



Public Health
England

Autonomous Portable Solar Ultraviolet Spectroradiometer (APSUS)

Rebecca Hooke, Andy Pearson, Phil Miles,
John O'Hagan

Public Health England

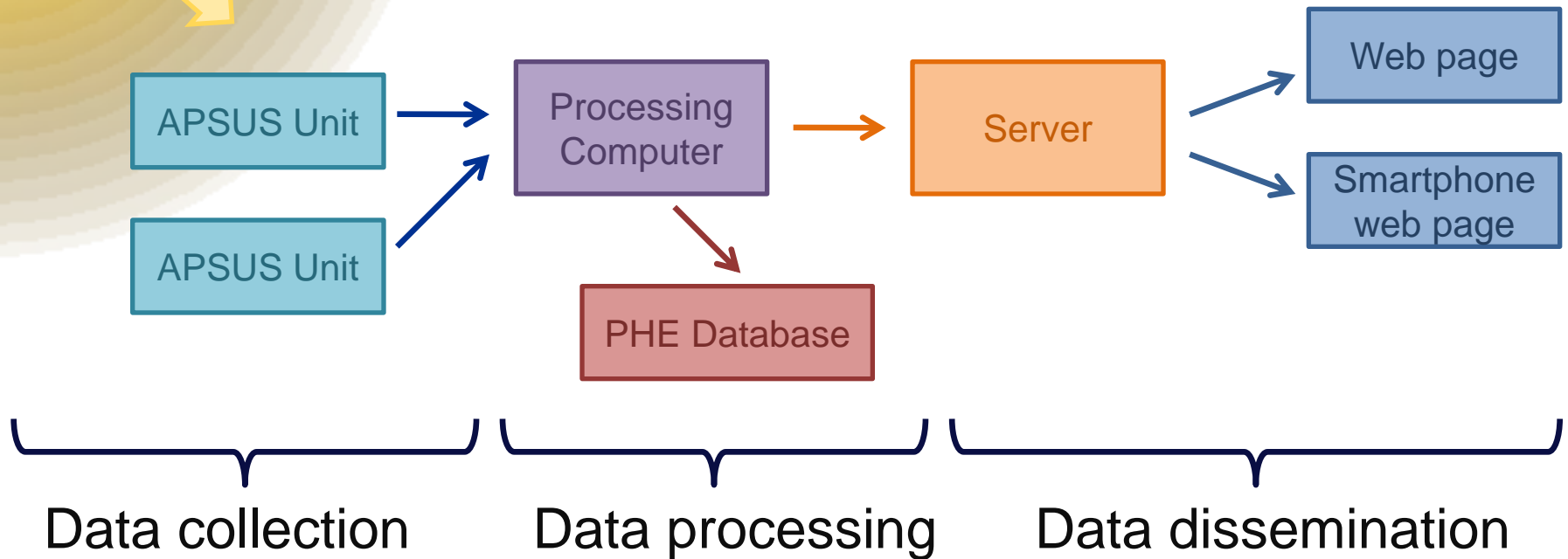
The development of APSUS

- A portable solar UV assessment capability
- Public benefit
- Scientific research benefit
- A spectral system

- APSUS unit
- APSUS system



The APSUS system



APSUS hardware

- Ocean Optics QE65000 diode array spectrometer
- Integrating sphere
- Other components
- Weather-proof housing
- Tripod
- No additional temperature control



Spectrometer: why the QE65000?

