

Invention

Development

Measurements

The new REM-3

Triple-mode

# *Improvement of construction of recombination chambers for mixed radiation dosimetry at work places*

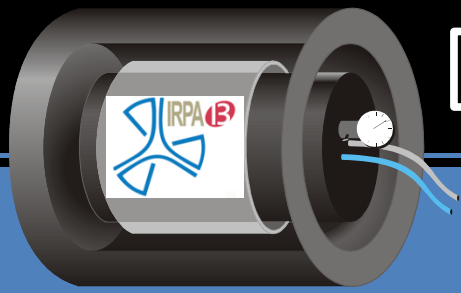


Dr eng. Michał A. Gryziński

**National Centre for Nuclear Research**

**POLAND**





Invention

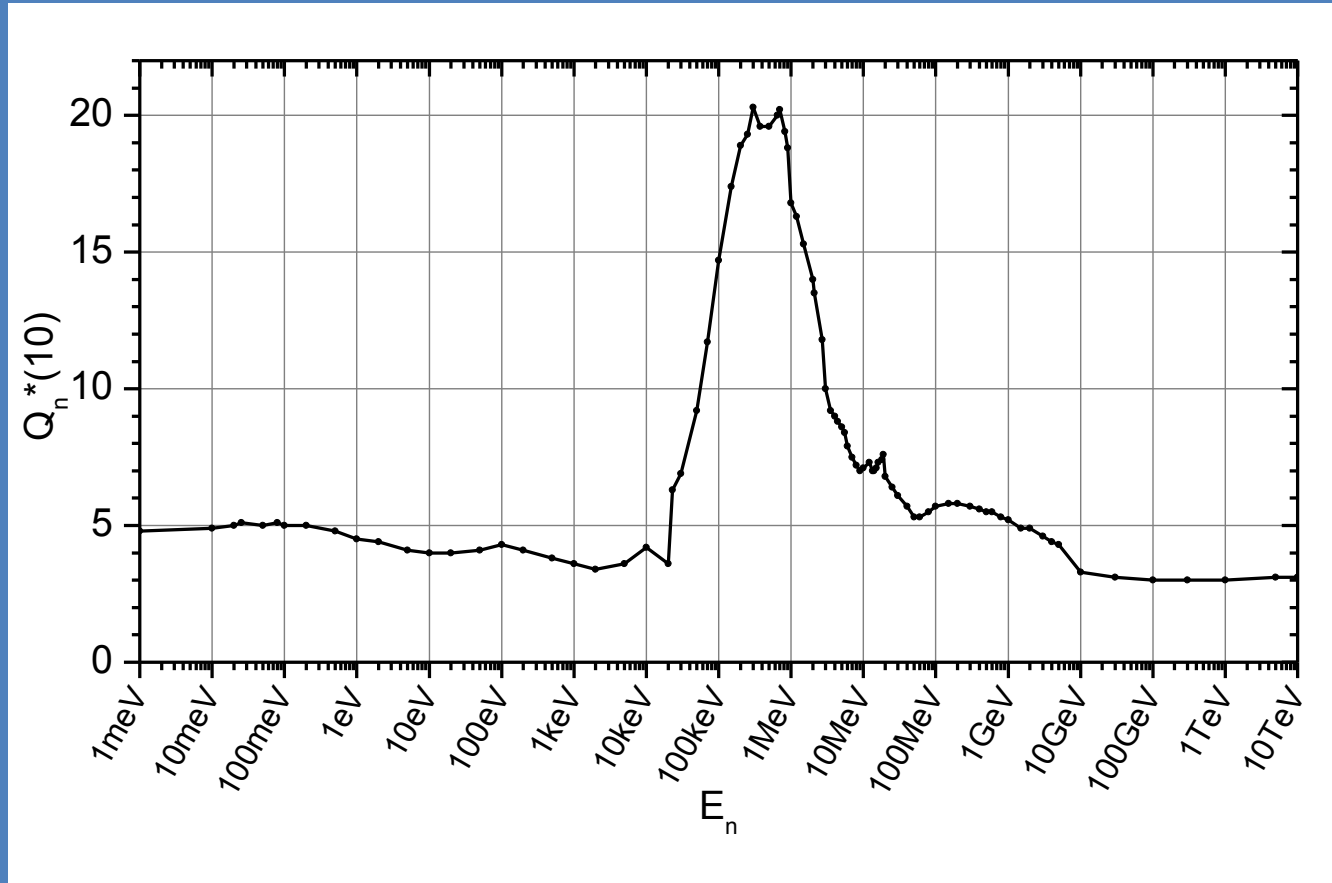
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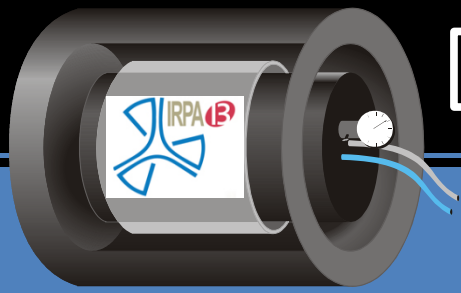
Triple-mode

