



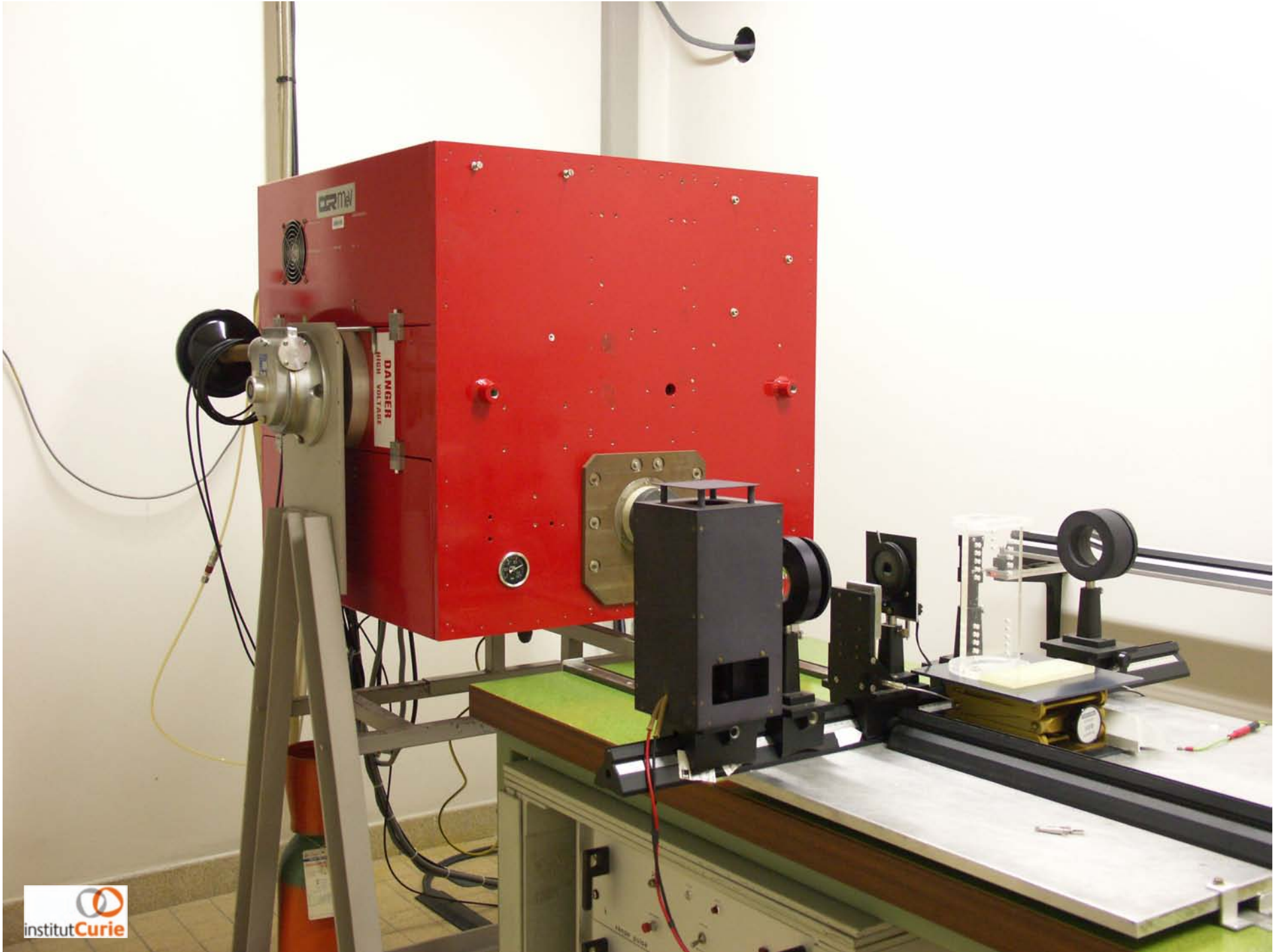
institut**Curie**

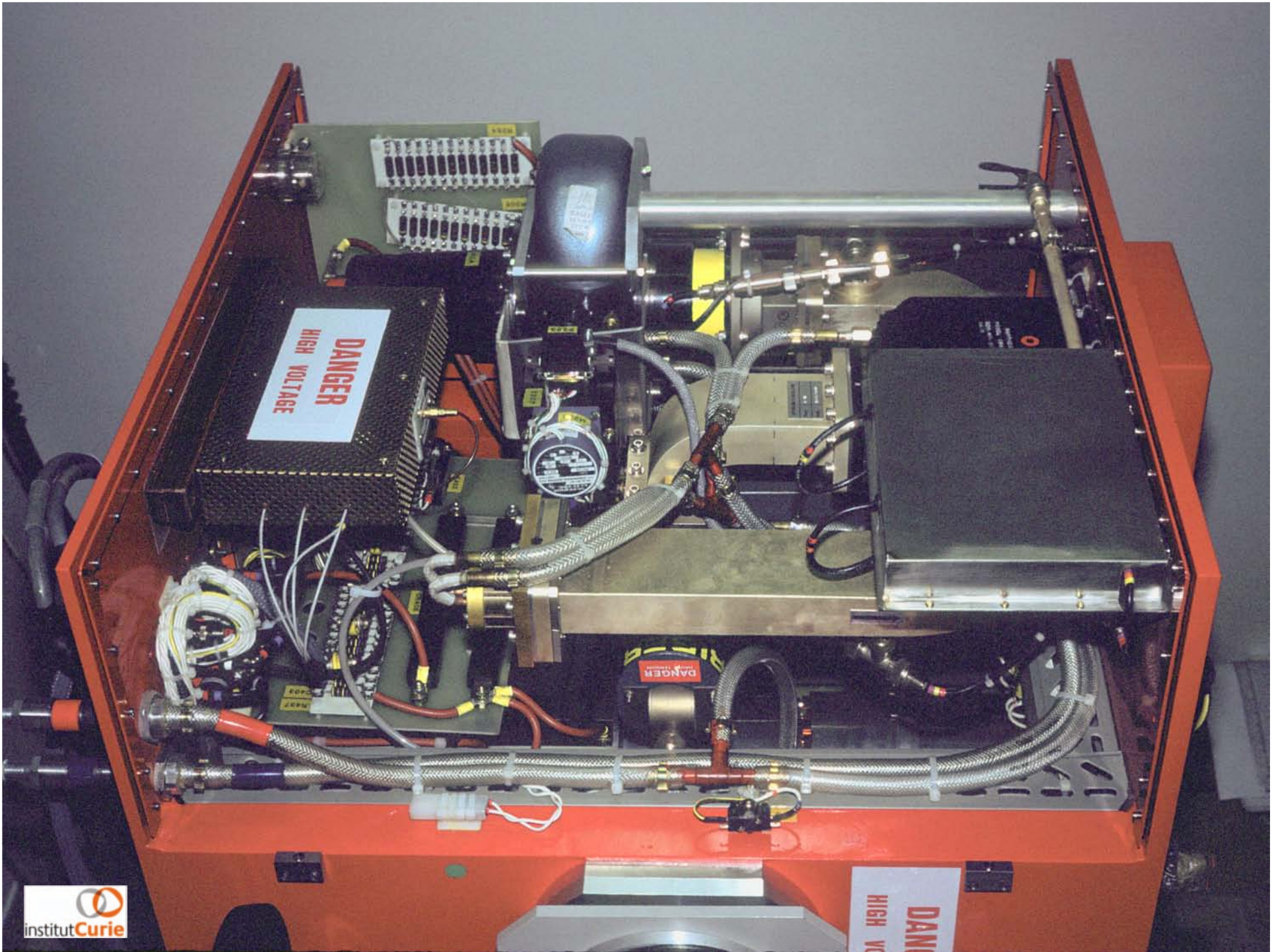
***Mise en œuvre d'un LINAC
pour des expériences de radiolyse pulsée
et de radiothérapie expérimentale
à très haut débit de dose***

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1989- Fondation du laboratoire







Caractéristiques nominales

LINAC “Kinetron”

Electrons 4.5 MeV

Magnétron 5 MW

Canon triode

Pulses 0.05-2.2 μ s

Fréquence de répétition 10-150 Hz

Dose par pulse 0.002-50 Gy

TEL = 0.19 keV/ μ m

EBR = 1.00 par rapport au ^{60}Co

Pilotage

**Interface conçu et réalisé par EuroMeV (PMB-ALCEN)
Pilotage sous LabView**

Trois modes :

Monocoup

Récurrent (fréquence et nombre de pulses ajustables)

Fractionné

Paramètres ajustables :

DQing (haute tension magnétron)

Largeur d'impulsion

Fréquence de récurrence

Polarisation grille

Chauffage canon triode

Délais (obturateur, flash xénon, backoff...)

