

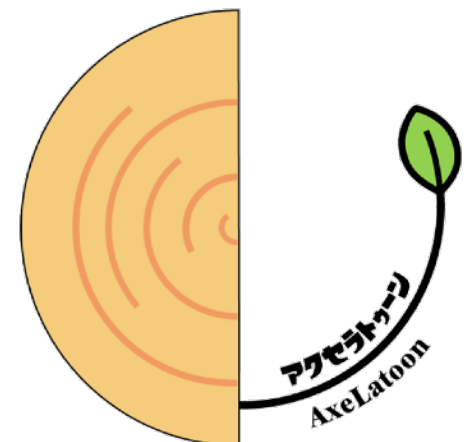
Activities for making accelerator in KOSEN

Takaoki Takanashi

RIKEN

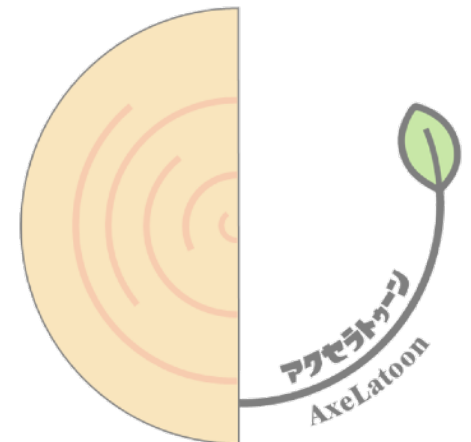
Axelatoon Collaboration

<https://www2.kek.jp/axltn/>



CONTENTS

- What is / Purpose of an Axelatoon
- KOSEN
- What is the subject? → Cyclotron
- Steps
- Activity status of each KOSEN
- Summary



What is / Purpose of an Axelatoon

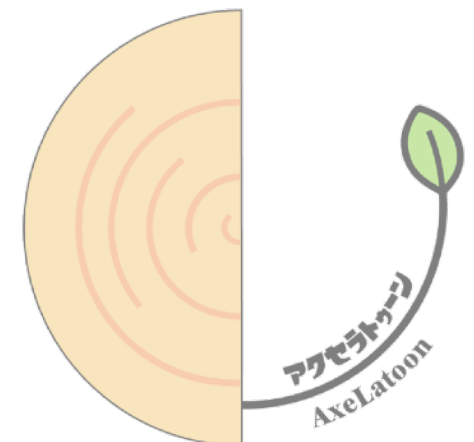
"AxeLatoon" is a name that is an education project for the next generation started by KEK together with a National Institute of Technology (KOSEN) in 2020.

Project is led by accelerator researchers who conduct world-leading research at Japan's accelerator facilities (RIKEN, etc.).

In usual, most of the education & outreach activities in the field of accelerator science and technology are information processing exercises such as data analysis from the large accelerator experiments. There are few activities in which students actually can touch the accelerator and build it by own self.

By collaborating with KOSEN, we aim to improve students' engineering skills and grow up the next generation of accelerator researchers through the fabrication of tiny accelerators by students' own hands.

The establishment of such a workshop will bring innovation to our community.

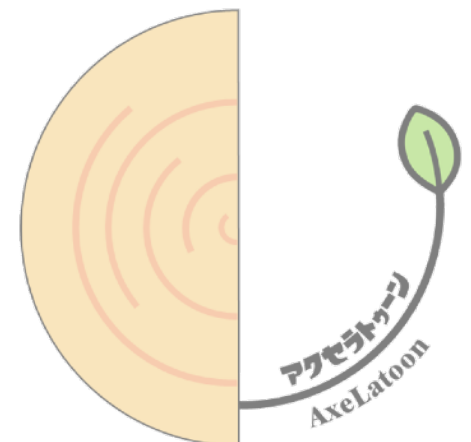
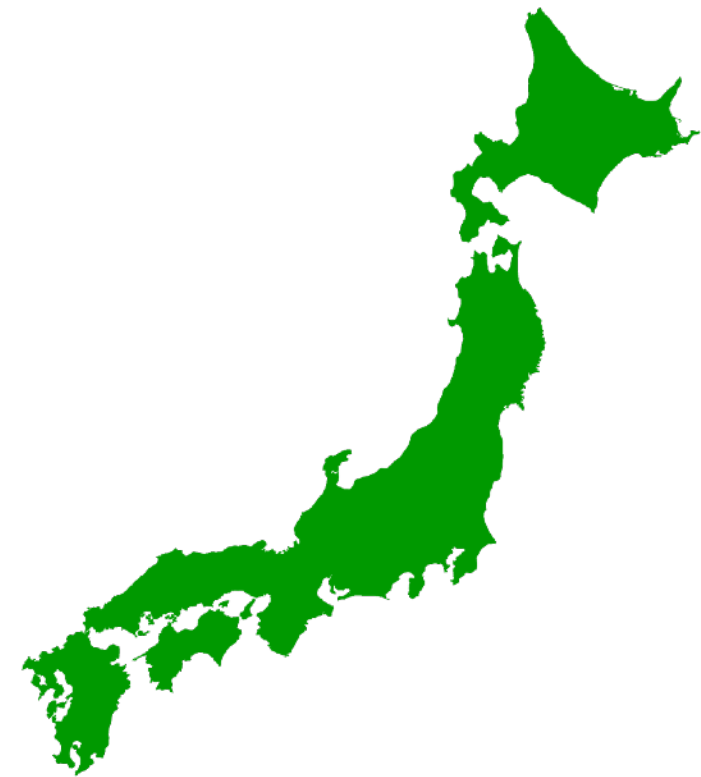