# Dosimetry at work places



$$H^*(10) = D^* Q^*$$





Invention

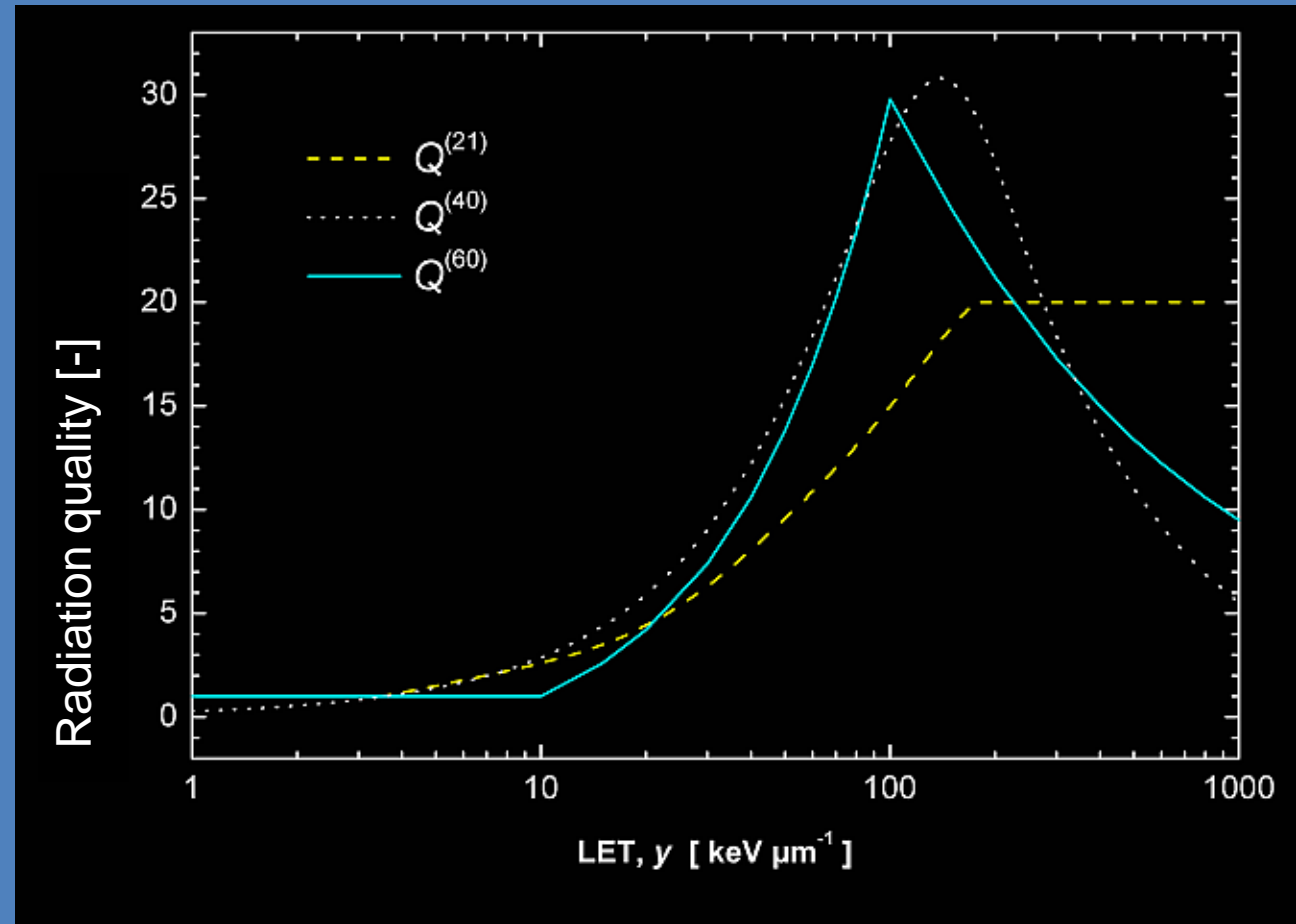
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# Dosimetry at work places

