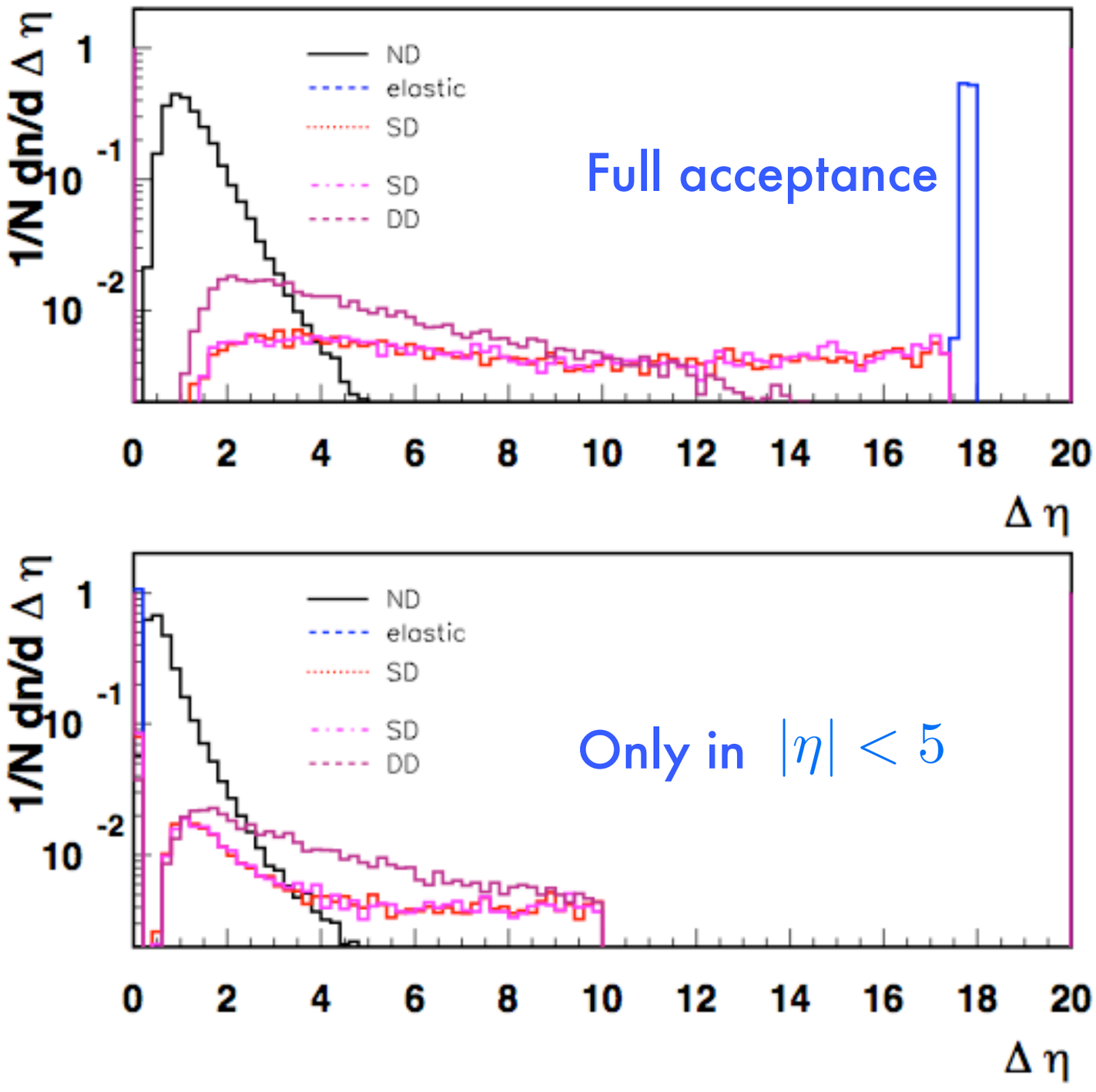
Operational definition for diffraction

- definition of "diffractive" and "non-diffractive" events
  - MC generator definition varies
  - even MC generators without explicit diffraction might generate diffractive like events
  - hadron level definition is needed !
- observation of elastic proton, -> Single diffractive Dissociation (SD)
  - but how to identify Double diffractive Dissociation (DD) ?
  - and Central diffractive Dissociation (CD) (except tagging both protons...) ?
- How to identify "diffractive like" events without p-tagging ?
- No way to tell a diffractive from a non-diffractive event
  - only possible for ensemble !!!

