CHARACTERIZATION OF SiPM SENSORS FOR THE dRICH DETECTOR AT THE ePIC EXPERIMENT

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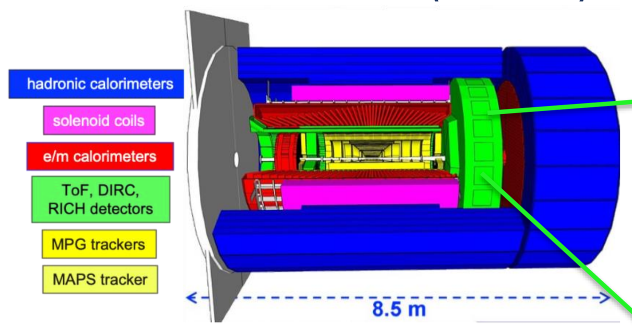
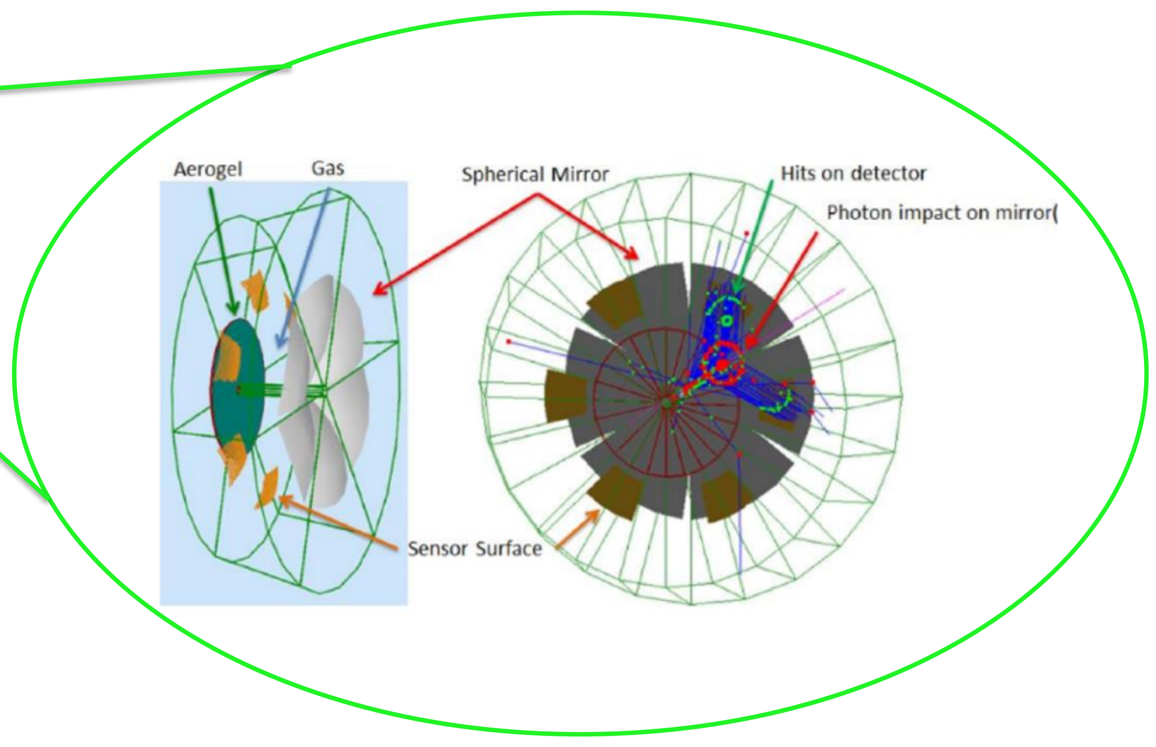
We report on the characterization of different types of Silicon Photomultipliers (SiPMs). SiPMs can detect and resolve single photons. They are considered as the baseline technology of choice to equipe the dual RICH detector (dRICH) at the ePIC experiment at the future Electron-Ion Collider. One of down sides of SiPMs is the presence of a Dark Count Rate (DCR) caused by thermal electrons which also depends on the bias voltage applied to the sensor. Such an effect can be minimized by lowering temperature of the sensors. We will show results from current-voltage (IV) and DCR scans at different temperatures (-20°C, -25°C, -30°C). These measurements are critical to understanding how best to "control" the DCR, maintaining an optimal dRICH detector performance over a long period of time and, in fact, making sure that the SiPMs are the best sensors to use.

ePIC and the dual RICH (dRICH)

The ePIC detector will be located at the IP6 interaction region, where electron and ion beams collide. It will include many subcomponents such as tracking and vertexing systems based on silicon sensors and gaseous detectors.
The Particles ID in the forward region is ensured by the dual Ring Imaging Cerenkov detector (dRICH).

