Hard Diffraction in ATLAS
SD JJ Feasibility Studies

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Forward Detectors

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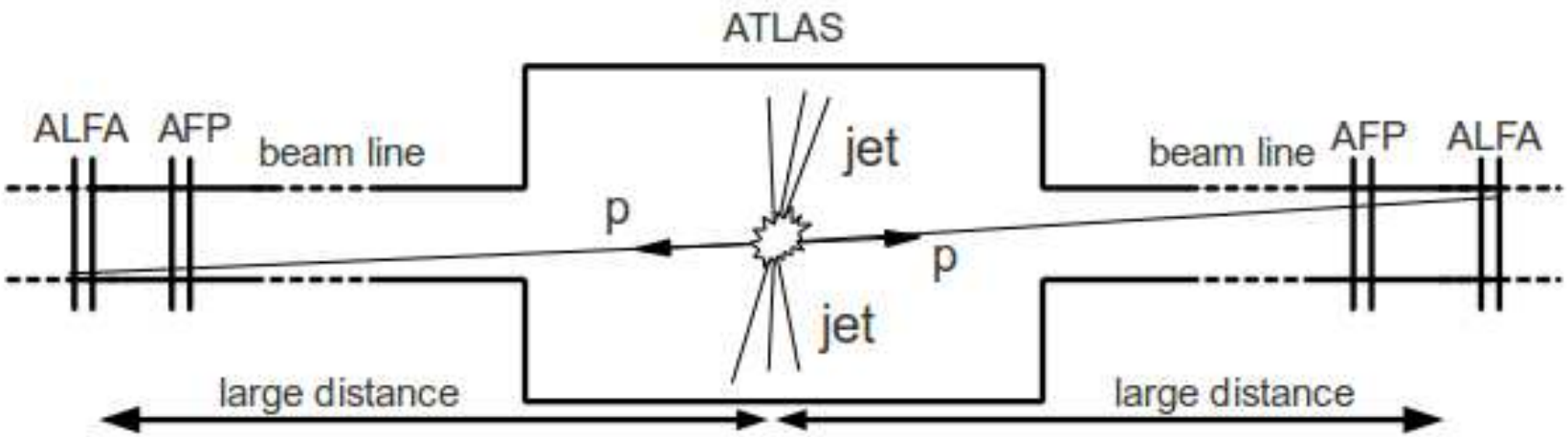
Intact protons – natural diffractive signature.



ALFA

- exists, 240 m from ATLAS IP
- elastic scattering
- special runs (high β^* optics)
- position detectors
- vertically inserted Roman Pots

