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UV line irradiance meter calibration

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Agenda

- The challenge
- Calibration set-up & procedure
- Arc-lamp suitability
- Calibration outcome

Hand-held 365 nm irradiance meter

Calibration accuracy: ± 5 %

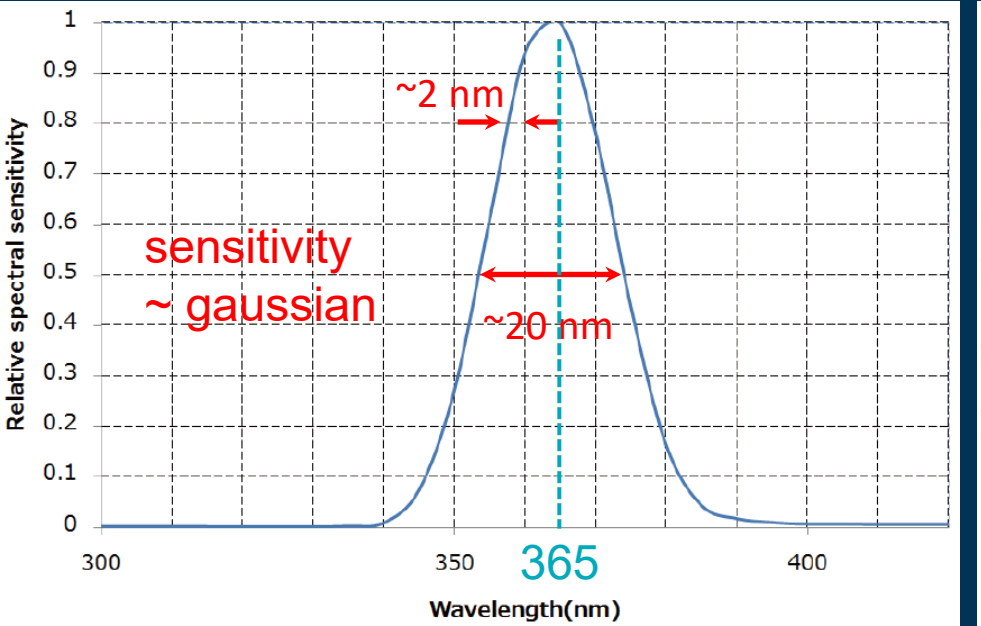
Sensitivity: 345 – 385 nm

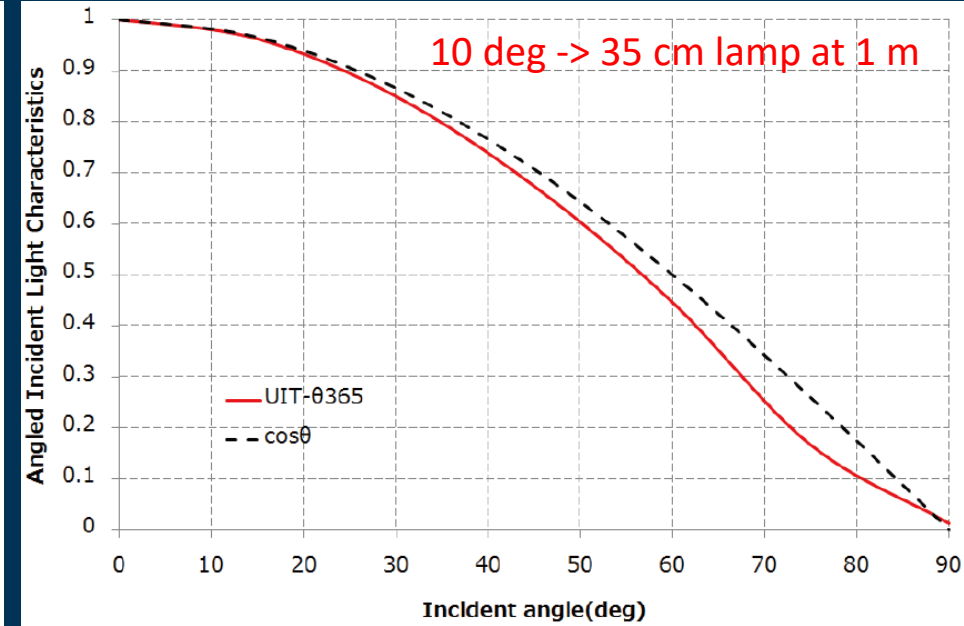
GRAYBOX

Poorly known sensitivity curve !

