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Investigation of systematic errors of FG5(X) gravimeters

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The currently most accurate FG5 and FG5X gravimeters, declare standard uncertainties at the level of 2-3 μGal, their inherent systematic errors affect the gravity reference determined by international key comparisons where FG5-type instruments predominate.
To determine the systematic errors of FG5(X) gravimeters, we equipped the FG5-215 and FG5X-251 gravimeters by new measurement systems running in parallel with the original systems. The new systems are using new detector, analogue-to-digital converter HS5 to digitize fringe signal and new method of fringe signal analysis based on FFT swept band-pass filtering. We investigated several effects on measurements that can cause biased results and corresponding corrections should be applied. Namely, we determined the effects of distortion and dispersion in fringe signal, coaxial cable effects, laser beam diffraction effect, beam verticality effect and the effect due to Coriolis acceleration. All these effects should be determined for a particular gravimeter, because for example in case of the distortion effect we found that the bias can reach up to 6 μGal, thus exceeding the expanded uncertainty of measurements. The presented methods are able to determine corrections with the uncertainty quite below 0.5 μGal for the particular effect and they can be determined for any FG5(X) gravimeter with minor modifications. We suppose that corrections related to the effects mentioned above should be standardly applied to the FG5(X) results, similarly as in the case of the self-attraction effect, to reach unbiased results with standard uncertainty of 2 μGal.