Institute for Nuclear Research (ATOMKI), Debrecen, Hungary (www.atomki.hu)
(TNA Manager: Tamás Szücs, tszucs@atomki.hu)

- The institute is founded in 1954
- Main research fields of ATOMKI:
  - Fundamental research in nuclear physics
  - Fundamental research in atomic physics
  - Particle physics
  - Quantum physics
  - Applications of nuclear physics and of accelerators
  - Applications of atomic and solid state physics, surface science and analysis
  - Environmental physics

- Main equipment of the Accelerator Centre:
  - Electromagnetic isotope separator: 50 eV – 50 keV (He, Ne, Ar, N, S, Se)
  - Electron cyclotron resonance ion source: 50 eV – 800 keV (He, N, O, Ne, Ar, Kr, Xe (from gases) and Ca, Ni, Fe, Zn, C, C, Zn, Au, Pb (from solids))
  - Radiocarbon AMS
  - 2MV Tandetron: Sputtering (H, B, C, N, O, Si, P, Ni, Cu, As, Au) and Multicusp ion sources (H, He)
  - **Cyclotron MGC-20E: 1 – 27 MeV (H, D, He)**

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We have experience with providing TNA:

- CHARISMA (2009-2014)
- IPERION CH (2015-2019)
- IPERION HS (2020-2023)
- E-RIHS (2022-)
- EUROPLANET 2024 (2020-2024)

Important for the users:

- Guest house on site or nearby accommodation
- Mensa on site or nearby restaurants
- Airport in Debrecen or direct shuttle transport from Budapest Airport
- Shopping Mall nearby

- Express mechanical and electronical workshop
- Supporting nuclear astrophysics group

MGC-20E cyclotron (https://www.atomki.hu/en/instruments/view/42)

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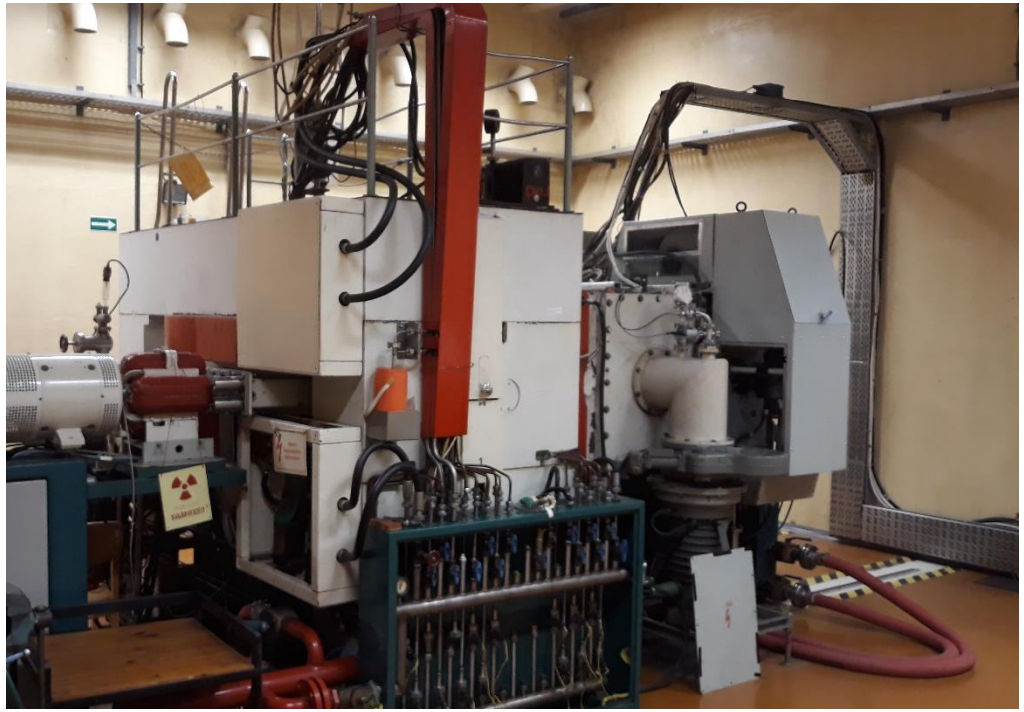
Table 2 Available cyclotron beams with maximally extracted beam intensities and the required harmonic mode of operation of the RF-system

Particle	Energy [MeV]	RF harmonic mode	Max. extracted current [μA]
p	2–2.6	3	20
	2.6–18	1	50
d	2.3–5.2	3	20
	5.2–10	1	50
$^{3}He^{2+}$	4–8.0	3	2
	8.0–27	1	8
$^{4}He^{2+}$	3.5–10.4	3	5
	10.4–20	1	20



Energy spread and stability of the extracted beam < 0.3%
Energy spread and stability of the analyzed beam < 0.1%

