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SPACIROC3: A Front-End Readout ASIC for JEM-EUSO cosmic ray observatory

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The SPACIROC ASIC is designed for the JEM-EUSO fluorescence-imaging telescope on board of the International Space Station. Its goal is the detection of Extreme Air Showers (EAS) above a few 10^{19} eV, developing underneath at a distance of about 400 km, in the troposphere. The SPACIROC family is dedicated to readout 64-channel Multi Anode PMT (MAPMT) or similar detectors. The two main features of this ASIC are the photon counting for each input and the charge-to-time (Q-to-T) conversions for each 8-channel sum. In the photon counting mode, the 100% trigger efficiency is achieved for 1/3 photo-electron (pe) input charges and in order to avoid pile-up in case of a large flux of photons, the double pulse resolution is required to be shorter than 10ns. For the Q-to-T converter, the ASIC should operate in a large dynamic range (1pe to 100pe per pixel). The operating conditions of JEM-EUSO require having low power dissipation (1mW/channel). High-speed performances with low power are obtained thanks to the SiGe technology used for the ASIC.

This ASIC has been submitted in three successive versions: SPACIROC1, which showed global good behavior, has been used to equip the EUSO-BALLON instrument. The second version was a conservative design to improve performances and decrease power consumption. The third version has been designed to improve the double pulse separation and to increase the charge dynamic range thanks to new front end architecture.

The design and performances (with and without MAPMT) of the third version of SPACIROC are presented in TIPP2014 paper.

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