Biofisica delle radiazioni presso il centro di protonterapia di Trento

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Congresso SIF 2015, Roma 21-25 Settembre
• 1.4.2015: official start of TIFPA
  Director: Prof. Marco Durante

• About TIFPA:
  – Innovative Research Center (synergy of INFN, UNITN, FBK & APSS)
  – Excellence as goal (high quality scientific research)
  – Transational research (impact on territory and technology transfer)
Proton Therapy - APSS

• Official Agreement signed
• Current goal: to setup one of the most advanced laboratories for radiation biophysics research in Proton Therapy
• Planning phase ongoing with IBA and Mantovani
Experimental cave - today

Two beam lines
Experimental Cave

Multi-functional laboratory
Construction Plan

- **Phase I**: plan design and basic equipment for beam characterization (3 months, ongoing!)

- **Phase II**: installation of equipment for physics and biology experiments (phase I + 6 months)

- **Phase III**: completion of installation experimental equipment, generation of quasi-monoenergetic fast neutrons (unique facility in Europe!) – phase II + 4 months

ready in ≈1 year
First experiments in waiting list:

- ROSSINI2 (ESA): material for space shielding
- LIMADOU (ASI): seismo electro-magnetic satellite for earthquake prediction
- PANC (NCI)
Protection by passive shielding
Percent Dose Reduction per Unit Areal Density for Single Materials

Shielding test results, ROSSINI-1, 2012-14

<table>
<thead>
<tr>
<th>Material</th>
<th>% Dose Reduction cm^2 g^-1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cella Energy B</td>
<td>5</td>
</tr>
<tr>
<td>Cella Energy A</td>
<td>4</td>
</tr>
<tr>
<td>Polyethylene HDPE</td>
<td>3</td>
</tr>
<tr>
<td>Kevlar</td>
<td>2</td>
</tr>
<tr>
<td>Moon Regolith</td>
<td>1</td>
</tr>
<tr>
<td>Aluminum</td>
<td>1</td>
</tr>
<tr>
<td>Mars Regolith</td>
<td>1</td>
</tr>
<tr>
<td>Moon Concrete</td>
<td>1</td>
</tr>
<tr>
<td>Nextel</td>
<td>1</td>
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</tbody>
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**PANC:** an International clinical trial on locally advanced pancreatic cancer and a pre-clinical study of immunotherapy+particle therapy

- **Clinical trial:** IMRT (USA+Europe), CIRT (NIRS, CNAO, HIT), protons (?)

- **Pre-clinical:** combination of high proton doses (hypofractionation) with new triterpenoid CDDO-Me (badoxolone metile), *in vitro + in vivo*

- Pre-clinical grant GSI-UT Southwestern, now at TIFPA
Thank you!
Pancreatic cancer ranks as the 4th leading cause of cancer related death in US (Siegel et al., *CA Cancer J Clin* 2014) and the only cancer where mortality is on the rise in Europe (Malvezzi et al., *Ann Oncol* 2014). Its average survival time after diagnosis is only 9 months.
Durante et al. Front Oncol, 2015
2. LIMADOU-CSES: studiare i terremoti
dallo spazio

LIMADOU-CSES: CHINA SEISMO-
ELECTROMAGNETIC SATELLITE
Electron bursts in inner belts

Correlations between EQ & ps: $\Delta T_{EQ-PB}$ distributions

**MIR** mission
- 1985-2000
- Altitude: 400 km
- Inclination: 51°
- $E_e$: 20 ÷ 200 MeV
- $E_p$: 20 ÷ 200 MeV

**METEOR-3** mission
- 1985-1986
- Altitude: 1250 km
- Inclination: 82°
- $E_e$: $\leq$ 30 MeV

**GAMMA-1** mission
- 1990-1992
- Altitude: 350km
- Inclination: 51°
- $E_e$: > 50 MeV

**SAMPEX/PET** Mission 1992-1999
- (Orbit Rate Rotation: July 1992 - May 1994)
- Altitude: 520+740km
- Inclination: 82°
- $4 \leq E_e \leq 15$ MeV
Wave – particles interaction mechanism

Schematic representation in a meridian plane of the trapped particle trajectories

1. EARTHQUAKE PREPARATION AREA
2. EM WAVES PROPAGATION INTO THE IONOMAGNETOSPHERE
3. EM WAVES GENERATE PERTURBATIONS IN THE LOWER IONOSPHERE
4. EM WAVES INTERACT WITH CHARGED TRAPPED PARTICLES IN THE INNER RADIATION BELT
5. PARTICLE PITCH ANGLE CHANGES
   ↓ MIRROR POINTS LOWERING
   ↓ PARTICLE PRECIPITATION
6. PBs PROPAGATE AROUND THE EARTH ALONG THE L-SHELL
   ↓ (LONGITUDINAL DRIFT)
   PBs DETECTABILITY AT ANY LONGITUDE

stationary trajectory of trapped particles
mirror points lowering
geomagnetic field lines
stationary lower boundary of the radiation belt
Calibrazione del detector con protoni fra 70-200 MeV: