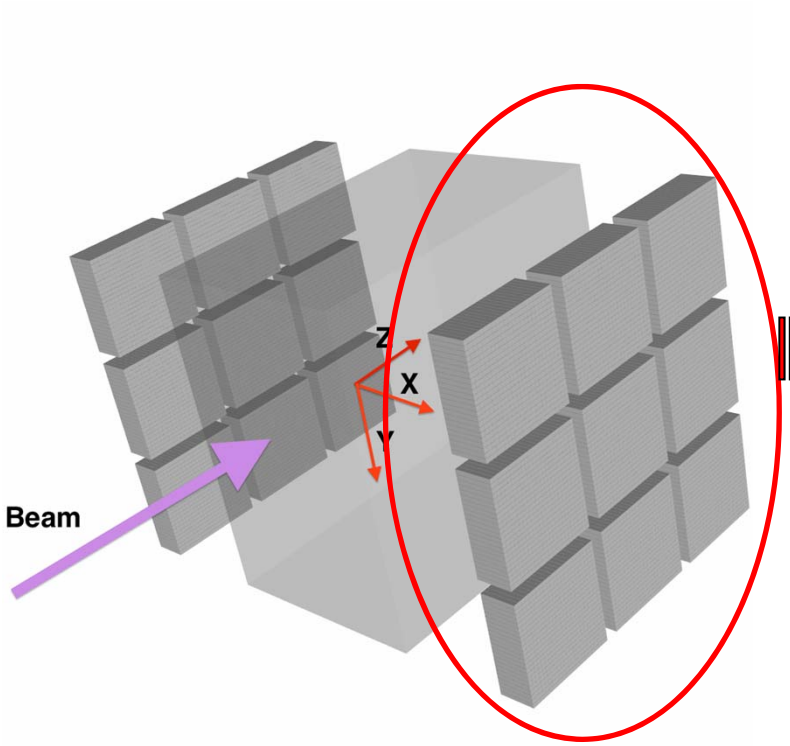
CATANA Novembre 2015

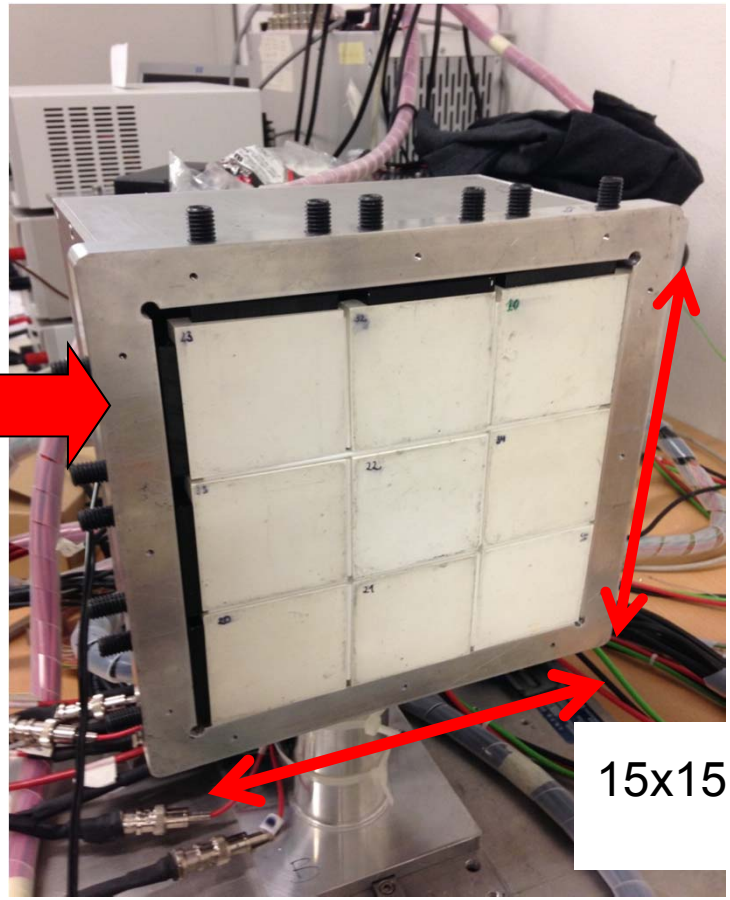
13-14 Novembre

DoPET

DoPET is a stationary 2 heads tomograph

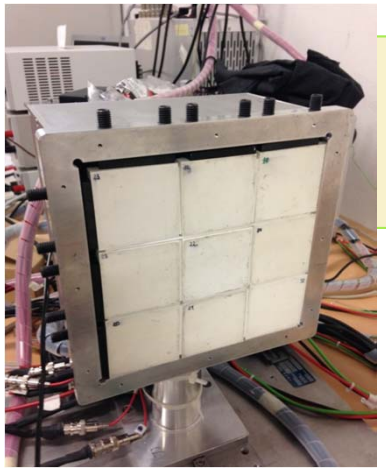
- gantry compatibility
- in-beam acquisition





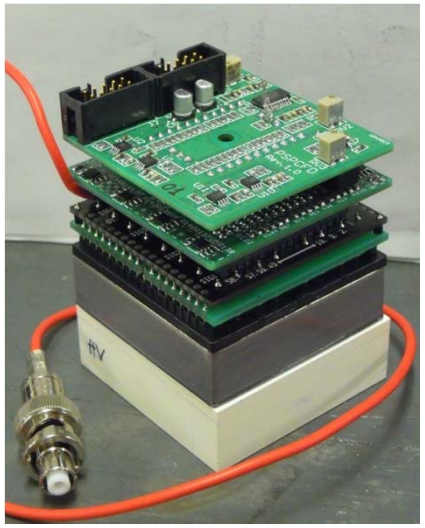
9 modules per head

15x15 cm^2



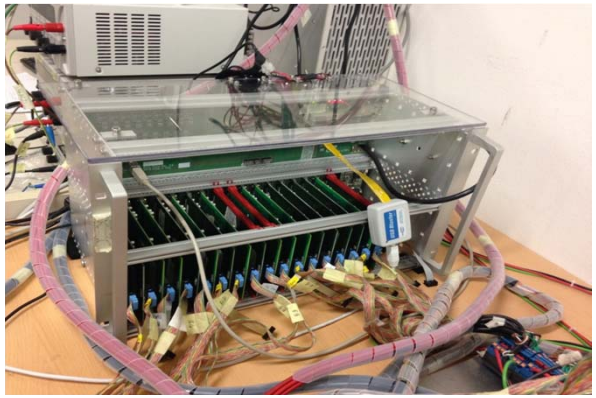
DoPET 9vs9

The current prototype is an upgrade of the 4x4 DoPET system



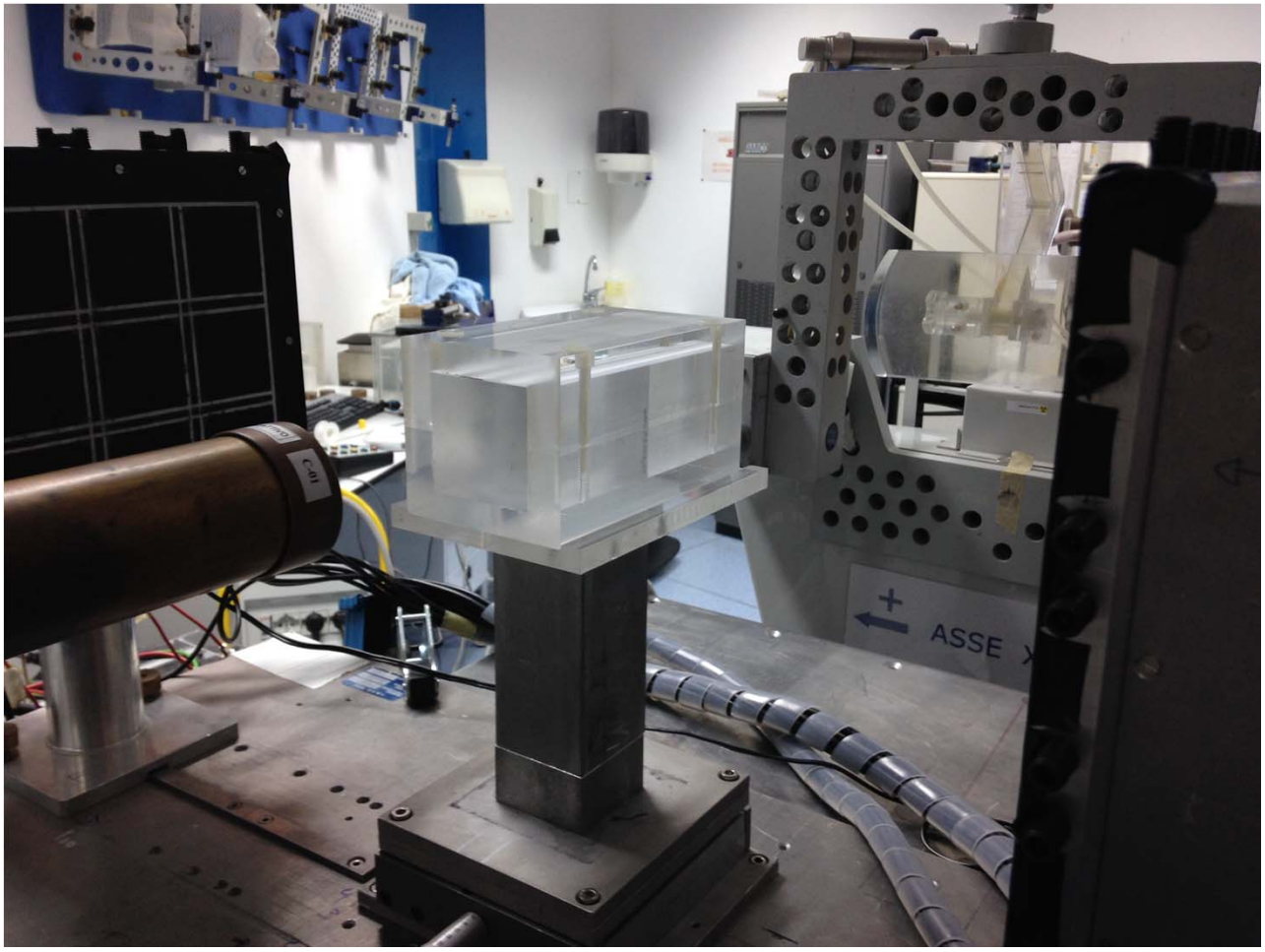
Vecchio, IEEE Trans. Nucl. Science, 56 (1), (2009)
Sportelli, IEEE Trans. Nucl. Science 58 (3) (2011)

- Detecting module (LYSO matrices, each 23 x 23 crystals, 2mm pitch)
  - PS-PMT 8500 Hamamatsu
  - Dedicated front-end electronics
  - ❖ Modularized acquisition electronics
    - ❖ FPGA based acquisition and coincidence processing
    - ❖ Coincidence time window ~5 ns.



- ➢ Activity is reconstructed with Maximum Likelihood Estimation Maximization (MLEM)
- ➢ Iterative algorithm
  - ➢ Reconstruction transforms acquired data in a 3D-activity distribution
- ➢ The reconstruction is performed in few minutes

CATANA: set-up



Response to range shifter insertion SOBP, D=15Gy

Capability to detect the presense of range shifters: to simulate possible changes in the density of the irradiated body, 3 range shifters were used

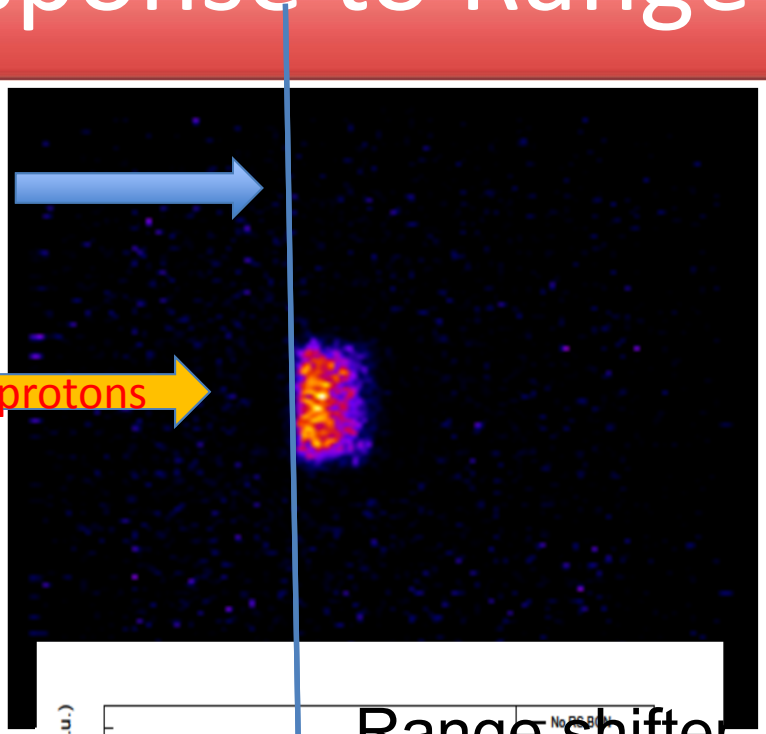
	Beam-shifter [mm]	Beam-on [s]	Dose-rate [Gy/min]
110735	0	80.2	11.2
120325	3	98.4	9.1
123214	4	102.9	8.8
121705	6	124.6	7.2

