

Discussion Meeting on Absolute Gravimetry, Joint meeting of JWG 2.1 Techniques and Metrology in Absolute Gravimetry and JWG 2.2 Absolute Gravimetry and Absolute Gravity Reference System

Date(s) of Meeting:	14-15 February, 2012	Location:	BEV, Vienna
Minutes Taker:	H. Wilmes, V. Pálinkáš		

Participants	
Name	Name
August Hochwartner (President of BEV) *	Reinhard Falk (BKG)
Harald Schuh (TUW, Vice President of IAG) *	Hartmut Wziontek (BKG)
Norbert Höggerl (BEV)	Herbert Wilmes (BKG), Chair Person JWG 2.2
Bruno Meurers (IMGW)	Sergiy Svitlov (F-A-U Erlangen-Nürnberg)
Christian Ullrich (BEV)	Manurung Parluhutan (Geod & Geodyn Centre)
Diethard Ruess (BEV)	Alessandro Germak (INRIM)
Marie Karbon (TUW-HG)	Domenico Iacovone (e-geos / ASI)
Norbert Blaumoser (ZAMG)	Emanuele Biolcati (INRIM)
Roman Leonhardt (ZAMG)	Christian Rothleitner (UNI-LU)
Vojtech Pálinkáš (VÚGTK, GO Pecný), Chair Person JWG 2.1	Olivier Francis (UNI-LU)
Gabriel Strykowski (DTU-Space)	Rene Reudink (TU-Delft)
Jens Emil Nielsen (DTU-Space)	Jan Krynski (IGIK-Warsaw)
Mirjam Bilker Koivula (FGI)	Jonas Ågren (Lantmäteriet)
Sebastien Merlet (LNE-SYRTE)	Henri Baumann (METAS)
Zhiheng Jiang (BIPM)	Derek van Westrum (microglacoste, USA)
Ludger Timmen (IfE)	Mark Eckl (NOAA)
	Vadim Nagorny (Metromatix, USA)
* only during opening session	
Distribution	
All participants and members of the Joint Working Groups	

Minutes of Discussion Meeting on Absolute Gravimetry	
0	Welcome and Introduction to BEV
	Welcome address on behalf of the BEV by Dipl.-Ing. August Hochwartner, President of the BEV
	Welcome address on behalf of the IAG by Harald Schuh, Vice-President of the International Association of Geodesy (IAG)
	Short presentation of the BEV with highlights in gravimetric history at the BEV by Norbert Höggerl, Diethard Ruess, Christian Ullrich (BEV) Introduction to the technical subjects of the discussion meeting by Herbert Wilmes (BKG)
1	Treatment of systematic effects in absolute gravity determination: self attraction, diffraction, finite speed of light and others
	Presentations on: - self attraction: 1) Jacques Liard, Vojtech Pálinkáš and Zhiheng Jiang , 2) Derek van Westrum, 3) Emanuele Biolcati and Sergiy Svitlov, 4) Sebastian Merlet, D'Agostino et al. - diffraction effect: Derek van Westrum - finite speed of light effect: 1) Christian Rothleitner, 2) Vadim Nagorny
	The working groups recommend: 1) that the gravity determination refers to the reference height associated with the "effective position" of the free-fall trajectory because this reference is least sensitive to the error propagation of the vertical gravity gradient determination. 2) Concerning the instrument types FG5 and A10 the company Microg-Lacoste is encouraged to include the determination of the reference height into the processing software. 3) The presented calculations of the self attraction correction (SAC) show good agreement. It is recommended to apply this correction in the measurement results. The model calculations are enclosed in the presentations. 4) The diffraction correction is estimated, the first approach, to $+1.2 \mu\text{Gal}$ with $\pm 0.5 \mu\text{Gal}$ standard uncertainty for an optimally aligned laser beam with a spot diameter of 9 mm. This refers to the JILAg, FG5, FG5X, FGL and A10 instrument types. This correction shall be applied. Other types of instruments need to calculate own corrections. 5) The correction of the finite speed of light effect will not be modified. Further experiments are recommended.
2	Determination of reference instrumental height and the choice of reference height of the comparisons
	Presentations: 1) Christian Rothleitner, Sergiy Svitlov and Vadim Nagorny, 2) Vojtech Pálinkáš, Jacques Liard and Zhiheng Jiang
	c.f. comments under topic 1

