A NEW DOSEMETR FOR MEASUREMENTS OF Hp(3) FOR MEDICAL STAFF

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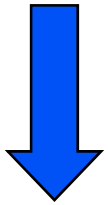
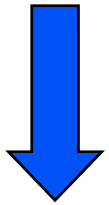
MOTIVATION OF WORK

There is no dedicated eye-lens dosemeters, designed for correct measurements of Hp(3)



ORAMED project Work Package 2 „Development of practical eye lens dosimetry in interventional radiology”



Objective: „Design and development of new practical dosemeters that are suitable to respond in terms of Hp(3) (measurement of eye lens dose)”

GOAL

To design and develop a new TLD based dosemeter, which will fulfil following conditions:

- measuring correctly Hp(3) for eye-lens
- comfortable for users and for dosimetric services
- waterproof
- inexpensive

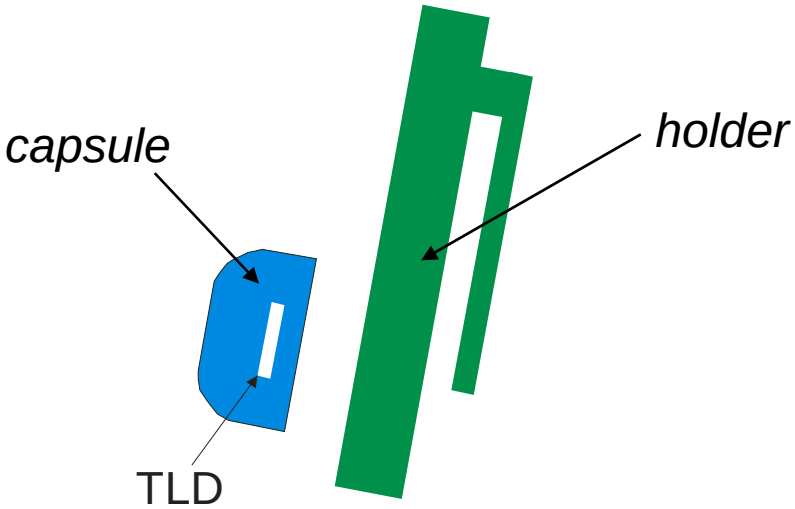
DESIGNING OF THE DOSEMETER

To be universal, the dosemeter should have a modular construction.

⇩

the dosemeter will consist of two separate parts:

- Measuring element : capsule with TLD detector
- Holder : to fix position of the capsule close to eye



DESIGNING OF THE DOSEMETER

Characteristics to be optimized:

- energy response
- angular response

What may be varied:

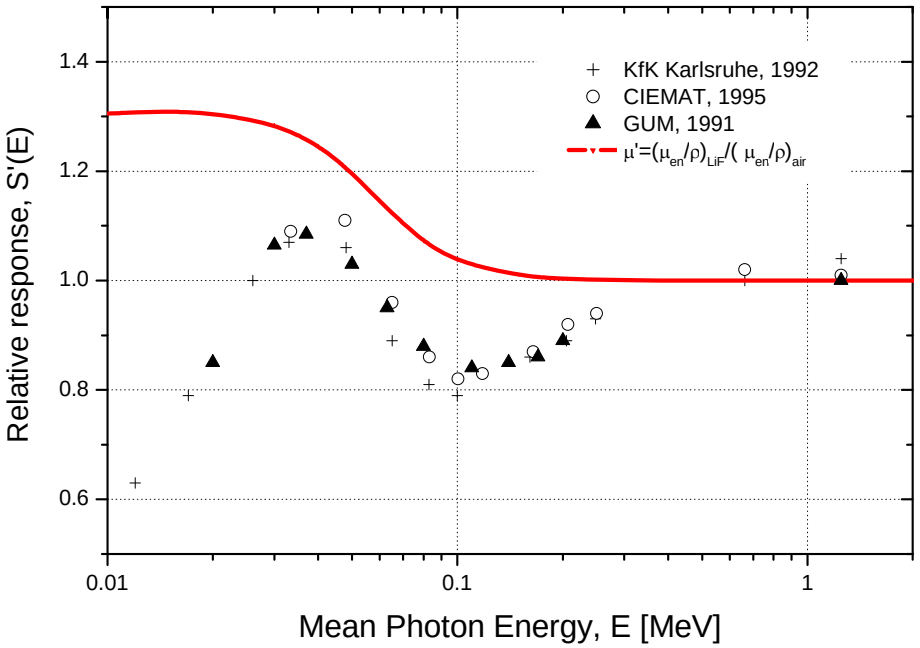
- TLD detector type
- TLD dimensions
- Capsule material
- Capsule dimensions