Unknown reason (filter, bandwidth etc.) !

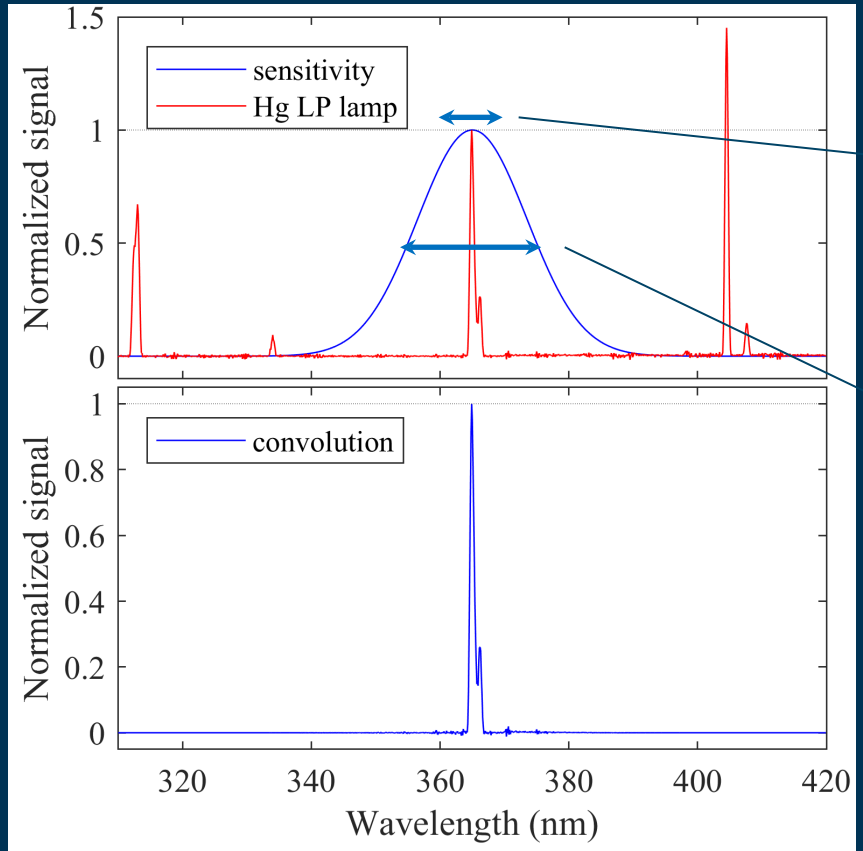
Unknown detection area !

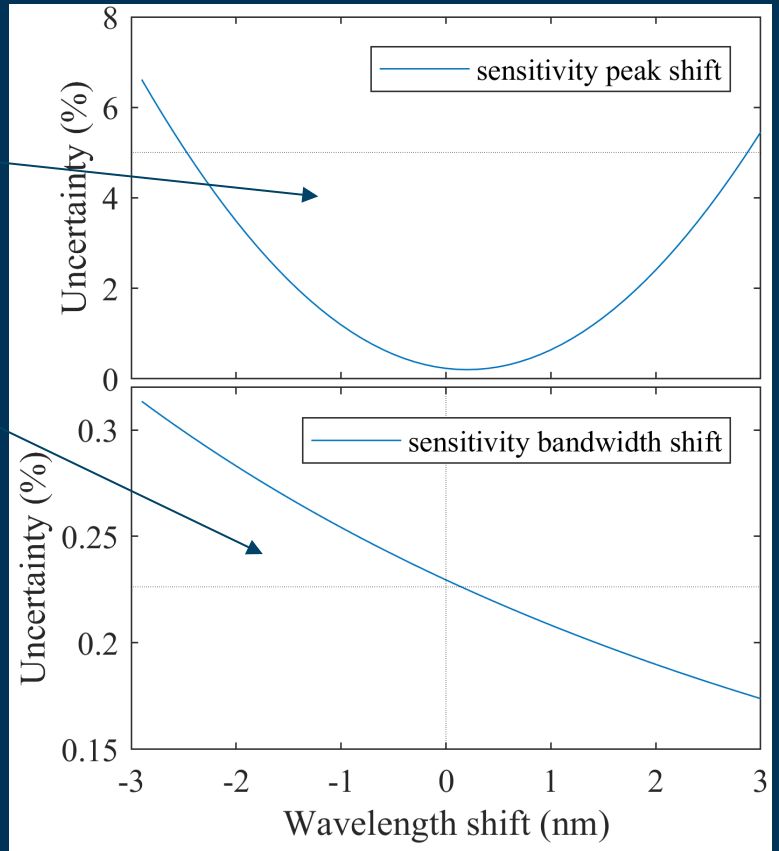




Calibration using Hg LP arc-lamp

Sensitivity peak shift of ± 1 nm -> 1 % irradiance uncertainty
Sensitivity bandwidth uncertainty of ± 1 nm -> 0.25 % irradiance uncertainty



