



EUROfusion



INSTITUTE OF PHYSICS

ENS-5.2.6.1-T005-01: Design of a system to detect the Li evaporation on the target 2021

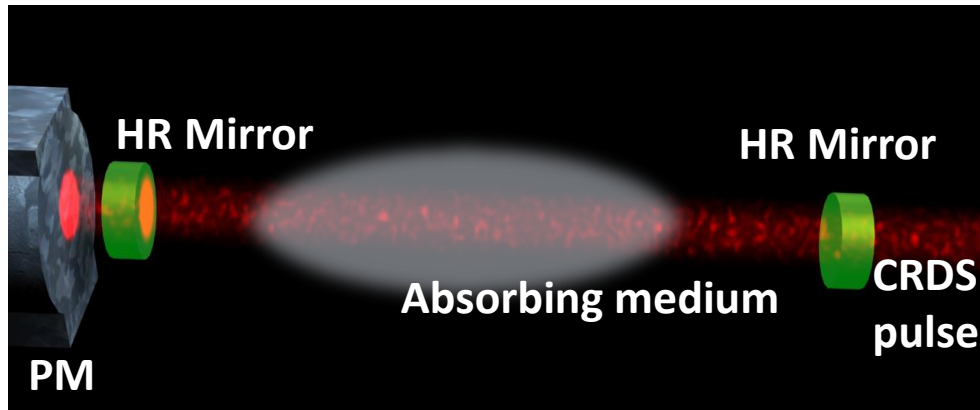
ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Dr. sc. Nikša Krstulović
Institute of Physics, Zagreb, Croatia
Centre for Advanced Laser Techniques

ENS-5.2.6.1-T005-01: Design of a system to detect the Li evaporation on the target 2021

ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Subtasks are about implementation of CRDS spectroscopy for detection of Li, D and T in second beam duct. It will provide measurement of concentrations of such species.



CRDS- Cavity Ring-Down spectroscopy-time which photons spend in resonator – lifetime

ABSORPTION-shorter lifetime

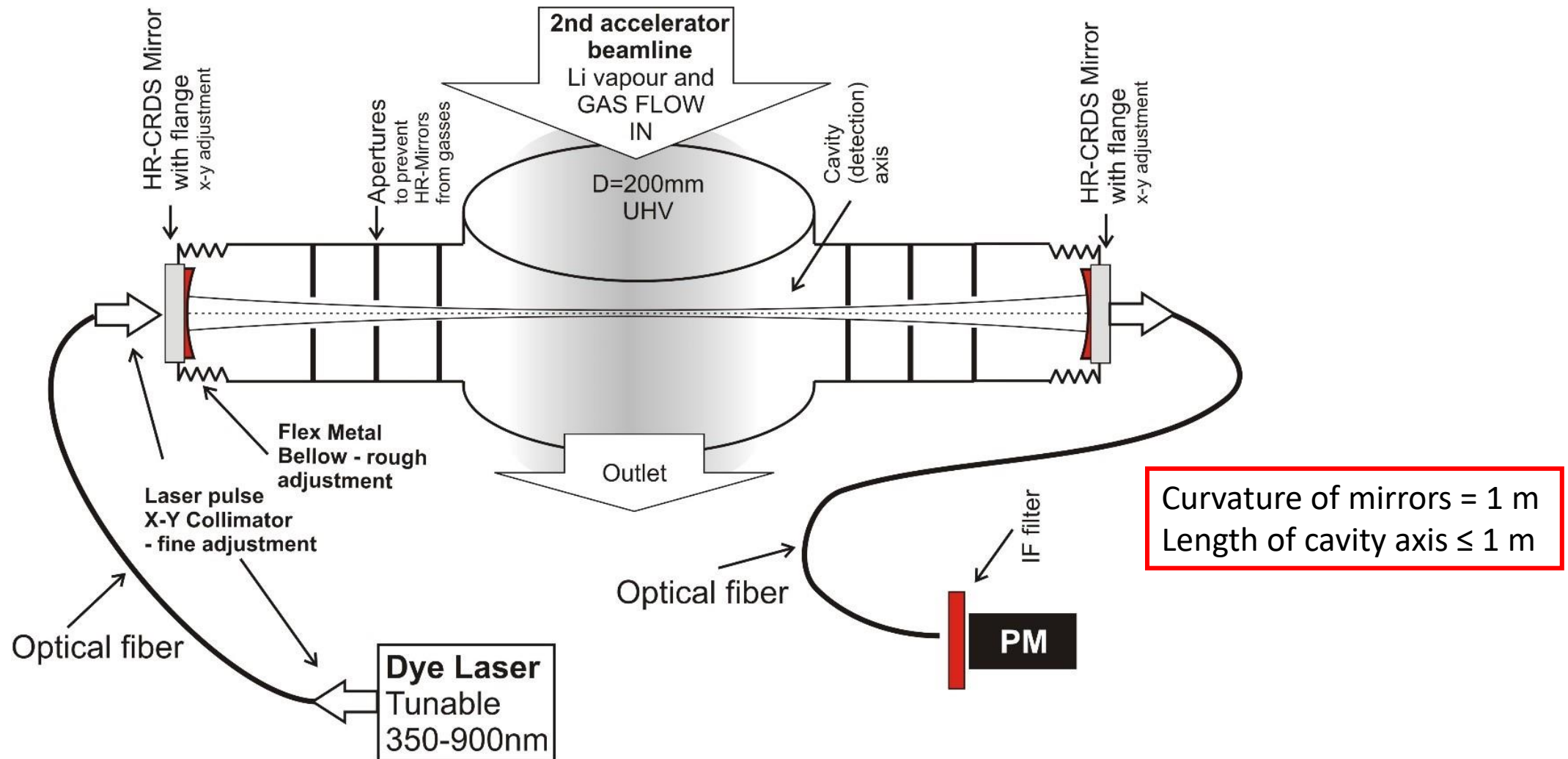
-> single or multi-exponential decay

->**CRDS is based on measuring time, not intensities**

- Limiting and critical factor – **mirror reflectivity** (R=99.95%)