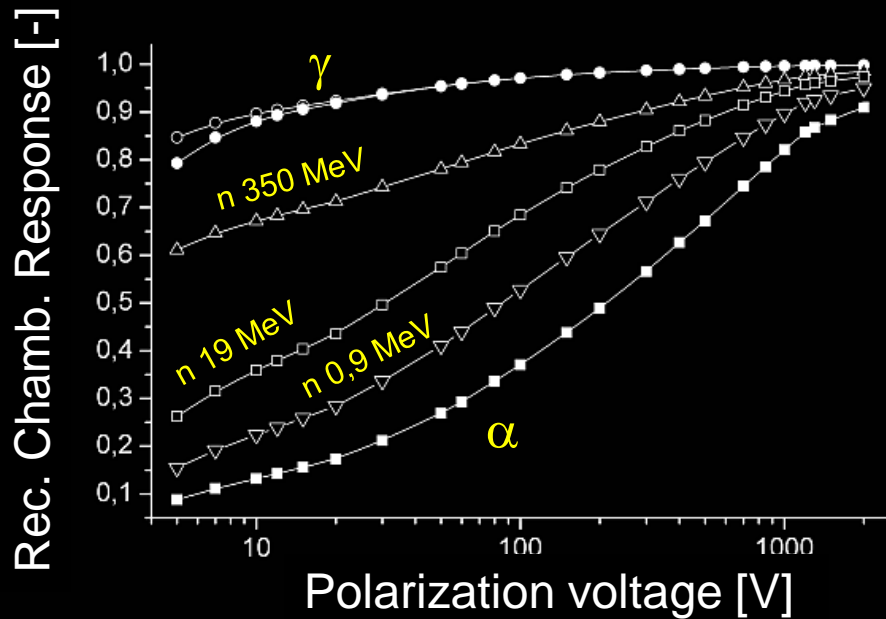


$$H^*(10) = D^* Q^*$$





# Recombination chamber response depends on LET

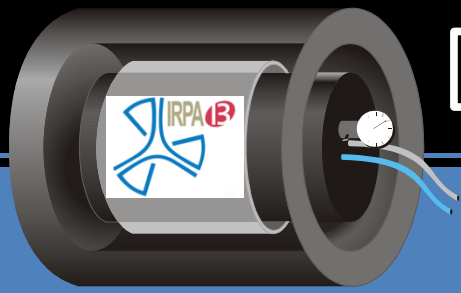


**Recombination chamber**



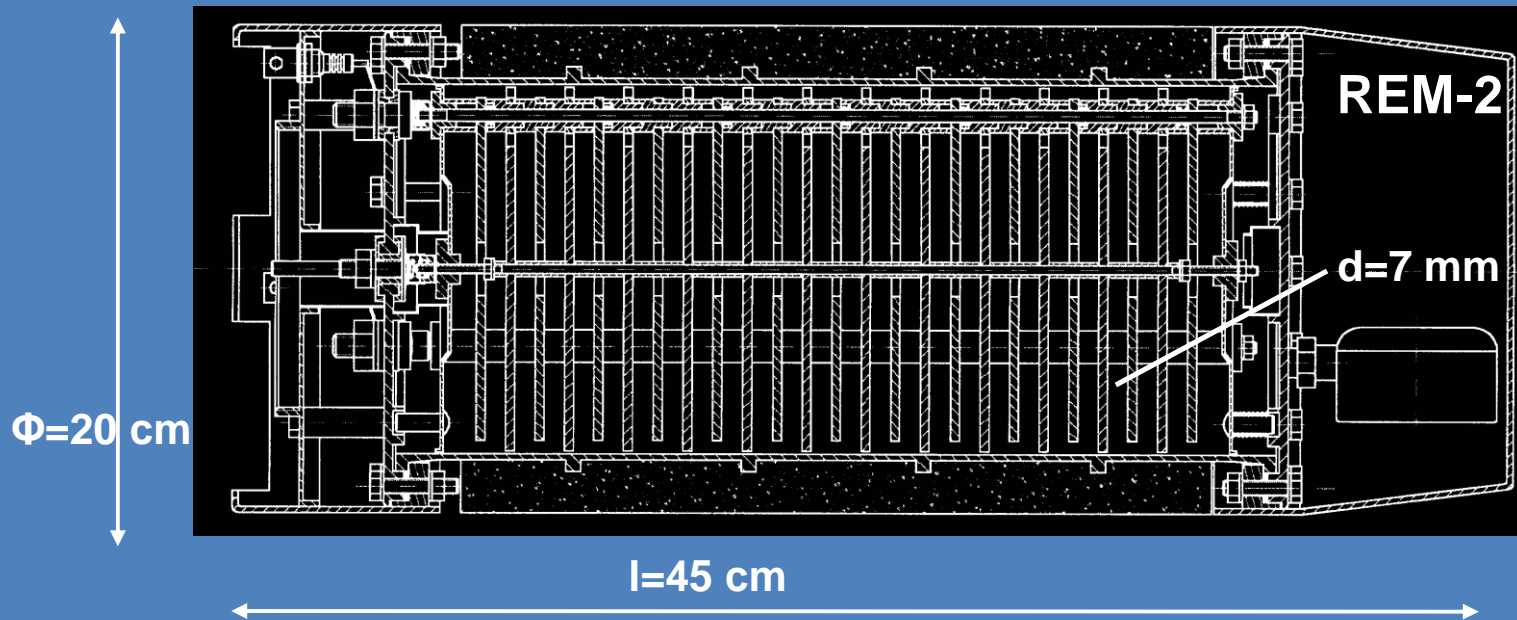
