Absolute gravity measurements in Hamburg (Groß Flottbek) at DESY (Deutsches Elektronen-Synchrotron) with the Hannover gravity meter FG5X-220 in August 2016
(Extension to the first report about gravity determination at that site in 2015)

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In the period from 01st to 04th of August 2016, absolute gravity measurements were carried out in five runs. A run is an automatically performed sequence of free-fall experiments. Each run was organized in that way that every half an hour a set with 50 free-fall experiments (drops) were started automatically with a 10 s interval between each drop.
The gravimeter was installed three times (3 setups). The first one was orientated in north direction which means that the tripod foot of the super spring with the spirit level showed northwards. The second setup was south orientated, and the last one again northwards. The reason is that slightly different systematic errors are inherent in the observations from different instrumental setups. The arithmetic mean of the two g-results from the two setups orientations is the final g-value of this gravity determination.
The results from 2015 and 2016 are comprised in Tab. 3. They agree not within the instrumental error estimate of the FG5X-220 gravimeter with respect to long-term repeatability which is about 0.02 μm/s^2. This overall estimate of the repeatability has been derived empirically as an average root mean square (r.m.s.) discrepancy from comparisons with other absolute gravimeter over the whole lifetime of the Hannover instrument, cf. first report dated 15th December, 2015. The discrepancies between the single epoch results are not only caused by instrumental errors but also by real gravity variations. E.g., local hydrological variations (groundwater change) may induce several 0.01 μm/s^2 (up to more than 0.1 μm/s^2 in the North German basin).

Table 1: Used coordinates of the absolute gravity site occupied by the Hannover meter FG5X-220 in Groß Flottbeck in 2015 and 2016

Station "DESY/DORIS"	φ [deg]	λ [deg]	H [m]	Description
Building 30a (Lager 048)	53.5776	9.8815	30	Perfect room conditions for abs. gravity measurements (temp. stability, low humidity, no windows, stable foundation); no permanent ground mark; coordinates from Google Earth (internet).

Table 3: Absolute gravity results of FG5X-220 measurements since 2015
(s(drop): std. dev. of a single drop (≡scatter); s(mean): std.dev. of mean result)

Station	Date	Drops	δg/δh [μm/s^2 / m]	$g_{h=1..250}$ [μm/s^2]	s(drop) [μm/s^2]	s(mean) [μm/s^2]
DESY/DORIS	12-14 Oct. 2015	1994	-2.826	9813689.771	0.103	0.002
	01-04 Aug. 2016	3742	-2.826	9813689.825	0.125	0.002

Table 2: Absolute gravity values of the FG5X-220 measurements on the "DESY/DORIS" point. The gradient insensitive sensor height ("dead-gradient-point") depends on the gravimeter setup and is about 1.25 m above floor level. Thus, the reference height h=1.250 m (above floor point) is chosen for comparison reasons. For relative gravimetry, the derived g-value at h=0.000 m is also given.

Site **Rathaus**	Measurement run (orientation)	Date in 2016	Drops	δg/δh [µm/s² / m]	$g_{h=1.250}$ [µm/s²]	$g_{h=0.000}$ [µm/s²]
Run 1	20160801a (N)	01. August	398	-2.826	9813689.847 s=0.001	
Run 2	20160802a (N)	02. August	650	-2.826	9813689.826 s=0.001	
Run 3	20160802b (S)	02. / 03. Aug.	1000	-2.826	9813689.807 s=0.001	
Run 4	20160803a (S)	03. August	695	-2.826	9813689.812 s=0.001	
Run 5	20160803b (N)	03. / 04. Aug.	999	-2.826	9813689.848 s=0.001	
Average		01. – 04. Aug.	3742	-2.826	**9813689.825**	**9813693.358**

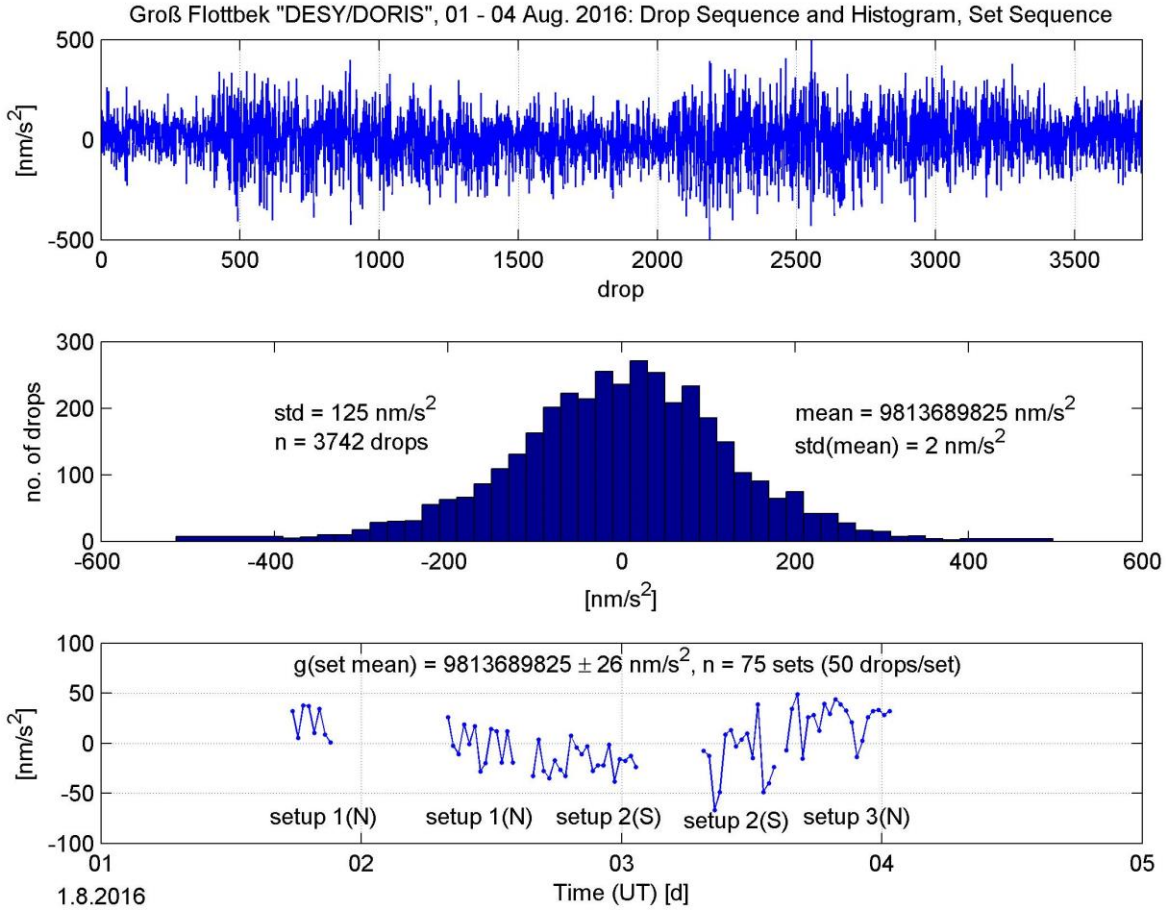

Figure 1: Statistical compilation of the station determination with the Hannover FG5X-220 absolute gravimeter at "DESY/DORIS" in Hamburg/Groß Flottbek, August 2016