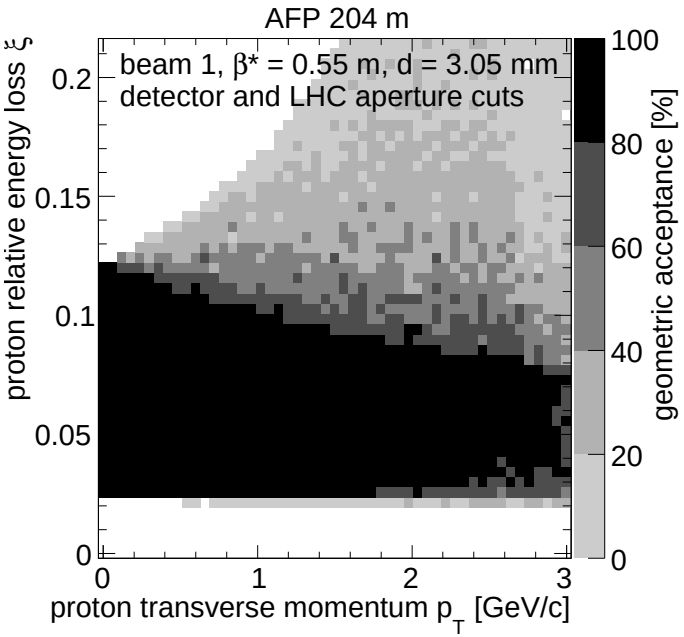
- soft events, pile-up background

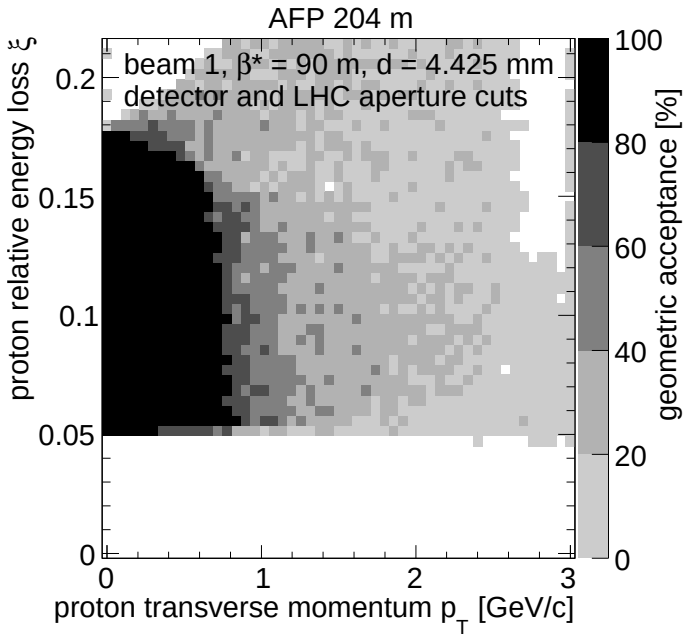
AFP

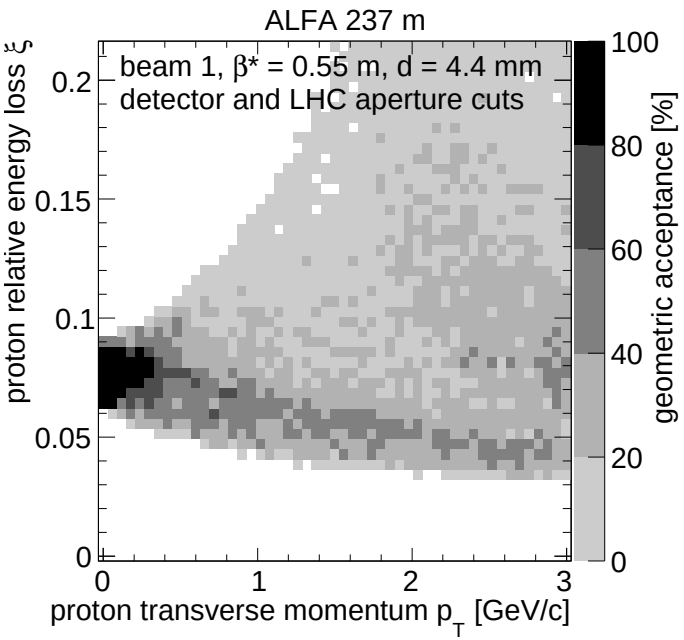
- planned, 210 m from ATLAS IP
- hard diffraction
- nominal runs (collision optics)
- position and timing detectors
- horizontally inserted RP