DESIGNING OF THE DOSEMETER

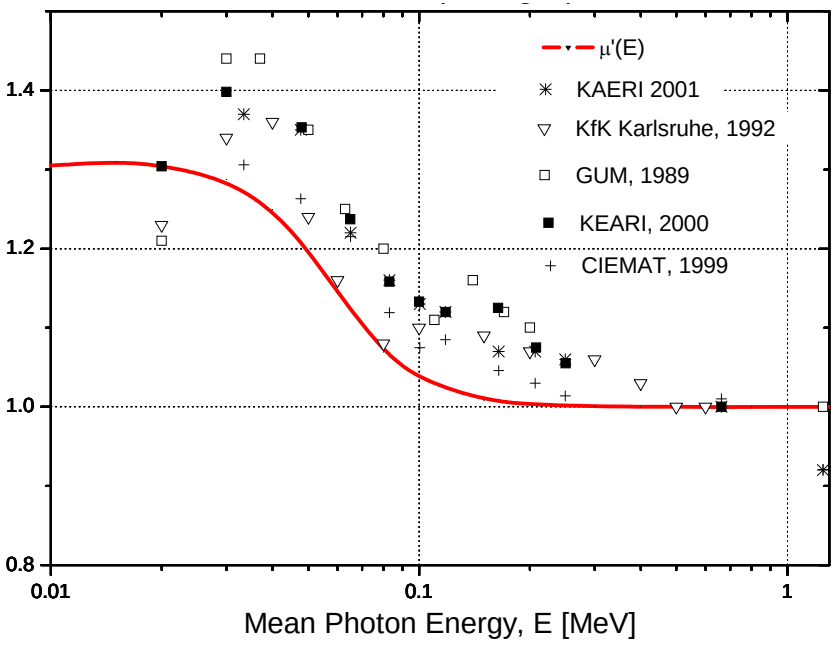
Choice of TLD type

Two detectors types of different energy response available:

LiF:Mg,Cu,P (MCP-N)



LiF:Mg,Ti (MTS-N)



DESIGNING OF THE DOSEMETER

Choice of capsule material

A variety of available polymers:

- PMMA
- polyurethane
- polystyrene
- polyamide
- polyethylene
- PVC
- PTFE
- *many others*

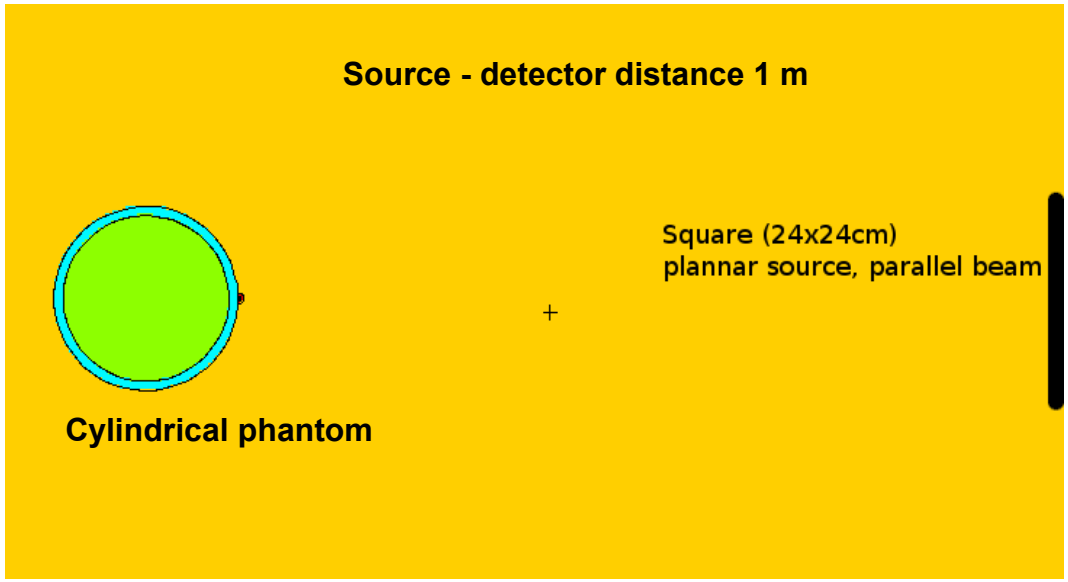
DESIGNING OF THE DOSEMETER

Tools for optimization:

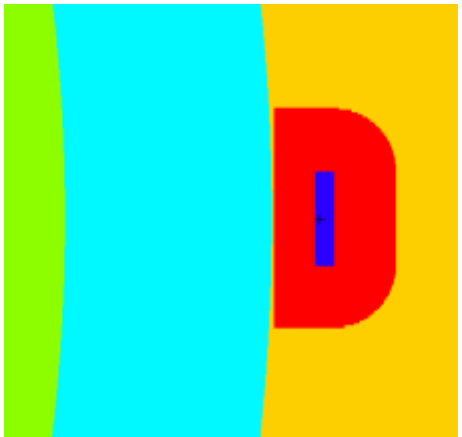
1) Computer simulations
2) Test measurements with X-rays

