## Session 2: Standards in absolute gravimetry

## *Wednesday, April 13th 09:00 - 10:30 CEST*

*Sessions Chairs: A. Germak (Italy) and S. Svitlov (Germany)*

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| 09:00 - 09:15 | local | **René Reudink**<br>*Derive the clock frequency of the FG-5 from the carrier frequency of the DCF77 time signal transmitter* |
| 09:20 - 09:45 | local | **Petr Křen, <u>Vojtech Pálinkáš</u>**<br>*Corrections of systematic effects of FG5/X gravimeters* |

# Derive the clock frequency of the FG-5 from the carrier frequency of the DCF77 time signal transmitter

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In the FG-5, time is measured with a Rubidium clock at each drop experiment of a test mass. This clock has an accuracy of $5*10^{-10}$ (5 mHz@10 Mhz). The clock gradually degrades over the years. At each maintenance service of the FG-5, this clock is measured and the frequency noted in the service report. But it is good practice to check the clock regularly. This check is ideally done with a clock that is at least one orde more accurate. In most cases this will be a Cesium clock or a Hydrogen Maser. Such a clock is by no means always available and rather expensive. An alternative is to use the 10 MHz output of a GPS receiver if it is suitable for this purpose. A third method of checking the FG-5's clock is to use the time signal transmitter DCF77. This transmitter continuously transmits time and date code in amplitude modulation on 77.5 kHz. The carrier frequency is extremely accurate ($2*10^{-12}$ per day, or $2*10^{-13}$ per 100 days (k=2)) because it is controlled by two Cesium clocks and a GPS controlled Rubidium clock (source: https//:ptb.de – the National Metrology Institute of Germany). The carrier frequency therefore counts as a frequency standard. This session explains how to successfully check the 10 MHz clock frequency of the Rubidium clock in the FG-5 directly from the 77.5 kHz carrier frequency. Note: The same principle can also be applied to time signal transmitters with a carrier frequency of 60 kHz such as the WWVB Ft. Collins, Colorado, USA. The great advantage of this method is that it is cheap and easy to perform with good results. In addition, long wave frequencies are generally stable to receive because they propagate like ground waves. A disadvantage is that the range of long wave frequencies is relatively limited. Good reception of DCF77 is possible up to about 1000 km around Mainfingen (Frankfurt), assuming good local reception conditions. Electrical equipment that is not properly suppressed and/or ferrous structures in the immediate vicinity of the receiver can adversely affect the reception quality. Depending on the weather and time of day, reception at a greater distance (<2000 km) is possible.

## Corrections of systematic effects of FG5/X gravimeters

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Measurements with FG5 and FG5X (FG5/X) absolute gravimeters are declaring uncertainties at the level of 2-3 µGal. At present, typically only the self-attraction and diffraction corrections are applied to gravity observations with FG5/X. Moreover, in case of the diffraction phenomena, corrections are usually reaching values up to 1.5 µGal, which seems to be significantly underestimated due to the low quality of the original collimator. Except the solution for the determination of the diffraction correction, from user's perspective, we are presenting methods and examples for evaluations of following corrections: distorsion (fringe size), dispersion in TTL cable, impedance mismatch, Coriolis, verticality and rotation of pulleys.