Eurados WG 11 High energy radiation fields (A. Esposito)

What is considered important for radiation protection research?

What is the final goal of our researches?

What direction for the future of active SP^2 and CYSP?

What is considered important for radiation protection research?

European Radiation Dosimetry Group presented at Eurados AM2014 his Strategic Research Agenda.
The SRA contribute or should contribute to identify future research needs in radiation dosimetry.

The EURADOS SRA will be mainly an input for the recently launched OPERRA that aims to build up a coordination structure that has the legal and logistical capacity to administer future calls for research proposals in radiation protection on behalf of the EC

One of the main goal of SRA is to **improve neutron dosimetry techniques towards improved radiation protection of the workers and the public**

Neutron sources are intentionally used and/or incidentally created in various scientific areas and technical applications (e.g. generation of electricity, radiography and tomography, material research, activation analysis, fundamental research, military activities, production of radioisotopes/radiopharmaceutics).

Some of the fields represent new challenges due to strongly pulsed radiation or very high energy ranges, i.e. radiation fields around high-energy particle accelerators, and at flights at high altitudes or at space missions

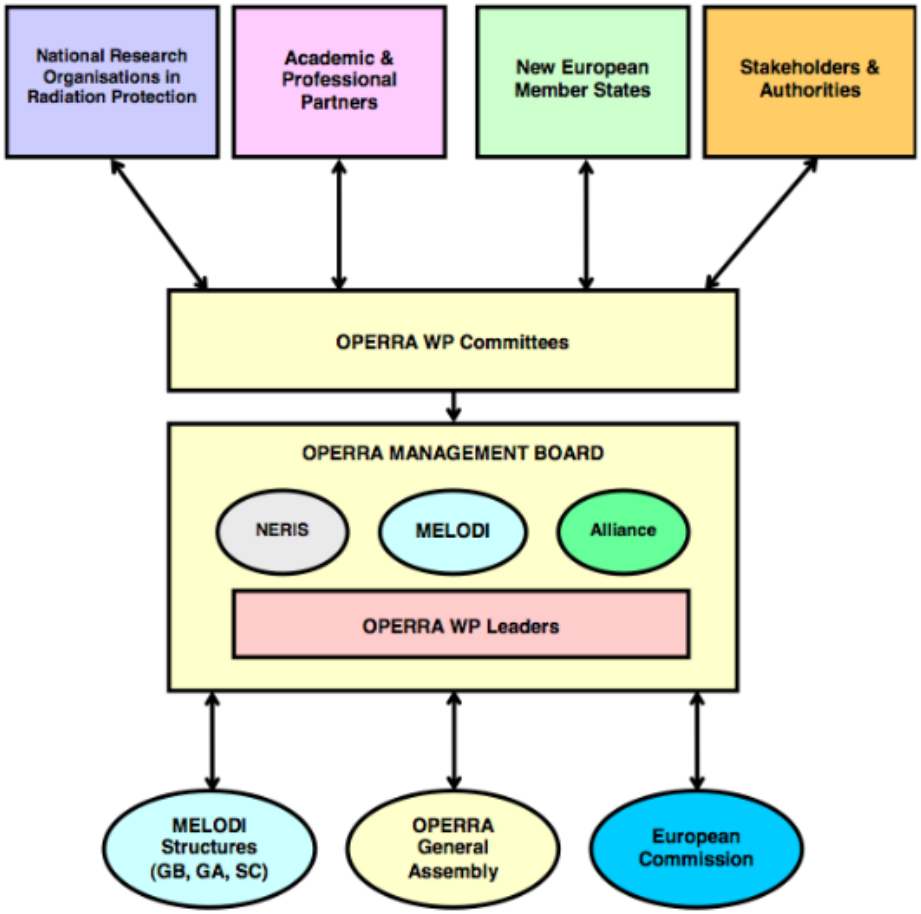
I would mention some new fields like

-High power, ultra-short pulse laser system for production of electron and or proton beam
-Laser driven accelerators

OPERRA (Open Project for European Radiation Research Area) project funded by the European Commission (EC)

Project start date:
01/06/2013
Duration:48months
Total budget:EUR 9 507 048.20

The final objective of the OPERRA proposal is to **build up an innovative mechanism for the joint programming and implementation of radiation protection research in Europe.**



The OPERRA consortium includes members of the European High Level Expert Group and the DoReMi network of excellence that set the policy goals, formulated with a number of experts the initial strategic research agenda on low-dose risk research and led the initiative of establishing the MELODI Association for the long-term and sustainable integration of low-dose risk research in Europe. Also, most of the OPERRA's partners are members of sister associations involved in radiation protection research, for example Alliance for radioecology or NERIS for nuclear emergency management.

