GLOphotonics

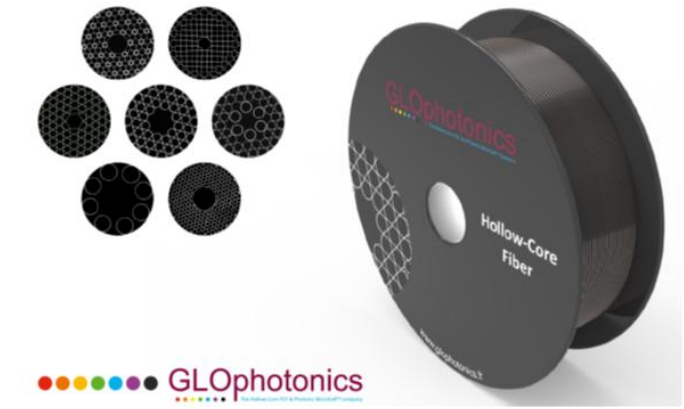
The Hollow-Core PCF & Photonic MicroCell™ company

Fibered gas cell for Quantum Applications

Thomas Billotte

QuTech Business & Technology Unit,
GLOphotonics

EPIC Online Technology Meeting on Quantum Sensors 11-05-2026



The Company

A French ***deep-tech*** company based in Limoges. Incubation in Bath (**2008**). Transfer to and re-incubation in Limoges (**July 2011**). Trading activities in **2013**

Development & supply of ***photonic components***, modules and/or systems based on a ***proprietary Technology****.

150 m² clean room (ISO-07)

2 drawing fiber towers, unique chain of fiber postprocessing

~20 employees. 80% in R&D, 12 PhD+

Strategic partnership with XLIM / GPPMM

Offering ***multi-sector markets high added-value*** products & services that are without equal and first of their kind.

* Hollow-core photonic crystal fiber (HCPCF) and Photonic MicroCell (PMC)

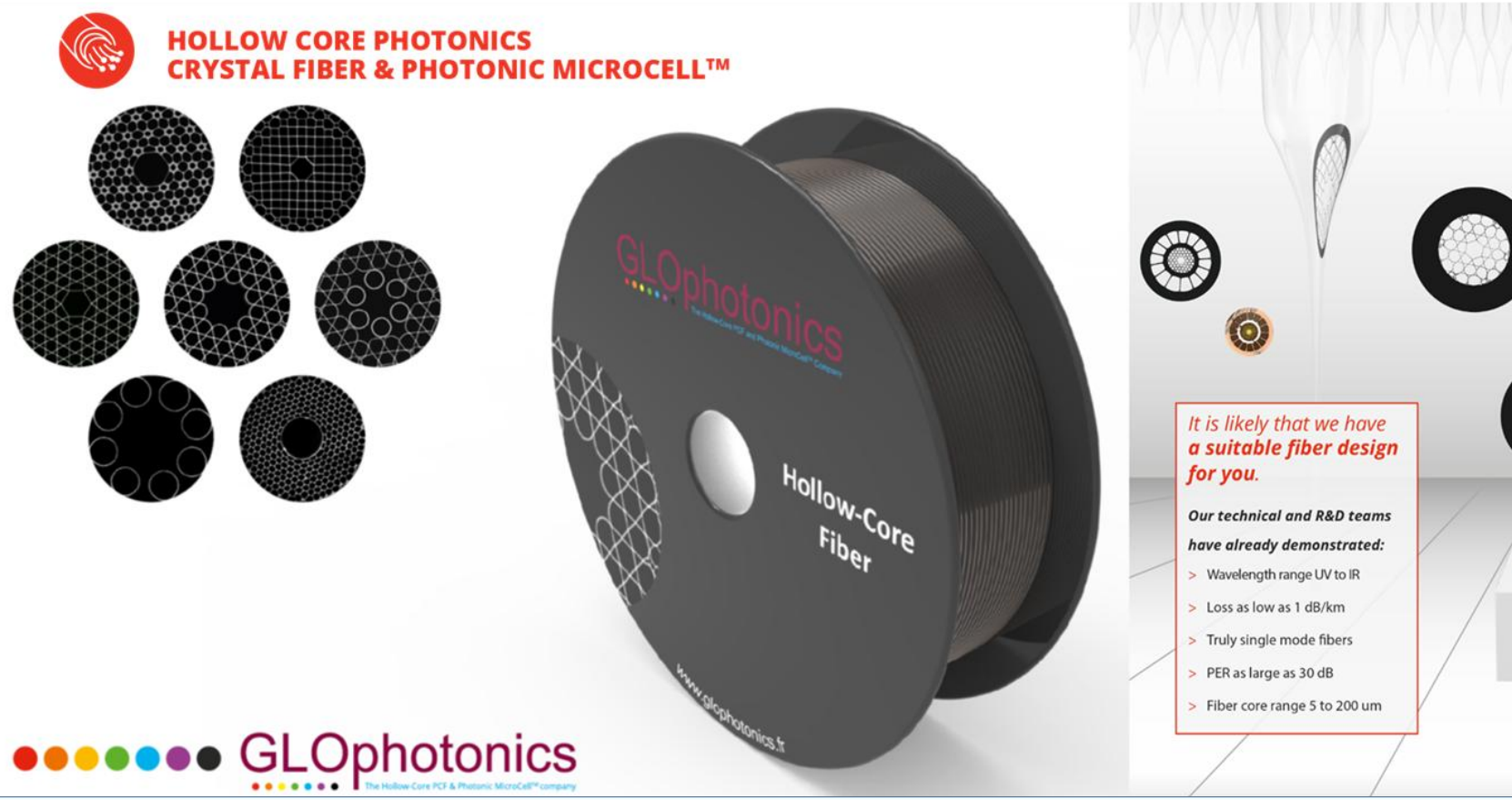
MULTISECTORIAL PRODUCT MIX

GLOphotonics HCPCF and PMC technology is equally a platform and key-nabling technology.

A feature, reflected in GLOphotonics products, service and offering.

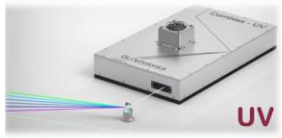
- HOLLOW CORE PHOTONICS CRYSTAL FIBER & PHOTONIC MICROCELL™
- BEAM DELIVERY
- PULSE COMPRESSION
- FREQUENCY CONVERSION & LASERS
- QUANTUM TECHNOLOGY
- TELECOM
- TECHNOLOGY SOLUTIONS

