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# $^{225}\text{Ac}$ -PSMA in Theranostic Prostate Cancer Therapy

Shuichi Shirtori, PhD

# The Era of Theranostics



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We **treat** what we see

We see what we **treat**



Credit : Prof. Richard Baum



# Theranostic Concept



Same ligand

## Diagnostic Purpose

SPECT : Tc-99m

PET : F-18, Ga-68

## Therapeutic Purpose

$\beta$  Emitter : Lu-177, Re-188

$\alpha$  Emitter : Ac-225



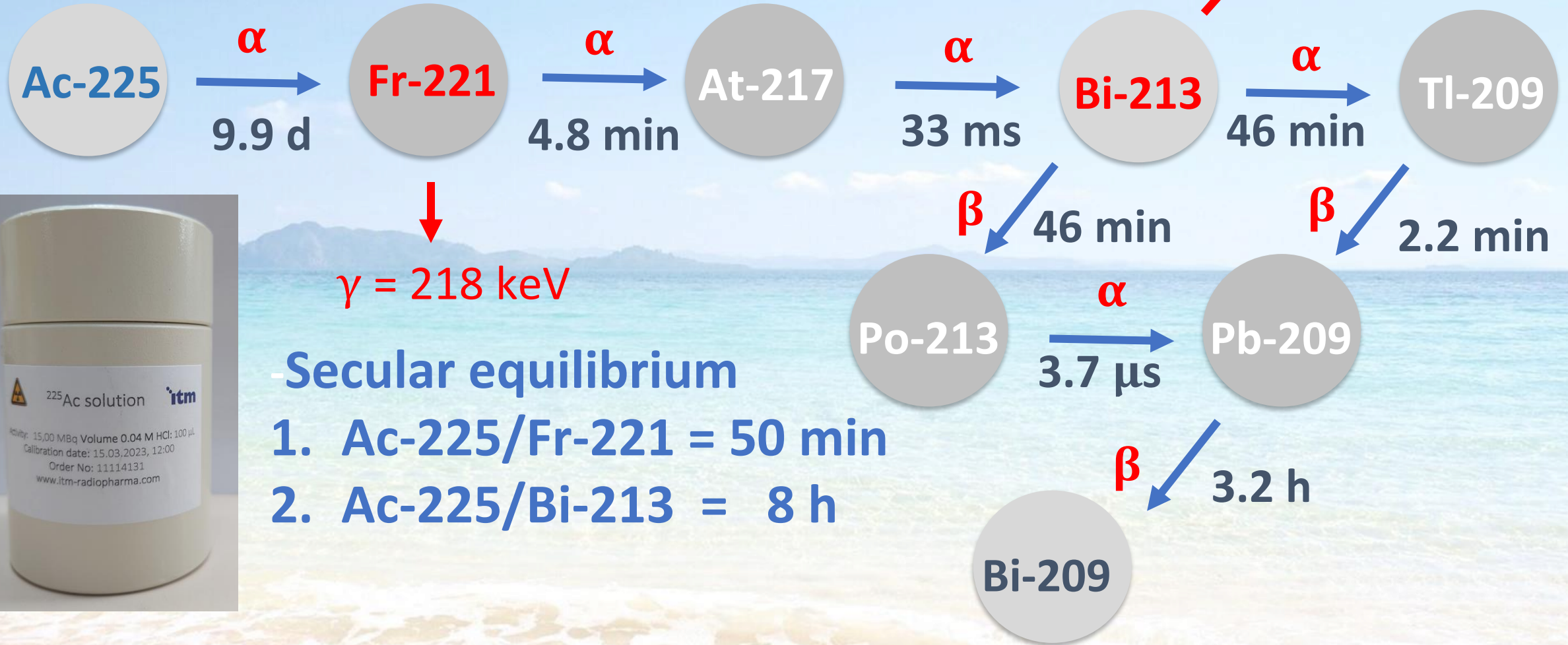
# Triplets Radionuclides

	Ga-68	Lu-177	Ac-225
Emission	$\gamma$ ray	$\beta$ ray	$\alpha$ ray
Half life	68 min	6.7 day	10 day
Production	Generator or Cyclotron	Reactor	Nuclear garbage

