

Concept of the Collaborative Chopper Spectrometer *TUKUYOMI* for J-PARC

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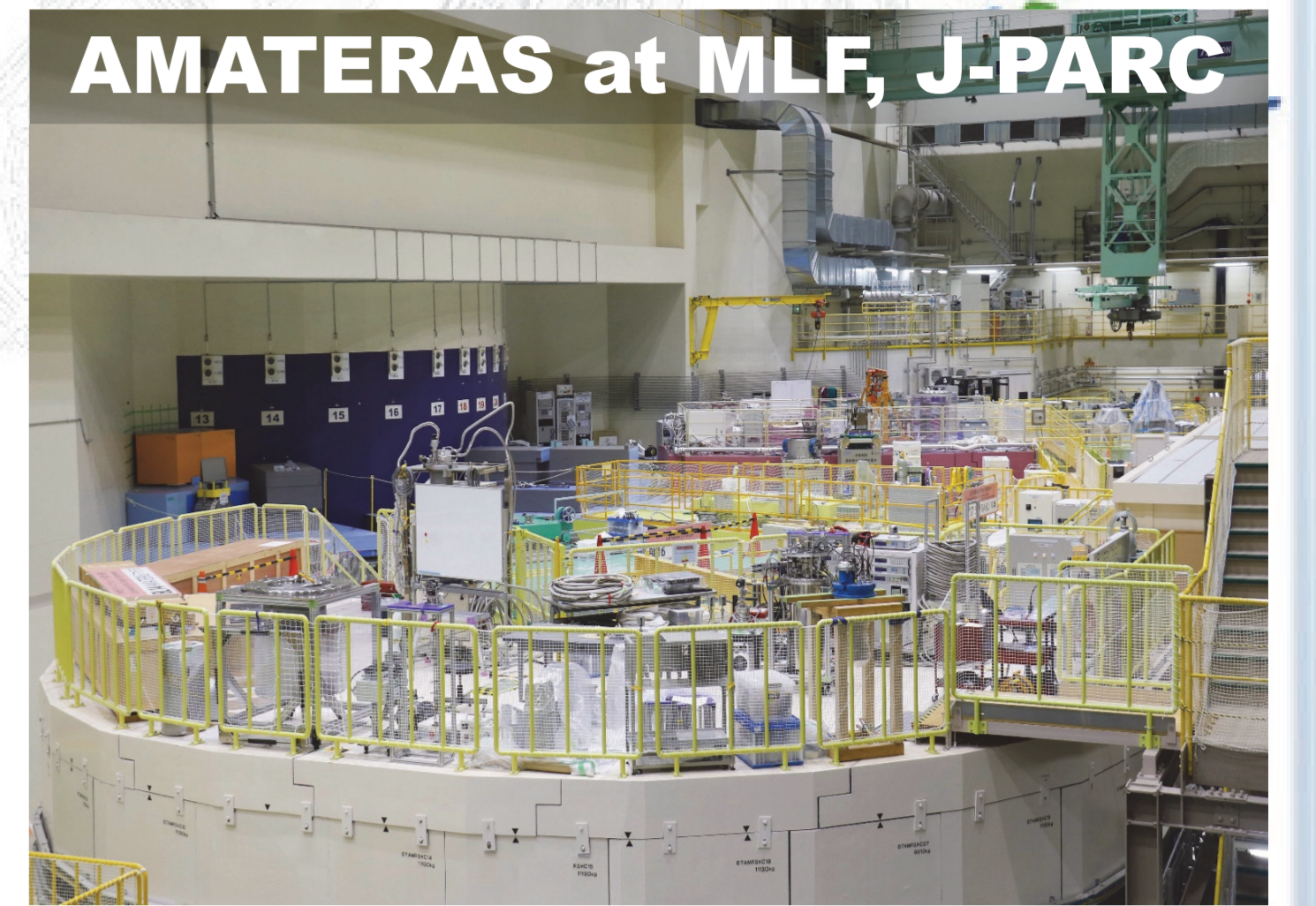
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■ Introduction

Here we show an initial and brief concept of our idea of TUKUYOMI, a collaborative chopper spectrometer (CCS) for AMATERAS. A CCS is a concept of a chopper spectrometer designed to collaborate with existing full-scale spectrometers to enhance scientific output by lower-cost in construction and operation by compromising on functionality and performance. CCS-TUKUYOMI is a complementary chopper spectrometer operating together with AMATERAS, a chopper spectrometer at Materials & Life Science Experimental Facility (MLF), J-PARC. TUKUYOMI will be a smaller and simplified version of AMATERAS. TUKUYOMI is expected to calm down overheated users' demands (excessive competition) and to enhance scientific output by small investment.