DESIGNING OF THE DOSEMETER

Computer simulations



Monte Carlo code
MCNPX

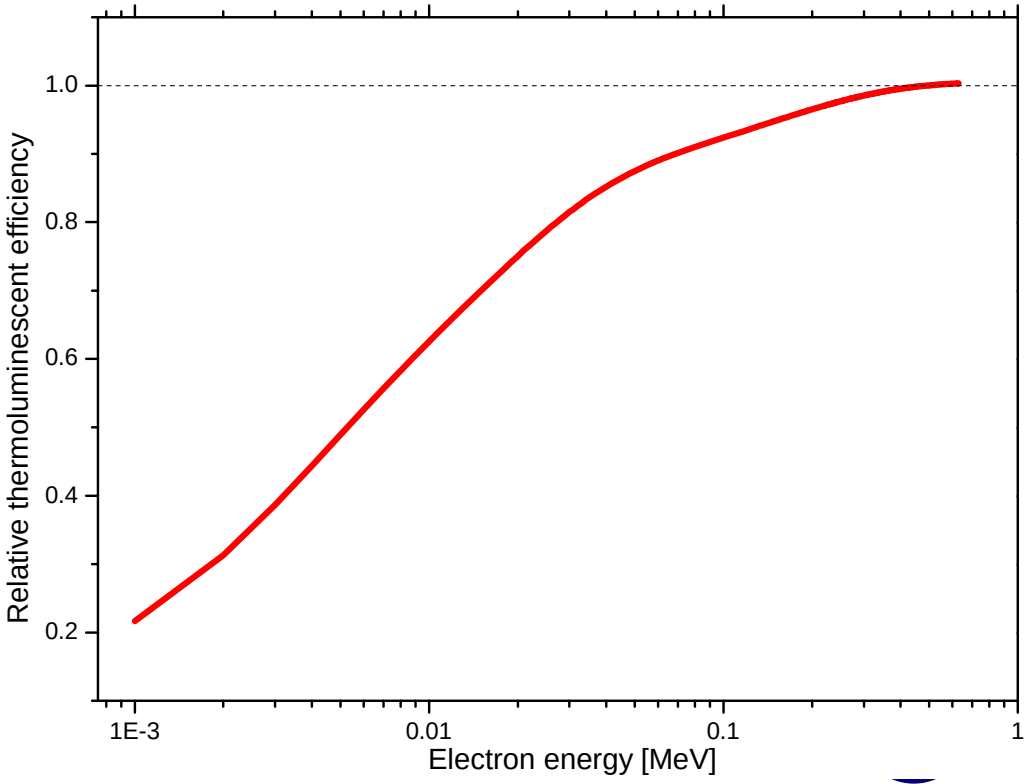


DESIGNING OF THE DOSEMETER

Computer simulations

Microdosimetric model of TL efficiency developed by Olko, *RPD 65, 1996*
RPD 99, 2002