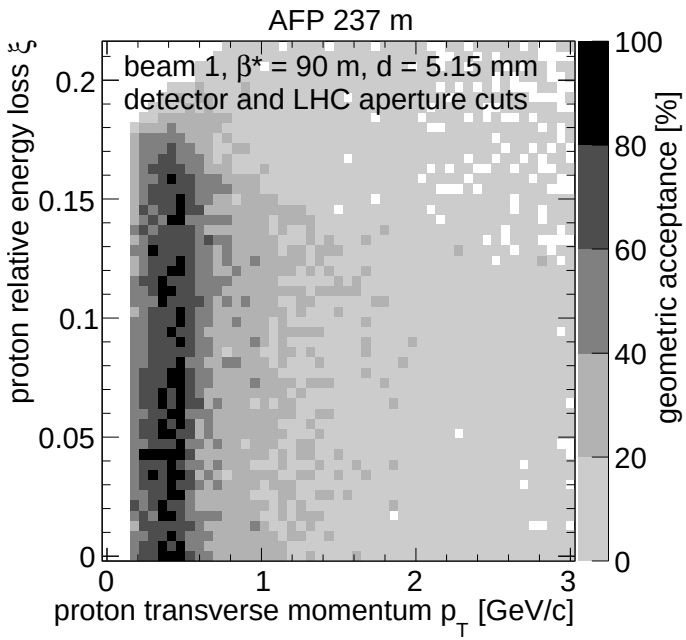
- proton detector for hard events

Detector Acceptance









Top:
AFP

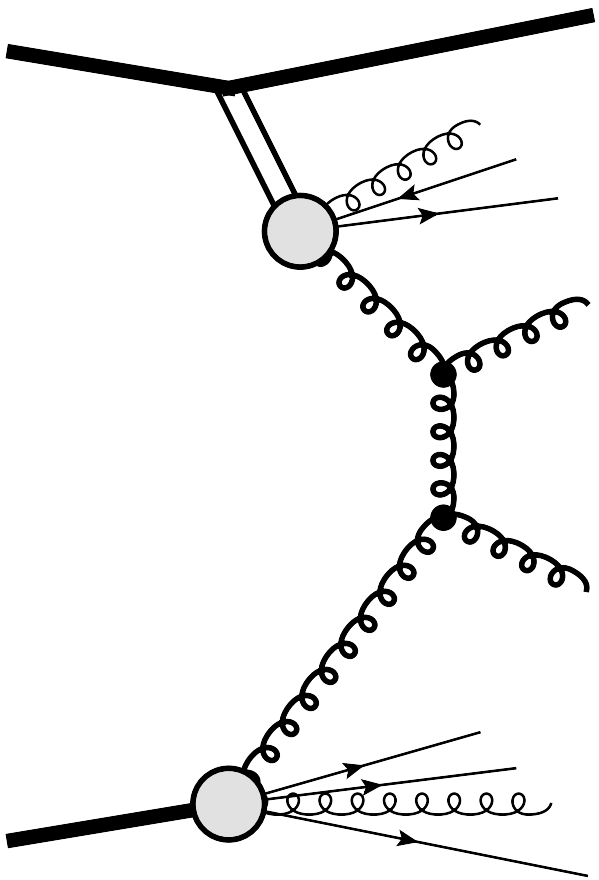
Bottom:
ALFA

Left:
$\beta^* = 0.55$ m
d = 15 σ

Right:
$\beta^* = 90$ m
d = 7.5 σ

SD JJ Production

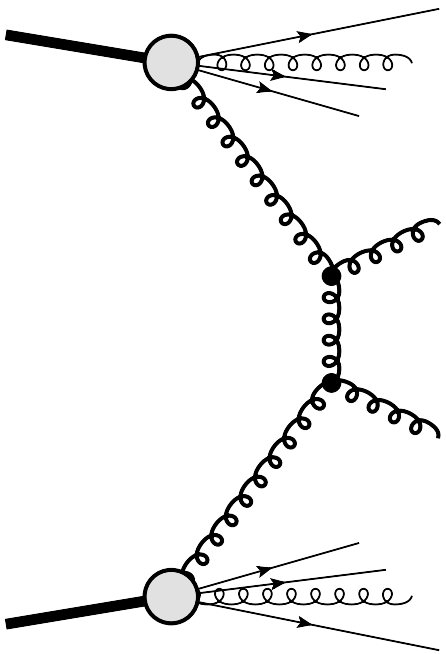
Motivation



- Measure cross section and gap survival probability.
- Current approach (in ATLAS): reconstruct gap in central detector.
- Possible analysis: proton tagging.