■ Concept of Collaborative Chopper Spectrometer (CCS)

The idea is inspired by a modern military concept, Collaborative Combat Aircraft (CCA). CCA is the concept of an AI-assisted unmanned combat aircraft operating in collaboration with a manned combat aircraft as a combat buddy (wingman). A Collaborative Chopper Spectrometer (CCS) is a complementary spectrometer designed to be used in conjunction with a full-scale chopper spectrometer (FCS). Like manned-unmanned teaming considered in the CCA concept, a CCS is used together with a FCS.

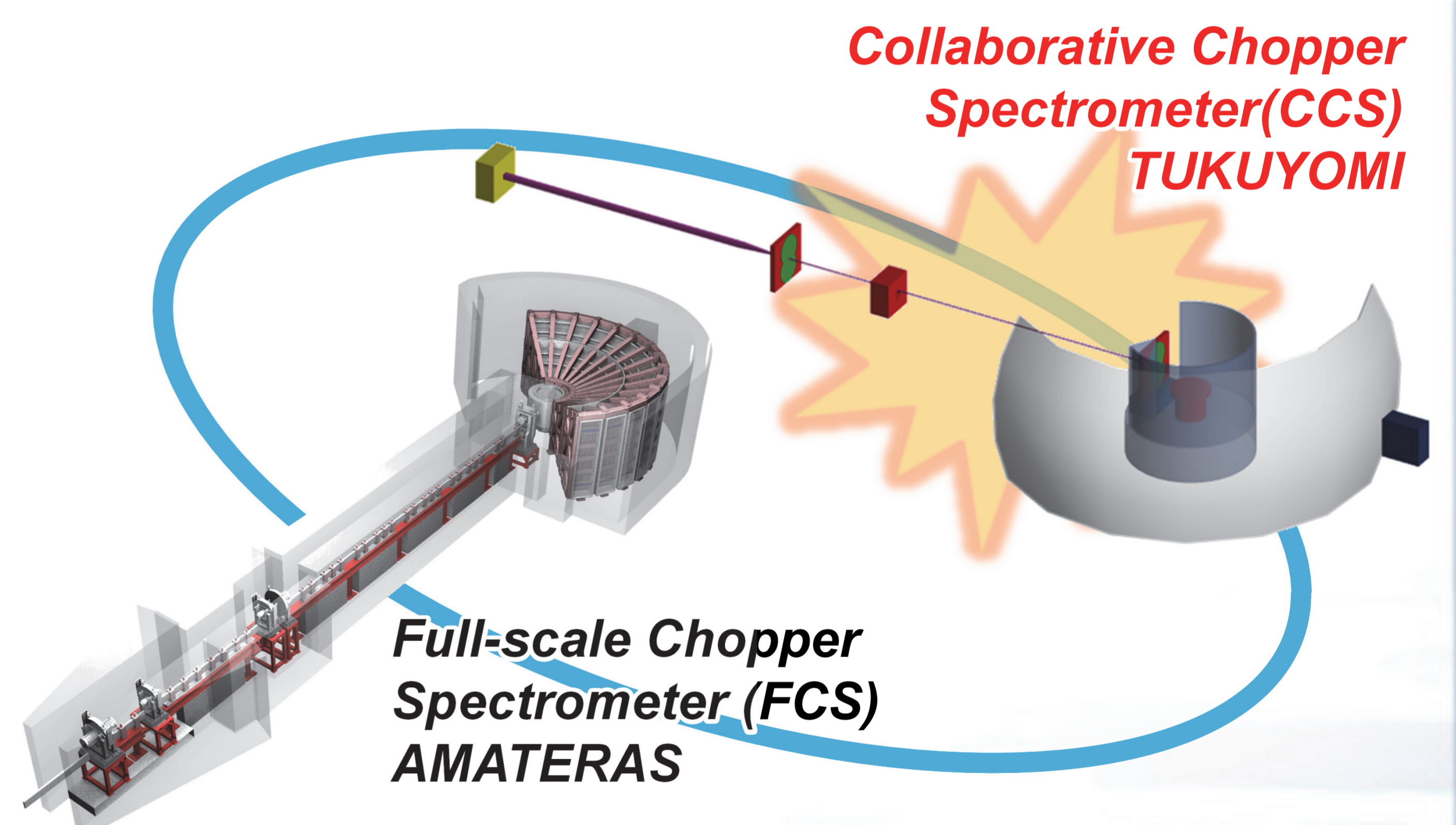


A FCS (in the most of cases) has the highest performance at the facility to lead the science at there. However, construction cost of a FCS usually high. Employing well-trained operating staff also some time can be challenge to the facility. If your facility can have unlimited resources, you can construct number of FCSs as much as you want. But, if not, a CCS may help your facility.

Collaborative Chopper Spectrometer (CCS)

- As a fundamental premise, CCS collaborates with its FCS. Highly edged and difficult experiments are carried out at its FCS. Its CCS deals with other experiments to reduce the load of its FCS.
