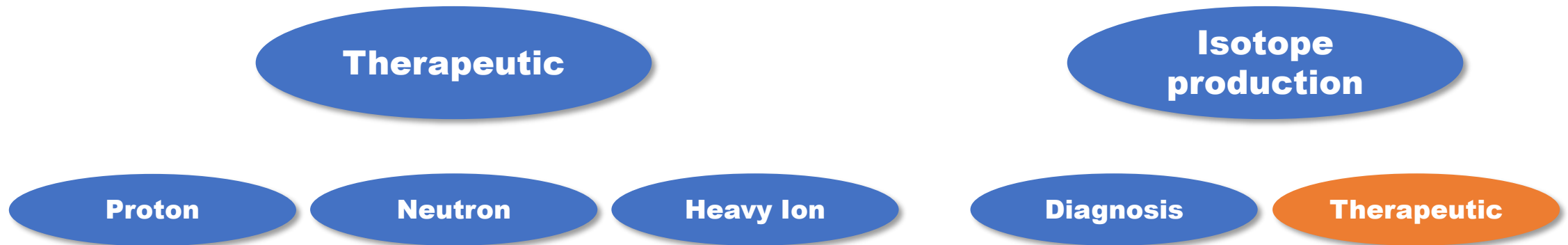


# **R&D for new MP-30 cyclotron**

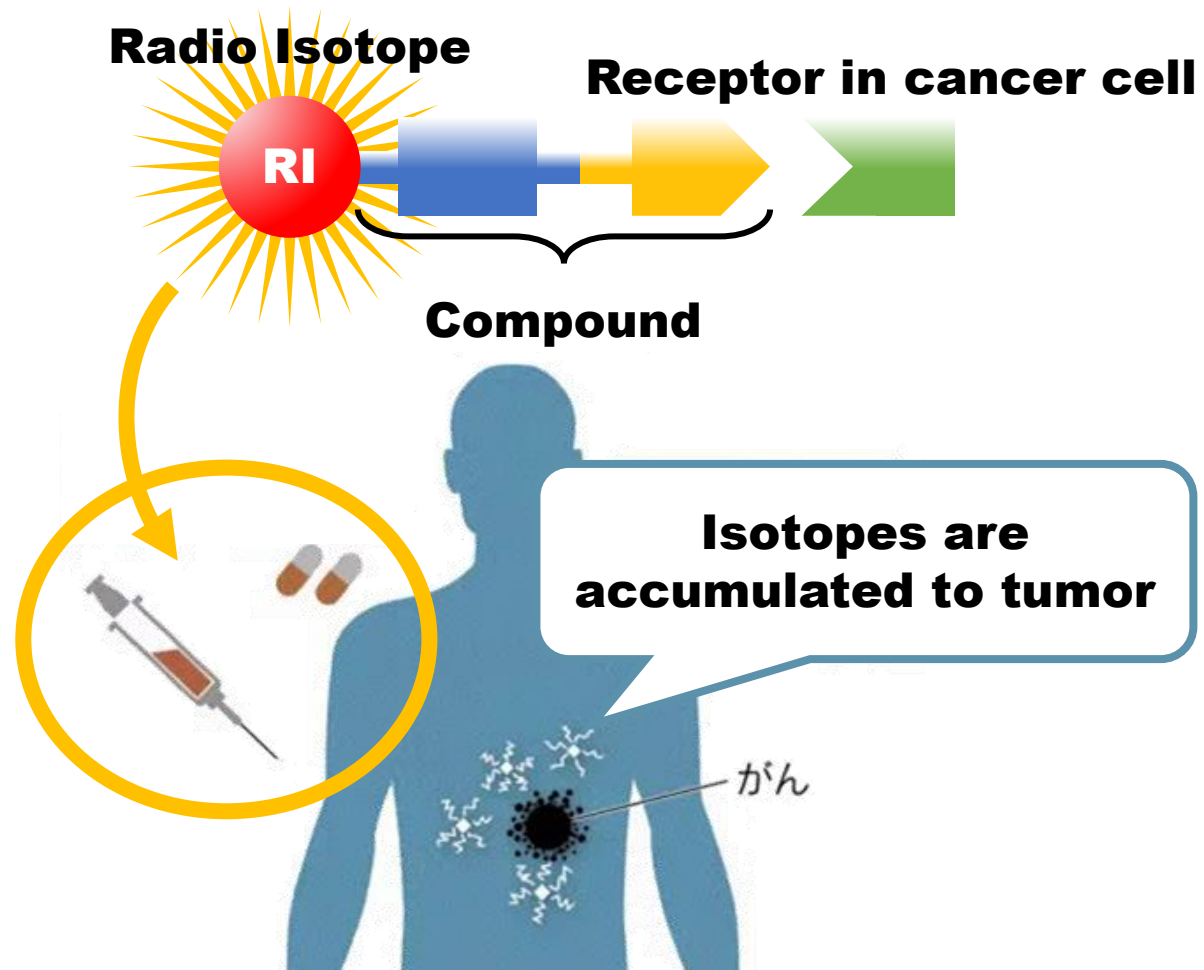
**Sumitomo Heavy Industries, Ltd.**

**Kazuya Taki**

# Our Products



# Targeted Therapy



# History of