- adopt HERA definition of diffraction: observation of rapidity gaps which are not exponentially suppressed ...
- NOTE: here diffraction is synonym for events with LRG

Largest Rapidity Gap in events

- Search for largest rapidity gap $\Delta\eta$ anywhere between any particles in

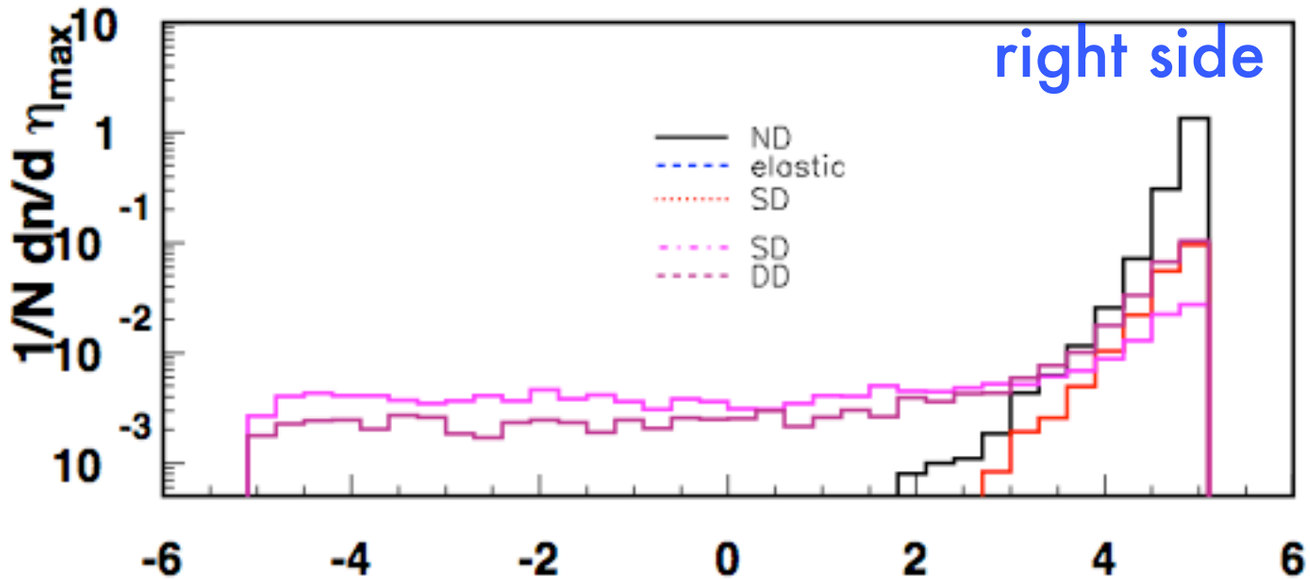


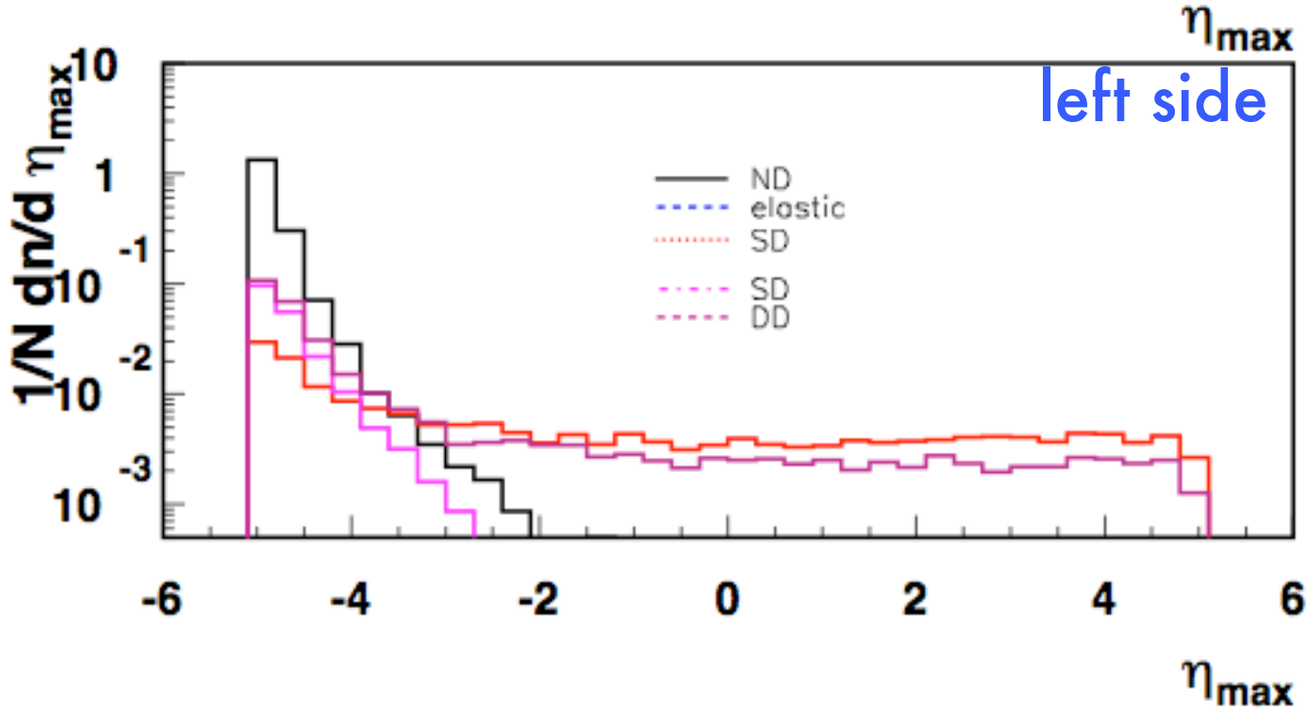
- Clear separation of diffractive events from ND at $\Delta\eta > 3$

- In visible region of $|\eta| < 5$ stilll separation from ND
- gaps are smaller !!!!

Rapidity Gaps in soft diffraction

- η_{max} distributions: maximal η of any energy deposition (any particle !!!)