- The first priority of CCS is achieving less financial cost and less human resource cost in construction and operation.
- The performance and the choice of measurements of CCS should be limited.
- CCS should equip ability of automated and autonomous operation.
- CCS should be considered as a part of its FCS. Under the manned-unmanned teaming concept, the user program of CCS should be considered as a part of that of its FCS. All proposals should be submitted to its FCS. The instrumental scientist of the FCS should consider and decide which proposals are carried out on her/his CCS.

CCS-TUKUYOMI & FCS-AMATERAS



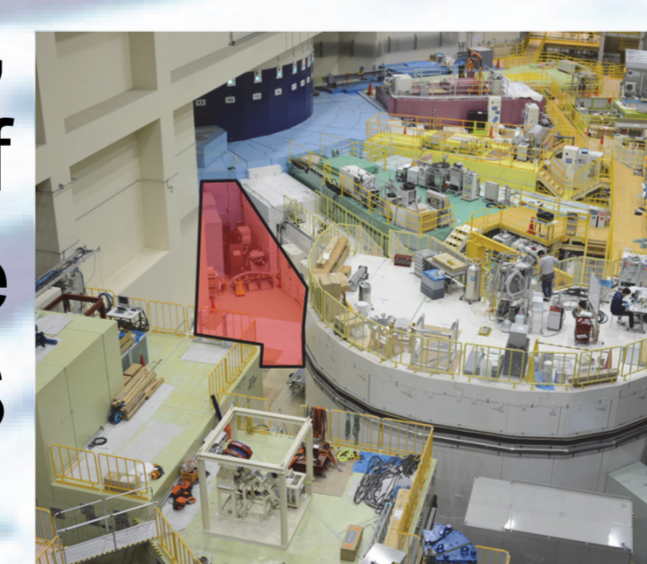
■ Why do we need CCS-TUKUYOMI, CCS of AMATERAS?

All of inelastic instruments at J-PARC is highly demanded and contributing to rich and fruitful outcomes from MLF, J-PARC. AMATERAS is not an exception. Only small number of proposals are approved at AMATERAS and many others are sent to the waiting list. If we can carry all "Reserved" proposals, the productivity of AMATERAS can be increased 3 times more, which should be done by CCS-TUKUYOMI.

■ Why to realize CCS-TUKUYOMI?

■ How to reduce the construction cost?