GLOphotonics The Hollow Core PCF and PMC company



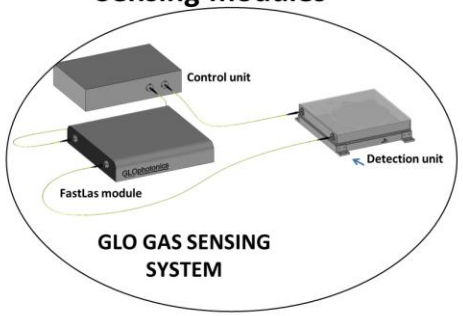
Beam Delivery modules

Lasers



Pulse compressors

Sensing modules



Datacom cables

TABLE OF CONTENT

HOLLOW CORE PHOTONICS
CRYSTAL FIBER & PHOTONIC MICROCELL™

BEAM DELIVERY

PULSE COMPRESSION

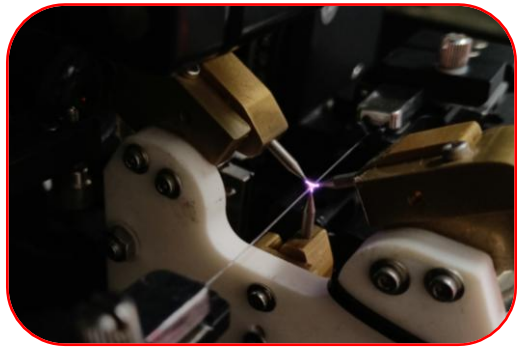
FREQUENCY
CONVERSION & LASERS

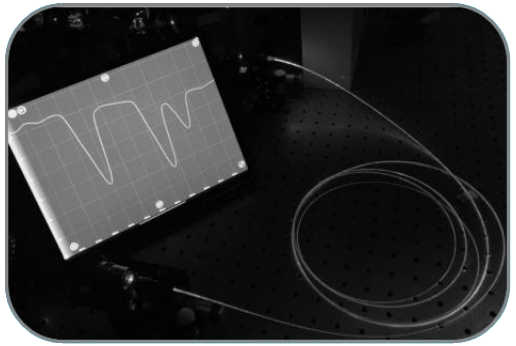
QUANTUM TECHNOLOGY

TELECOM

TECHNOLOGY SOLUTIONS

- GLOphotonics Hollow core fiber and post-process capabilities
- Photonic Micro-Cell (PMC) as fibered gas cell
- Integrated optically pumped magnetometer



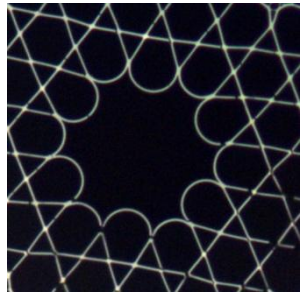
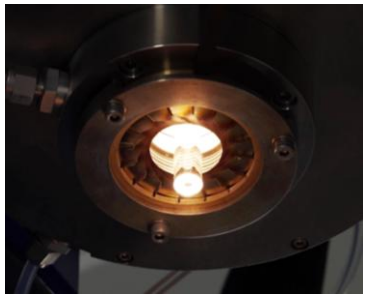
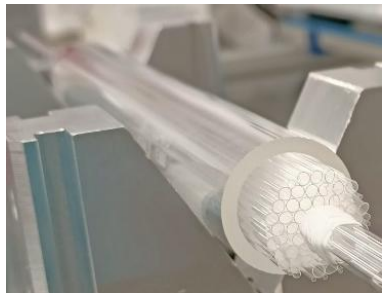


GLOphotonics
The Hollow-Core PCF & Photonic MicroCell™ company

Hollow-core fiber post process capabilities

HCPCF

Hollow Core Photonic Crystal Fiber

What is it?

- HCPCF outstands by guiding light in a hollow channel surrounded by a microstructured cladding
- GLO is a pioneering industrial in this field by offering its partners varied and bespoke HCPCF

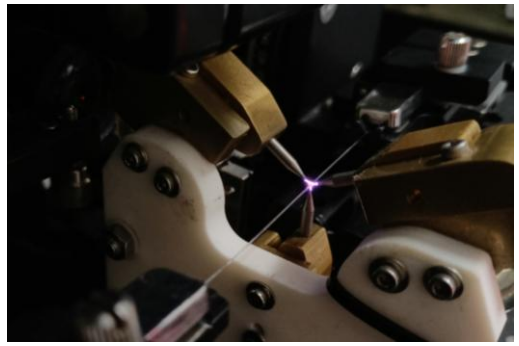
How it is made?

- HCPCF are produced using a set of special techniques making its preform and in its drawing process
- GLO enjoys fiber drawing infrastructure purposely design for HCPCF requirements

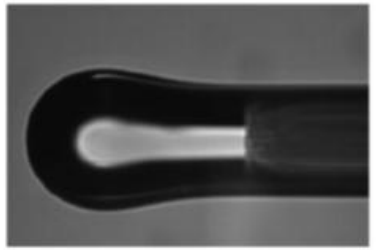
HCPCF Post-process

In-Fiber gas processing

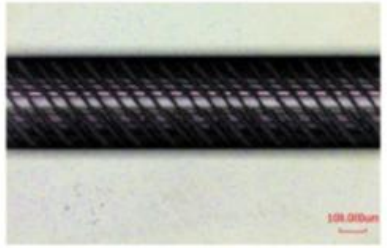
Glass post-processing



Micro-lensing



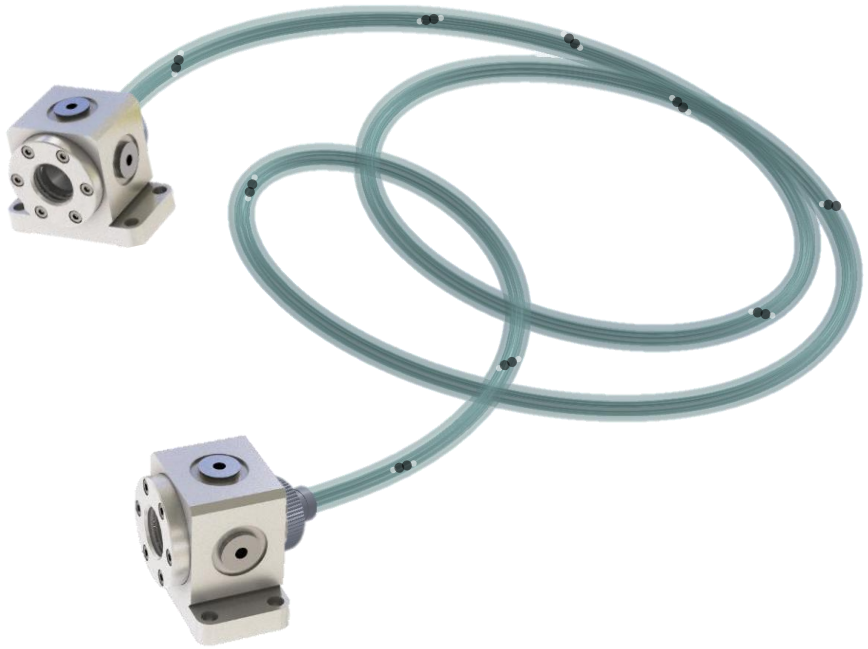
Fiber side engraving



Fiber-Fiber splicing

Hollow-core fiber post process to Photonic Micro-Cell (PMC)

Photonic Microcell (PMC) : Hollow core fiber functionnalized with a gas



- Million-fold enhancement in Gas-Light interaction
- Unique microconfinement of gas and atom vapors in optical fiber
- Shapable footprint
- Platform technology

Opto-mechanical PMC

- ***Used in most of GLOphotonics applications***

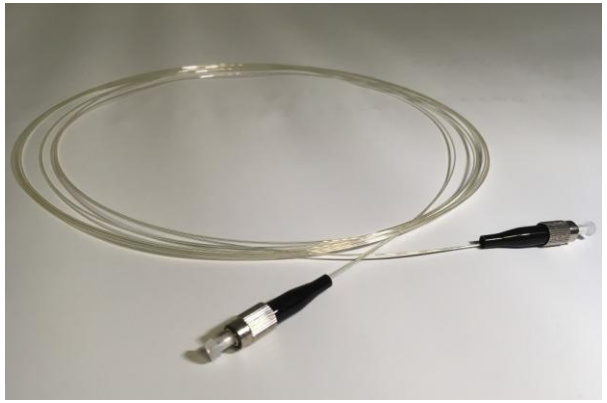
BEAM DELIVERY

PULSE COMPRESSION

FREQUENCY CONVERSION & LASERS

QUANTUM TECHNOLOGY

All fibered PMC



QUANTUM TECHNOLOGY

- ***Telecom***
- ***Astronomy***
- ***Instrument Calibration***
- ***Environment / Space***