Retour sécurités et mesures analogiques

Dosimétrie en ligne par mesure (intégration) du courant faisceau

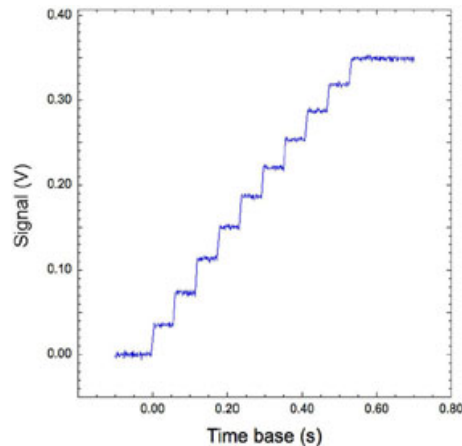
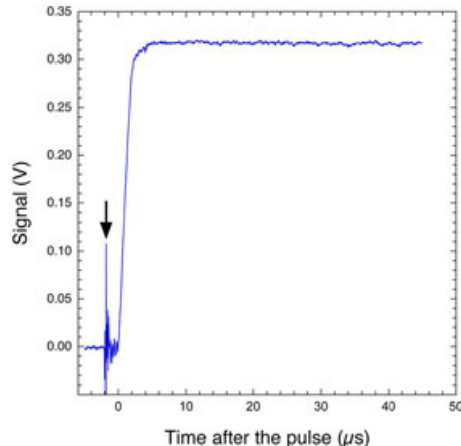
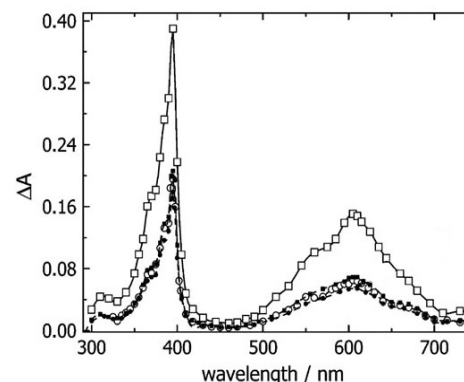
Dosimétrie impulsionnelle par spectrophotométrie du radical méthyle viologène dication

Das et al. (2003) J Phys Chem 107: 5998-6006

100 mM formate / N₂O sat.