OPERRA promotes research that will ensure that health risks are better understood and quantified, and that identifies improved approaches to radiation protection in relation to occupational, medical, environmental and accidental exposures.

DoReMi = Low Dose Research towards Multidisciplinary Integration

What is the final goal of our researches?

EURADOS Working Group 11 High Energy Radiation Fields

The motivation is to increase the knowledge and expertise regarding field characterization and dose assessment in various activities where high energy radiation fields are found, like in medicine, research, civil aviation, and space.

AIMS

- To measure and characterize high energy fields for assessment of human exposure and for instrument calibration
- To determine the instrument response in high energy fields, especially in pulsed fields
- To assess the dose due to solar particle events
- To measure cosmic radiation at ground level and at aviation altitudes
- To compare the different systems (instruments, calculation codes) used for high energy field dosimetry.

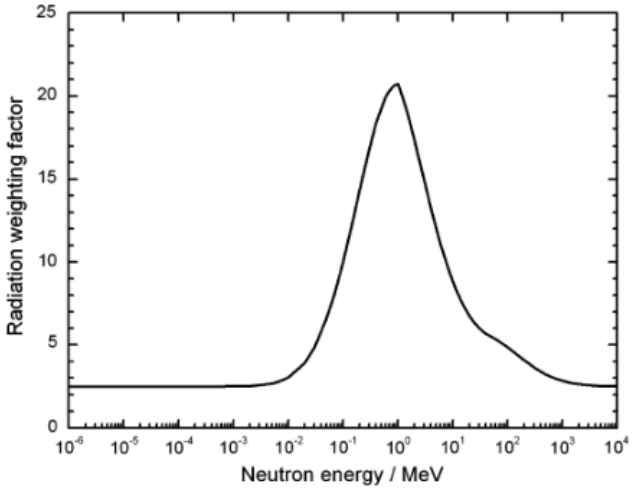


Fig. 1. Radiation weighting factor, w_R, for neutrons versus neutron energy.