EPIC Online Technology Meeting on Photonics for Quantum Industry
Thomas Billotte

TABLE OF CONTENT

HOLLOW CORE PHOTONICS
CRYSTAL FIBER & PHOTONIC MICROCELL™

BEAM DELIVERY

PULSE COMPRESSION

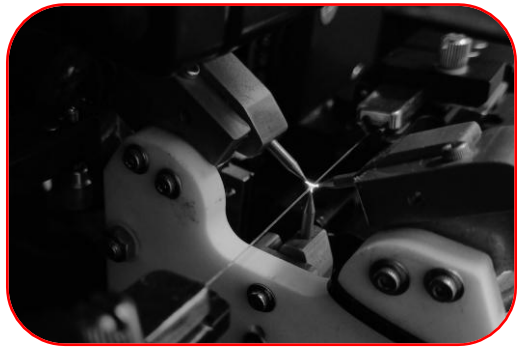
FREQUENCY
CONVERSION & LASERS

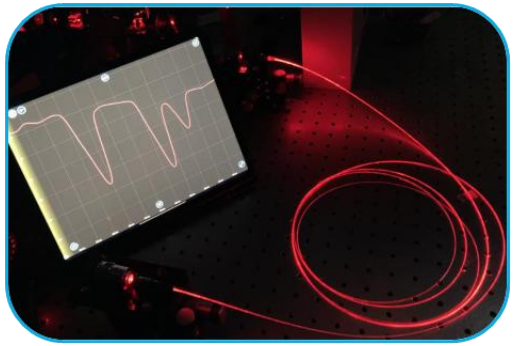
QUANTUM TECHNOLOGY

TELECOM

TECHNOLOGY SOLUTIONS

- GLOphotonics Hollow core fiber and post-process capabilities
- Photonic Micro-Cell (PMC) as fibered gas cell
- Integrated optically pumped magnetometer

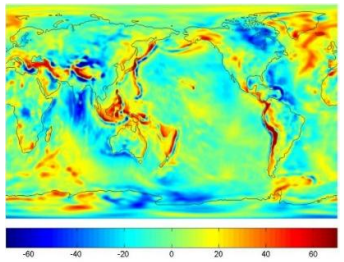




GLOphotonics
The Hollow-Core PCF & Photonic MicroCell™ company

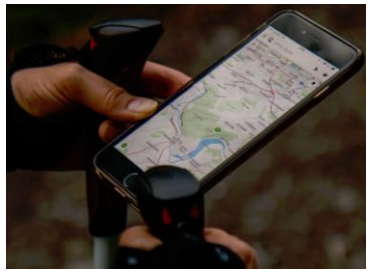
Trend in Frequency reference & quantum sensing

Geophysics



Space

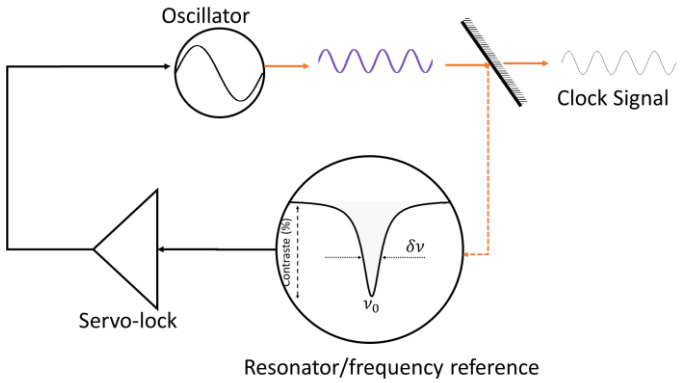
Global positioning



Internet, IOT,…

Quantum information

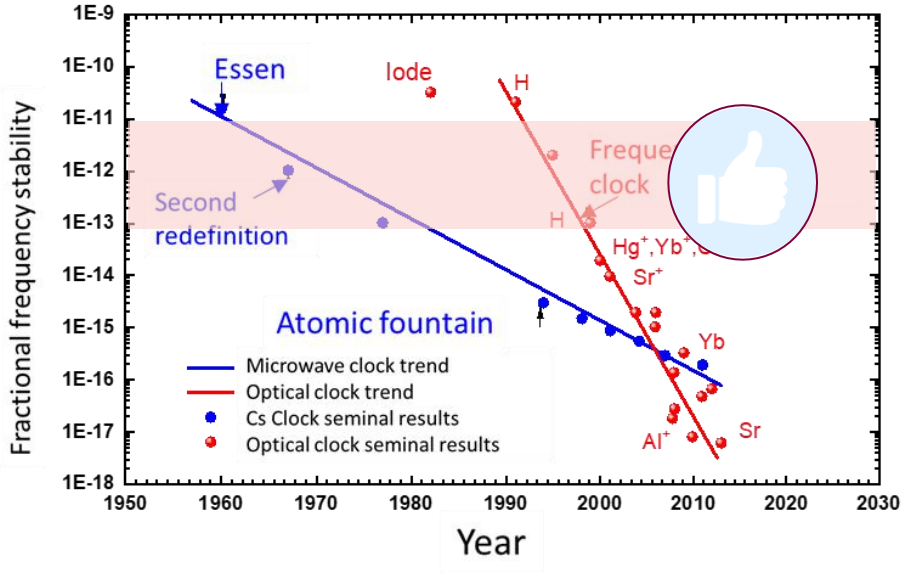
A good quantum sensor is set by how good its associated clock



Resonator spectral line KPI

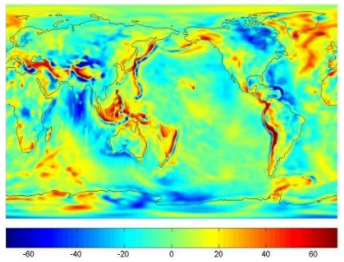
- **High contrast**
- **Narrow linewidth**

Fractional frequency stability of 10^{-11} -10^{-13} is sufficient for a large number of applications



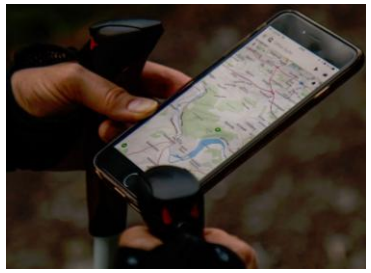
Trend in Frequency Reference: Miniaturization

