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COMPASS RICH-1

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Abstract

RICH-1, one of the key detectors of the COMPASS experiment at CERN SPS, is described. Photon detectors are MWPCs equipped with CsI photo-cathodes.

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COMPASS RICH-1 has been designed to perform hadron identification up to about 60 GeV/c in the crowded environments of the large angle spectrometer of the COMPASS experiment, running at CERN SPS at high beam rates.

RICH-1 is a gas RICH with 3 m long C_4F_{10} radiator at atmospheric pressure and constant, uniform temperature ($\sim 25^\circ$) to be obtained with a high flow ($\sim 50\,m^3/h$) gas circulation system equipped with heat exchanger installed for the 2002 run. Transmittance higher than 70% for 165 nm photons for a typical path in the radiator medium of 4.5 m has been obtained in operation by pre-cleaning the radiator gas in dedicated set-ups and using, on-line, molecular sieves. The vessel ($\sim 80\,m^3$) description can be found in Ref. [1]. In year 2001, RICH-1 has been operated with a mixture of N_2 and C_4F_{10} in the ratio 1:1.

The mirror system consists of two spherical mirror surfaces, with 6.6 m radius, segmented in 116 pieces covering a total area $> 20\,m^2$, focalising the Cherenkov photons onto two sets of photon

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detectors placed above and below the acceptance region. The major parameters of the produced mirrors can be found in Ref. [1]. No degradation of the reflectance for wavelengths larger than 165 nm has been measured after 2 years. The mirror supporting mechanical structure [1] is light and rigid: no mirror angular displacement was observed after a few weeks, while the long term stability will be obtained with vessel thermalisation.

UV Cherenkov photons are detected by eight identical MWPCs for a total active surface of $5.4\,m^2$, equipped with CsI photocathodes segmented in pads of $8\times8\,mm^2$. These RD26-like detectors [2] are also chosen by several other projects (for a recent review, see, for example: Ref. [3]). Details about photon detector design and construction, and CsI delicate handling, can be found in Refs. [1,4]. The photon detectors, electrically stable in low radioactive environments, are critical to operate at COMPASS due to the huge far beam halo of the CERN muon beam: reduced voltages are applied (~2000 V, to be compared with optimum values of 2050–2100 V).

The 84,000 analogic read-out channels are controlled by a system with distributed intelligence, based on the large front-end BORA boards [5]. Noise level as low as $\sigma=1100$ electrons equivalent is now obtained. The typical occupancy level is $<3\%$ and the dead time is 500 ns/event up to 75 kHz trigger rates.

RICH-1 has been commissioned in year 2001: $\sim$12–13 photons per ring have been detected (to be compared with $\sim$19, estimated for nominal detector performances [6] and 2001 gas mixture).

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