Relative TL efficiency of MCP-N for secondary electrons ⇨

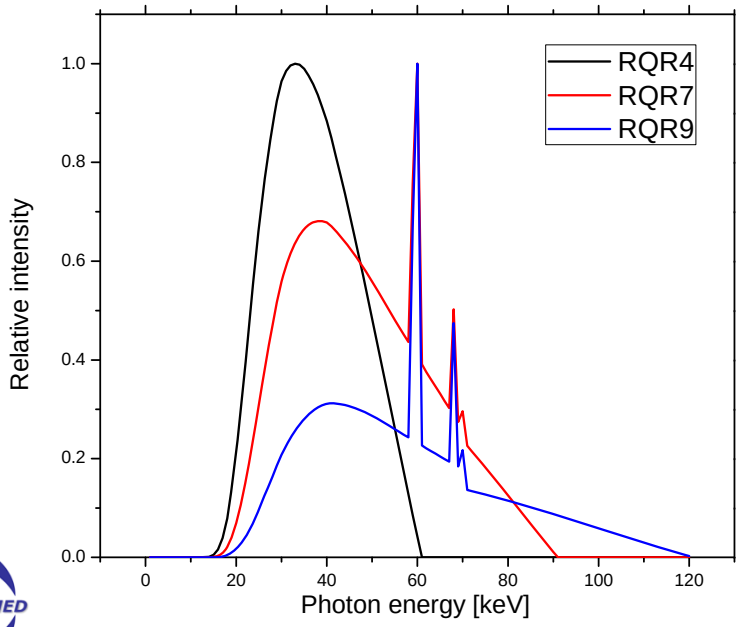


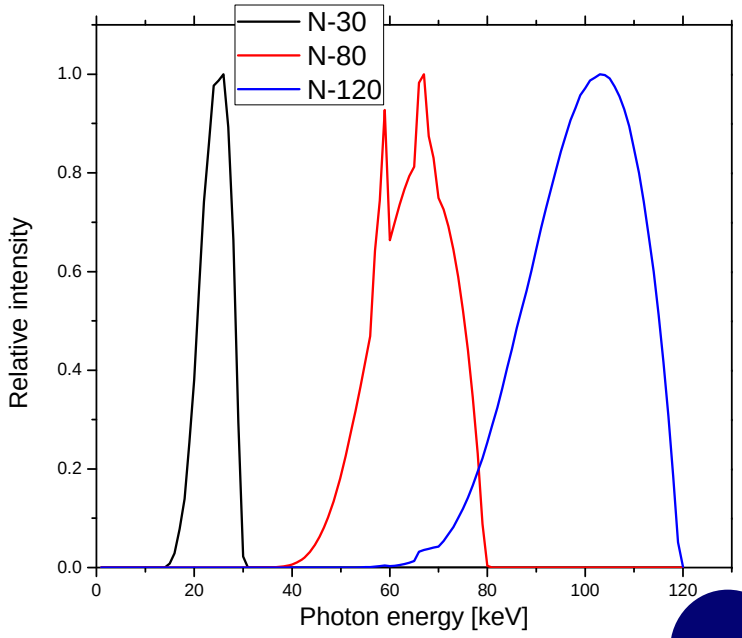
DESIGNING OF THE DOSEMETER

Test measurements

Irradiations at CEA, Saclay, France

X-ray spectra: IEC RQR series, ISO narrow N series





DESIGNING OF THE DOSEMETER

Steps of dosemeter development:

1. Working model: only capsule, technology: cutting

DESIGNING OF THE DOSEMETER

Steps of dosemeter development:

1. **Working model:** only capsule, technology: cutting
2. **Pre-prototype:** capsule – final version, holder – provisional

   technology: injection moulding

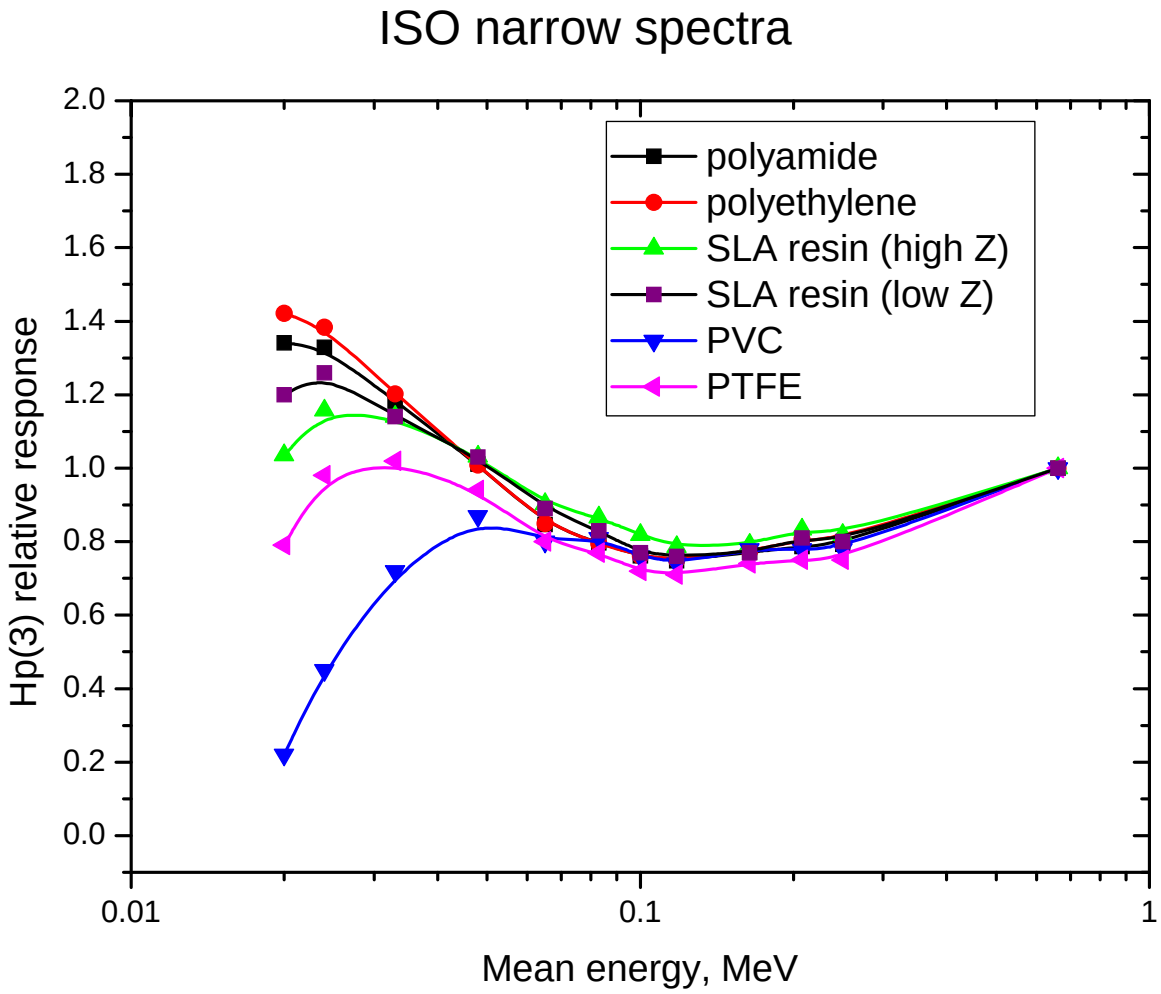
DESIGNING OF THE DOSEMETER

Steps of dosemeter development:

1. **Working model:** only capsule, technology: cutting
2. **Pre-prototype:** capsule – final version, holder – provisional
   technology: injection moulding
3. **Final prototype**