G = 0.625 μmol.J⁻¹

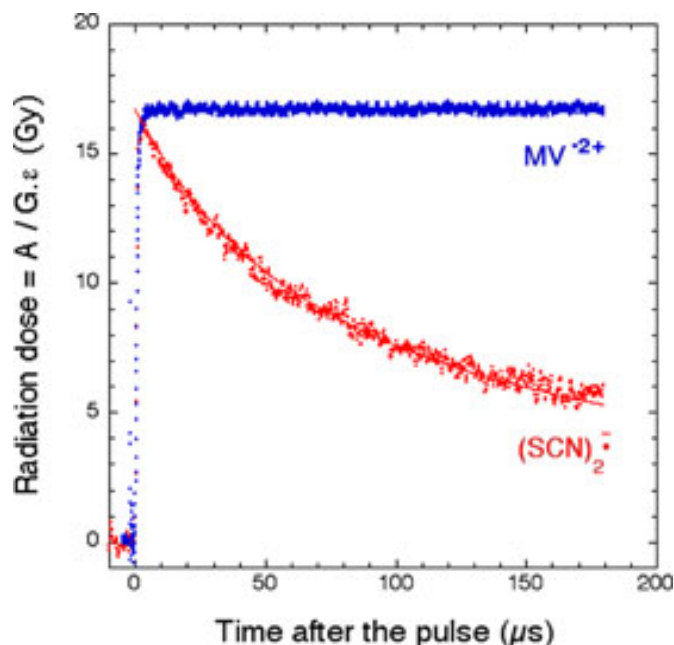
e₆₀₃ = 13 300 M⁻¹.cm⁻¹



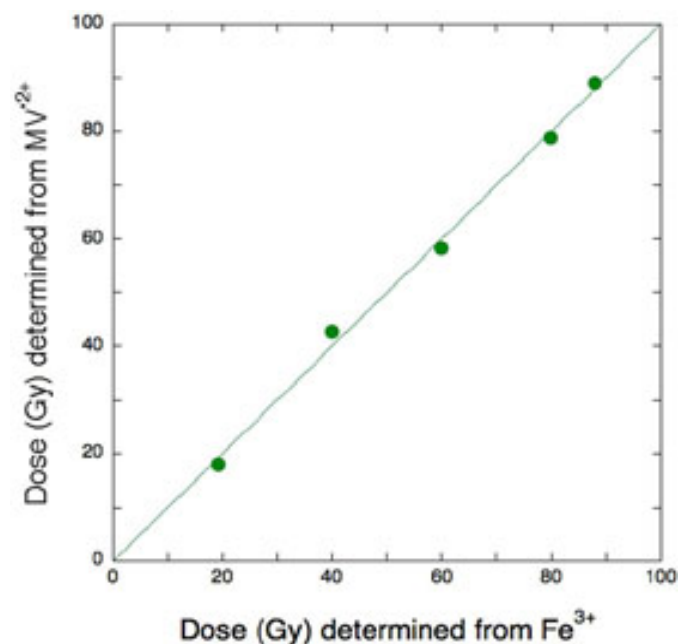
Time-dependent formation of the MV^{z+} radical at 603 nm following exposure of an N₂O-saturated solution of methyl viologen (1 mM) in 100 mM formate buffer to a 1.05 μs pulse (37.8 Gy) of 4.5 MeV electrons. The reaction was half-over within the duration of the pulse. The arrow points to the parasitic signal due to ignition of the hyperfrequency source 2 μs before activation of the electron gun.

Optical detection of the formation of the MV^{z+} radical (observation 603 nm, optical path length 10 mm) upon exposure of a 1 mM solution of methyl viologen in N₂O-saturated formate buffer to 10 successive, 0.75 μs pulses of 4.5 MeV electrons at a repeat frequency of 19 Hz. The total dose delivered to the irradiated sample was 42.1 Gy.

