Muon4Future 2025, Venice, 26-30 May 2025







ISIS Neutron and Muon Source THE ROYAL SOCIETY

# Scintillating fibre-based muon beam monitor for the FAMU experiment

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Looking for 1S-hyperfine splitting in muonic hydrogen to extract the proton Zemach radius.



Н

X-rays

µ<sup>-</sup>beam

#### **Requirements for the FAMU beam monitor:**

# Beam profile detection and characterisation





## Beam intensity measurement for data normalisation

Two planes of scintillating fibres.

Each plane composed of 32 squared fibres:

- pitch 1 mm
- length ~ 6.5 cm
- interspaced by 1 mm.

Each fibre read-out at one end by a SiPM.









## How can I extract the muon beam intensity $\varphi$ ?

R. Rossini et al. (the FAMU Collab.), *The Muon beam monitor for the FAMU experiment: design, simulation, test and operation*. Front. Detect. Sci. Technol., Vol. 2, 2024. DOI: <u>10.3389/fdest.2024.1438902</u>











Qtot is linear in beam intensity.



#### Hodoscope simulation

Simulation using Geant4

- 64 polystyrene scintillating fibres (32 x 32, 1 mm pitch, 1 mm interspacing)
- 15  $\mu$ m TiO<sub>2</sub> coating on each fibre
- 2 PVC entrance windows (thickness 100 µm)





## Total deposited energy in fibres

 $W_1 = (49.61 \pm 0.09) \%$  $W_2 = (24.9 \pm 0.4) \%$ 



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#### THE ROYAL **SOCIETY**

International Exchange Grant between our group and ISIS to study the feasibility for a set of multi-purpose beam monitors for the ISIS muon beam facilities.

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