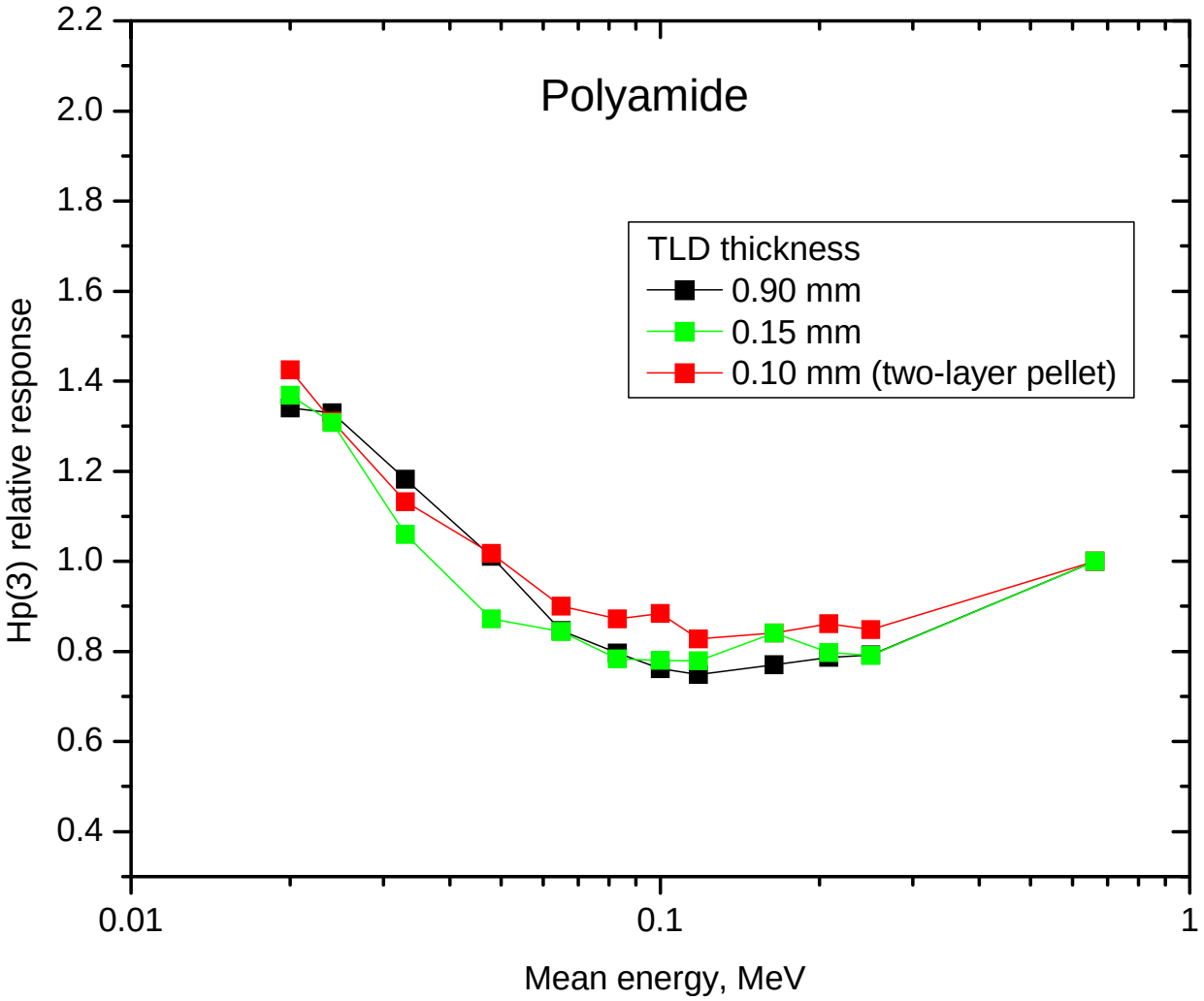
RESULTS

Simulations: various capsule materials



RESULTS

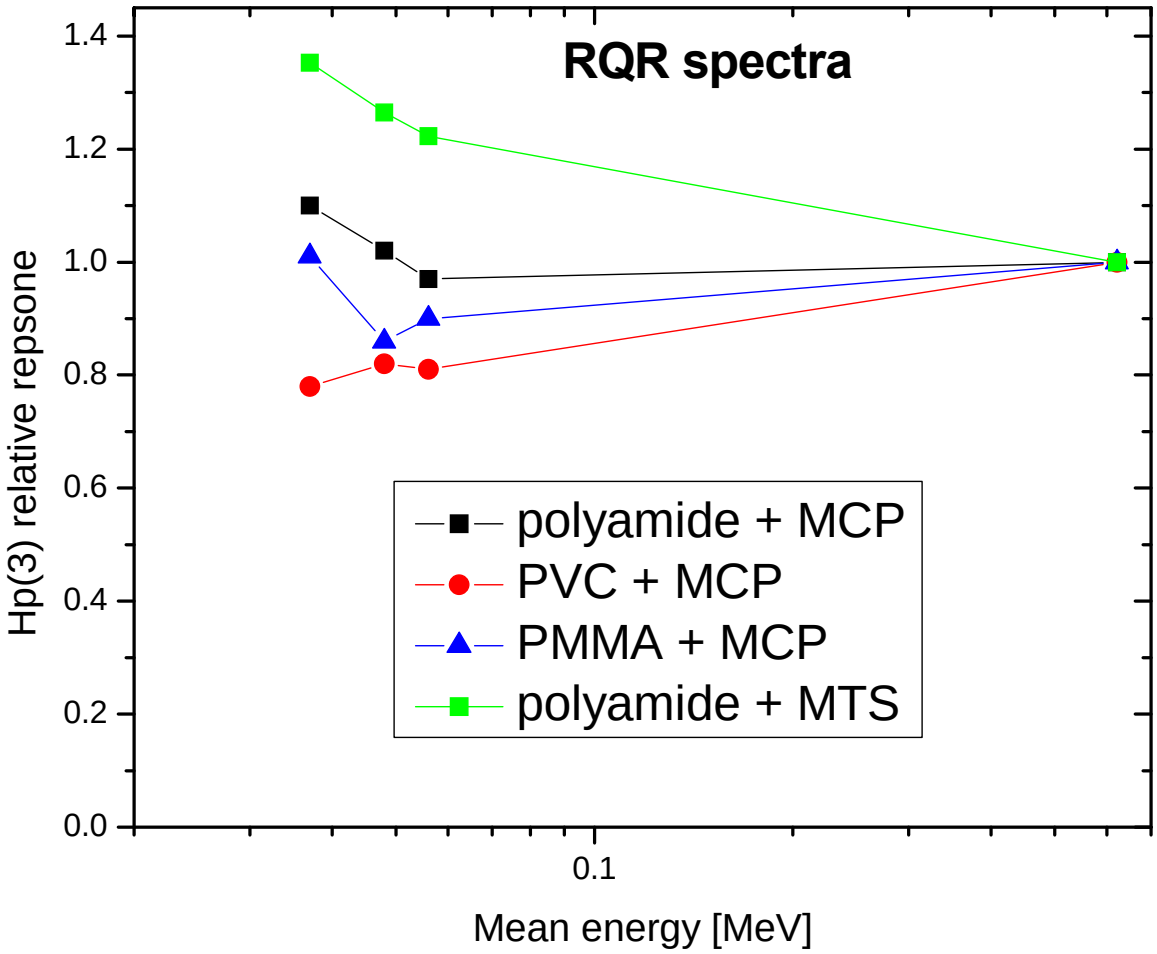
Simulations: TLD thickness



RESULTS

Measurements

tests with capsule models made of various materials



FINAL CHOICE

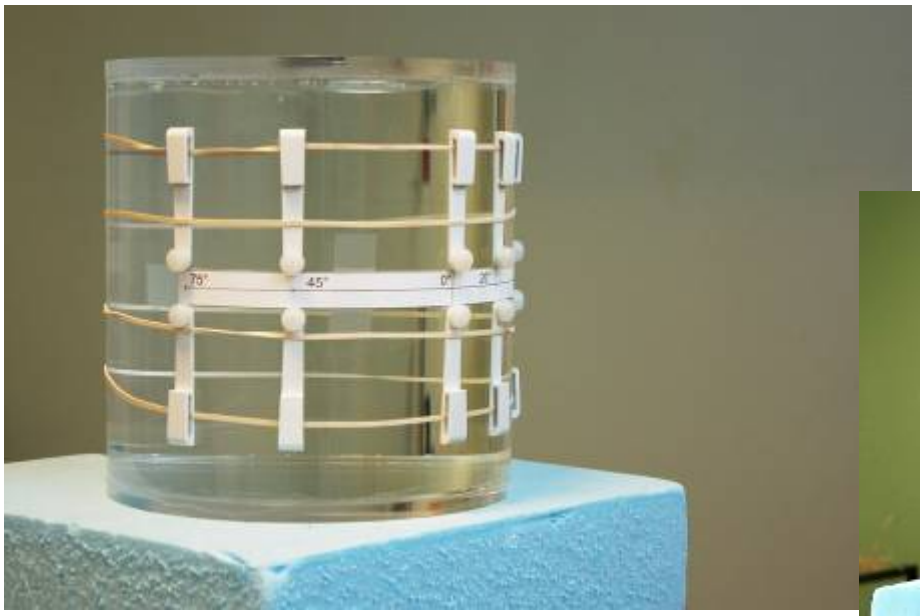
