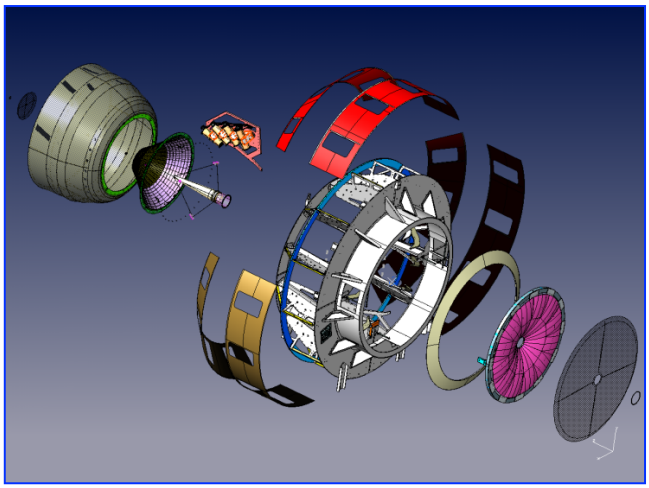
CLAS12 – High Threshold Cerenkov Counter (HTCC)

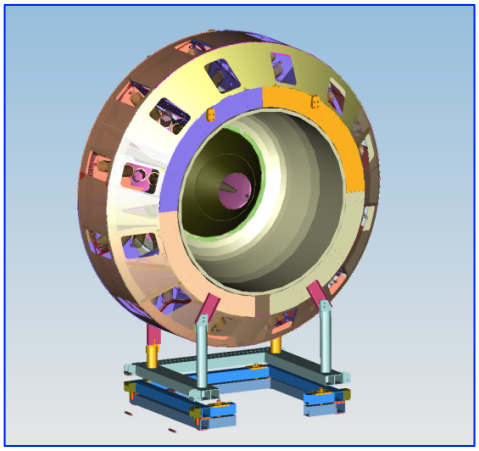
The **HTCC** will be one of the detector systems of the **CLAS12** spectrometer and used to generate fast trigger signal in experiments with electron beam. The **HTCC** will be installed in front of the R1 Drift Chambers and will introduce a minimal amount of materials. At the same time it will provide efficient coverage of the **CLAS12** acceptance with no gaps or overlaps. The **HTCC** is one unit, and the core component of it is a multifocal mirror consisting of 60 lightweight composite ellipsoidal mirrors. Each sector of the **CLAS12** is covered with 2 identical half-sector mirrors that are focusing Cerenkov light on eight 5-inch phototubes (total of 48 channels for entire detector). The system is required to provide high rejection of charged π-mesons and low background noise for reliable identification of scattered electrons.



HTCC - TECHNICAL PARAMETERS

PARAMETER	DESIGN VALUE
Working Gas	**CO_2@1atm, 25°C**
Angular Coverage	**ϑ= 5° – 35°; ϕ= 0° – 360°**
Threshold	**15 MeV/c** (electrons)
Threshold	**4.9 GeV/c** (charged pions)
Rejection of pions at 2 GeV/c	**~10^3** (99.9% electron detection efficiency)
Rejection of pions at 4 GeV/c	**~0.5x10^3** (99.9% electron detection efficiency)
Overall Dimensions	**~15 ft** and **L = 6 ft** along beam direction
Mirror Type	**Combined Ellipsoidal, dimensions of 8 ft in diameter**
Mirror Substrate Structure	**Acryl** (0.01”) + **PMI Foam** (0.6”) + **Acryl** (0.01”)
Mirror Thickness	**(130 – 135) mg/cm ^{2}**
Number of Channels	**(12x4) = 48**
Photomultiplier Tubes	**Electron Tubes 9823QKB** (5”, quartz window)
Number of Reflections	**1 (80%) + 2 (20%)**
Magnetic Field	**35 Gauss** (along PMT axis)
Magnetic Shield	**Multilayer with compensation coil**

- **Construction Strategy and Project Leadership:**



  - ❖ HTCC system Group Leader: **Youri Sharabian**
  - ❖ Construction strategy:
    - Manufacturing of the critical HTCC components (such as mirror facets including tooling sets for substrates assembly) to be done at JLab.
    - Coating of the mirrors, manufacturing of Winston Cones, Magnetic Shields and parts of the HTCC Containment Vessel (CV) to be done by vendors.
    - Tests of mirror facets (reflectance, shape), and QA of final assembly of the HTCC half-sector mirror to be done at JLab.
    - Alignment checks of components (including composite parts) of the CV, defining fiducial points of reference. Assembly and tests of the CV at JLab.
    - Final assembly and tests of the detector to be done at JLab.

- **Significant Dates:**

  - ❖ May 2013 : Commissioning of a jig for final assembly of the HTCC mirror
  - ❖ May 2014 : Quality control of the assembled ellipsoidal mirror for HTCC
  - ❖ Aug 2014 : Quality control of the HTCC containment vessel construction
  - ❖ Nov 2014 : Start of Comprehensive tests of shape stability of assembled mirrors
  - ❖ Feb 2015 : Installation of the Combined Mirror in the Containment Vessel
  - ❖ Jun 2015 : Assembly of the detector completed
  - ❖ Nov 2015 : Upgraded gas supply system installed and running
  - ❖ Apr 2016 : Defining Compensation coil currents using Helmholtz Coils
  - ❖ July 2016 : HTCC software (event reconstruction, calibration) tested and ready for use
  - ❖ Aug 2016 : Preparation of the detector for transporting and installation in the Hall

- **Project Status**:
  - Fully assembled and tested HTCC has been transported using special transportation cart from TEDF building to Hall B in January 2017.
  - The detector has been installed in CLAS12 and alignment checked.
  - HTCC was connected to dry CO_2 gas supply system and continuously purged at flowrate of 6.5 l/min. No significant gas leaks as a result of the detector transportation and installation process observed. Relative humidity in the detector volume (18.8 m^3) was as required.
  - Additional study and checks of the HTCC was conducted in situ. Calibration has been completed for all channels at two different PMT high voltage settings. Results compared with data obtained earlier in the TEDF.
  - The HTCC was up and running throughout entire KPP run with no failures.
  - Preliminary results on HTCC obtained during KPP run reported on Feb 27, 2017.

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