

LHC Experiment Radiation Monitoring (RADMON)

Radiation Monitoring in the LHC experiments .. why ?

- Radiations = danger for detectors and electronics;
- Detectors lose performance over time;
- Compare the efficiency of shielding with simulations;
- Long-term background monitoring;
- Feedback on machine conditions, etc ..

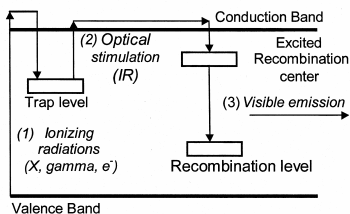
Radiation Monitoring Issues

- Monitor intense and mixed radiation environments;
- Environment different for each sub-detector,
 - Different sensitivities required!

Passive and/or active monitors needed !

Optically Stimulated Luminescence materials (OSLs)

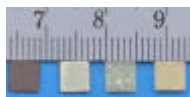
- INSTANTANEOUS RAD. DOSE MEASUREMENT -



Collaboration CERN and CEM² (Montpellier, FR)

High sensitivity dose measurements (mGy)

- (1) e⁻/h⁺ pair generation and trapping;
- (2) Infrared stimulation (800-1300 nm);
- (3) Visible emission (500-700 nm) ∝ Dose.

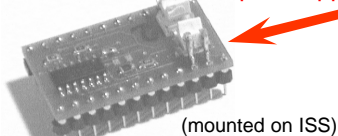


DEVELOPMENT OF SENSITIVE MATERIALS

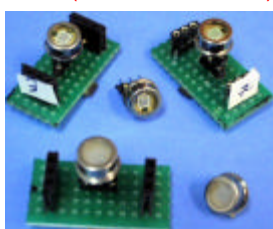
- Thermal neutrons (Boron Doping)
- Photons and charged particles
- Fast neutrons (PE mixture)

ON-LINE REMOTE READOUT APPROACHES

Space Applications (OSL sandwiched)



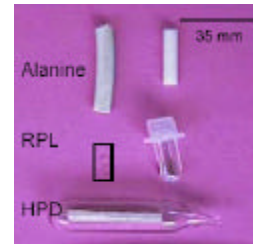
LHC experiments (OSL deposition on dice)



F.Ravotti, M.Glaser, M.Moll

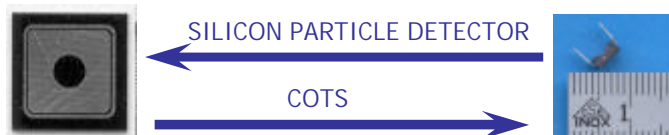
Passive Dosimeters

- DIFFERENT TYPES TO COVER A WIDE DOSE RANGE;
- SMALL SIZES;
- HAVE TO BE REMOVED FOR READOUT;
- PARTICLE AND ENERGY DEPENDENT RESPONSE !!



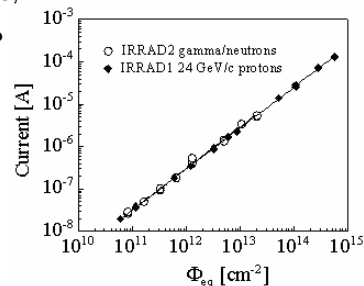
p-i-n diodes

- MEASUREMENT OF THE INTEGRATED P. FLUENCE -



WIDE FLUENCE RANGE

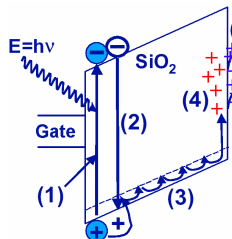
- (1) Si displacement damage;
- (2) Resistivity increase ∝ Φ
→ (forward bias)
- (3) I_{LEAKAGE} increase ∝ Φ
→ (reverse bias)



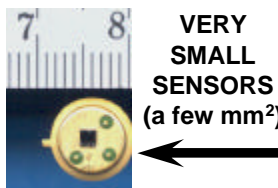
SMALL SENSORS
ON-LINE READOUT

RADIATION-sensitive Field Effect Transistors (RADFETs)

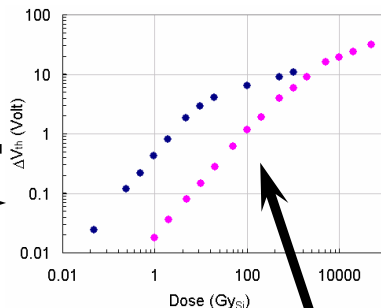
- MEASUREMENTS OF THE INTEGRATED RAD. DOSE -



- (1) e⁻/h⁺ pair generation;
- (2) e⁻/h⁺ pair recombination;
- (3) e⁻/h⁺ transport;
- (4) hole trapping;
- (5) Build-up of Interface



VERY SMALL SENSORS (a few mm²)



SIMPLE READOUT over long distances (2-wires measurement)

WIDE DOSE RANGE (SiO₂ thickness)