# Actinium-225



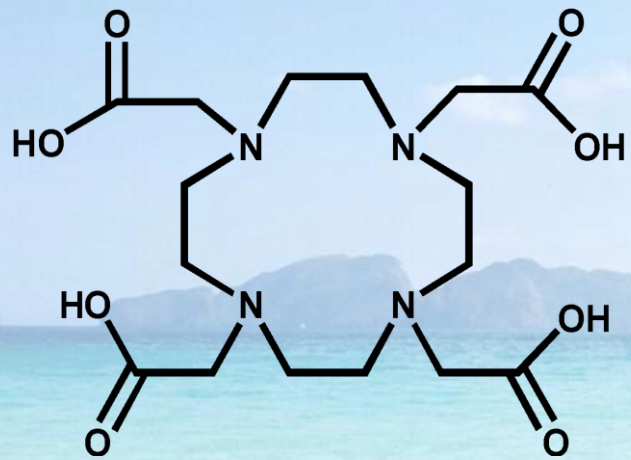
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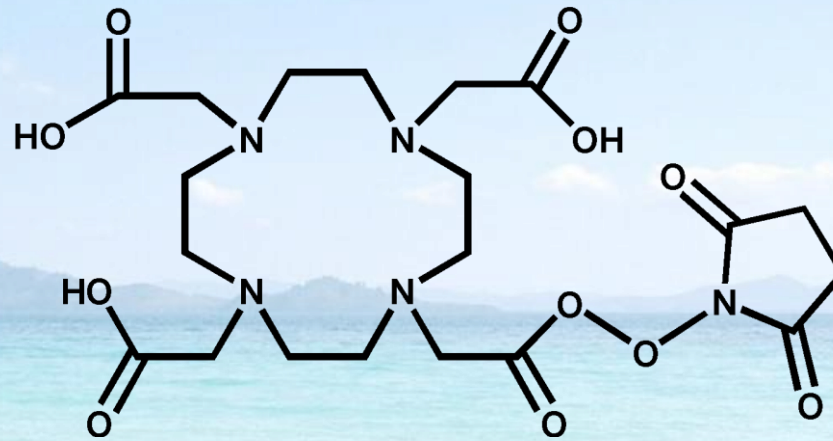
# Chelators for Labelling



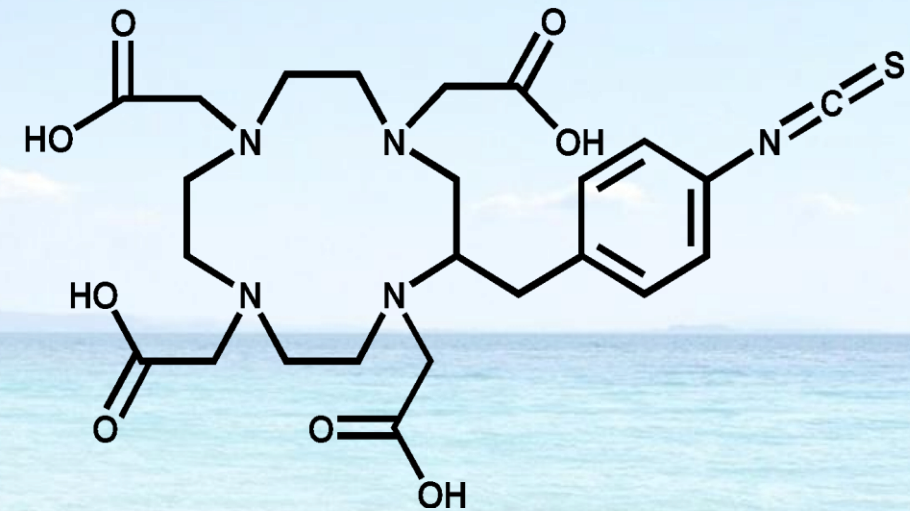
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DOTA



