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Distributed fiber optic radiation sensors

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Distributed fiber optic radiation sensors

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BAM 8.6 Fibre Optic Sensors

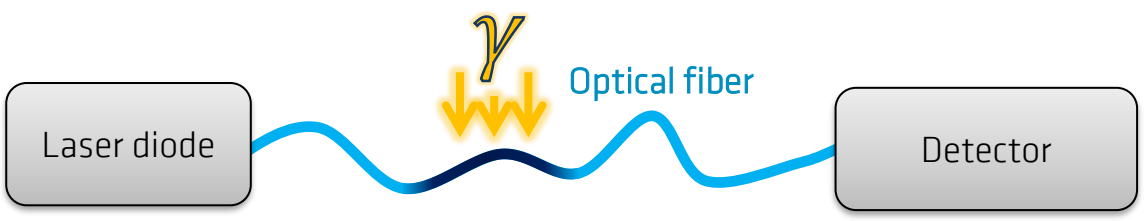
Why distributed fiber optic sensors for nuclear environments?

Because fiber optic sensors (FOS) can measure:

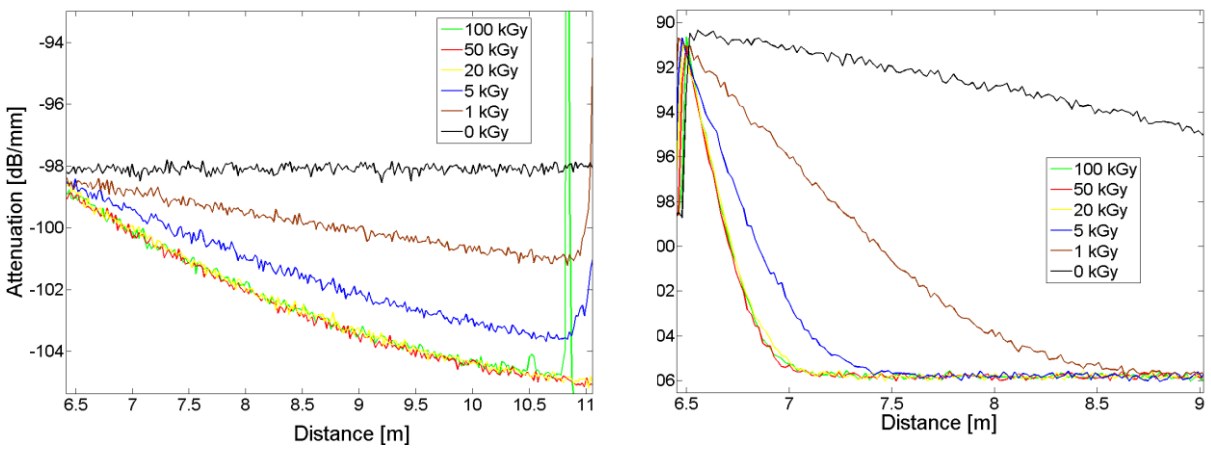
- at ionizing radiation
- in strong electromagnetic fields
- at high temperatures
- at hard-to-reach places
- over long distances (distributed)
- in real-time
- several physical quantities (temperature, strain, humidity etc.) at the same time (multiparameter sensors)

Fiber optic dosimetry can be realized by detecting:

- radiation-induced attenuation (RIA)
- refractive index change
- radio-, thermo- and optically-induced luminescence



Distributed fiber optic radiation sensors based on glass optical fibers (GOFs)

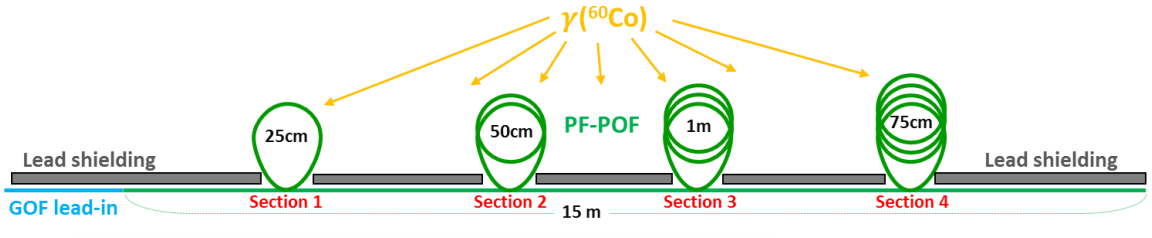


RIA of two different doped radiation-sensitive glass optical fibers.

