AB-BNCT project at Grenoble :

collaboration proposal with CNAO

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INSERM

CNRS

LPSC - IAB technical developments for AB-BNCT

IAB

- Elaboration of theranostics systems based on BODIPYs for optical imaging and boron neutron capture therapy (BNCT)

LPSC

- **Neutron spectrometry and fluence measurement with the instrument Mimac-FastN :**
  - for characterization at the BSA output
  - for estimation of the target degradation (as a function of time and beam current)
  - for radioprotection purpose around the installation
- **Active phantom mode with the instrument Mimac-FastN :**
  - Measurement of boron dose in the tumor, as a function of its depth
  - Microdosimetry with a tissue equivalent-gas

Institute for **Advanced Biosciences**

CENTRE DE RECHERCHE UGA – INSERM U 1209 – CNRS UMR 5309

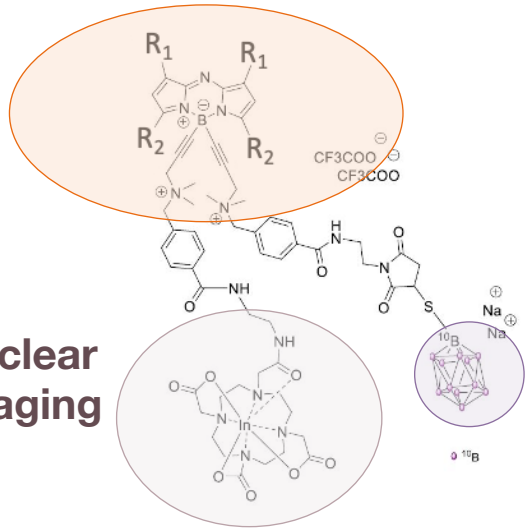
Elaboration of theranostics systems based on BODIPYs for optical imaging and boron neutron capture therapy (BNCT)

iAB EPIGENETICS CHRONIC DISEASES CANCER

UNIVERSITÉ Grenoble Alpes | Instituts thématiques | Inserm Institut national de la santé et de la recherche médicale | cnrs | CHU GRENOBLE ALPES | EFS ÉTABLISSEMENT FRANÇAIS DU SANG