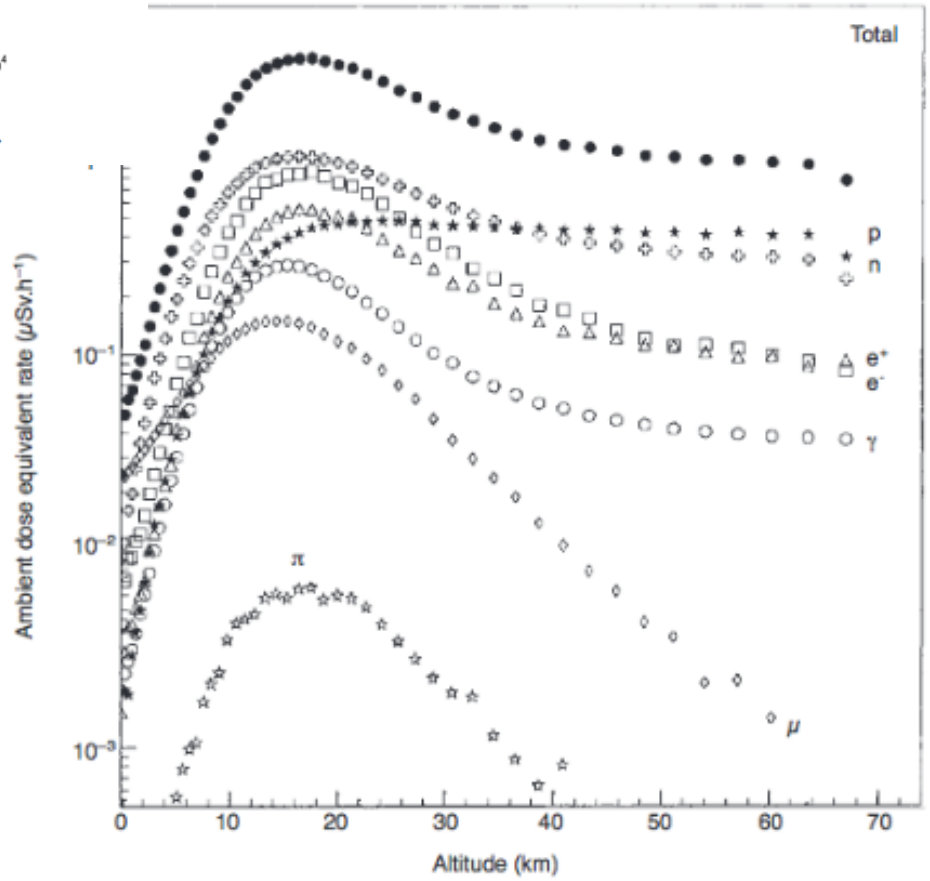


Figure 3. Calculated ambient dose equivalent rate as a function of altitude at the geographical position 35°N137°E. The contributions of individual components are also shown.

What direction for the future of active SP^2 and CYSP?

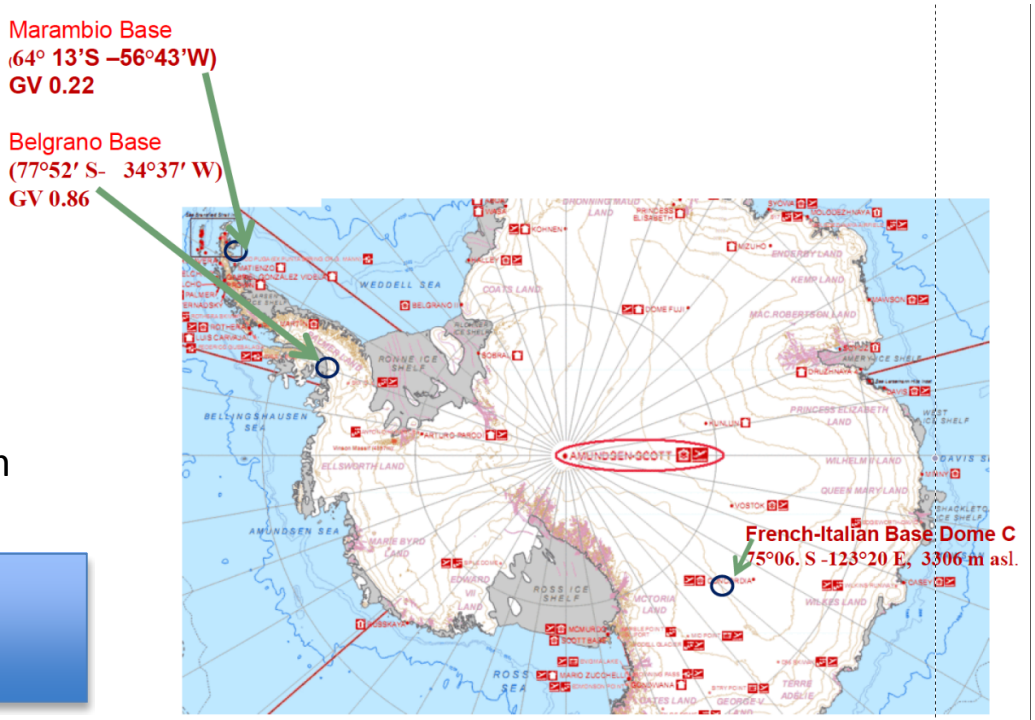
A Zanini gave a talk on behalf of **V Ciancio**. The talk was on radiation measurements, neutron spectrometry and dosimetry at high latitudes. It included description of the CORA (COSmic Rays in Antarctic) project at Marambio Base of Argentina (coordinates 64ºS, 56ºW, cutof rigidity 0.2 GV). Collaborators are INFN, University of Torino, University of Trieste, University La Plata, Istituto Antartico Argentina and INFN Bologna. Note that a French Italian station is at 75 S -123 E, 3300 m asl.

