Riga Technical University
Institute of Telecommunications

RIGA TECHNICAL UNIVERSITY
Faculty of Electronics and Telecommunications

AFFOC Solutions

«Quantum Optics and Photonics 2021»

Microsphere-based OFC-WGMR multi-wavelength source and its applications in telecommunications

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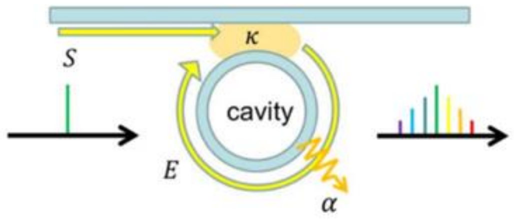
Microsphere-based OFC-WGMR multi-wavelength source and its applications in telecommunications

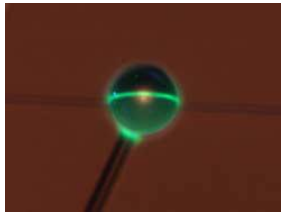
The ”***Development of optical frequency comb generator based on a whispering gallery mode microresonator and its applications in telecommunications***” project aims to obtain new knowledge on whispering gallery mode resonator-based optical frequency combs (WCOMBs) and to develop, construct and test a comb generator prototype for telecommunication applications. The planned result of the project is the portable WCOMB prototype for commercial fiber optical communication systems.

The created WCOMB will achieve the following requirements:

- ✓ *provide a frequency comb in the optical C-band (1530-1565 nm), with the number of channels corresponding to 2n (n – integer number) that is typical number of FOTS solutions (such as 8, 16 channels)*

- ✓ *channels' spacing interval between the (WGM) resonator's frequency comb maximum peaks corresponds to the spacing intervals of wavelength-division multiplexing (WDM) transmission system data channels specified by (ITU-T G.694.1) recommendation (such as 100 and 50 GHz).*



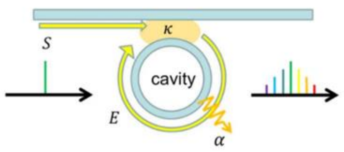


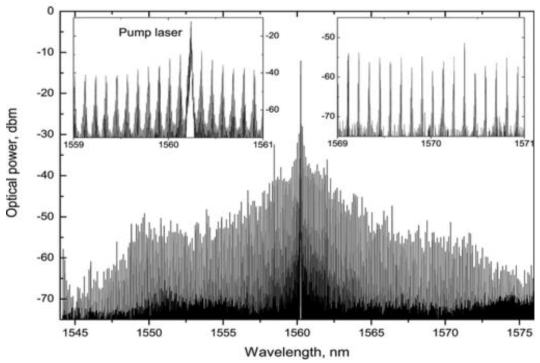
Why does we need optical frequency combs (OFC)?

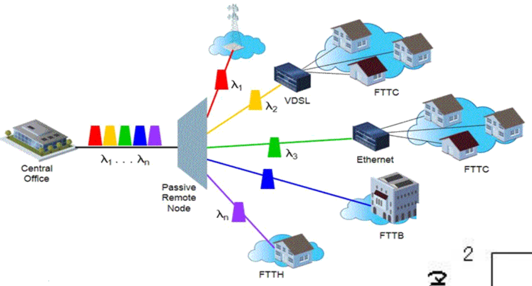
Telecommunications - sending information remotely using a medium. Nowadays, the transmission of information is performed by electrical or optical devices, which ensure the rejection of signals at high speeds, long distances and large volumes.

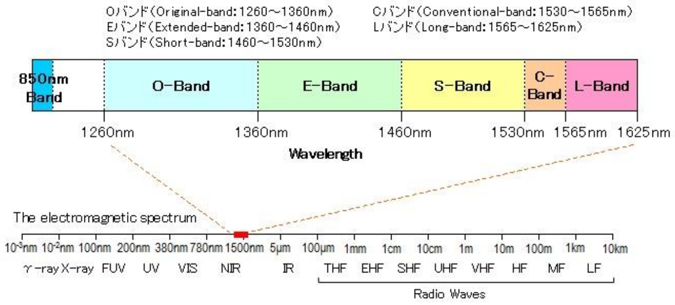
Optical frequency combs (OFC generators) are used for a variety of applications and have been used in such technologies as: *optical clocks*, *RF photonic oscillators*, applications requiring a *precise optical frequency reference*, *microwave systems*, coherent *optical communications in the field of telecommunications*, etc.