Biological evaluation of the compounds

Fluorescence and vectorization



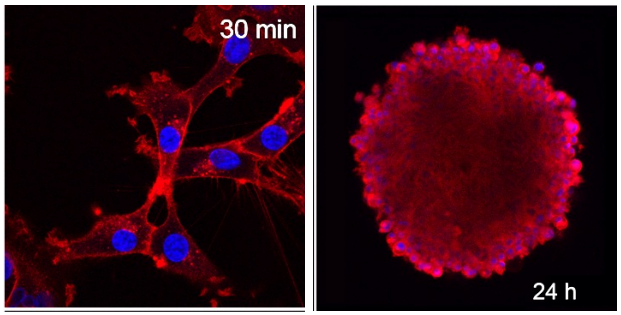
Nuclear imaging

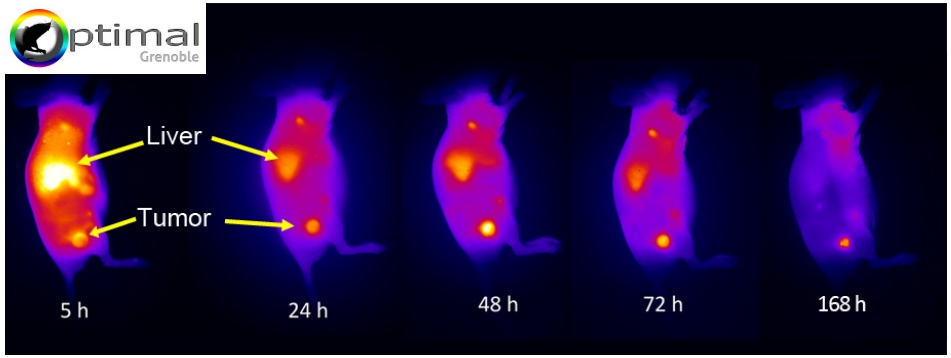
Boron source

Dr. C. Goze
A. Godard
Pr E. Bodio

Godard et al Bioconjugate Chem 2020

2D and 3D cell internalization

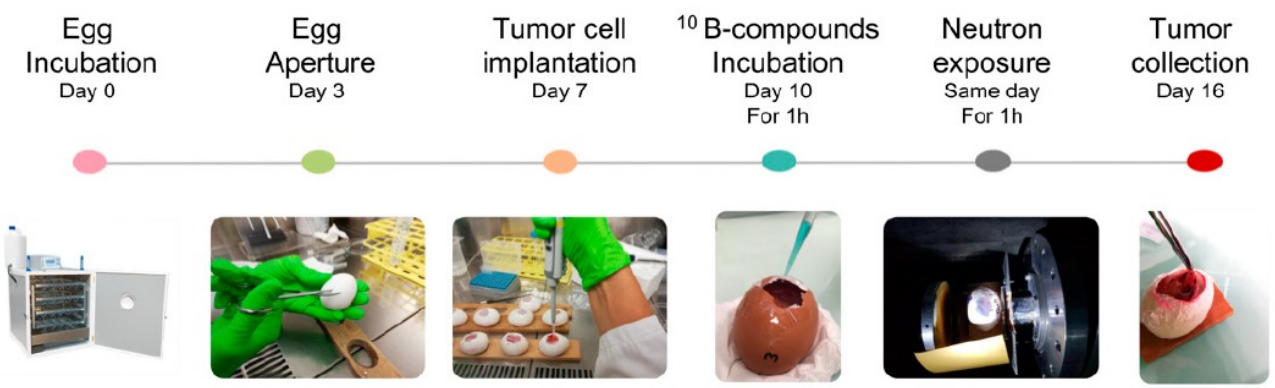




- **Efficient tumor uptake**: maximum accumulation at 48-72 h post IV administration
- Hepatic elimination
- Tumor/Skin > 3 after 24 h
- **Tumor/Muscle ratio** > 5 with a max. ~30, at day 7

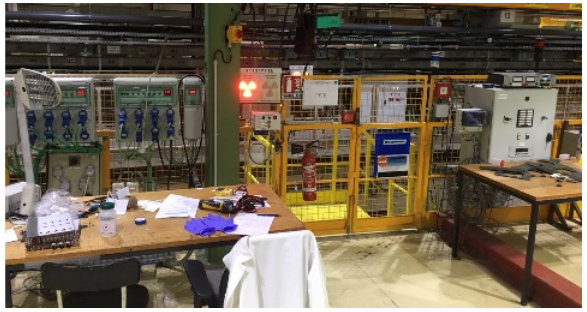
IAB EPIGENETICS CHRONIC DISEASES CANCER

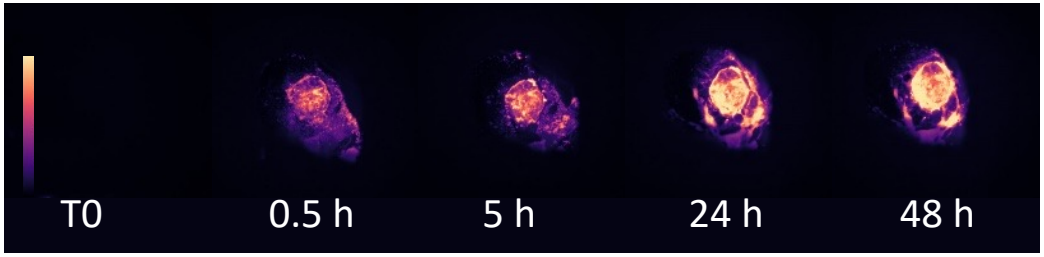
Evaluation of BNCT efficacy in cells and in ovo