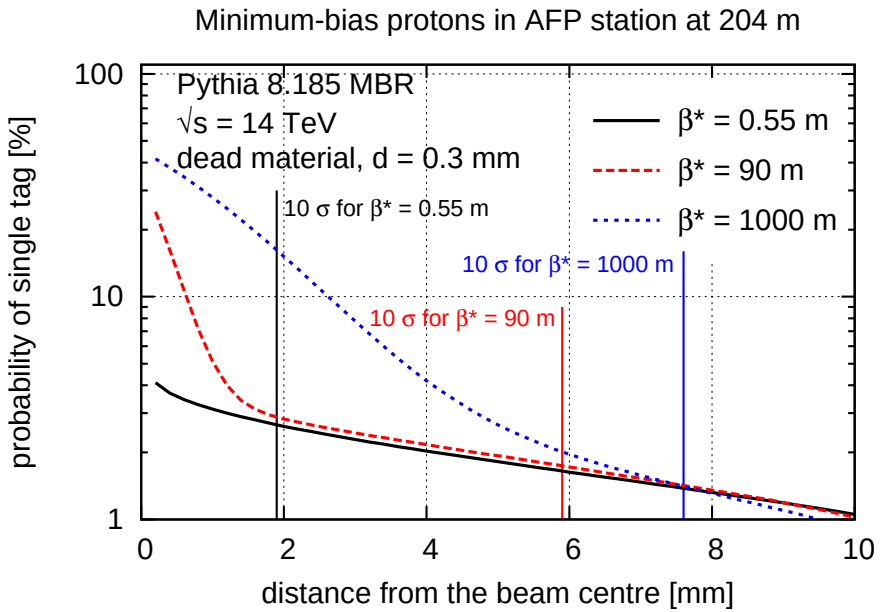
Background

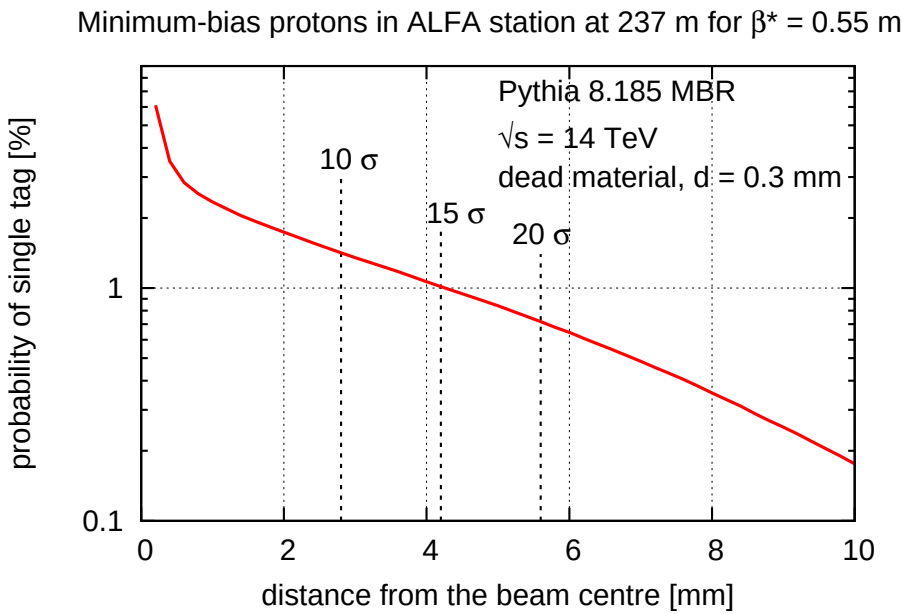
Non-diffractive jets
+ pile-up



Non−difftactive Production

Soft single tag probability





Cuts:

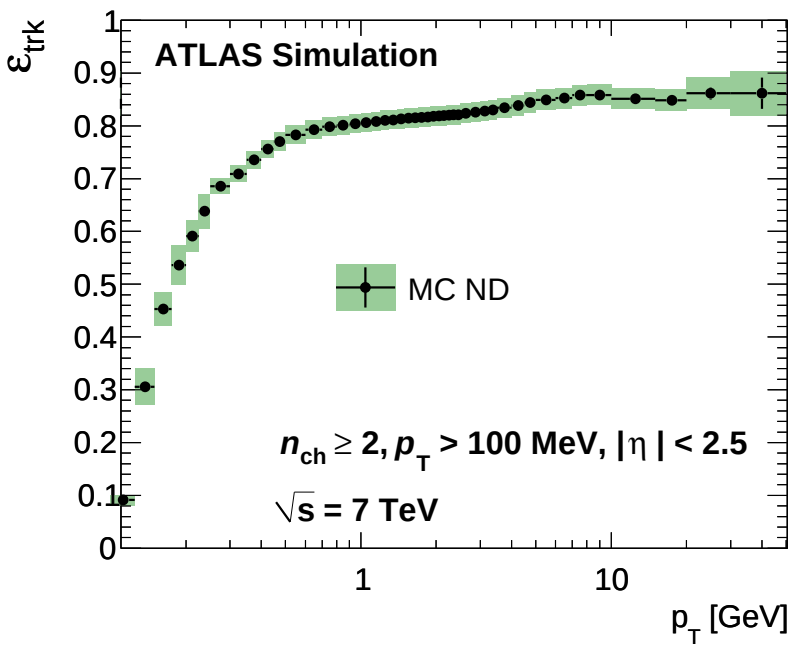
- proton in AFP/ALFA,
- one reconstructed vertex.

