

Interactive comment on “Results from the intercalibration of optical low-light calibration sources 2011” by B. U. E. Brändström et al.

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First we thank Anonymous Referee #2 for an extensive review of our manuscript.

This manuscript is written under two constraints: time and tradition. Time, since the results of the intercalibration workshops 2011 ought to be published before the next one. Tradition, since this is a long-term intercalibration effort spanning over 30 years. Therefore continuity must be preserved by not suddenly changing neither method nor equipment.

Apart from our response to Anonymous Referee #2 (below) we also refer to our response to Anonymous Referee #1.

Response to Extensive comments (EC)

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EC1: We strongly agree regarding the referees intention. Yet, doing this in this manuscript would apart from delaying it significantly, double its length and require changes of both the title and author list. This is a different and very important subject. Many of us will be very happy to participate in such an effort, hopefully also this referee.

As indicated on p.93 li. 23 the apparent spectral radiant sterance (Eq. 2) is directly taken from Baker and Romick (1976). As far as we know this equation has been used to convert Rayleighs to apparent spectral radiant sterance (apparent spectral radiance) at least since early 1960's.

Although utterly important, these matters do not directly affect neither the method, nor the results presented in this manuscript.

We will add a sentence about the relation between column emission rate (R) and spectral column emission rate ($R/\text{\AA}$). The relation is the same as between radiance and spectral radiance. (Formally the spectral radiance is the partial derivative with respect to wavelength of the the radiance, but it is maybe more understandable to state that radiance is the spectral radiance integrated over wavelength?)

EC2: The series of intercalibration workshops described in this manuscript has been mainly European. Sources from the U.S. has occasionally participated. (for example in Kiruna 2006). As stated (p. 94 li. 11–13) this European series of intercalibrations were initiated by work, mainly in the U.S. by Torr et al. as reported by Lauche and Barke (1986). As described on page 98 starting at line 25, an indirect intercalibration with a Canadian source has also been done. These results are under analysis and will be presented in a later publication.

Regarding other types of calibrations, in particular instrument calibrations (which is a very important topic), the first author of this paper gave an invited talk at the optical meeting in Siuntio, Finland 2011 on this subject. This will be published eventually. We agree to add a short sentence about this, but this subject is vast and very much out of

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the scope of this paper that concerns intercalibrations only.

EC3: The Fritz-Peak source first appear in the 1960's (Torr et al 1983). We have found no reference from this time apart from a diagram in Torr et al. (1983). This source was intercalibrated against a NBS traceable source in 1979 as indicated on p. 94 starting at line 24 (Torr and Espy 1981). It is since then assumed to be stable. Our first question when taking over the responsibility of this equipment were if this assumption is justified?

The ratios presented in Table 3 supports this assumption. If any of the participating radioactive C14 light-standards are becoming unstable with time, it would be very unlikely that they would be unstable in exactly the same way. Such instabilities would be discovered by periodic intercalibration workshops.

Furthermore: the preliminary results of the intercalibration at UNIS, Svalbard with totally different equipment also supports this assumption within at least 20%. We elaborate more on this topic in our response to Anonymous referee #1. It would of course have been even better if we could have brought the C14 sources to UNIS. Unfortunately this was impossible due to flight-safety regulations.

To repeat the traceability measurement of Torr and Espy (1981) is strongly desired. This can't be done as long as no suitable calibration facility exists within convenient distance for ground transport on the Scandinavian or European mainland. This may hopefully change very soon, but not before next intercalibration workshop.

Yet, we do have carried out validation measurements linking the Fritz-Peak source directly to the FMI integrating sphere in Sodankylä, Finland, as well as indirectly both to the calibration facility at UNIS, Svalbard and to calibrations of one FMI MIRACLE EMCCD-imager carried out by T.S. Trondsen, Keo Scientific in Canada. This is described in the manuscript page. 97-99 starting at line 23. The results of these validation efforts produced large amounts of data that requires careful analysis and will be published later.