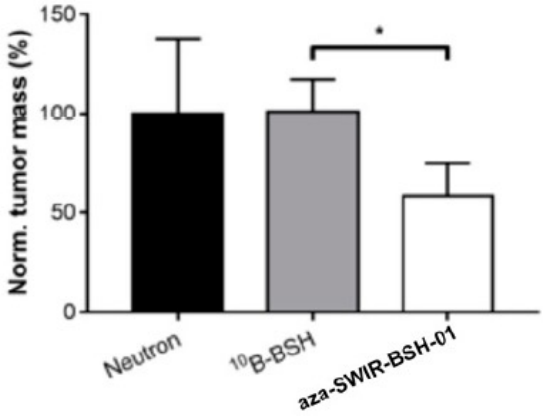


NEUTRONS FOR SOCIETY

Dr U Köster







- In ovo model for BNCT applications : Maximum uptake at 24/48h pi

Kalot et al. Cells 2020
Sauerwein et al. Life 2021

- Significant tumor growth reduction vs BSH alone

IAB EPIGENETICS CHRONIC DISEASES CANCER

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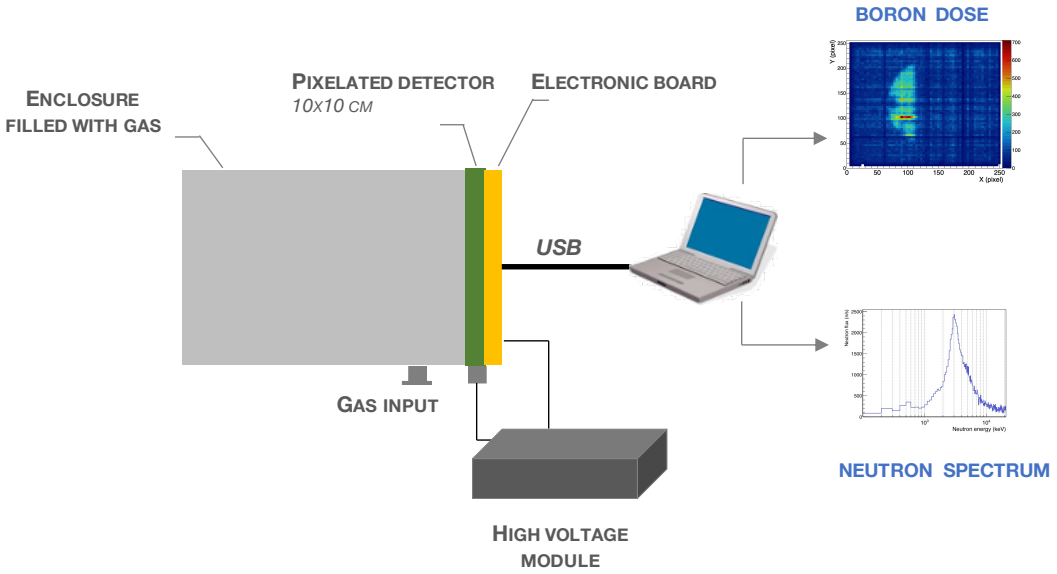
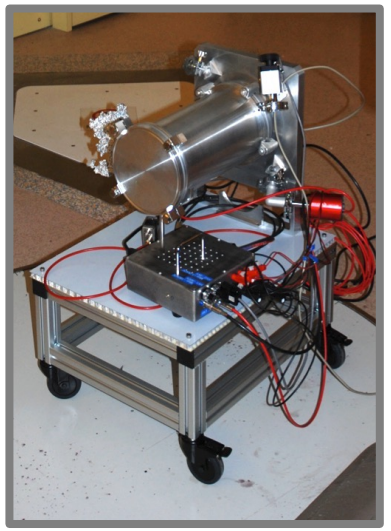
GRENOBLE | MODANE