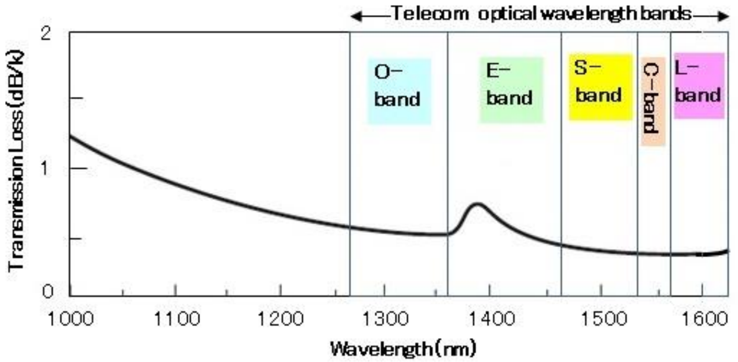
Growing demand for increasing data volumes and transmission speeds, which can be largely provided by NG-PON2 networks. The *OFC-WGMR is a future Spectral and power efficient solution for the NG-PON2 networks*.







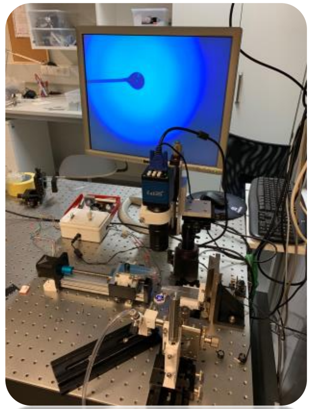


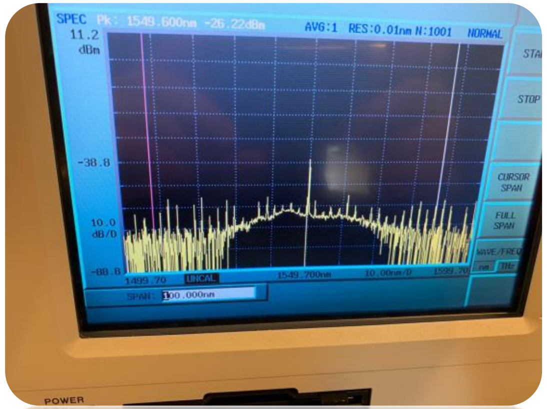


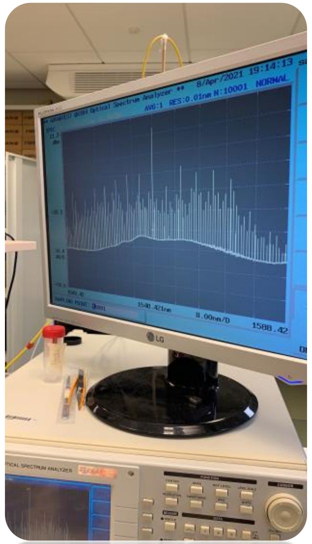
OFC applications in telecommunication systems

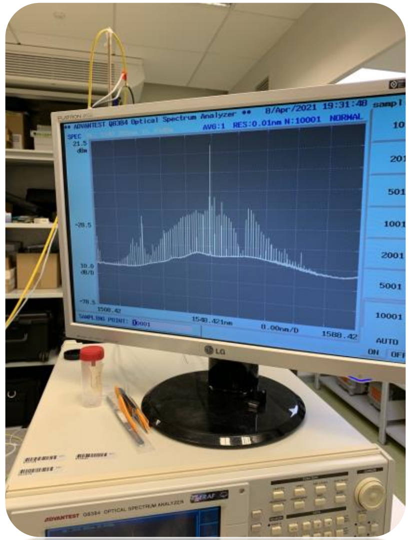
- ***In fiber optical communication systems*** for data channel typically a *single light source is used*, for example, WDM systems. To enlarge the data transmission rate, multiple light sources can be used WDM data transmission technology (*where laser arrays are used as a light sources*) is expensive due to the need for many lasers that have to be synchronized.

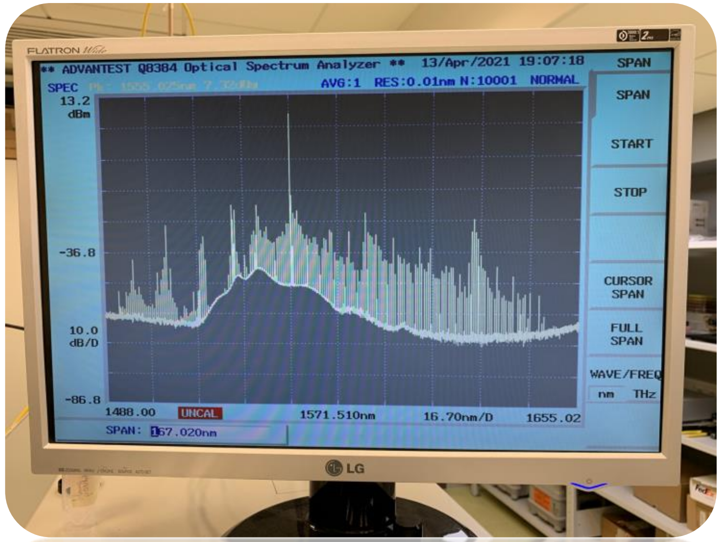
- Microresonator optical ***frequency combs OFC have applications in the field of Telecommunications***. WCOMB ***use a single pump source and then generates spectra of various peak frequencies***. Each of these frequencies can be used as data channel light source in fiber optical transmission systems. Therefore WCOMB is smaller, less energy consuming and less expensive that standard laser arrays (multiple separate laser sources).



