

"Where the Earth meets the Sky"



Sky Brightness on La Palma



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The island of La Palma is known to be one of the first class astronomical observing places on the Earth. Strong regulations for artificial lighting help to keep the sky brightness at the natural level though the pressure by the economic and especially touristic development is high. During and after the Starlight Workshop on 9th and 10th November 2009 studies and measurements at different places on the island could be made by *Günther Wuchterl* (Austria), *Friedel Pas* (Belgium), *Martin Morgan-Taylor* (Great Britain) and *Andreas Hänel* (Germany). To these, measurements by *Torsten Güths* have been added, that he made with a Globe at Night SQM-L during a stay on La Palma in August 2009.

Sky background brightnesses have been measured with Sky Quality Meters with lens SQM-L (Unihedron), which have been checked by intercomparison.

Excursion 10th/11th November, La Cumbrecita

First we tried to observe at the Mirador Llano de Jable west of the recreational site El Pilar on the volcanic mountain chain La Cumbre Nueva ($\lambda=-17.8483^\circ$, $\varphi=28.6178^\circ$, $h=1340$ m). The Cumbre divides the island into two halves and represents a weather division and which are also used by the local amateurs. On this night however it was very windy and bathed in clouds.

Therefore we continued towards the visitor's centre, where the sky got clear and further on to the Mirador La Cumbrecita in the National Park Caldera de la Taburiente ($\lambda=-17.85658^\circ$, $\varphi=28.6984^\circ$, $h=1296$ m). At this place there was no wind, only occasionally clouds came down from the higher crater rim. Though the view of the sky was partly obscured by the high mountains in the west and the east, the Milky Way was very impressive, the zodiacal belt and the Gegenschein were clearly visible, as well as M 33, a test object for the Bortle scale, which would classify this place with the value 1-2. The sky background was measured at 21.58 mag/arcsec² between midnight and 2 o'clock, this high value certainly due to the bright Milky Way which is estimated to influence the sky background brightness by 0.2.-0.3 mag/arcsec². At the same time *Günther* measured with his instrument illuminances of several millilux. The place is well cut off from the bright lights of the Aridane valley. Back to the hotel in Los Concajes, it was clear there and *Martin* got a measurement of 19.7 mag/arcsec².

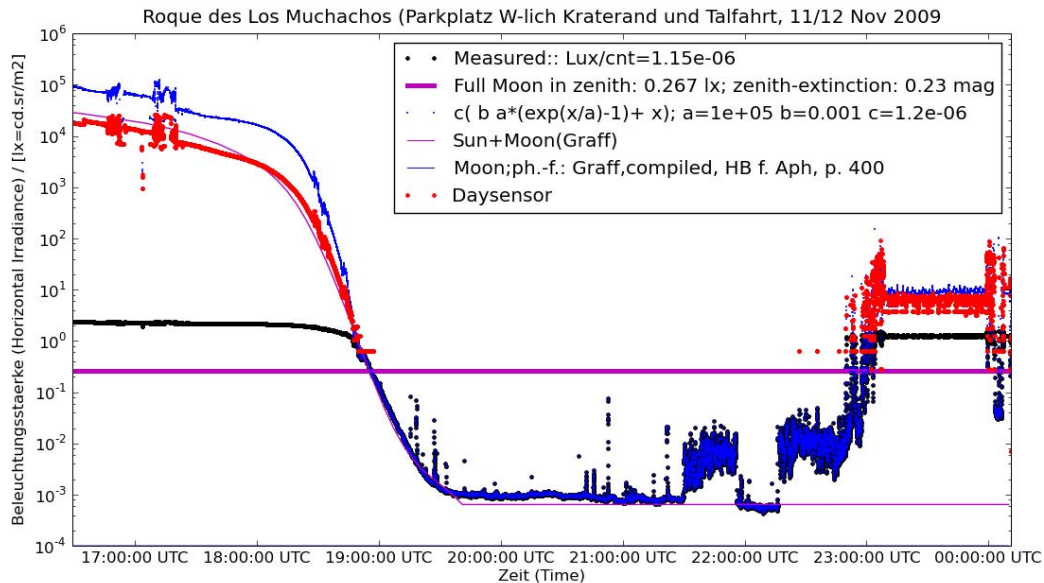
Nearby on a lapilli area Llano de Jable at the foot of the volcanic cone Montana Quemada, *Andreas* could already observe comet Bradfield (1987s) in November 1987.