**$H^*(10)$ -meter**

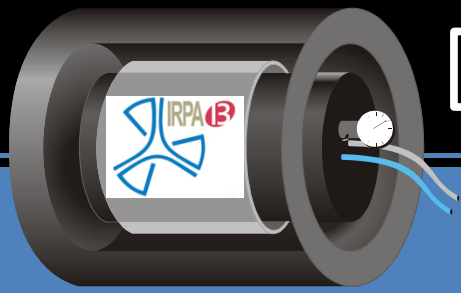




# Recombination chamber

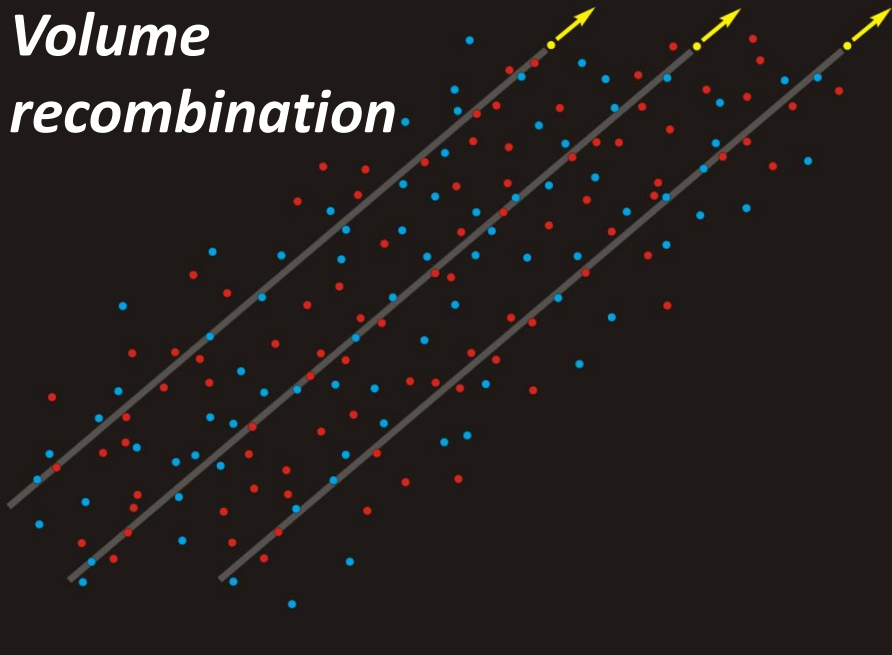
Recombination chamber is a **tissue-equivalent**, high-pressure ionization chamber operating under conditions of local recombination of ions.



