New compact electron accelerator-driven neutron facility AISTANS

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1. Introduction: **Background (Purpose)**

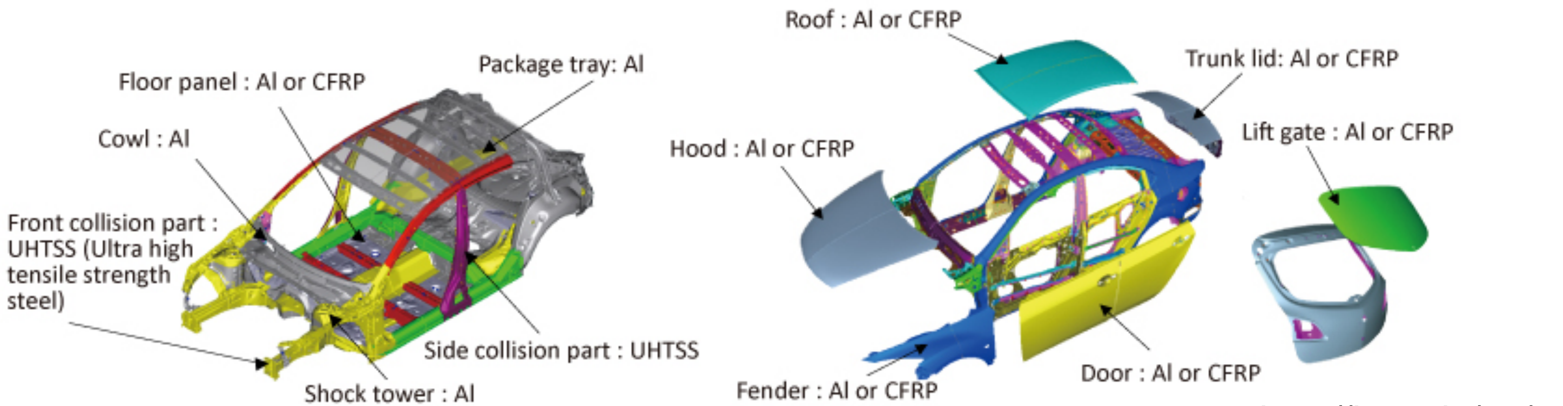
Innovative Structural Materials Association (ISMA)