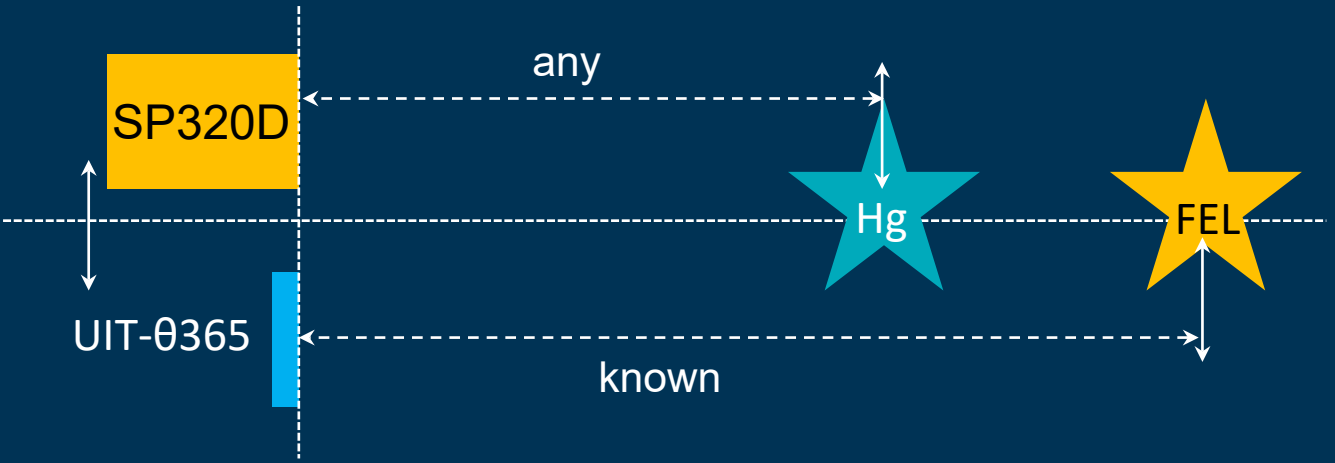


365 nm irradiance line calibration set-up

Instrument System SP 320D / ISP40-101 Spectralon

Hg LP Quartz / FEL standard

365 nm irradiance line calibration procedure



Spectral SP320D measurement

2 lamps (Hg, FEL), 1 detector (IS)

Integrated UIT-θ365 measurement

1 lamp (Hg), 1 detector (USHIO)

$S =$ SP320D raw measurement

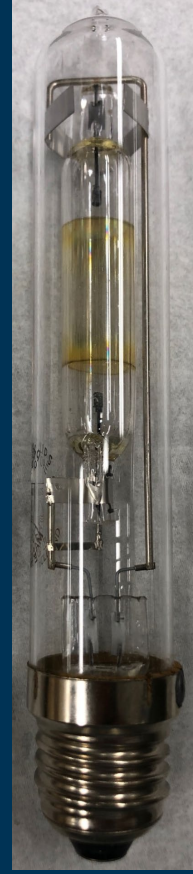
$E =$ irradiance $(\mathrm{mW \cdot cm^{-2} \cdot nm^{-1}})$

$\mathrm{d}\lambda =$ wavelength step (nm)

$U =$ UIT–θ365 measurement $(\mathrm{mW \cdot cm^{-2}})$

$$\frac{E_{Hg}}{S_{Hg}} = \frac{E_{FEL}}{S_{FEL}} \qquad E_{Hg} = E_{FEL}\frac{S_{Hg}}{S_{FEL}}$$