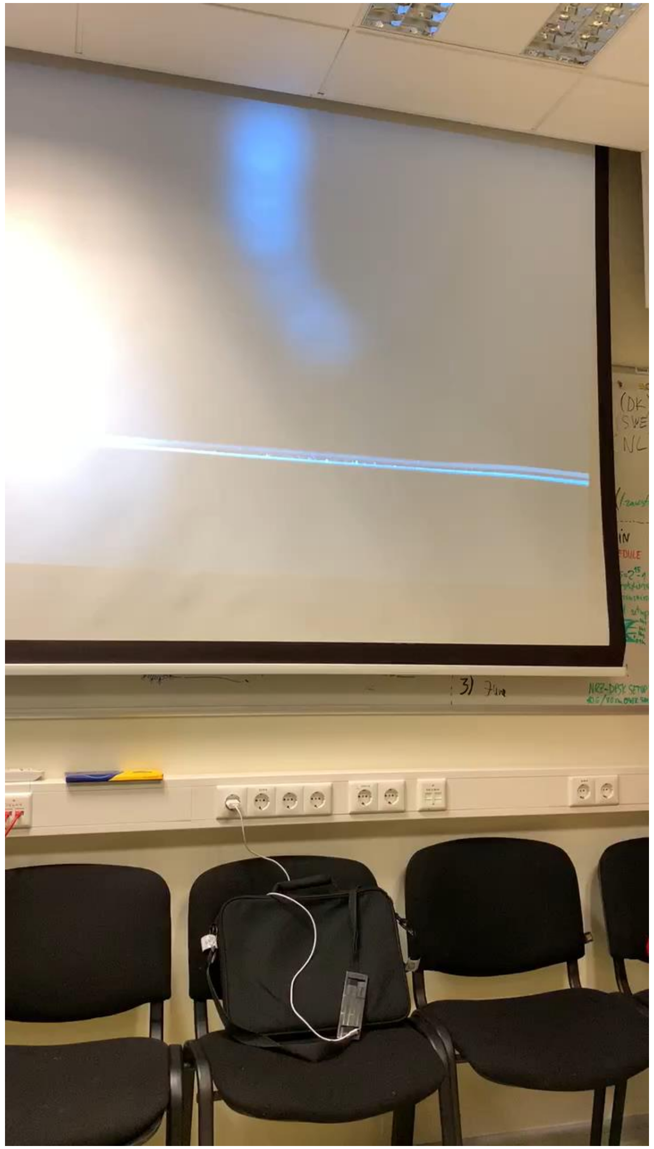


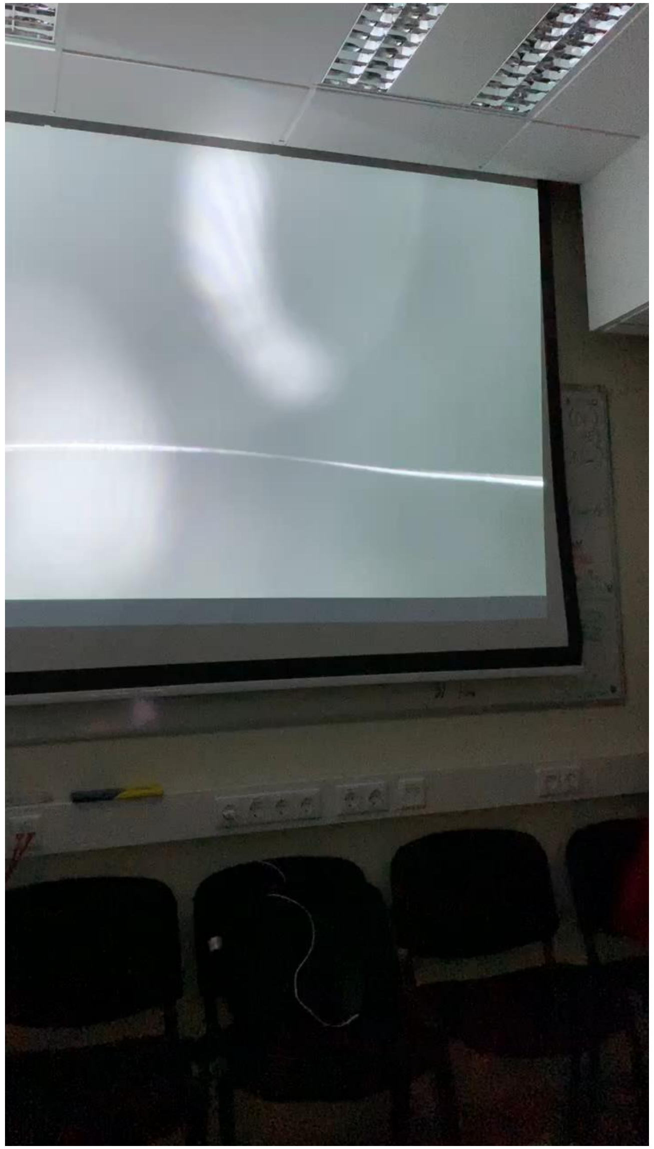






WGMR-OFC (Tapered fiber and coupling conditions)