Excursion 11th/12th November, Roque de los Muchachos

After the excursion to the observatory Roque de los Muchachos we stayed for observing at the Mirador de los Andenes, which is east of the Roque de los Muchachos, directly beside the road and offered a free view towards the South. ($\lambda=-17.86726^\circ$, $\varphi=28.76132^\circ$, $h=2255$ m). During dawn the Milky Way became already visible and later the zodiacal light was again visible though it merged with the Milky Way. SQM measurements showed values of 21.55 – 21.60 mag/arcsec² and in reality the sky did not appear darker than the evening before. Artificial lights from the cities in the Los Llanos valley were in the beginning very well blocked by the clouds, which however were illuminated by the lights. Short before 20 o'clock the Hubble Space Telescope crossed the sky though it did not appear as bright as half a year before on Fuerteventura.

Later the clouds in the Caldera vanished partially and some of the lights in the Los Llanos area even shone up quite glaring, supposedly mainly from sports or commercial areas. This seems to correspond to the situation that could be observed earlier at Mallorca, where also sports facilities dominated as light sources during the early evening.

Towards Santa Cruz de La Palma a faint light dome was visible. Towards the North only 3 smaller villages very visible, which did not disturb. At Barlovento to the North it was even raining on this evening, as the club AstroTour of amateur astronomers there gave lectures to students and wanted to observe.



The lux measurements as recorded by *Günther*. from dawn (end 19:50) to the drive back (starting at 21:30) till the lights in Sta. Cruz de la Palma (from 22:45, parking lot 23:00 – 0:00).

Excursion 12th/13th November, El Pilar

Short before sunset the sky at the Cumbre was very clear, this promised to become a clear night. Therefore after a break for dinner at the Hotel in Los Concajes, observation at El Pilar was planned. However coming back to the mountains, some clouds hang already over on the eastern side (which seems to be quite normal), at the Mirador on the east side of Montana de la Venta ($\lambda=-17.82320^\circ$, $\varphi=28.6138^\circ$, $h=1320$ m) 21.15 mag/arcsec² was measured, influenced by some clouds. On the western side it was clearer though not so as clear as the afternoon before promised ($\lambda=-17.8483^\circ$, $\varphi=28.6178^\circ$, $h=1340$ m). Some clouds hang over the Los Llanos valley and sometimes clouds fall down from the rim of the Cumbre Nueva. It was very windy again and the lights of El Paso and Los Llanos shone up very bright. The sky background appeared brighter than the nights before and it was measured at 21.34 – 21.4 mag/arcsec².

For comparison additional measurements should be taken again at La Cumbrecita, but there it was totally cloud covered, while at the visitor's centre of the National park ($\lambda=-17.85296^\circ$, $\varphi=28.65460^\circ$, $h=849$ m), 21.4 mag/arcsec² was measured. The evening before *Alberto Irusta* measured at this location 21.3 mag/arcsec².

An intercomparison of different SQM-Ls gave these differences (negative values correspond to brighter magnitudes = lower values):

SQM-L #	difference	owner/user
2563	reference	Andreas Hänel
2762	-0.08	Martin Morgan-Taylor
2164	-0.25	Fabio Falchi
4010	-0.10	Alberto Irusta
3158	-0.16	GAN (Torsten Güths)

r' extinction values from the Carlsberg Meridian Circle are given as additional information in the following table.

All measurements

Date	time(UT)	alt.	longitude	latitude	brightness	SQM #	ext.	observer
11.08.2009	22:14	750	-17.98110	28.76560	21.43	3158	0.096	T. Güths
15.08.2009	21:23	1400	-17.93688	28.75462	21.75	3158	0.093	T. Güths
16.08.2009	02:04	1400	-17.93688	28.75462	21.72	3158	0.125	T. Güths
17.08.2009	21:40	2230	-17.86508	28.76235	21.60	3158	0.096	T. Güths
18.08.2009	03:22	2230	-17.86508	28.76235	21.91	3158	0.170	T. Güths
10.11.2009	23:40	1296	-17.85659	28.69849	21.58	2536		A. Hänel
11.11.2009	20:45	2255	-17.86726	28.76133	21.55	2536	0.084	A. Hänel
11.11.2011	21:15	2256	-17.86726	28.76133	21.60	2536	0.084	A. Hänel
12.11.2009	20:30	1320	-17.82320	28.61377	21.15	2536	0.088	A. Hänel
12.11.2009	20:45	1341	-17.84834	28.61784	21.34	2536	0.088	A. Hänel
12.11.2009	21:25	1341	-17.84834	28.61784	21.40	2536	0.088	A. Hänel
12.11.2009	21:45	849	-17.85296	28.65461	21.40	2536	0.088	A. Hänel

