EPJ Web of Conferences **48**, 00024 (2013)
DOI: 10.1051/epjconf/20134800024

New optics for resolution improving of Ring Imaging Cherenkov detectors

M. Šulc[1,2,a], D. Kramer[3], J. Polak[2], L. Steiger[2,4], M. Finger[5], M. Slunecka[5]

[1]Technical University of Liberec, Department of Physics, Studentska 2, 461 17 Liberec, Czech Republic
[2]Research Centre for Special Optics and Optoelectronic Systems (TOPTEC), Institute of Plasma Physics, AS CR, Sobotecka 1660, 51101 Turnov, Czech Republic
[3]Institute of Physics, AS CR, Na Slovance 1999/2, 182 21 Praha 8, Czech Republic
[4]Institute of Mechatronics and Technical Engineering, Technical University of Liberec, Studentska 2, 461 17 Liberec, Czech Republic
[5]Charles University Prague, Faculty of Mathematics and Physics, Ke Karlovu 3, 121 16, Prague 2, Czech Republic and JINR, Dubna, Russia

Abstract. The Ring Imaging Cherenkov detector (RICH) of the COMPASS experiment at CERN is key tool for particle identification. Two reflecting spherical mirror surfaces, covering a total area of about 21 m^2, hosted in the radiator vessel, provide Cherenkov radiation focusing to photon detectors. These ones are based on the use of multi-anode photo-multiplier tubes. They are coupled to individual lens telescopes, made from special fused silica aspherical lenses. Design, construction, and Hartmann test of lenses qualities and alignment were described. The RICH detector uses C_4F_{10} as radiator gas. The refractive index of the radiator gas is substantial parameter. It varies with temperature, atmospheric pressure and gas purity. Its accurate knowledge is essential for the particle identification performance. A modified Jamin's interferometer was proposed, constructed and tested to allow on-line refractive index measurement with accuracy better than 10^{-6}. The new types of fused silica Cherenkov radiators was designed to the tests of electron multiplier detector too.

1 Introduction

The high-energy COMPASS experiment [1] is a fixed-target experiment at CERN SPS that uses a muon beam to study nucleon spin structures, and hadron beams for hadron spectroscopy research. An essential element of the COMPASS spectrometer [2] is the ability to perform hadron identification in a wide range of particle momenta at high rates and over a large angular acceptance. This capability is provided by gaseous Ring Imaging Cherenkov detector - COMPASS RICH-1.

This detector is the most complex one at COMPASS experiment. It uses a lot of optical elements and methods for particle identification. It is using 80 m^3 of C_4F_{10} radiator, a 21 m^2 large wall of spherical mirrors and a 5.5 m^2 large photon-detector area. Multi-wire proportional chambers (MWPC) with CsI photocathodes are used for the detection of Cherenkov photons in the peripheral region (75% of the total area). The central part of detector, covering 25% of total area, was equipped by 576 multianode (4x4) photomultiplier tubes (MAPMT) during the upgrade [3]. The MAPMTs are coupled to individual telescopes of fused silica lenses to enlarge the effective detection area.

One of the most important characteristics of Ring Imaging Cherenkov detectors is the refractive index of the radiator. Its accurate knowledge is essential for particle velocity measurement and particle identification. Both the absolute values at specific wavelengths and the dispersion of the refractive index significantly influence the precision of a particle momentum measurement. A modified Jamin interferometer was proposed, constructed and tested to allow on-line refractive-index measurement.

The new types of detector, thick gaseous electron multipliers (TH-GEM), were tested with the aim to replace CsI photodiodes. It was necessary to develop and produce the set of fused silica Cherenkov radiators for the detector tests with particle beams.

2 The lens telescope

The spherical mirrors have focused light into Cherenkov ring in detector plane. The previous detectors MWPCs were replaced by PMTs ones in part of this plane. It is why two-lens telescope was designed to

[a] e-mail: sulc@ipp.cas.cz

5. S. Dalla Torre et al., Nucl. Instr. and Meth. A **639**, 271-273 (2011)
6. M.Sulc, Jemná mechanika a optika(Fine mechanics and optics) 56 [9], 247/250, (2011)