Neutron spectrometry and active phantom mode with the instrument Mimac-FastN

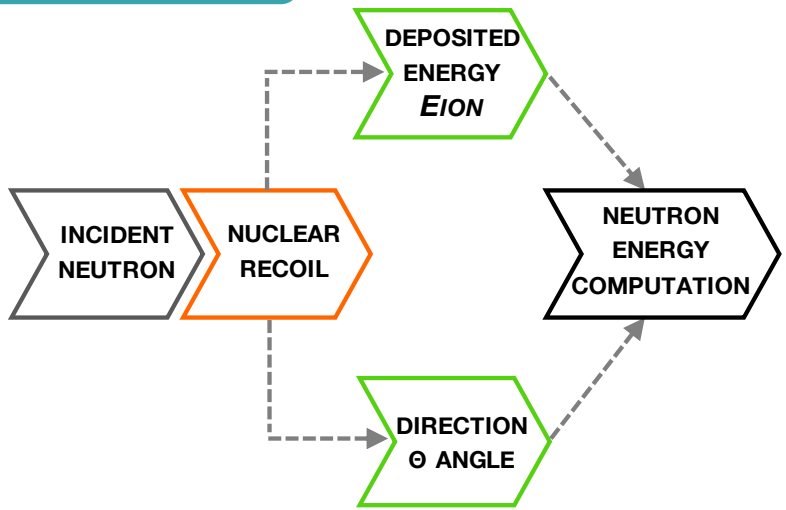
cnrs Grenoble INP | UGA

MIMAC-FASTn instrumentation

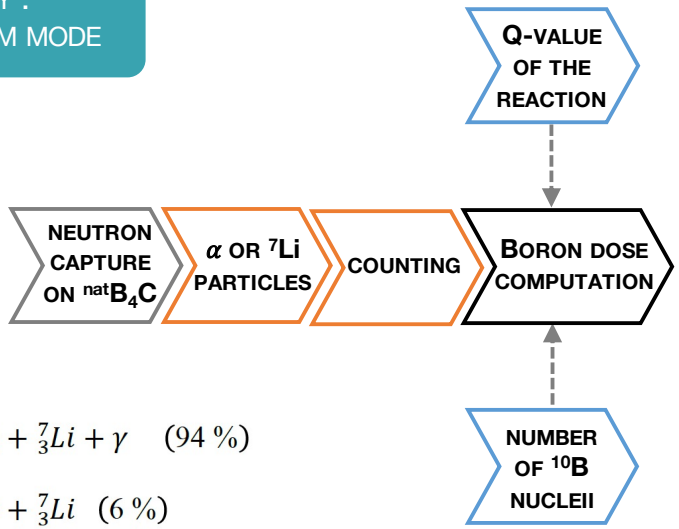




DIRECTIONAL NEUTRON SPECTROMETRY



DOSIMETRY : ACTIVE PHANTOM MODE

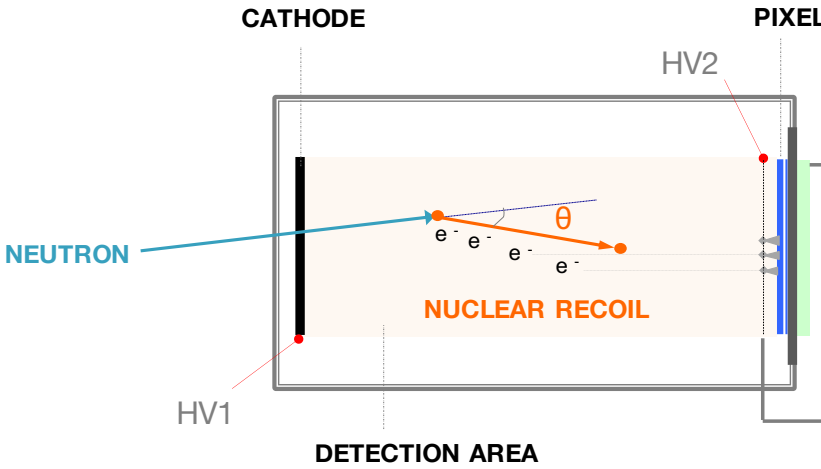


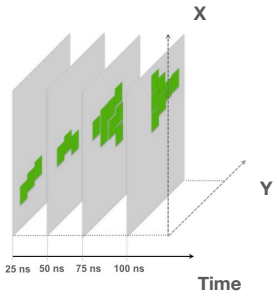
$$n + {}^{10}_{5}B \rightarrow {}^{4}_{2}He + {}^{7}_{3}Li + \gamma \quad (94\,\%)$$