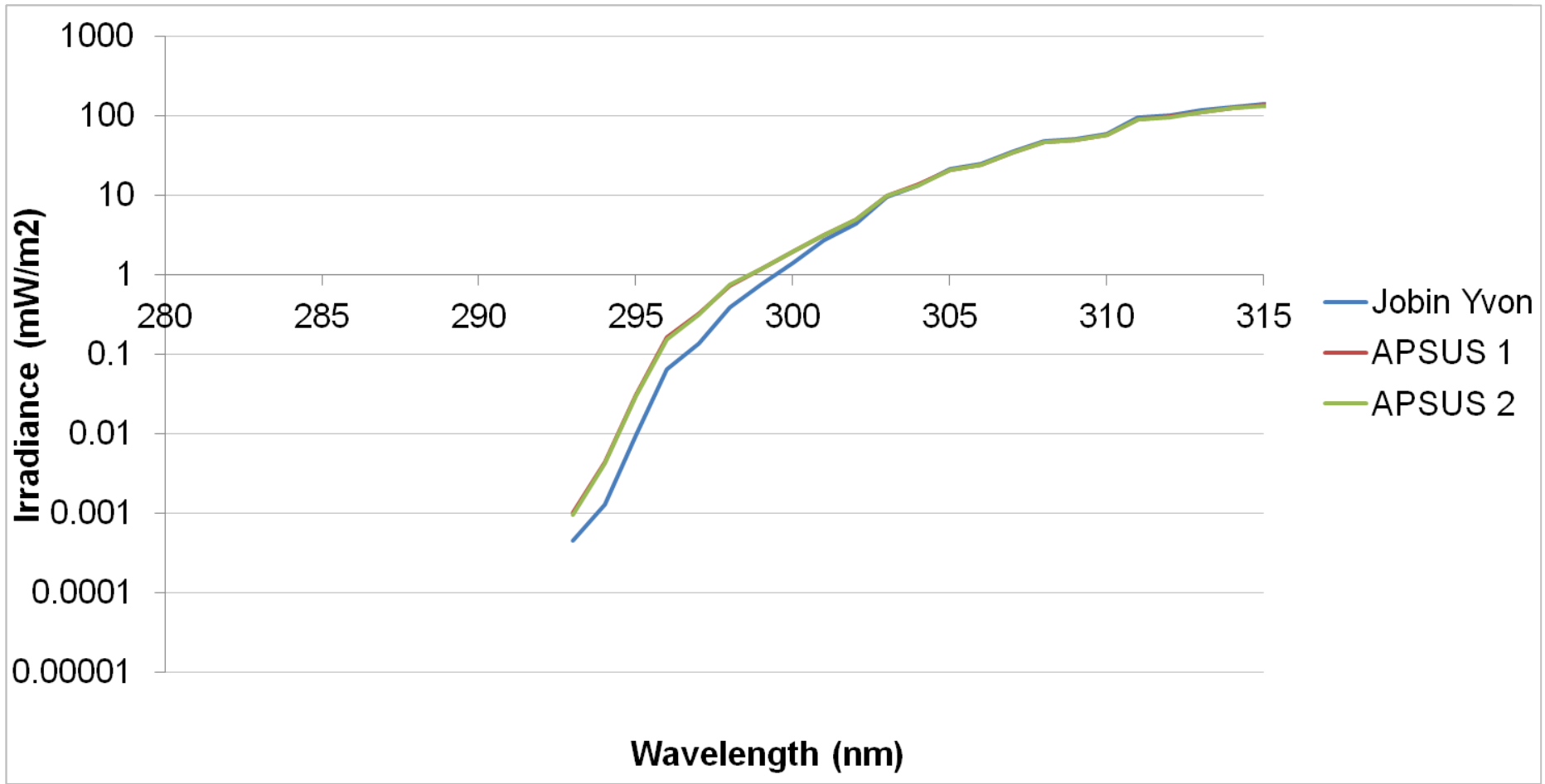
- Measurement of the shortest UV wavelengths:
 - Highest dynamic range
 - High signal to noise ratio
 - Thermoelectric array cooling
- Most suitable spectrometer
- Modifications:
 - 50 μ m slit
 - Solar blind filter



Irradiance calibration

- Using solar spectrum and Jobin Yvon D3-180 spectroradiometer
- Jobin Yvon calibration traceable to PTB
- 12 noon, 22 July 2012

Irradiance calibration



Irradiance calibration

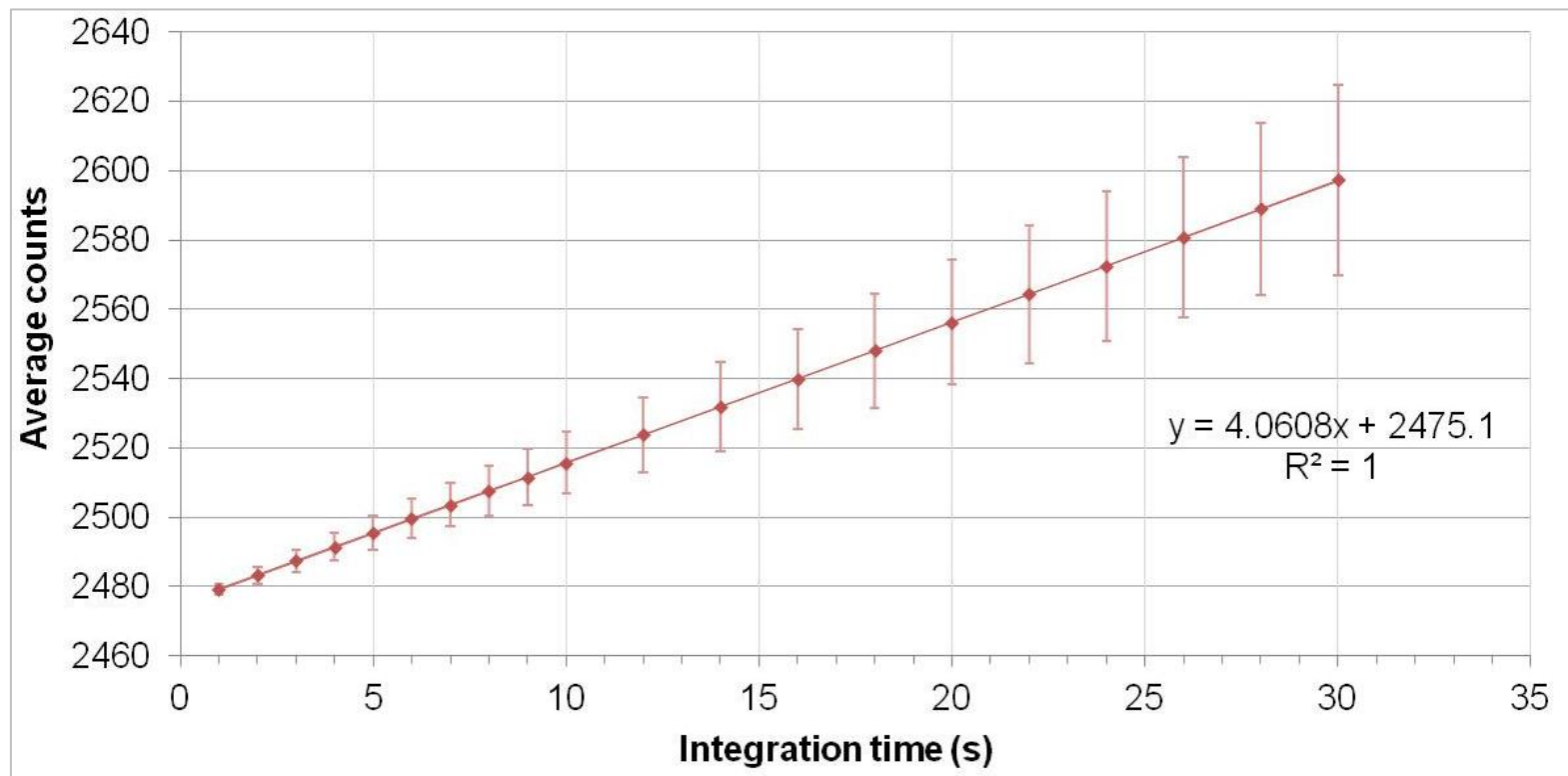
- Using solar spectrum and Jobin Yvon D3-180 spectroradiometer
- Jobin Yvon calibration traceable to PTB
- 12 noon, 22 July 2012
- Minimises stray light contribution