DOTA-NHS

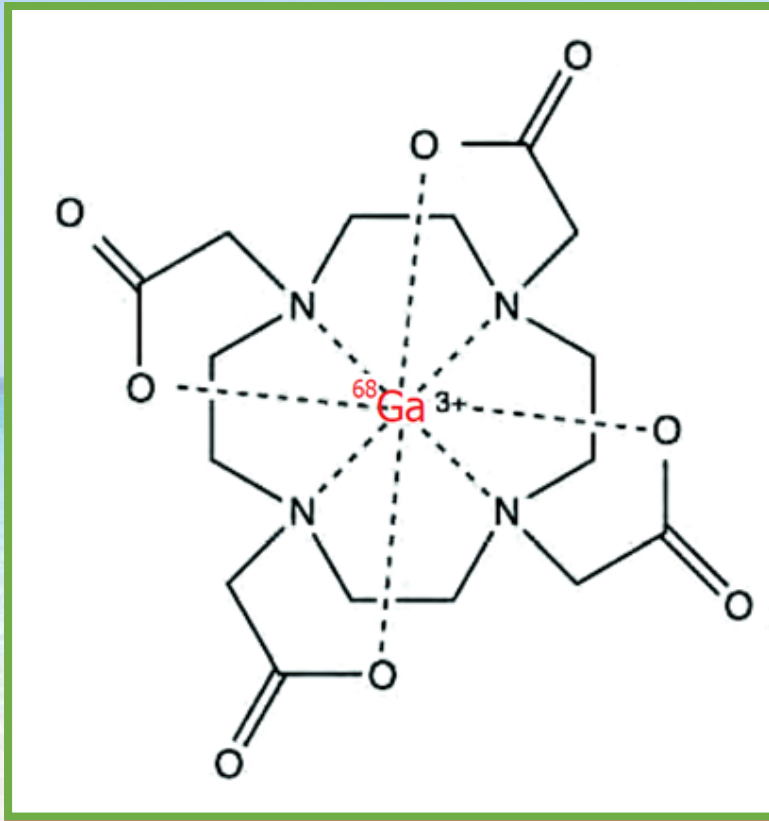


DOTA-NCS

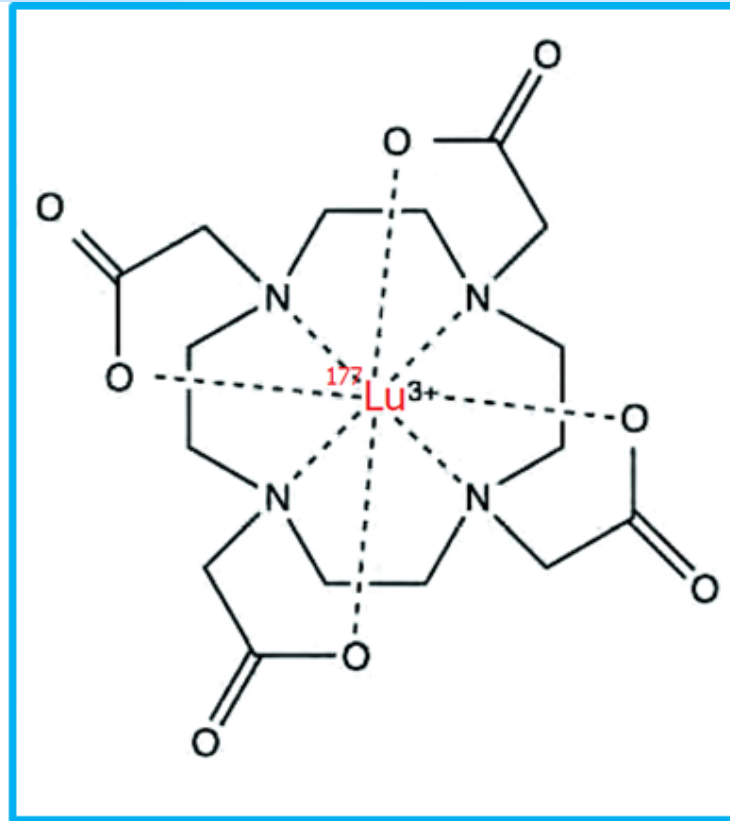
# Labelling Methodology



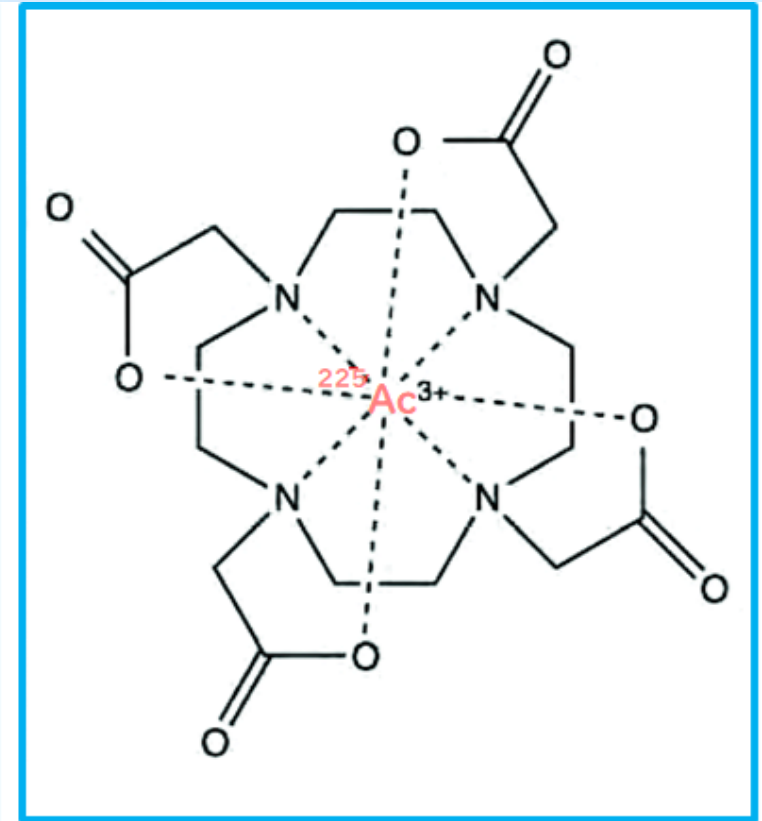
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76 pm