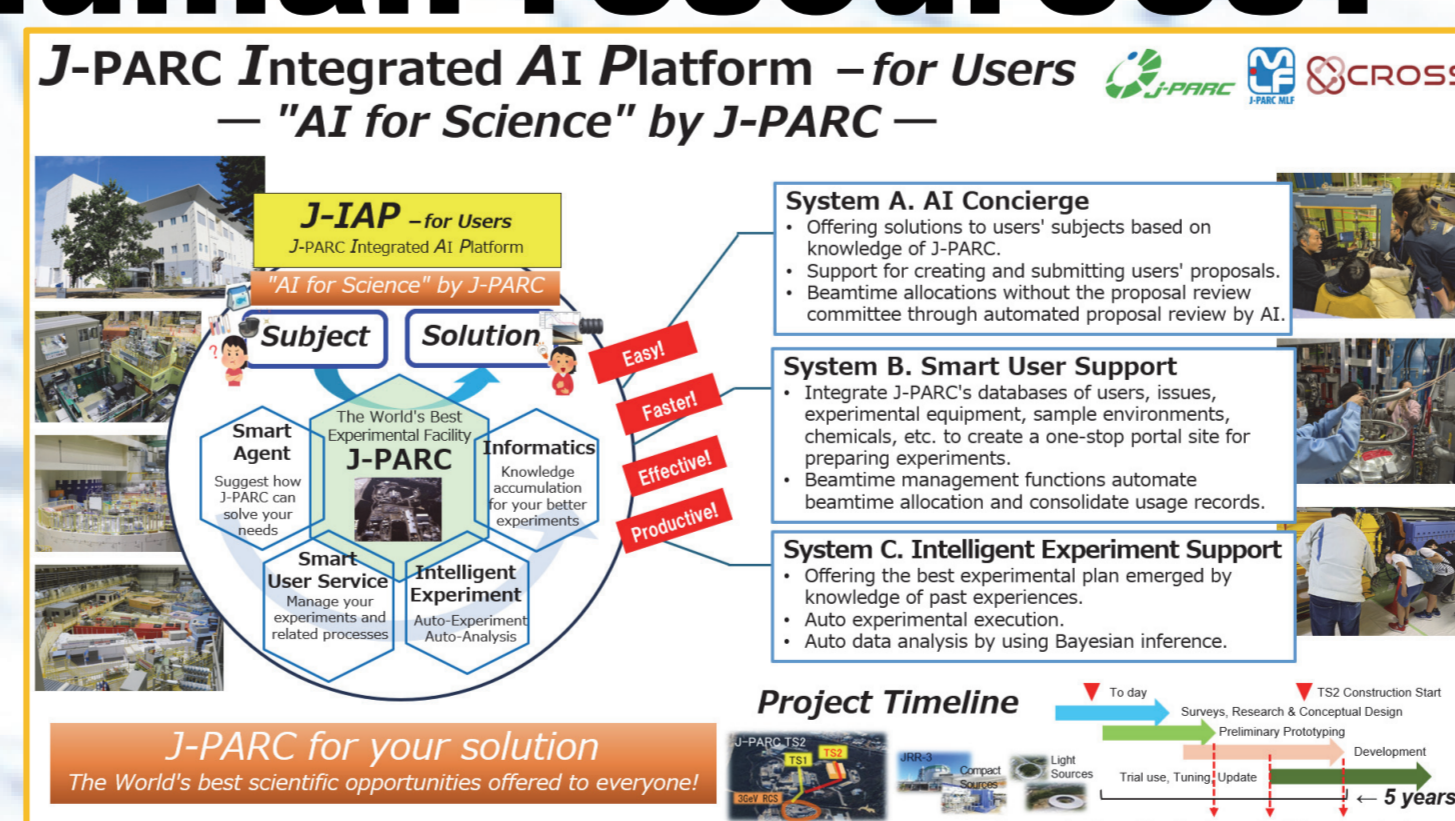
- **Make smaller.** Relaxing energy resolution from 1% to 3~4% or more, flight paths can be shorten 2/3 of AMATERAS, which cause reduction of cost of 50% in shielding and 30% in beam transport. We also can reduce number of detectors. In reality, there is a high demand at AMATERAS for experiments with slightly loose resolution and high intensity.
- **Omitting choppers:** May be, we can remove a pulse-shaping chopper, which AMATERAS equipped, with 5-10 % reduction of cost.
- **Others:** If the 2nd target station of MLF will be a lower repetition rate source, we may be able to omit counter measures against T0 background.