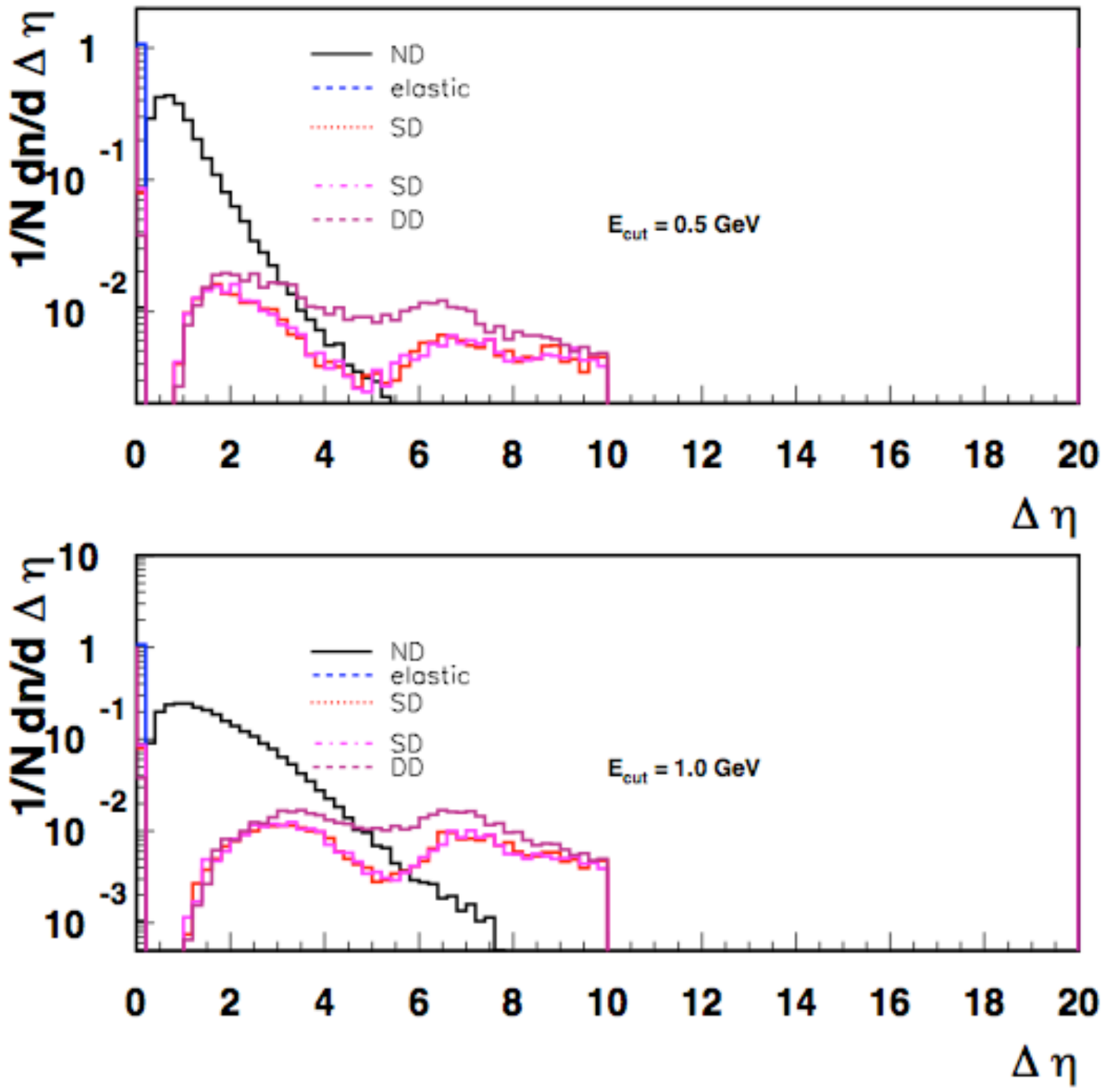


- easiest way to separate diffractive from ND events

- Clear separation of non-diffractive from "diffractive" events at large η_{max}

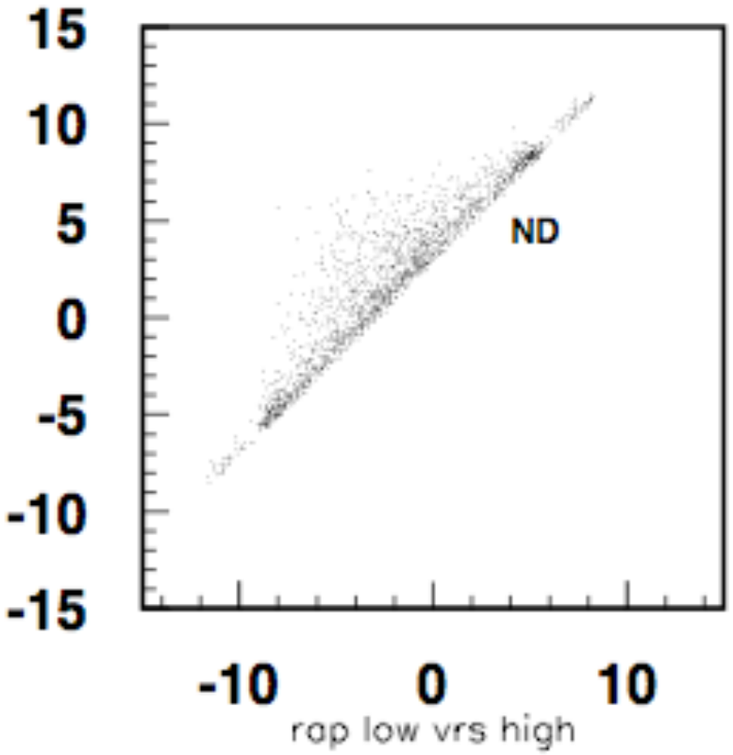
