Benchmarking ion-acoustic signals with Cherenkov radiation imaging and gel dosimetry: *A proposal*

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The physics of Cerenkov light production during proton therapy

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Abstract

There is increasing interest in using Cerenkov emissions for quality assurance and *in vivo* dosimetry in photon and electron therapy. Here, we investigate the production of Cerenkov light during proton therapy and its potential applications in proton therapy. A primary proton beam does not have sufficient energy to generate Cerenkov emissions directly, but we have demonstrated two mechanisms by which such emissions may occur indirectly: (1) a fast component from fast electrons liberated by prompt gamma (99.13%) and neutron (0.87%) emission; and (2) a slow component from the decay of radioactive positron emitters. The fast component is linear with dose and doserate but carries little spatial information; the slow component is non-linear but may be localised.

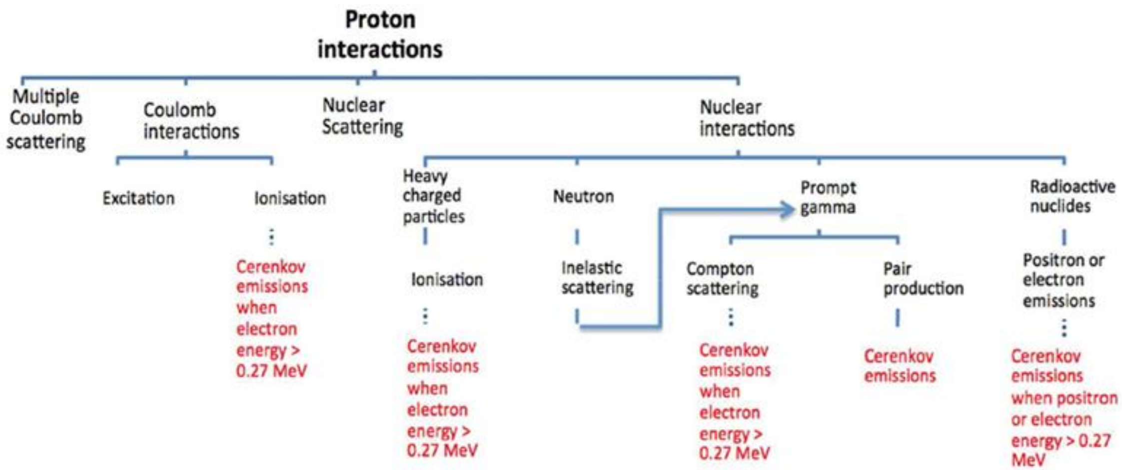


Figure 1. Detailing the different mechanisms by which protons interact with matter and emit Cerenkov radiation.

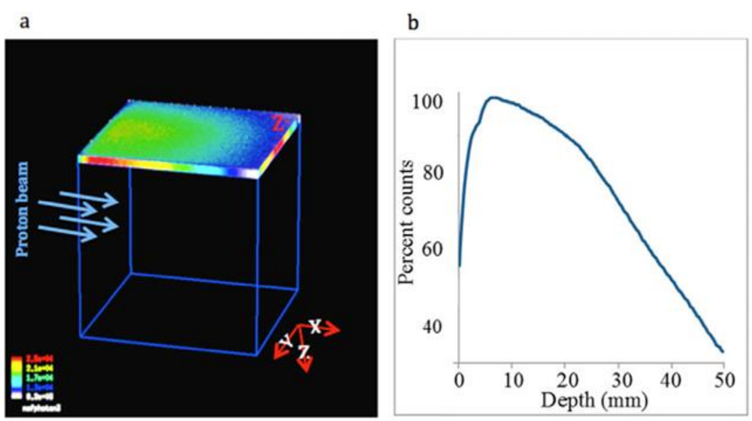


Figure 3. (*a*) Simulated 2D light distribution in a $5 \times 5 \times 5\,\text{cm}^3$ water phantom irradiated by a 60 MeV proton beam. Refraction and reflection at boundaries were applied. The scoring area is a mesh pixelated into $0.2 \times 0.2\,\text{mm}^2$. (*b*) Light distribution profile across the *Z*- face as function of distance.