Energy conservation society

Reducing weight of transportation vehicles
Target: Structural materials

- Innovative Materials
- Multi-Material

Example of Multi-material Application for Vehicle Weight Reduction

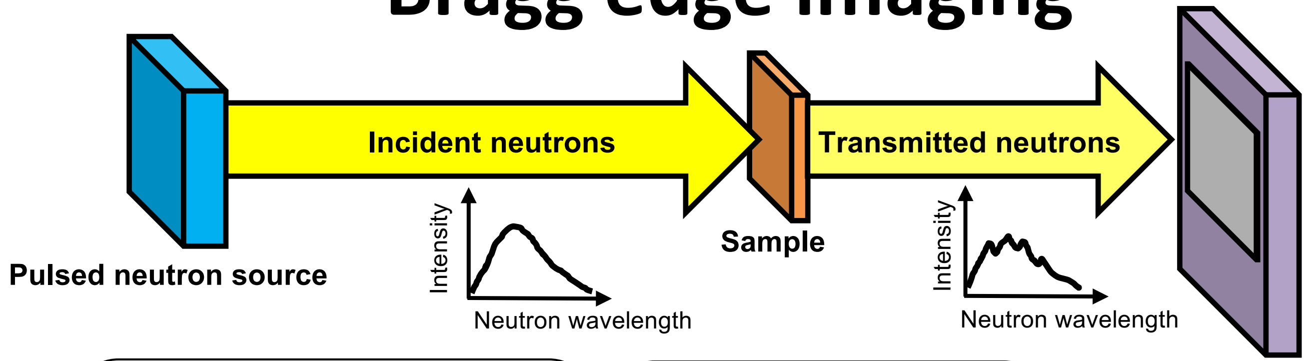


http://isma.jp/en/works/

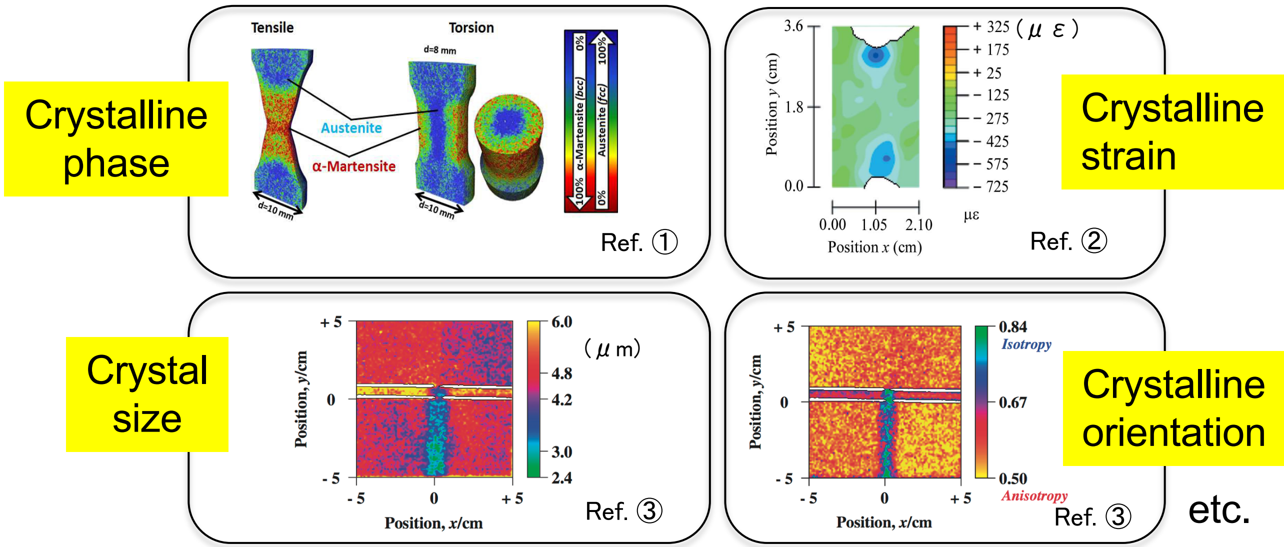
AIST: Construction of a dedicated CANS for nondestructive analysis of structural materials

1. Introduction: **Method of measurement**

Bragg edge imaging



Event mode detector



- Images of various information at once
- Easy understanding

① R. Woracek et al., Physics Procedia 69 (2015) 227 – 236

② K. Iwase et al., Journal of applied crystallography 45 (2012) 113 – 118

③ H.Sato, et al., Materials Transactions, Vol. 52, No. 6 (2011) pp. 1294 to 1302

Combination of AISTANS and Bragg edge imaging

→ Development of structural materials

1. Introduction: **Target parameters**

Neutron flux

At sample position

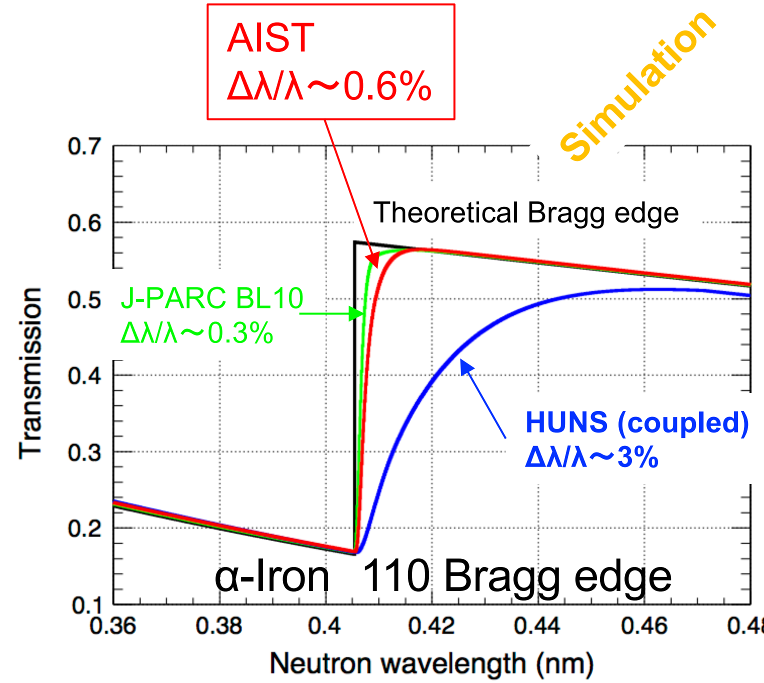
- 10cm × 10cm beam
- 2D ND maximum counting rate
  $10^5 \sim 10^6$ cps
  (nGEM, μNID)