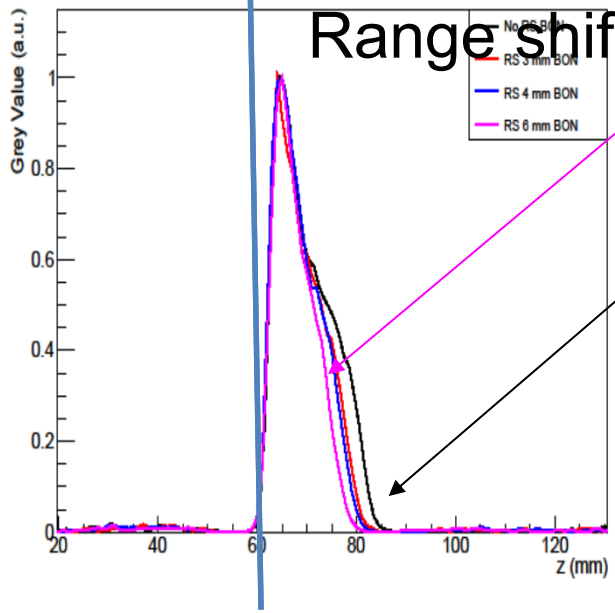
Response to Range shifters

PMMA phantom
entrance surface

protons

SOBP 2cm
∅ 30mm
D= 15 Gy



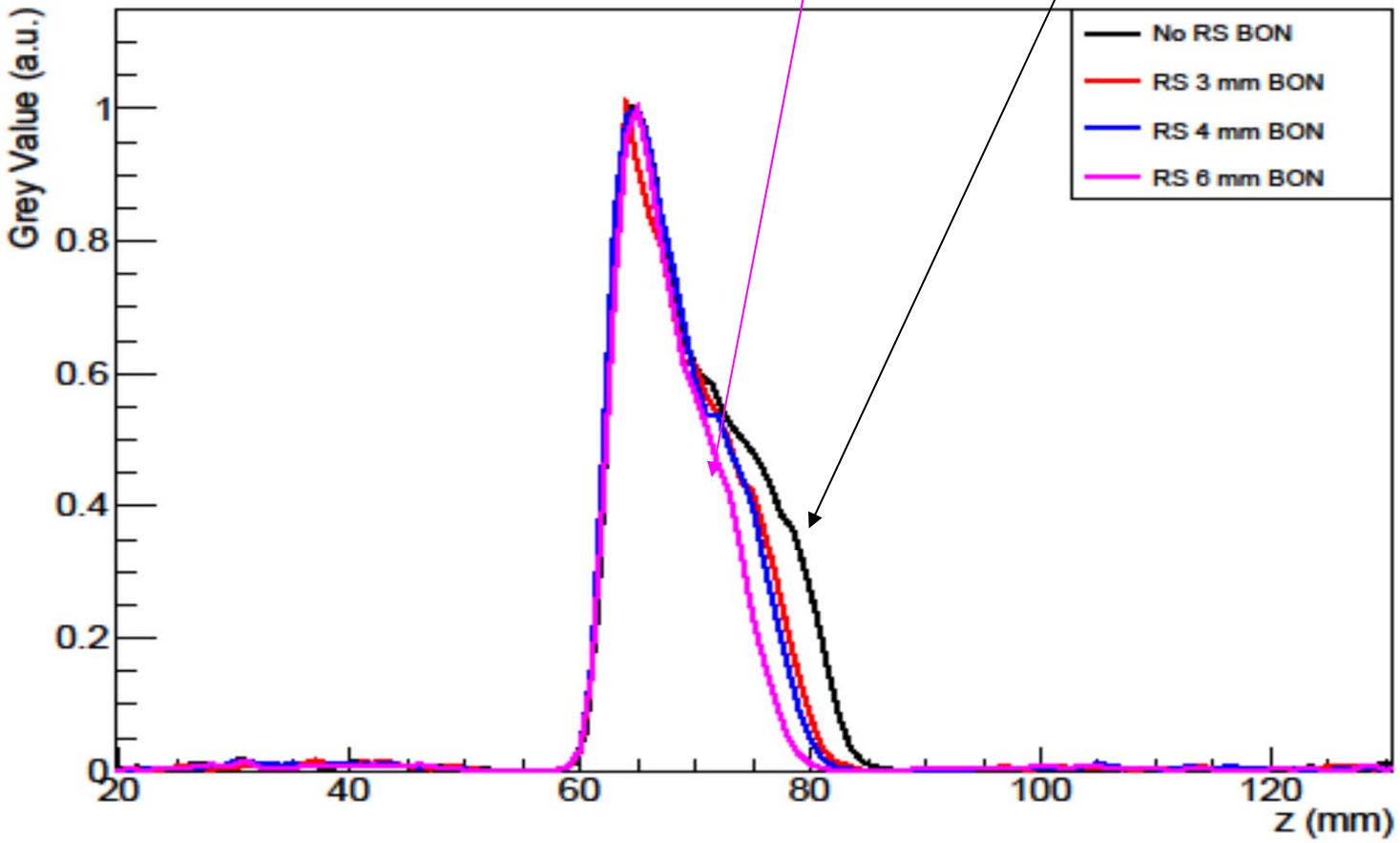


Range shifter 6-4-3-0 mm

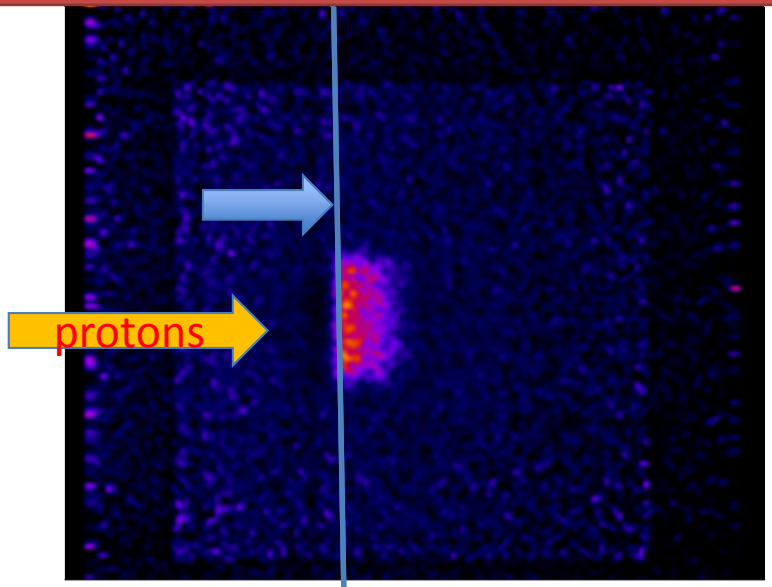
Reconstructed
iInduced activity:
central slice image
15 cm x15 cm
AFTER-TREATMENT
[300s-600s]
6mm range shifter

SOBP, D=15Gy
3 range shifters, after treatment

Range shifters: 6 - 4- 3- 0 mm



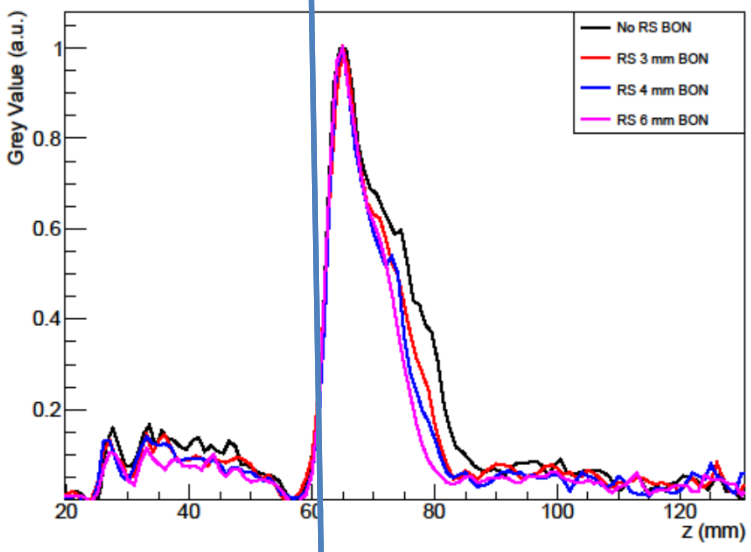
Response to Range shifters



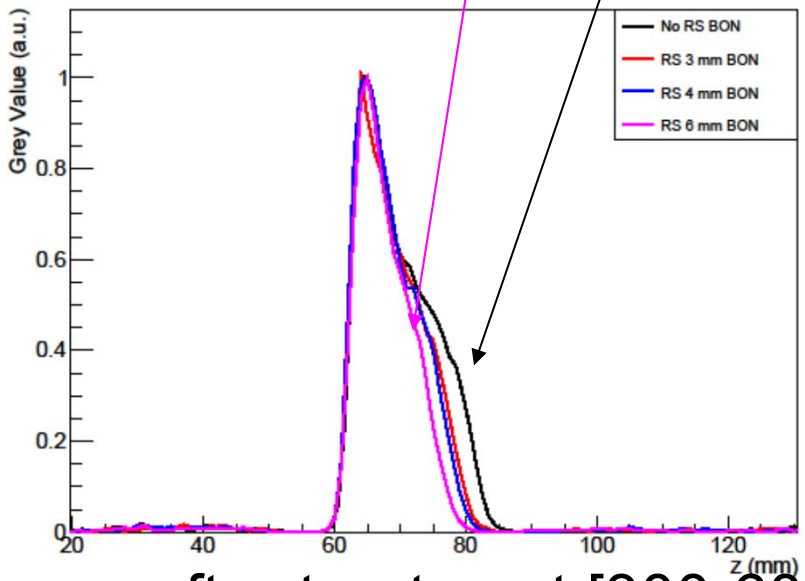
SOBP 2cm, ∅ 30mm, 15 Gy

Reconstructed induced activity:
central slice image
15 cm x15 cm
IN-TREATMENT CASE
Δt 0-125 s

Range shifter 6-4-3-0

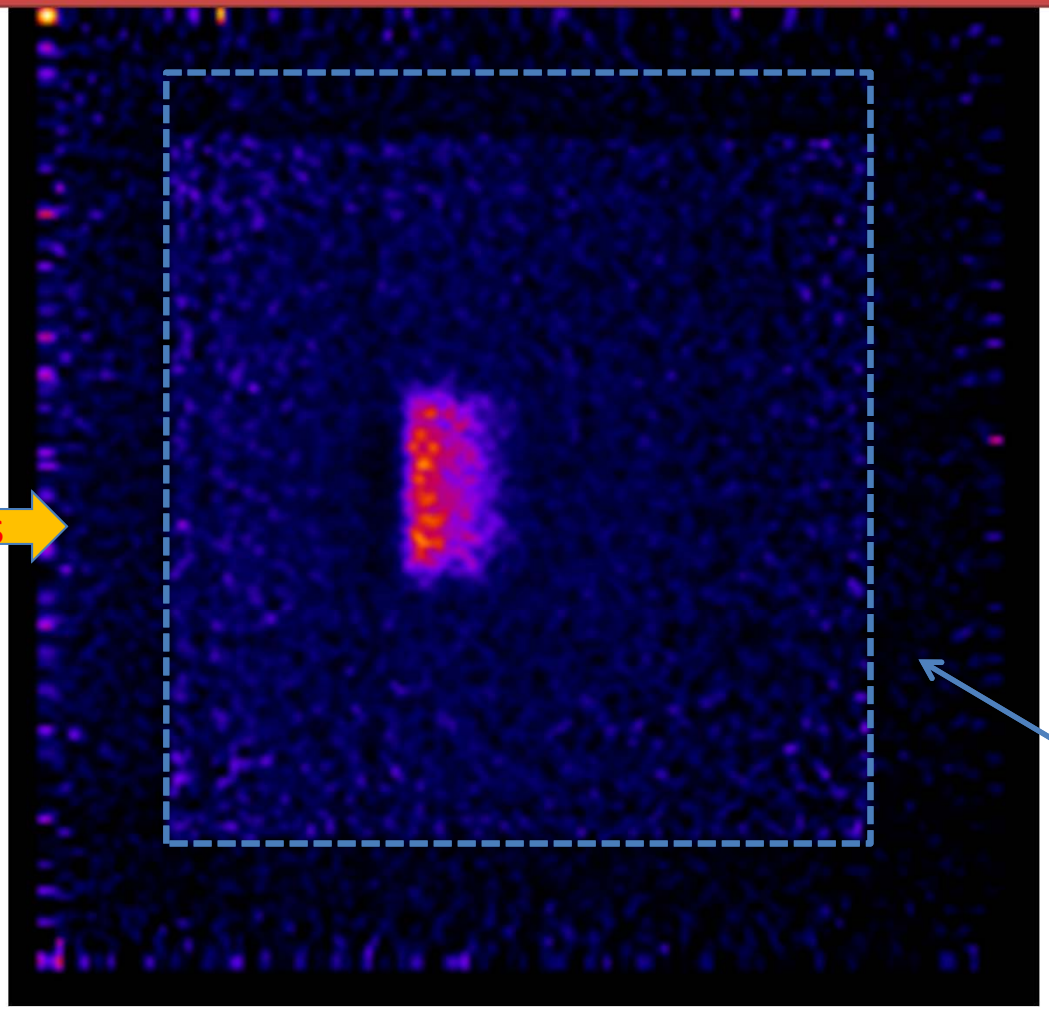


in-treatment



after-treatment [300-600s]