※Construction at BL13, next to AMATERAS beam line, allows us to share shielding with AMATERAS, which may cause another reduction of construction cost.

■ How to reduce the operating human resources?

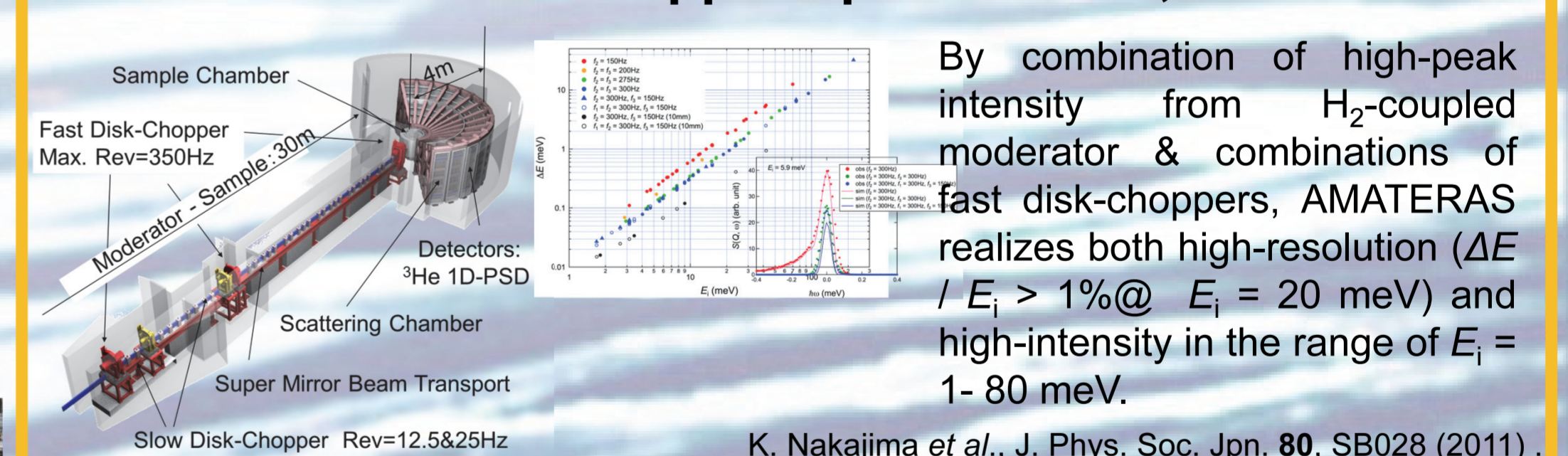
One of the solution is introducing ability of automated and autonomous operation to CCS. MLF, J-PARC now launched the project of AI-Platform, which can be adapted to TUKUYOMI. Since 85% AMATERAS proposals plans simple rotation scan, things may be easy.



■ Concluding comment

Continuously improving the productivity of research output is one of the important challenges in facility management. If resources were unlimited, this would be an easy task. However, in reality, budgets and human resources are always limited. Therefore, maximizing results by making the most of the resources given is the arts of facility management. In this respect, the concept of balancing high and low costs in instruments selection is important. CCS can be one solution. Therefore, for the future plan of MLF, J-PARC, we would like to propose TUKUYOMI as a candidate instrument in order to improve the productivity of the facility and enable more users to access MLF in a sustainable manner.

