TAMPEREEN TEKNILLINEN YLIOPISTO
TAMPERE UNIVERSITY OF TECHNOLOGY

SUPUVIR

SUPercontinuum broadband light sources covering **UV** to **IR** applications

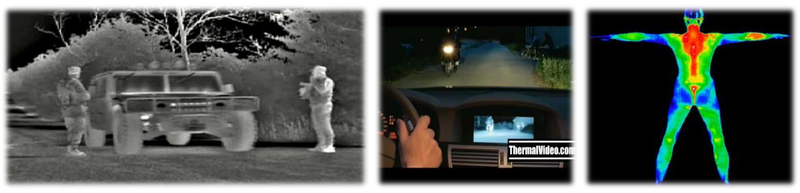
Octave-spanning supercontinuum generation in a multi-mode indium fluoride fiber

ESR 12- Zahra Eslami
Recruitment Start date - 01 - 08 - 2017
Supervisor - Goery Genty

Objective: **High power multimode supercontinuum (SC) [1] sources for the mid-infrared (MIR)**

SC are promising candidates for mid-IR applications

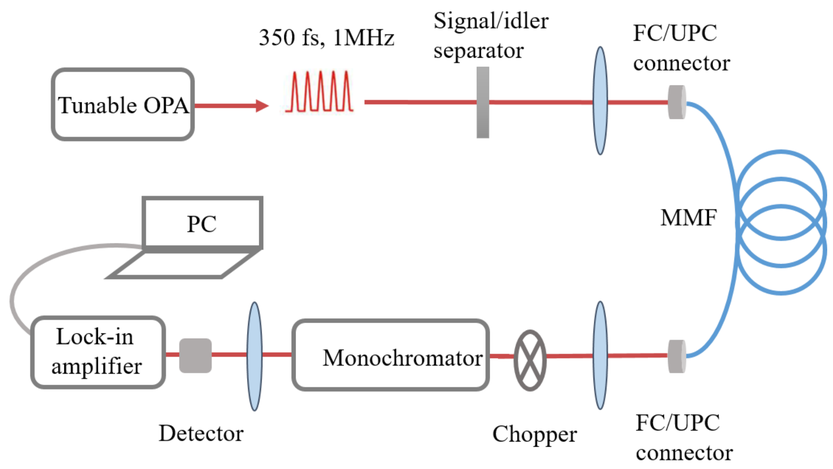
- Molecular fingerprinting [2]
- Medical surgery [3]
- Infrared microscopy [4]
- Environmental monitoring and LIDAR [4]



SC generation in mid-IR

- **SC generation in nonlinear fiber**: Depending on relation between pump wavelength and zero dispersion of fiber as well as pump pulse characteristics different nonlinear process such as self-phase modulation / four-wave mixing / soliton dynamics can lead spectral broadening.
- **Soft glass fibers (fluoride)**: high intrinsic nonlinearity and wide transmission band in the mid infrared (0.3 - 6 µm)
- **BUT**: damage threshold of soft glasses is low! → Limits significantly power spectral density
- **Our solution:** use multimode (large core) fibers

Experimental setup and fiber parameters



Pump source
- Tunable optical parametric amplifier (OPA)
- Peak power up to: 3 MW
- Pulse duration: 350 fs

Fiber
- Core size: 100 µm
- Length: 1 - 2 m
- Zero-dispersion wavelength (ZDW) ~1700 nm