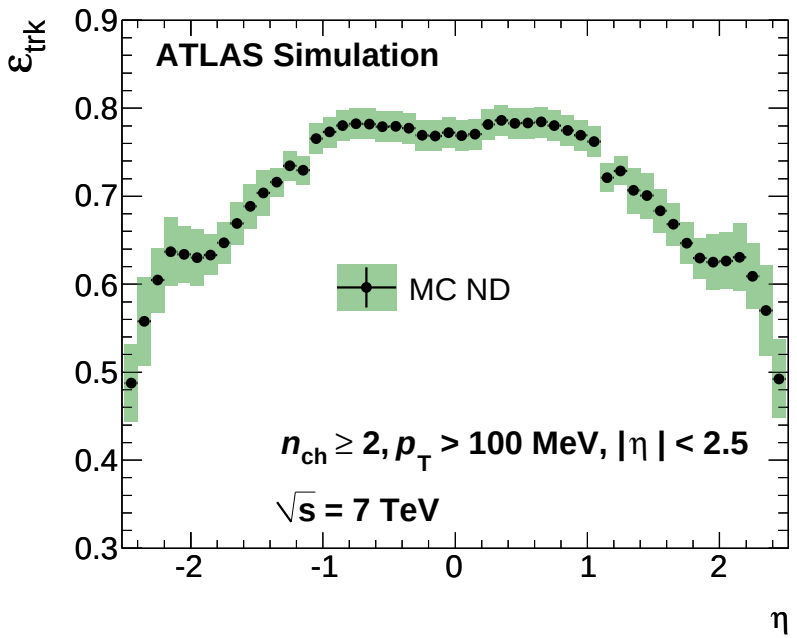
One Vertex Requirement

Two inefficiency sources:

- soft vertex is merged with a hard one ($\Delta z = 1.5$ mm),
- not enough reconstructed tracks pointing to the soft vertex ($n_{trk} = 4$).

ATLAS – track reconstruction efficiency:



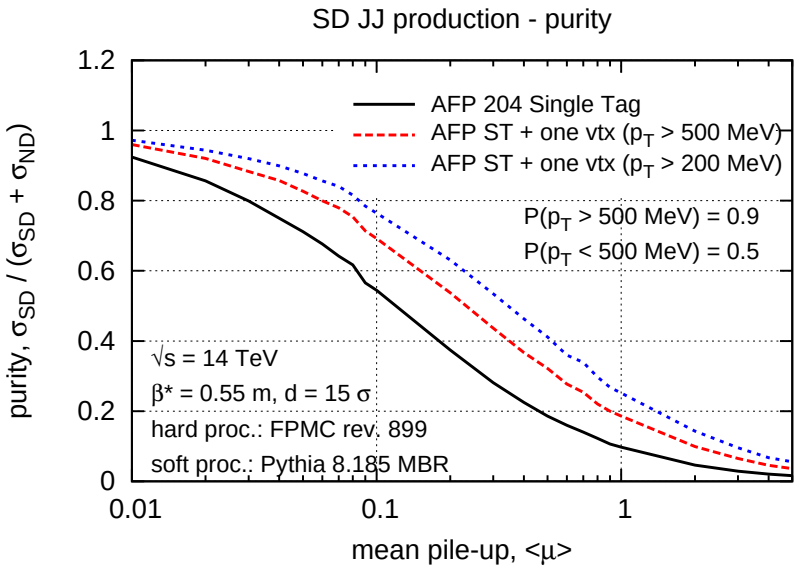


Proposed approach:

$P(200 < p_T^{trk} < 500 MeV) = 0.5$,

$P(p_T^{trk} > 500 MeV) = 0.9$.