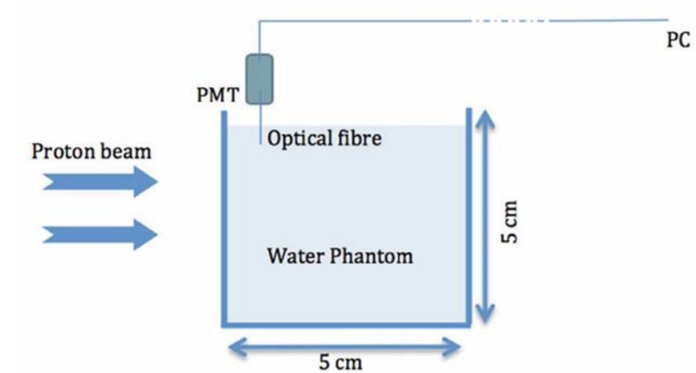


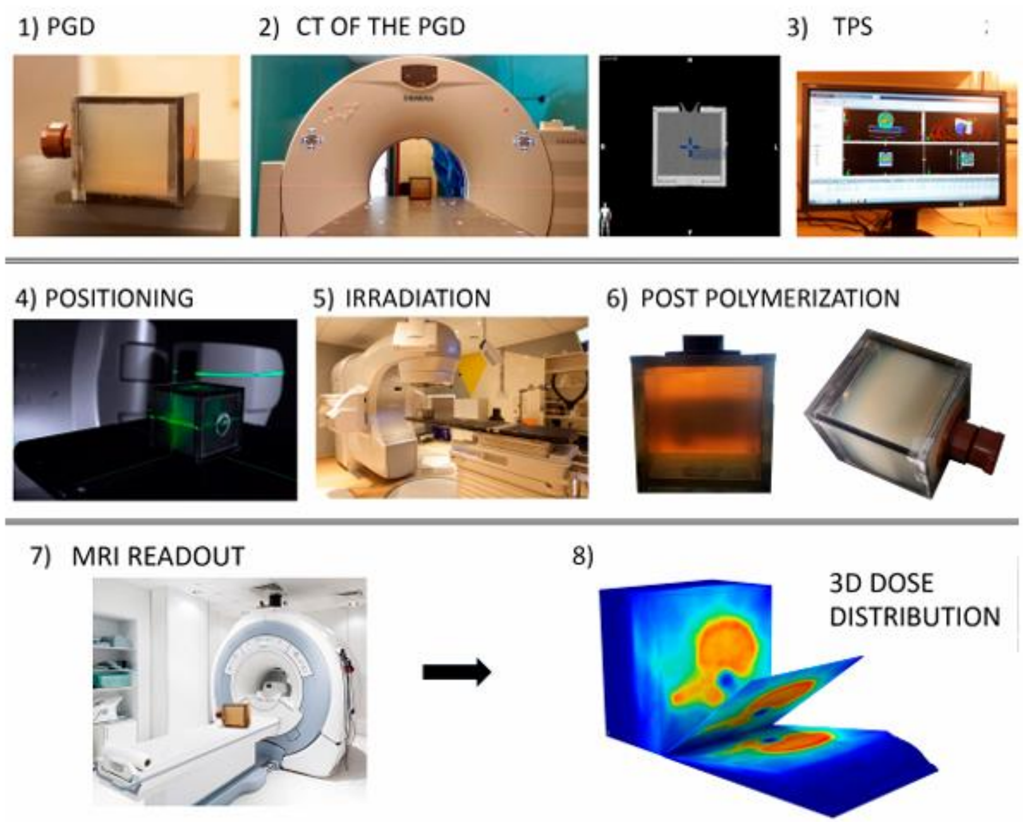
Figure 4. Experimental setup showing the water phantom, proton beam and photomultiplier tube.

gels

Review

Chemical Overview of Gel Dosimetry Systems: A Comprehensive Review

Micaela A. Macchione [1,2,3], Sofía Lechón Páez [1,3], Miriam C. Strumia [1,3], Mauro Valente [4,5,*] and Facundo Mattea [1,3,*]



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Read-out of radiosensitive gels with ultrasound elastography: technique description and preliminary studies

Remo Crescenti, Jeff Bamber, Nigel Bush, and Steve Webb

Joint Department of Physics, Institute of Cancer Research and Royal Marsden NHS Trust, Sutton, Surrey, UK

Phys. Med. Biol. **52** (2007) 6747–6759

Characterization of the ultrasonic attenuation coefficient and its frequency dependence in a polymer gel dosimeter

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Radiation dose imaging with ultrasound shear-wave elastography and radiation sensitive gels

Remo A Crescenti, Jeffrey C Bamber, Nigel L Bush, and Steve Webb

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Characterization of dose-dependent Young's modulus for a radiation-sensitive polymer gel

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QUANTITATIVE ULTRASONIC ELASTOGRAPHY FOR GEL DOSIMETRY

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