Data from the South Pole should be used for comparison. It became clear that the measured neutron dose rates are or seems not consistent with those measured at Zugspitze or Spitsbergen, based on the HMGU BSS spectrometers

Marambio 64° 13'S – 56° 43'W	Chacaltaya 5230 m asl 16° 29' S- 68°8' W	Cervinia 3480 m asl 45°56' N - 07°42' E
0.20 (mSv/h)	0.09(µSv/h)	0.05(µSv/h)

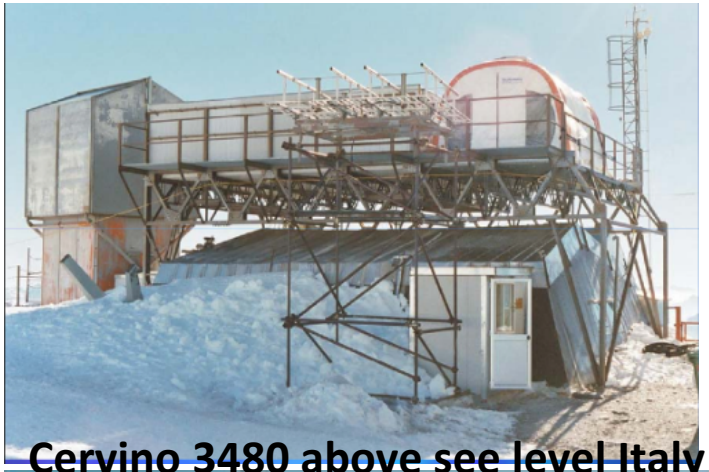
Misprinting milli instead of micro
Measurements made using a conventional rem counter

0.075 µSv/h @2650 m asl Zugspietze
0.0087µSv/h @ 0 m asl Spietsbergen



The idea is to use our CYSP, possibly equipped with large area thermal detectors, for environmental high precision measurements, GLE included, taking into account that our instrument is an extended range mono-directional spectrometer!! CYSP is able to avoid any influence of albedo from earth or snow . For environmental neutron dose assessment could be useful also our extended range spherical spectrometer SP^2

Marambio Base (64° 13’S –56°43’W) Antartic



Cervino 3480 above see level Italy

Chacaltaya 5400 above see level Bolivia

Ny-Ålesund are 78°N55'24'' and 11°E55'15'

Jungfraujoch, 3580 m above sea level Switzerland

Zugspitze mountain at 2650 m above sea level Germany

The Cervino option is easy to do
The Testa Grigia lab is easily to reach using a cableway during the winter
Various neutron measurements were performed there in the past years.
No measures with an extended range instruments

The Marambio antartic base is more less easy to reach but it represents for us an opportunity to measure the ambient dose equivalent and the neutron spectrum taking into account the values already measured, not in agreement with values measured at Spietzbegen. No measures with an extended range instruments
The Chacaltaya lab is an interesting option from the point of view of altitude but the low latitude produce a drop of interest. No measures with an extended range instruments

All overmentioned options mean a collaboration with Alba Zanini of INFN-To

The Zugspietze option is less interesting from the point of view of the value of ambient dose equivalent but at Zugspietze the neutron spectrum as well as the ambient dose equivalent are very well known.

The Spietzbergen is another interesting option.

Both the options mean the collaboration with Vladimir Mares and Werner Rhum from Helmotz Munich

Whatever option means
- a strong organization
- a lot of time for organization
- a long measurement time
- possibly an increase of detectors sensitivity
- availability of collaborators and last but not least money

I suggest to start with a CYSP test, far from our accelerator, in order to understand how much time we need for environmental measurements at medium latitude at see level

What direction for the future of SP^2 and CYSP?