Effect of temperature on measurement

- Thermoelectric array cooling kept at -10°C
- Background is stable from 20°C to 40°C
- Variation in sensitivity:
 - 17% from 0°C to 20°C
 - 5% from 20°C to 40°C
- Wavelength measurement is stable from 20°C to 40°C
- Internal temperature should be kept between 20°C and 40°C to minimise variation

Dark signal

- Linear relationship between average dark signal and integration time

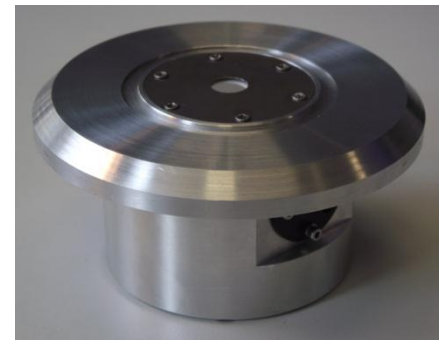


Dark signal

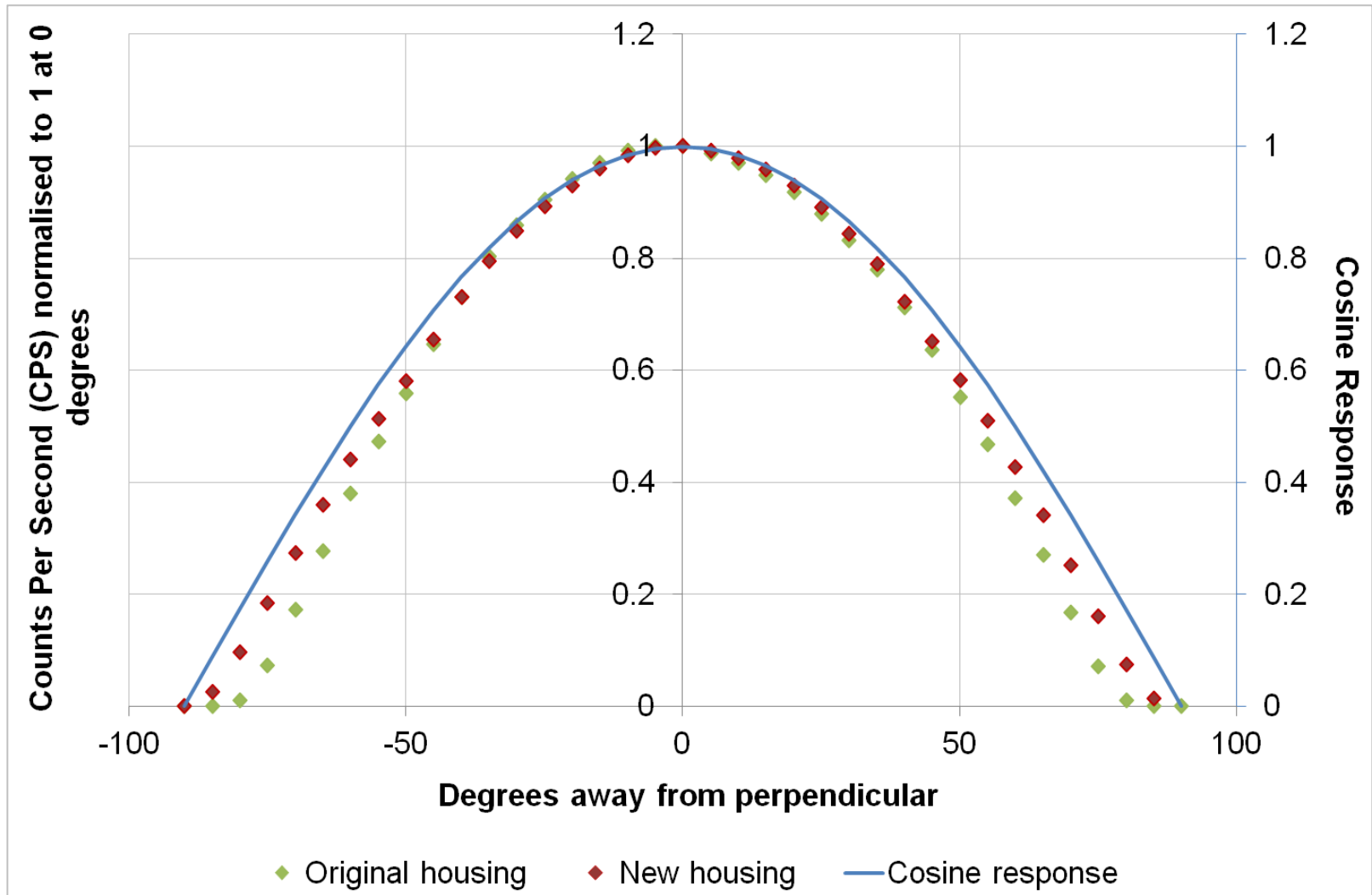
- Linear relationship between average dark signal and integration time
- Model developed that approximates dark signal as spectrally flat
- One standard deviation difference at time of calibration would give rise to $<0.05\%$ variation
- No requirement for dark signal measurement