Assuming
10 % detection efficiency

$\geqq 10^4 \sim 10^5$ n/cm^2/s

Neutron wavelength resolution

- Moderator (Decoupled Solid methane)
- Flight path length (8m)
  ($\Delta\lambda/\lambda = \Delta t/t$)

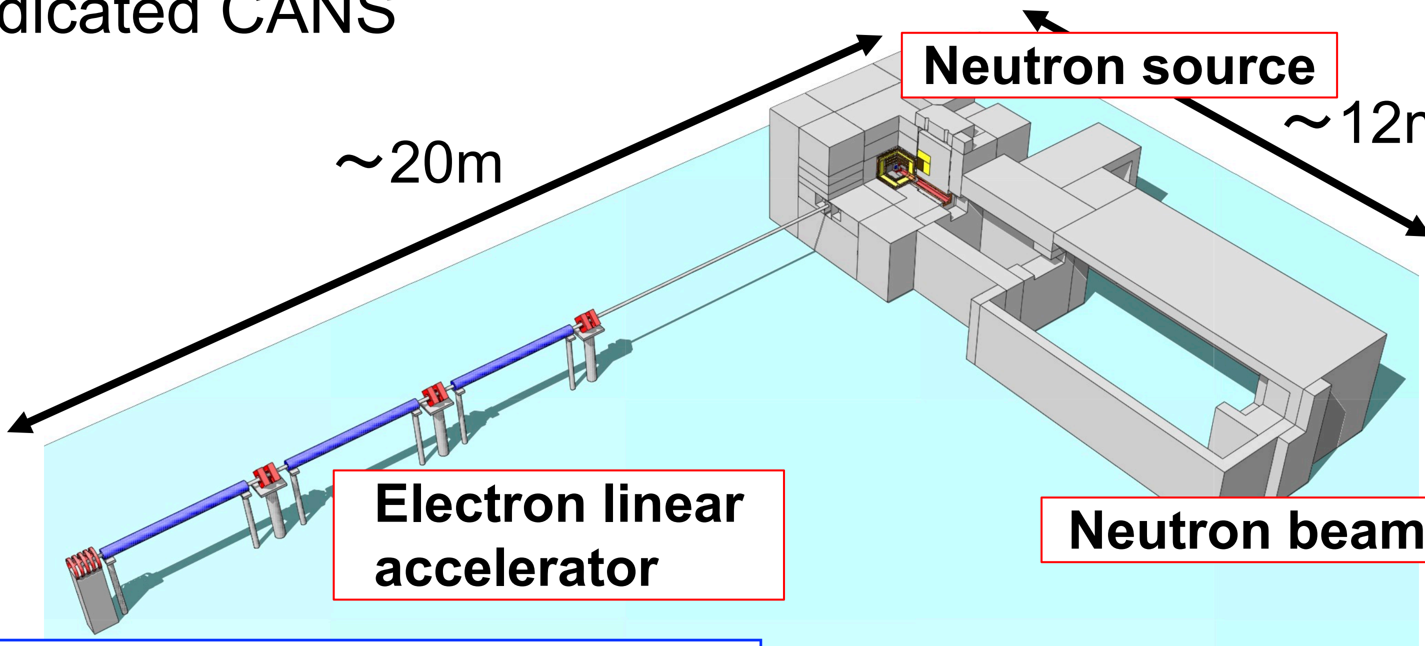


Clear target parameters for AISTANS design

1. Introduction: **Main components**

Bragg edge imaging
dedicated CANS

- **Sharp pulse:**
  - **Solid methane at 20K**
  - **Decoupled moderator 3 cm thick**