Response to Range shifters



SOBP 2cm, ∅ 30mm, 15 Gy

Reconstructed induced activity:
central slice image
15 cm x15 cm
IN-TREATMENT CASE
Δt 0-125 s

Random events contribution

in-treatment

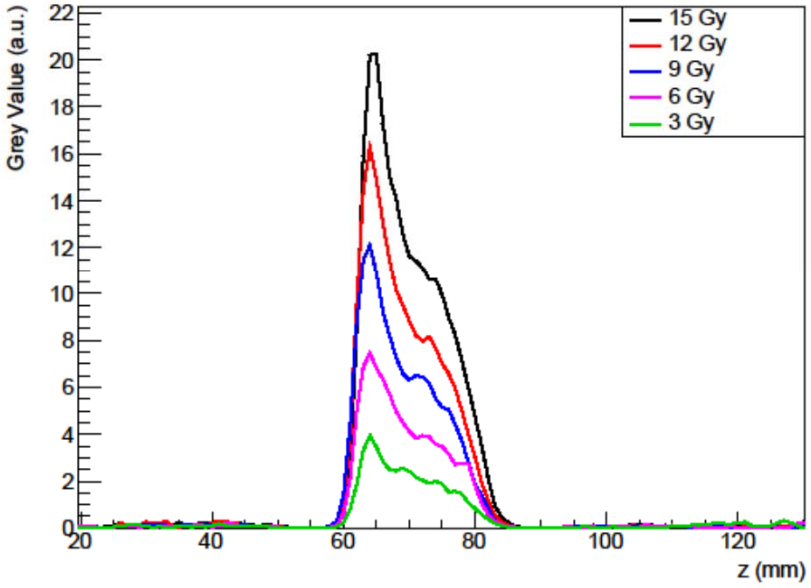
Response for different doses with a fixed dose/rate SOBP

222723
211551
210849
205916
205010

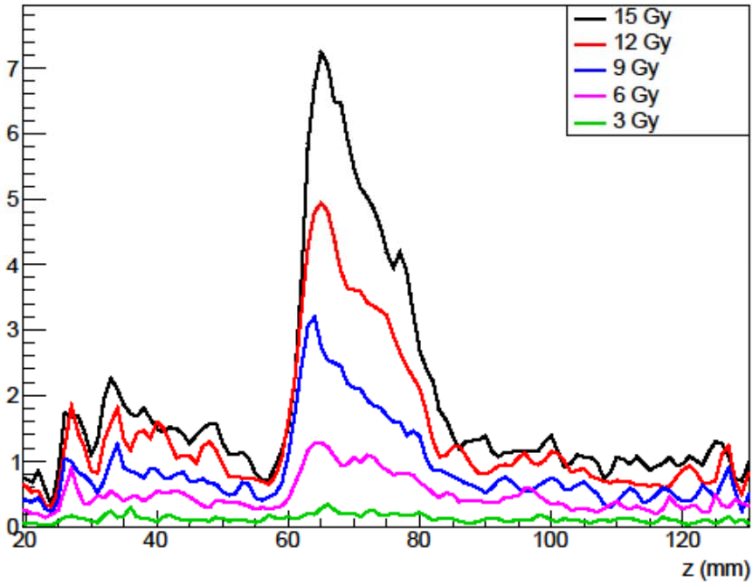
DOSE	Dose-dever time [s]	Dose/rate [Gy/min]
3 Gy	16.3	11.04
6 Gy	30	12
9 Gy	48	11.25
12 Gy	56.4	12.77
15 Gy	72.9	12.35

SOBP 2cm
∅ 30mm,
D =15 Gy
PMMA

after-treatment [300s-600s]

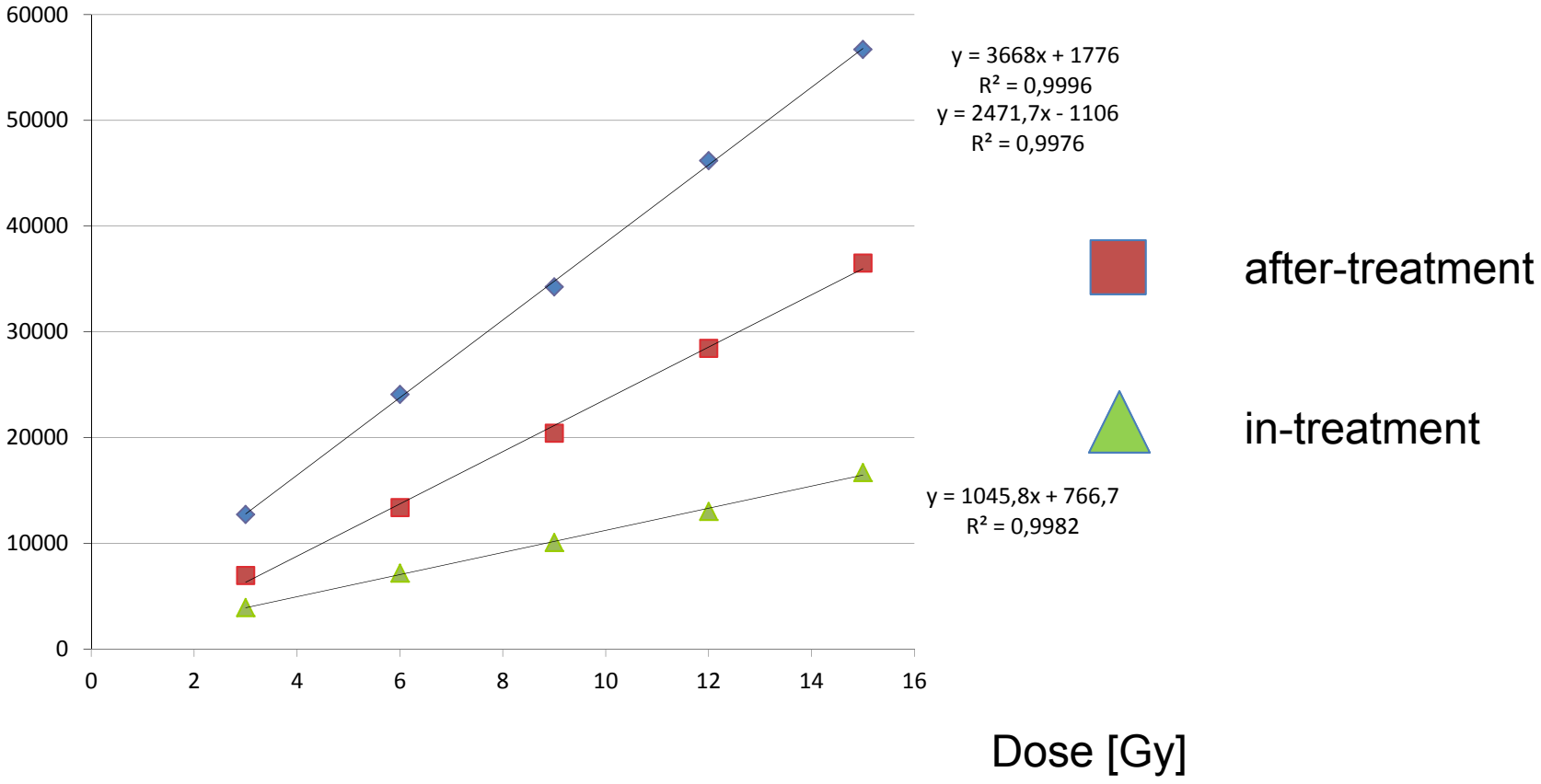


In-treatment: Δt variabile 16.3s 72.9s



Response for different doses with a fixed dose/rate

Reconstructed counts in the energy window 350-850 keV



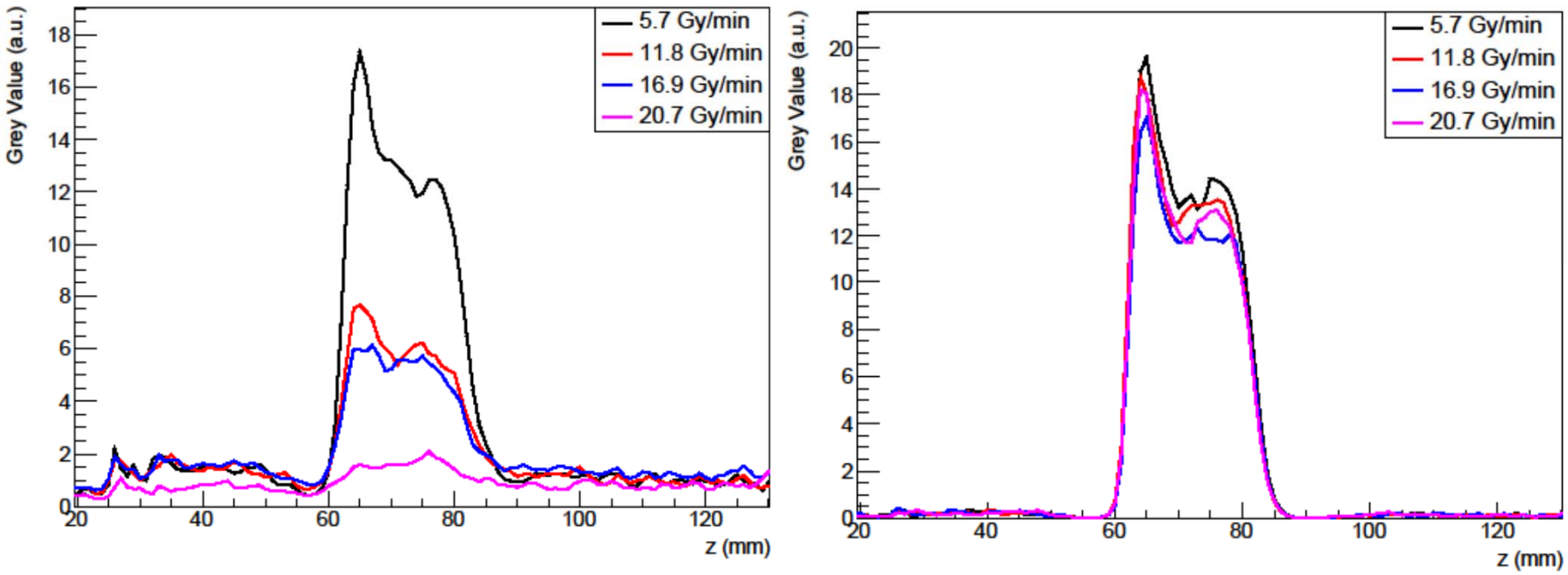
The response is linear with rispect to the delivered dose

Response to different dose/rate
FULL ENERGY

	DOSE	Dose-dever time [s]	Dose/rate [Gy/min]
00448	15 Gy	157.9	5.7
02241	15 Gy	76.5	11.8
03530	15 Gy	53.1	16.9
05227	15 Gy	43.4	20.7

