

211Atに関する取り組み、 社会実装に向けた今後の展開と課題

第10回原子力委員会定例会議

住友重機械工業株式会社
インダストリアルマシナリーセグメント
メディカル&カンタムソリューションズSBU

設計部 RI設計グループ

樋口 博紀

2026年3月10日

History of Accelerator Business

Approx. 50 years business history



1972
Cyclotron for
Research
(Osaka Univ.)



1981
PET Cyclotron
(Kyoto Univ.)



1988
Injector for
Carbon Therapy
(NIRS)



1997
**Proton Therapy
System**
(National
Cancer Center)



2009
BNCT System
(Kyoto Univ.)



2015
**Cyclotron for
Radionuclide Therapy**
(Fukushima Medical
Univ.)

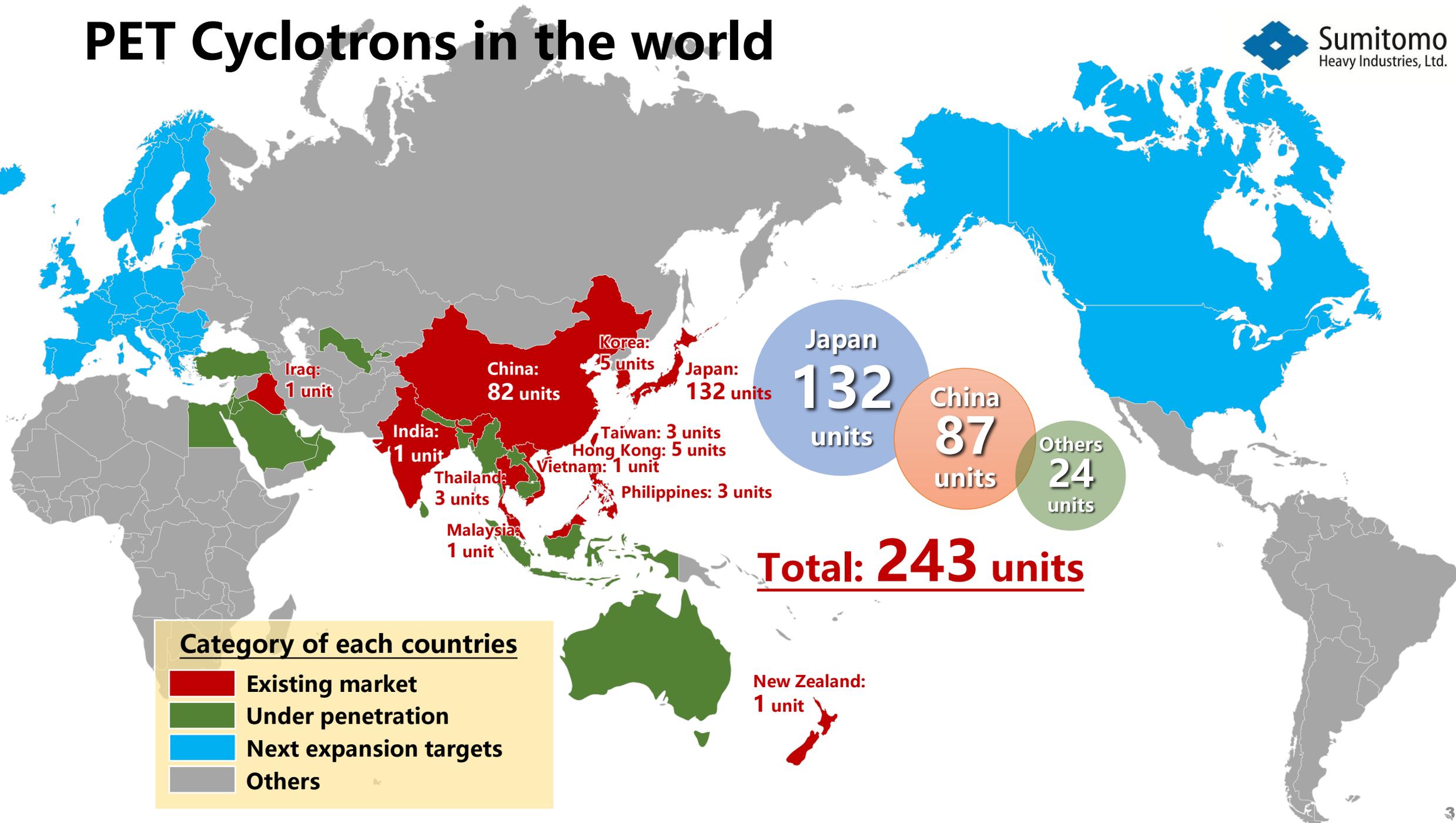


2020
World's First Medical
Device Approval for
BNCT System in Japan

Accelerator Business

Medical Business

PET Cyclotrons in the world

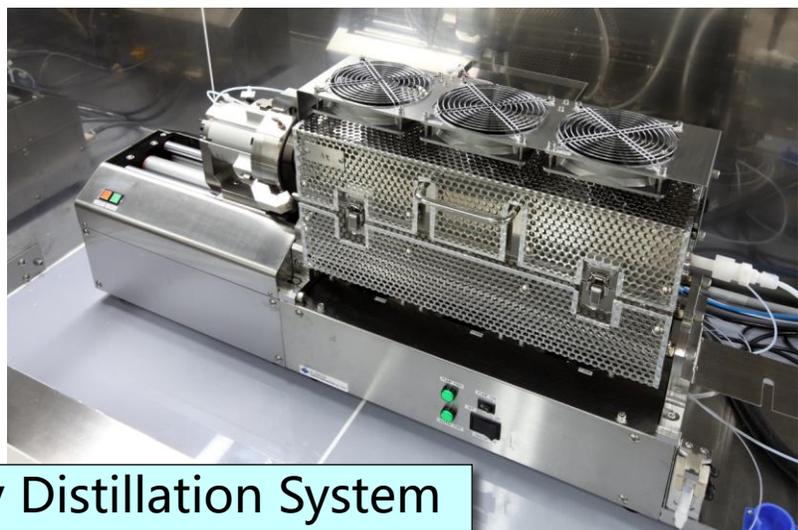
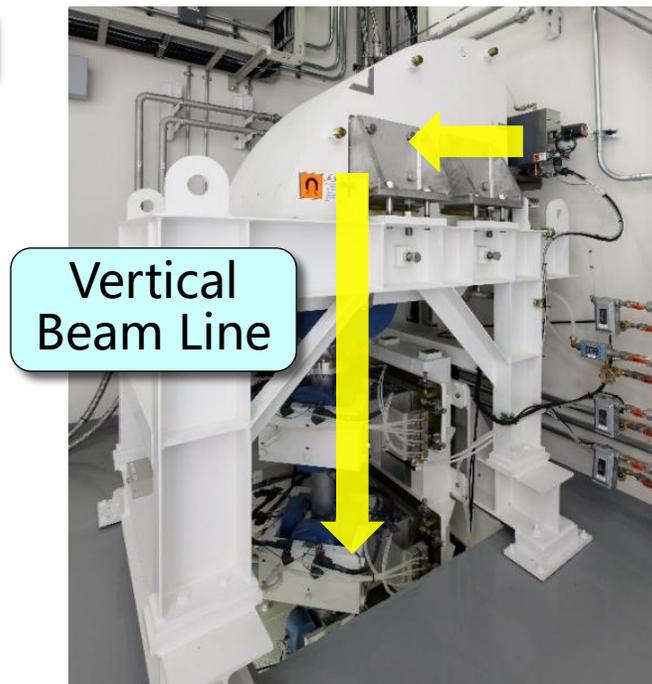
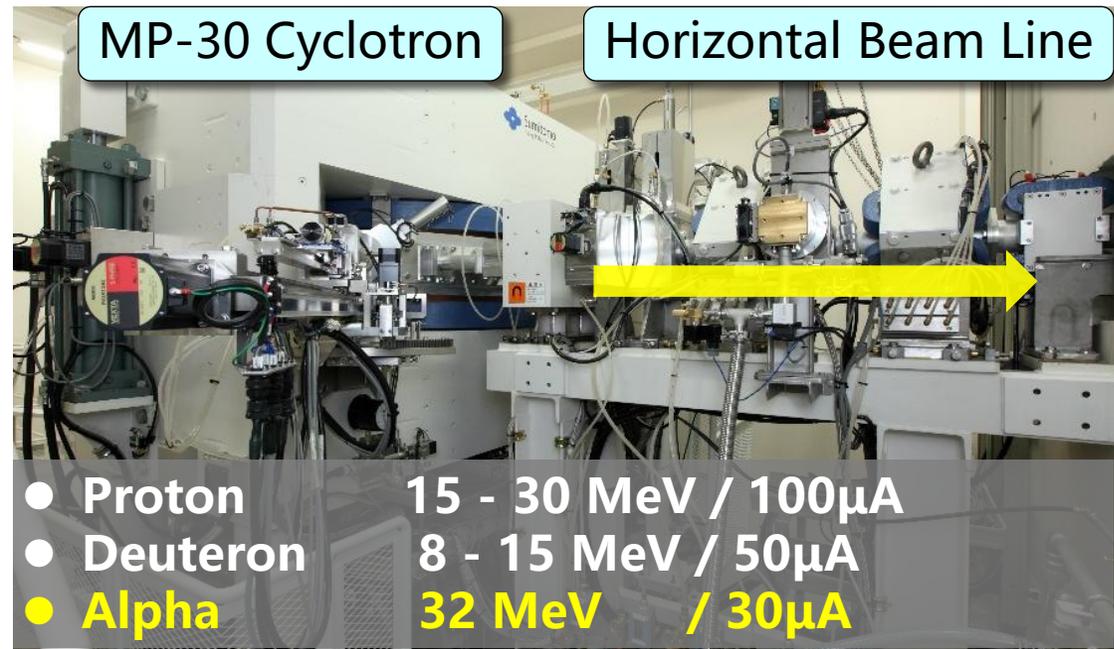


Category of each countries

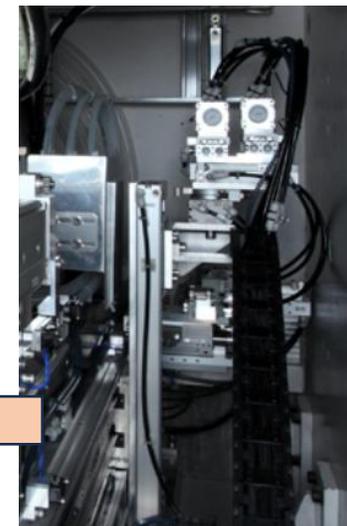
- Existing market
- Under penetration
- Next expansion targets
- Others