Geophysics



Space

Global positioning

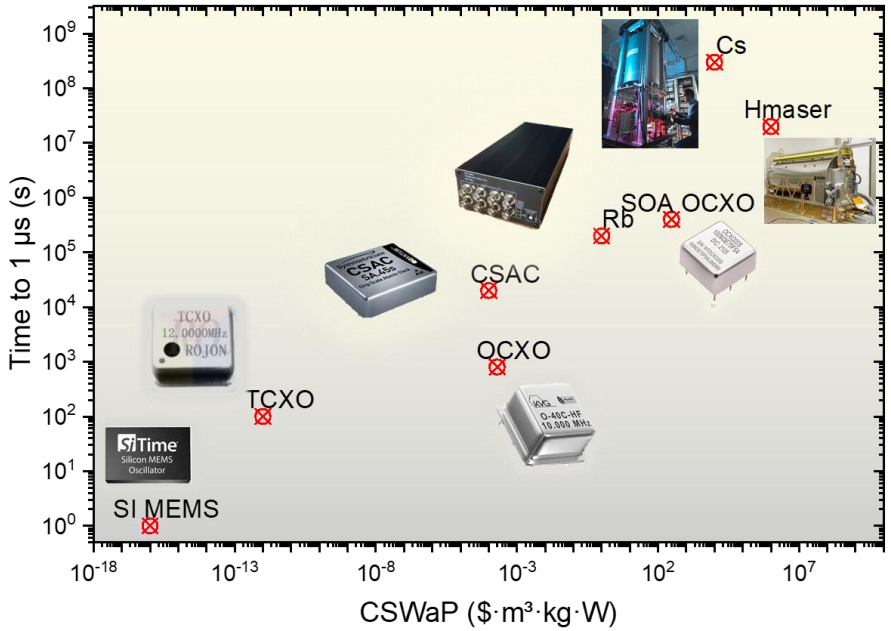


Internet, IOT,…

Quantum information

Beyond Frequency Stability: Advancing Quantum Sensor Requirements

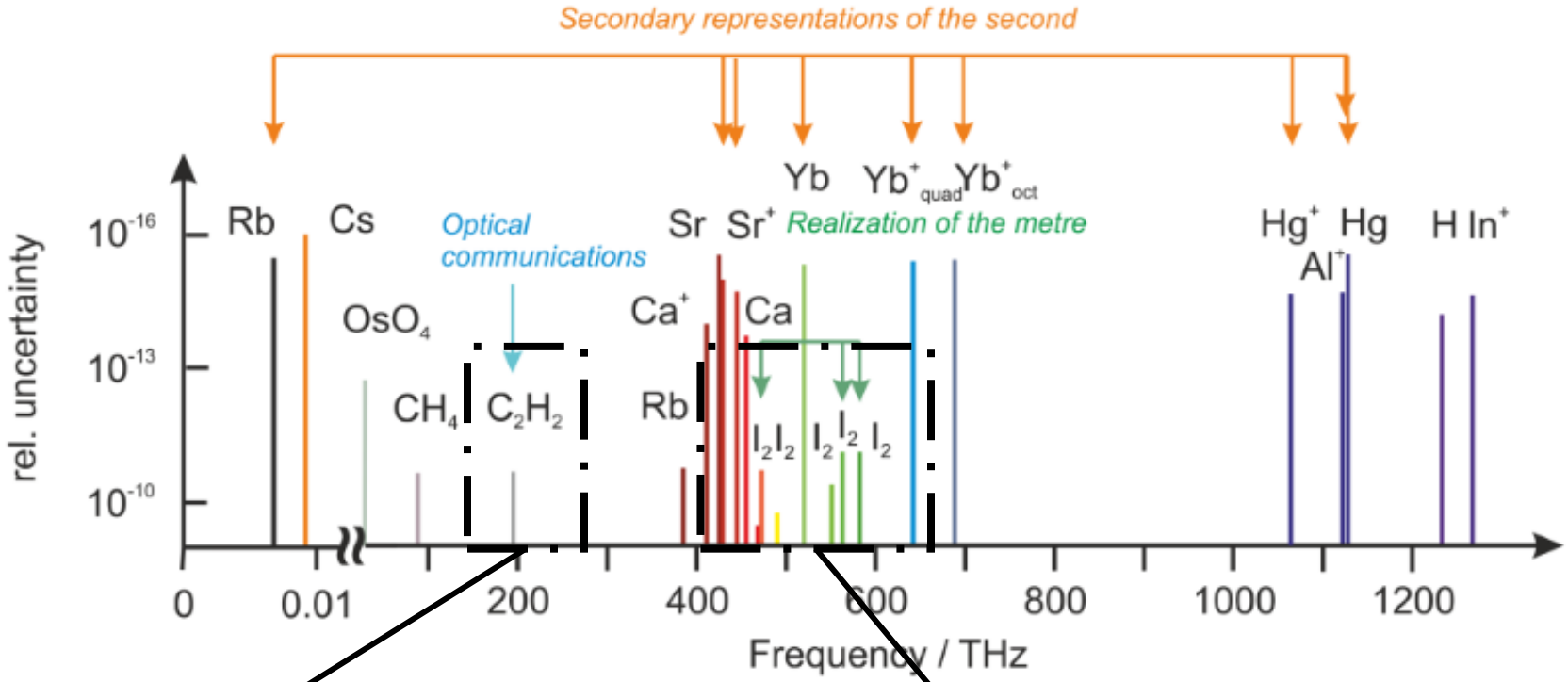
- COMPACTNESS
- Low CSWaP (Cost, Size, Weight & Power)
- FREQUENCY COVERAGE



HCPCF & PMC as key enabling technology for miniaturized atomic clock

I_2 PMC standard product

BIPM molecules recommendation for frequency reference

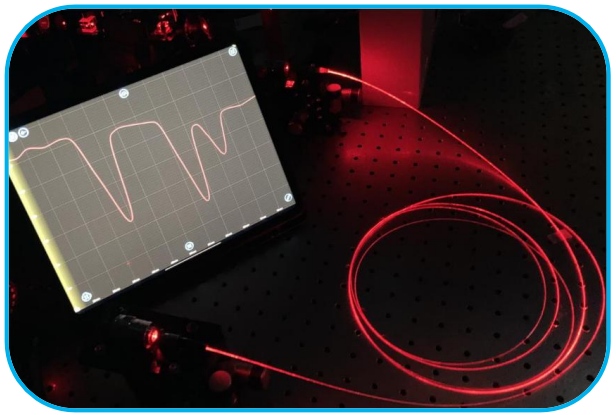


Acetylene: Optical communications wavelength

Iodine: Wide frequency coverage in visible wavelength

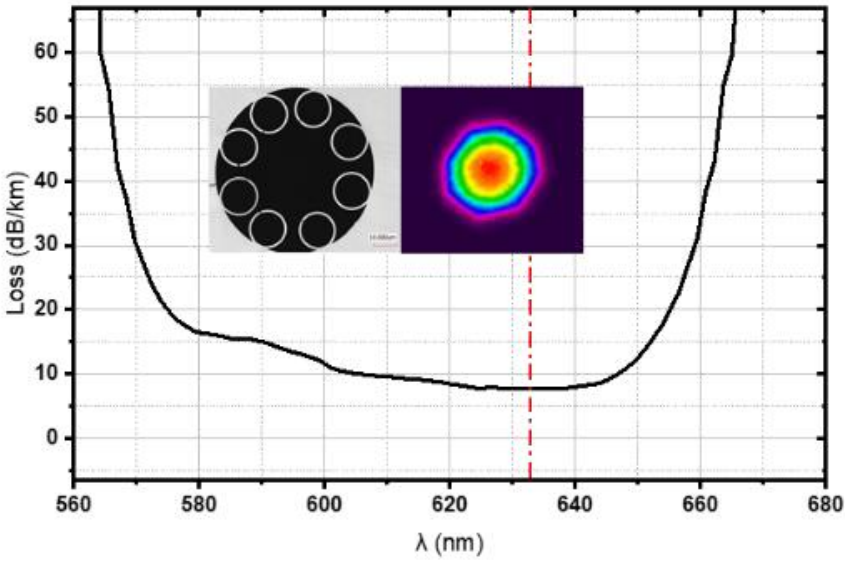
F. Riehle *et al.* 2018 *Metrologia* 55 188

Iodine PMC

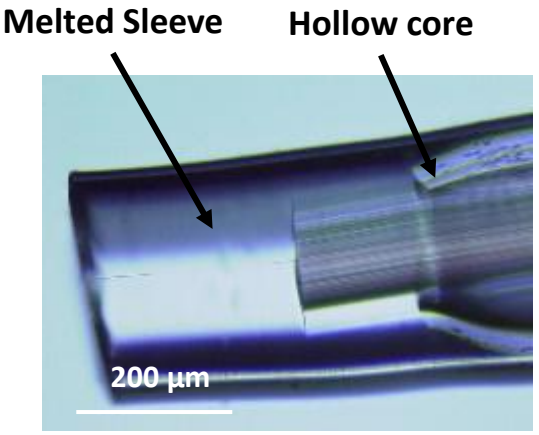


Physical Properties		
Gas filled hollow-core fiber length range	1 m ≤ L ≤ 5 m	
PMC terminations	Glass End-capped at both sides mounted on FC/APC connectors	
Connector types	Input port: FC/PC or FC/APC	
Spectroscopic and optical properties		
Wavelength range	500 to 700 nm	
Absorption contrast C_D (P(33)6-3 line – 633 nm)	5 % ≤ C ≤ 50 %	
FWHM linewidth (P(33)6-3 line – 633 nm)	≤ 1.04 GHz	
Off resonance Insertion loss (with coupling efficiency of 100%)	From port 1 to 2	≤ 3.5 dB
	From port 2 to 1	≤ 5.5 dB