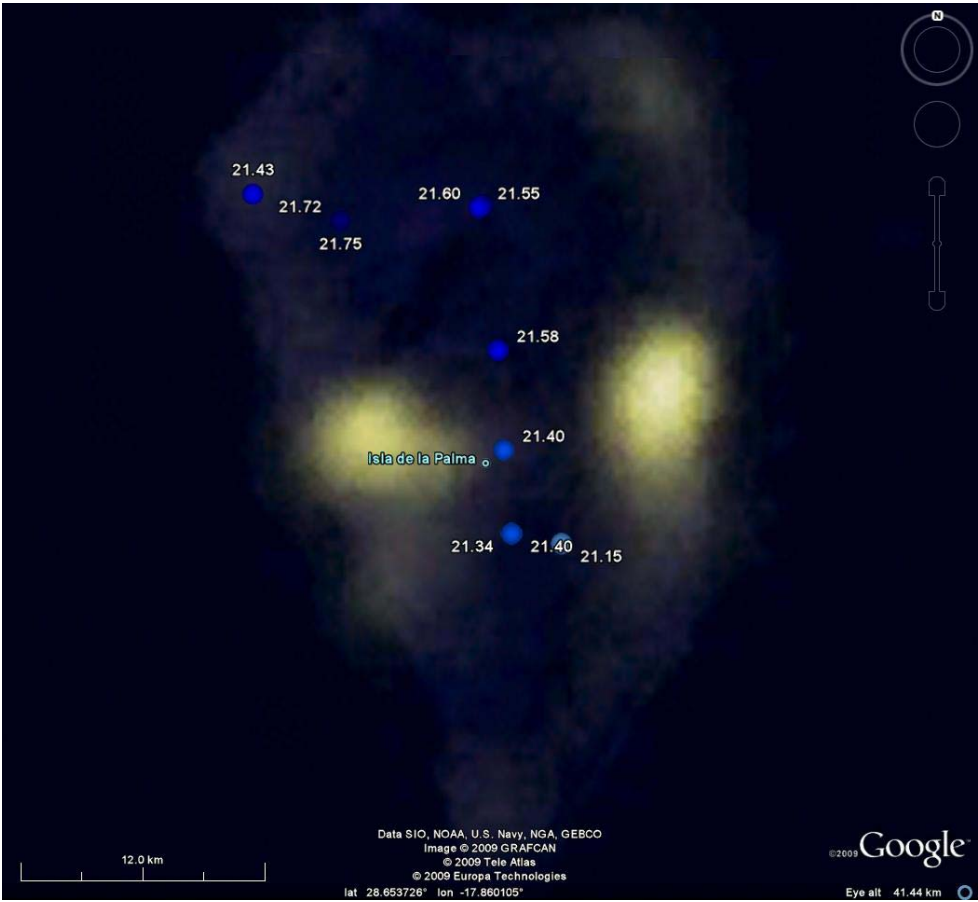
Conclusions

There seemed to be no essential difference from the sky background brightness between La Cumbrecita and Roque de los Muchachos (Andenes) although at different altitudes. At La Cumbrecita the sky appeared even darker as the lights from the El Paso/Los Llanos valley were blocked by montana Bejenada.

In addition the sky brightness at the zenith was brighter than the brightness observed in April 2009 in the nature park Westhavelland about 70 km west of Berlin in Germany with the same SQM-L (21.78 mag/arcsec²). Even after compensating an influence by the Milky Way of about 0.2 mag/arcsec² the brightnesses are comparable that one could conclude that in the Westhavelland best observing conditions can be found, if one neglects the large light dome of Berlin towards the east. Lower light domes like those of Brandenburg or Rathenow extend comparably high like the light domes over the brighter cities on La Palma.



The excursionists reflected in one mirror segment of the Gran Telescopio Canarias at the observatory hotel.



The measurements overlaid on the GoogleEarth DMSP map





The sky at La Cumbrecita, 21.55 mag/arcsec²



Sky at Los Andenes, 21.6 mag/arcsec²



Sky at Llano de Jable, 21.4 mag/arcsec²

all images: f=4.5mm, 1:2.8, Canon EOS 1000 D, ISO 800, 5 min RAW format

La Cumbrecita



The clouds over the Cumbre are illuminated by the lamps of El Paso (30mm, 1:1.4, 30s, ISO 800)



NGC 7000 North America Nebula, 5 x 30s = 150s exposure time 1:1.4/30mm, ISO 800



Orion, Barnard's Loop and the Rosetta nebula, 5 x 30s = 150s exposure time 1:1.4/30mm, ISO 800

Mirador de los Andenes



The centre of the Milky Way setting over Roque de los Muchachos, 3 x 30s = 90s exposure time 1:1.4/30mm, ISO 800