Largest Gap: dependence on energy cut

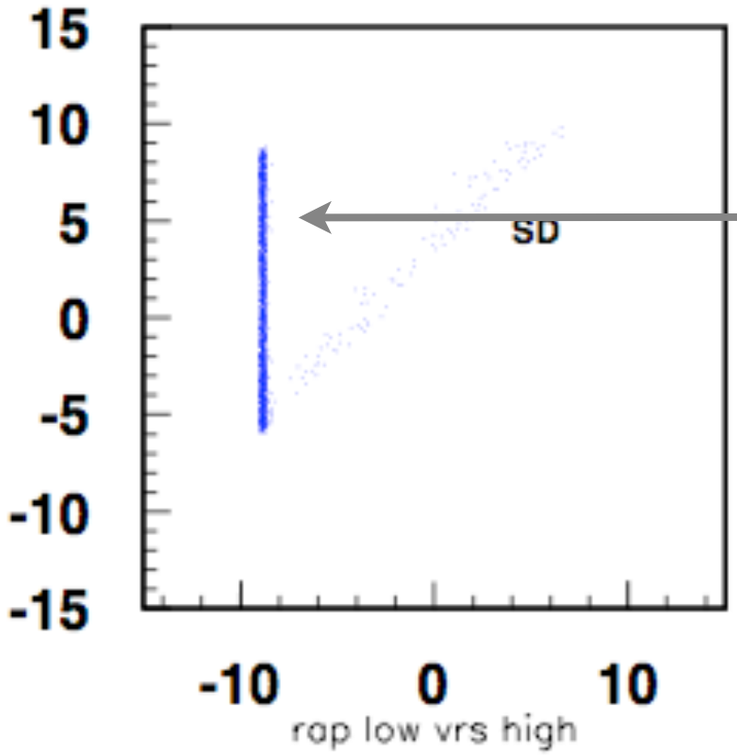
- energy cut on individual particles changes η_{max} and $\Delta\eta$ distributions

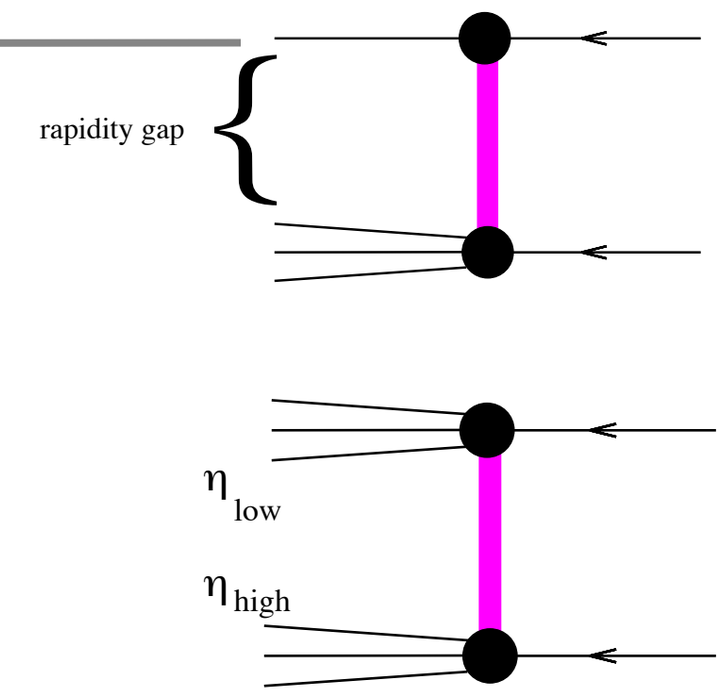