Total: 243 units

30 MeV Cyclotron Facility at Fukushima Medical Univ.



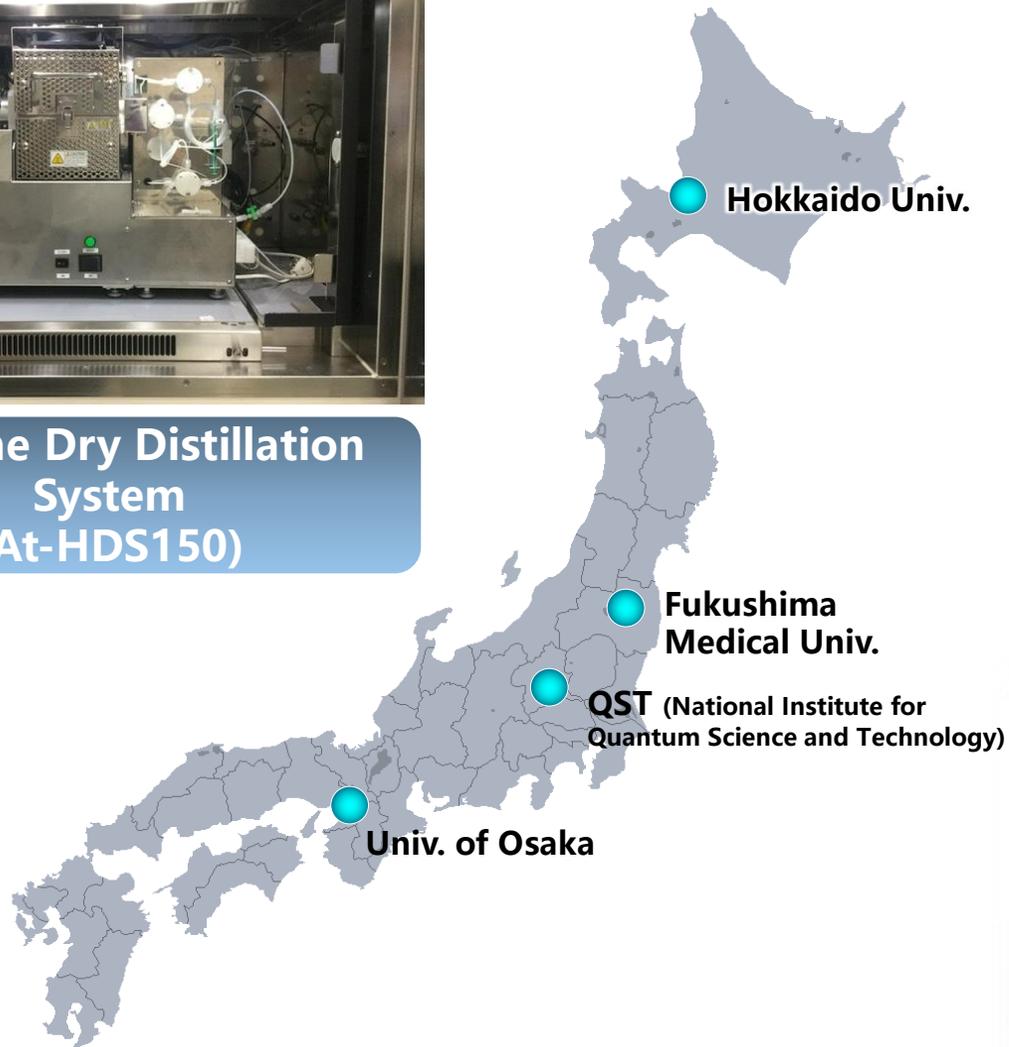
Automatic transportation of solid target to a hot lab room



Development of Purification and Synthesis Modules Sumitomo Heavy Industries, Ltd.



Astatine Dry Distillation System (At-HDS150)



Purification: Dry, Wet

Synthesis: 4 At-labeled Compounds



Multi Purpose Synthesizer (CFN-MPS200)



Multi Purpose Synthesizer (SmartPharm™)

*Portions of the system were developed with support from the Corporate Technology Management Group as part of the Frontier Development Project.

The Action Plan for Promotion of Production and Utilization of Medical Radioisotopes (Outline)

31st May, 2022 Atomic Energy Commission, Japan

Background

Expectations for Radioisotope Therapy

- Increased focus on “*theranostics*” (therapy + diagnosis)

Movements and Problems in Japan

- *Restart of research reactors* that can produce large amounts of radioisotopes (JRR-3, “Joyo”) On the other hand, insufficient number of
 - *Hospital beds* for radioisotope therapy
 - *Human resources* who promote production and utilization of radioisotopes

International Situation

- *Vast investment* for radioisotope production and R&D
- Forming network of research reactors and accelerators
- Accelerated *competition for acquisition* of radioisotopes and their raw materials

Developing the Action Plan that aims to provide domestic radioisotopes to patients

The Action Plan contributes to

- Improvement of people’s welfare by enhancing the medical system through cutting-edge nuclear science and technology
- Ensuring economic security in terms of medical services

Goals to be Achieved during next decade

- ① Establishment of a Stable Radioisotope Diagnostic System through *partial domestic production of Mo-99/Tc-99m*
- ② Implementation of *Radioisotope Treatment Using Domestic Radioisotopes*
- ③ *Dissemination of Radioisotope Treatment* in Medical Setting
- ④ Making Radioisotope-Related Fields, centered on Medicine, as a “*Strength*” of Japan

Contents of the Action Plan

(1) Promoting Initiatives for Domestic Production and Stable Supply of “Important Radioisotopes”

- Stable supply of *Mo-99/Tc-99m* using JRR-3 and accelerators (Manufacturing approximately *30% of domestic demand* by the end of FY2027 as far as possible, and supply to domestic)
- Strengthening R&D for mass production of *Ac-225* using “*Joyo*” and accelerators (Production demonstration by FY2026 with “*Joyo*”)
- Strengthening efforts to commercialize *At-211* (Indicating usefulness as a pharmaceutical product by FY2028)

(2) Establishment of systems and structure to promote utilization of radioisotopes in medical setting

- Establishment of hospital rooms for radioisotope treatment (Average number of months to wait for radioisotope treatment: *3.8m (2018) ->2m (2030)*)
- Preparation for commercialization of new radiopharmaceuticals (Th-227, Ga-68)

(3) Promoting R&D Contributing to Domestic Production of Radioisotopes

- Technical development support for production by research reactors and accelerators
- Promotion of initiatives by the Fukushima International Research and Education Organization
- Establishment of systems of non-clinical studies of radiopharmaceuticals

