Expected b-tagging performance for ATLAS in LHC Run 2

**Basic b-tagging algorithms**

- **SV-based algorithms: SVF**
  - Reconstructs one secondary vertex inclusively per jet, using displaced tracks that are not identified as coming from long-living particles, and removing vertices consistent with material interactions.

- **IP-based algorithms: IP2D and IP3D**
  - Based upon the signed IP significance of the tracks, which is defined as positive if it is in the same direction as the jet momentum direction relative to the primary vertex.

- **Multi-vertex fit algorithm: JetFitter**
  - JetFitter reconstructs the full PV → B → C decay chain assuming that the b-hadron decays along the jet axis.

**MVx tagging algorithms : from Run 1 to Run 2**

- **MVx**: a combined tagging algorithm
  - Combines the outputs from the three basic algorithms
  - Two Neural Network multivariate tools were used in Run 1, MV1c (trained against light and c-jets) and MV1c (trained against a mixture of light and c-jets), based on the inputs from intermediate MVA tools.
  - Several improvements have been made for Run 2:
    - MV2c20 (trained with 80% light and 20% c-jets) is the default Run 2 tagging algorithm.
    - Uses Boosted Decision Tree (BDT).
    - Uses inputs directly from the basic algorithms, which allows us to better exploit correlations between the input variables.
    - Simplifies the algorithm by omitting additional intermediate multivariate tools.

**Conclusions and outlook**

- The Run 2 performance is significantly improved in terms of both light and c-jet rejection.
  - For a 70% b-tagging efficiency the light-jet rejection is increased by a factor of about 4.
  - Or, fixing the light-jet rejection at the value achieved for the 70% b-jet efficiency in Run 1, a relative gain of 10% in b-tagging efficiency is expected. In an analysis with four b-quarks in the final state (e.g. ttH(bb)), this increase represents a gain of 40-50% in signal acceptance.
  - The improvement at high pT is mostly due to updated b-tagging and tracking [2] algorithms, whilst the improvement at low and medium pT is mostly due to the addition of the IBL.

**References**

1. Expected performance of the ATLAS b-tagging algorithms in Run2:
   https://twiki.cern.ch/twiki/bin/view/AtlasPublic/FlavorTaggingPublicResults
2. The optimization of ATLAS Track Reconstruction in Dense Environments:
   ATL-PHYS-PUB-2015-006
3. Data commissioning:
   https://twiki.cern.ch/twiki/bin/view/AtlasPublic/InDetTrackingPerformanceApprovedPlots