July 20-26 / 2005.
Rosario. Argentina.

Abstracts of contributed papers vol. 2

ICPEAC 2005

XXIV International Conference on Photonic, Electronic and Atomic Collisions.

Rosario 2005

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TESTING UNIT DEVELOPED FOR GERDIEN AIR-ION DETECTORS

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Since 1905 (just a century before) the Gerdien condenser [1] plays an important role in research of atmospheric ions. Usually, the air-ions generate extremely low input currents of 10^{-12}-10^{-13} A during fine weather conditions [2]. In recent years a resistor of $\geq 10^{10}$ Ω in the feedback loop of the fempto op-amplifier uses in these and similar low current measurements.

We developed the testing unit as a current reference of nominally 10^{-12} A intended for testing the measuring devices on current leakage and other deviations. This home-made unit is an independent battery-powered module, which provides a constant charge of 10^{-12} C per cycle, frequency of order 1 Hz. The main components comprising the testing unit are: NE555 timer, LM336 reference diode in the voltage divider, low noise HGJ2MT mercury-wetted contact relay and a polystyrene capacitor (10 pF) that periodically delivers defined portion of electricity to the sensor under testing. To be sure that the zero drift is determined and eliminated before the testing, a digital zeroing unit is developed [3] as well.

The Gerdien atmospheric ion detector CDI-07, designed and built in our laboratory, consists of AD549 op-amplifier. The sensitivity higher than 10 ions/cm^3 was attained during the calibration (Fig. 1), when the electronic circuits were temperature stabilized. This sensitivity is by a factor of 10 higher than that previously reported in [5].

Nominal testing currents below 10^{-12} A are desirable, but there are numerous limitations, such as capacitances of open contacts in the relay, current leakage across the insulators, instabilities and others.

On the other hand, there is the fundamental limit of the charge that can be delivered from the testing unit to a sensor, given by the quantization of the conductance [4], [5]. Our aim is to extend the nominal constant charge delivered from the testing unit to values lower than 10^{-12} C per cycle.

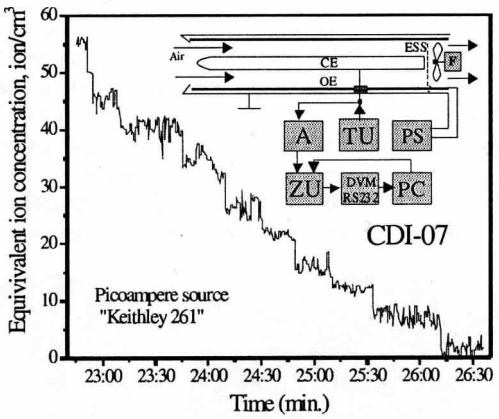

FIG 1. The plateaus of constant calibration currents. Inset: Block diagram of the Gerdien air-ion condenser (OE outer electrode; CE collecting electrode; ESS electrostatic shield; F fan; A ammeter; TU testing unit; PS power supply; ZU digital zeroing unit; DVM digital voltmeter; PC personal computer).

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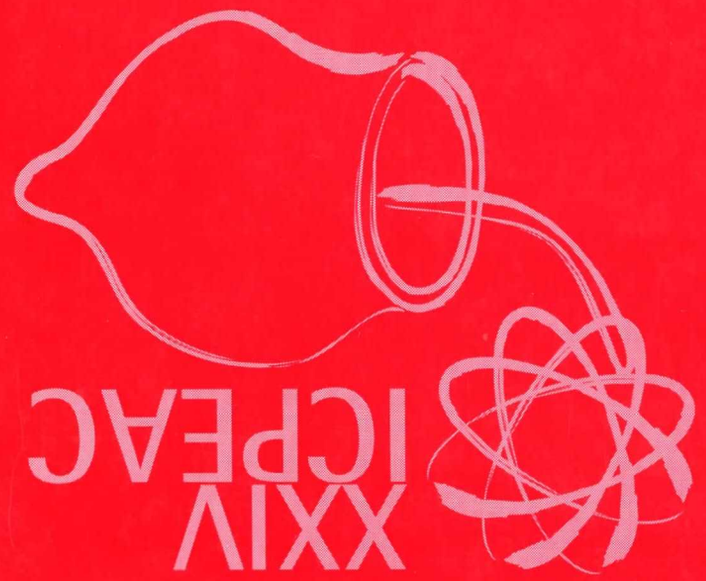
Rosario 2005



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