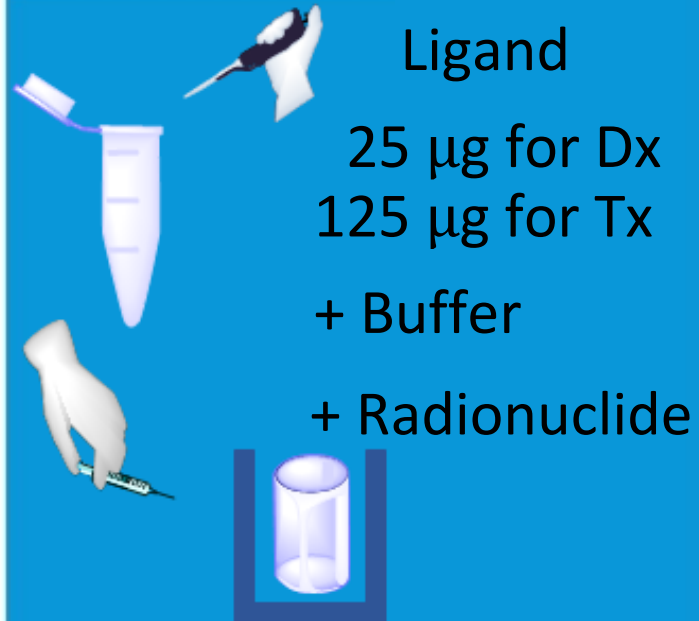
86 pm



111 pm

# Labeling Process

## Preparation



## Incubation



100  $^{\circ}\text{C}$ , 20 min  
Cool down to rt

## Formulation



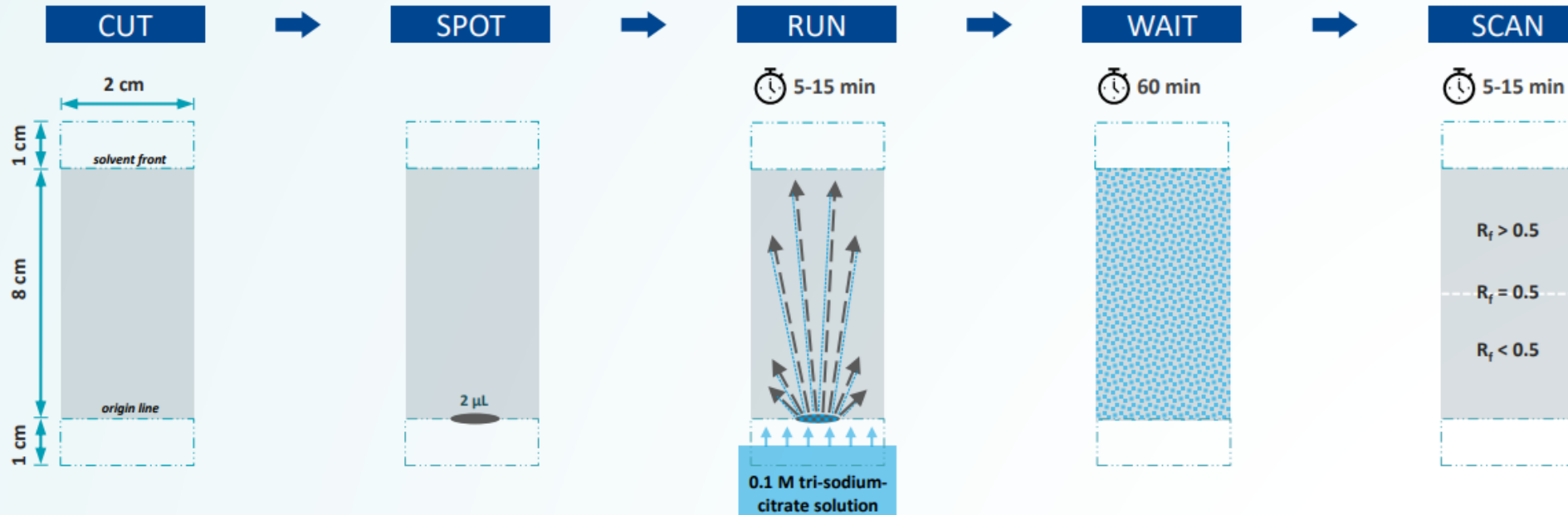
0.22  $\mu$   
filtration



Dilution to 10 ml for Dx  
Dilution to 10 or 50 ml for Tx



# Quality Control



1. Cut the plate into 2x10 cm strips.
2. Measure 1.0 cm from the bottom of the strip. Using a pencil, very gently draw a line across the strip at the 1.0 cm mark.

