

## **EURAMET TC-PR**

# **Highlights and Scientific Challenges**

**G07-10-03**

**Marek Šmíd, TC-PR Chair**

**ČMI, Czech Republic**

## TC-PR Research Activities with Global Impact (EMPIR)

### *Fundamental research:*

- *Developing new primary standards for radiometry*
- *Metrology for emerging technologies – quantum optics*



### *Optical measurements for ENVIRONMENT:*

- *Traceability for surface spectral solar ultraviolet radiation*
- *Metrology for Earth Observation and Climate*

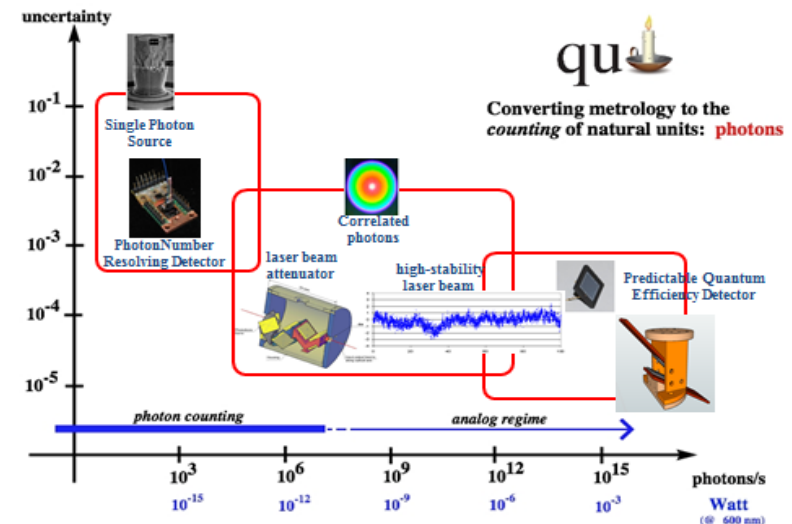
*SolarUV*

*Met EOC*



# New primary standards and traceability for radiometry

Follow-up JRP 2.3 Qu Candela (iMERA Plus):



## IMPLEMENTATION & MANAGEMENT

WP7 - MANAGEMENT

### WP1- PQED for absolute radiometry

- Manufacture new set of single photodiodes
- PQED Traps from single photodiodes
- Predict responsivity of PQED
- Towards radiometric determination of fundamental constants

### WP2- CT-PQED cryogenic primary standard @ 1 ppm

- Optimise CT-PQED
- Tools for the experiment
- Validation: PQED against PQED
- Validation: PQED against cryogenic radiometer
- CT-PQED in-house stability with time

### WP3 – RT-PQED room temperature primary standard @ 100 ppm

- RT-PQED characterisation
- Predictability under common experimental conditions
- Validation over wavelength (360-900 nm) at 100 ppm

### WP4 – RT-PQED applications to photometry, radiation thermometry and fibre optics

- reference luxmeter for photometry
- filter radiometer for radiation thermometry
- fibre optic power meter

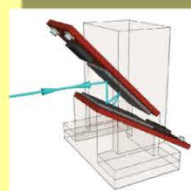
### WP5 - RT-PQED as travelling artefact for spectral responsivity

- Realisation of travelling artefacts
- Test on travelling artefact
- Star-like comparison (Europe and outside)

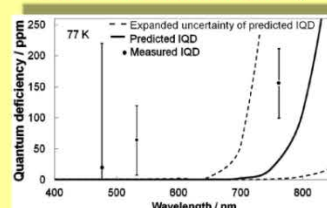
### WP6 - IMPACT

#### Improved standard diodes

$$R(\lambda) = \frac{e}{h} \frac{\lambda}{c} * (1 - \rho(\lambda)) * (1 - \delta(\lambda))$$



#### Measurement of h/e



**Cost reduced by a factor of 10 !!!**

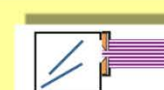
**User friendly and cost-effective  
primary standard**

**Photometry  
Thermometry  
Fibre optics**

Source of uncertainty: diffraction,  
beam geometry, ...