Microsphere-based OFC-WGMR multi-wavelength source

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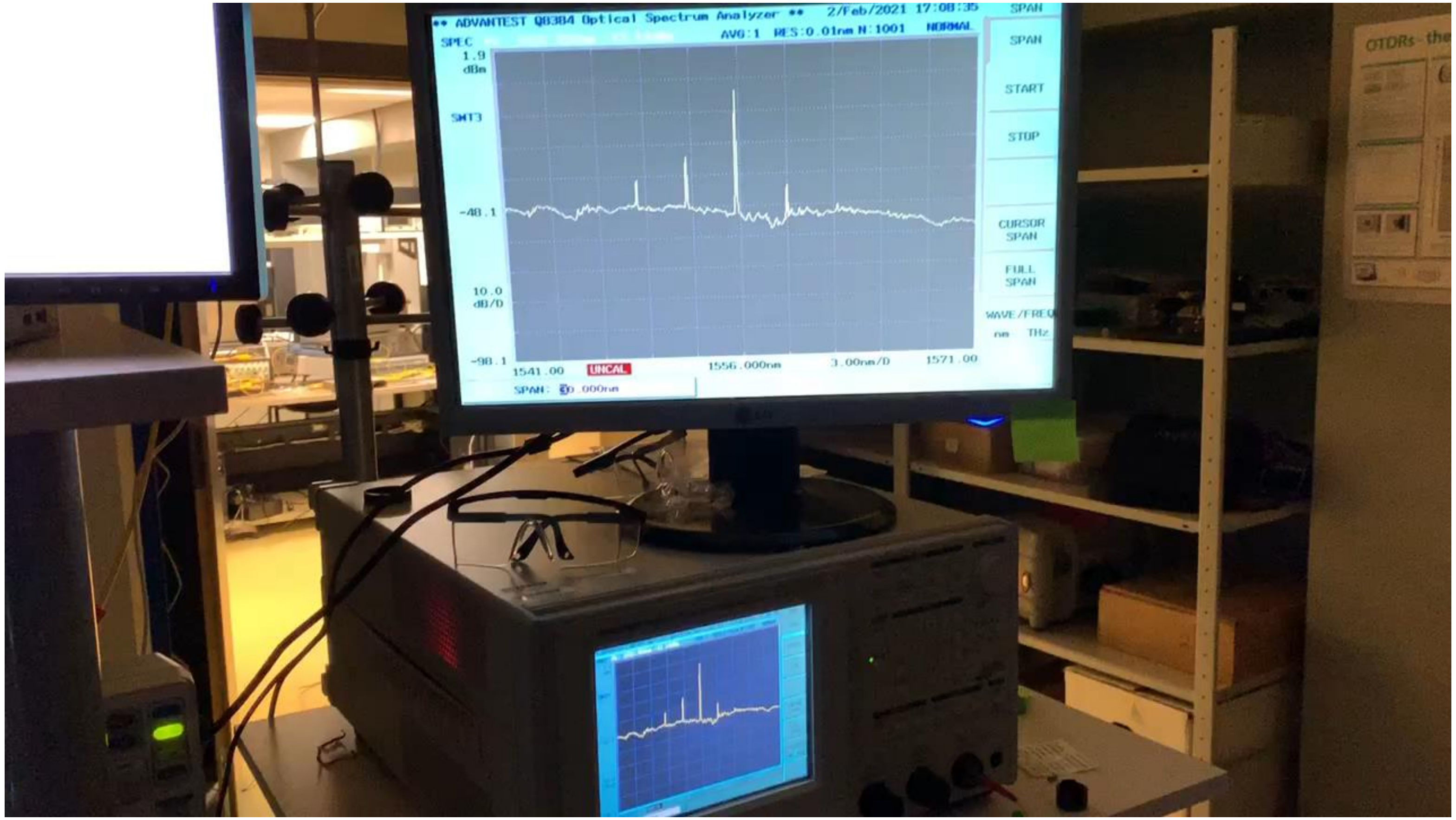