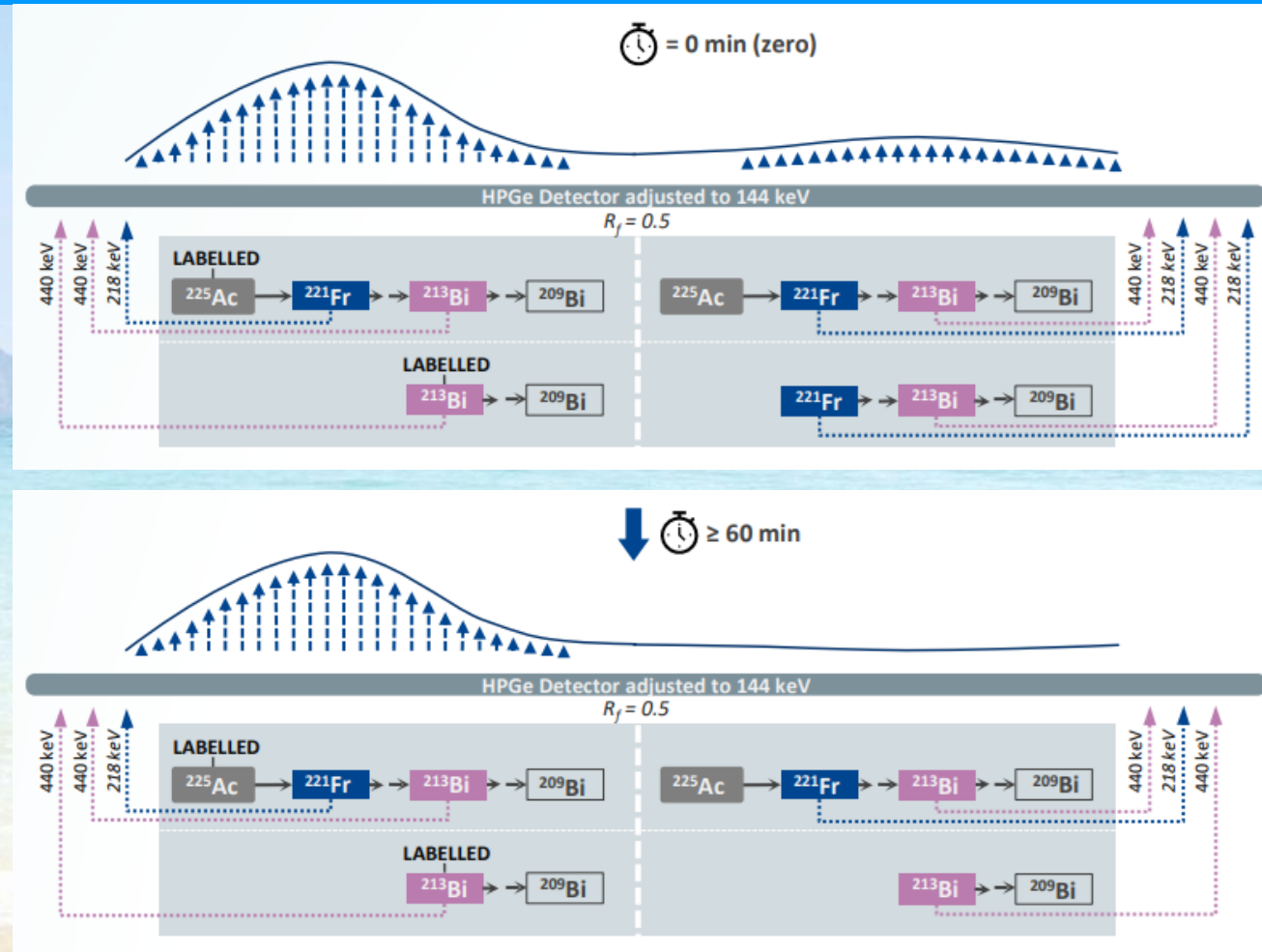
1. Spot 2  $\mu\text{L}$  of  $^{225}\text{Ac}$ -labelled solution in the middle of the drawn line on the TLC strip.

1. Place the prepared TLC strip in the beaker so that the "Mobile phase" does not spill over the drawn line then cover and leave it undisturbed.
2. Take the TLC out as soon as the run performed.

1. Allow the strip to dry horizontally for a few minutes at room temperature before analyzing it.

1. Gamma spectrometry or TLC Scanning should be performed in 1 hour since the TLC strip has been developed.

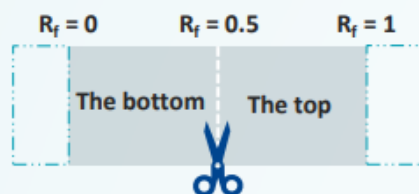
# Quality Control



# RPC calculation

## TLC Gamma Spectrometry

- 1 Cut the TLC strip at  $R_f = 0.5$  in half in the bottom and top parts.



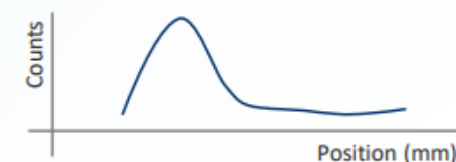
- 2 Adjust energy spectrum at 218 keV (F-221). Analyze parts separately applying the same settings and geometry for a time period long enough to have sufficient counts. Usually, 150-250 sec is enough but for the accurate result 1000-2000 s can be recommended).