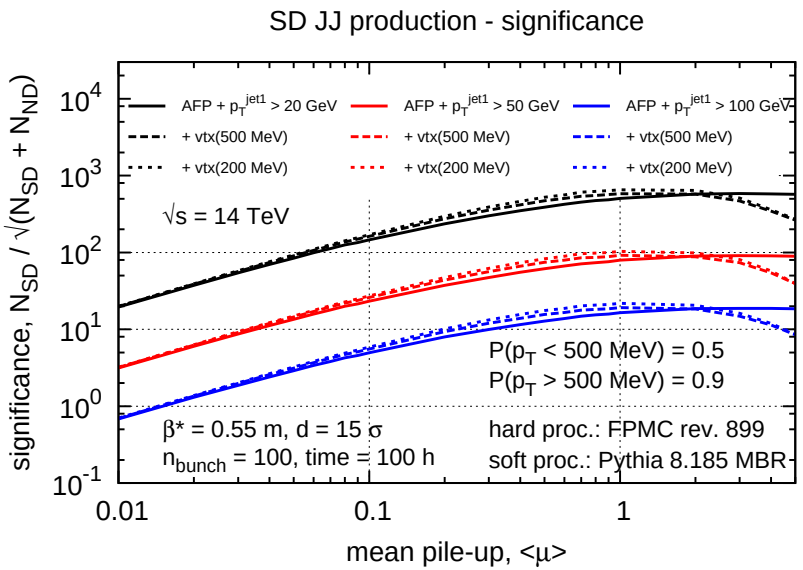
SD JJ in AFP

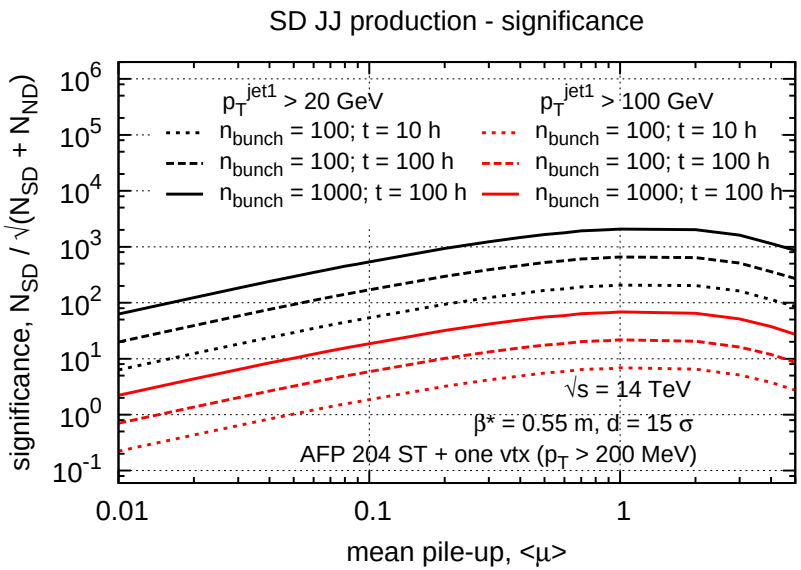


$\sqrt{s} = 14$ TeV, $\beta^* = 0.55$ m
distance from the beam $= 15\ \sigma$

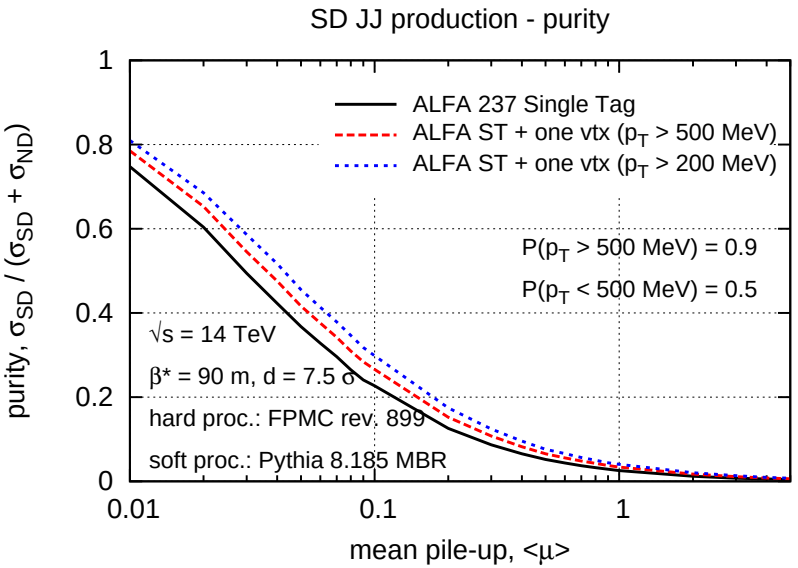
purity depends on the min p_T of reconstructed track (pile-up vtx recognition)