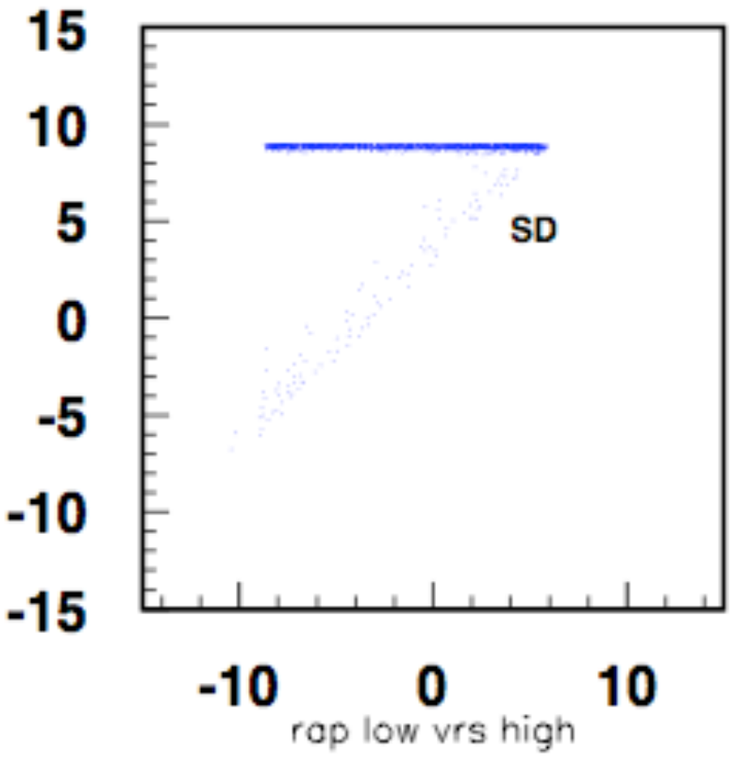
- with increasing Ecut on particles, gap becomes larger...
- separation only at larger gaps possible.
- needs to be checked with realistic detector simulation