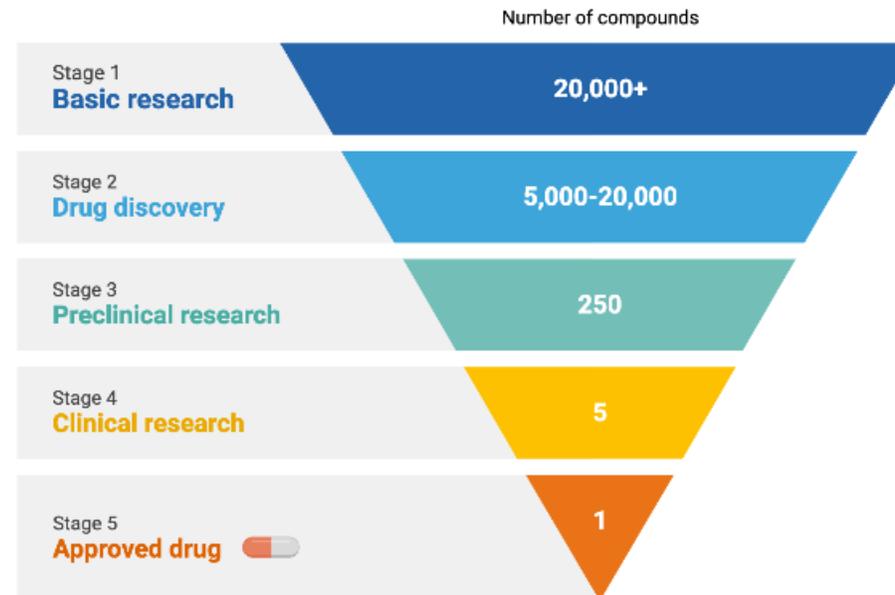
(4) Strengthening Research Infrastructures, Human Resources, and Networks for Production and Utilization of Radioisotopes

- Strengthening Human Resources in the Field of R&D and Medical Setting
- Strengthening the Supply Chain in line with Domestic Production
- Study of Mechanisms for Waste Treatment and Disposal

Our Mission

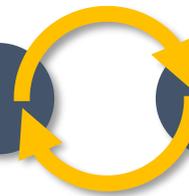
Drug discovery is a narrow funnel. **²¹¹At shortage narrows this funnel even further.**

Drug Discovery & Development Funnel



<https://www.biorender.com/template/drug-discovery-development-funnel>

²¹¹At Availability

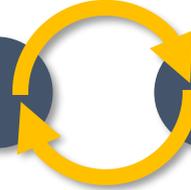


Speed of Drug Discovery

Sumitomo will excel drug discovery by providing a reliable ²¹¹At supply.

Barriers to Own a Cyclotron

^{211}At Availability



Speed of Drug Discovery

There are several issues that must be solved to own a cyclotron.

- ✓ **A huge budget is required for buildings, cyclotrons, etc.**
- ✓ **Running costs are also quite high.**
- ✓ **Cyclotrons require specialized knowledge for maintenance and operation.**

If ^{211}At can be purchased stably, these problems will be solved. 💡 💡 💡



Sumitomo
Heavy Industries, Ltd.

Not necessary the case

~~Cyclotron~~

^{211}At

At-211 Users

Sumitomo will be an ^{211}At Supplier

We are planning to start the ^{211}At supply business at The University of Osaka in 2027.

Sumitomo will own and operates new MP-30X.



 Sumitomo
Heavy Industries, Ltd.

1st New MP-30X

$[^{211}\text{At}]\text{NaAt}$, $[^{211}\text{At}]\text{At-PSMA}$, and more



Clinical Trial



Research Center of Nuclear Physics(RCNP)
TAT Cyclotron Building

^{211}At



We will realize the supply of ^{211}At from here and expand it to the world.

Our Silver Bullet – The **New** MP-30X

MP-30 Current Model

Operation started at Fukushima Medical University in 2016.

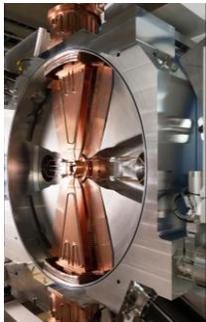
Maximum He²⁺ beam current is 30 eμA.

2 hours irradiation produces about 1.2 GBq with 20 eμA.



Development of the **New MP-30X** started in 2023

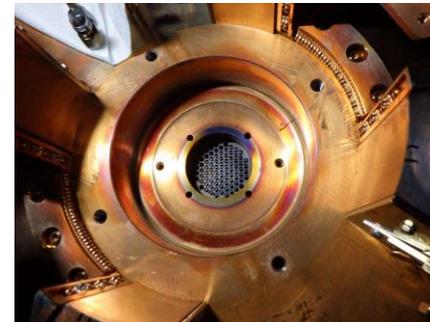
The goal for the cyclotron is **200 eμA**. Gathering all the technologies we have built up over the years.



