Production and purification of ^{129m,131m,133m}Xe for a new medical imagine technique – gamma MRI

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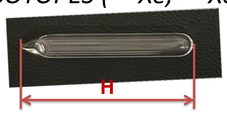
ILL PRODUCTION (^{129m,131m}Xe)

•*STABLE XENON ISOTOPES (^{128}Xe, ^{130}Xe) CLOSED IN QUARTZ:*



p_{Xe}=300mbar
H=46mm
d_{inner}=6mm, d_{outter}=8mm

•*IRADIATION OF STABLE XENON ISOTOPES(^{128}Xe, ^{130}Xe)AT ILL:*

- ❑TIME OF IRRADIATION: 7 days
- ❑NEUTRON FLUX: $1{\cdot}10^{15}$ n/s ·cm^2

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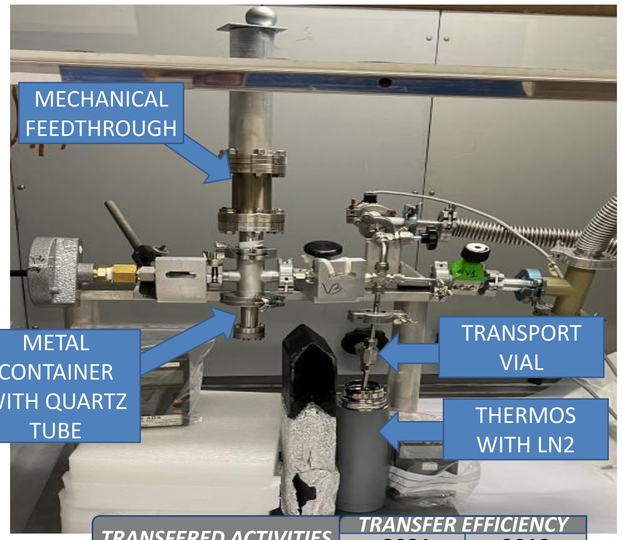
	CALCULATED ACTIVITIES	PRODUCED ACTIVITIES
^{128}Xe	^{129m}Xe: 257(3)MBq ^{125}I: 0.17(5)MBq ^{127}Xe: 0.17(4)MBq	^{129m}Xe: 250(4)MBq **(-3%)** ^{125}I: NOT DETECTABLE ^{127}Xe: 0.10(2)MBq
^{130}Xe	^{131m}Xe: 299(4)MBq ^{125}I: 0.52(7)MBq	^{131m}Xe: 271(5)MBq **(-9%)** ^{125}I: NOT DETECTABLE

+ CONTAMINATS OUTSIDE QUARTZ TUBE:
^{65}Zn, ^{126}I, ^{140}La, ^{175}Yb, ^{177}Lu, ^{181}Hf, ^{199}Au

^{129m,131m}Xe PRODUCED AT ILL

•*SETUP TO OPEN QUARTZ TUBES AND TRANSFER ^{129m}Xe AND ^{131m}Xe INTO TRANSPORT VIAL (TRANSFER PERFORMED IN MEDICIS LAB):*

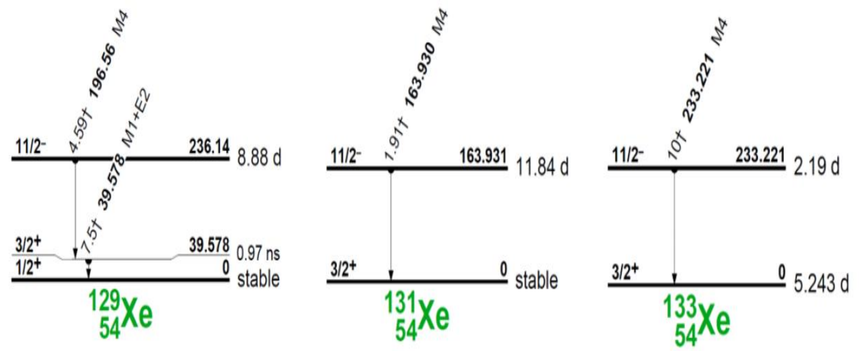


	TRANSFERED ACTIVITIES	TRANSFER EFFICIENCY 2021	TRANSFER EFFICIENCY 2019
^{129m}Xe	216(1) MBq	87%	69%
^{131m}Xe	220(2) MBq	81%	