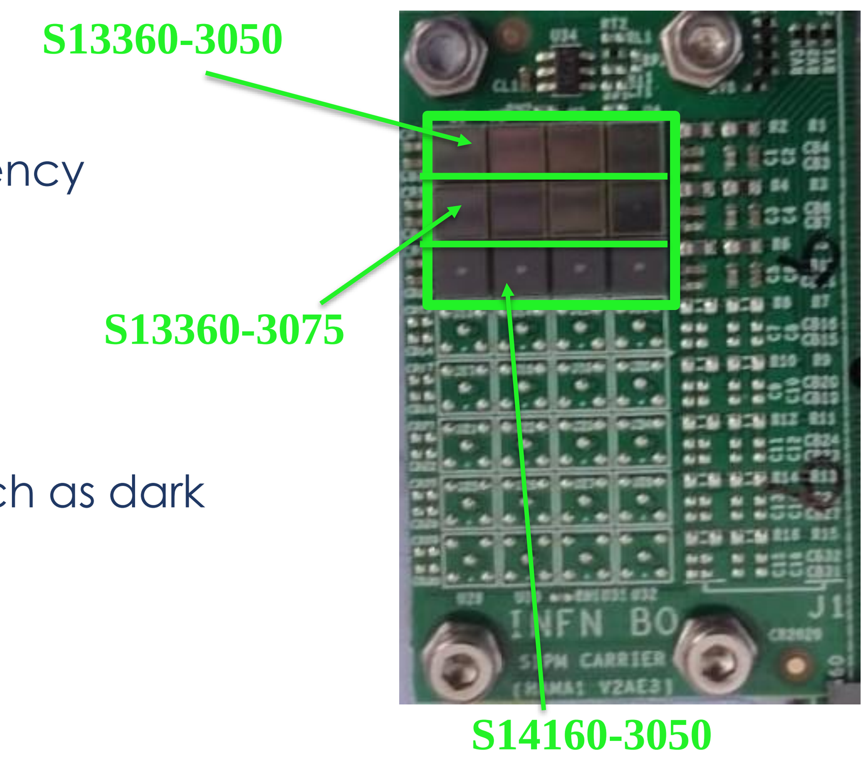




- **Two radiator**: aerogel ($n \sim 1.02$), C_2F_6($n \sim 1.008$)
- **Mirrors:** 6 large open sectors
- **Sensors**: 3x3 mm^2 pixel, 0.5 m^2 / sector:
  1. Single photon detection
  2. Best candidate SiPM