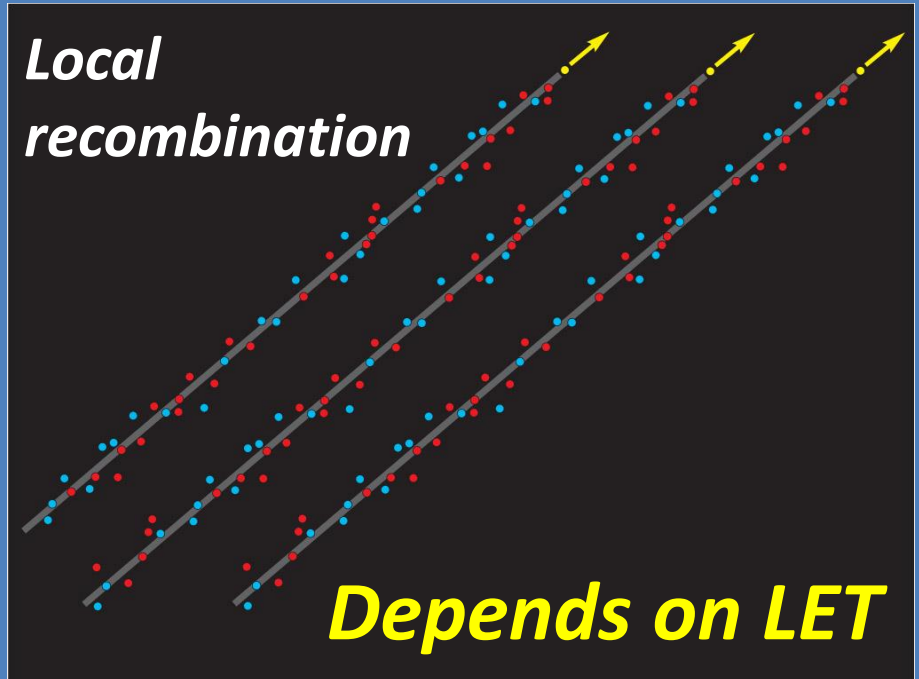


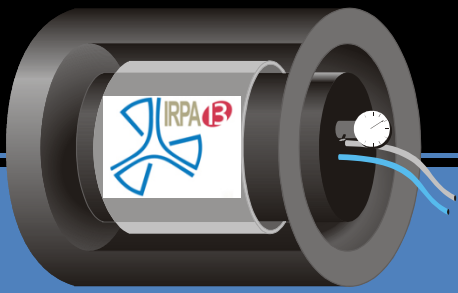
# Local recombination of ions

**Volume recombination**



**Local recombination**





# Half of the century of development

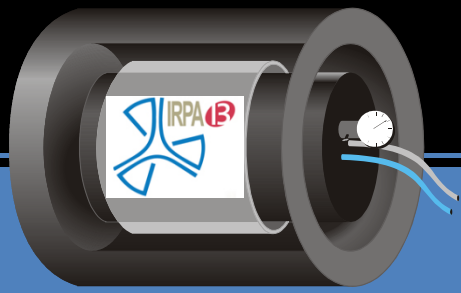
*20 recombination methods;  
30 recombination chambers;  
15 various recombination dose meters*



*REM-2 manufactured by POLON in Bydgoszcz  
(used in CERN, JINR, FermiLab and others)*

*Recombination chambers mentioned in  
IAEA/ICRU/ICRP publication*





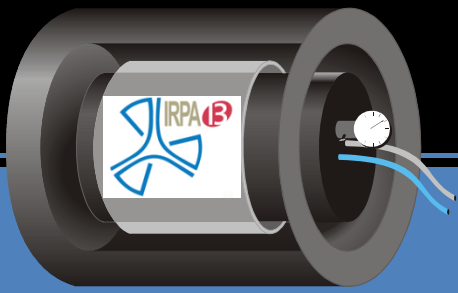
# *Hundreds of measurements...*

*Measurements performed in many different radiation fields: high energy, reactor beams, isotopic sources, accelerators, environmental, pulse*

*Several international intercomparison experiments (CERN, JINR, GSI, HZB...)*



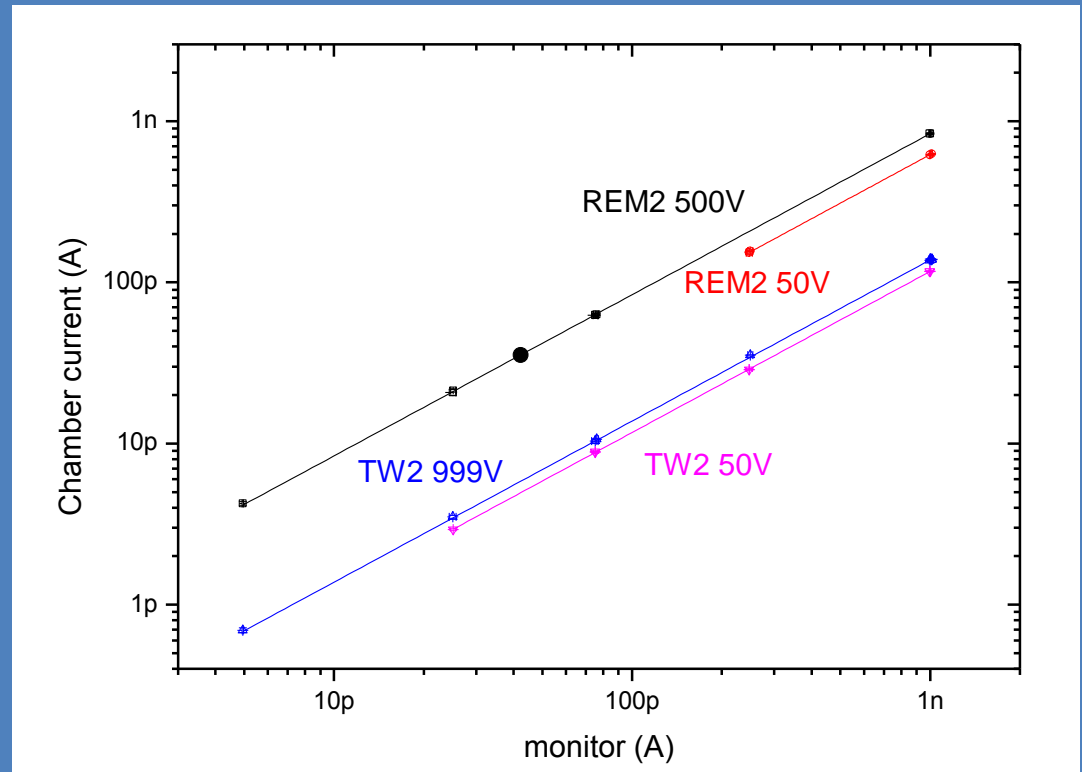




## Lately measurements in 2012

Neutrons (60MeV protons on W target)  
Burst length 1 $\mu$ s and 10  $\mu$ s  
Dose equivalent/burst 0.8  $\div$  165 nSv  
Dose equivalent rate  
0.3 mSv/h  $\div$  60 mSv/h