- 3 Calculate the radiochemical purity according the formula:

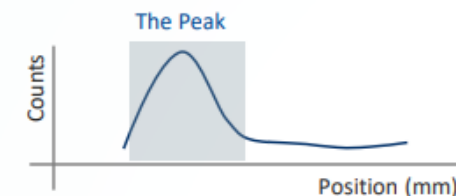
$$\text{RCP} = 100\% - \left( \frac{\text{Counts 'The Bottom'}}{\text{Counts 'The Bottom' + 'The Top'}} \right) \times 100$$

## TLC Scanning

- 1 Analyze the strip for a time period long enough to have sufficient counts.



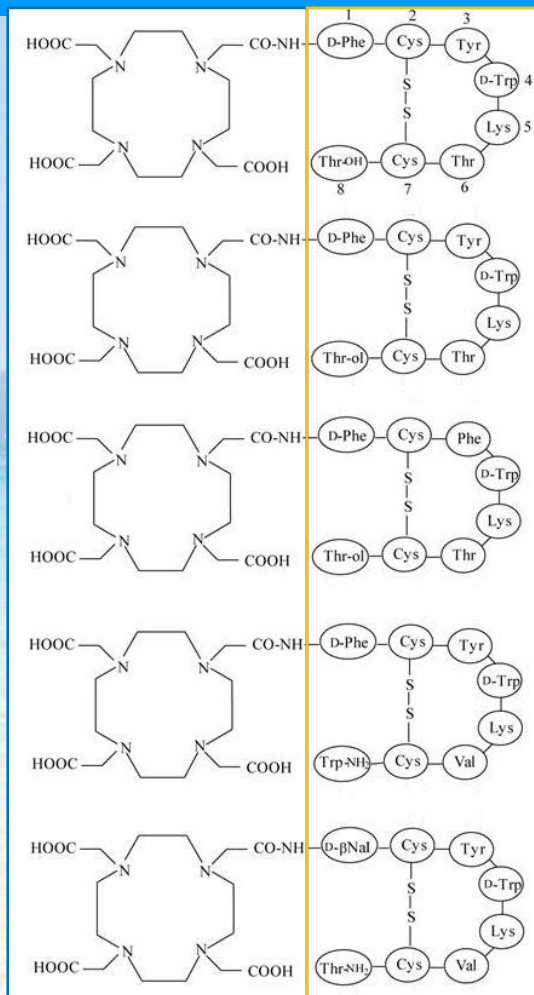
- 2 Integrate the Peak on the bottom part of TCL strip ( $R_f < 0.5$ )



- 3 Calculate the radiochemical purity according the formula:

$$\text{RCP} = 100\% - \left( \frac{\text{Counts 'The Peak'}}{\text{Total Counts}} \right) \times 100$$