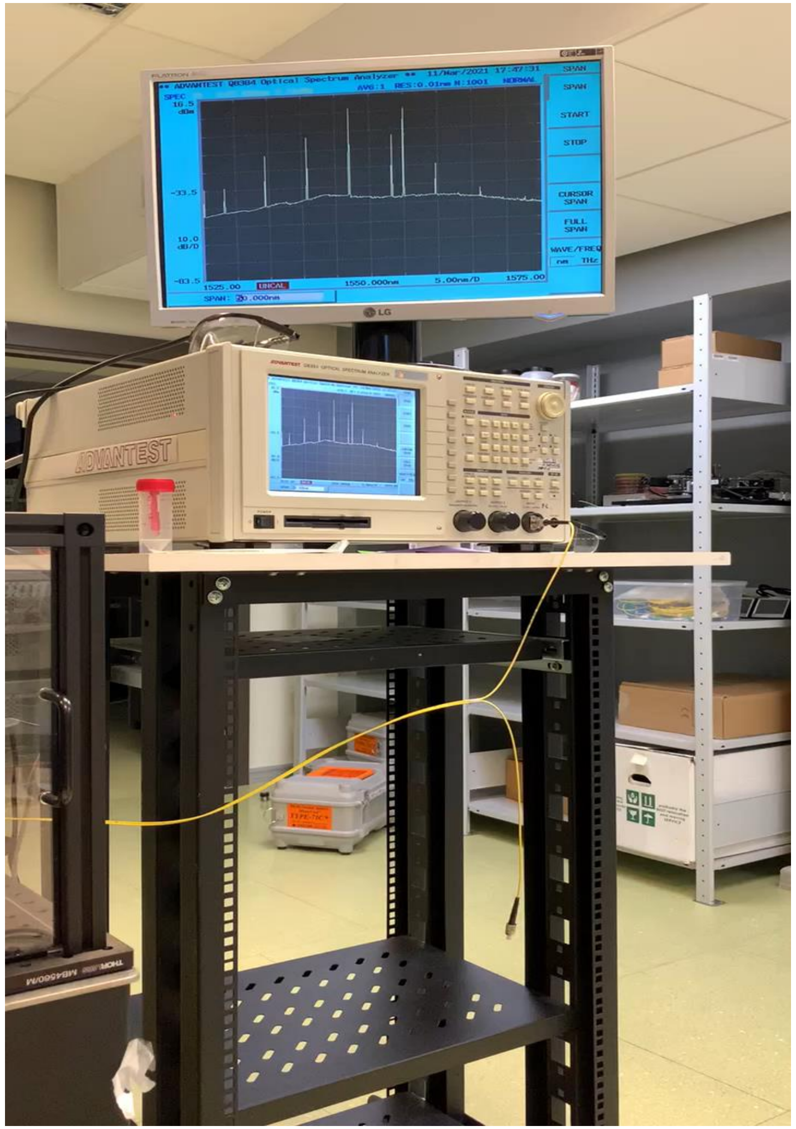

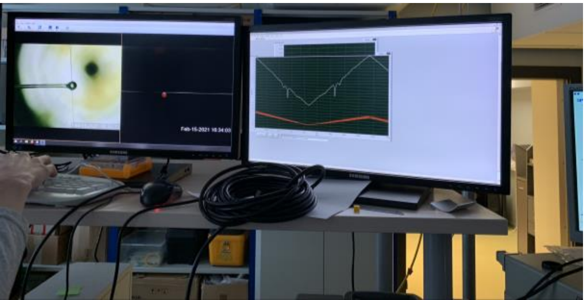

Microsphere-based OFC-WGMR multi-wavelength source and its applications in telecommunications