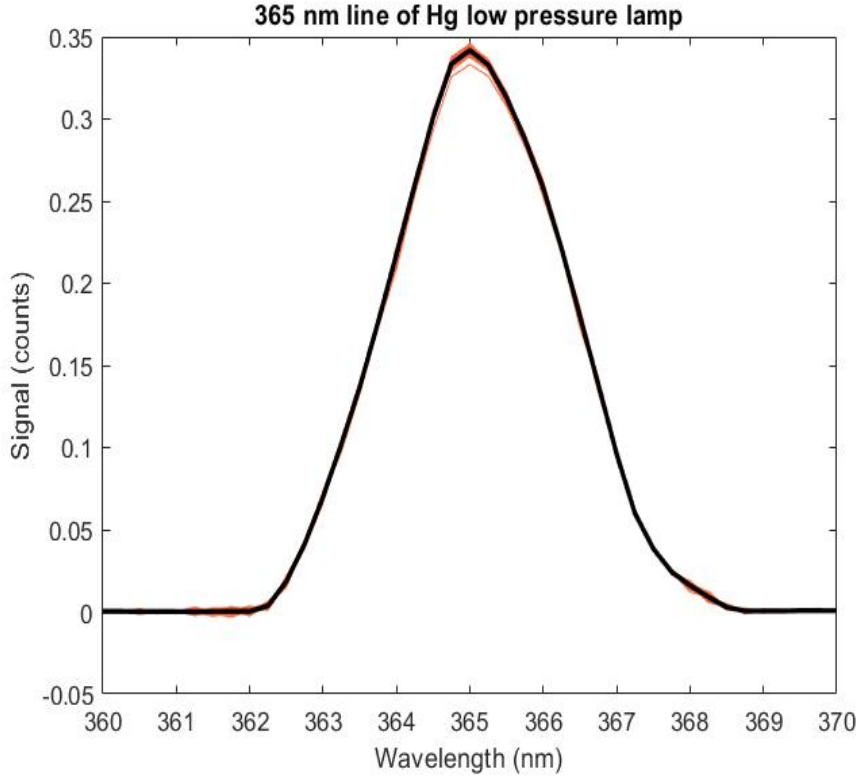
Calibration: $$C = \frac{\mathrm{d}\lambda \cdot \sum E_{Hg}}{U_{Hg}}$$