# For NeuroEndocrine Tumor



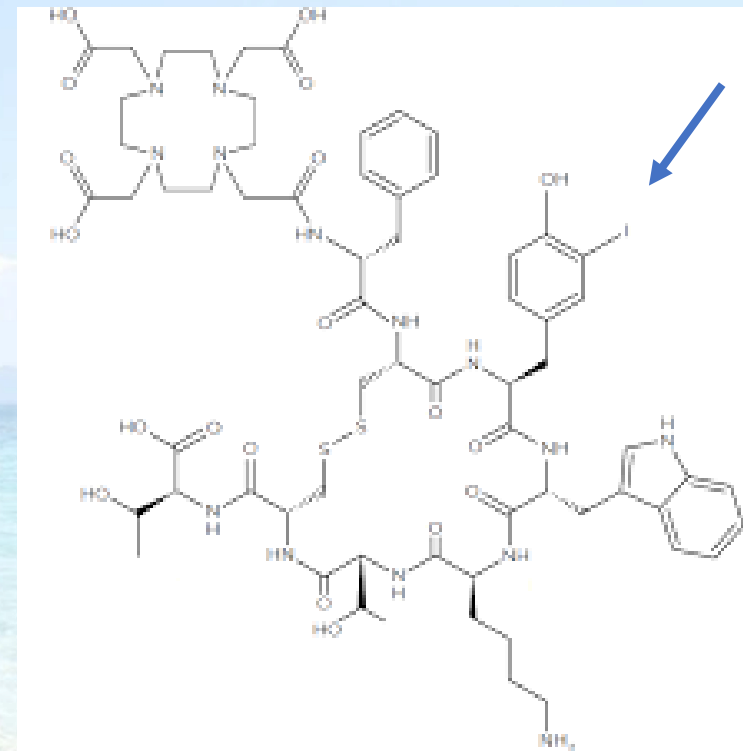
DOTATATE

DOTATOC

DOTANOC

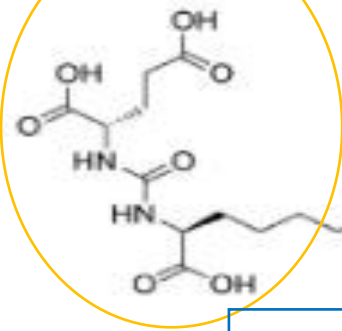
DOTAVAP

DOTALAN

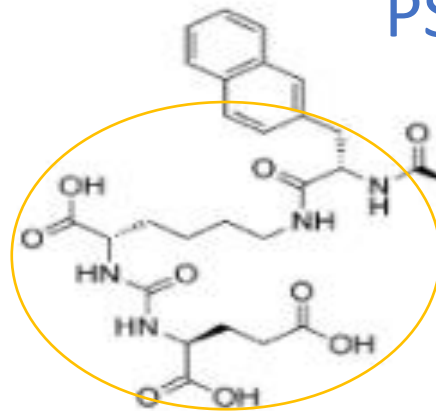


HADOTATATE

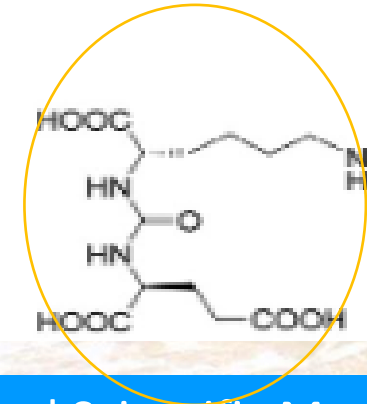
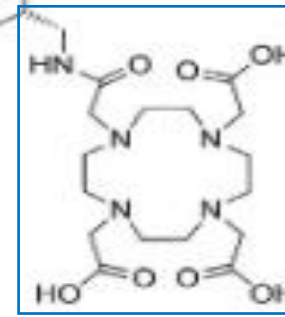
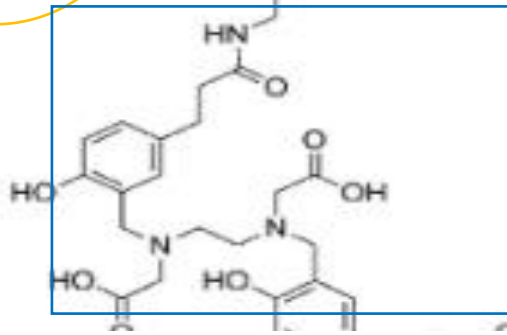
# For Prostate Cancer