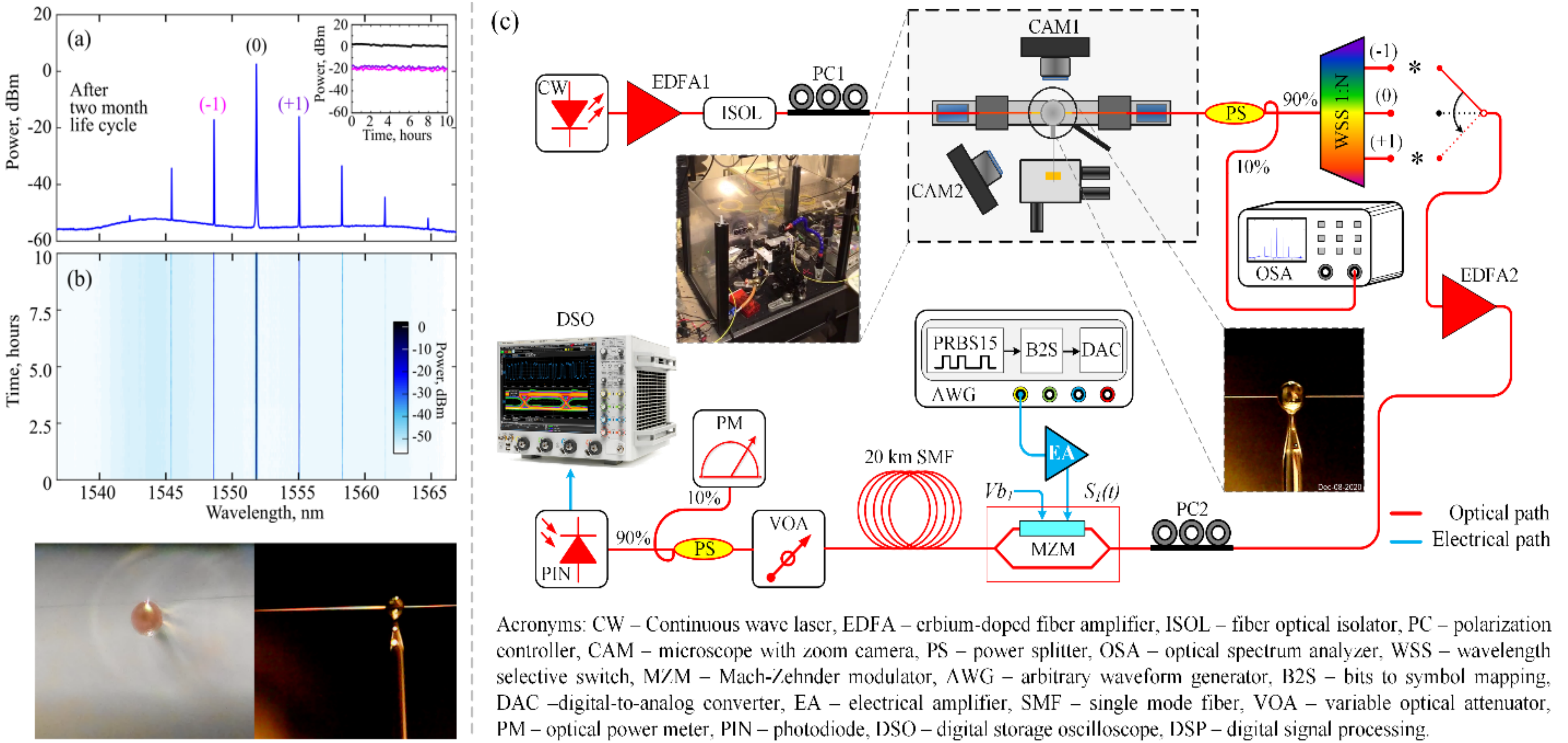

Fig. 1. *Measured OFC performance over a 10-hour period: (a) optical spectrum with inset representing captured power stability, and (b) power distribution stability over the wavelength. (c) The experimental setup of the designed silica microsphere WGMR-OFC as a light source where 400 GHz spaced carriers provide NRZ-OOK modulated 2.5 and 10 Gbps data transmission over 20 km SMF fiber. Insets show tapered fiber and silica microsphere resonator positions of coupling conditions and WGMR-OFC reduced humidity and dust-prevention cover box.*

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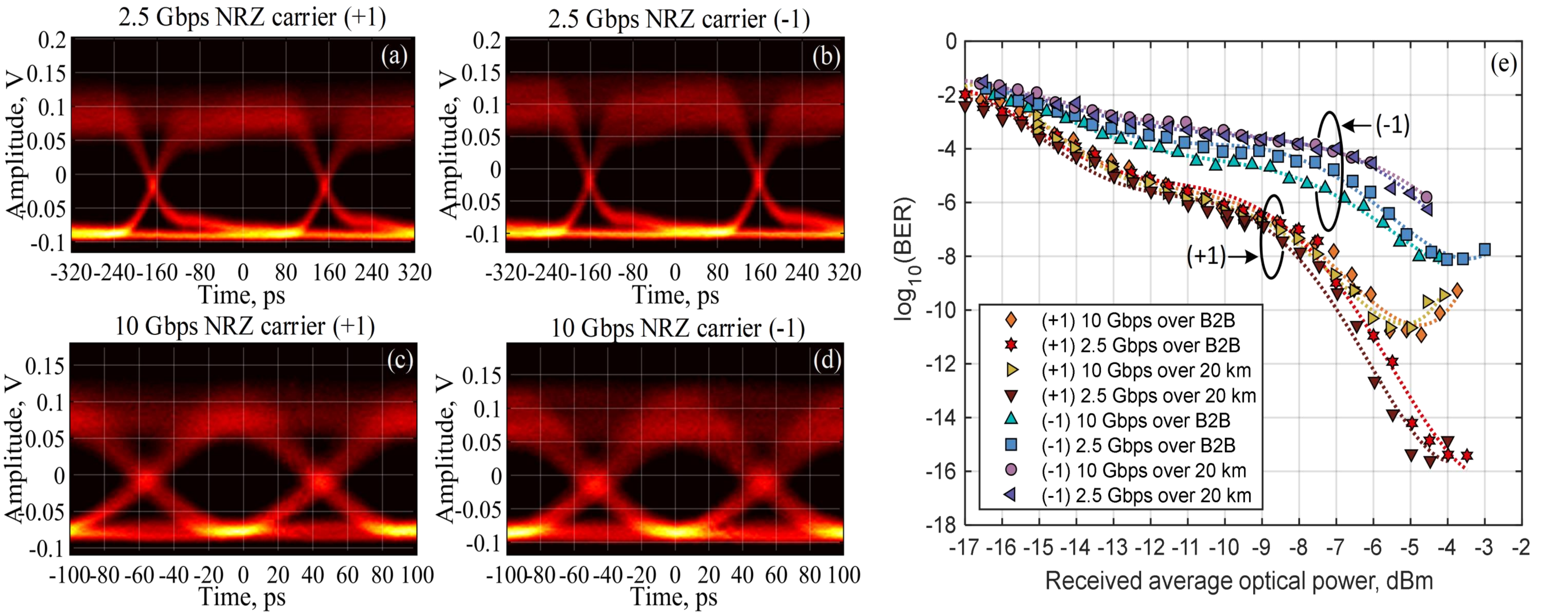

