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A Cylindrical GEM Detector with Analog Readout for the BESIII Experiment

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Inner Trackers are key detectors in Particle Physics experiments; excellent spatial resolution, radiation transparency and hardness, and operability under high occupancies are main requirements. While planar Gas Electron Multiplier detectors are common in modern spectrometers, only one Cylindrical-GEMs detector has been produced up to now by the KLOE2 Collaboration and is being commissioned.

We are developing a cylindrical GEM detector with analog readout to upgrade the inner tracker of the BESIII experiment at the BEPC-II e+e- collider.
The new detector is expected to match the momentum resolution (σpt/Pt~0.5% at 1 GeV) and radial resolution (σxy~120μm) of the drift chamber and will improve significantly the spatial resolution along the beam direction (σz ~200μm) with very small material budget (about 1% of X0).

The inner tracker will be composed by three layers of triple cylindrical GEM with an angular coverage of 93% of the solid angle. Each layer will be assembled with five cylindrical structures: the cathode, three GEMs and the anode readout. A new Rohacell based technique will be used to manufacture the structure in order to minimize the material budget with respect to the state of the art.
The anode configuration will be also innovative; a jagged strips layout has been developed to minimize the capacitance couplings. The anode design has been studied by means of Maxwell and Garfield simulations and with a small-scale planar prototype.

The relatively strong BESIII magnetic field requires a new analogue readout; full custom front-end electronics, including a dedicated ASIC, will be designed and produced for optimal data collection.

To improve the spatial resolution in the magnetic field a μTPC readout feasibility study has been performed. The performance of analogue readout up to 1 T magnetic filed and of the new anode has been evaluated by means of a beam test performed at CERN within the RD51 collaboration.
Preliminary results of the test will be presented together with the mechanical design of the detector and the preliminary design of the frontend electronics.

The project has been recognised as a Significant Research Project within the Executive Programme for Scientific and Technological Cooperation between Italy and P.R.C. for the years 2013-2015, and more recently has been selected as one of the project funded by the European Commission within the call H2020-MSCA-RISE-2014.

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