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Exploring the upper measuring limit of pressure gauges for ITER by experimental variation of instrumental parameters

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Neutral gas pressures in the vacuum vessel of ITER will be measured by hot cathode ionization gauges. The design is based on the ASDEX pressure gauge which is operated successfully in many fusion experiments worldwide. Further development is needed to fulfill superior requirements: the upper measuring limit has to be at least 20 Pa in hydrogen at a magnetic flux density of up to 8 T. The required measurement accuracy of 20 % implies sufficient differential sensitivity.
This work aims at proving compliance of the pressure gauges with requirements of the ITER experiment by means of laboratory tests.
An experimental campaign was conducted to explore the accessible measuring range by consecutive variation of gauge parameters: electron emission current, electrode potentials and transparency of the acceleration grid. A special prototype was manufactured that features an exchangeable acceleration grid; transparencies from 20 % to 80 % are available. The ion over the electron current as a function of pressure and magnetic flux density was obtained for each parameter set.
A monotonic behavior was achieved even up to 30 Pa by a reduction of the grid transparency and an increase of the electric field strength at the cathode to accelerate the electrons. While the former leads to a lowering of the ion current, which is unfavorable for the sensitivity limit in the low pressure range, this can be compensated in part by a higher electron current.
The reproducibility of the gauge response under repeated experimental conditions is to be tested in near future. These results enable the calculation of statistical errors to estimate the measurement accuracy.

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