- **Improvement of neutron flux:**
  - **10 kW electron beam**
    = 10 × HUNS-I
- **Optimization for Bragg edge imaging:**
  - **100 Hz**

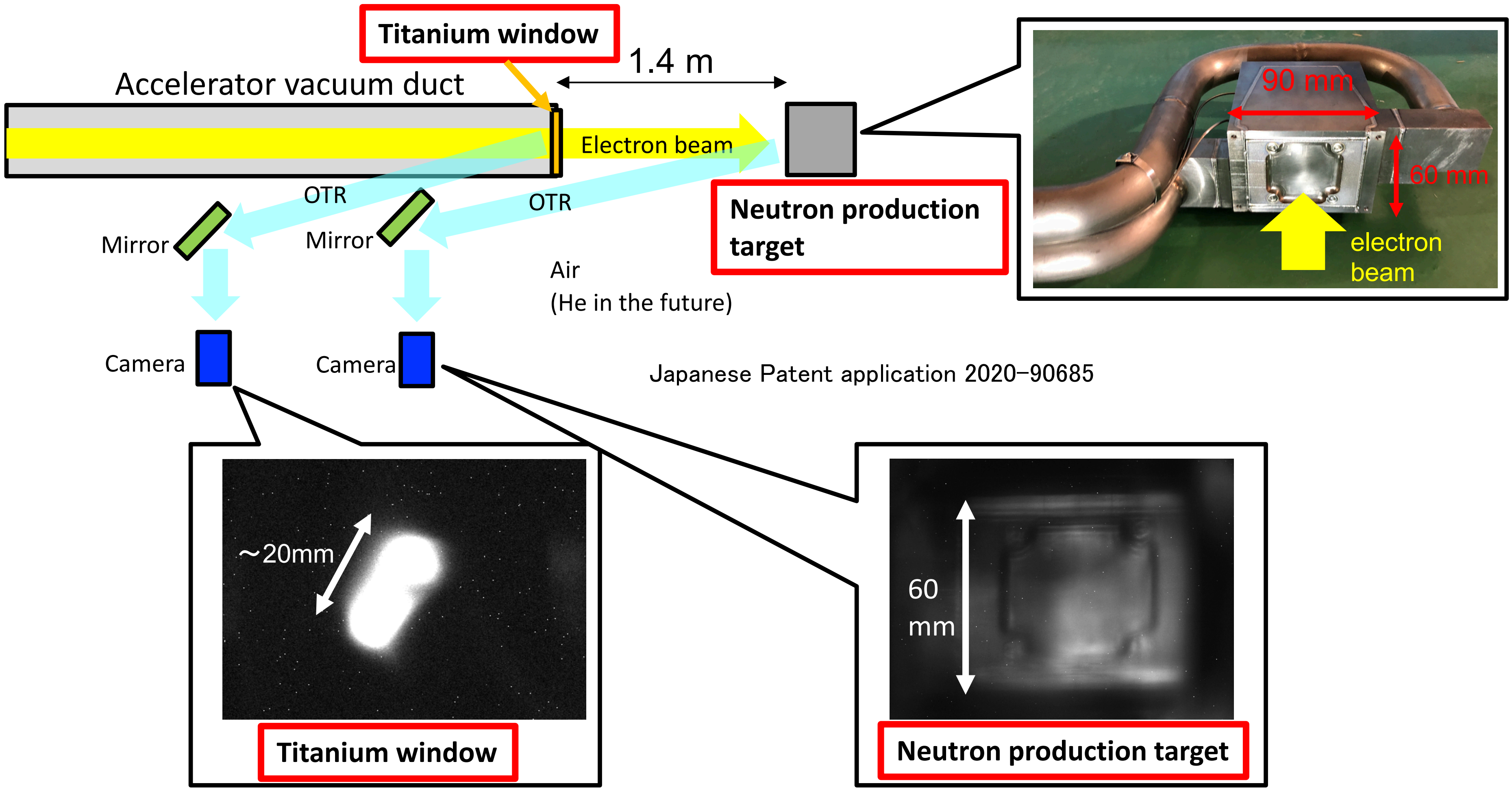
- **Improvement of measurements:**
  - **Super mirror guide tubes**
  - **High detection efficiency and count rate 2D detector**