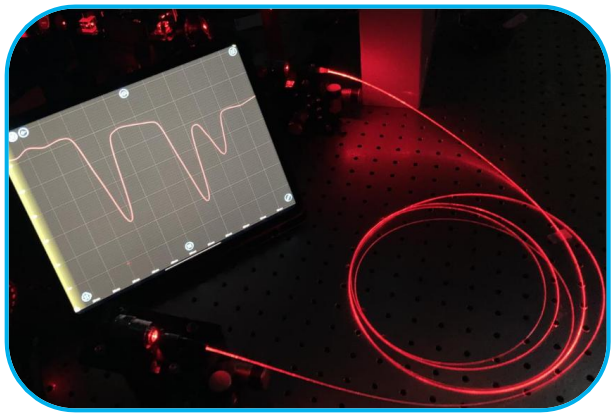
Low loss Hollow Core Fiber

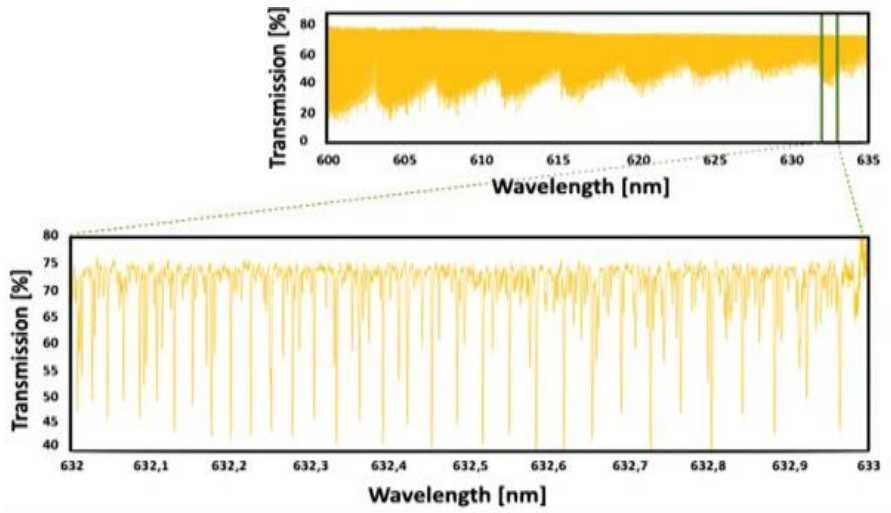


End-cap encapsulation



I_2 PMC standard product



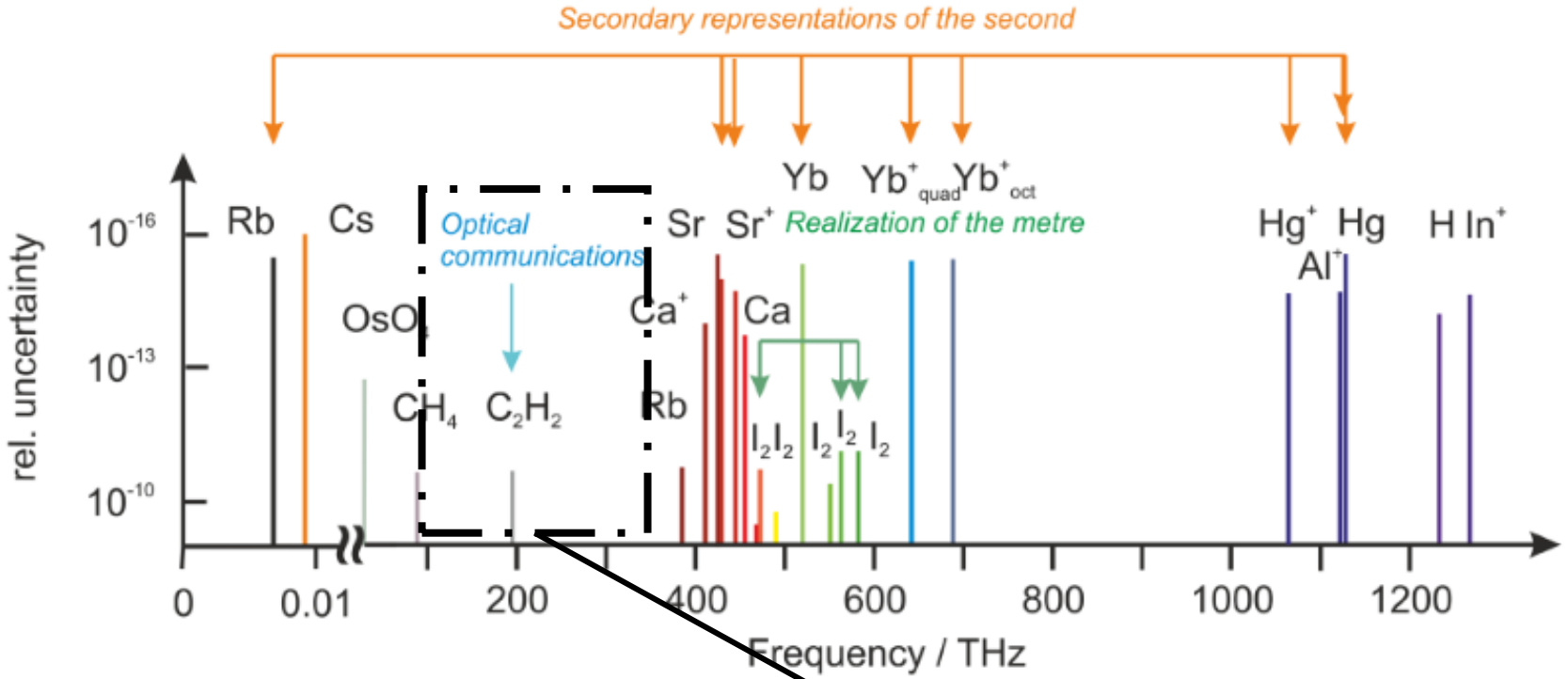


Physical Properties		
Gas filled hollow-core fiber length range	1 m ≤ L ≤ 5 m	
PMC terminations	Glass End-capped at both sides mounted on FC/APC connectors	
Connector types	Input port: FC/PC or FC/APC	
Spectroscopic and optical properties		
Wavelength range	500 to 700 nm	
Absorption contrast C_D (P(33)6-3 line – 633 nm)	5 % ≤ C ≤ 50 %	
FWHM linewidth (P(33)6-3 line – 633 nm)	≤ 1.04 GHz	
Off resonance Insertion loss (with coupling efficiency of 100%)	From port 1 to 2	≤ 3.5 dB
	From port 2 to 1	≤ 5.5 dB

- **High contrast signal at room temperature compared to standard gas cell**
- **High contrast Doppler-free signal**
- **Wide wavelength coverage from 500 to 700nm**