Response to different dose rates

62MeV- 15Gy

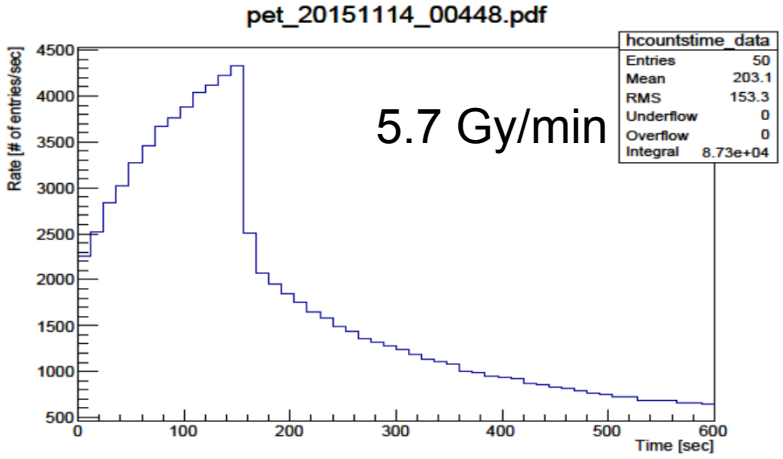


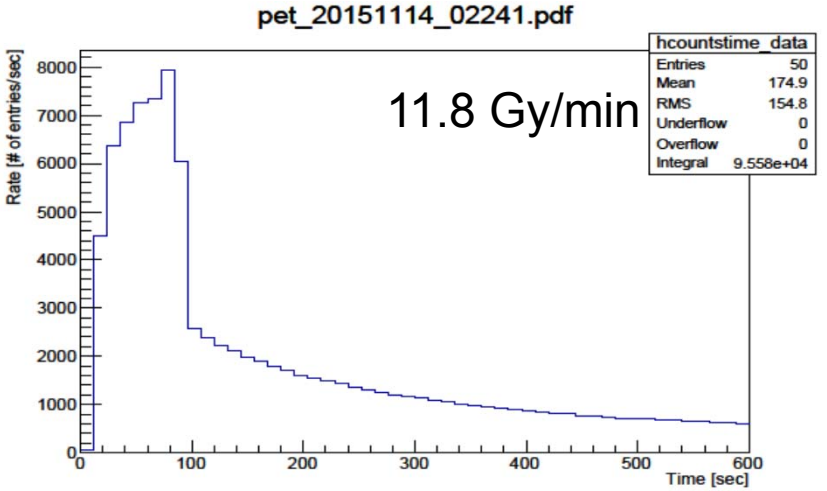
20.7 Gy/min Δt= 43.4 s

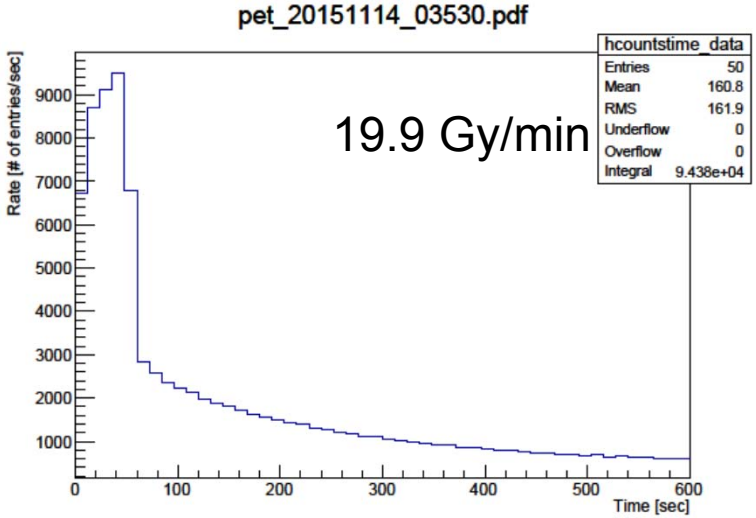
5.7 Gy/min Δt= 157.9 s

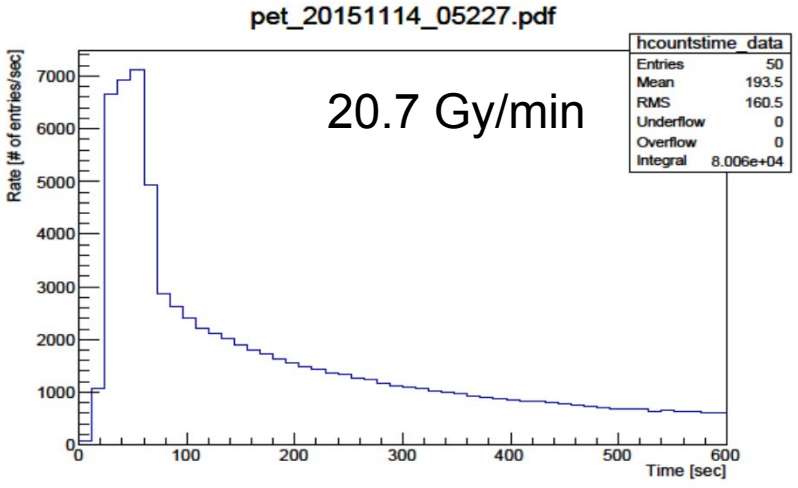
Time-profile study

Experimental time profiles for the different dose rates

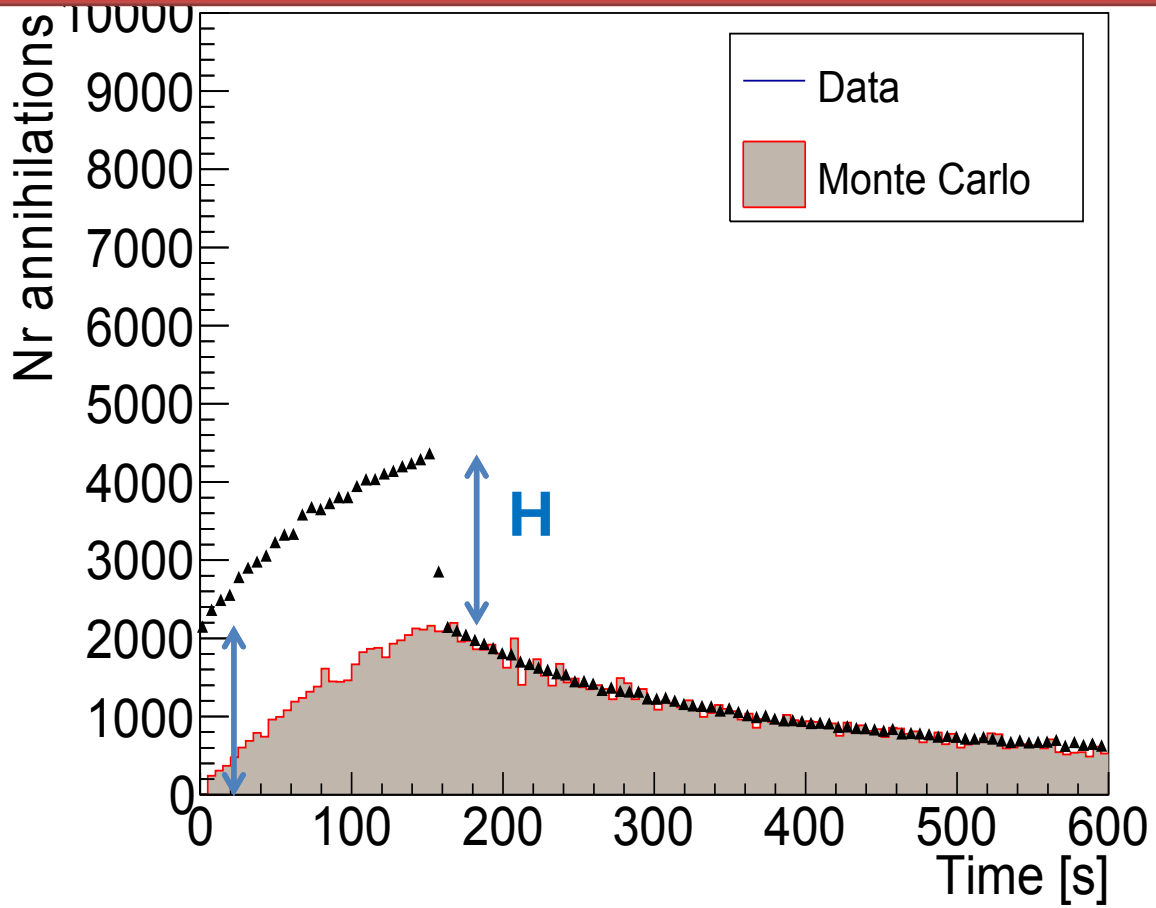








Comparison for 5.7 Gy/min between MC and experimental data

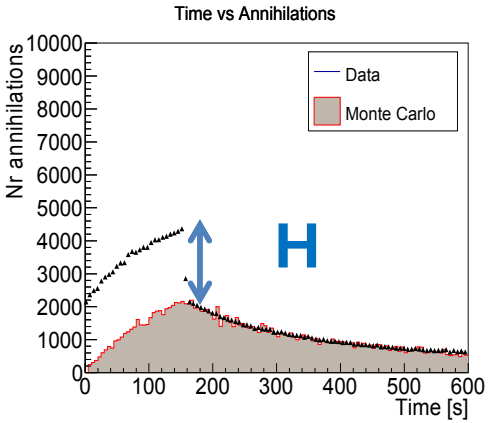


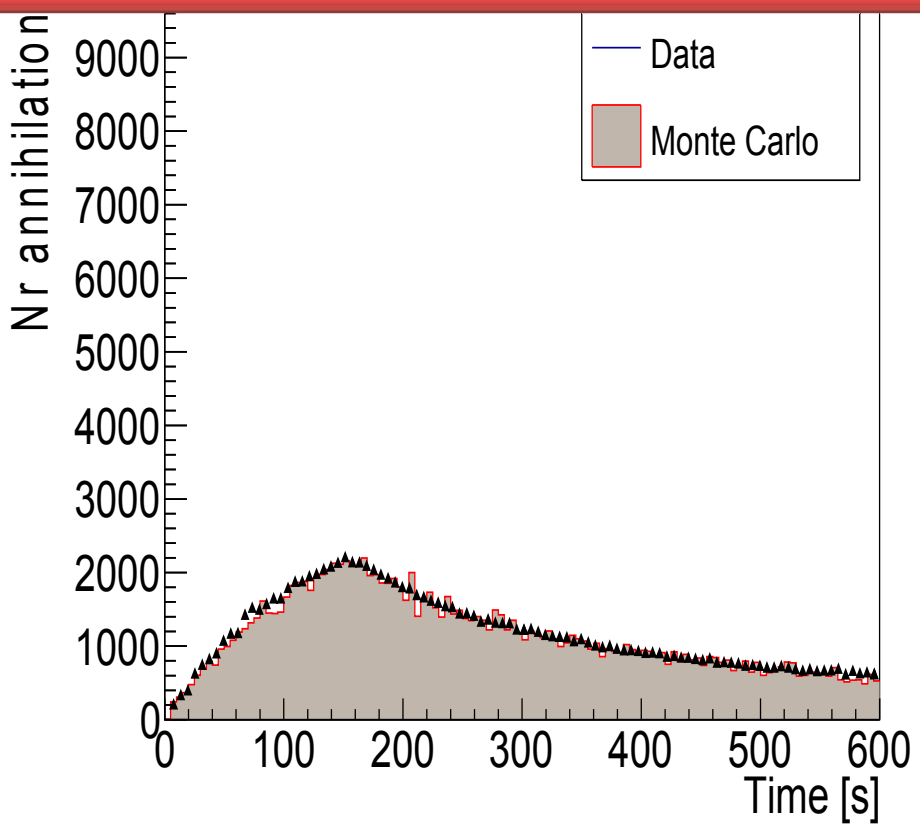
15 Gy, p 62 MeV on PMMA , Δt= 157.9 s

The reconstructed events include the contribution of the random events: this contribution has the same amplitude of the annihilations events only in the in-treatment phase and is constant (H)

Comparison for 5.7 Gy/min between MC and experimental data

15 Gy, p 62 MeV on PMMA , Δt= 157.9 s

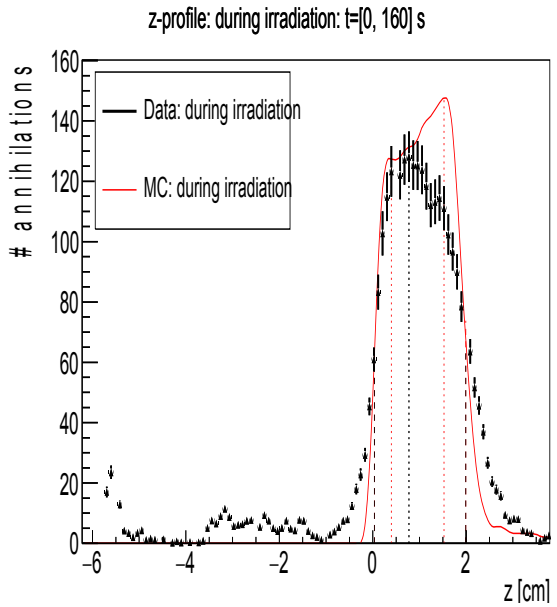




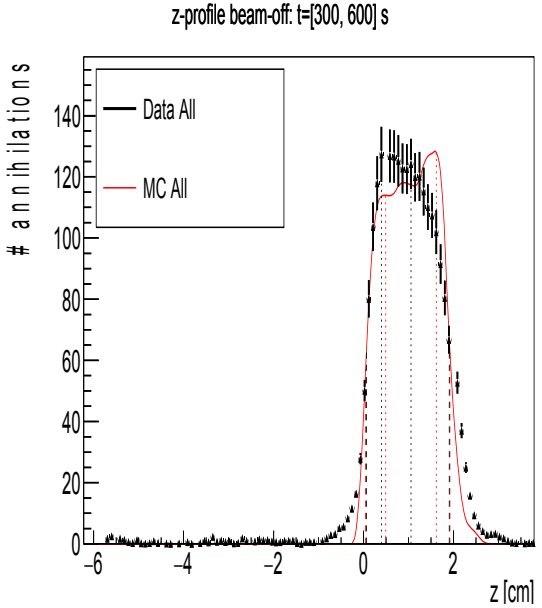
After the substraction of the random counts countribution, H, the experimental data are in agreement, in term of shape, with the expected number of annihilations