high significance for jets with p_T up to 100 GeV



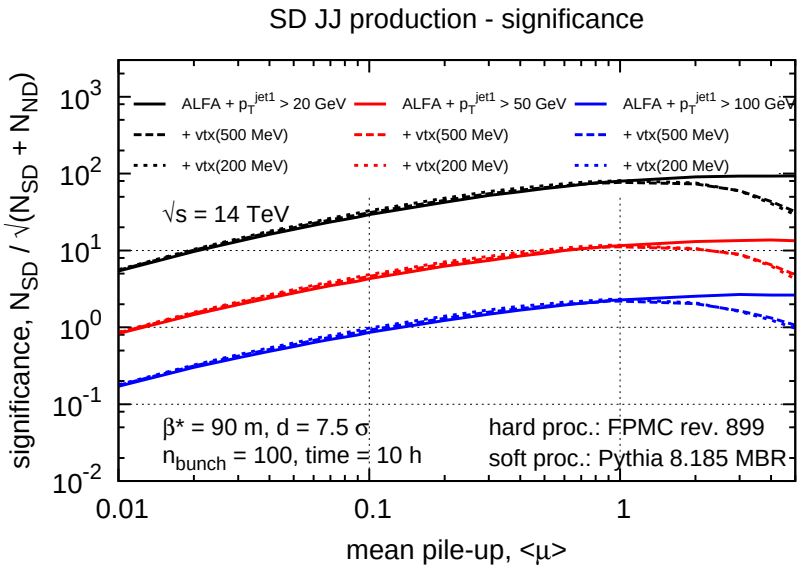


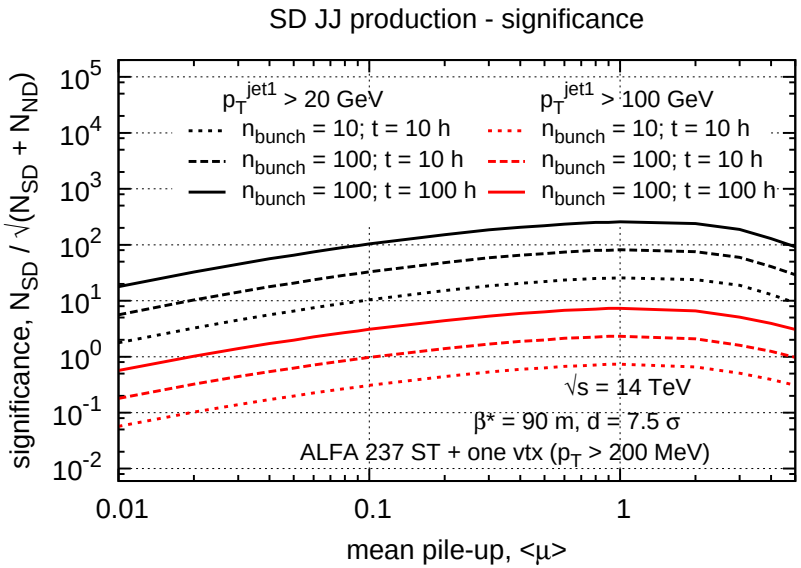
SD JJ in ALFA



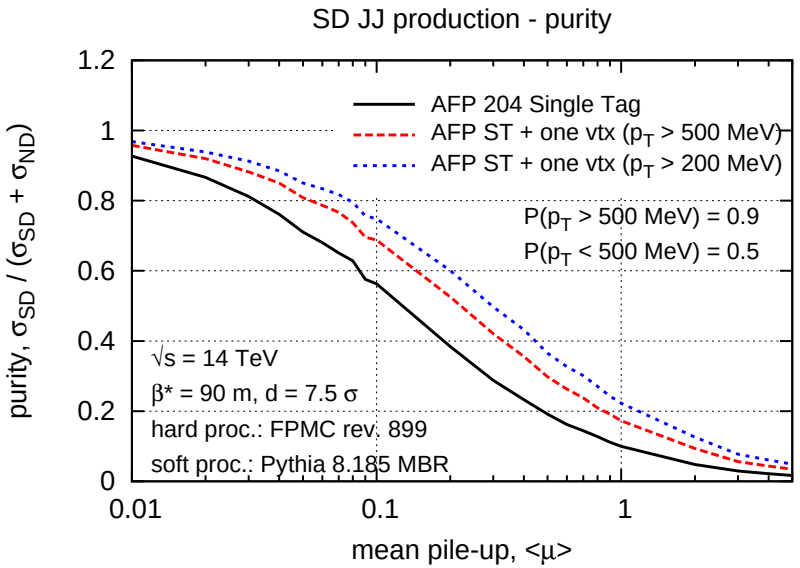
$\sqrt{s} = 14$ TeV, $\beta^* = 90$ m
distance from the beam $= 7.5\ \sigma$

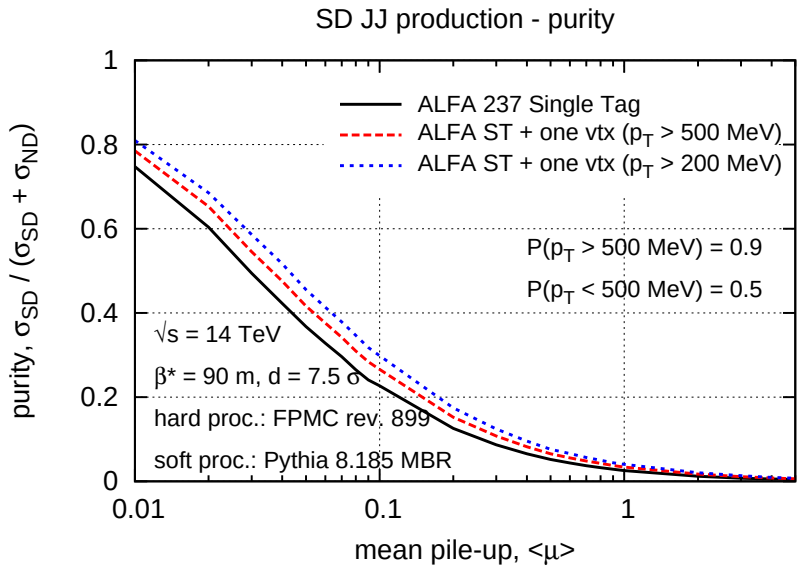
high significance for jets with p_T up to 50 GeV