Fitted function  $y = ax$



**Recombination methods are suitable for pulsed radiation dosimetry**

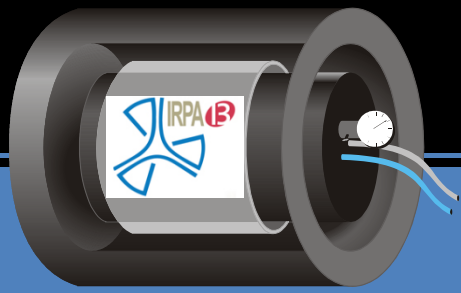


# *New generation of recombination chamber denoted REM-3 is lately constructed and under the tests!*

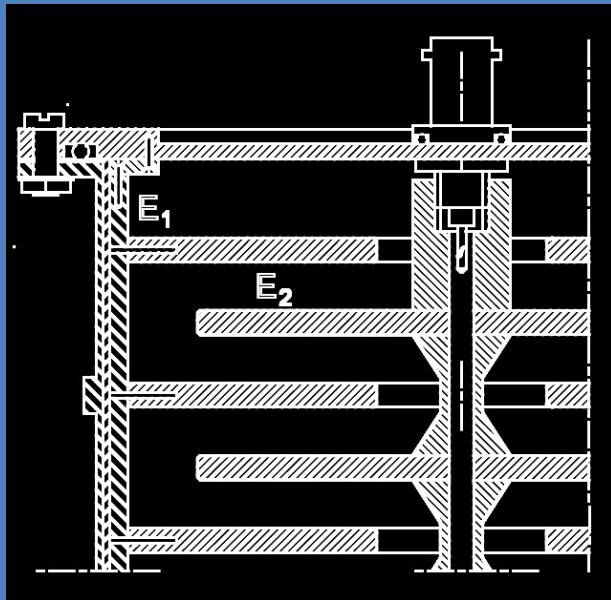
- innovative positioning of insulators*
- polypropylene insert and electrodes*
- easy switch between differential and summation mode*

*All modifications supported by Monte Carlo calculations*





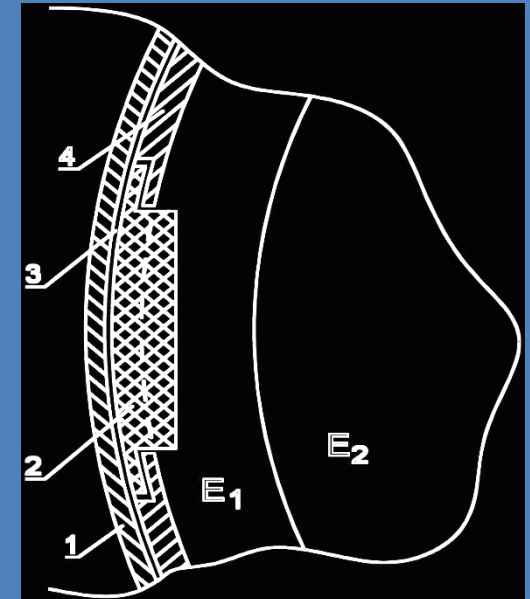
# Positioning of insulators and PE insert