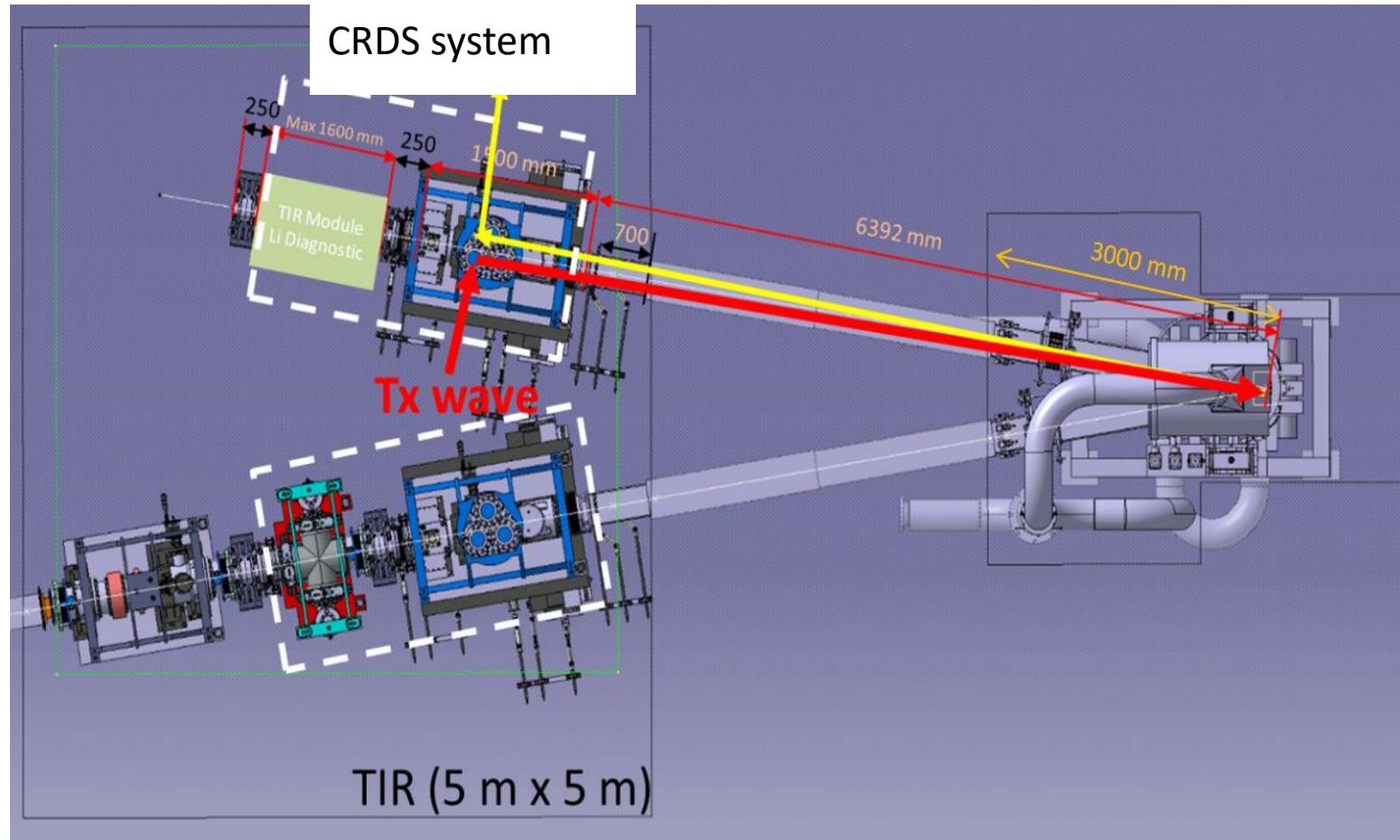


ENS-5.2.6.1-T005-01: Design of a system to detect the Li evaporation on the target 2021





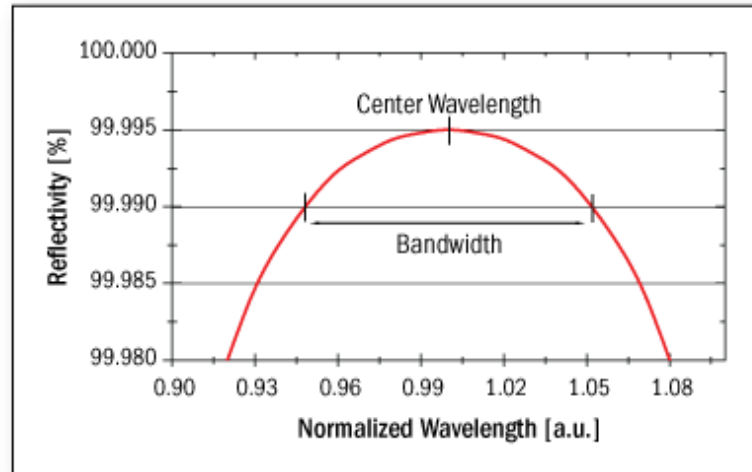
ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023



CRDS detection system will be installed on the second beam duct while the lasers and photomultiplier (detector) will be installed outside the TIR room and connected with fibers



ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023



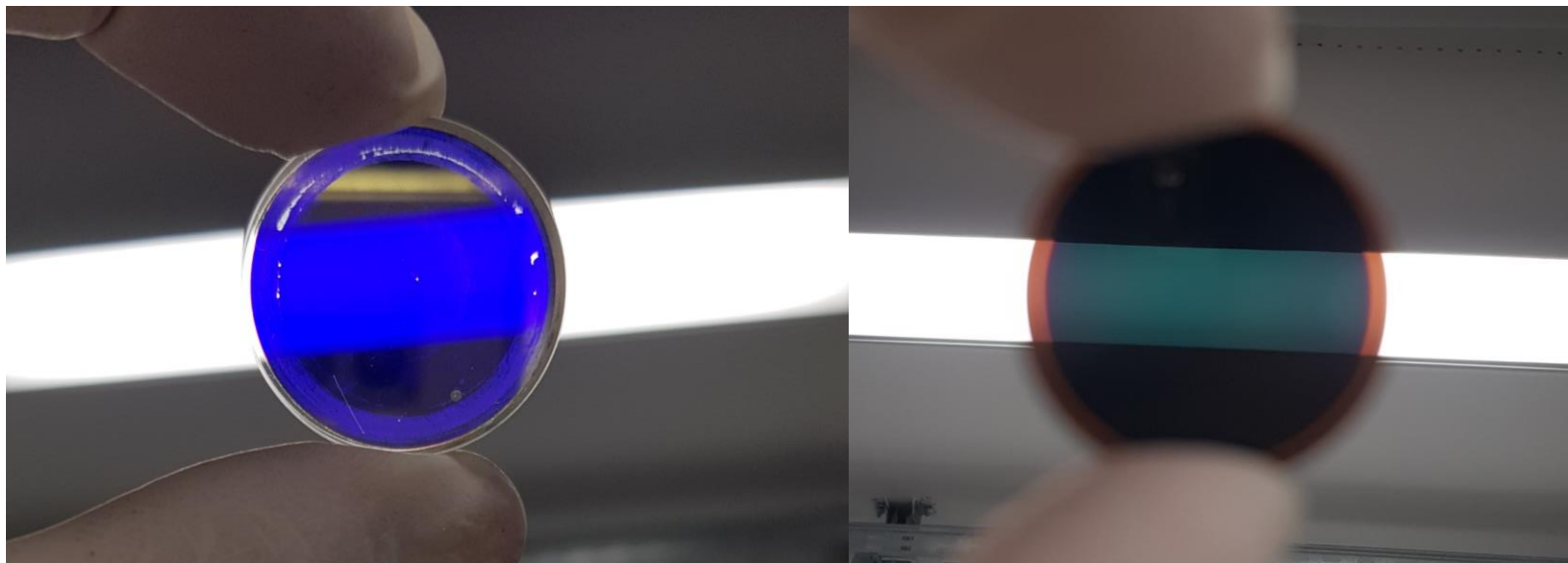
Gamma-rays from Cobalt-60 at RBI's Gamma-ray service lab
Dose: 2 MGy, expected dose for one year?

- **This value should be reconsidered**
 - mirrors are not directly exposed to radiation
 - measurements are done for 1 MGy and 2 MGy doses

Goal is to assess the degradation of mirror coatings upon irradiation (mirror reflectivity)

ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Results after 1 MGy irradiation