KOSEN

National Institute of Technology (KOSEN)

KOSEN is Japanese higher education institutions that grow up advanced technology and engineering professionals through 5 years of integrated education. There are 51 colleges of technology throughout Japan, producing engineers and entrepreneurs with creativity and practical skills through distinctive lectures, experiments, practical training, and other classes. Students can also gain more practical experience through programs such as robot contests (Robocon) and programming contests (Procon).

Some graduated students go on to universities and graduate schools and work as researchers. The know-how developed at technical colleges is thus need for the production of accelerators, a comprehensive science that combines a variety of technologies.



What is the subject ? → Cyclotron

There is a precedent for building a cyclotron at home (Takanashi 2019). This scale, there is a great possibility that a group of students can make one. We assume that it will take about 1-2 years to make by the student group (For reference, Takanashi took 5 years).

- High vacuum
- Strong magnetic field
- High Radio frequency
- Control over them

The basic technology is packed for make accelerator, and some of these are not handled in normal robot production for example. It is considered a good theme for the education of technical college students who are expected to play an active role in a wide range of technical fields in the future.

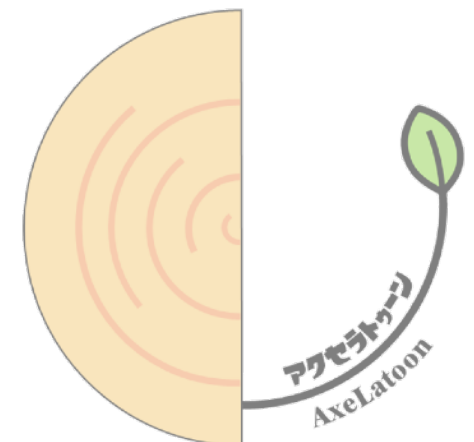


https://makezine.jp/blog/2019/08/mft2019_report_01.html

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Steps

First, we are working with KOSEN Ibaraki College to create the model cases for students to build their own accelerators. Now, Ibaraki College and Oyama College have already started designing accelerators based on electromagnetic field distribution simulations using Geant4, etc., and manufacturing actual parts (to be introduced later). Due to the global pandemic of the COVID-19 that began immediately after the project started, we are continuing our activities using WEB based communication tools such as Zoom and Slack.

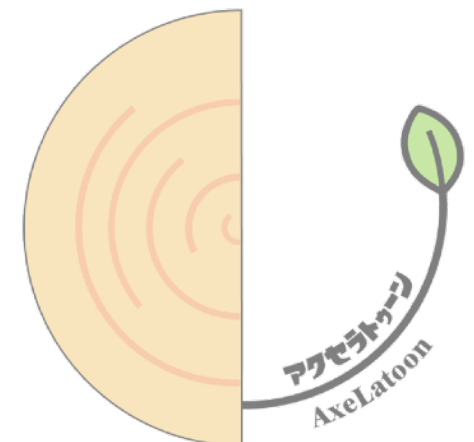
We also develop workshops and promote accelerator production to Japanese technical colleges. To this end, we have established a system whereby researchers from large accelerator facilities in Japan can collaborate with each technical college as mentors. The fabrication of components is done in collaboration with local factories and other facilities to provide educational opportunities that complement community-based school education.