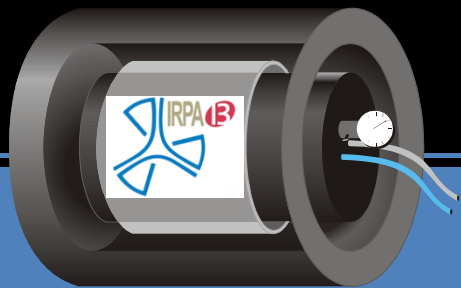


*Shortening of stabilization*

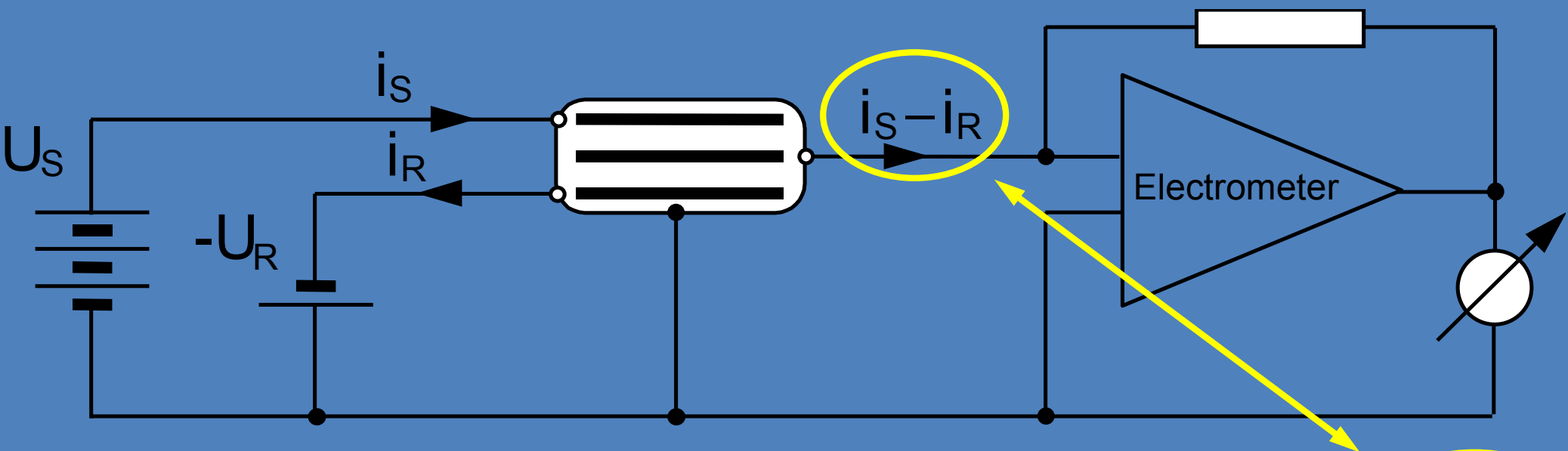
*Better energy response characteristics*

*Technology of printing  
conductive layer (shaping)*





# Differential and summation mode

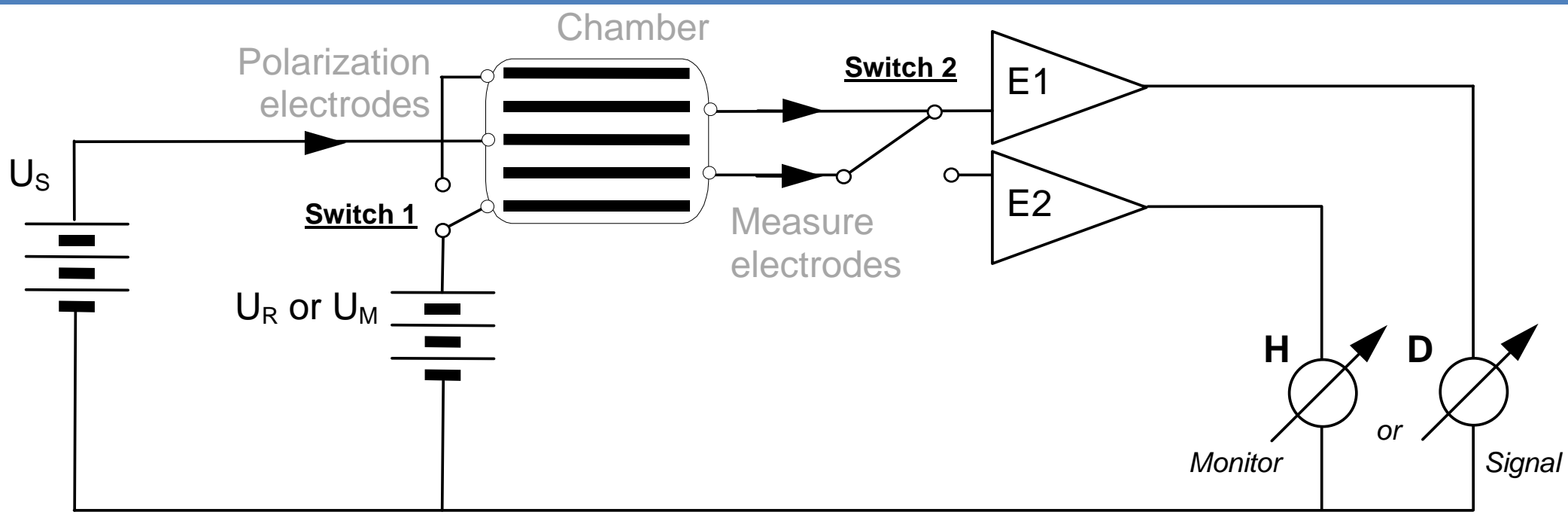


Lower sensitivity!!!