Comparison for 5.7 Gy/min between MC and experimental data

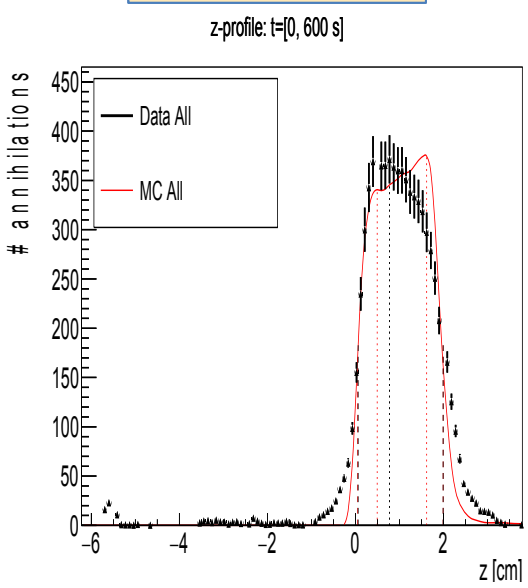
During irradiation: t< 158



After irradiation: 300-600 s

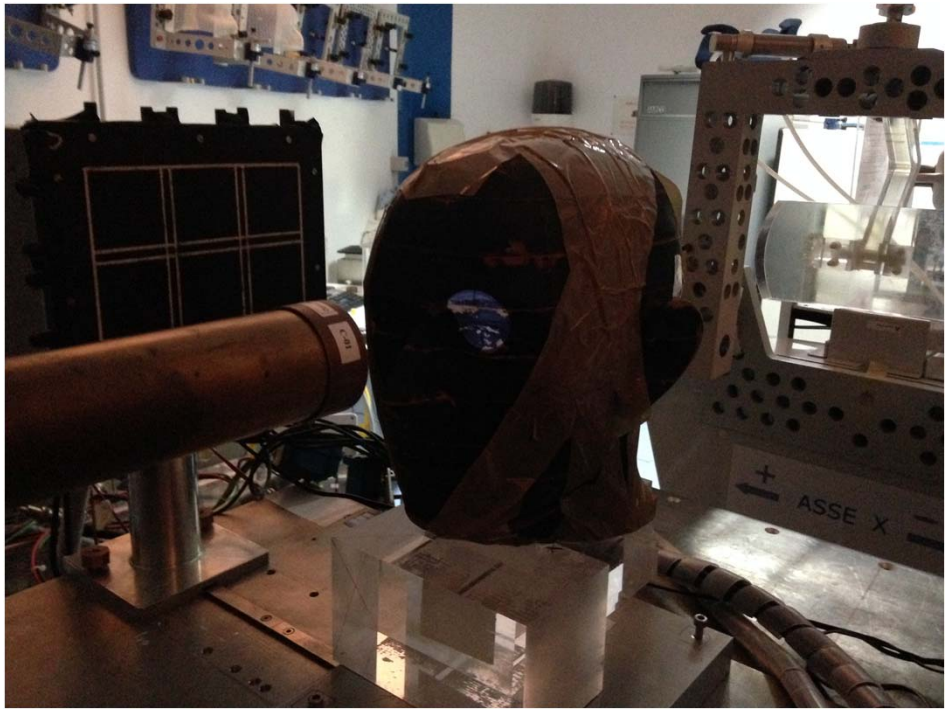


All data



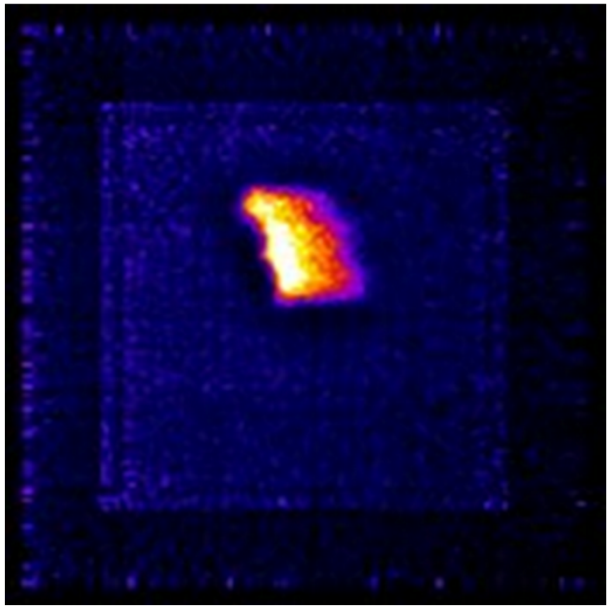
Δw50%	in-treatment [cm]	after-treatment [cm]	all [cm]
MC	1.95	1.87	1.94
data	1.96	1.84	1.93

An example of the reconstruted images using an antropomorphic phantom

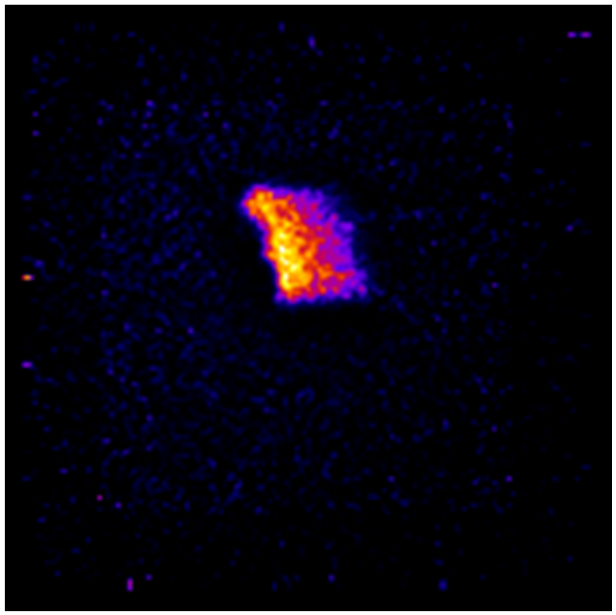


slice cent. RANDO (170244)

SOBP
∅ collimator 30mm
D=15Gy, Δt=70s



in-treatment



after-treatment

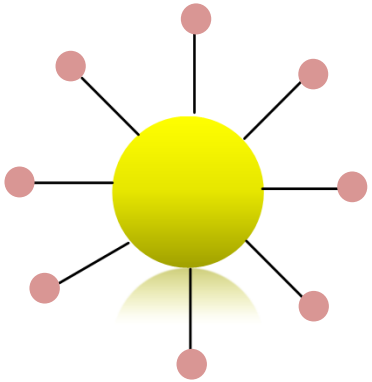
Session 6 of the ICTR-PHE meeting.

DoPET: an in-treatment monitoring system for particle therapy

Presa dati a metà marzo presso il centro di protonterapia di Trento

Presa dati CNAO aprile 2015

***In-treatment tests for the monitoring of proton and carbon ion therapy with a large area PET system at CNAO**
V. Rosso et al.
NIMA
http://dx.doi.org/10.1016/j.nima.2015.11.017
*****
In-beam PET data characterization with the large area DoPET prototype
G. Sportelli et al.
Accepted for publication on JINST

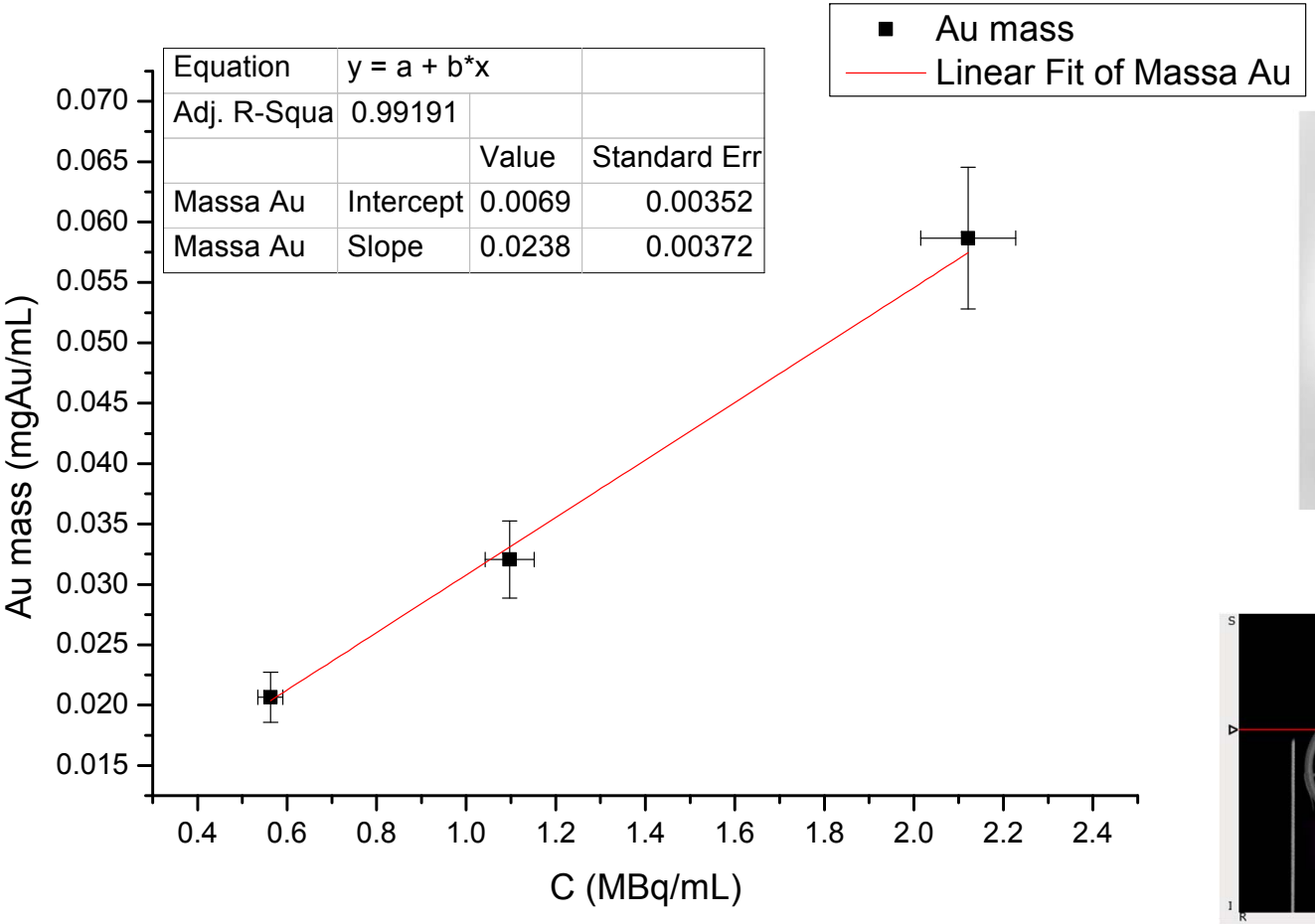


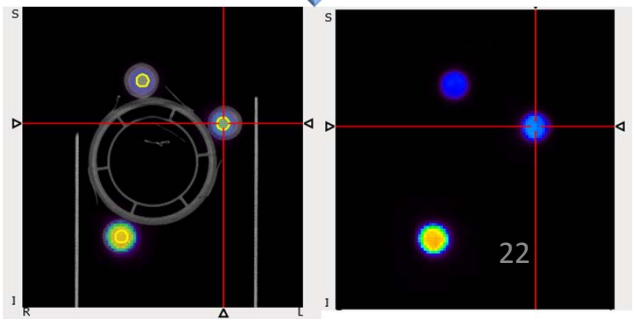
nATT
up-date

in-vivo measurements

linearity

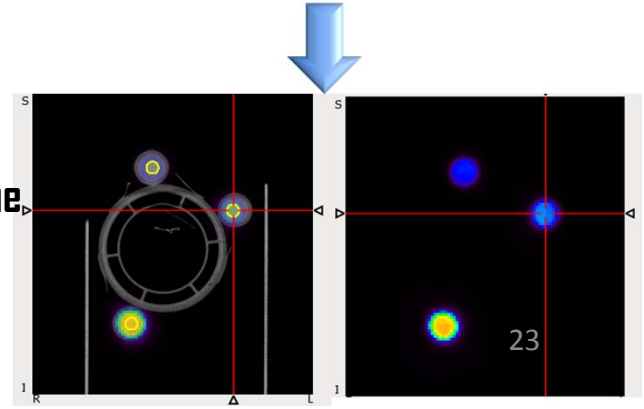
Pisa - CNR: Studio in vivo con **^{18}F - FDG - GNP** e **^{18}F - RGD - GNP**



