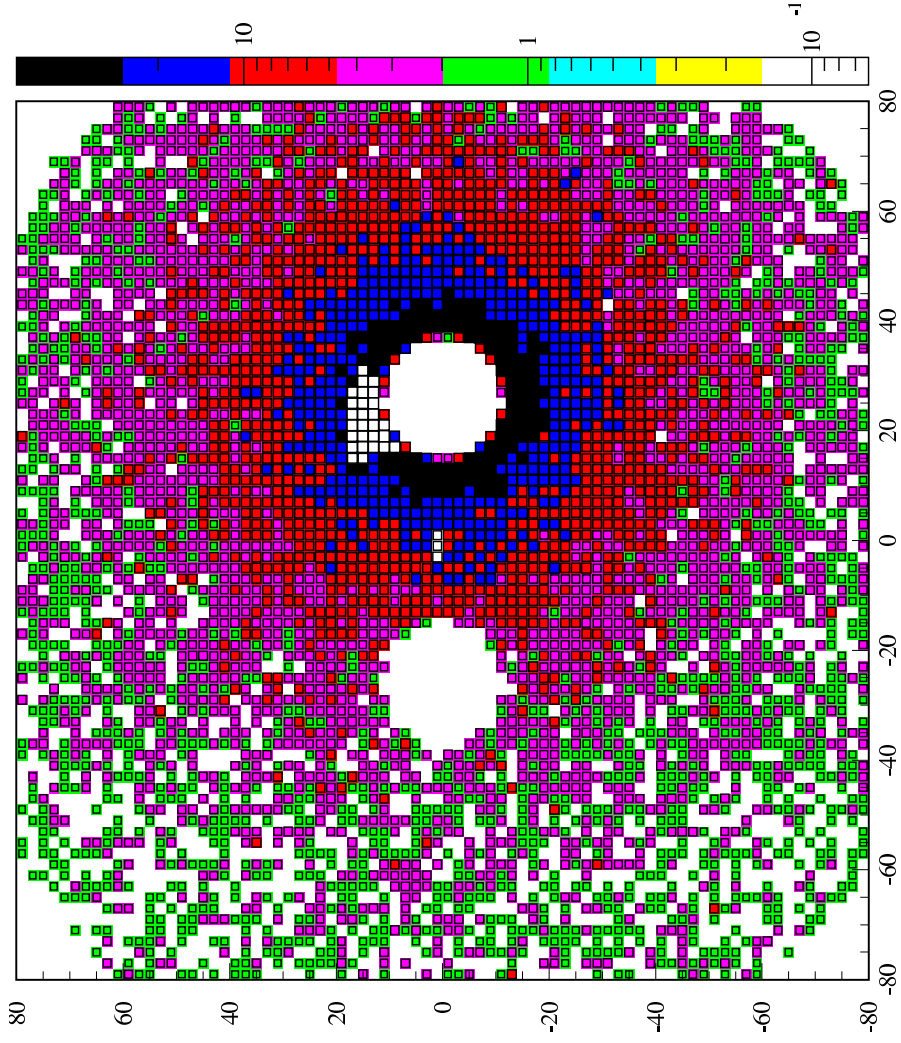
- $\gamma\gamma \rightarrow eeqq$  generated with PYTHIA6
- Crossing-angle 0 mRad.
- Hits in LCAL, and hits seen above beam-strahlung (thanks to A Stahl).

# Crossing-angle and the LCAL



- $\gamma\gamma \rightarrow e\bar{e}q\bar{q}$  generated with PYTHIA6
- Crossing-angle 0 mRad.
- Hits in LCAL

