



## Highlights from TC-PR

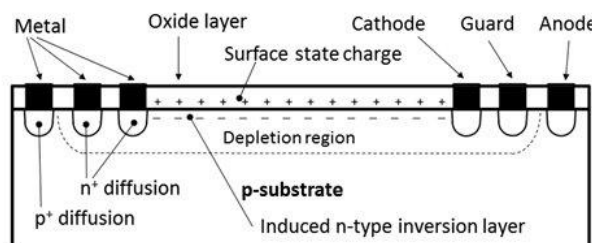
Jarle Gran, Justervesenet,  
TC-PR Chair (in 2 more days)

Madrid and Tres Cantos, Spain  
15 – 18 May 2017

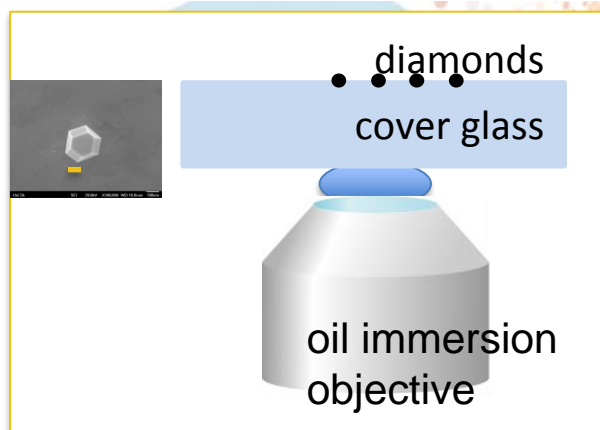


# Previous presentations

- 2015:



- 2016:



SIQUTE  
ZIONTE

- All projects based on **quantum metrology** and were complementary in terms of predictable sources and detectors and covers different dynamic range (with a slight overlap). The excellent work is **of strategic importance** and planned to continue in present fundamental call for both technologies supplemented with **new ideas and their promising results**.

# EMRP project completing 2017

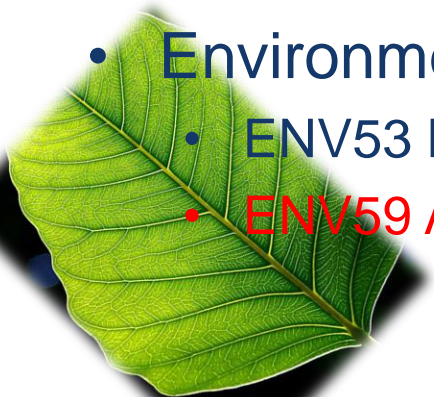


- Environment

- ENV53 MetEOC2 – Metrology for earth observation and climate
- ENV59 Atmoz – Traceability for atmospheric total column ozone

- Energy

- ENG55 PhotoClass – Towards an energy-based parameter for photovoltaic classification
- ENG62 MESaiL – Metrology for efficient and safe innovative lighting



- Ozone

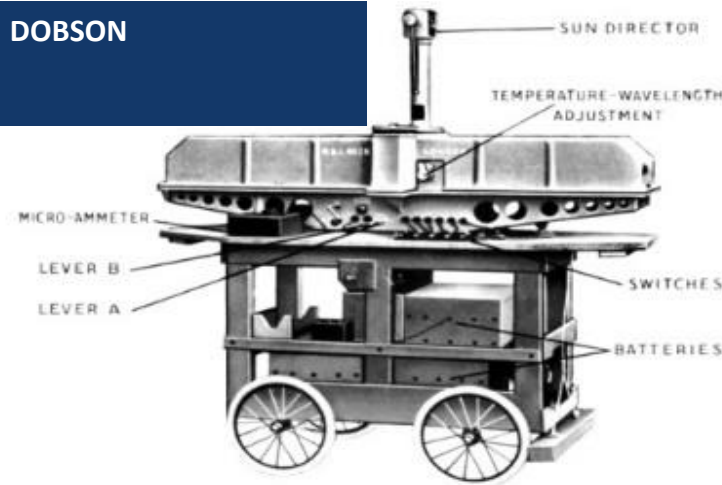
- Absorbs UV light - prevents **sun burn, skin cancer etc.**
- UVB radiation 100s of millions more intense outside atmosphere
- Human produced CFCs destroyed ozone layer since 1970s
- Montreal treaty (1987) reduced ozone depletion – But, NO recovery observed and model projects no recovery before ~2050 - 2070
- Defined as an **essential climate variable**
- Recovery to pre-1970 levels?
- Measure with 1 % accuracy



