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A small current measurement system for gaseous micropattern detectors suitable for operation at high voltages

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Future upgrades of several large particle detectors intend to employ gaseous micropattern detectors. This class of detectors, which include Gas Electron Multipliers (GEMs), Micro-MEsh Gaseous Structure detectors (MicroMegas) and similar, usually require the measurement of small currents (pA) at high potentials (kV) with respect to ground. While only this in itself presents an obstacle, the measurements very often need to satisfy other strict requirements, such as small current resolution, low power consumption, high readout frequencies (1 kHz) or simultaneous readouts of multiple channels.

Several instruments that overcome some of these difficulties have been proposed or developed, often lacking in characteristics that would make them universally applicable. We present a description of a high-resolution picoammeter developed in our laboratory. Tests of the prototype with a local Gas Electron Multiplier sheet setup demonstrate that it satisfies all the aforementioned requirements, including a current resolution of less than 15pA, a readout frequency of 1kHz, the ability of simultaneous readout of multiple channels (up to 16) and low battery power consumption. Several prototypes have been sent for independent testing to other institutions, providing feedback for possible improvements, which are either already under way or planned as future upgrades.

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