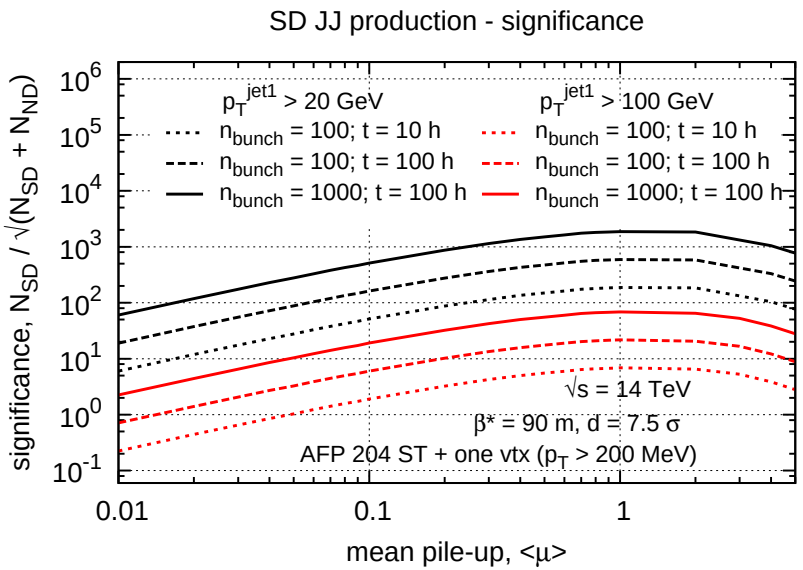


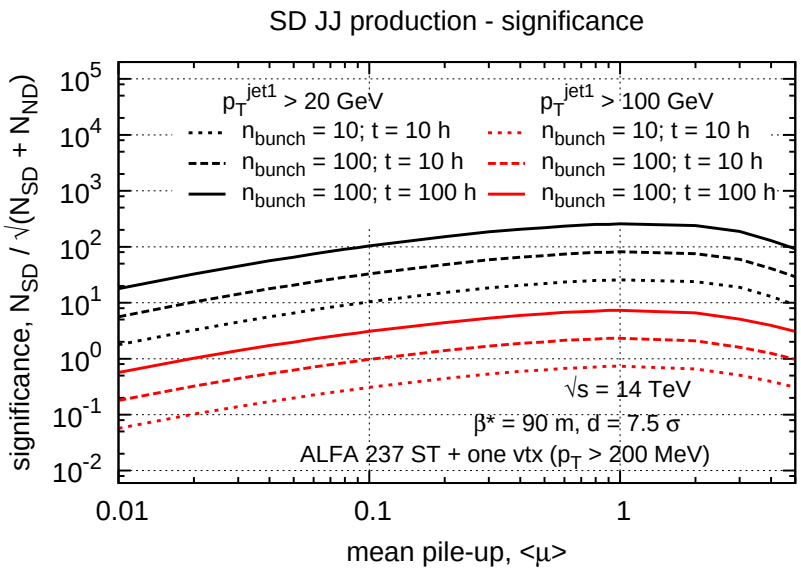


SD JJ – AFP vs. ALFA









Summary

Summary

- Example of Section "Predictions for the Future LHC Runs" of Chapter 4 was shown.
- From the presented one can have a feeling:
  - which running conditions (pile-up, luminosity) are needed,
  - about the (possible) measurement significance.
- Cut flow:
  - single tag + one vertex for the Single Diffractive processes (SD JJ, SD W, SD Z, SD JGJ, SD γ+jet),
  - double tag + one vertex + timing (if possible) for the Double Pomeron Exchange productions (DPE JJ, DPE W, DPE Z, DPE JGJ, DPE γ+jet).
- Various optics scenarios could be studied.
  For now the plan is to include $\beta^* = 0.55$ m and $\beta^* = 90$ m (with and without crossing angle).

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