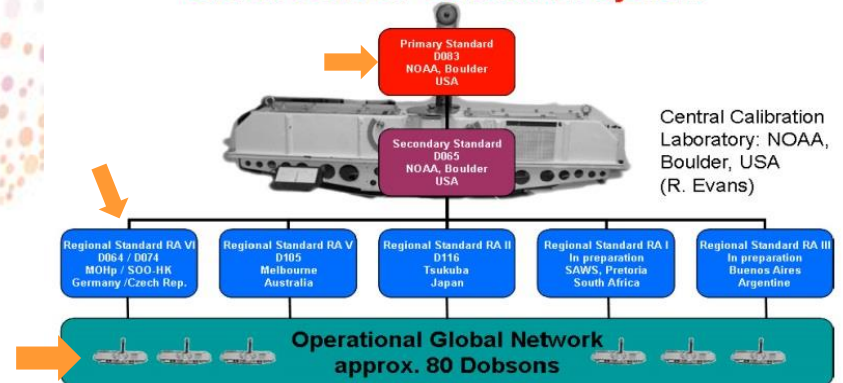


## A traceable and harmonized Global Total Column Ozone Network

DOBSON



### Global Dobson Calibration System



Calibration of station instruments: Dobson intercomparisons (every 4 years, to be extended) (Ulf Köhler): Responsibility of Regional Calibration Centers



Global network of approx 80 instruments  
Consistency between instruments to 0.5 %  
Operational history since 1926

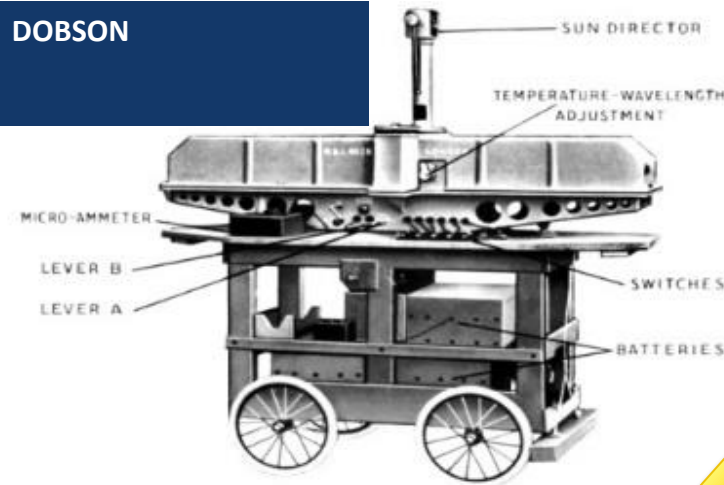


Manually operated  
Cost intensive  
Stopped manufacturing



## A traceable and harmonized Global Total Column Ozone Network

DOBSON

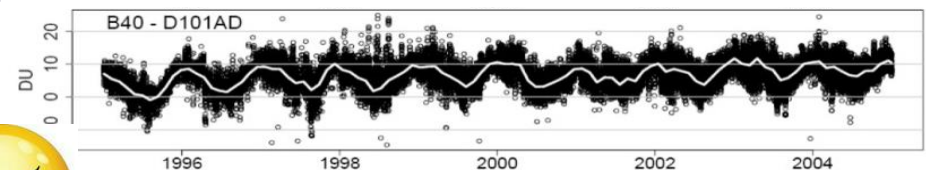


No good way of linking pre 1970 with post 1970 results



1980s

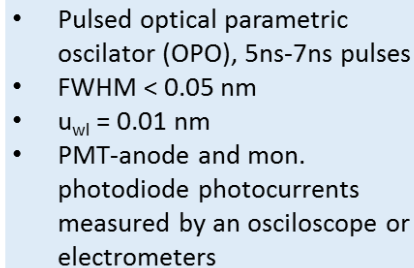
1) Seasonal relative total ozone differences of up to 3% between Brewer and Dobson:



Scarnato et al., 2009



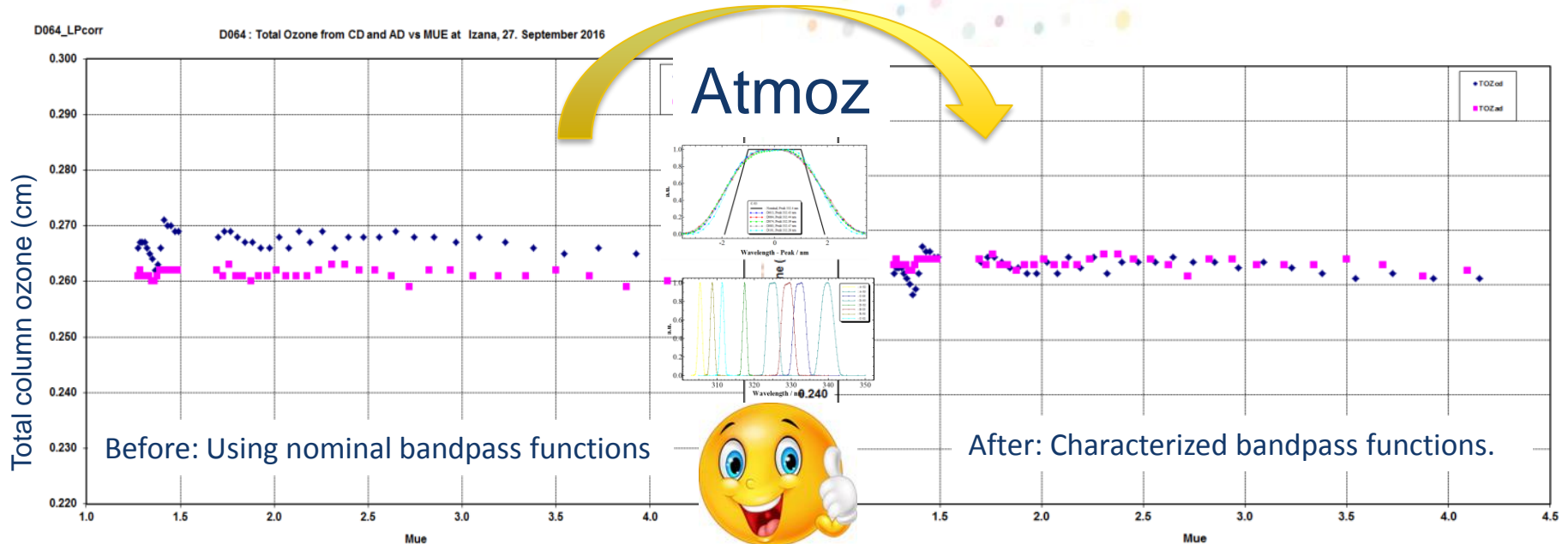
- With tuneable laser at PTB:  
D064(DWD), D083(NOAA), D101(Arosa), D013(Portugal)



The diagram illustrates the optical layout of the Large Binocular Telescope (LBT). It shows the path of light from the 'Optical Table' at the top, through a 'Monochromator', a 'Parabolic Mirror', an 'Aperture', a 'Flat Mirror', and a 'Beam Splitter' into the 'Light Tight Box'. Inside the box, the light passes through an 'f/10' lens, a 'Monitor Detector', and another 'Flat Mirror' before reaching the 'Optical Entrance' and 'Dobson Unit' at the bottom. A 'Maxi-Arc Source' is also shown on the right side of the optical table.

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## A traceable and harmonized Global Total Column Ozone Network



- 🧐 Work by Atmoz solved discrepancy between channels of Ozone measurements
- 🧐 Major impact on linking global network centennial data pre- and post ozone depletion 1970s
- 🧐 Enabling replacement of instrument and reliable SI traceable data.

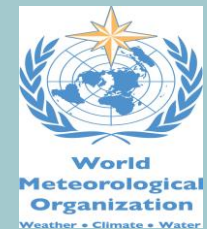




## A traceable and harmonized Global Total Column Ozone Network

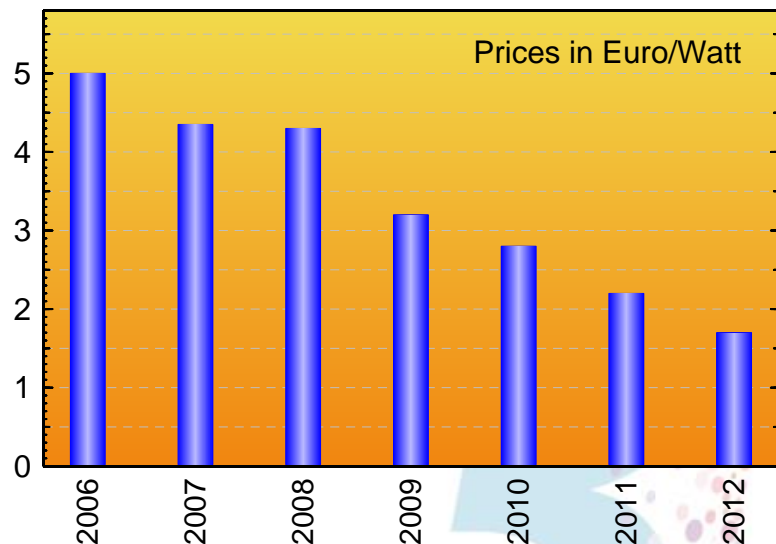
- **Project Coordination:** SFI DAVOS,  
*Julian Gröbner pmod wrc*
- **Duration:** 10/2014 – 9/2017
- **Total Budget:** 2.5 M€
- **9 Partners** NMI-DI, Industry, Universities