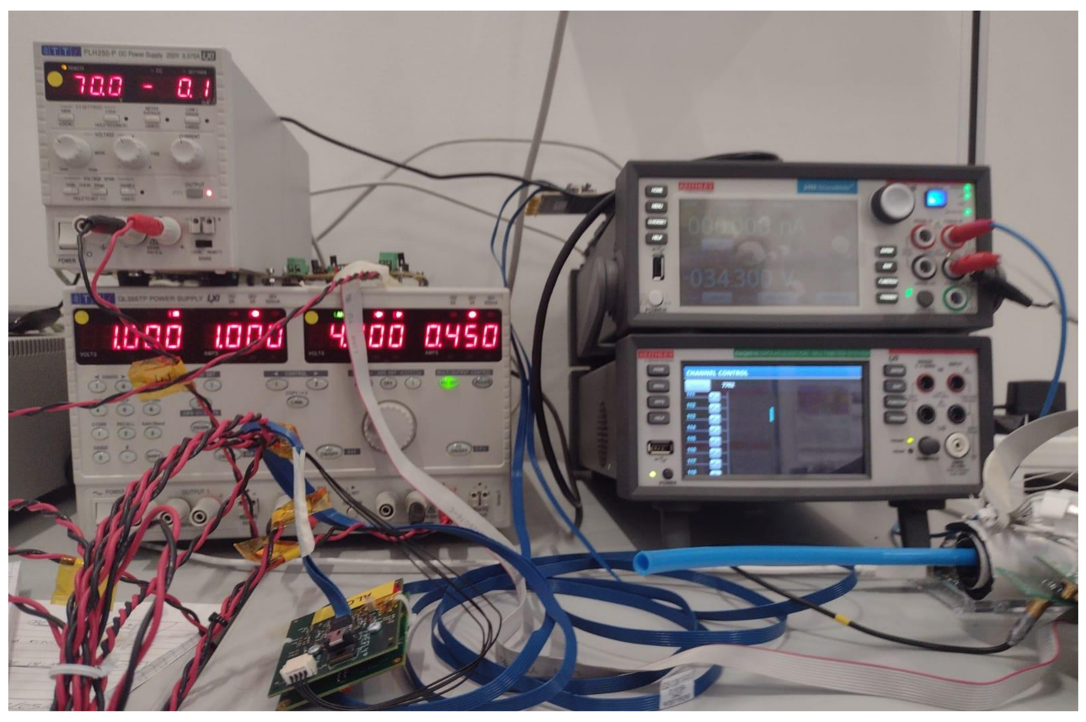
SiPMs sensor

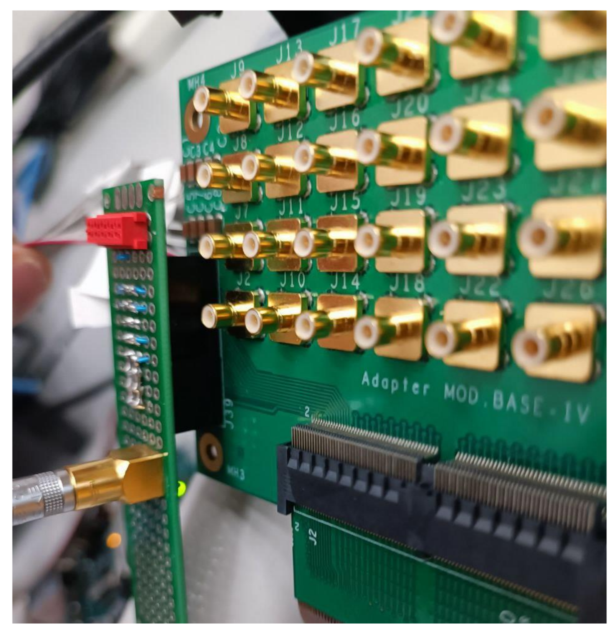
- **PRO:**
  1. Cheap
  2. High Photon Detection Efficiency
  3. Good time resolution
  4. Insensitive to magnetic field
- **Cons:**
  1. Different sources of noise, such as dark count rate and crosstalk
  2. Sensitive to radiation