Targeted Therapy

**<sup>177</sup>Lu-DOTA-TATE**

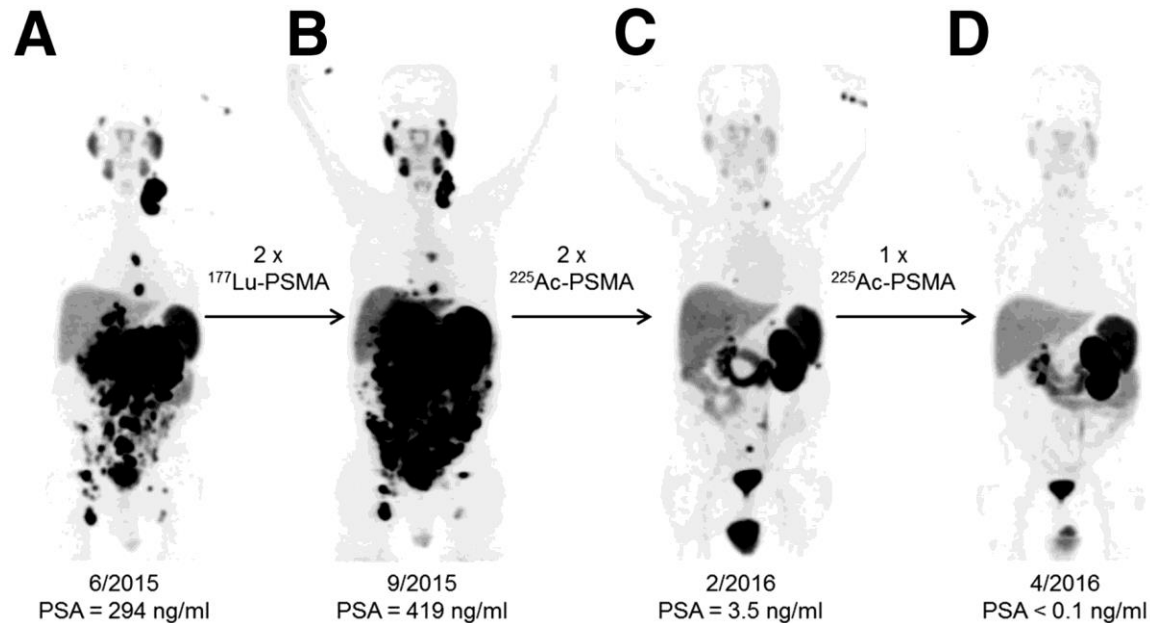
Approved in 2018.

Beta emitter

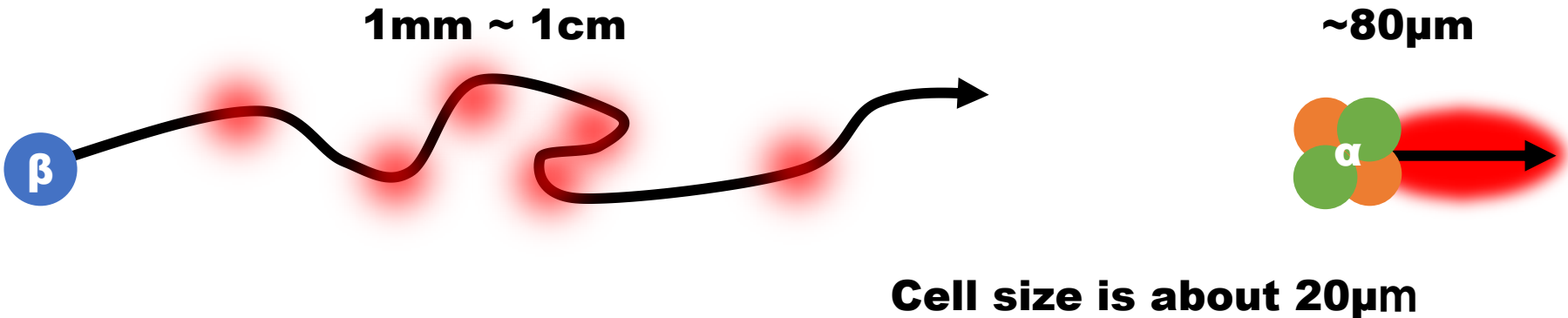
**<sup>225</sup>Ac-PSMA-617**

Clinical trial is on going.