Cyclotron Technology



**Ion Source Technology
for Heavy Ion Therapy**



**Injection Technology
for Boron Neutron Capture Therapy**

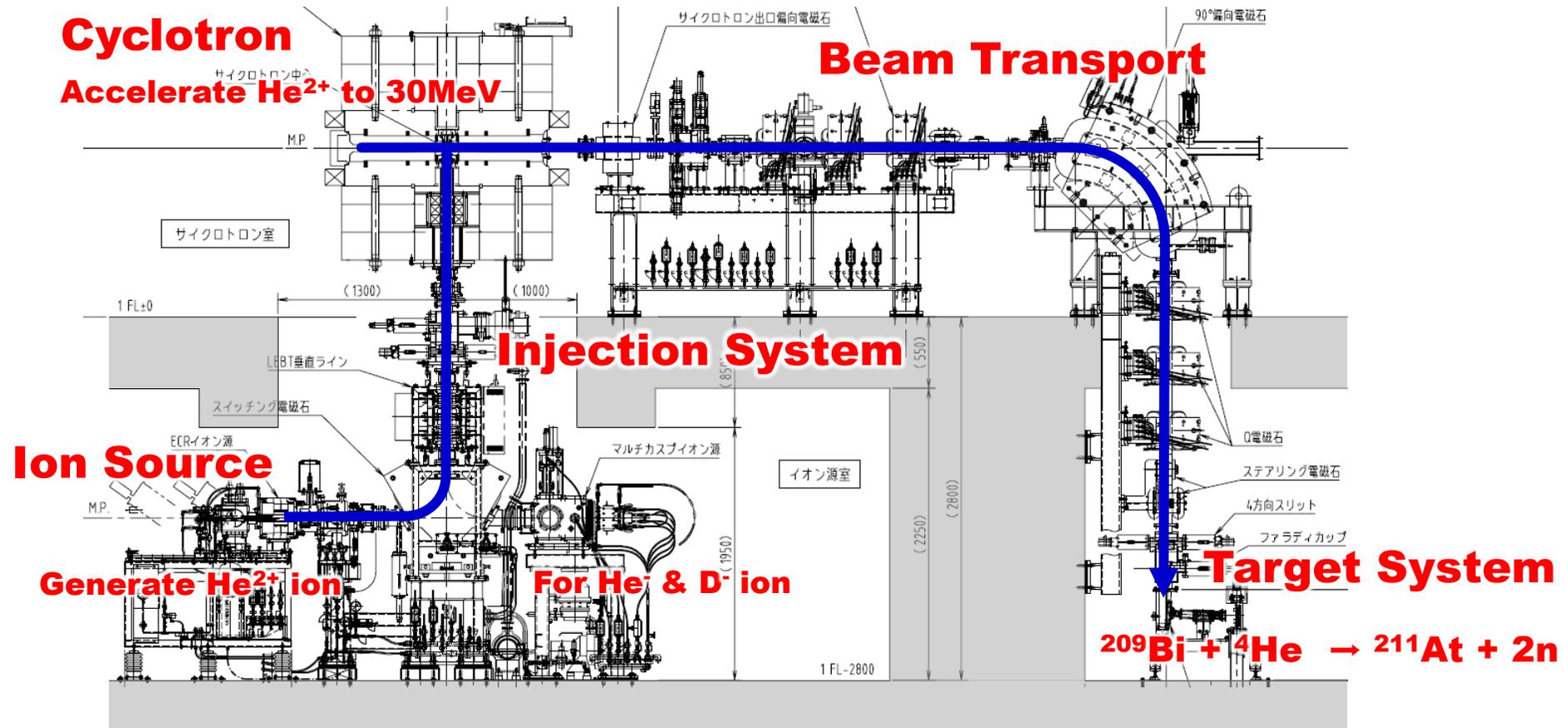


Target Technology

Development will be completed in 2026.

The MP-30X

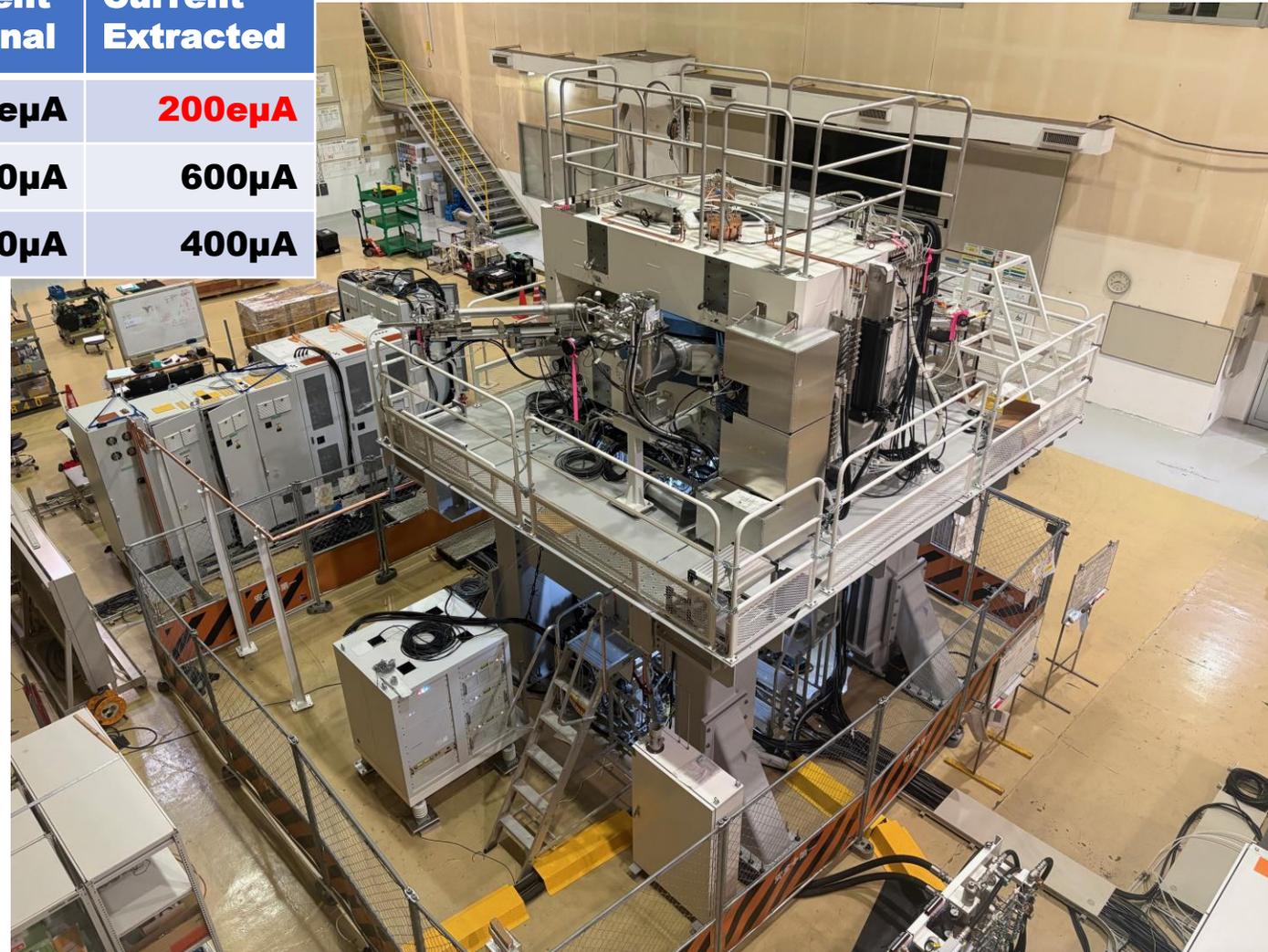
He ²⁺ (Alpha)	Proton	Deuteron
30 MeV	15 to 30 MeV	8 to 15 MeV
200 euA	600 uA	400 uA
External Target (>1port)		



