Pressure evolution inside the high voltage modules of plasma instrumentation when exposed to vacuum during ground test campaigns or after launch to space

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The Jovian plasma Dynamics and Composition analyzer (JDC), which is part of the Particle Environment Package (PEP) on board of the JUICE spacecraft, uses high voltages up to 5kV, during operations. These high voltages are used in the ion-optical part of the instrument, where the strongest electrical fields are encountered. Preventing internal high voltage discharges in this region is a key design driver. For this reason, a design rule of keeping the field strength <3kV/mm is applied. However, the dielectric strength of a vacuum gap has a pronounced minimum much below the 3kV/mm design rule at the Paschen minimum at about $10^{-2}$ to 1 mbar. To successfully operate using the <3kV/mm design rule, the sensor needs proper venting of its inner volume to get the internal pressure significantly below the Paschen minimum pressure.

Below the Paschen minimum pressure the gas flow in the instrument is a non-collisional molecular flow. The time spent to further reduce pressure inside of the instrument when the instrument is exposed to vacuum (e.g. in space or in a test facility) depends on the internal outgassing source strength, the temperature and the geometric shape of the outgassing path.

We determine the time constants of the pressure reduction in molecular flow regime by placing micro pirani pressure sensors inside critical volumes of real instruments.

We compare the outgassing performance of the Miniature Ion Precipitation Analyzer (MIPA) on Bepi Colombo with the JDC sensor. Measurements showed too long outgassing time constants for JDC in order to be able to operate the instrument during the very time constraint on-ground test campaign where only approximately 3 days are available to reach a save vacuum of $<10^{-3}$ mbar inside of the instrument. We present the implemented solution to improve outgassing performance of JDC and show it is sufficient for the on-ground test campaign.