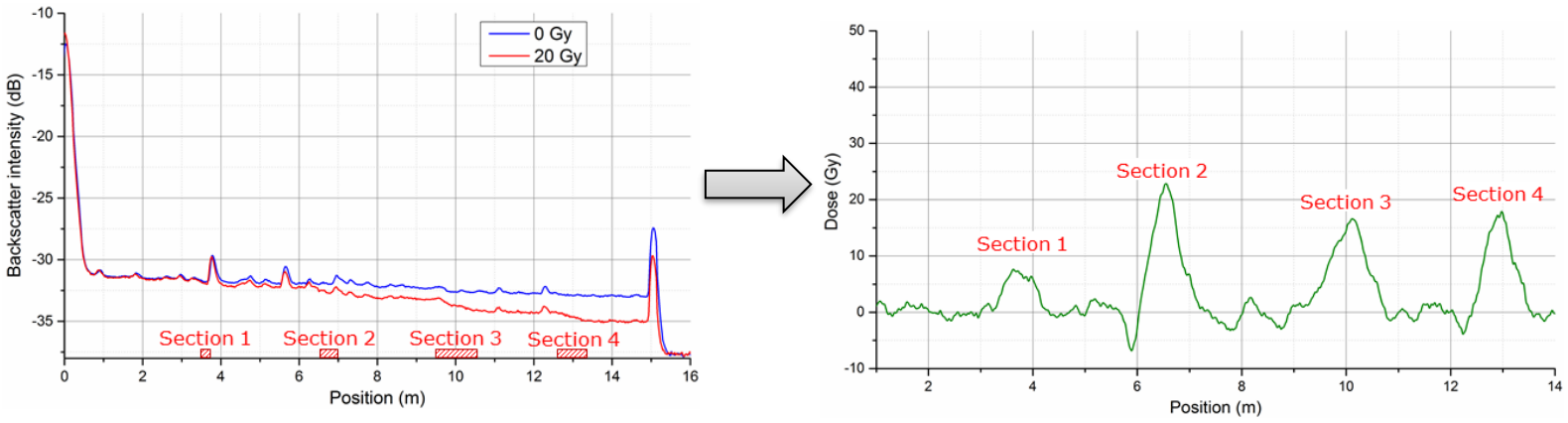
- ➢ sensitivity of the radiation sensors can be influenced by the choice of dopants in the fiber core
- ➢ spatially resolved monitoring along kilometer-long sensing fibers

Wosniok, A., et al. (2016), *Gamma radiation influence on silica optical fibers measured by optical backscatter reflectometry and Brillouin sensing technique*, Proc. of SPIE, 9916

Distributed fiber optic radiation sensors based on polymer optical fibers (POFs)



- ➢ sensitivity of the radiation sensors can be influenced by the type of polymer material
- ➢ dose resolution in the range of a few Gy by measuring RIA
- ➢ monitoring by strong longitudinal strain



Stajanca, P., and Krebber, K. (2017), *Radiation-induced attenuation of perfluorinated polymer optical fibers for radiation monitoring*, sensors, 17(9)

Experimental configuration for POF irradiation (top) and RIA increase after irradiation to 20 Gy (bottom left) with the reconstructed dose distribution (bottom right).

Summary

The RIA sensor response of POF- and GOF-based sensors is dependent on:

- wavelength of the used laser source
- dose rate
- environmental temperature

Application areas of fiber optic radiation monitoring:

- ✓ nuclear power plants
- ✓ particle accelerators
- ✓ nuclear waste repositories
- ✓ radiation profiling of nuclear waste containers

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The research on the POF-based radiation sensors has received funding from the People Programme (Marie Curie Actions) of the European Union's Seventh Framework Programme FP7/2007 2013/ under REA grant agreement n° 608382.
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