2. Current status: **Electron LINAC**

Frequency	2.856 GHz
Acceleration energy	36.5 MeV
Peak current	275 mA (maximum)
Beam pulse width	10 μs (maximum)
Repetition rate	100 Hz (maximum)
Beam power	10 kW (maximum)

Simple electron LINAC and transportation system

2. Current status: **Electron LINAC**



Beam transportation : Under commissioning

2. Current status: **Electron LINAC**

Electron beam at target

Energy: ～40 MeV

Peak current: ～100 mA

Pulse width: 4 μs

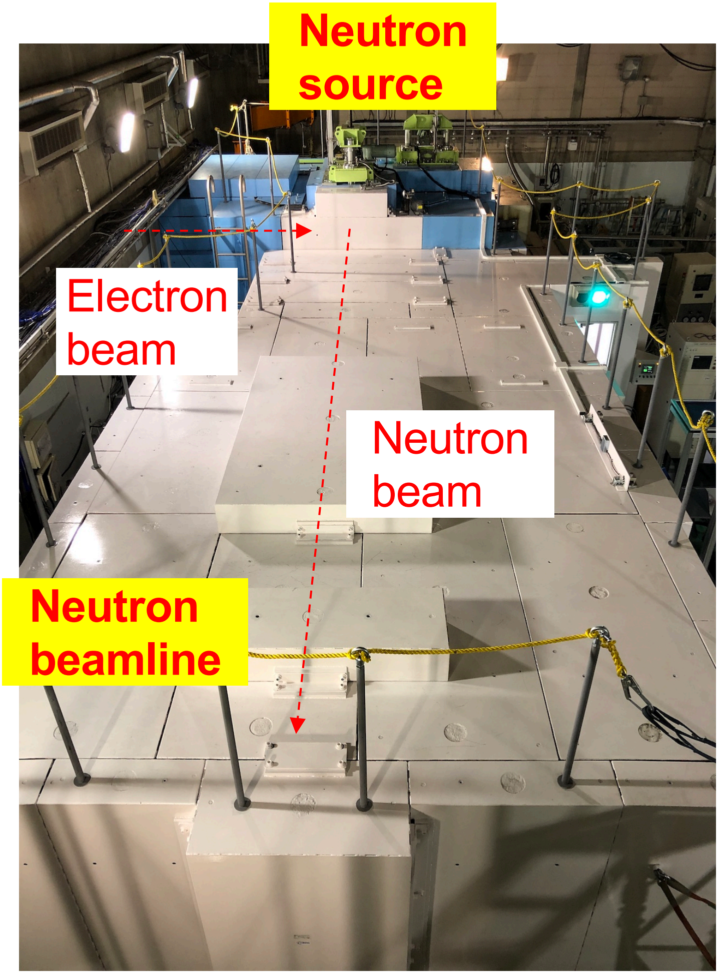
Repetition rate: 50 Hz

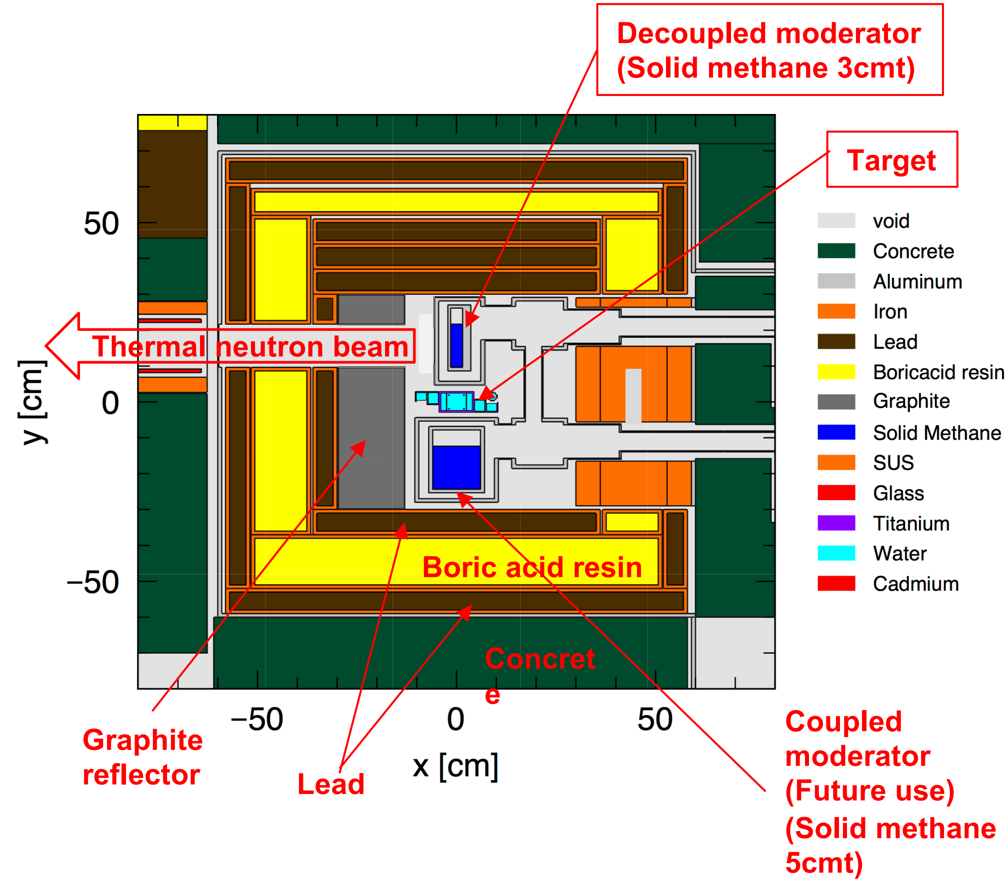
Power: ～1 kW

Beam pulse observed at the target

Beam pulse data (charge) → Absolute flux spectrum evaluation

2. Current status: **Neutron source**





Cross section of the neutron source

Neutron beam from solid methane moderator : 2020～

2. Current status: **Solid methane moderator**

Solid methane is produced in the neutron source.

2. Current status: **Neutron transportation**

Selectable : Super mirror guide tubes or Vacuum ducts

2. Current status: **Neutron beamline**

Beam shutter light

Shutter controller
Door controller
similar to J-PARC MLF

Radiation
monitor

Entrance

2. Current status: **Neutron beamline**

3. Flux measurement: **System**

3. Flux measurement: **Analysis**

3. Flux measurement: **Results**

4. Summary

- **First thermal-cold pulsed neutron beam from the decoupled solid methane moderator at AISTANS**
- **Thermal peaks were observed at an expected neutron wavelength.**
- **Roughly in agreement between experiment and calculation flux spectra in absolute values**
- **Many Bragg edge imaging data will be provided for structural materials.**

Acknowledgement

This is based on results obtained from a project commissioned by the New Energy and Industrial Technology Development Organization (NEDO).

Thank you very much for your kind attention.

References

[1] K.Kino *et al*., Nuclear Instruments and Methods in Physics Research, A 927 (2019) 407-418.
[2] B.E. O'Rourke *et al*., Nuclear Instruments and Methods in Physics Research, B 464 (2020) 41–44.