Corrélation méthyle viologène / thiocyanate/ Fricke

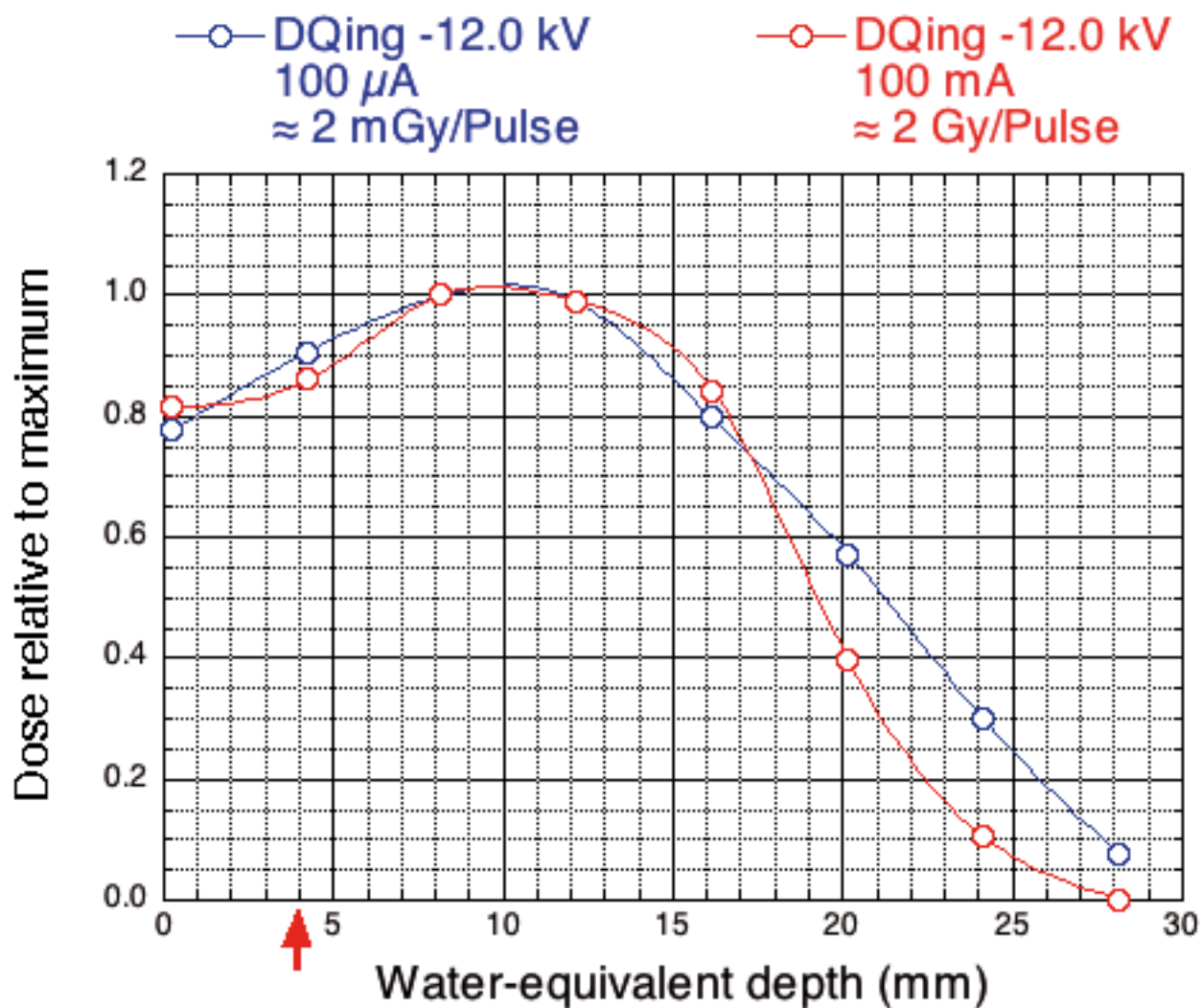


Time-dependent evolution of the methyl viologen MV^{2+} and thiocyanate $(\text{SCN})_2^-$ radicals immediately after a $1.0 \mu\text{s}$ pulse of 4.5 MeV electrons (16.6 ± 0.1 Gy). The decay of the $(\text{SCN})_2^-$ radical occurs by recombination and was fitted (continuous line) to the second-order equation $1/A(t) = 1/A_0 + kt$. Found: $k = 3.74 \cdot 10^5 \text{ s}^{-1}$.

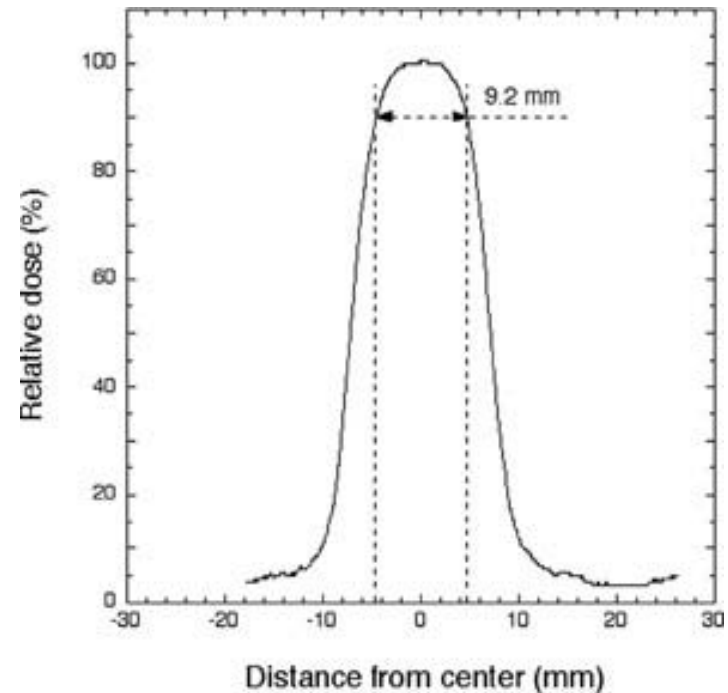
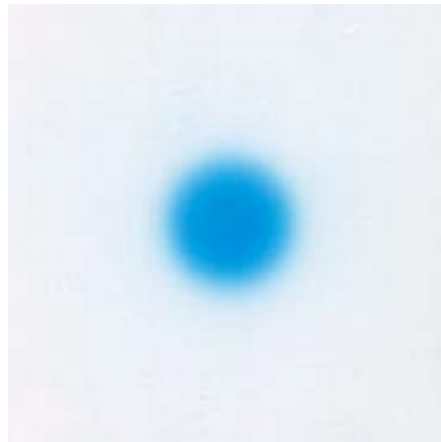


Correlation between methyl viologen and ferrous sulfate (Fricke) dosimeters at conventional dose-rate (0.128 Gy/s , ^{137}Cs γ -rays). Fe^{3+} ($\epsilon_{304} = 2,204 \text{ M}^{-1}\cdot\text{cm}^{-1}$, $G = 1.61 \mu\text{mol}\cdot\text{J}^{-1}$) and MV^{2+} ($\epsilon_{603} = 13,300 \text{ M}^{-1}\cdot\text{cm}^{-1}$, $G = 0.625 \mu\text{mol}\cdot\text{J}^{-1}$) were measured by optical absorption using a Cary-3E spectrophotometer.