Untreated HR Mirror

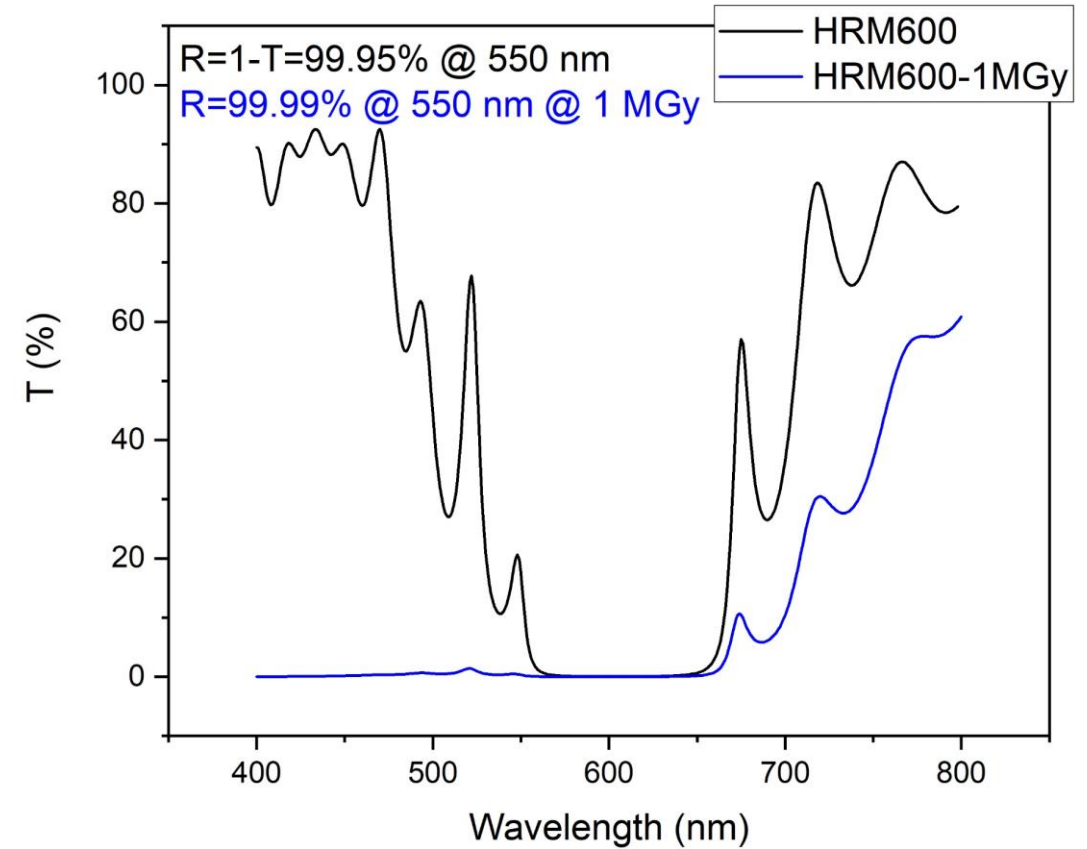
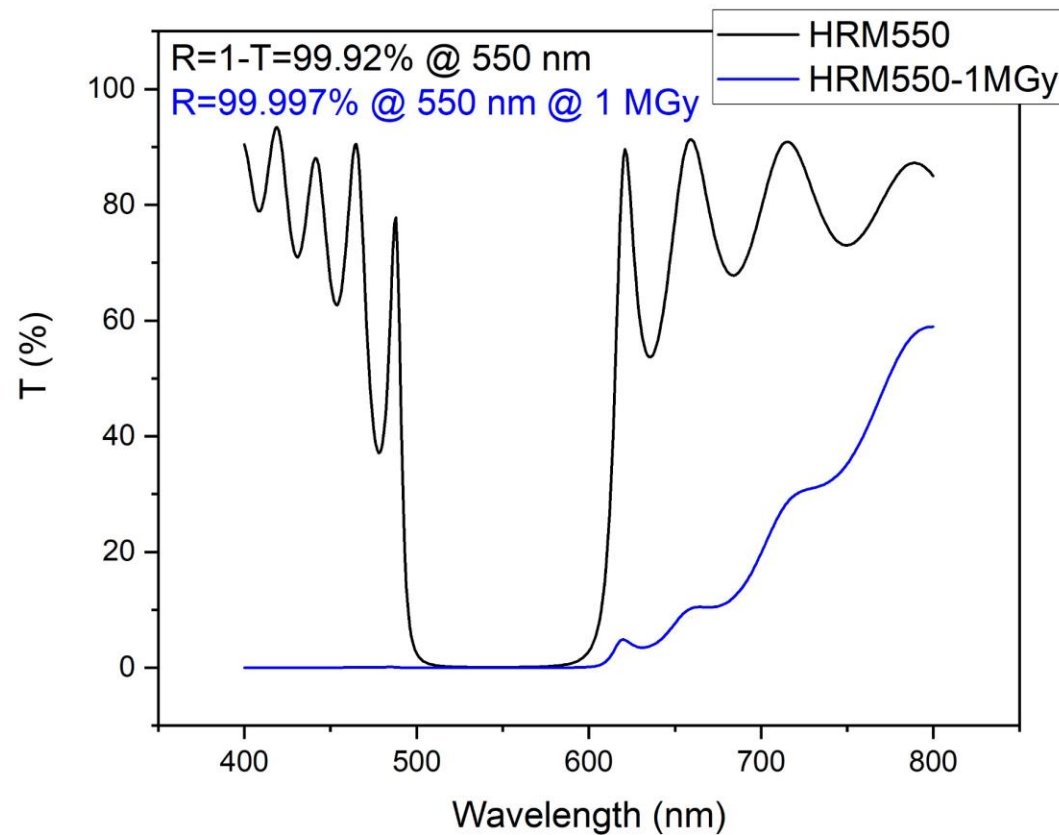
Irradiated HR Mirror