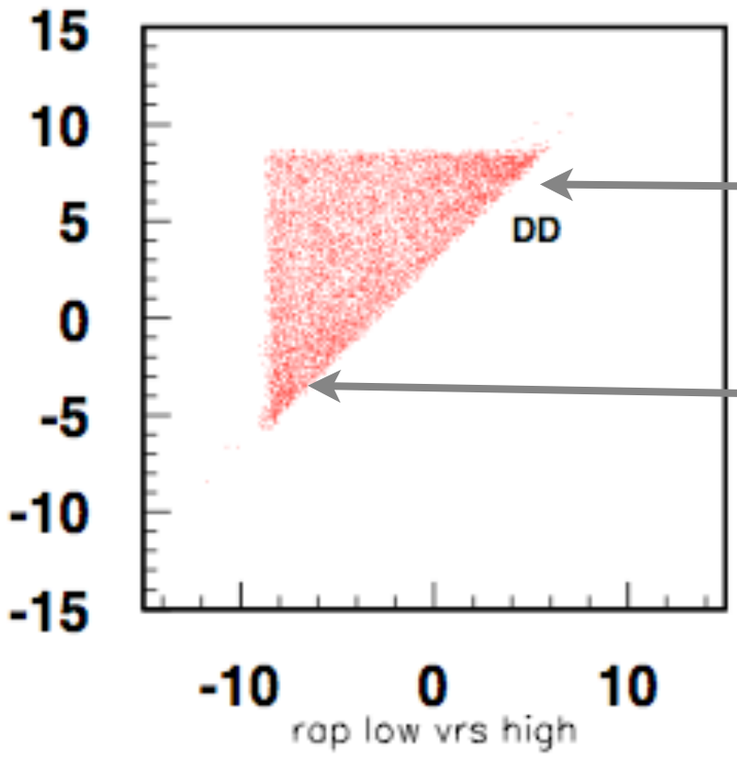
Identify where the Gap $\Delta\eta$ is ...