C_2H_2 PMC standard product

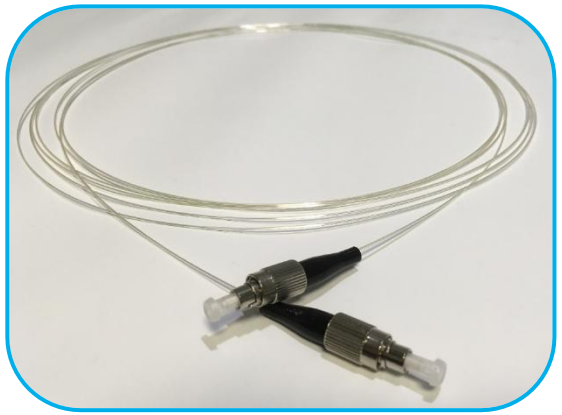
BIPM molecules recommendation for frequency reference

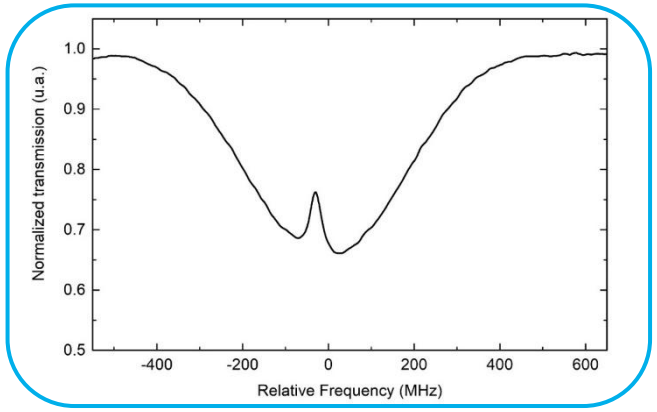


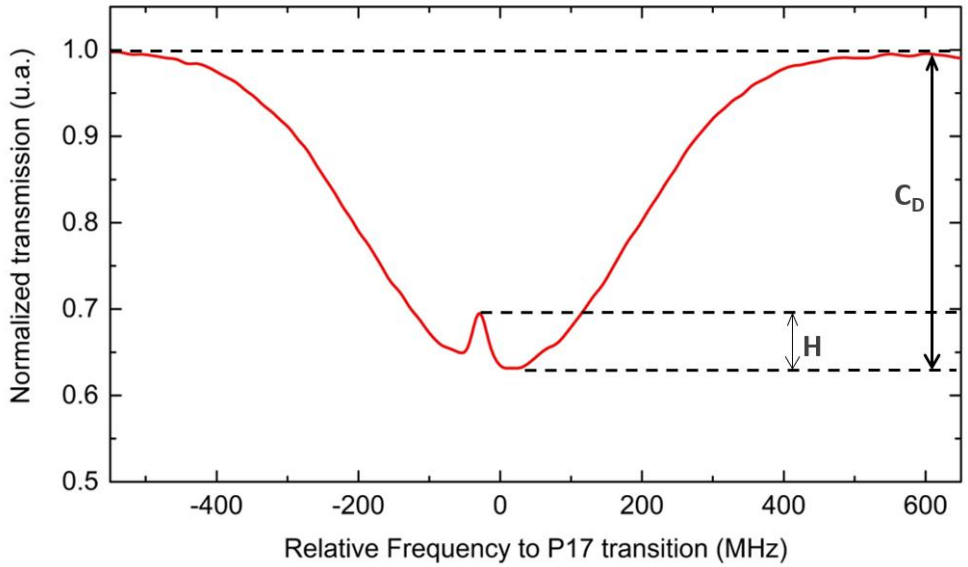
Acetylene: Optical communications wavelength

F. Riehle *et al.* 2018 *Metrologia* 55 188

C_2H_2 PMC







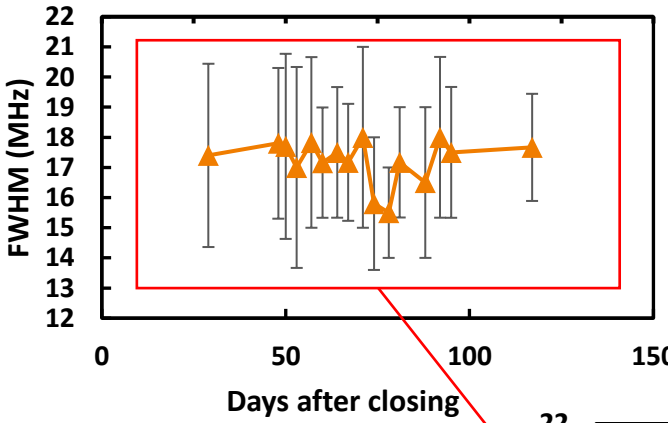
High contrast Saturable Absorption signal

Physical Properties

Gas filled hollow-core fiber length range	2 m ≤ L ≤ 6 m
PMC terminations	Glass End-capped at both sides mounted on FC/APC connectors

Spectroscopic and optical properties

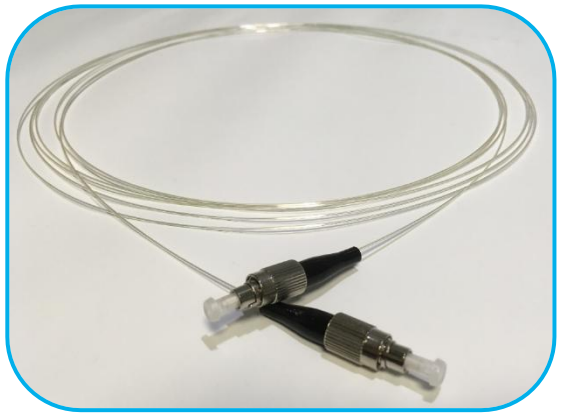
Wavelength range	1510 to 1545 nm	
Absorption contrast C_D	5 % ≤ C ≤ 60 % (P17 line – 1535,39 nm)	
FWHM linewidth	510[(2)] ± 50 MHz (P17 line – 1535,39 nm)	
Doppler-free feature contrast $C_{SD}=H/C_0$ (with Saturable Absorption Technique)	minimum of 10% (for a minimum coupled pump power of 100mW)	
Off resonance Insertion loss (with coupling efficiency of 100%)	From port 1 to 2	≤ 3.5 dB
	From port 2 to 1	≤ 5.5 dB

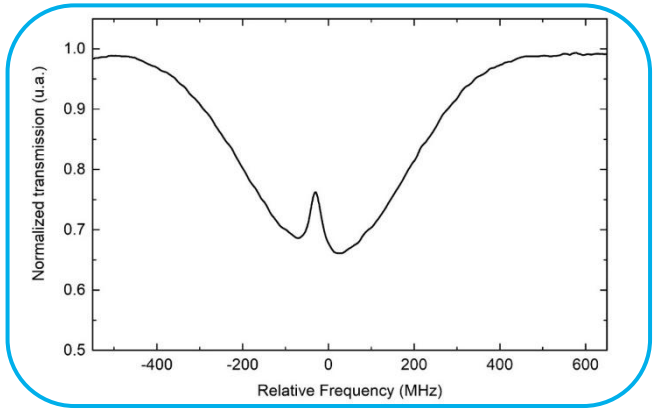


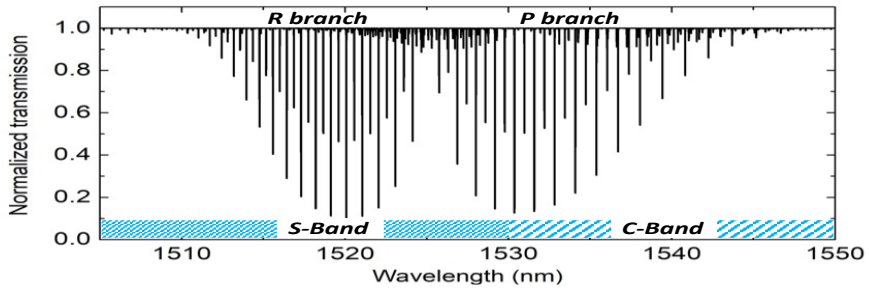
Doppler-free FWHM stable after more than 2 years