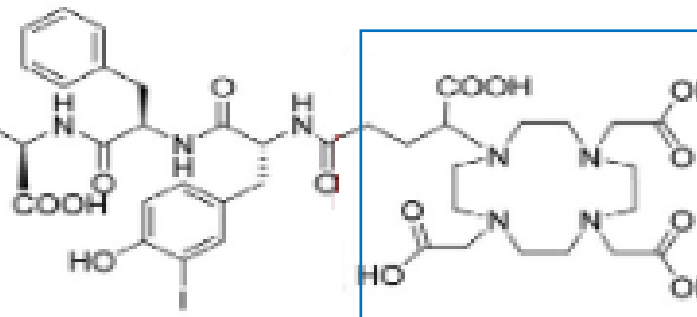
PSMA-11



PSMA-617

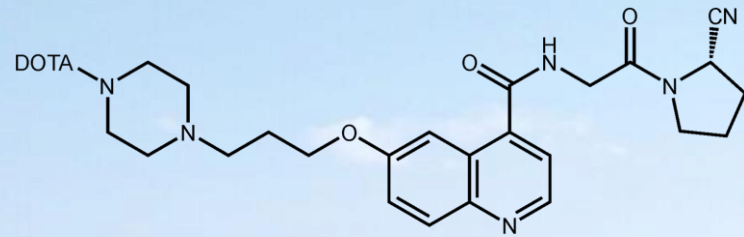


PSMA I&T

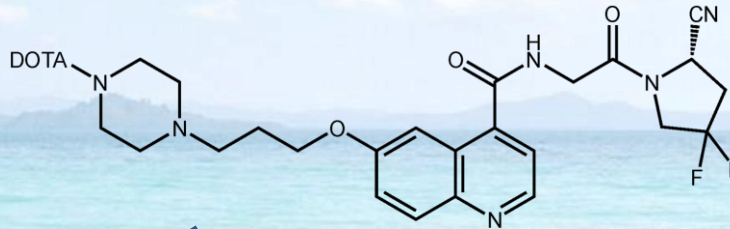




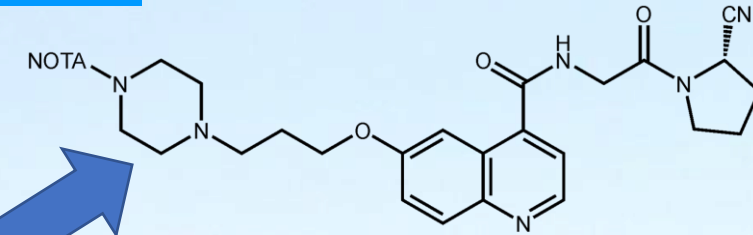
# The FAPI Series



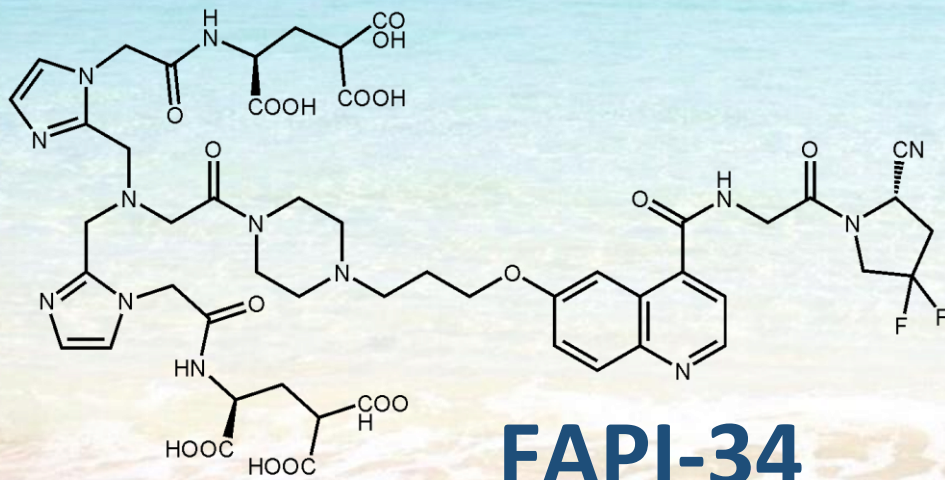
**FAPI-02**



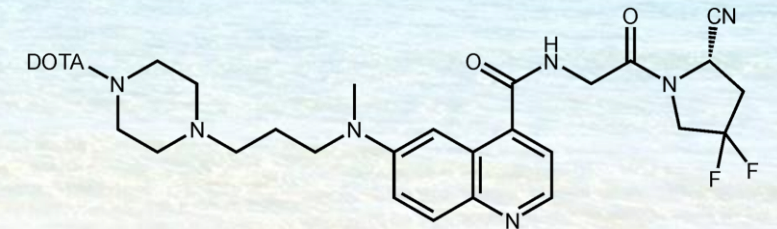
**FAPI-04**



**FAPI-74**



**FAPI-34**



**FAPI-46**

# Case in Germany 1

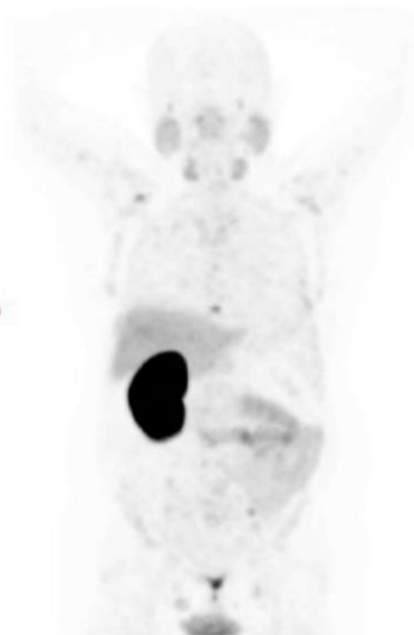


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Sep 2015

3 x  
 $^{225}\text{Ac-PSMA}$   
→



Feb 2017

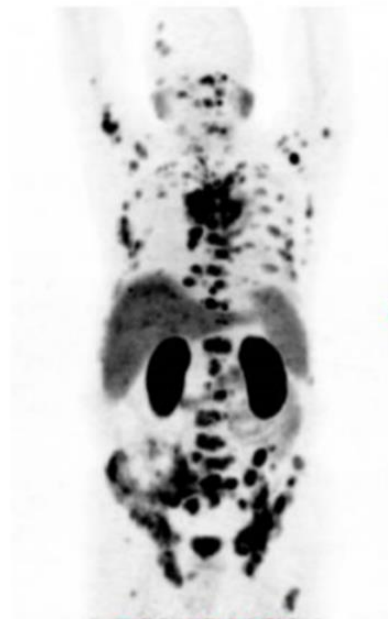


11

# Case in Germany 2



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Nov 2014  
PSA 120 ng/ml

3 x  
 $^{225}\text{Ac-PSMA}$   
→



March 2015  
0.3 ng/ml





# Case in Germany 3



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European  
Commission



July 2016

3 x  
 $^{225}\text{Ac-PSMA}$   
→



Feb 2017

Joint  
Research  
Centre



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# Thank You for Your Attention



NILMANEE T.  
Radiochemist



TOSSAPORN S.  
Radiochemist



JUREEPORN A.  
Physicist



BANTITA A.  
Radiochemist



PITIMA R.  
Radiochemist



JIRAWAT J.  
Officer

## #TEAM RADIOPHARM SIRIRAJ



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Radiopharmacist



YANEE K.  
Radiochemist



PORNPUN J.  
Physicist



LANYAWAT M.  
Radiochemist



KITSADA S.  
Engineer