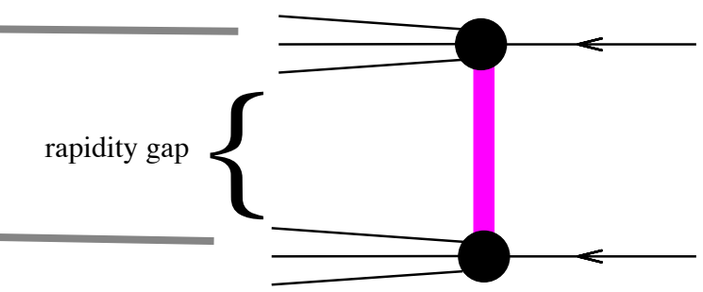






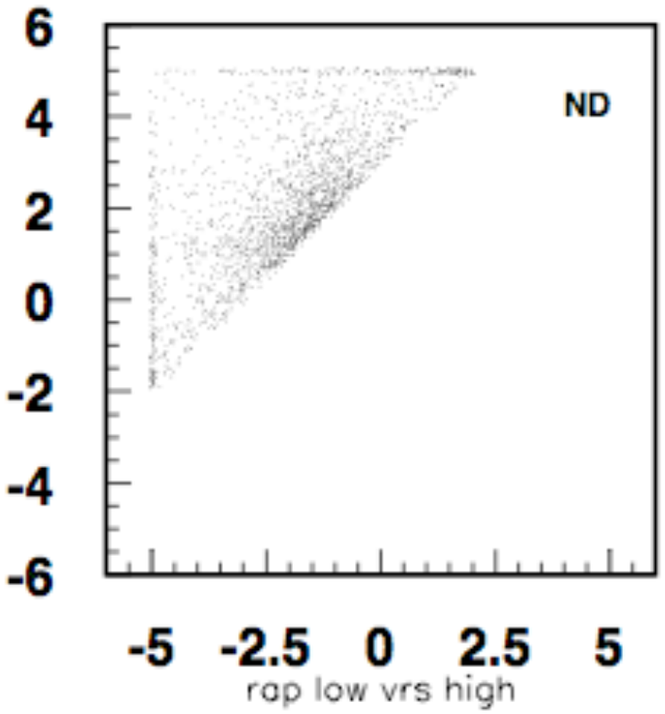


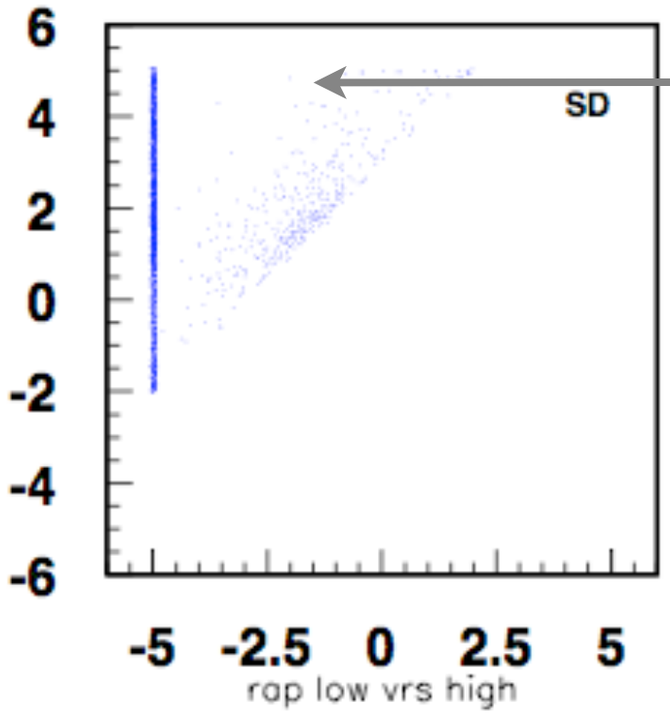


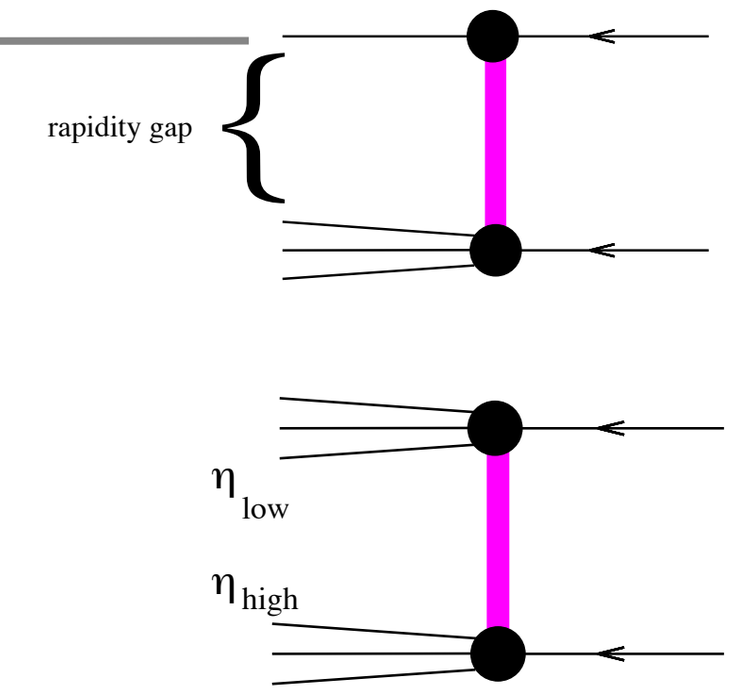


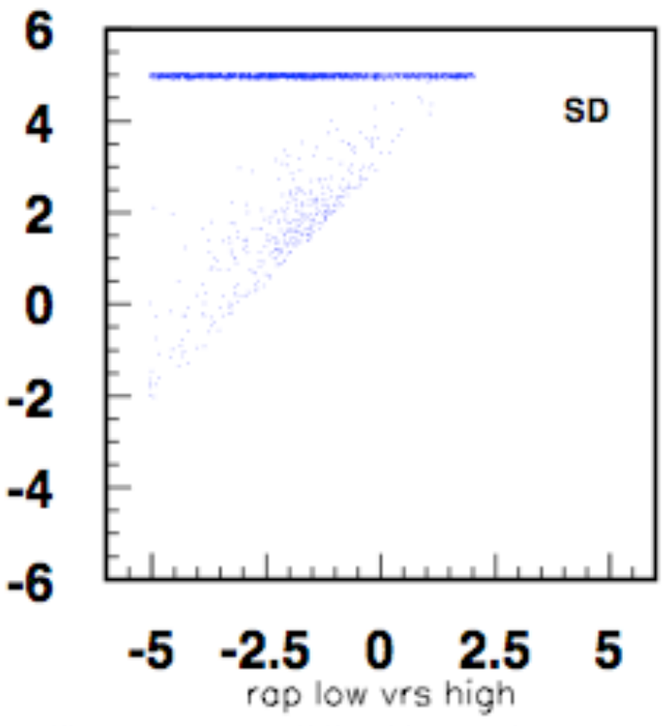
Identify where the Gap $\Delta\eta$ is ...

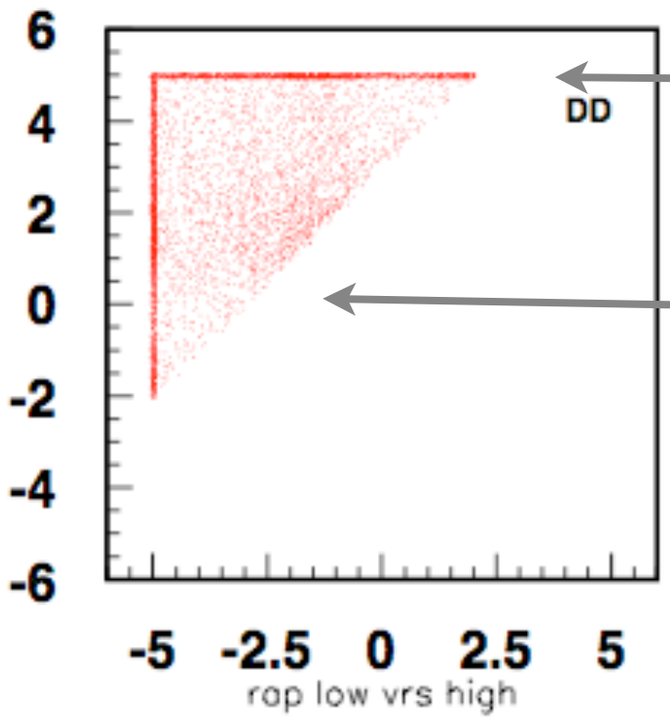
- Now looking only in the visible region of $|\eta| < 5$

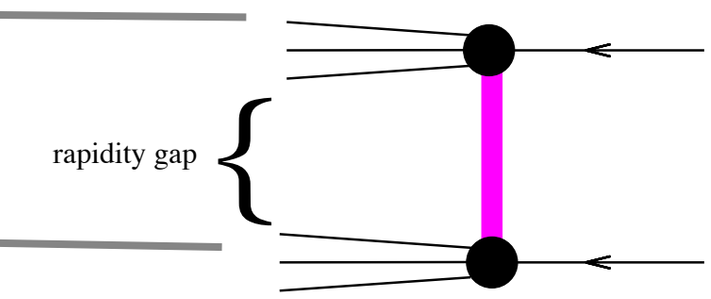












- DD events can be identified with a gap between fwd and bwd hits.... (obviously!)

Conclusion

- rapidity gap definition allows generator independent definition
  - rapidity gap depends on actual energy cut
- rapidity gap allows to identify single diffractive dissociation (SD) as well as double diffractive dissociation (DD)
- rapidity gap also allows to identify non-diffractive events: $\Delta\eta < 3$
- rapidity gap definition works in all environments: ep, pp and ee
- rapidity gap definition can be applied to both soft and hard "diffractive" events