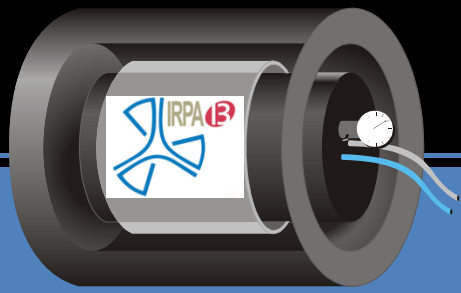


# Triple-mode...

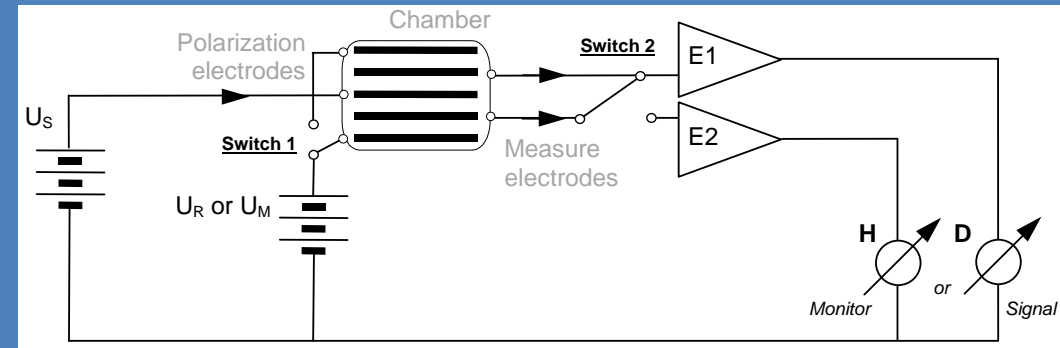


**Separate polarizing of electrodes  
(two voltages in the same time allow to  
measure H or D and selfmonitoring)**



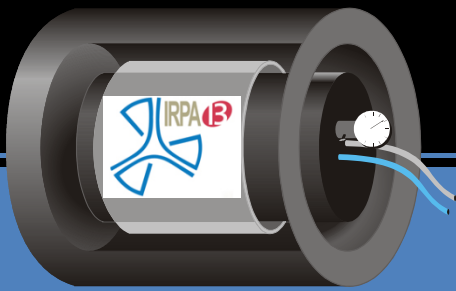


# Automatic triple-mode system



1. Normal works in **summation mode**
2. In case of raised levels of radiation switch to **differential mode**
3. In case of unstable radiation level switch to **selfmonitoring mode**





# Conclusion

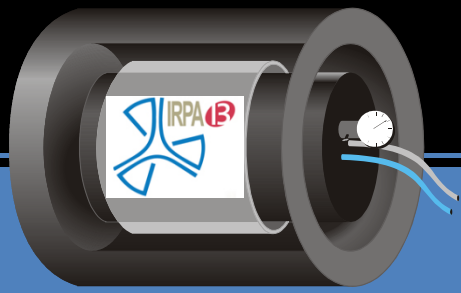
*Further investigation...*

*...combining with ultrasensitive chambers to dosimetric system...*

*...documentation for remanufacturing!*

- flat energy response in the range from 1 meV to 10 TeV (20%)*
- rapid stabilization, atomic composition, mass, materials, range...*
- remote control, data transfer, long-life detector*
- direct values of  $H^*(10)$  for differential mode*
- sensitivity adoption to actual radiation (automatic)*



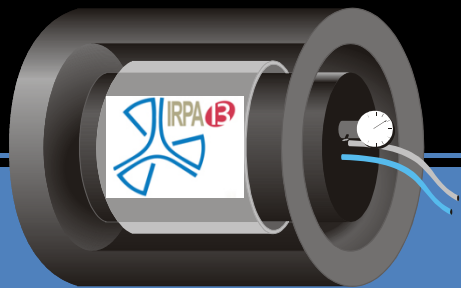


## *General conclusion for recombination chambers e.g. REM-3*

1. Give information **both** on absorbed dose and on radiation quality
2. Are sensitive to **all kinds** of radiation (incl. high energy neutrons)
3. Give information on photon and neutron **contribution** to  $H^*(10)$
4. Wide application also satisfactory for **work places monitoring** (also suitable for in-beam measurements)



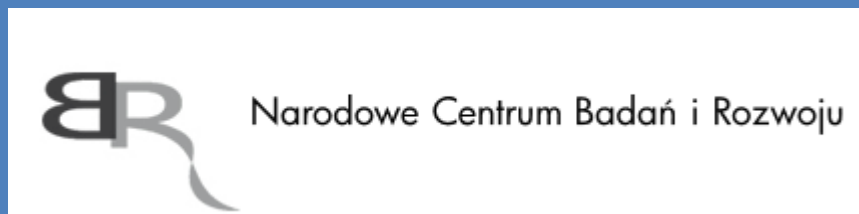


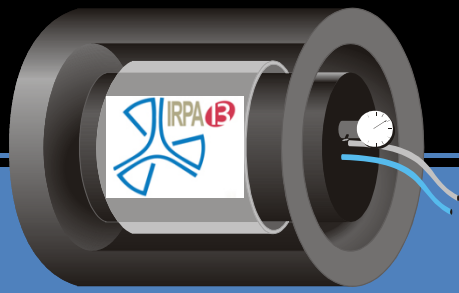


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*Thank you for your attention!*





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