Cold-neutron Disk-chopper Spectrometer, AMATERAS



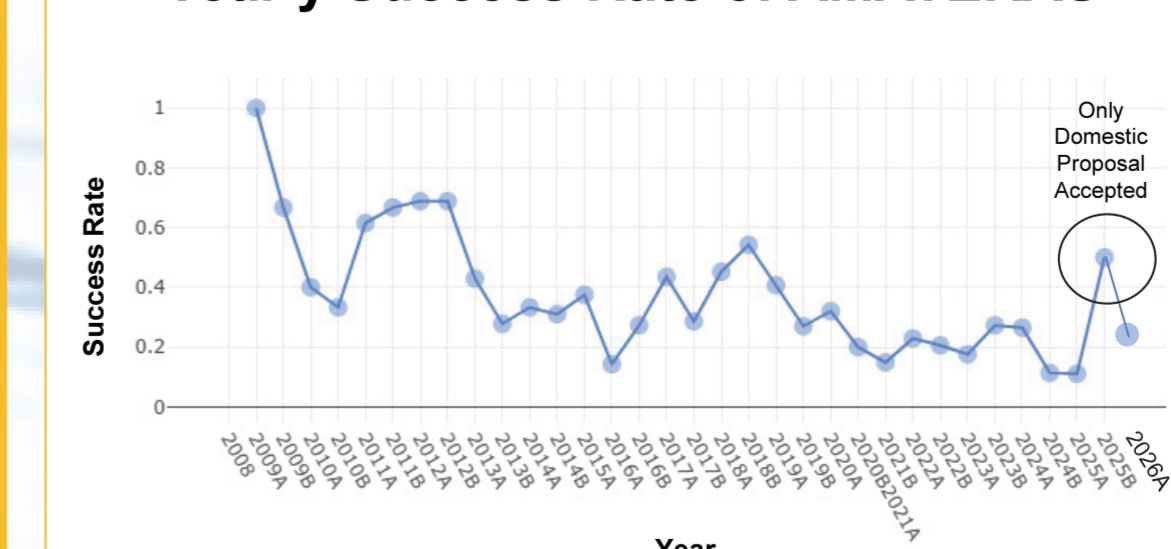
AMATERAS is highly demanded, with recent competition rate is 3 ~ 10. Many excellent proposals are sent to the waiting list. On the other hand, AMATERAS produces ~ 15 papers per year, including some that rank in the top 10%.

Proposals Submitted to AMATERAS in 2026A

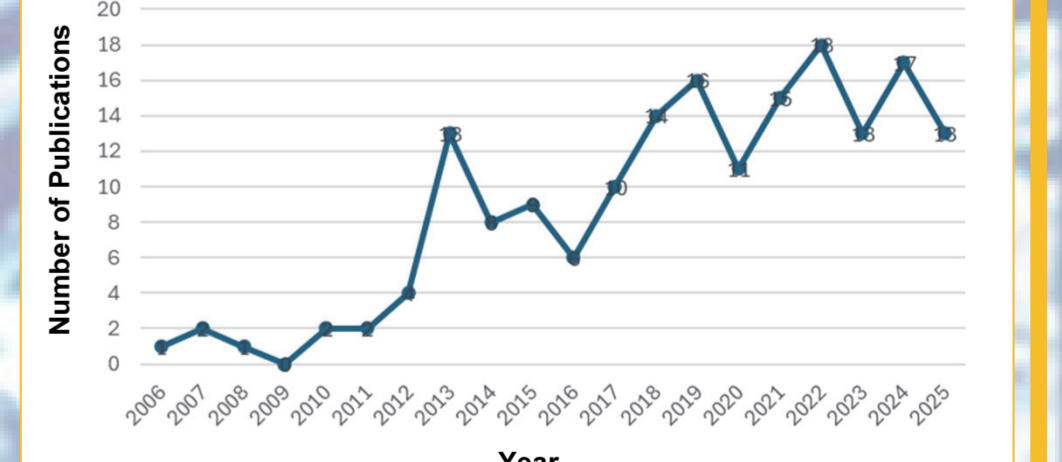
Total Number	47
Accepted	11
Reserved	20
Not approved	2+6*
Success Rate	0.23

*Due to national security reason (not scientific)

Yearly Success Rate of AMATERAS



Number of Publications from AMATERAS



TOP 10% Publications from MLF in 2023

Rank	Author	Title	Journal	Year
1
2
3
4
5
6
7
8
9
10

Rank	Author	Title	Journal	Year
1
2
3
4
5
6
7
8
9
10

※ To see more in detail, visit <https://mlfinfo.jp/en/about/mlf/statistics.html>.