GLOphotonics
The Hollow-Core PCF & Photonic MicroCell™ company

C_2H_2 PMC







Physical Properties		
Gas filled hollow-core fiber length range	2 m ≤ L ≤ 6 m	
PMC terminations	Glass End-capped at both sides mounted on FC/APC connectors	
Spectroscopic and optical properties		
Wavelength range	1510 to 1545 nm	
Absorption contrast C_D	5 % ≤ C ≤ 60 % (P17 line – 1535,39 nm)	
FWHM linewidth	510[(2)] ± 50 MHz (P17 line – 1535,39 nm)	
Doppler-free feature contrast $C_{SD}=H/C_0$ (with Saturable Absorption Technique)	minimum of 10% (for a minimum coupled pump power of 100mW)	
Off resonance Insertion loss (with coupling efficiency of 100%)	From port 1 to 2	≤ 3.5 dB
	From port 2 to 1	≤ 5.5 dB

- **FC connectorization**
- **Insertion loss of ~3,5dB**
- **Very high contrast Doppler-free signal**
- **>2years lifetime**
- **Fractionnal Frequency Instability 10^{-11}@1s**
- **Telecom wavelength coverage from 1510 to 1545nm**

TABLE OF CONTENT

HOLLOW CORE PHOTONICS
CRYSTAL FIBER & PHOTONIC MICROCELL™

BEAM DELIVERY

PULSE COMPRESSION

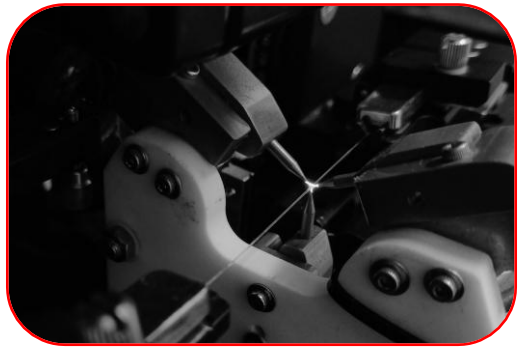
FREQUENCY
CONVERSION & LASERS

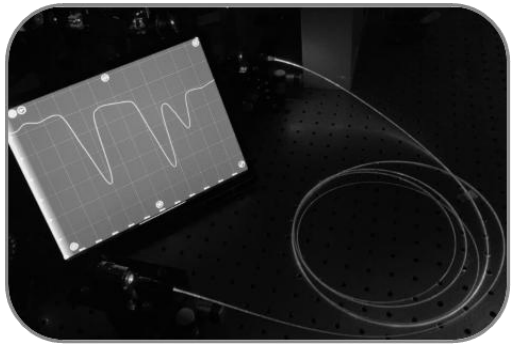
QUANTUM TECHNOLOGY

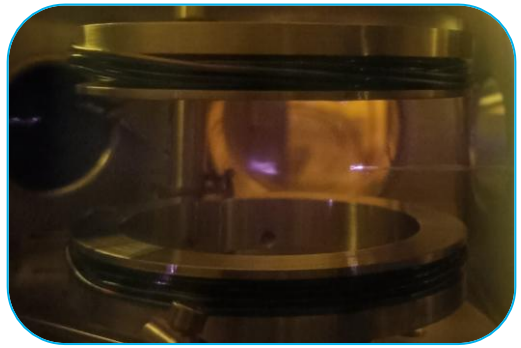
TELECOM

TECHNOLOGY SOLUTIONS

- GLOphotonics Hollow core fiber and post-process capabilities
- Photonic Micro-Cell (PMC) as fibered gas cell
- Integrated optically pumped magnetometer