***Fig.2.** Eye diagrams of the received signal after 20 km transmission over SMF fiber at a data rate of 2.5 Gbps for (a) carrier "+1" and (b) carrier "-1", and at a data rate of 10 Gbps for (c) carrier "+1" and (d) carrier "-1", and (e) the plots of BER vs. average received optical power in B2B and after 20 km transmission of the NRZ-OOK modulated signal with bitrates of 2.5 and 10 Gbps for "+1" and "-1" carriers.*

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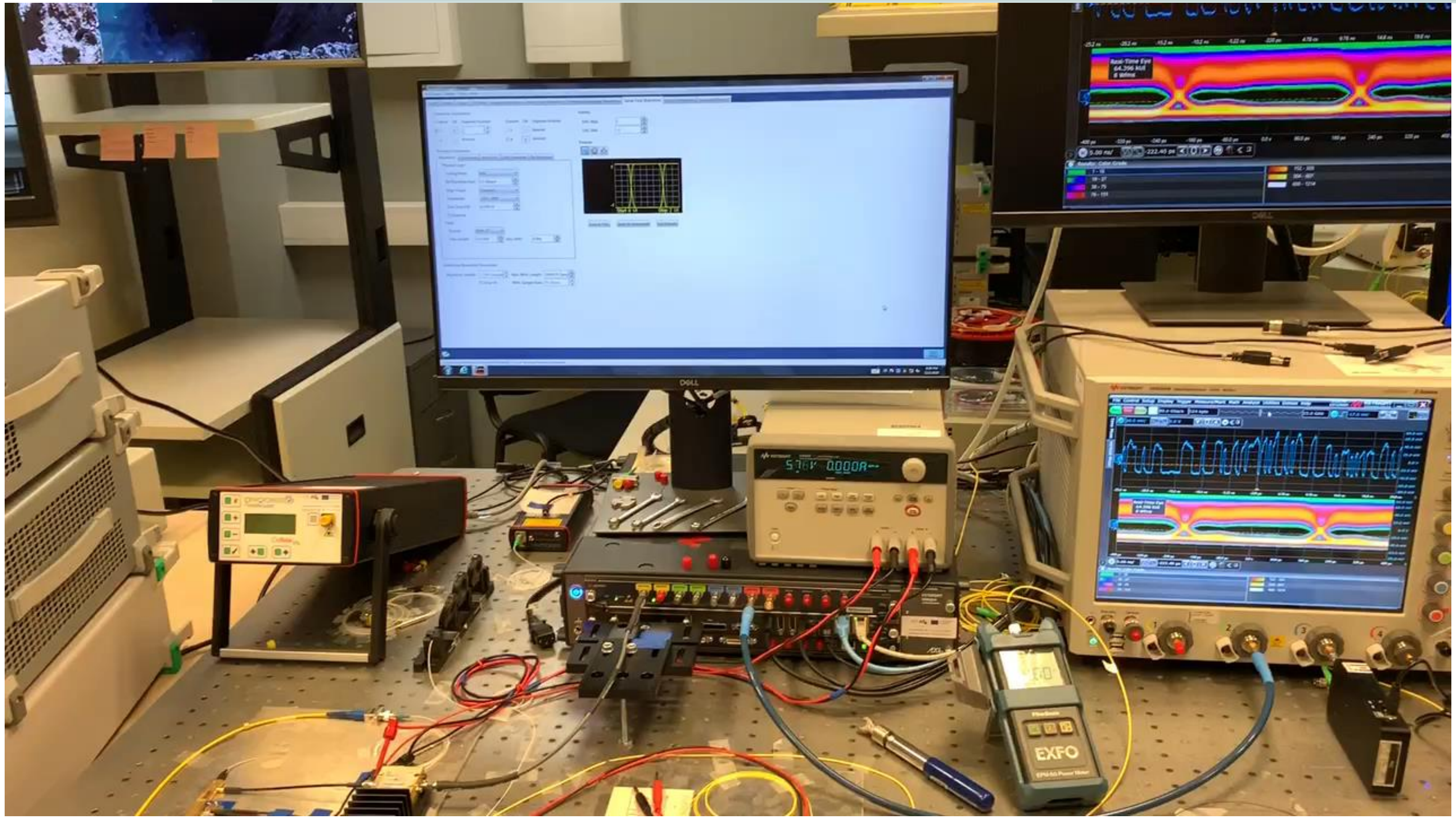