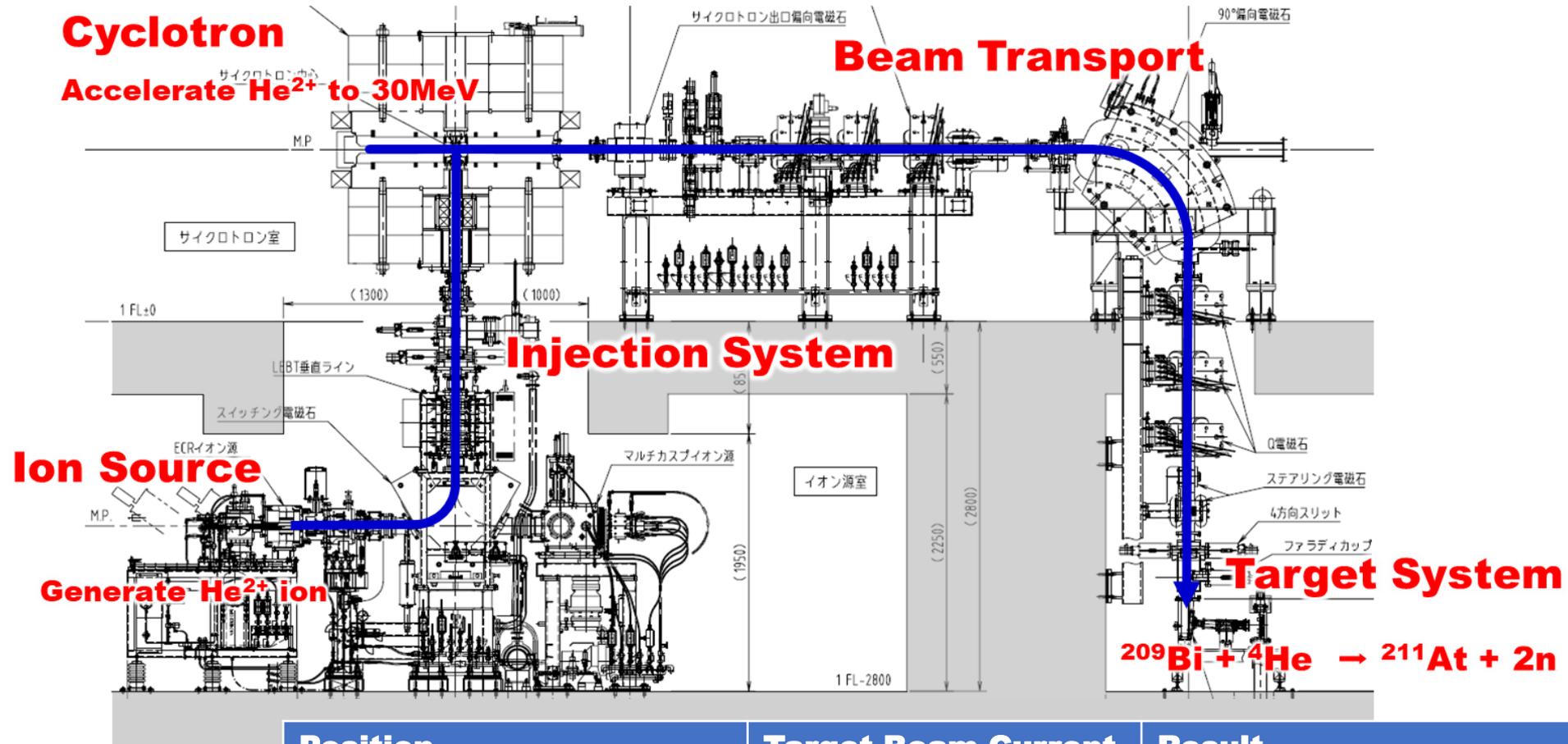
New MP-30X Cyclotron Astatine-211

Particle	Beam Current Internal	Beam Current Extracted
Alpha	400 μ A	200 μ A
Proton	~600 μ A	600 μ A
Deuteron	~400 μ A	400 μ A