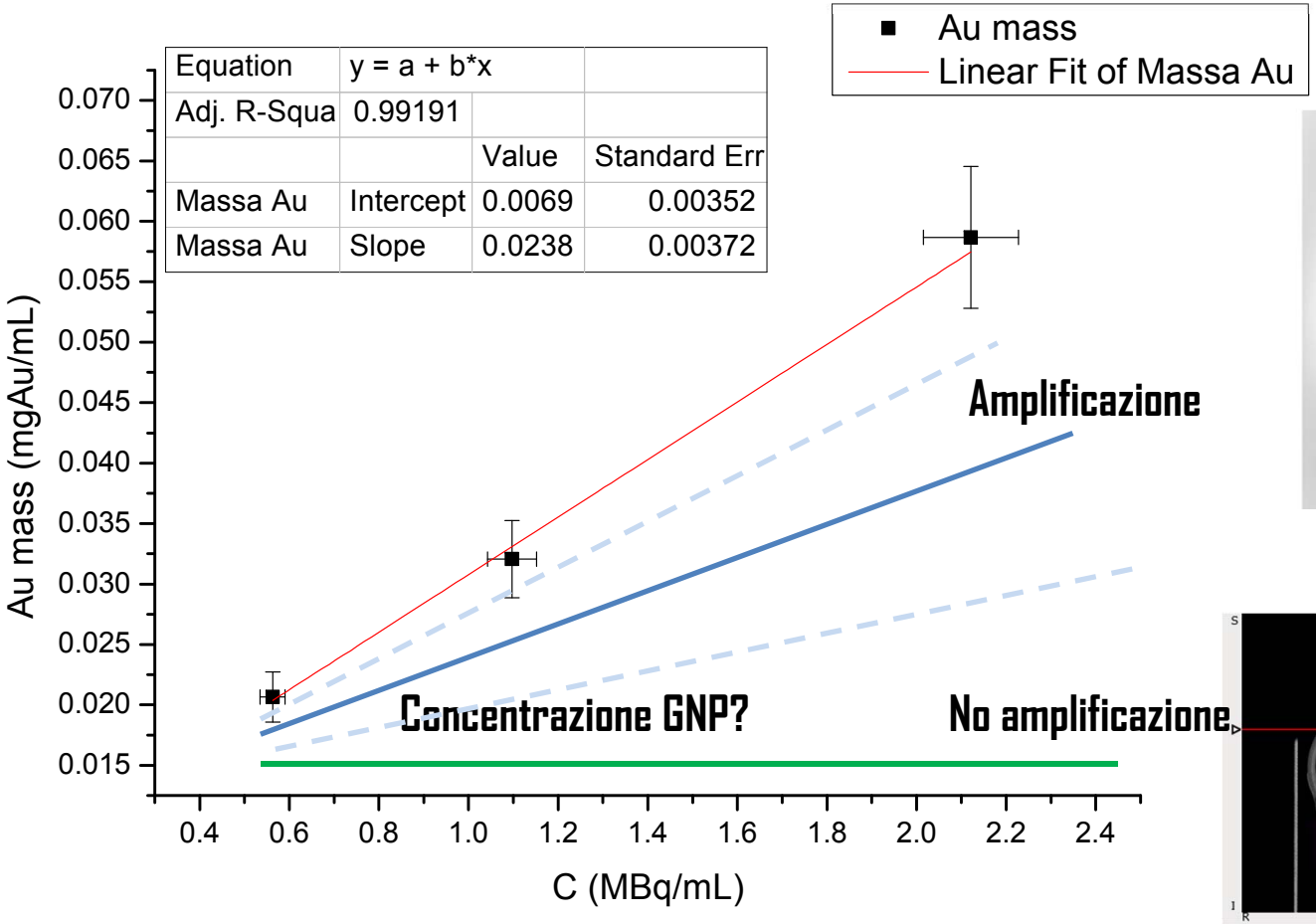


Studio in vivo

Pisa - CNR: Studio in vivo con **^{18}F - FDG - GNP** e **^{18}F - RGD - GNP**

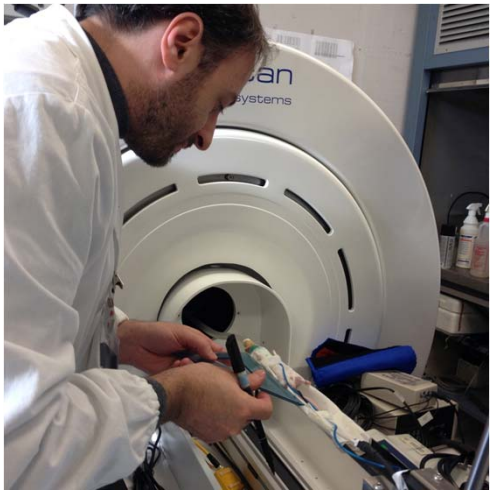


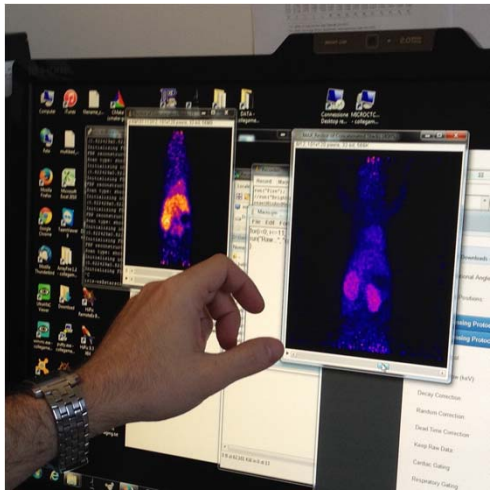
Equation	y = a + b*x		
Adj. R-Squa	0.99191		
		Value	Standard Err
Massa Au	Intercept	0.0069	0.00352
Massa Au	Slope	0.0238	0.00372