Angular response

- Custom made integrating sphere housing
- Optimised for angular response

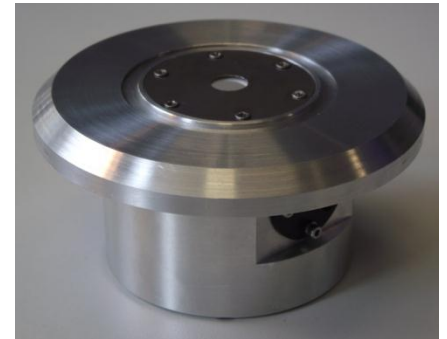


Angular response



Angular response

- Custom made integrating sphere housing
- Optimised for angular response
- Angular response improved with new input



Summer 2012 measurements

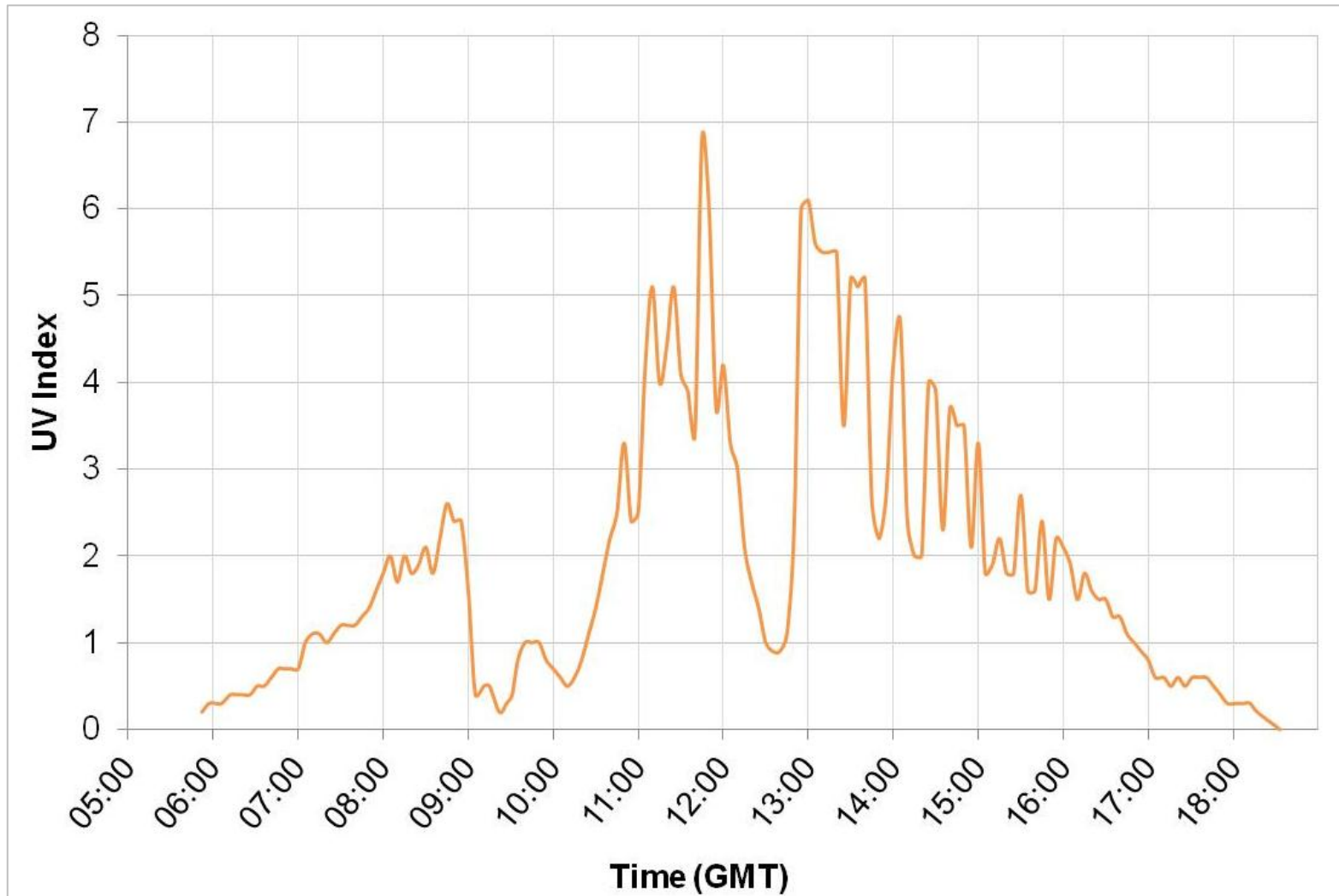
- Measurements taken at main Olympic sites:

London

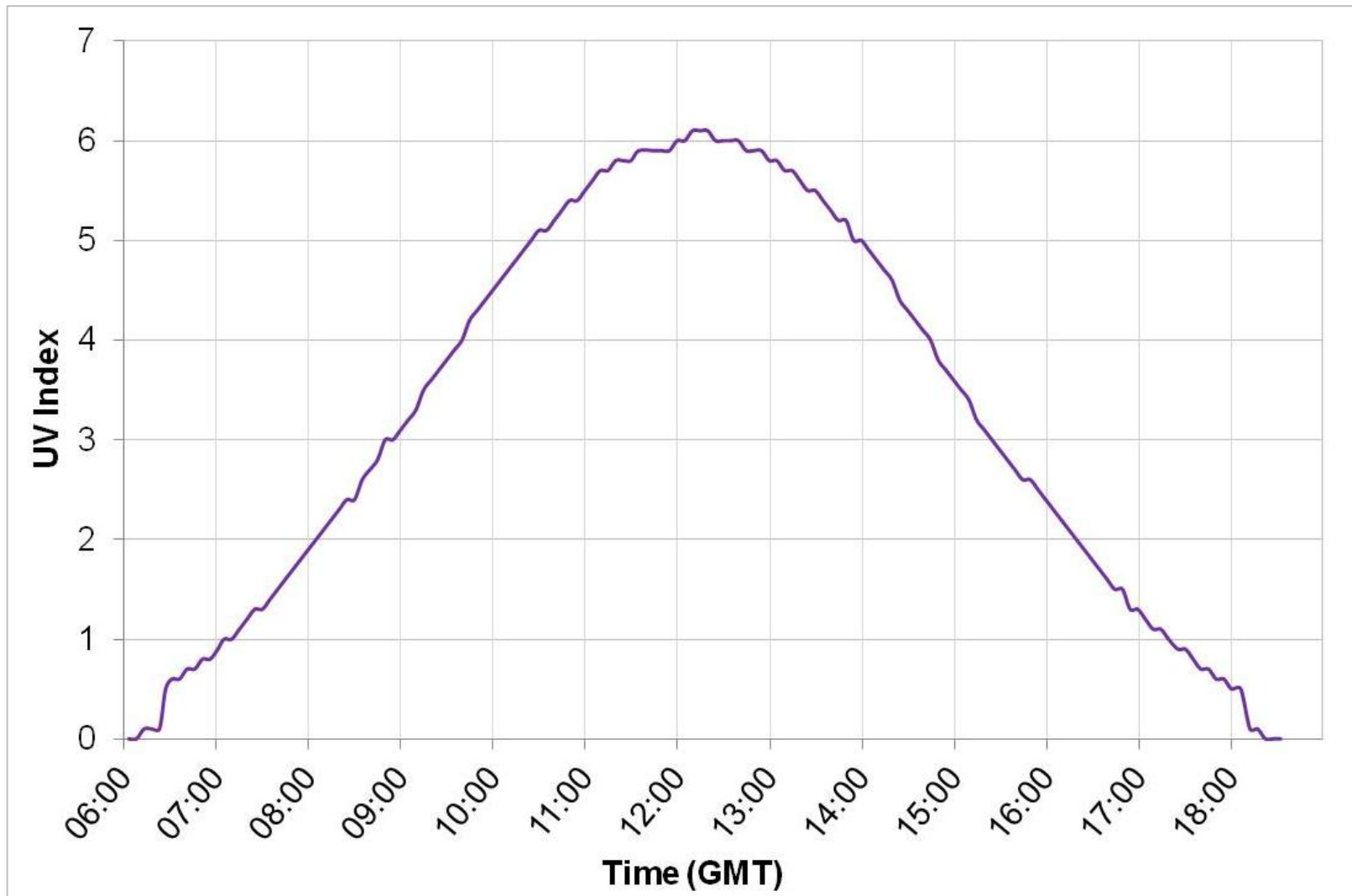
Weymouth



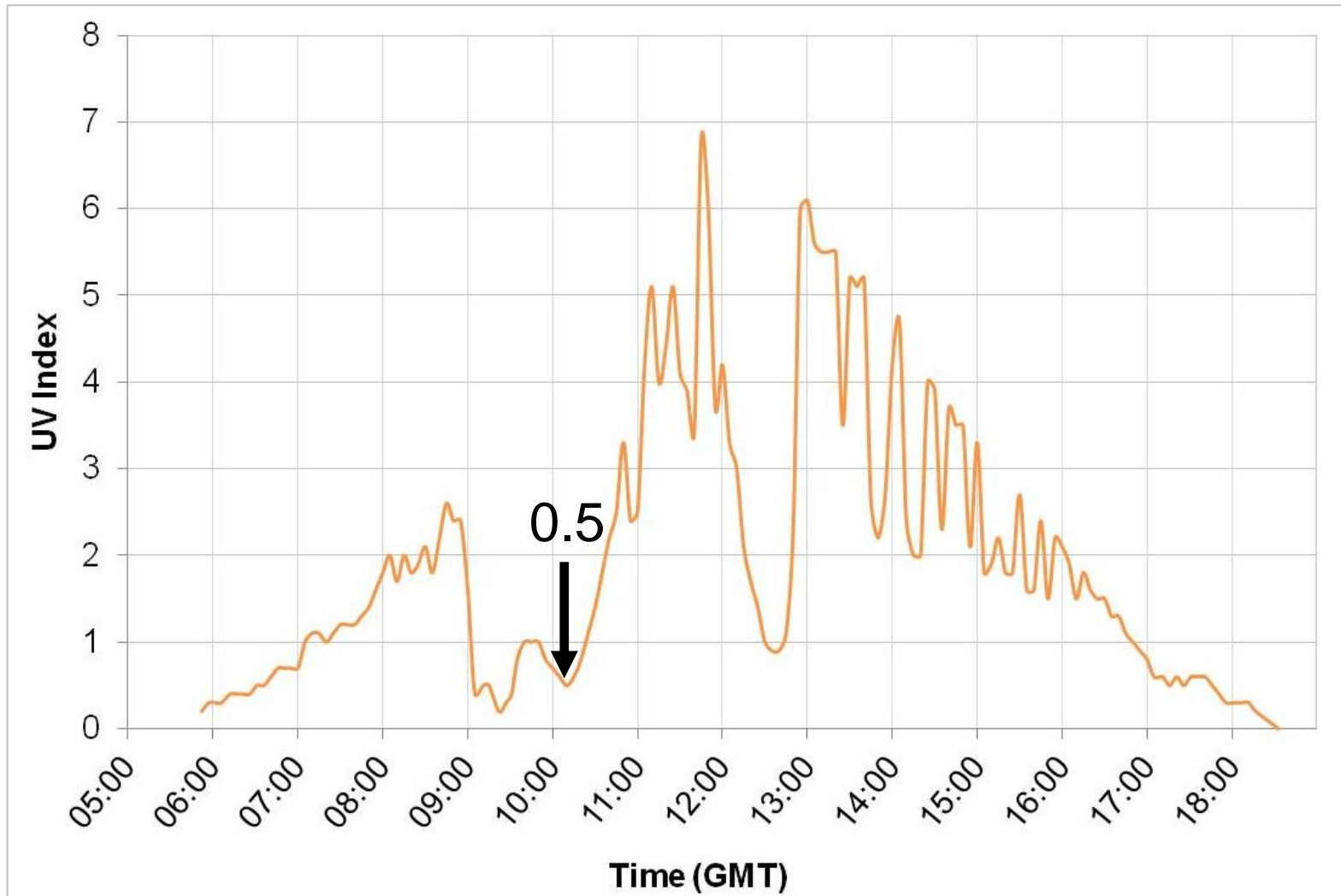
Summer 2012 measurements



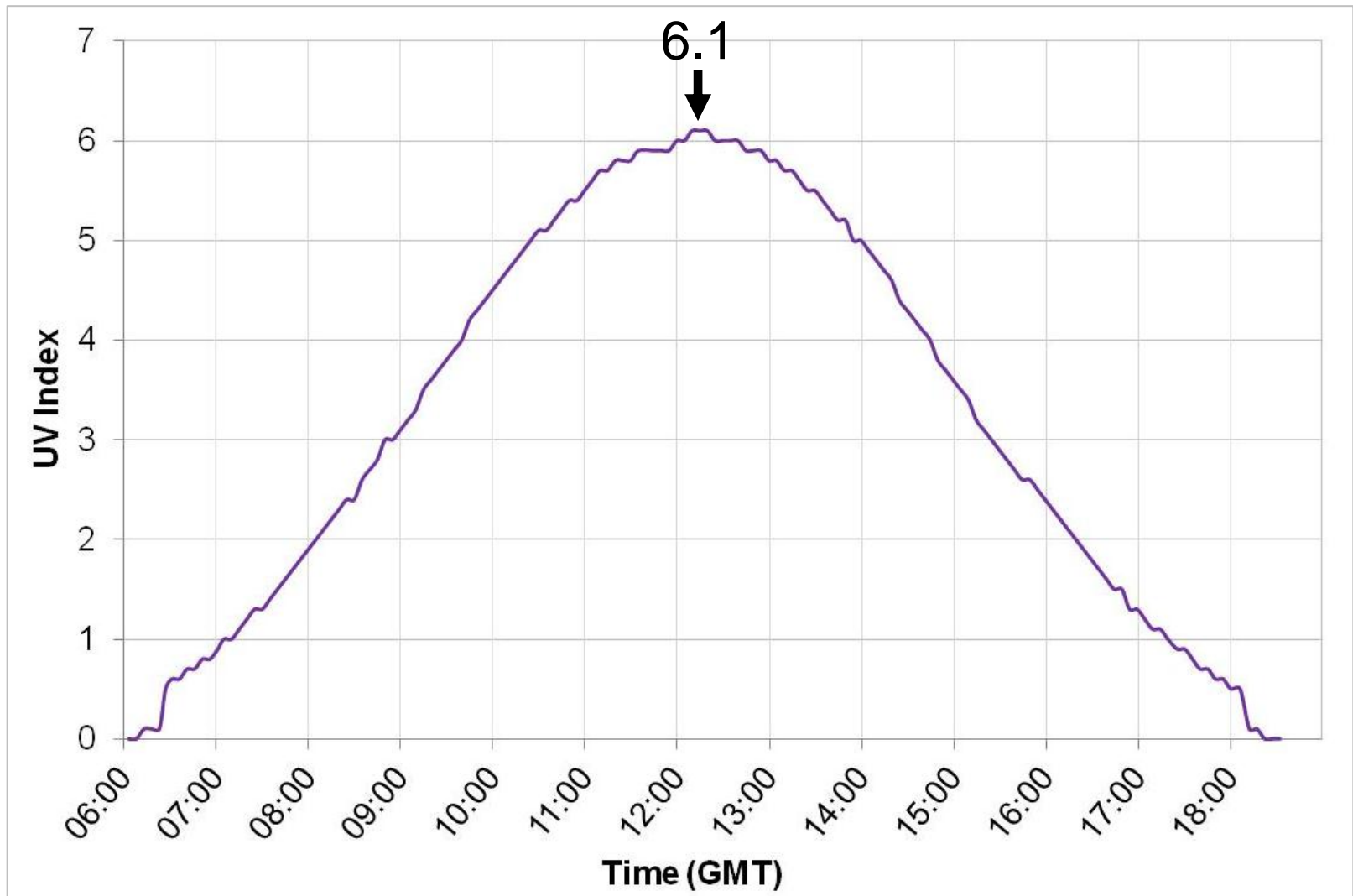
Summer 2012 measurements



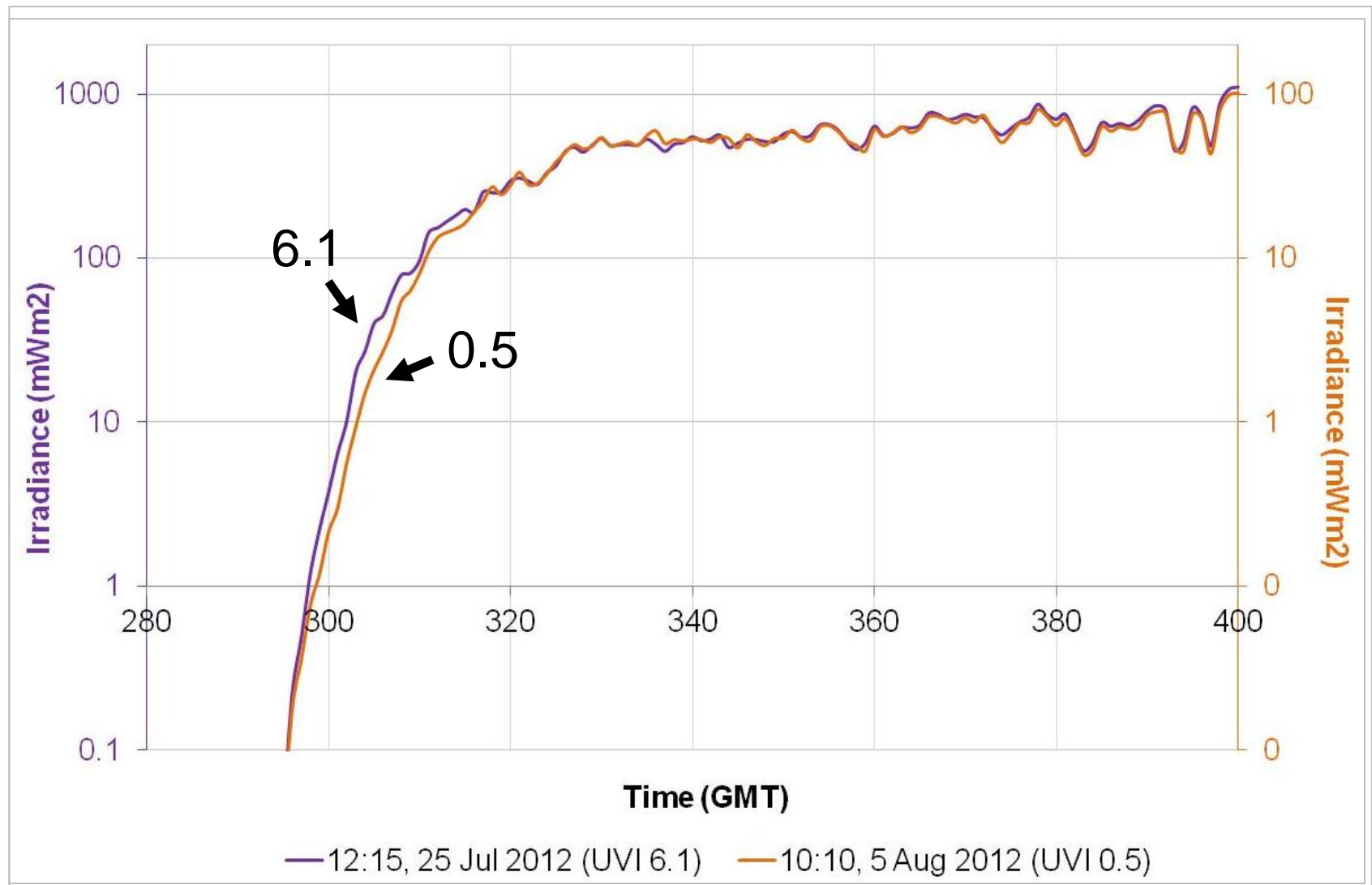