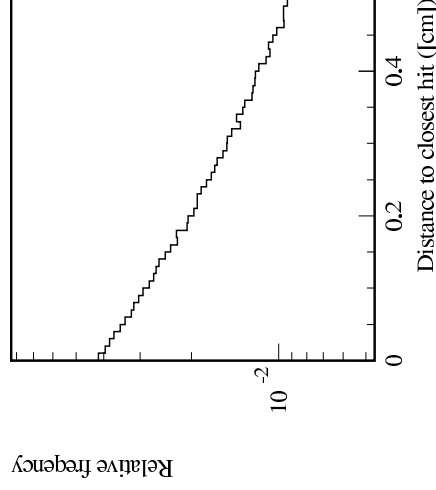
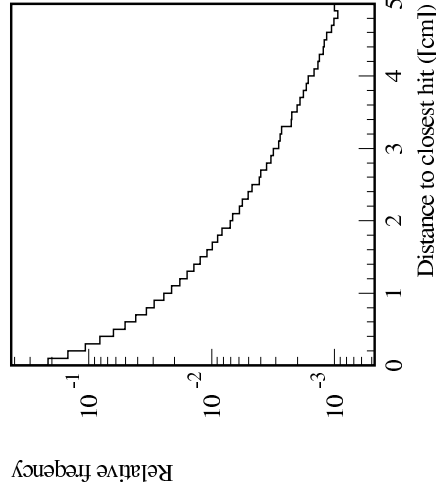
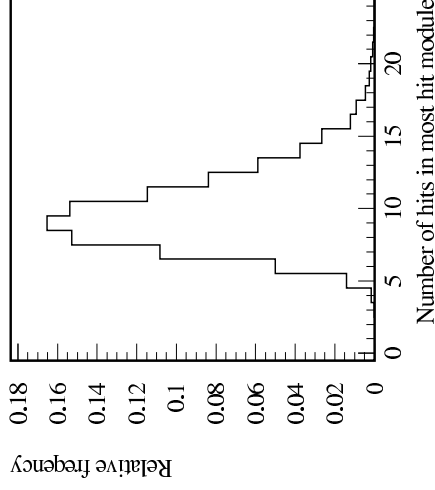
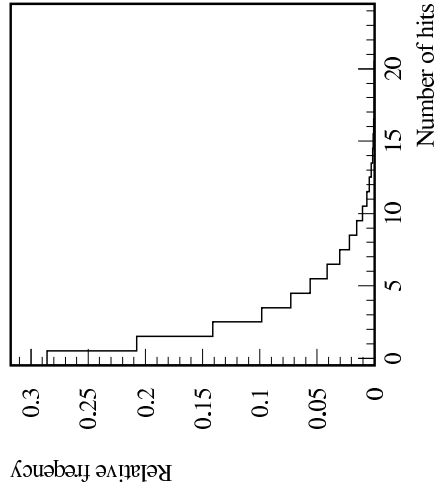
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- Crossing-angle 10 mRad.
- Hits in LCAL, and hits seen above beam-strahlung (thanks to A Stahl).

# Example of hit-simulation: Hit-densities in SIT1

$t\bar{t}$  in SIT1 at 500 GeV



- $t\bar{t}$  events at 500 GeV.  $\tau\tau$  and light  $q\bar{q}$  also studied, and GigaZ.  $t\bar{t}$  at 500 GeV is the worst case.
- SIT 1 is at  $R=16$  cm.
- Studied solution: single long microstrip detectors covers the full  $z$ -range (62 cm). 22 modules in  $\phi$ .

# ***New features coming soon***

- Interface with **ZVTOP** for b-tagging (See next talk).
- **dE/dx** plugin, with the side-effect that all hits will be available.
- Implies a rather complex re-write of the driver for the detector simulation.
- Several options already coded.
- Performance issues to be studied.
- Idem for backward compatibility issues.
- LCIO to be studied
- **New version within one-two months.**

# Getting hold of **SGV**

Down-load from

<http://home.cern.ch/berggren/sgv.html>

LC geometry-files can be found on

<http://home.cern.ch/berggren/lc/lc.html>

Also a pre-installed version in the cern.ch afs-cell (HP-UX, DigitalUnix, Aix and Linux) by executing

</afs/cern.ch/delphi/tasks/sgv/share/pam/sgvenv.sh>



# Summary

- The new release of **SGV** incorporates the bug-fixes that had been pending.
- New features:
  - Event display.
  - Z-dependent TPC errors.
  - Non-zero crossing angles.
  - Hit coordinates.
  - Interface to BDK/BDKRC (weighted event generators).
- Up-coming:
  - **ZVTOP**
  - **DE/dx**
  - **LCIO**