3	ICAG-2009, current status and next steps
	Presentation: Zhiheng Jiang
	The working groups support Jiang's preparative work of the final report to the CIPM. The team of authors will inform all participants of ICAG-2009 to check the compilation of results and on the final publication in the Metrologia scientific journal.
4	ECAG-2011 in Walferdange
	Presentation: Olivier Francis and Henri Bauman
	22 instruments participated in the ECAG-2011 in Walferdange. The operators will be informed about the submitted corrections of self attraction and diffraction. They will be given the opportunity to check and correct the submitted parameters before a final publication of the results.
5	ICAGs and RICAGs: development of the Technical Protocol, Site requirements, periodicity
	The Technical Protocol goes through continuous developments with each new regional and international comparison. Latest improvements are documented under topics 1 and 2. The Technical Protocol should include clear statements about the deadlines to be fulfilled by the participants and by the Pilot Laboratory.
	The function of the "Site Requirements" document was discussed. It is seen helpful for the preparation of AG reference sites and the selection and preparation of future AG comparison sites. The text will be distributed to the members of both working groups. Corrections will be compiled to obtain an updated version of this document. Periodicity: The working groups agree with the present periodicity of comparisons, four-yearly ICAGs with intermediate RICAGs two years after the ICAG.
6	Realization of the International Gravity Reference System
	Presentation: Mark Eckl Presentation: Reinhard Falk Presentation: Herbert Wilmes Presentation: Wu Shuqing, presented by Zhiheng Jiang Presentation: Jan Krynski
	Successful scientific comparisons have been done at the TMGO and Wettzell sites. Both sites are capable to host ICAGs or RICAGs in the future. Evident progress can be seen at the proposed comparison site of the National Institute of Metrology in Beijing. The working groups support the planned RICAG in 2015 APMP at this site. The realization of an International Gravity Reference System requires the adaption of constants, corrections and models which shall be documented in the IERS Conventions. The IERS Conventions 2010, Technical Note 36 can be downloaded from http://www.iers.org/nn_11216/IERS/EN/Publications/TechnicalNotes/tn36.html . The IGRS realization shall be based upon the ICAG and RICAG comparison results.
7	Reference gravity stations from the view of the offset determination
	Presentation: Hartmut Wziontek Presentation: Christian Ullrich and Diethard Ruess
	The capability of the reference stations with a superconducting gravimeter for an AG offset

	check was demonstrated if the SG drift determination is fulfilled at the level of uncertainty. For the Austrian AGs, JILAG-6 and FG5-242 the offset determination between both instruments was possible on the basis of ICAG determinations and local comparisons.
8	AGrav database – current status and future development
	Presentation: Hartmut Wziontek
	The community is asked to contribute AG site information and AG measurement data. Support can be given for the upload of larger data quantities.
9	Treatment of ICAGs, RICAGs and scientific comparisons
	For the future comparisons it is recommended to make the Pilot Study results available for the processing and publication without delay.
	Closing Comments: The two working groups foresee to establish the AG determination as a new Service of IAG to meet the requirements of the Global Geodetic Observing System (GGOS)
10	Adoption of the meeting protocol
	The presenting authors agreed to distribute their viewgraphs among the workshop participants and the members of the two working groups. The participants thank the Bundesamt für Eich- und Vermessungswesen (BEV) for the great hospitality during hosting this discussion meeting and for the invitation to visit the Conrad observatory on Trafelberg.

Annexes:

Presentations:

- Harald Schuh: Welcome address
- Norbert Höggerl: Introduction to BEV
- Christian Ullrich: Introduction to BEV Gravity
- Vojtech Pálinkáš, Jacques Liard and Zhiheng Jiang: Self-attraction effect of different types of gravimeters and the effective position of the free-fall solution
- Derek van Westrum: Preliminary Results for The Self Attraction Correction in Absolute Gravity Measurements
- Emanuele Biolcati and Sergiy Svitlov: Self-attraction effect and correction on three absolute gravimeters
- Giancarlo D'Agostino, Sébastien Merlet, Arnaud Landragin and Franck Pereira Dos Santos: LNE-SYRTE cold atom gravimeter Self gravity effect & Diffraction
- Derek van Westrum: The Diffraction Correction in Interferometric Absolute Gravity Measurements
- Christian Rothleitner and Olivier Francis: Second order Doppler shift corrections / Correction due to the finite speed of light
- Vadim Nagorny, Yevgen Zanimonskiy and Yevgen Zanimonskiy (jr): Contradictions of the finite speed of light correction in absolute gravimeters

- Christian Rothleitner, Sergiy Svitlov and Vadim Nagorny: Reference instrumental height in absolute gravimeters
- Vojtech Pálinkáš: Discussions and conclusions
- Zhiheng Jiang, Felicitas Arias and Lennart Robertsson: ICAG2009 Key Comparison + Pilot Study, Status and Results
- Olivier Francis, Tomas Volarik and Henri Bauman: European Comparison of Absolute Gravimeters ECAG-2011
- Mark Eckl: Table Mountain Geophysical Observatory (TMGO)
- Reinhard Falk et al.: The Regional International Comparison of Absolute Gravimeters in 2010 in Wettzell
- Herbert Wilmes: Realization of an International Gravity Reference System
- Wu Shuqing, presented by Zhiheng Jiang: The facility of Absolute Gravimetry at NIM, ready for RICAG-2015 and toward ICAG-2017
- Jan Krynski: On the new International Gravity Reference System
- Diethard Ruess and Christian Ullrich: 20 years of International Comparison of Absolute Gravimeters (ICAG) at the Bureau International des Poids et Mesures (BIPM) in Paris with participation of the BEV
- Hartmut Wziontek: Combination of superconducting and absolute gravity measurements - a benefit for intercomparisons
- Hartmut Wziontek: International Database for Absolute Gravity Measurements "AGrav"

The presentations of the Joint Workshop on Absolute Gravimetry at the BEV in Vienna 2012 are available on the BEV FTP server:

ftp://rapospp:4p0S.pU53r@ftp.bev.gv.at/WS_AbsGrav_BEV_2012