

11th International Workshop on Ring Imaging Cherenkov Detectors (RICH2022)



Contribution ID: 55

Type: **presentation**

Torch pattern recognition and particle identification performance

Tuesday 13 September 2022 17:00 (25 minutes)

The Time Of internally Reflected CHerenkov (TORCH) detector is a proposed large-area time-of-flight detector, which aims to enhance the particle identification performance of the LHCb detector in the 2–10 GeV/ c momentum range. The Cherenkov light pattern in TORCH is a three-dimensional image (in space and time), which is folded by reflections from the sides of the detector modules. This talk will describe the development of pattern recognition algorithms for TORCH and discuss the challenge of reconstructing detector images in the high occupancy environment expected in the phase II upgrade of the LHCb detector. The reconstruction separates different species of hadron using likelihood ratio tests. The probability density function of the TORCH image is computed semi-analytically from the known Cherenkov emission spectrum, and knowledge of the detector optics. This approach has been shown to be robust and provide good separation between hadron species in the momentum range of interest. The image reconstruction and likelihood calculation are well suited to parallelisation and R\&D into implementation on hardware accelerators is ongoing. The expected particle identification performance of TORCH, and potential applications in the LHCb physics programme will also be discussed.

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Session Classification: Pattern Recognition and data analysis

Track Classification: Pattern recognition and data analysis