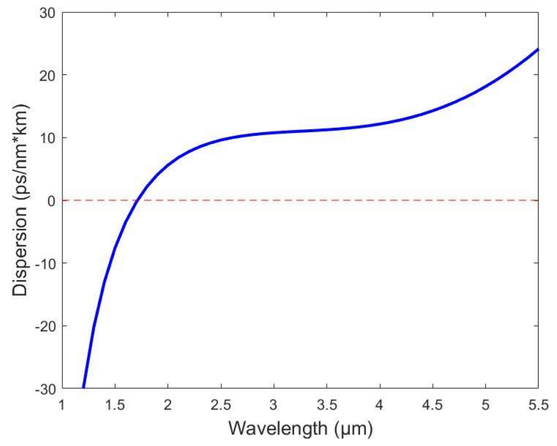
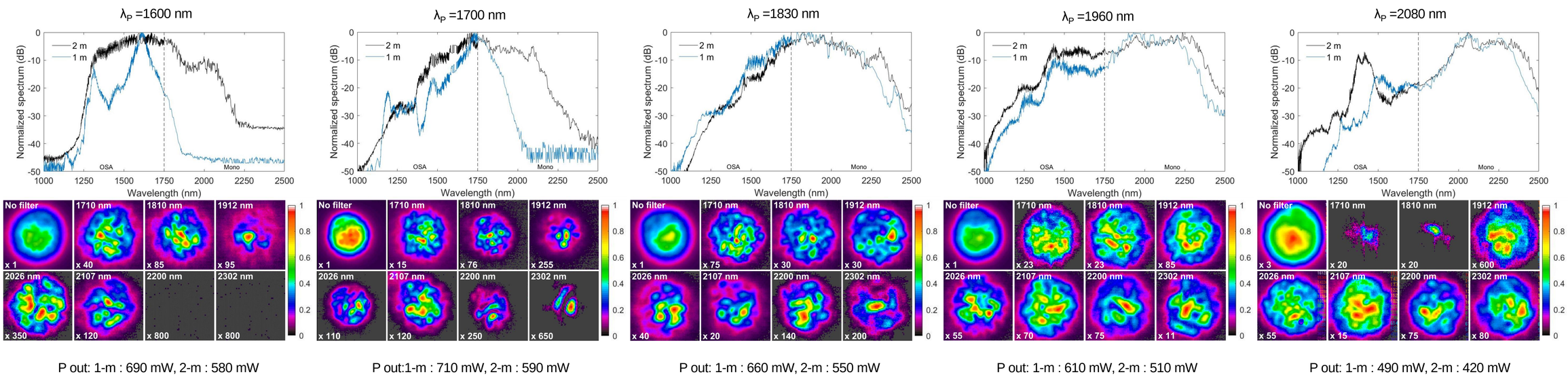


Fig 1. Experimental setup for supercontinuum generation in a 100 µm core multimode indium fluoride fiber.

Fig 2. Dispersion curve of indium fluoride fiber

Results : First demonstration of high power octave-spanning supercontinuum generation in a multi-mode indium fluoride fiber



P out: 1-m : 690 mW, 2-m : 580 mW

P out:1-m : 710 mW, 2-m : 590 mW

P out: 1-m : 660 mW, 2-m : 550 mW

P out: 1-m : 610 mW, 2-m : 510 mW

P out: 1-m : 490 mW, 2-m : 420 mW

Fig 3. SC in 1-m and 2-m long MMF fiber with 100 µm core as a function of different pump wavelengths. Corresponded beam profile of 2-m fiber output at different wavelength bands are shown. Numbers on the profile photos represent the factor by which the SC signal was amplified.

Progress

Puplication: **Zahra Eslami**, Piotr Ryczkowski, Caroline Amiot, Lauri Salmela, Goery Genty,'' Octave-spanning supercontinuum generation in a multi-mode indium fluoride fiber'', Submitted to JOSAB
Obtained ECTS credits: 29/40
Planed secondment: ITME – M24-25 – 2 weeks
Future plan: SC study in Chalcogenide multimode fiber using high energy nanosecond and femtosecond pumping

References
[1] J. M. Dudley and G. Genty, Physics Today 66, 29-34 (2013)
[2] C. Petersen *et al*., Nature Photonics 8, 830-834 (2014)
[3] A. Seddon, Summer Topicals Meeting Series (SUM), IEEE, 232-233 (2015)
[4] S. Lambert-Girard *et al.*, Applied Optics 7,1647-1656 (2015)

Acknowledgements
This project has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 722380