TLD:

MCP-N LiF:Mg,Cu,P
4.5 mm diameter, 0.9 mm thick

Capsule:

Polyamide, thickness 3 mm

Test X-ray irradiations of pre-prototypes at CEA, Saclay, France

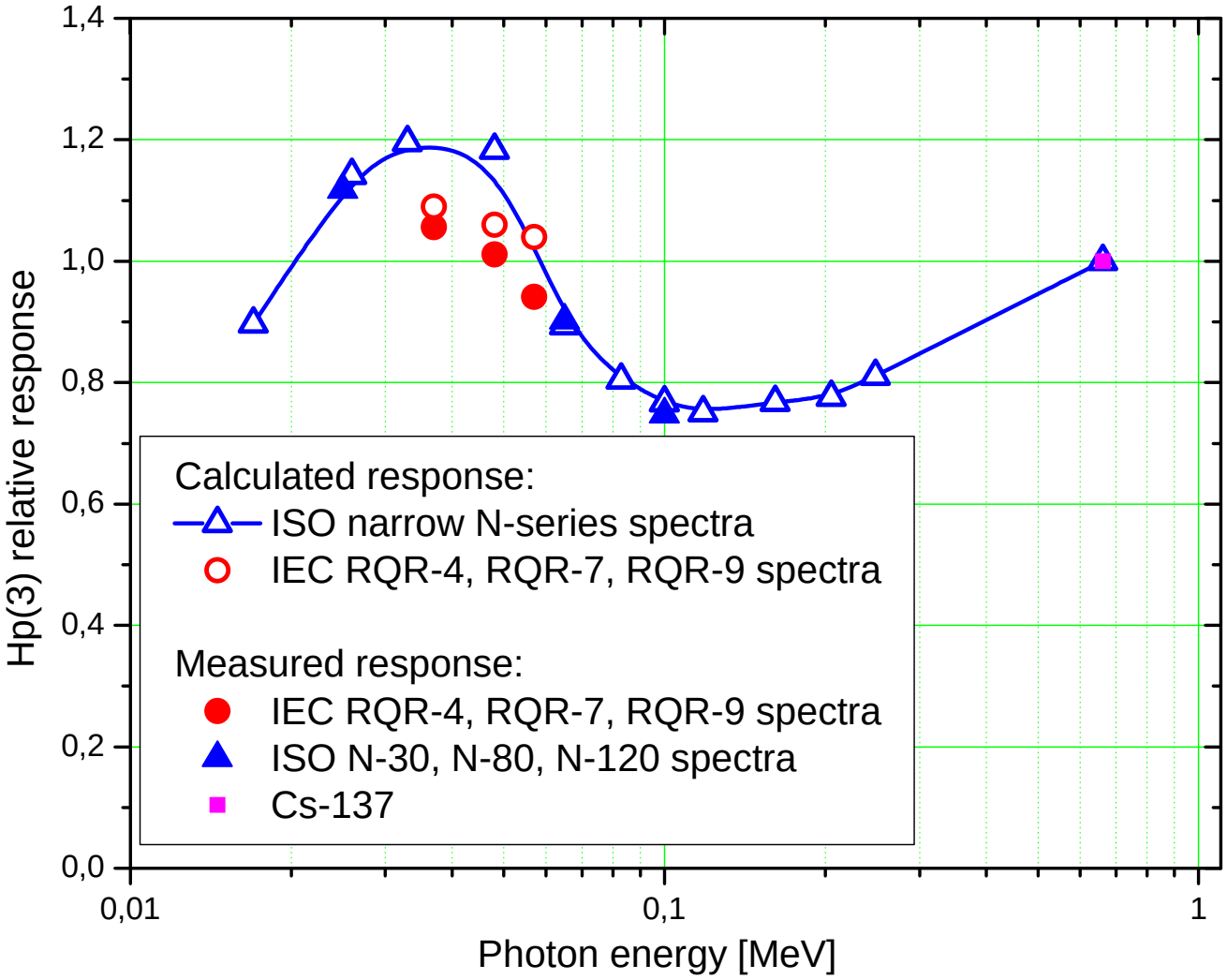


← Dosimeters on the water filled cylindrical phantom– 20cm height, 20 cm diameter