$$n + {}^{10}_{5}B \rightarrow {}^{4}_{2}He + {}^{7}_{3}Li \quad (6\,\%)$$

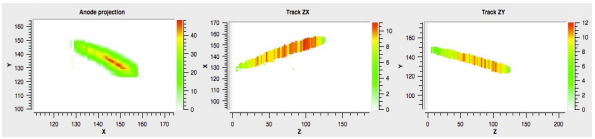
MIMAC-FASTn operating principle

3D DETECTION

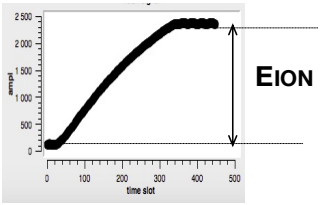




3D TRACK OF THE NUCLEAR RECOIL :



ENERGY DEPOSITED IN IONIZATION :



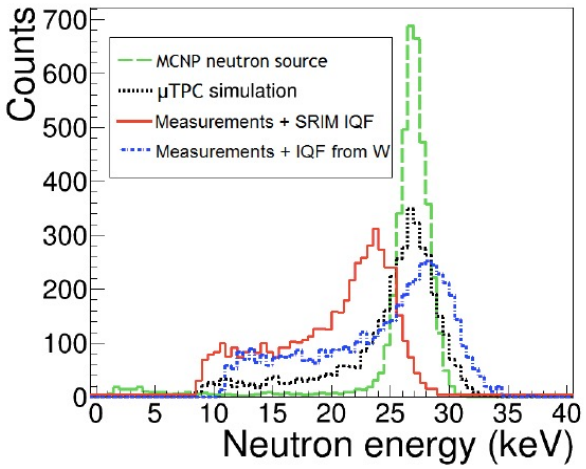
$$E_n = \frac{(1 + m_R)^2}{4m_R} \times \frac{E_R}{cos^2(\theta_{RN})}$$

WITHOUT ^{3}HE OR ^{6}LI

Neutron spectrometry mode

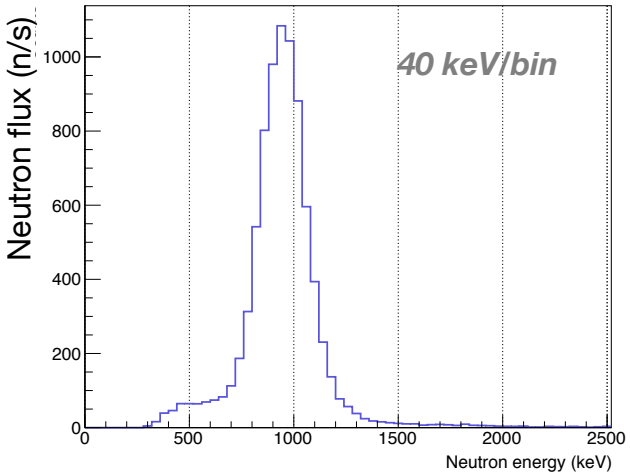
Measurements in monoenergetic neutron fields :

NEUTRON FIELD OF 27 KEV



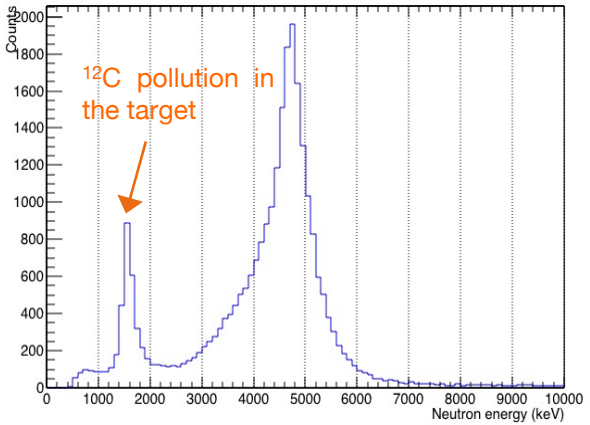
Measurement at AMANDE with the reaction $^{45}Sc(p(2.92MeV),n)$
in a mixture of C_4H_{10}/CHF_3 (50%) at 30 mbar
(IRSN/LMDN)