Jan 23 at Sumitomo Ehime Factory

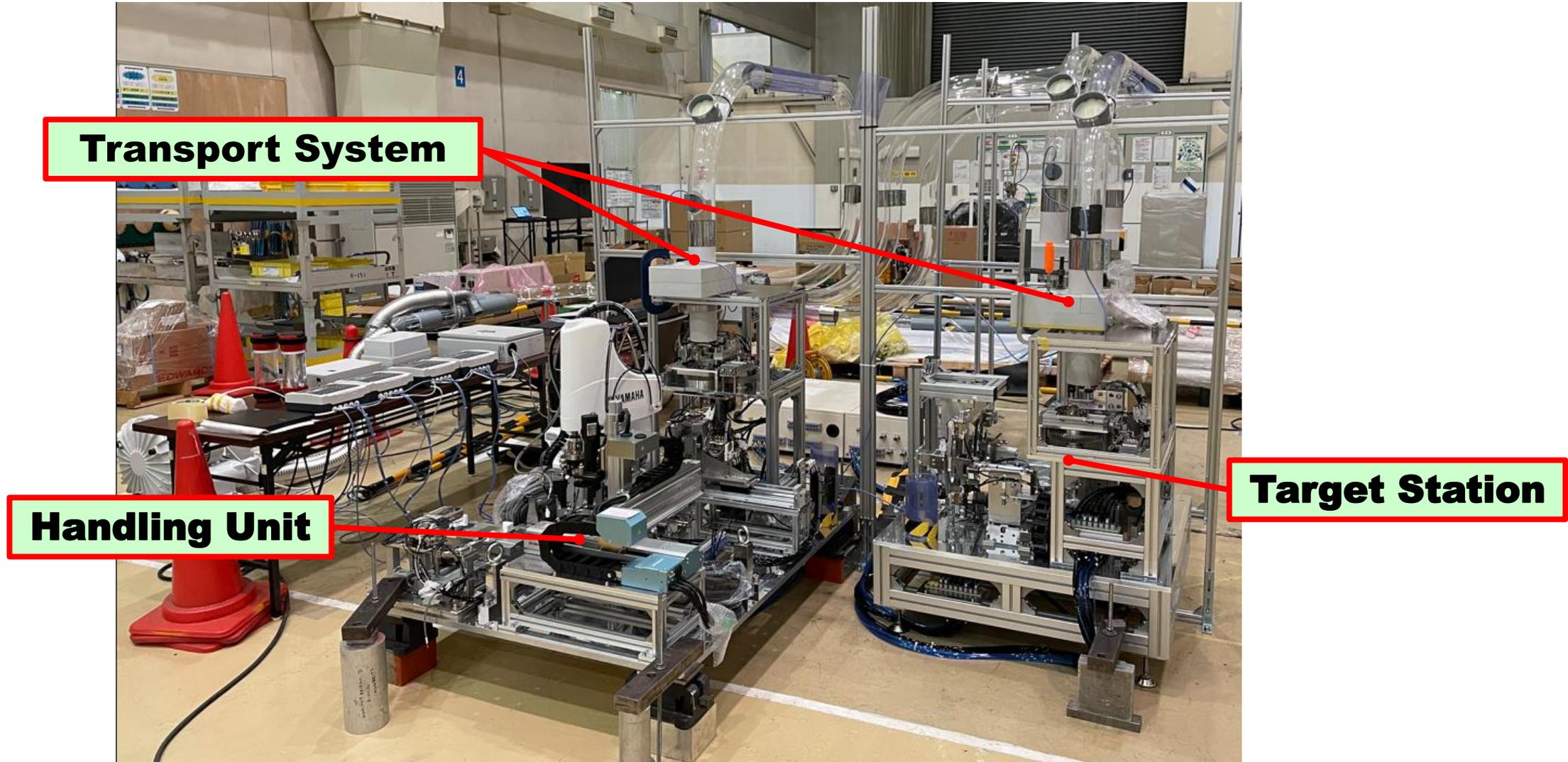


Development Status



Position	Target Beam Current	Result
End of Injection System	2.0emA	3.6emA ✓ - January 2026
Cyclotron Central Region	400eμA	February 2026
Extracted from Cyclotron	200eμA	October 2026

New Target System for MP-30X Cyclotron Astatine-211



*The system were developed with support from the Corporate Technology Management Group as part of the Frontier Development Project.

Latest News – Press Release

The University of Osaka and Sumi x +

https://www.shi.co.jp/english/info/2026/6kgpsq0000003ys1.html

geant4 root mad-x SHI python ubuntu others radio isotope phits J-PARC User Suppor... Google Scholar http://forpe.shi.co.j... ibsimu SBS ChatGPT

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News

TOP > News - Fiscal 2026
> The University of Osaka and Sumitomo Heavy Industries Establish Joint Research Division for the Social Implementation of Astatine-Based Targeted Alpha Therapy Toward the Practical Application of Cancer Drug

NEWS

The University of Osaka and Sumitomo Heavy Industries Establish Joint Research Division for the Social Implementation of Astatine-Based Targeted Alpha Therapy Toward the Practical Application of Cancer Drug

January 19, 2026

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Sumitomo Heavy Industries, Ltd. (Head office: Shinagawa-ku, Tokyo; Representative Director, President and CEO: Toshiro Watanabe; hereinafter referred to as "SHI"), in collaboration with the University of Osaka (main campus: Suita City, Osaka; President: Atsushi Kumanogoh), has established a Joint Research Division for the Social Implementation of Astatine-Based Targeted Alpha Therapy (hereinafter referred to as the "Joint Research Division") at the TAT Cyclotron Building of the Research Center for Nuclear Physics, the University of Osaka.

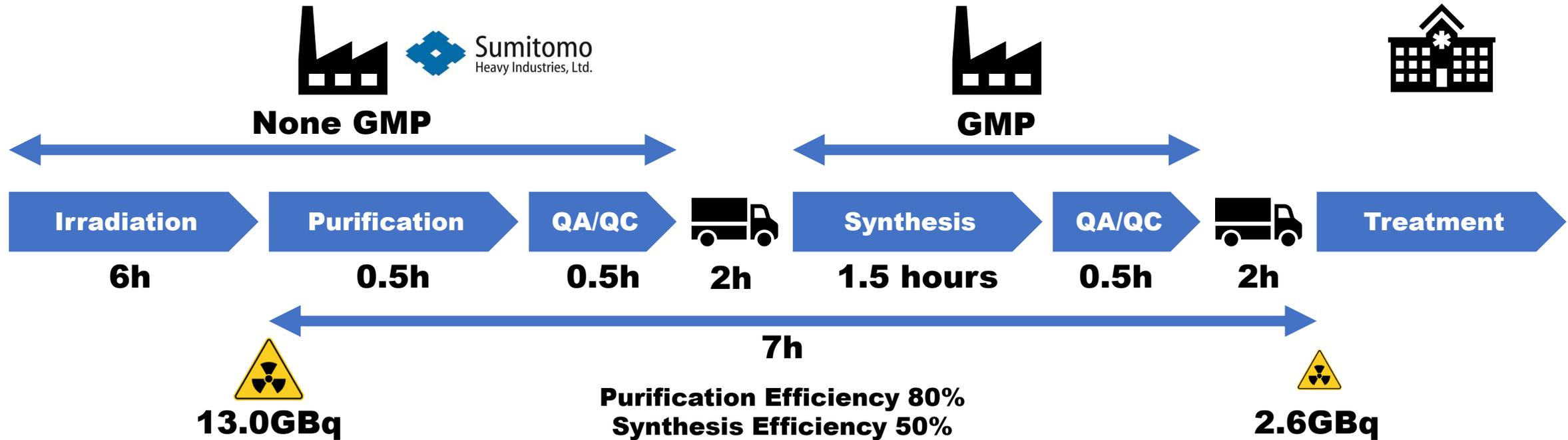
Targeted alpha-particle nuclear medicine therapy which uses a radioactive isotope At-211(atomic number 85; half-life: 7.2 hours) has attracted attention as a novel treatment modality capable of selectively targeting cancer cells. The Joint Research Division aims to establish the technological foundation and quality standards required for the stable, high-quality production and supply of At-211 as an active pharmaceutical ingredient.