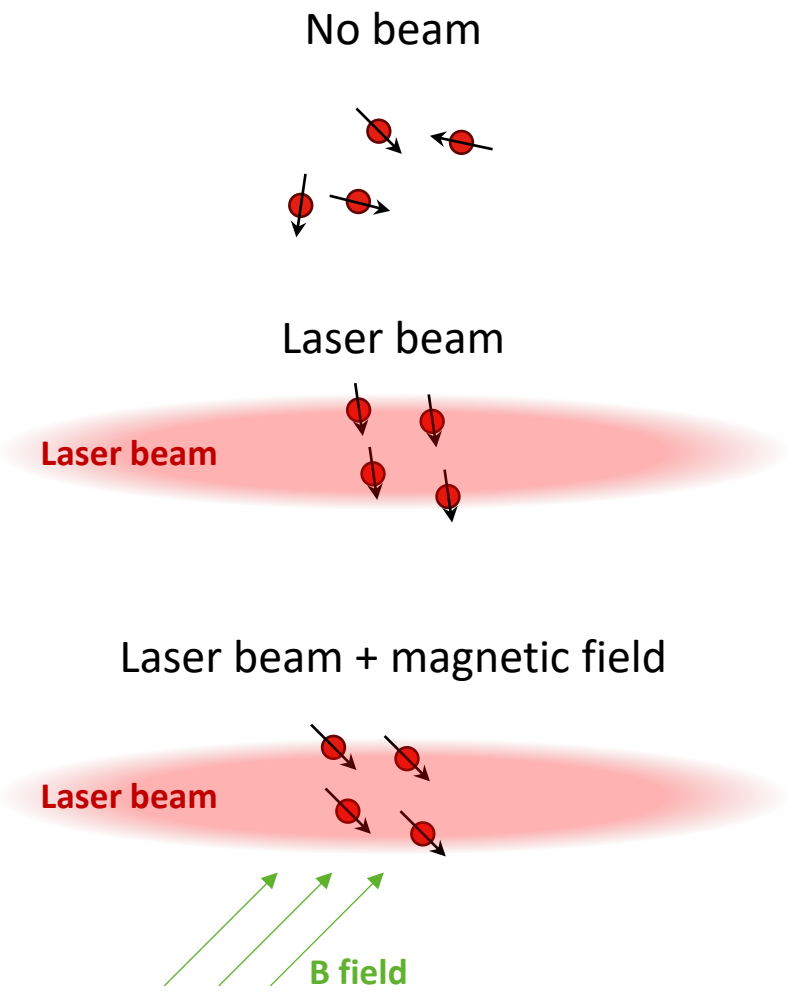


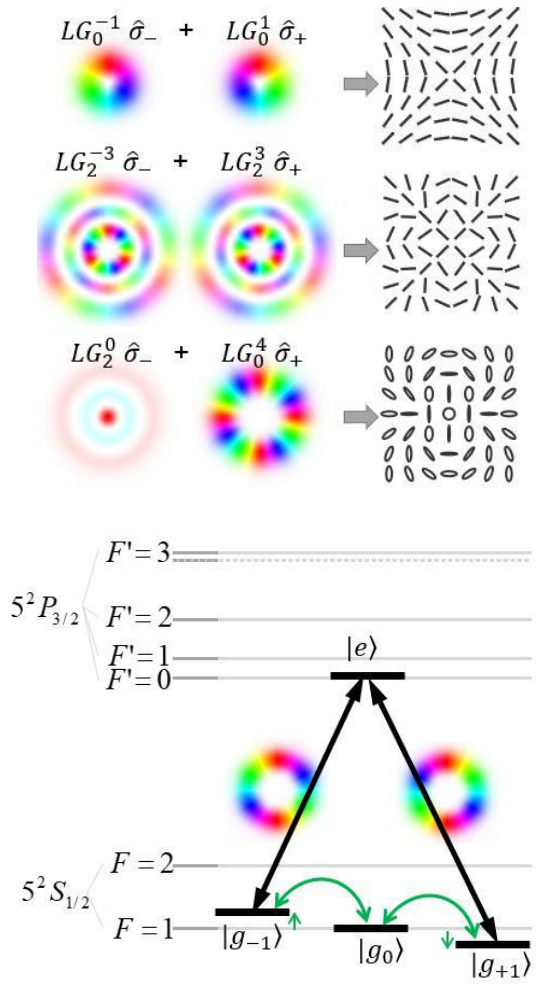


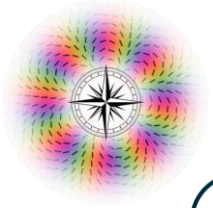


GLOphotonics
The Hollow-Core PCF & Photonic MicroCell™ company

Optically pumped magnetometer





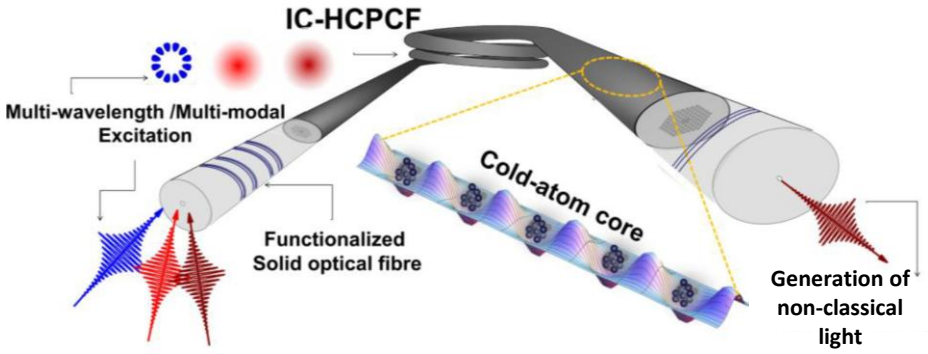


VMAg Quantera project

British Geological Survey · JG|U · PTB · Johannes Gutenberg Universität Mainz · Wigner · University of Glasgow · Université de Limoges · GLOphotonics

- Define Fundamental Limit of Vector Magnetometry
- Fabrication of Cavity enhanced Optical Pumped Magnetometer
- High order modes generation and their impact on magnetometry
- Creation of PMC Optical Pumped Magnetometer

Toward Rb PMC & integrable quantum magnetometer

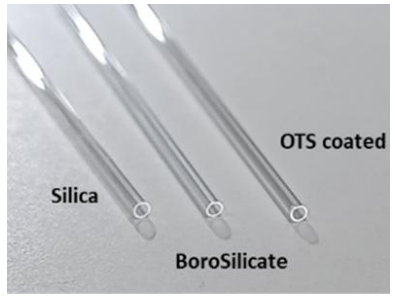


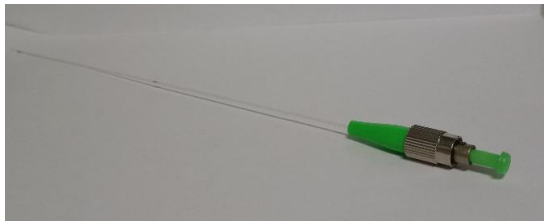
Scientific and technological challenges to address

- ❖ Atom-surface interactions
- ❖ Alkali atoms chemical reactivity
- ❖ Long alkali vapor loading time (months for a HCPCF)
- ❖ Sealing parameter to adjust without losing Rb atoms/signal

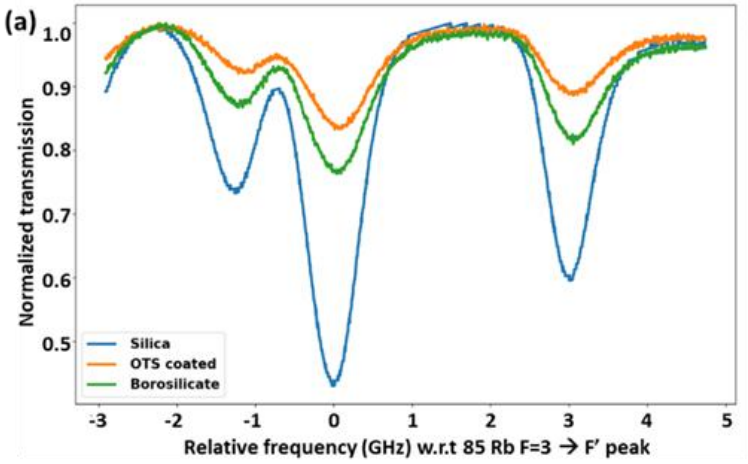
Capillary as a step toward Rb PMC

- *Capillary of ~770µm inner diameter*
- *Platform to study loading dynamics and splicing parameters for different materials*





- Rb successfully sealed in capillary
- Plugable to SMF patchcord on one side



Capillary development as both a platform study and a component itself

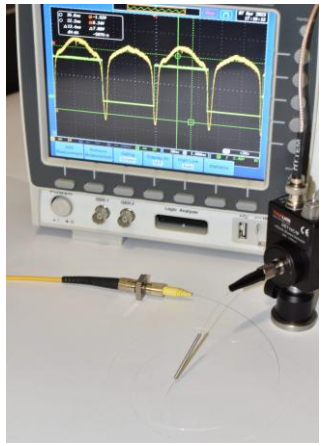
R. Baby et al. ''Towards Rb PMC: loading, splicing, and lifetime studies on different capillaries", Paper 14078-10, SPIE Photonic Europe (2026)

What GLO can offer

- Low loss Hollow Core Fiber of different core size, modal content, and different guiding wavelength to fit with your applications

- PMC as fiber gas cell filled with different gas (C_2H_2, I_2, CO_2…)
    - *High contrast*
    - *Integrable*
    - *Lower power requirement*

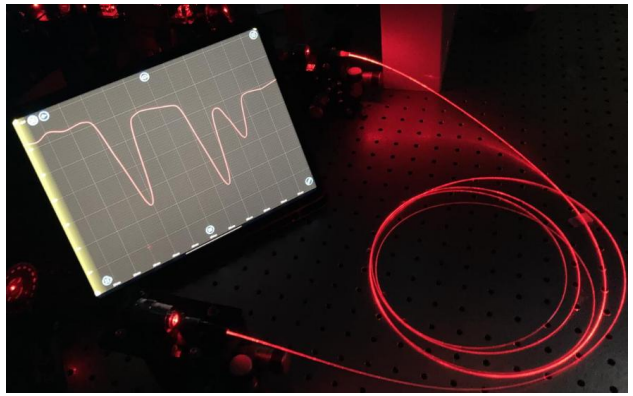
- Collaborative project or Custom engineering to develop and build your fiber solution

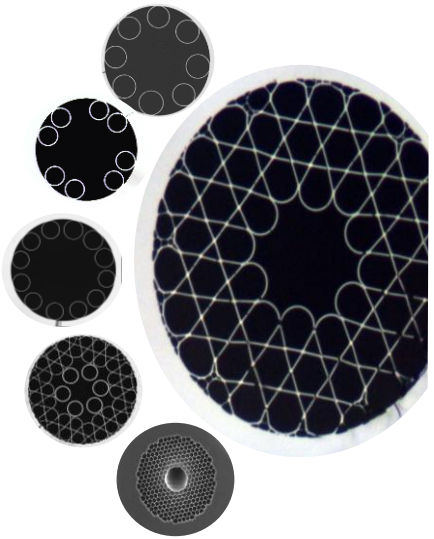


We are looking for:

- Extend people knowledge on HCPCF
- Collaborator to characterize and/or be the final user of Iodine PMC

Thank you for your attention





Thomas Billotte