Neutron beam characterization quasi “on line”by CYSP

- no scattering effect
- no time consuming

IThemba beam size at 10m from a target is 12.5x12.5 cm2

TSL flexible beam size

NPL

PTB

Nescofi@BTF

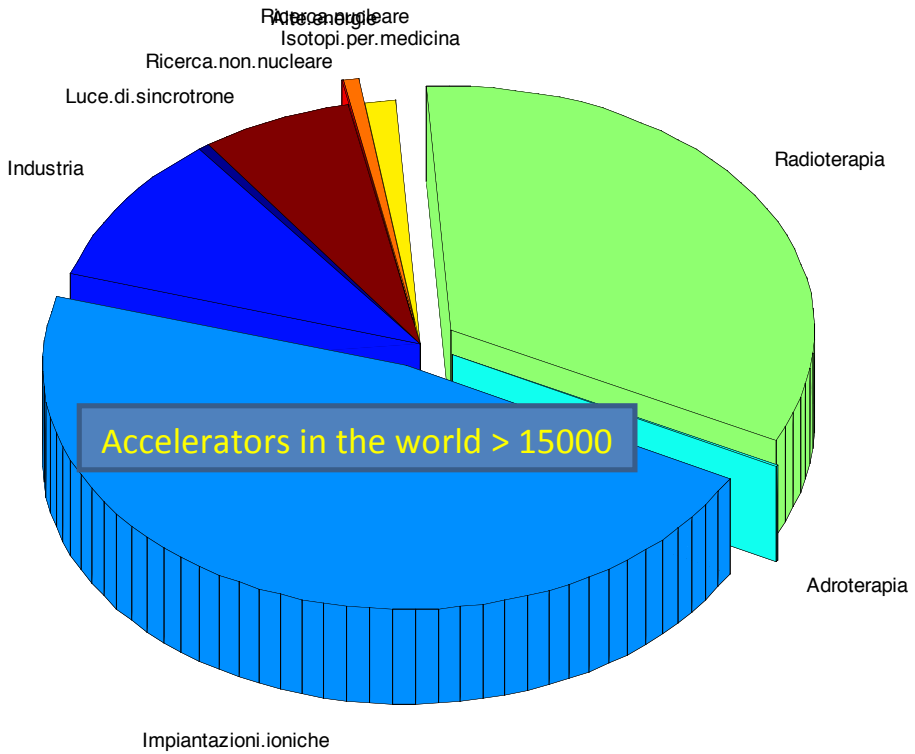
Neutron Therapy

Any other facility

Possibility to contact IThemba labs or TSL and use CYSP as beam spectrometer

Neutron ambient dose equivalent evaluation quasi on line by SP^2

assessment of human exposure around
Accelerators and high energy accelerators
Proton beam facilities
Carbon ion beam facilities



Members of the Working group discussed future issues that should be covered by the WG11.

One could be a Task on Technical Dosimetry around Laser-Based Facilities.

This is of interest because of current efforts to build such systems for example in Czech Republic , Hungary and Romania (funds fro EC for about 900Meuro).

The agenda of this task could include

a)basic work to understand the phenomena that occur in the radiation fields produced by such facilities (which are characterised by high dose rates within very short pulses)
b) identification of detectors suitable in the field of short pulses (atto-second, femto-second),
c) perhaps work on photons and neutrons
d)Inter-comparison exercises at such a facility could also be useful (perhaps at the Rutherford laboratory in the UK).

The goal would be to validate the dosimetry around such facilities.

W Rühm will propose this task at the Council meeting

FLAME

nominal peak power	300 TW
pulse length	≥ 20fs
repetition rate	10 Hz
output energy	8J
laser intensity	~ 10^{20} Wcm^{-2}

Active detectors are difficult to operate in terawatt or petawatt laser-matter interaction for many reason.

The laser–plasma interaction at relativistic intensities (>10^{18}W/cm^2) in the focus of a high-energy creates

- a huge amount of electrons, X-rays and charged particles in very short time from fs to ps.

- an electromagnetic pulse (EMP) due to the interaction of charged particles and x rays with structures inside the target chamber.

Due to those problems many diagnostics used in terawatt or petawatt laser experiments rely on passive detectors such as x-ray film, nuclear activation, Imaging plate, radio-chromic film, and CR39 track detectors even if active detectors provide higher sensitivity and faster feedback after each laser shot.

In addition such laser operate
- shot by shot
- any single shot is different from the others

Detector for diagnostics CYSP equipped with large area detectors

Detector for assessment of human exposure SP^2 equipped with large area detectors

After their calibration in a reference field preliminary tests @FLAME followed by test @Gemini or Vulcan facility at Central Laser Facility or everywhere is in operation such a laser.

All facilities in EC are accessible through a network Laserlab Europe filling general or specific calls

Conclusions

The active spherical and cylindrical extended range spectrometers equipped with large area detectors are both suitable for future needs in high energy radiation fields dosimetry and spettrometry.

Neurapid collaboration

-has to work hard to project and realize new prototypes

-to finds additional funds to cover expenses for a realization and calibration of a new CYSP and a new SP^2 through external collaborations.

-to start with a campaign of environmental measurements with preliminary test of the behavior of actual CYSP and SP2 during long time measurements possibly at home (my house?).

- to decide which external collaboration

- to sign an agreement with the chosen external collaboration

Finally become very important

- to create a cluster of partnerships among experimental groups in the same fields in order to increase synergies and to decrease costs

- to enter into an international network in order to be able to participate to European calls to obtain funds to continue in other word to become a critical mass

Thank you