View towards the South with the lights of Los Llanos cloud covered at right and the lights of El Hierro in the centre 30mm,



Later the clouds over Los Llanos have dissolved and glaring lights presumably from sports lighting became visible (totally overexposed). (all: 1:1.4, 30s, ISO 800)



The lights of Sta. Cruz de La Palma as seen high from the Northwest ... (30mm, 1:1.4, 1s, ISO 800)



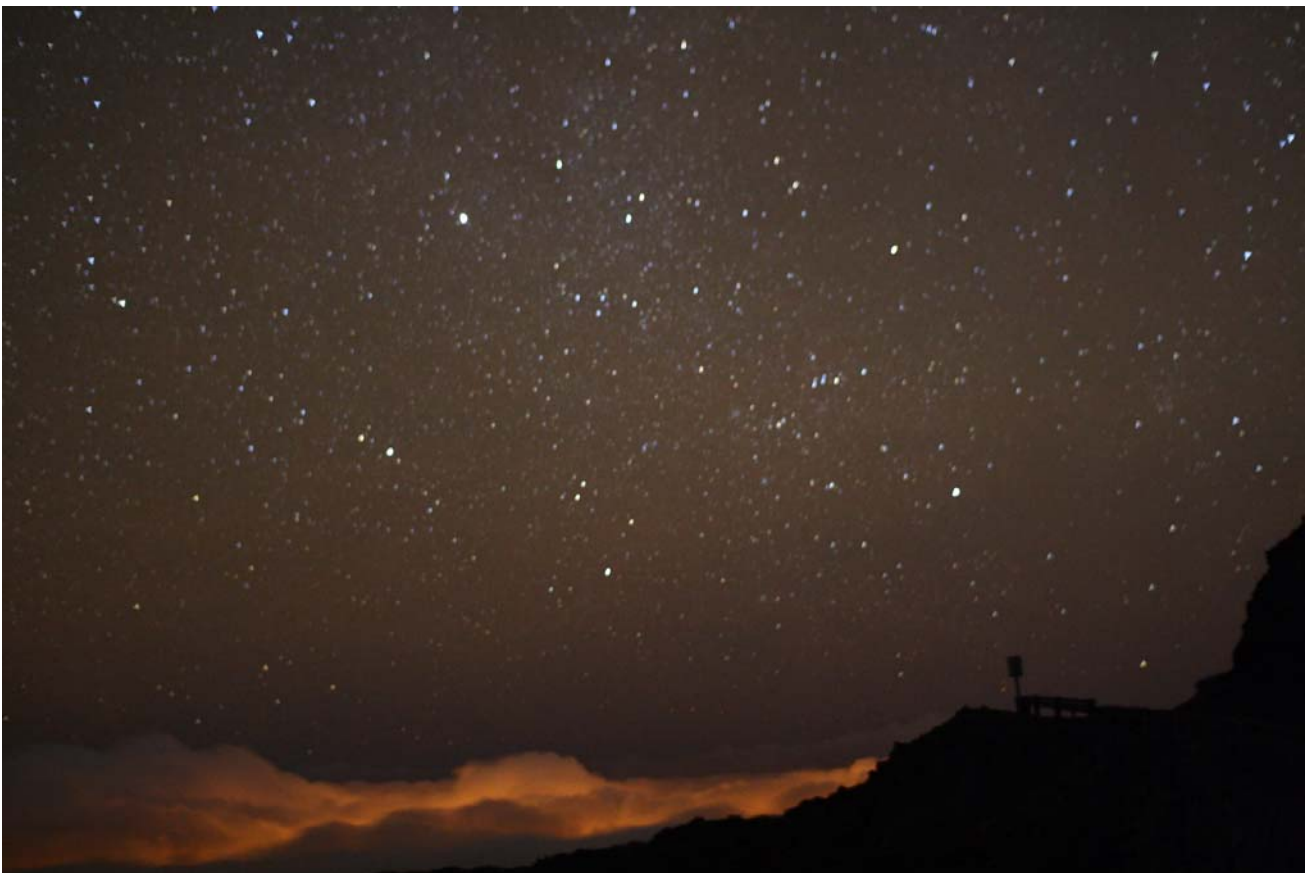
... and as seen from the Southwest (30mm, 1:1.4, 1s, ISO 800)



.. and from nearby (30mm, 1:1.4, ¼ s, ISO 800)



View from the Llano del Jable Mirador towards the valley with the cities of Los Llanos and El Alto (30mm, 1:1.4, 8s, ISO 800)



Auriga rises in the east over the illuminated clouds (30mm, 1:1.4, 30s, ISO 800)