Based on the outcome of the research and development conducted by the Joint Research Division established at the TAT Cyclotron Building of the Research Center for Nuclear Physics at the University of Osaka, SHI will be responsible for supplying the market while collaborating closely with industry, academia, and the government to develop a sustainable framework for social implementation. This framework will support the practical application and broader adoption of novel At-211-based alpha-particle nuclear medicine therapy.

[Overview of the Joint Research Division for the Social Implementation of Astatine-Based Targeted Alpha Therapy]

Division TAT Cyclotron Building, Research Center for Nuclear Physics, The University of Osaka

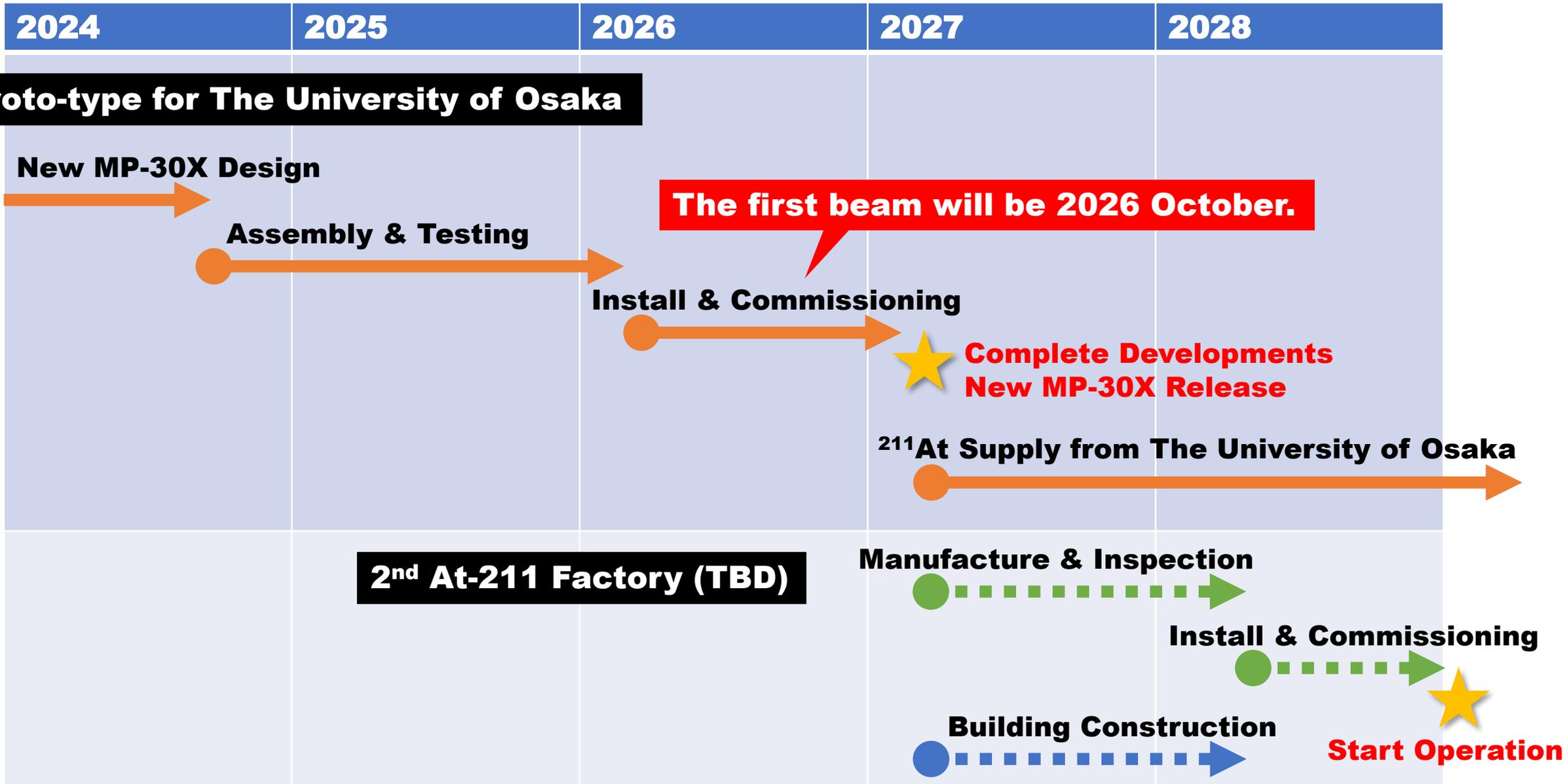
Supply Chain Model



If <400MBq/patient, >6.5 patients could be treated by one irradiation at one factory.

**If 2 irradiations are performed per day for 240 days,
a total of 3,120 treatments/year would be possible.**

Schedule



今後の課題

- ・ アスタチン供給量の増強

理論上、6時間照射13GBq、1日3回製造可。ターゲット技術、製造施設増強、複数製造拠点等の課題あり。

- ・ アスタチンサプライチェーンの構築

輸送、複数企業の参画等に課題あり。100%商用拠点としての展開。

- ・ アスタチンの品質管理

産学の協力必須。

- ・ アスタチンの廃棄物処理

産官学の協力必須。

- ・ アスタチンの安定供給

複数製造拠点、バックアップ体制等の課題あり。

- ・ アスタチンに関する人材確保・育成

新卒・キャリア採用、共同研究、社内OJTによる育成。

- ・ アスタチン製造のグローバル展開

海外での反響は大きい。日本での実績をどのように展開するか、コミュニティでの議論を含め課題あり。

特に使用量(飛散率)、輸送等の規制緩和や廃棄物処理については国をあげて支援をいただきたい。