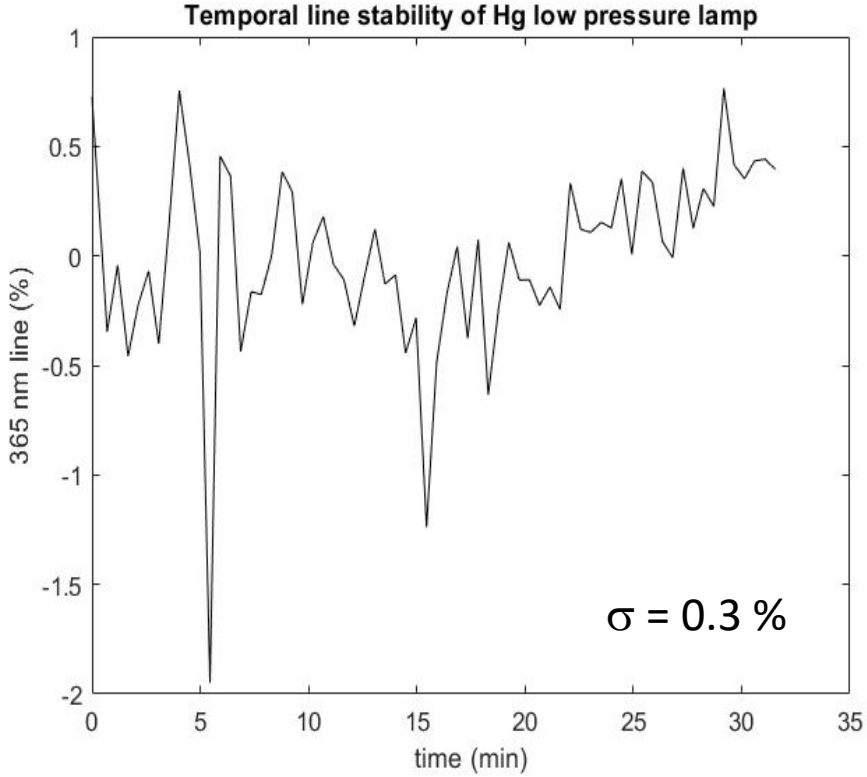
Philips Hg LP 93109

Hg LP temporal stability

Series of 365 nm line, broadened by the 2.5 nm BW

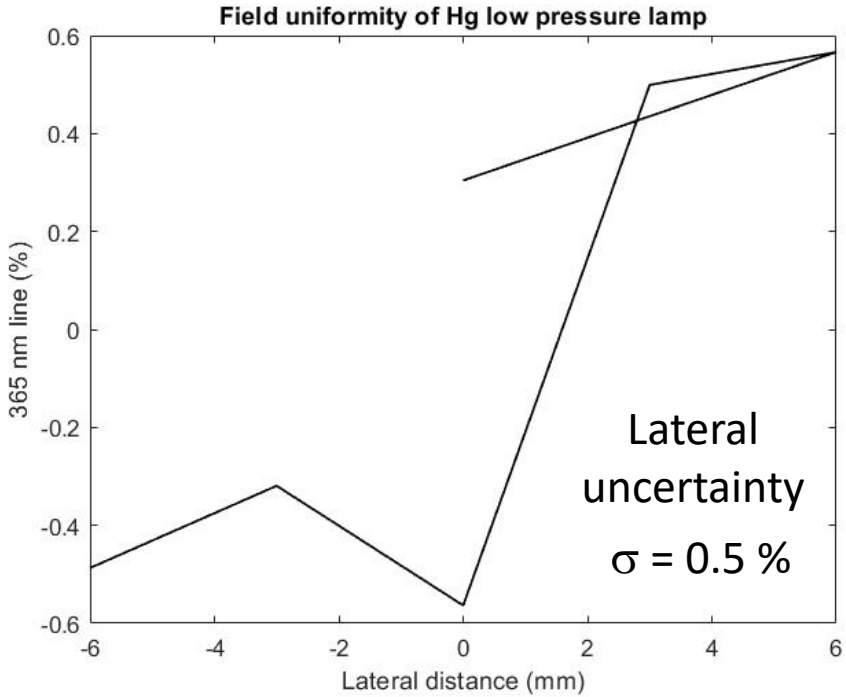


Time-series of percentage variation

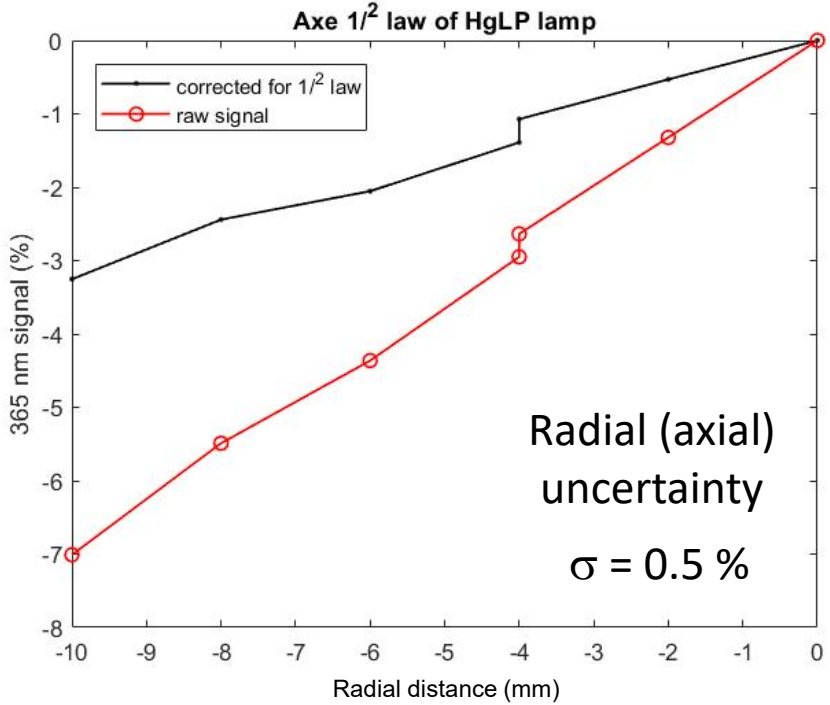


Azimuthal and Radial stability

Series of measurements versus horizontal probe shift



Series of measurements versus axial probe shift



Outcome

- Total uncertainty: SQRT(1^2 + 0.25^2 + 0.3^2 + 0.5^2 + 0.5^2 + 3^2) = 3.25 % < 5 %
- Our FEL standard lamp uncertainty dominates outcome

Conclusion

- Hg LP suitable: sharp 365 nm peak, temporal stability, spatial light uniformity
- Calibration of “graybox” photometer with 3.25 % < 5% uncertainty
- Procedure can be applied to other detectors with poorly known/realised sensitivity curve (photopic/scotopic measurements etc.)

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