NEUTRON FIELD OF 949 KEV



Measurement at AMANDE with the reaction T(p(2.099MeV),n)
in a mixture of He/CO_2 (5%) at 700 mbar
(IRSN/LMDN)

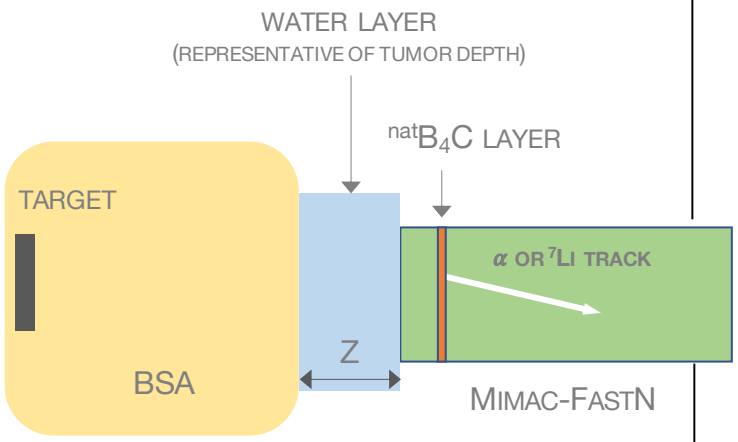
NEUTRON FIELD OF 5 MEV



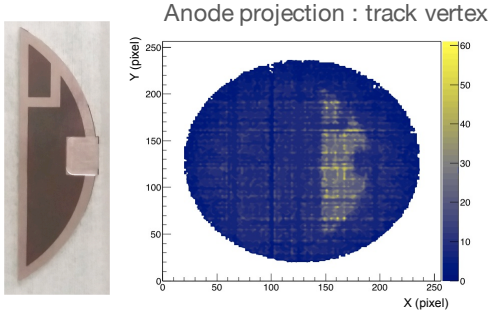
Measurement at AMANDE with the reaction D(d(1.8MeV),n)
in a mixture of He/CO_2 (5%) at 700 mbar
(IRSN/LMDN)

Active phantom mode

Principle :



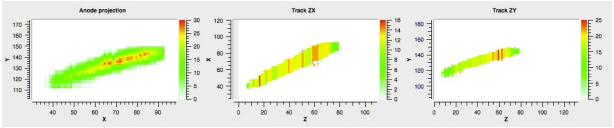
COUNTING OF α AND ^{7}LI PARTICLES → **BORON DOSE ESTIMATION = F(Z)**



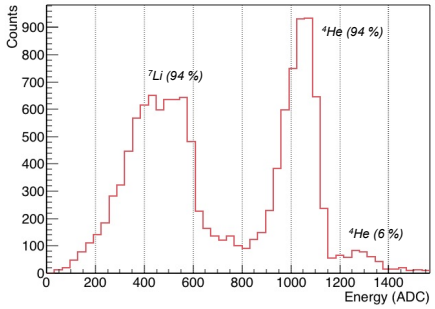
PROFILE OF THE PRIMARY CHARGE DEPOSIT ALONG THE TRACKS → **MICRODOSIMETRY**

Measurement with a He/CO_2 (5%) gas mixture :

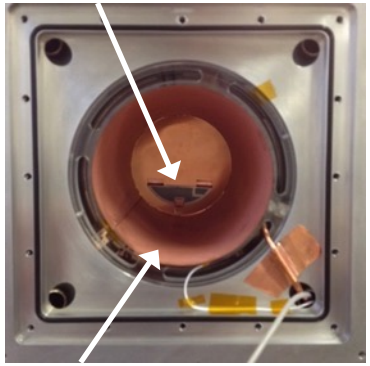
Alpha track



Ionization energy spectrum



Boron carbide coating



Field cage

Experimental set-up for measurement of thermal and epithermal neutron captures on ^{10}B

You are welcome to participate

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