THE EXPERIMENTAL SETUP

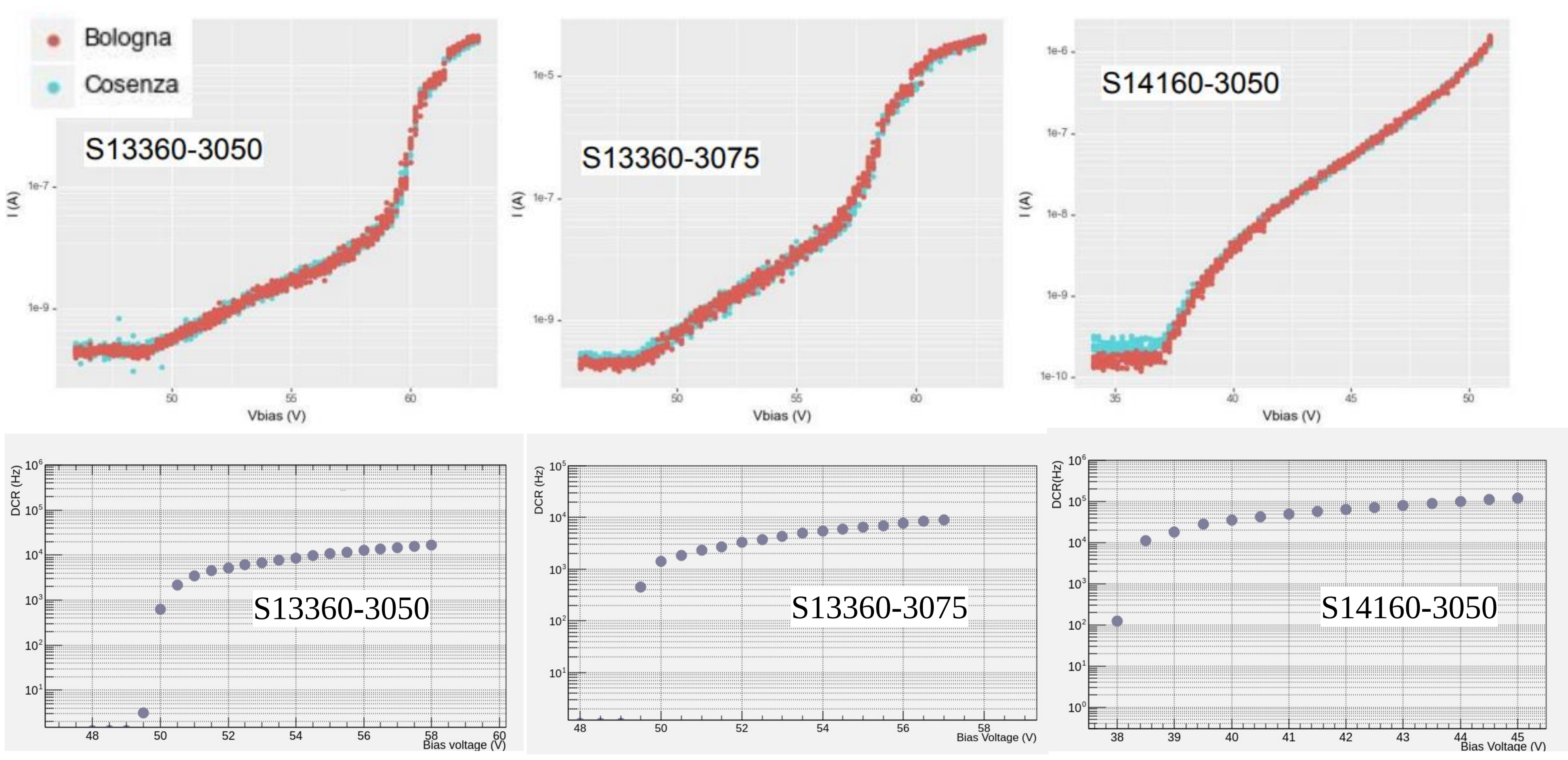
- 7 Boards on which **SiPMs** are mounted
- Custom made **portable Peltier box**
- **Ultra pure Air** tanks used to control the humidity in the inner box
- 1 **Adapter board** to regulate the voltage supplied to the SiPMs
- 1 **ALCOR board** for the data acquisition
- A digital-output relative humidity and temperature **sensor DHT11**, readout by an **Arduino board**
- A **Master Logic board** for communication with the Adapter board
- A **FPGA** to program and read the ALCOR data
- **PLH250-P power supply** used to bring the high voltage to the sensors
- **QL355TP power supply** for the front-end boards
- **TSX1820P power supply** used to bring power to the Peltier elements
- An **Adapter board** used to enable IV scans
- A **DAQ** with a **multiplexer** for the automatization of the measurements
- A precision **Source meter** that performs IV scans
- The **Grafana** web application to monitor the system





RESULTS

To test the capabilities and functioning of the setup, we compared the IV scan measurements with test ones taken in Bologna using a climatic chamber at the same temperature.
We have also performed measurements of Dark Count Rates before irradiating the sensors.



OUTLOOK

Recently, we have irradiated the boards with proton beams at TIFPA in Trento. The purpose of this is to test radiation damage for different proton energies (145, 75, 45, 25, 18 MeV).
The next steps will be to characterize again the sensors after irradiation and to repeat such studies with neutron radiation at Legnaro Lab in early August.