GAMMA MRI APPROACH

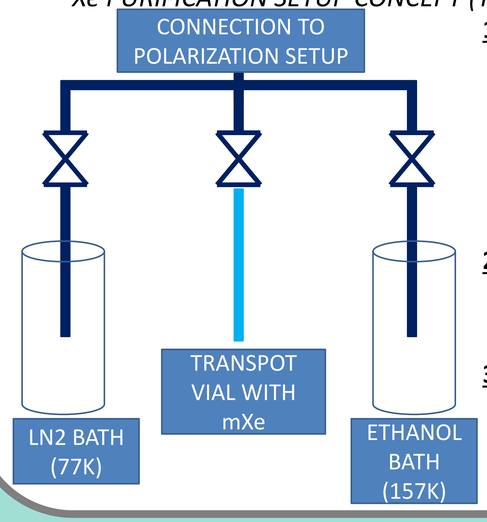
MAGNETIC RESONANCE IMAGING (MRI) + **SINGLE-PHOTON EMISSION COMPUTED TOMOGRAPHY (SPECT)**

•*HYPERPOLARIZATION - ANISOTROPIC EMISSION OF GAMMA RAY FROM HYPERPOLARIZED ISOTOPES WITH I>1/2*



PURIFICATION METHOD OF ^{m}Xe SAMPLE

•*^{m}Xe PURIFICATION SETUP CONCEPT (TO BE USED IN MID DECEMBER 2021)*



1) ETHANOL BATH (ETHANOL + LN2):
- H_2O TRAPPED – AFTER PURIFICATION: $p_{H2O}<1{\cdot}10^{-9}$bar
- CO_2 PARTIALLY TRAPPED – AFTER PURIFICATION: $p_{CO2}<2{\cdot}10^{-2}$bar

2)LN2 BATH (ETHANOL + LN2):
- mXe TRAPPED – AROUND 85% OF mXe ACTIVITY IN THE SAMPLE

3)PUMPING OUT OF RESIDUAL GASES:
- O_2 – REMOVED
- N_2 – REMOVED

*LOSS OF ≈20% OF ACTIVITY DURING PURIFICATION PROCESS

ISOLDE PRODUCTION (^{129m,131m,133m}Xe)

•*COLLECTION OF mXe IN ANNEALED Au FOIL AT GLM CHAMBER:*
- ❑ANNEALING TEMPERATURE: 600^{0}C
- ❑TIME OF ANNEALING: 20min
- ❑SQUARED COLLIMATOR (1mm x 1mm)
- ❑TARGET: UC_X (COLD PLASMA)
- ❑SAMPLE HOLDER:

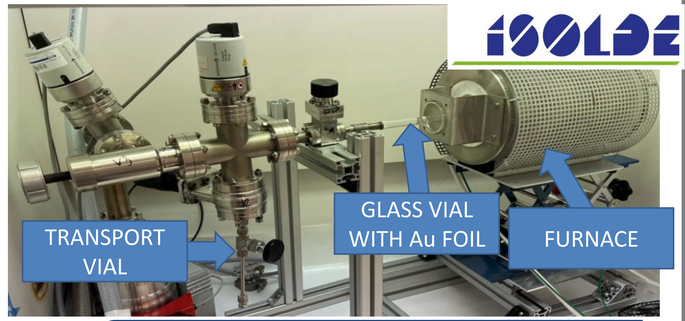
•*RESULTS OF TEST COLLECTION:*

	TEST COLLECTION (10/2021)		
	HOT TARGET WITH PROTONS	COLD TARGET NO PROTONS	HOT TARGET NO PROTONS
^{129m}Xe	2.6±0.2MBq/h	0.06(1)MBq/h	0.09(1) MBq/h
^{131m}Xe	3.4±0.3MBq/h	<0.01MBq/h	0.09(2) MBq/h
^{133m}Xe	8.0±0.3MBq/h	0.19(5) MBq/h	3.7(4) MBq/h
			PRODUCTION RATE DECREASE WITH TIME AFTER PROTON IRRADIATION

+ POSSIBLE PRODUCTION WITH AND WITHOUT PROTONS

^{129m,131m,133m}Xe PRODUCED AT ISOLDE

•*SETUP TO EXTRACT mXe FROM Au FOIL AND TRANSFER mXe INTO TRANSPORT VIAL:*



	mXe COLLECTION (11/2021) HOT TARGET, NO PROTONS		
	ACTIVITY AFTER COLLECTION	EXTRACTION EFFICIENCY	TRANSFER EFFICIENCY
^{129m}Xe	NOT PRESENT DURING COLLECTION		
^{131m}Xe	**1h HEATING IN 400^{0}C**		
	45(1)kBq	82%	87%
^{133m}Xe	**2.5h HEATING IN 400^{0}C**		
	878(8)kBq	85%	73%
^{133m}Xe	**3.75h HEATING IN 400^{0}C**		
	45(1)kBq	84%	55%

21% (2018)