Irradiations with X-rays →

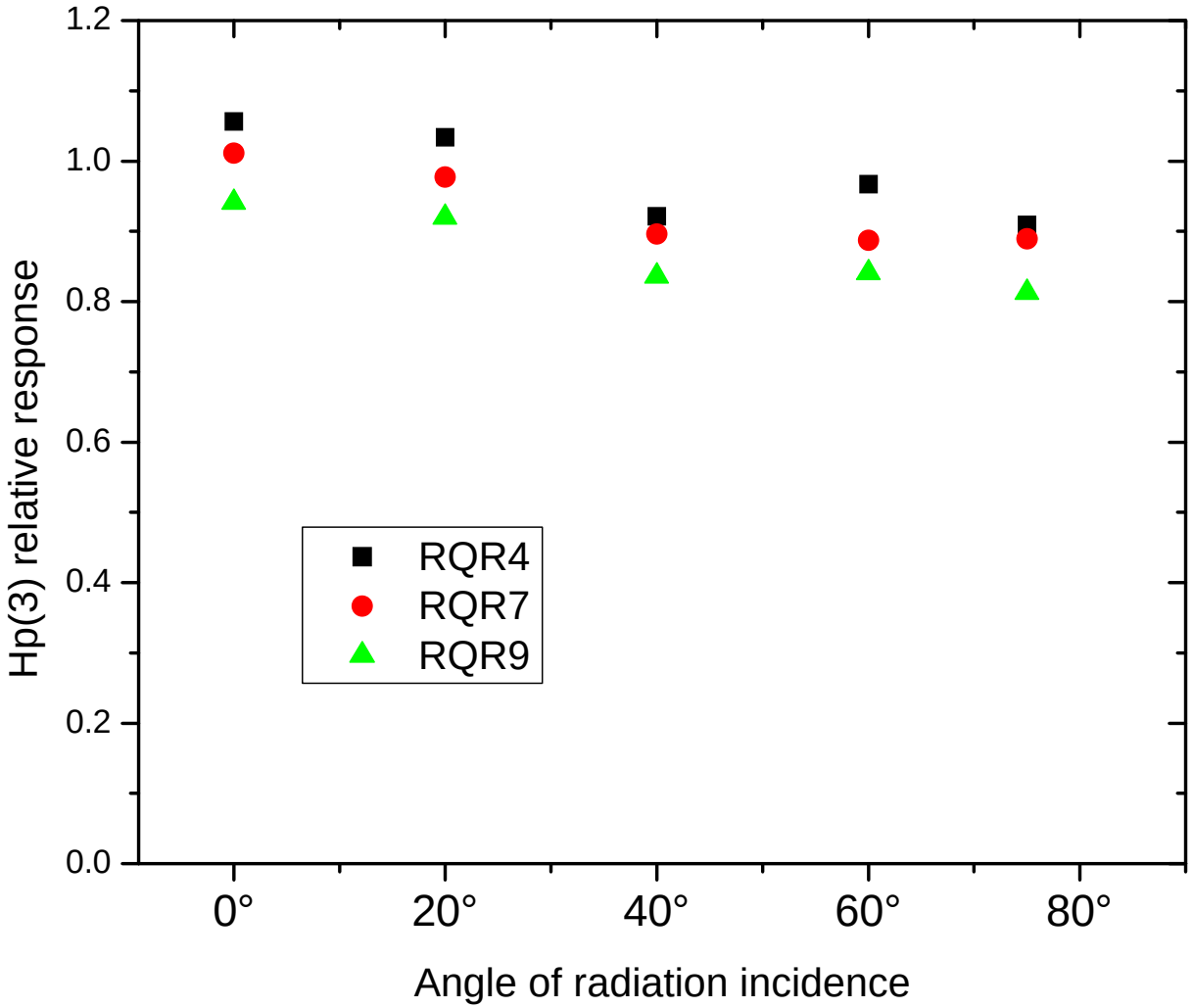
RESULTS

Energy response



RESULTS

Angular response



FINAL VERSION

EYE-D™ dosemeter

SUMMARY

In frame of the FP7 ORAMED project, a new dosemeter ***EYE-D***™, dedicated for measurements of eye-lens doses, has been developed.

The performed tests, proved that ***EYE-D***™ measures correctly Hp(3) within the relevant energy range.
The dosemeter posses also a flat angular characteristic.

The ***EYE-D***™ dosemeter is produced and offered by the Radcard company.