**Power**



**Irradiance**







## *Metrology for emerging technologies – quantum optics*

**Quantum Key Distribution - the only viable solution to future proofing the security of our data**



# Metrology for Industrial Quantum Communication Technologies

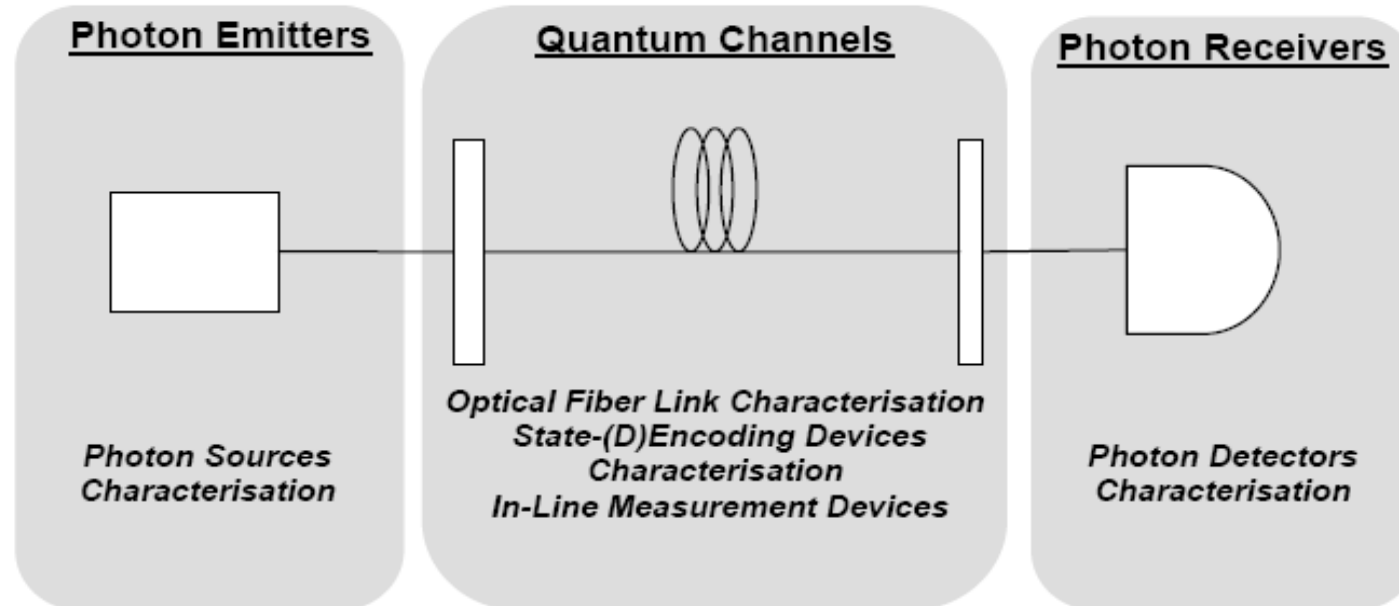


5





## Key Outputs of MIQC



- **Objective :** to develop a pan-European measurement infrastructure to develop standards and characterisation facilities for commercial Quantum Key Distribution (QKD) devices.



## TC-PR Research for ENVIRONMENT/ CLIMATE MONITORING

## Current measurement uncertainties - the barrier for further improvement of forecast model for predicting climate and climate changes

## WMO BSRN Target uncertainties - four main radiation parameters:

- **direct solar irradiance**                    **1.5 Wm<sup>-2</sup> (or 0.5 %);**
- **diffuse solar irradiance**                **3 Wm<sup>-2</sup> (or 2 %);**
- **downward longwave irradiance**                **3 Wm<sup>-2</sup> (or 2 %); -**
- **global irradiance**   **5 Wm<sup>-2</sup> (or 2 %).**

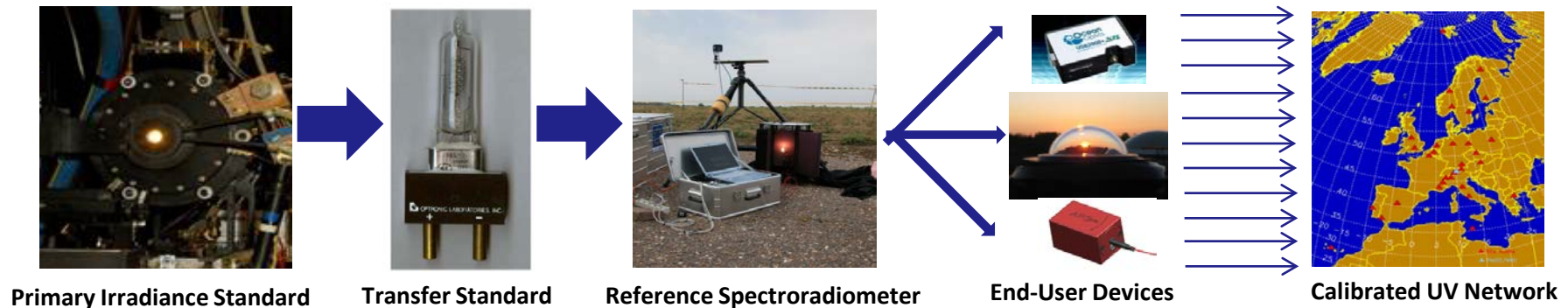
## NMIs role:

- to shorten traceability chain from NMI to end-user
- to develop transfers standards and methodologies
- to provide KT, trainings, ...

## ENV03: Traceability for surface spectral solar ultraviolet radiation"

**Project Coordination:** *Dr. Julian Gröbner, PMOD WRC Davos*

*pmod wrc*



- Enhance the reliability of spectral solar UV radiation measured at the Earth surface
- Develop new techniques and devices for traceability improved 5% -> 2%
- Disseminate: Intercomparison Campaigns and Workshops





# ENV04: Metrology for Earth Observation and Climate

Towards establishing a European Metrology Centre for Earth Observation and Climate

Project coordinator: Nigel.Fox@npl.co.uk



## Objective:

To provide globally sampled data of the Earth system with trustable accuracies sufficient to detect small signal changes over decadal timescales from a background of natural variability

## Steps towards:

- Pre-flight and In-flight calibration of radiometric meas. systems
  - standards to maintain traceability: plate black body radiators
- to establish SI traceability in orbit – TRUTHS
- Training on uncertainty analysis
- support to : ESA, EUMETSAT, EC  
& international organisations: WMO, CEOS, GEO, GCOS ...