CRDS performance does not depend on intensity of light,
but on time which photons spend in resonator (this depends on reflectivity)



ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Results after 1 MGy irradiation – transparency measurements

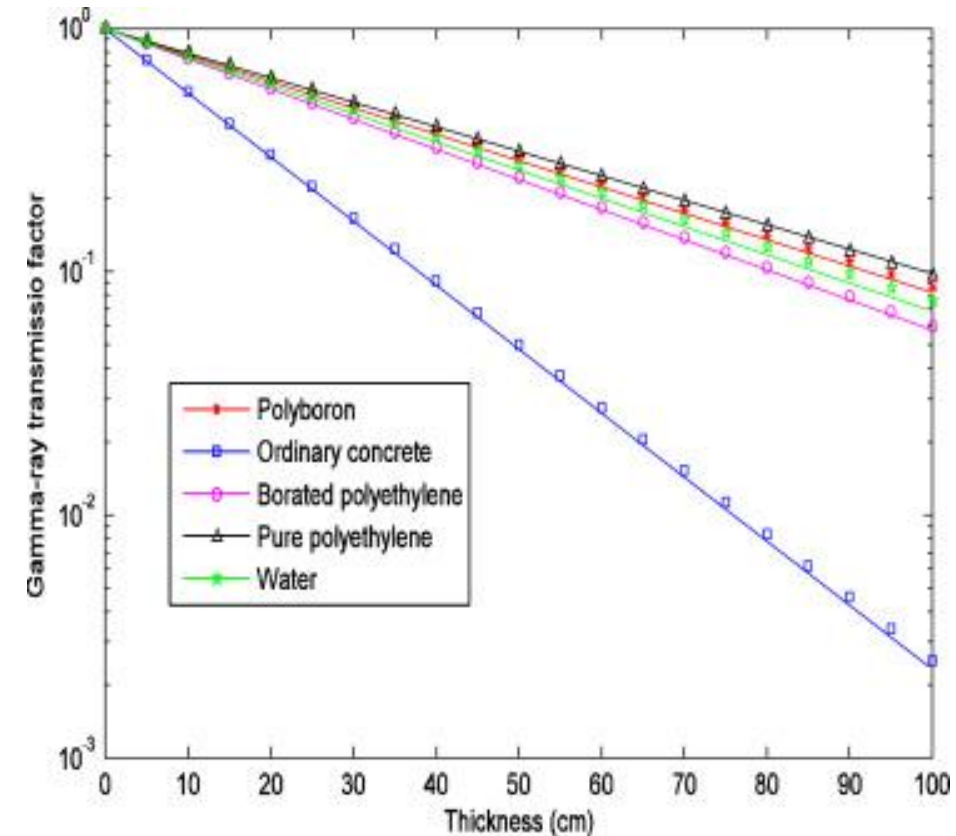
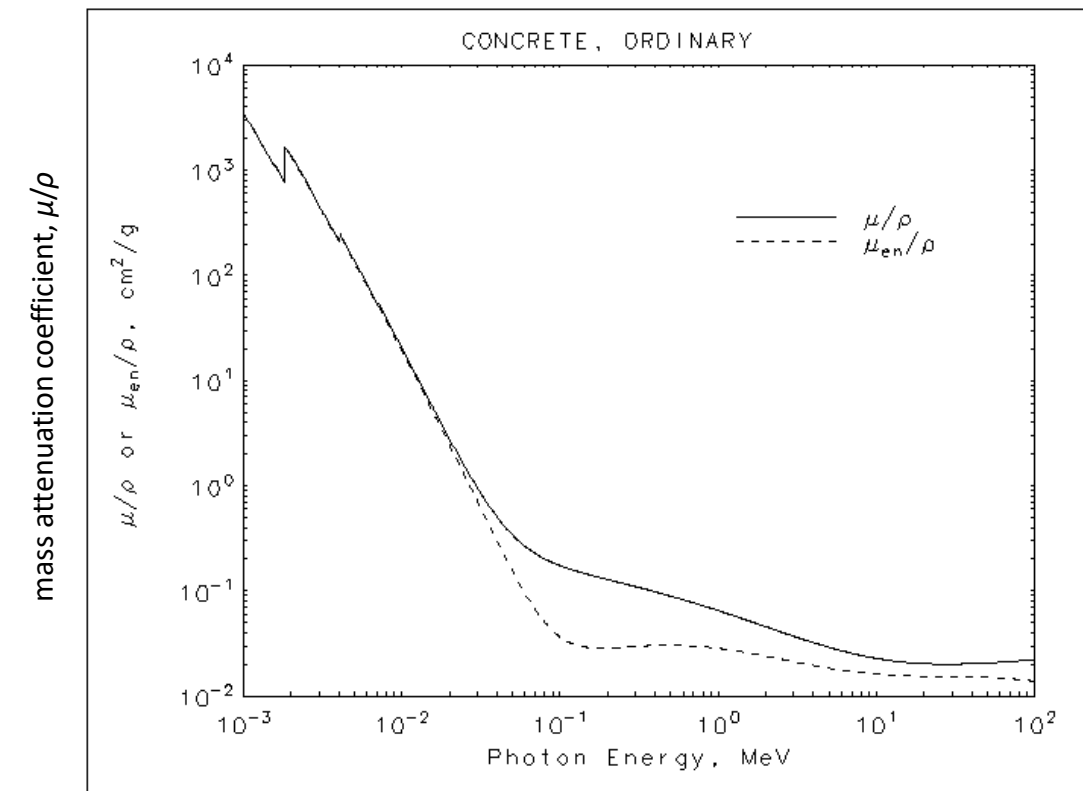


Lower Transparency after irradiation - this is due to the darkening of the glass

- Reflectance measurements (to assess the quality of multilayer optics) in progress...
- status of multilayer optics has to be assessed...

ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Results after 1 MGy irradiation – **need for shielding/attenuation** – find a best solution



ENS-5.2.6.1-T018-01: Irradiation campaign of mirrors for the CRDS 2023

Neutron induced damage would be emulated by simultaneous **dual-beam ion irradiation** at RBI's DiFU dual-beam facility.

Beam of self-ions (like oxygen ions) would be used to reach several dpa (displacement per atom) of **radiation induced damage in the mirrors**.

In progress...

Short overview:

- Shielding is needed
 - Attenuation rate
 - Which material (concrete, stainless steel)
- Reflectance measurements to assess quality of HR mirrors
- Gamma irradiation considering attenuation (new test)
- Building of CRDS system (by the end of 2024) – task #1
- **Key issue: source/orientation of gamma irradiation**
- **shielding of optical fibers**

THANK YOU!