Summer 2012 measurements



Summer 2012 measurements

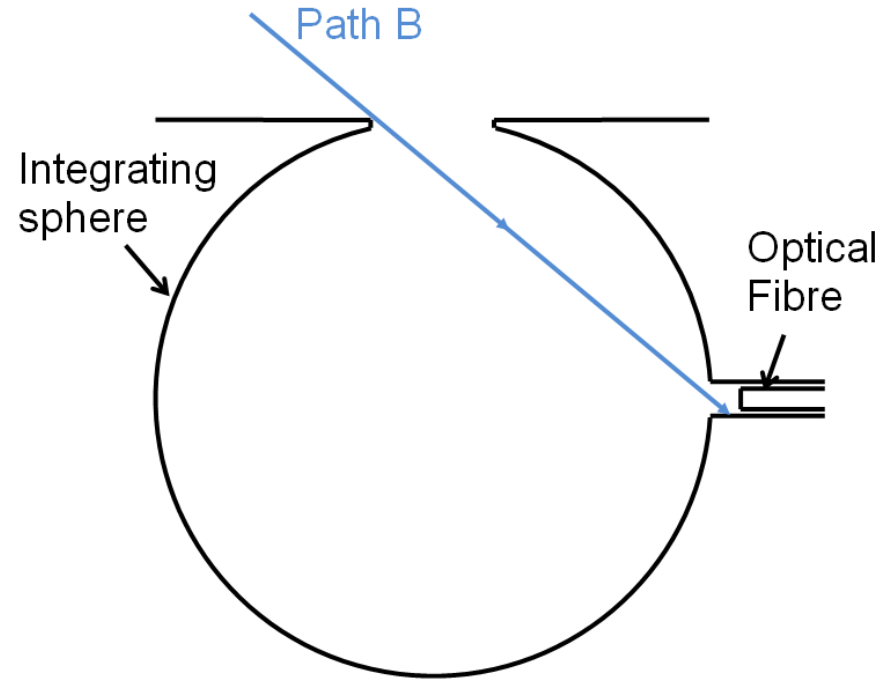
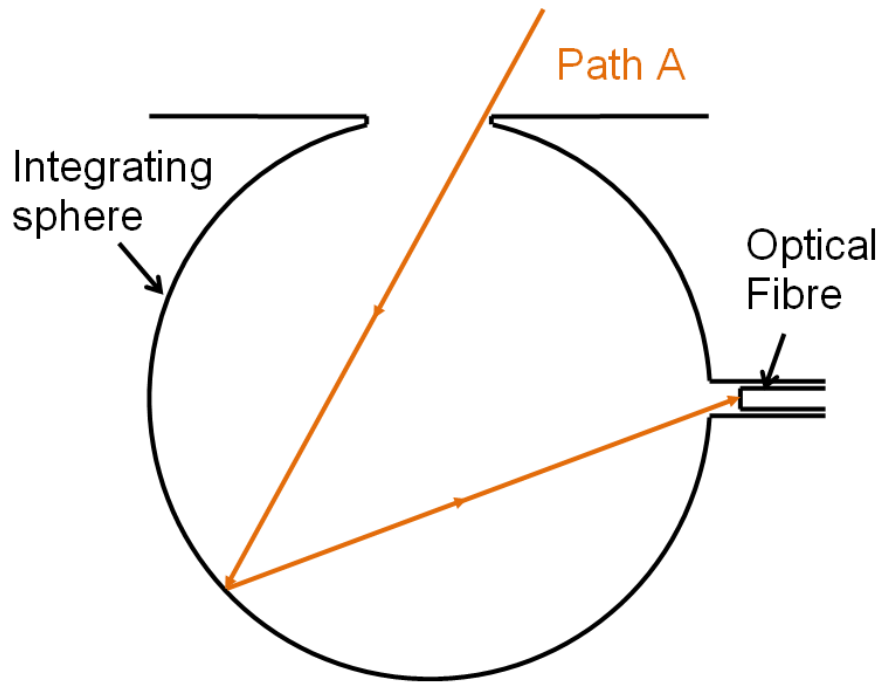


Summer 2012 measurements



Limitations

- Hot spot and dim patch effect



Limitations

- Hot spot and dim patch effect
- QE65000 thermoelectric cooling is not robust
- Limitations due to ambient temperature
- Web pages are not yet live

Looking forward

- Further weighting functions
- More detailed dark signal modelling
- Further characterisation
- Paper submitted
- Significant step forward



Acknowledgements

- National Institute for Health Research (NIHR)
- Technology Development Group, PHE
- Many other people!

Thank you
Any questions?