Many physics analyses at the LHC are looking into processes where the jets are originating from quarks, while the jets in the background are more gluon enriched. Because of the different color interaction and hadronization, gluon jets are wider, with higher multiplicities and a more uniform energy fragmentation, while quark jets are more likely to produce narrow jets with hard constituents that carry a significant fraction of the energy. These differences can be used to construct a probability tagger capable of discriminating jets initiated by light-flavour quarks from those initiated by gluons.

The set of variables on which the discriminator is based is chosen by studying their discrimination performance on the simulation. Their discrimination power is compared with receiver operating characteristic (ROC) curves. These curves show the efficiency to select a quark jet, for a selection cut on the variable which rejects a given fraction of gluon jets. In addition to the ROC curves, correlations are studied to obtain the minimal set of uncorrelated variables with highest discrimination power.

The quark-gluon likelihood discriminant is constructed out of three variables, each accessing the particle flow composition of the jet:

- the multiplicity, i.e. the total number of particle flow candidates reconstructed within the jet
- the jet energy sharing variable $p_T D$ which has $p_T D \rightarrow 1$ for jets made of only one particle that carries all of its momentum and $p_T D \rightarrow 0$ for a jet made of an infinite number of particles
- the angular spread is measured by minor axis of the jet in the $\eta - \phi$ plane ($\sigma_2$)

A better discrimination power and stability to pile-up effects is found by restricting the charged particle flow candidates to those linked to tracks compatible with the primary interaction vertex, and restricting the neutral particle flow candidates to those which have $p_T > 1$ GeV.

The likelihood discriminant is binned in $p_T$ and pile-up ($\mu$) and developed for both the central and forward region of the detector.