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Operation and performance of the Belle II Aerogel RICH detector

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The Aerogel Ring Imaging CHerenkov (ARICH) detector is a key component of the Belle II experiment at the SuperKEKB collider in Tsukuba, Japan, designed to provide excellent charged particle identification in the forward region. The experiment aims to accumulate 50 times more data than its predecessor to enable precise studies of rare B and D meson decays, as well as tau lepton processes. The ARICH system, utilizing silica aerogel radiators and 420 Hybrid Avalanche Photo Detectors (HAPDs), is optimized to distinguish between charged kaons and pions up to momenta of 4 GeV/c.

Since the start of full physics runs in 2019, Belle II has collected over 500 fb−1 of data. The 2024a-b run posed significant challenges for ARICH due to increased accelerator background and a partial failure in the cooling system. A comprehensive realignment was conducted using high-momentum dimuon events and a novel calibration procedure. Despite concerns over neutron-induced damage to the HAPDs, their performance remains within expectations, aided by close monitoring of leakage currents.

In light of these operational difficulties, the ARICH detector continues to deliver reliable and precise kaon-pion separation. This report presents an overview of the detector's performance, recent challenges, and the measures implemented to maintain optimal operation.

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