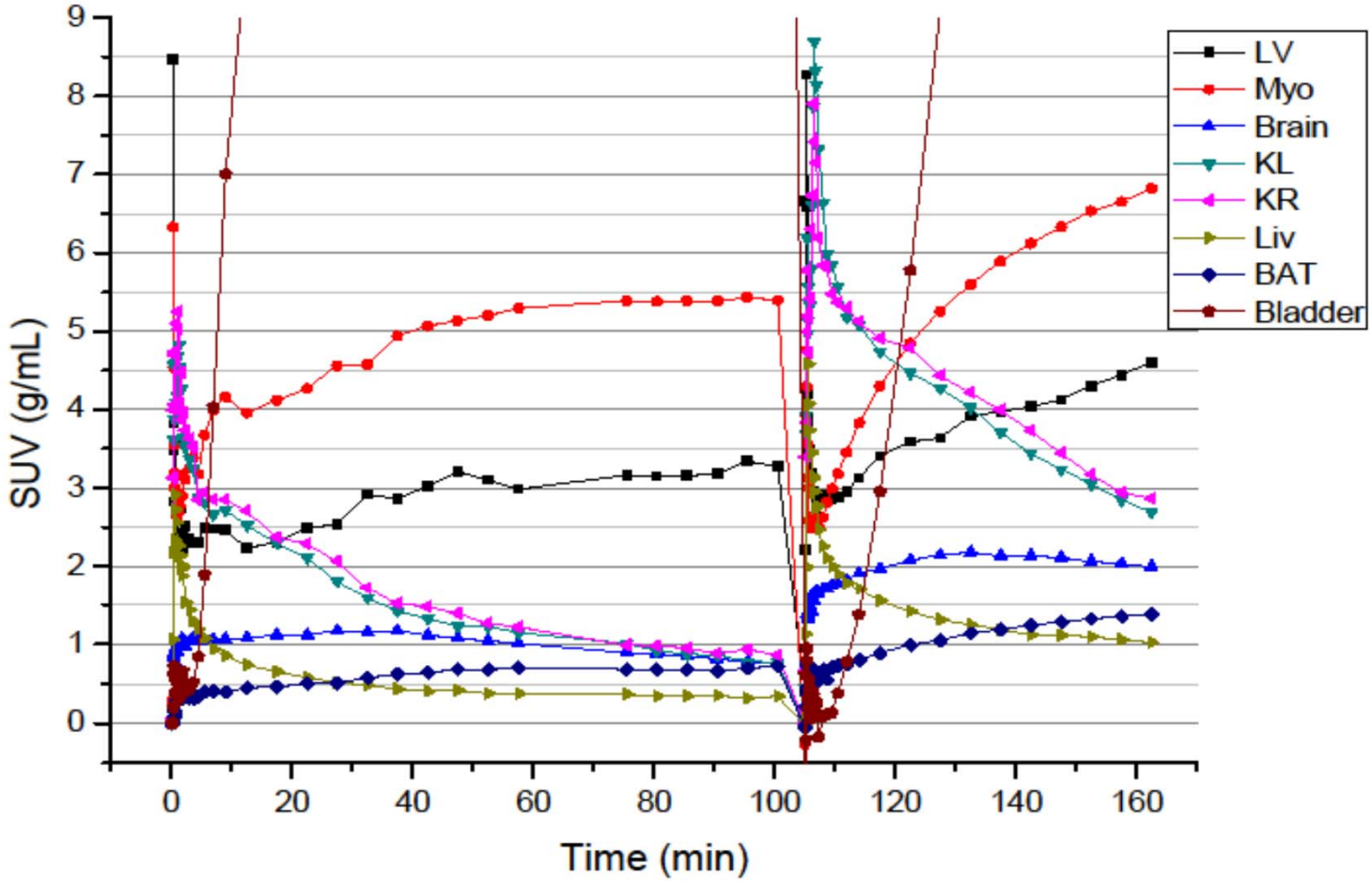
in vivo measurements

Pisa – CNR: in vivo with ^{18}**F - FDG - GNP**





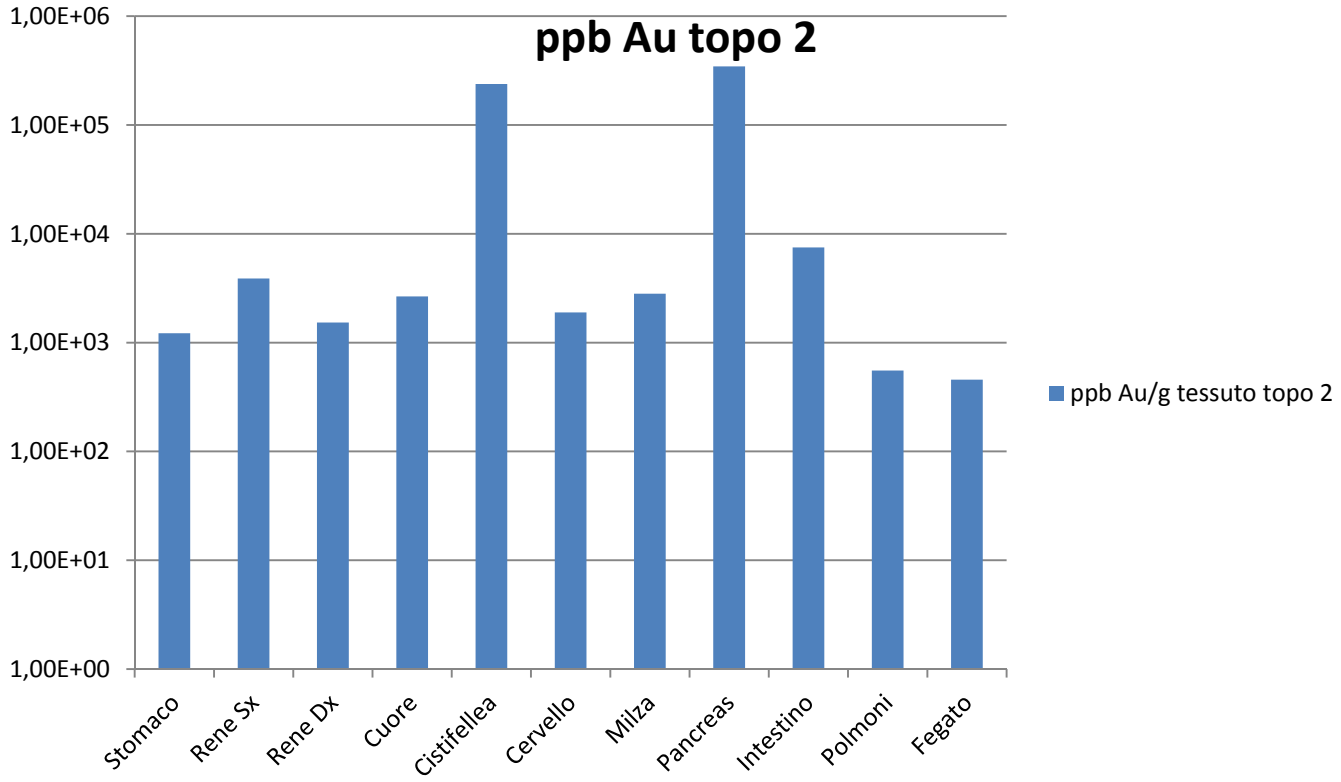
II test in-vivo



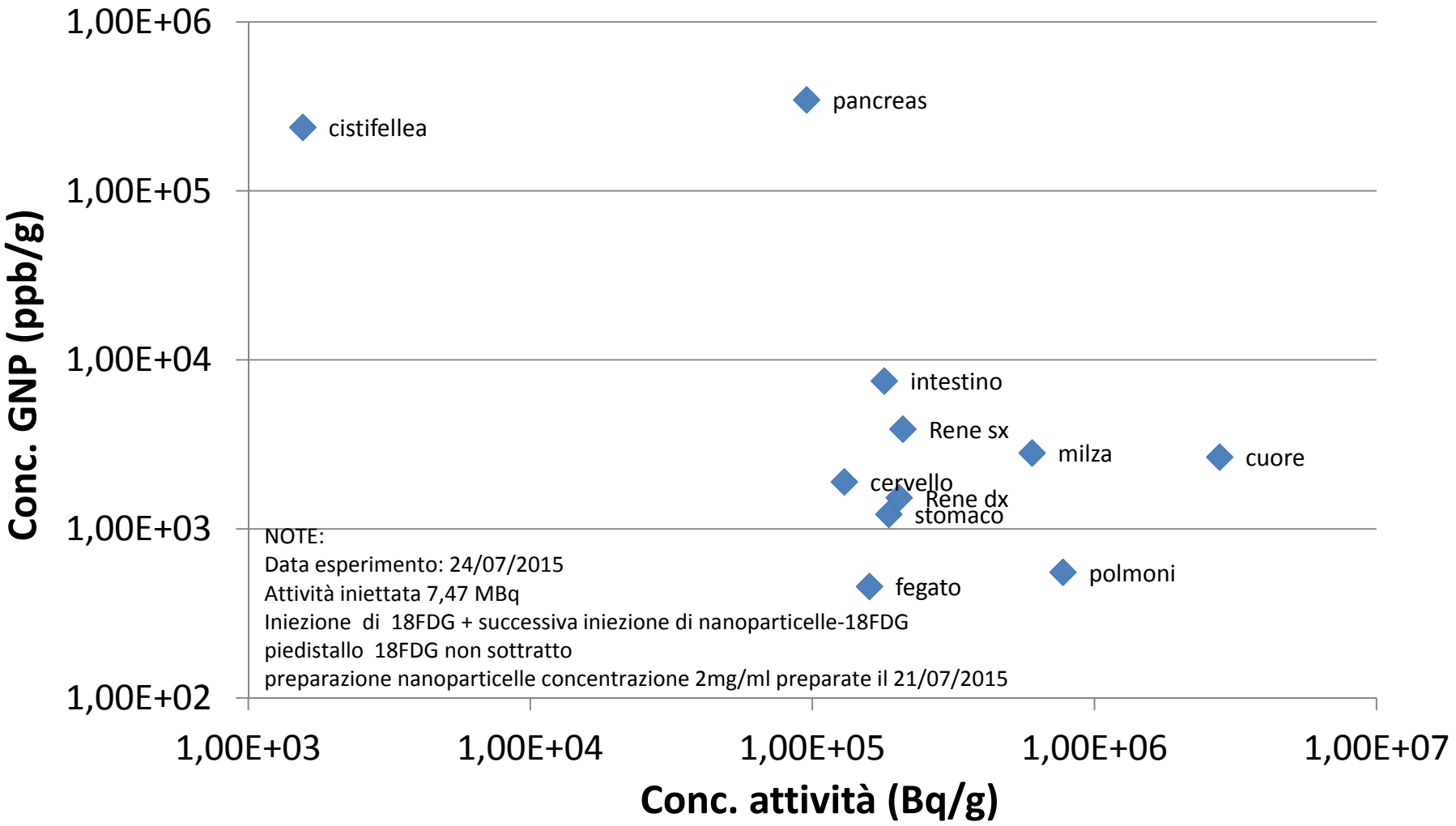
2 iniezioni; la I solo FDG, la II nanoparticelle marcate con FDG,

Il test in-vivo

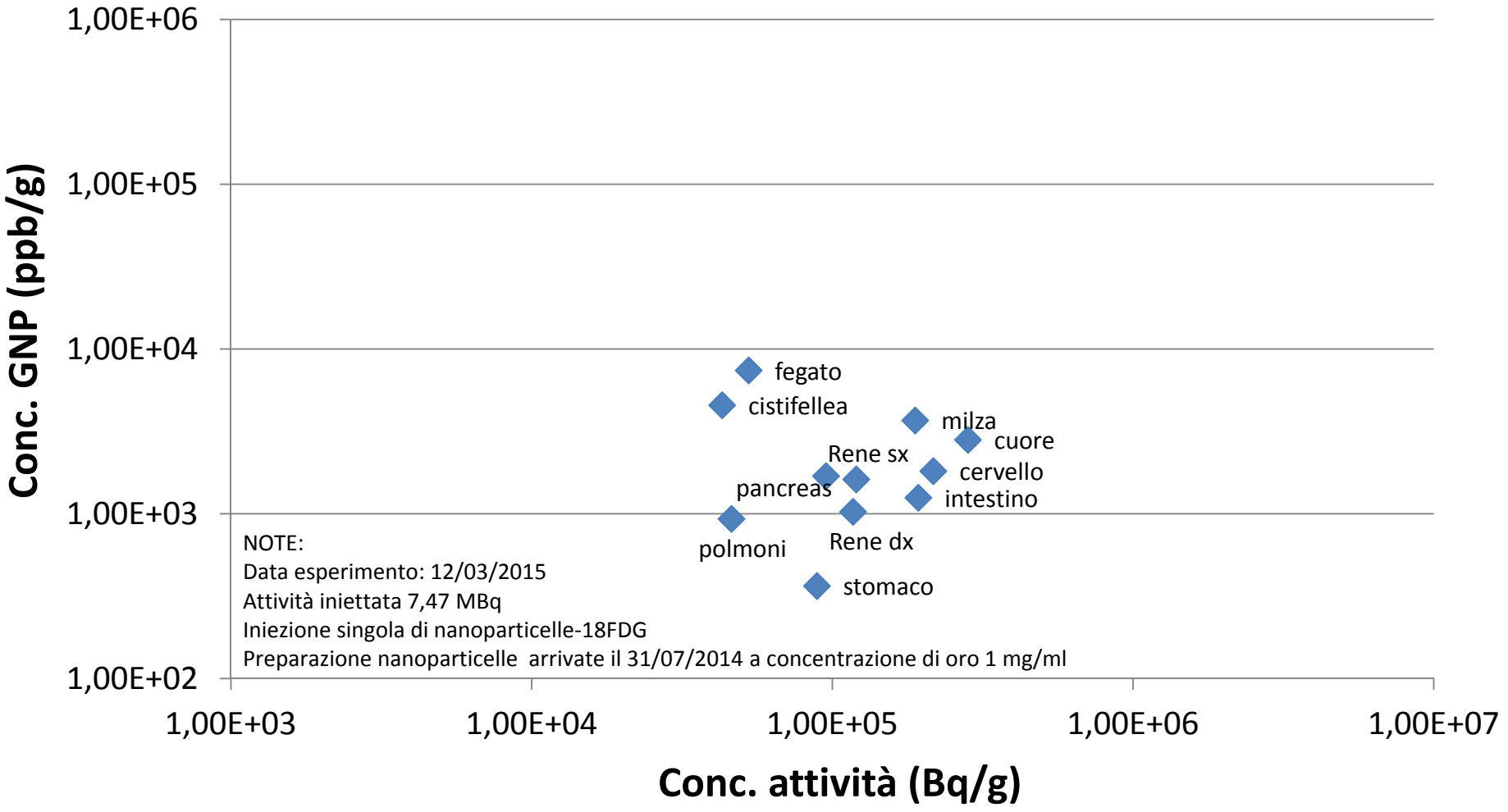
studio post-mortem attraverso spettrometria di massa



Topo 2: Correlazione radioattività ex vivo Vs concentrazione oro



Topo 1: Correlazione radioattività ex vivo Vs concentrazione oro



nATT RDH Gruppo di lavoro Lecce
Lab Anatomia Comparata e Citologia Disteba- Università del Salento
email luciana.dini@unisalento.it

Distribuzione di GNPs in topo sano mediante analisi ultrastrutturale al TEM- STEM+EDX

Data esperimento: 24/07/2015
Attività iniettata 7,47 MBq
Iniezione di 18FDG + successiva iniezione di nanoparticelle-18FDG
preparazione nanoparticelle concentrazione 2mg/ml preparate il 21/07/2015

Organi prelevati:

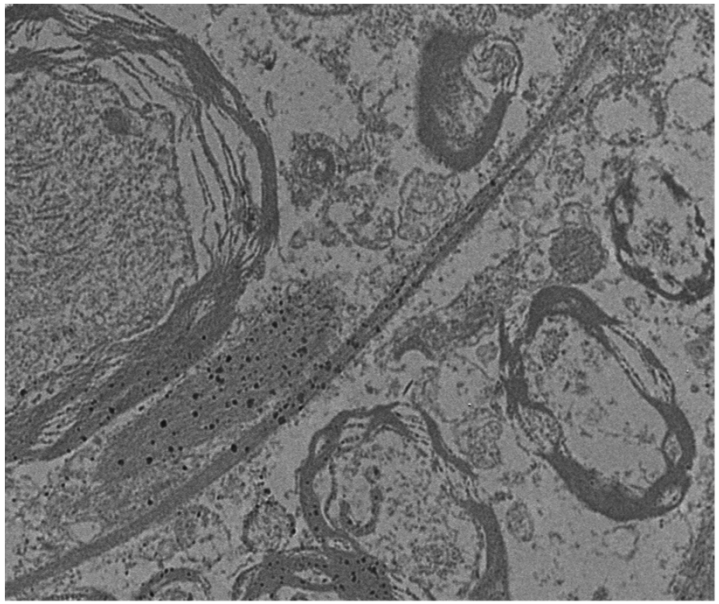
CERVELLO, PANCREAS, RENE sx, RENE dx, CISTIFELLEA, COLON, DUODENO, CUORE, FEGATO, MILZA, STOMACO

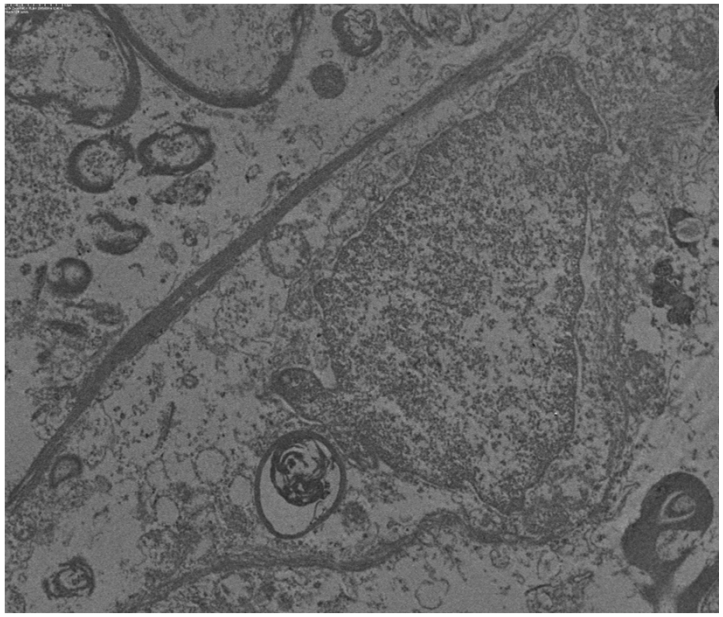
I campioni al momento del prelievo sono stati fissati in glutaraldeide 1% in tampone cacodilato e processati secondo la metodica standar.

Per ogni campione sono state già ottenute 5 sezioni di circa 60 nm di spessore all'ultramicrotomo (da due blocchetti differenti) per osservazione al TEM e 2 sezioni di circa 80 nmdi spessore per microanalisi (EDX).

Valutazioni semiquantitative per definire la numerosita' delle GNP
Distribuzione delle GNP nei vari organi, e definizione della localizzazione nell'organo (tipo di cellule) e della localizzazione subcellulare