Alpha emitter



# Beta or Alpha



	<b>Path length</b>	<b>Linear Energy Transfer (LET)</b>
<b>Beta emitter</b>	<b>Too long</b>	<b>Low</b>
<b>Alpha emitter</b>	<b>cell size</b>	<b>High</b>

# Alpha Emitter

RI	Reaction	Manufacturing
$^{225}\text{Ac}$	Decay of $^{225}\text{Ra}$ . $^{225}\text{Ra}$ is generated by neutron irradiation to $^{226}\text{Ra}$ .	Reactor
	Proton irradiation to $^{226}\text{Ra}$ .	Accelerator < 25MeV
$^{211}\text{At}$	Alpha irradiation to $^{209}\text{Bi}$ .	Accelerator 30MeV
$^{149}\text{Tb}$	Proton irradiation to $^{152}\text{Gd}$ .	Accelerator >50MeV
$^{230}\text{U}$	Proton irradiation to $^{232}\text{Th}$ .	Accelerator <70MeV

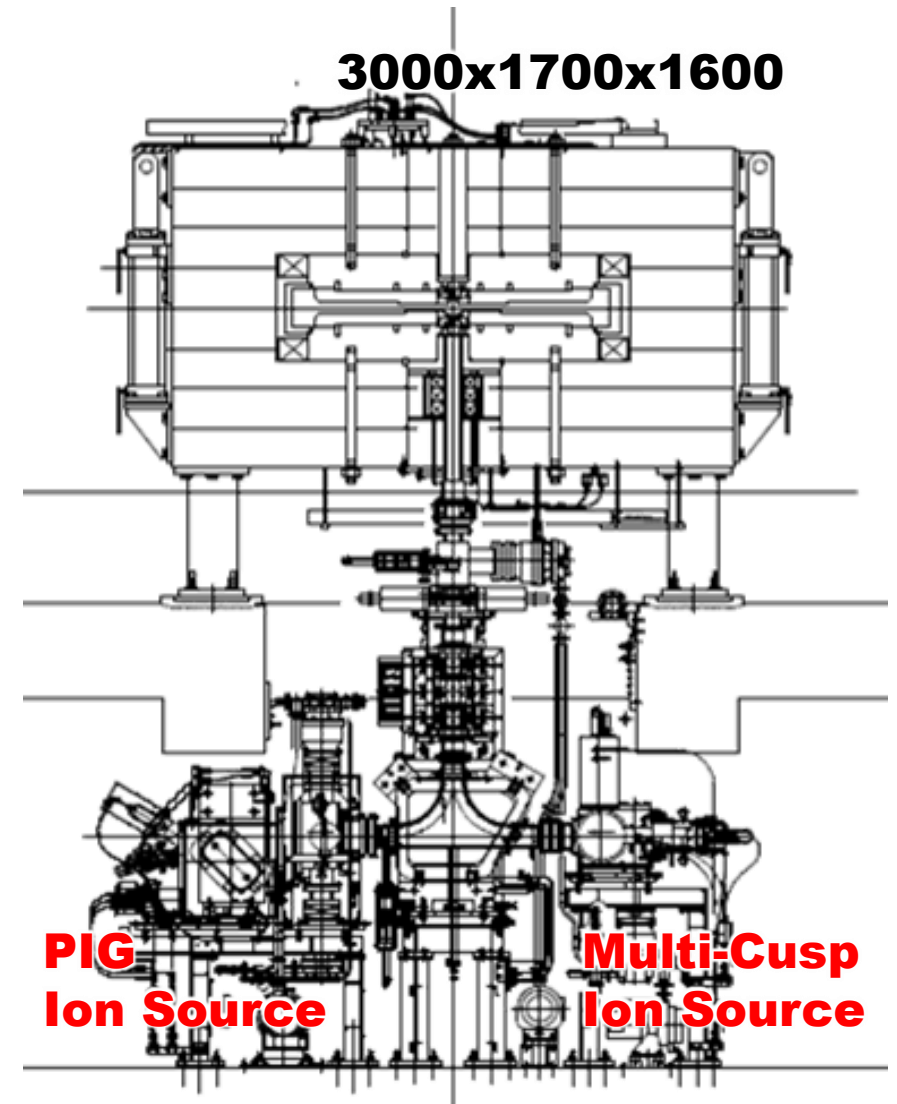
**$^{225}\text{Ac}$  disadvantage about accessibility and handing to  $^{226}\text{Ra}$ .**

# MP-30

	Proton	deuteron	Alpha
Energy	15 to 30MeV	8 to 15MeV	30MeV
$f_{RF}$	73.7MHz	37.7MHz	37.7MHz
$V_{dee}$	50kV	27.5kV	27.5kV
Harmonic #	4	4	4
Current	400 $\mu$ A	200 $\mu$ A	30 $\mu$ A



Installed at Fukushima Medical University in 2016.



# Beam Orbit Design

- 1. Design of the isochronous magnetic field**
  - Optimization of pole shape
- 2. Design of an injection into the cyclotron**
  - Inflector voltage and initial energy
  - Buncher voltage and position
  - Condition of the injection beam
  - Improvement of center region
- 3. Design of LEBT**
  - Optimization from the ion source to the injection matching point
- 4. Design of extraction orbit**
  - Adjustment of B1 by EH-coil
  - Position of a deflector and a magnetic channel