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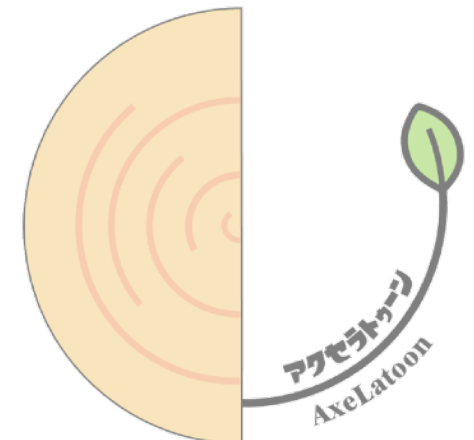
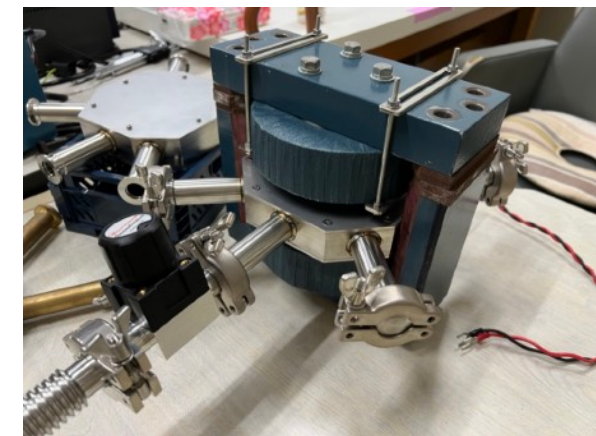
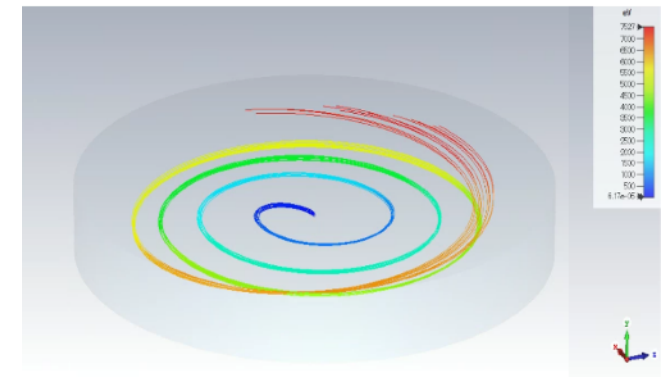


Activity status of each KOSEN

Activities at KOSEN, Ibaraki College

October 2020, we held several remote sessions at Ibaraki College to introduce the history and principles of accelerators to students and proceeded to get and set up the equipment (TMP and PC etc. necessary for accelerator fabrication). In April 2021, an "A-Lab" team was formed by students that aim to make a basic type cyclotron and the team began learning to use simulation codes for electromagnetic field distribution under the guidance of researchers (Dr. Otani (KEK) and others).

After that the team was divided into Teams A and B with 5 to 6 members each and started designing an own cyclotron respectively. The designed vacuum chamber and Dee electrodes are made with a local company on the machining process.



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Activity status of each KOSEN

Activities at KOSEN, Oyama College

Member of the Oyama College has resumed face-to-face workshops in August 2021 after conducting remote discussion and simulations using software for a long time due to the pandemic.

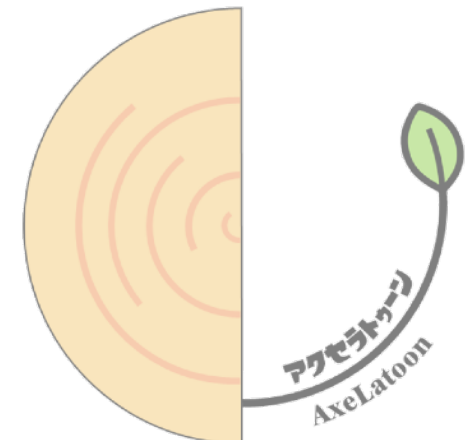
The students formed a team named "ATHENA" and have been working on the development. The progress was announced at the Physical Society of Japan Jr. session held in March 2022 and at Maker Faire Tokyo 2022 held in September 2022.



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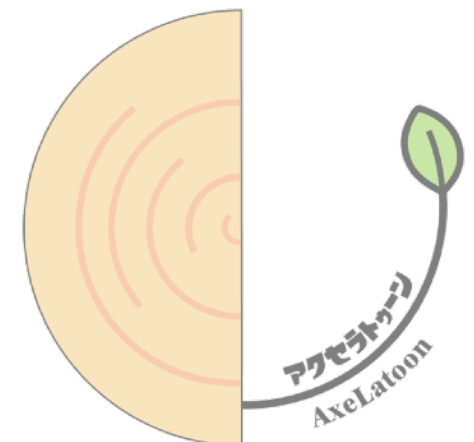


Summary

Expanding AxeLatoon !

After starting activities at Ibaraki College in 2020 and Oyama College in 2021, we have been gradually expanding our activities. In December 2021, we held briefing sessions at Nagaoka College and Nagano College, and the activities started in 2022. Activities at Ibaraki College were reported at ISATE2021, an international symposium jointly organized by the KOSEN Organization and five polytechnics in Singapore.

We have started accelerator fabrication activities at the KOSEN. In cooperation with nearby KOSEN, we are working toward the driving of a tiny cyclotron accelerator. Also students themselves are reporting their results and conducting research activities. Discussions are underway to expand the project to other technical colleges throughout Japan.



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Acknowledgments

This project has been supported by
The Comprehensive Growth Program for Accelerator Science.
Chuden Foundation for Education,
General Donation for the Research,
Educational and Social Activities by KEK,
SOKENDAI Outreach Activities,
and
The grant program for young inventors of the Futaba foundation