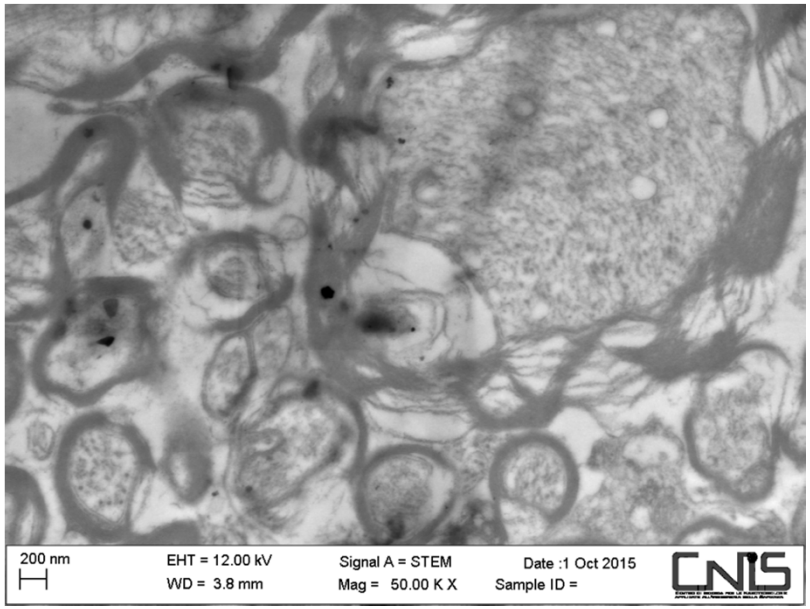
Cervello



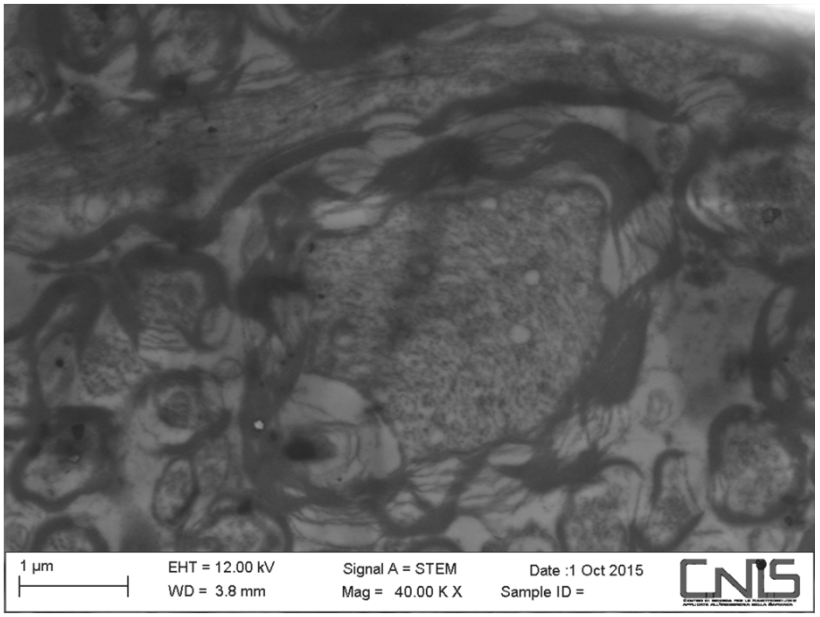


Le NPs sono presenti negli avvolgimenti mielinici delle cellule di Schwann

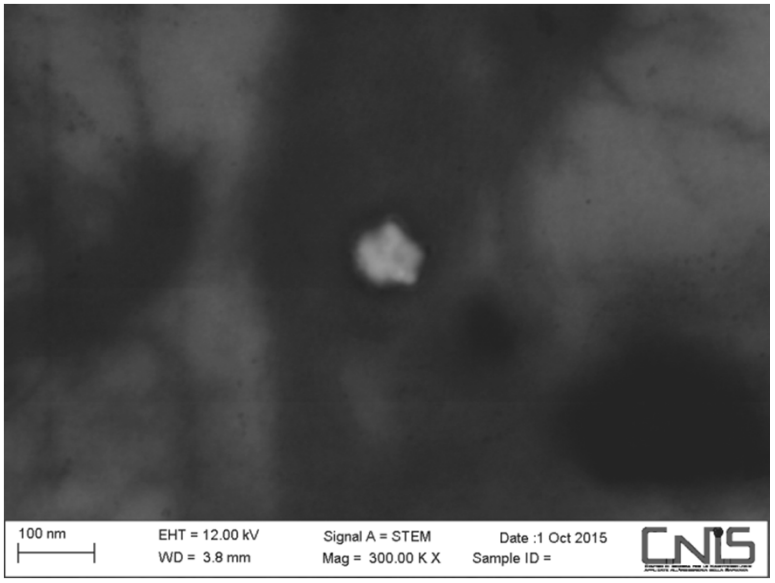
Cervello

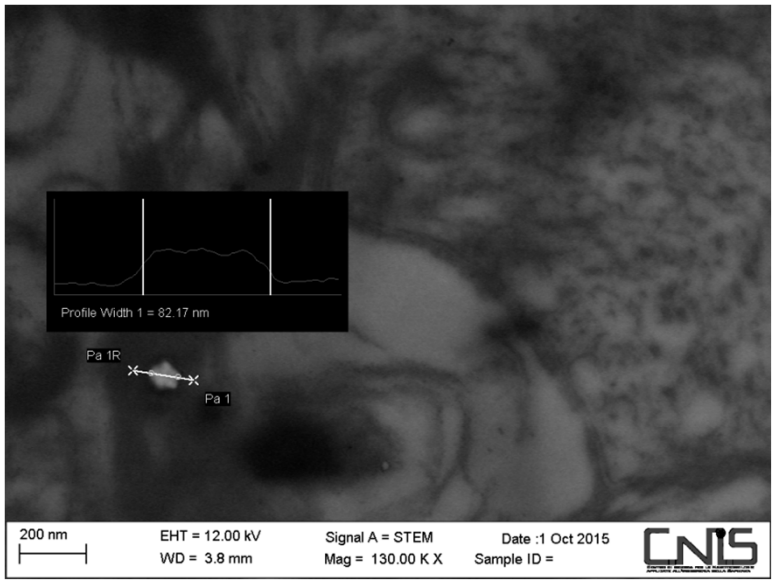


Bright field (NP sono nere)

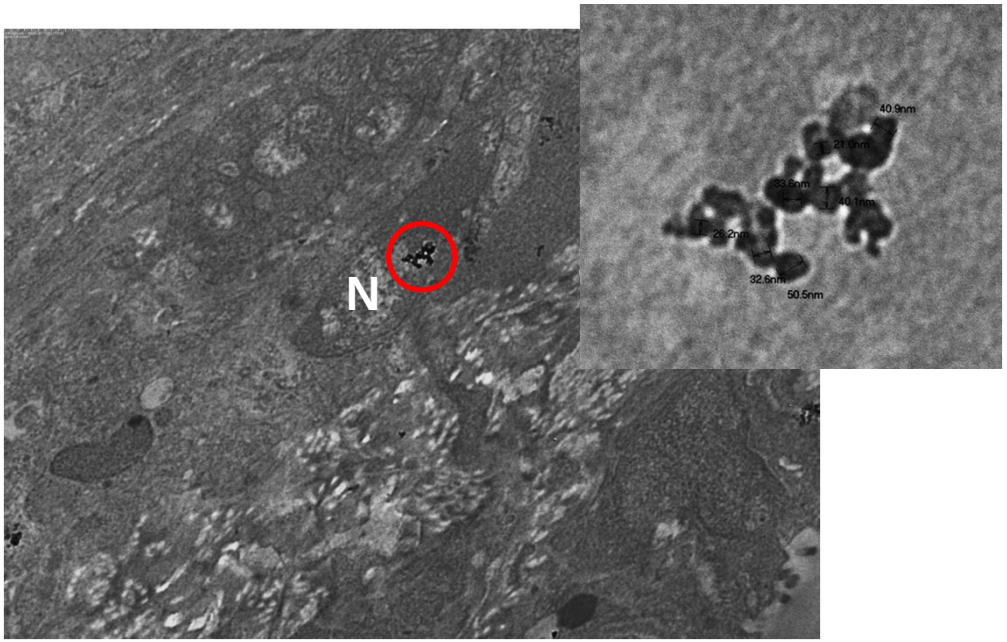


Dark field (NP sono chiare)

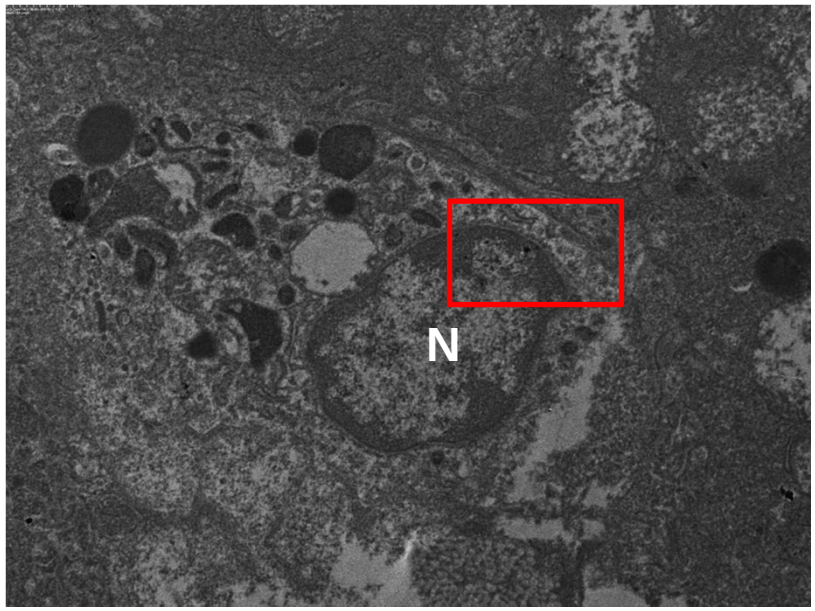


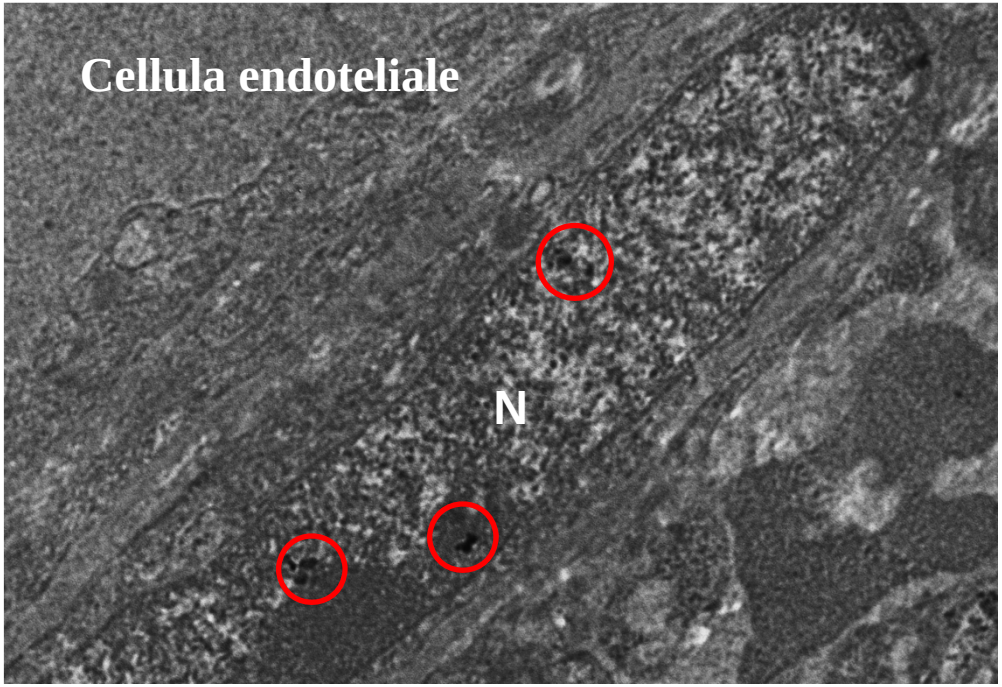


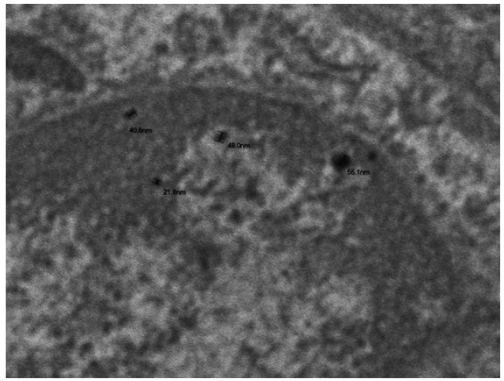
EDX che conferma la natura di Au Np



FEGATO

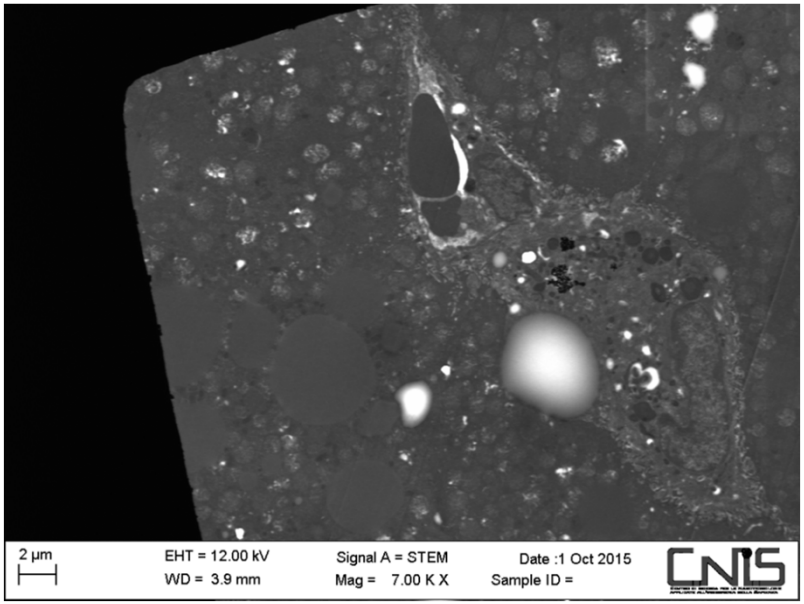




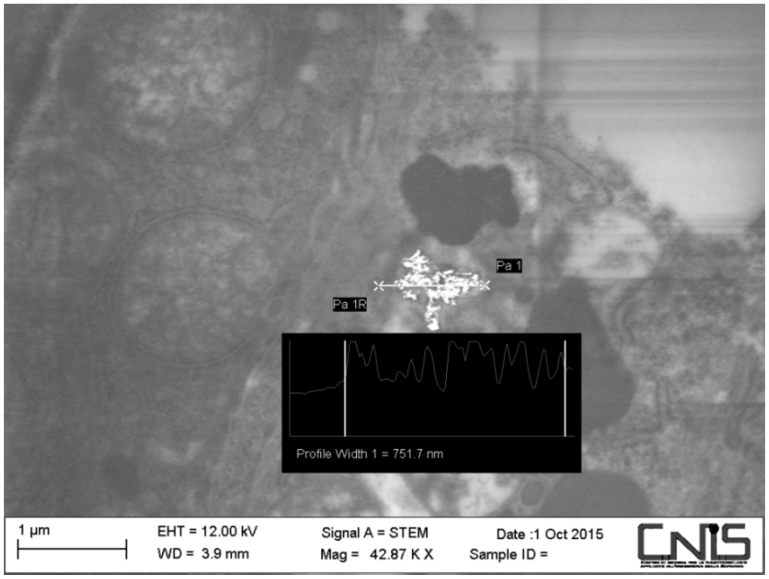


Le GNP si aggregano in vacuoli;
Nel nucleo appaioni in forma di piccoli clusters

FEGATO



- Bright field (NP sono nere)



Dark field (NP sono chiare)