Dose en profondeur



Champs d'irradiation - Exemple



Gafchromic film imaging (scale 1:1, left) and densitometric analysis (right) of the irradiation field used for localised, PULS irradiation of HBCx-12A tumor xenografts in nude mice (4.5 MeV electrons, Ø 12 mm aperture secondary collimator).

Applications

In vitro

Mécanismes radicalaires

Métalloprotéines

Flavoprotéines

Ponts disulfure...

Réponse cellulaire précoce (*Effet-W*)

Débit de dose

Microfractionnement

In vivo

Radiothérapie expérimentale

Débit de dose

Fractionnement

Efficacité anti-tumorale

Complications (nécrose, fibrose)

Spécificités d'organe

Carcinogénèse radio-induite

Inserm U219 ➡ U350 ➡ U612 ➡ Plateforme Institut Curie (Orsay)



Inserm



Jean-Marc Lhoste
Daniel Lavalette



Jean-Michel Lentz
Hervé Tourbez



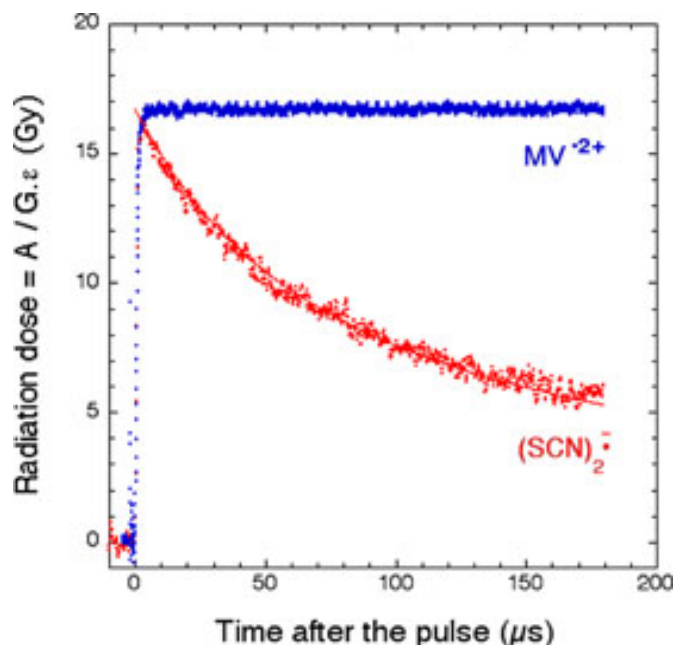
Maurice Petit
Stéphane Hermans



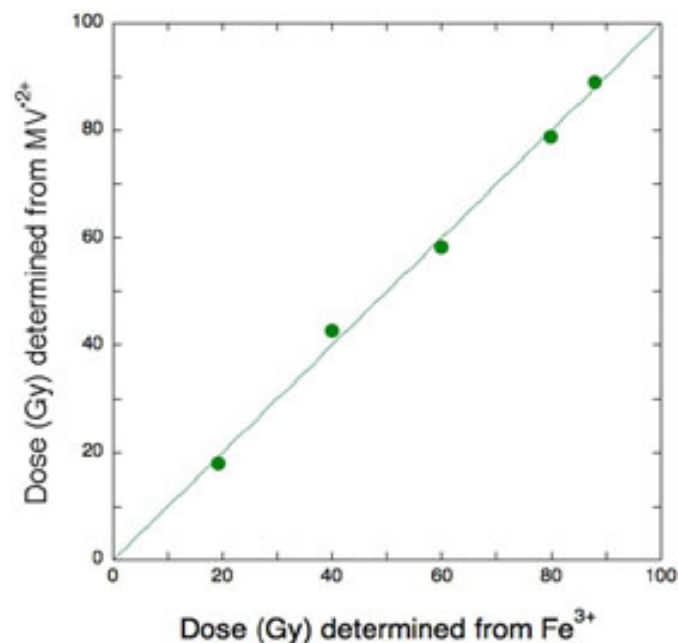
EuroMeV
PMB-Alcen



Corrélation méthyle viologène / thiocyanate/ Fricke



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