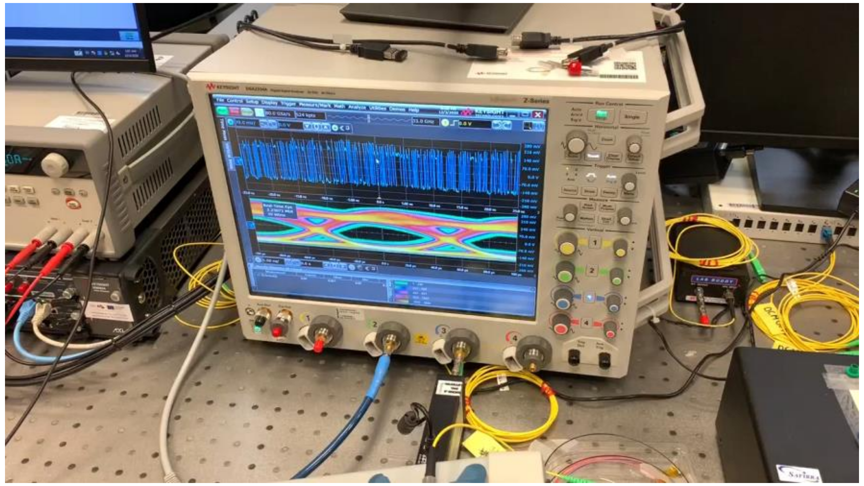

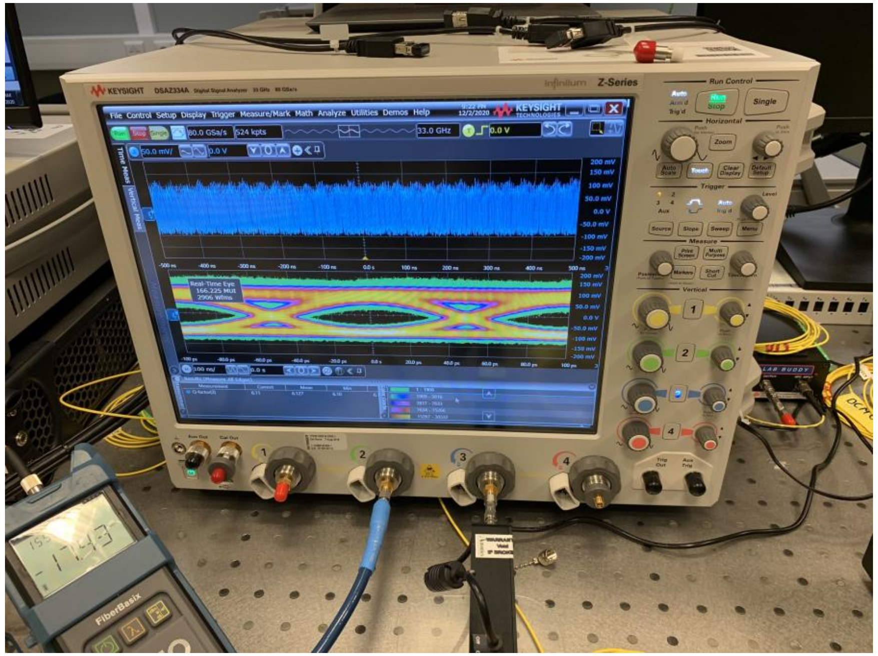

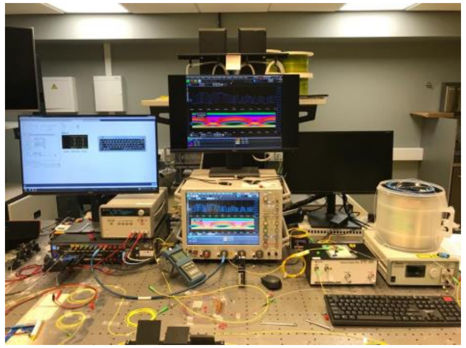

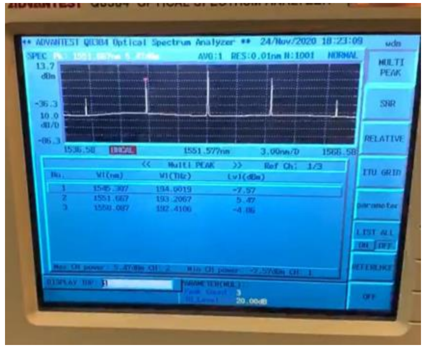

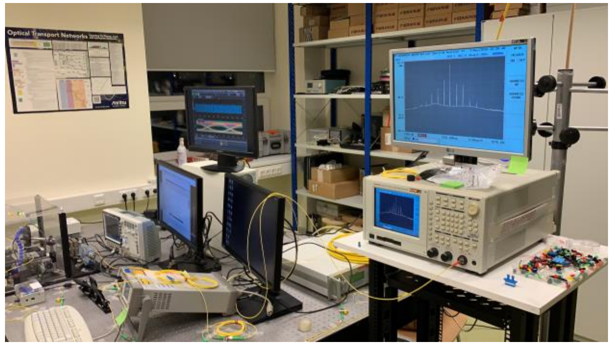

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Acknowledgments

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