### Stakeholders and Collaborators

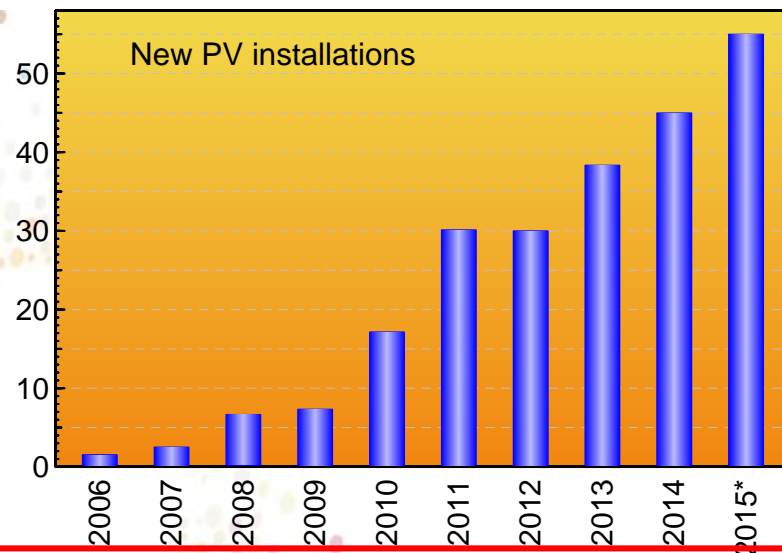




System prices for end customers  
in Euro / Watt



Yearly worldwide newly  
installed PV Power / GW



## Standard test conditions

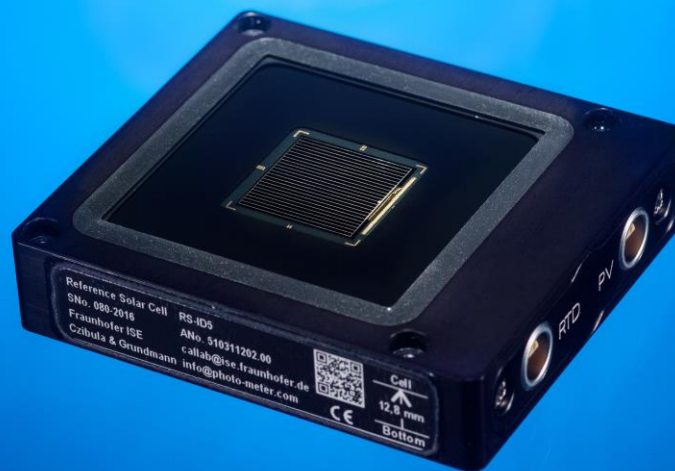
- Reference solar spectrum AM1.5
- Irradiance  $E_{STC} = 1000 \text{ W/m}^2$
- Cell temperature  $25^\circ\text{C}$
- Undefined angle

Peak-Power conditions



Photometry and  
Radiometry

Financial success depends on energy generation of installation



New reference device

- Stability  $< 0.1 \%$
- Wider spectral range
- Improved linearity
- Cell technologies

Covers a wider range of operational conditions and enables the determination of the TRUE energy production of an installation





Standardisation	Publication type (Edition)	Publication date	Current Stage	Next Stage	Abstract
<a href="#">IEC 61853-2</a>	International Standard (1.0)	2016-09-06			IEC 61853-2:2016 defines measurement procedures for measuring the effects of angle of incidence of the irradiance on the output power of the device, determines the operating temperature of a module for a given set of ambient and mounting conditions and measure spectral responsivity of the module. A second purpose is to provide a characteristic set of parameters which will be useful for detailed energy predictions. The described measurements are required as inputs into the module energy rating procedure described in IEC 61853-3.
IEC 61853-3		2018-01 (Fcst.)	ACDV 2016-04	TCDV 2016-09	
IEC 61853-4		2018-01 (Fcst.)	ACDV 2016-04	TCDV 2016-09	



MEMS based system by NPL improves characterizations with less measurements and increased speed

Prices: Loughborough University

*Best Paper Prize* at the 11th Photovoltaic Science Application and Technology (PVSAT-11) conference

*Best Student Award* during 31st European PV Solar Energy Conference and Exhibition (31st EU PVSEC).







## Funded Partners (NMI, EU):



## Unfunded Partners (Industry):

Scuola universitaria professionale  
della Svizzera italiana

**SUPSI**



## REGs (Universities, Research Institutes)



Thank you for your attention!