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The preliminary results of the intercalibration at UNIS (Table 4) indicates agreement within 20% for relevant wavelengths. This is in our opinion very promising.

This intercalibration series is the regular check of the participating sources, including Fritz-Peak.

EC4: We will improve the description of the method in the revised manuscript and also add a schematic diagram of the intercalibration photometer. For a low count rate the SNR cannot be increased by increasing the integration time as the dark-current (the main noise component here) also increase with time. This issue is not new to this intercalibration session, it might even be a design compromise in the instrument itself.

As this intercalibration is a long-term commitment spanning well over 20 years, we cannot suddenly change the method. A reader that wish to reproduce this measurement needs to either borrow our equipment or build his own intercalibration photometer. In both cases all participating sources are needed. We would be more than happy to arrange this and also to provide copies of all design drawings and documents in our possession. However, to provide all this information in the manuscript would require many more pages.

EC5: Traditionally, the ratios of Table 3 have been the provided error estimations. With a few exceptions the errors are less then about $\pm 10\%$ for wavelengths where the sources have a significant output. Even where the sources have poor output typically errors are typically less than $\pm 20\%$. This is clearly acceptable error levels for absolute calibrations. We will update the text of the revised manuscript to reflect this. We also refer to our response on this issue to Anonymous Referee #1.

Response to Minor comments (MC)

MC6: We will add (apparent spectral radiance) Radiometric and photometric quantities unfortunately has an overabundance of names. So this comment is well-justified.

MC7: We have received an extensive set of documentation together with the intercali-

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bration photometer. Many of the reports and publications that do exist are very difficult to obtain. We intend to make as much as possible of this material available on Internet, but it will take some time to digitize (scan) everything. At least four official intercalibration workshops (1983, 1987, 1989, 1991, 1995) are not published at all, but carefully documented. The results were probably sent directly to the source-owners. Unfortunately, not much is published after 1986. The reports starting in 2000 more or less only stated the results in the form of a table. We are trying to remedy this in our manuscript. We will revise the text so it better adheres to the information in Table 1.

MC8: We will fix this problem. (We think the correct version is “Fritz-Peak” with a hyphen, but even “Fritz Park” is sometimes found)

MC9: “Well-known” refers to the fact that they appeared in many intercalibration workshops and/or that they are of Hans Lauches design. (Exist in our documentation) We will clarify this in the text.

MC10: We agree and will do that.

MC11: This is a typo, it should read Fritz-Peak. For reference it can be mentioned that this typo is caused by different source naming conventions during the years, especially for the time before 1980. This is rather unfortunate as it makes it complicated to identify sources in earlier measurements.

MC12: Our documentation indicates that this source has a continuous spectra with two peaks, one around 4400 Å and one close to 6350 Å. On the other hand, quantum efficiency for the PMT rapidly drops of towards the red part of the spectra. This is the most plausible explanation for poor SNR towards the red part of the spectra. We will elaborate this more in the text of the revised manuscript. Next intercalibration workshop will hopefully include the possibility to measure the spectras of all participating sources. We will then be able to provide a better answer to this issue.

MC13: We agree, this is a typo.

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MC14: We agree and will add this to the running text.

MC15: We agree, this is a typo.

MC16: We will add a schematic diagram of the intercalibration photometer. There are two orange (pink?) boxes. The one to the left is a power supply, and the one to the right is output amplifier and pulse shaper for the PMT output. Immediately to the left of this box is the Peltier cooler connector which looks pink too.

MC17: We will add labels to Fig. 2.

MC18: Source names were in this plot, but as they are rather long we were encouraged to remove them for cosmetic reasons. We can try to put them back, if the journal allows this.

Please also note the supplement to this comment:

<http://www.geosci-instrum-method-data-syst-discuss.net/1/C47/2012/gid-1-C47-2012-supplement.pdf>

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 1, 91, 2011.

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