Operation in 24/5

Beamlines offered for TNA users

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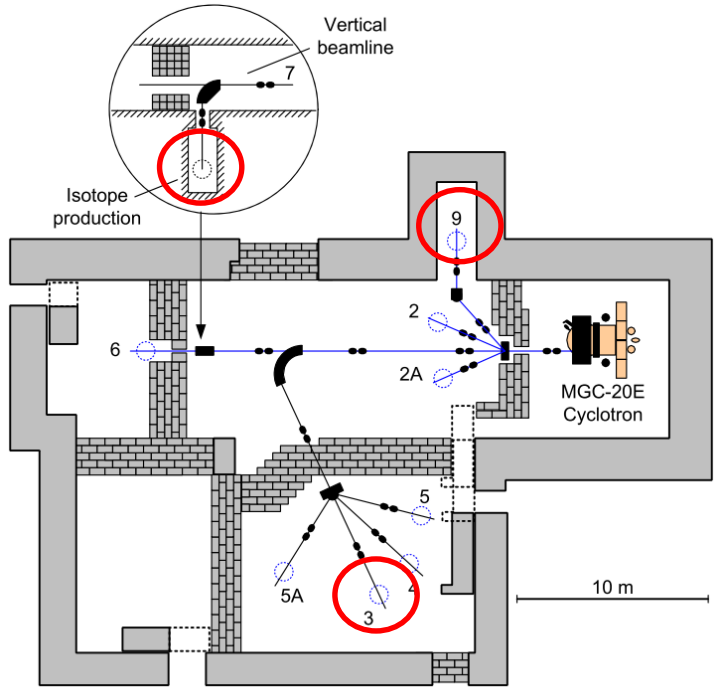
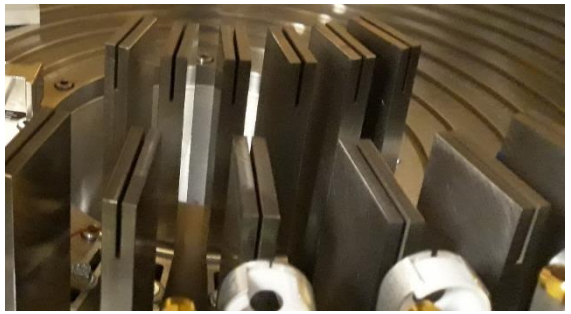
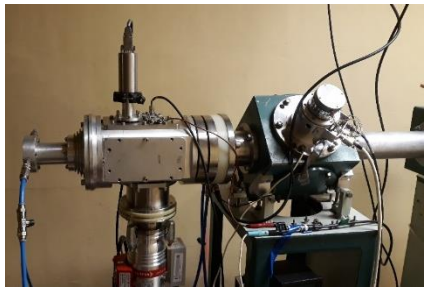
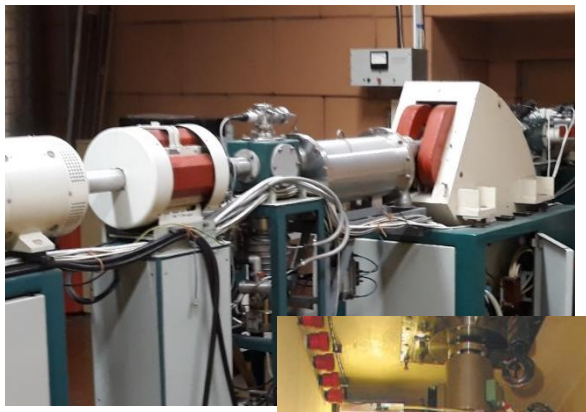


Fig. 2 Cyclotron vaults and beamlines

Scattering chamber equipped with Si detectors on turntable 3. beamline	Irradiation chamber with RBS 9. beamline	Vertical beamline for isotope production 7. beamline







Auxiliary equipment

Vacuum evaporator

Target analysis

PIXE
RBS
XRF
Alpha-spectrometer
SNMS
ICPMS

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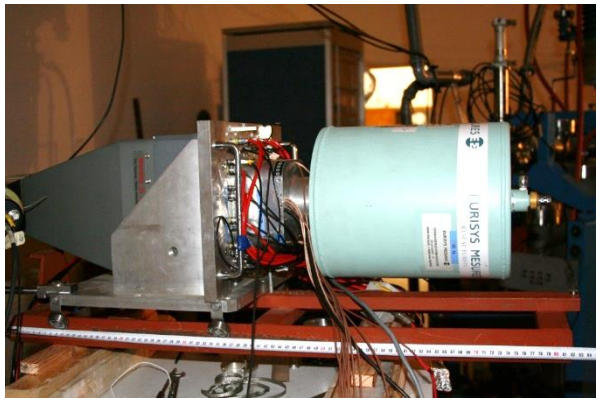
Radiochemistry lab

Atomki booklet (2014) ed. Mátyás Hunyadi

Auxiliary equipment

HPGe detectors for offline counting		HPGe detectors for in-beam measurements	
100% relative efficiency in ULB shielding	LEPS in shielding	Single crystal detectors with 100% and 45% relative efficiencies	Clover type composite detector



Recent nuclear astrophysics related results from the cyclotron

A. Ornelas, et al.: *α scattering and α-induced reaction cross sections of ^{64}Zn at low energies*, Phys. Rev. C **94**, 055807 (2016)	A α-nucleus optical potential study using the scattering chamber
Z. Halász, et al.: *Experimental study of the astrophysical γ-process reaction ^{124}Xe(α,γ)^{128}Ba*, Phys. Rev C **94**, 045801 (2016)	Heavy element synthesis related cross section determination with thin windowed gas cell target
T. N. Szegedi, et al.: *High precision half-life measurement of ^{125}Cs and ^{125}Xe with γ-spectroscopy*, Nucl. Phys. A **986**, 213 (2019)	Auxiliary measurements to improve the precision of the activation method
T. Szücs, et al.: *Cross section of α-induced reactions on ^{197}Au at sub-Coulomb energies*, Phys. Rev. C **100**, 065803 (2019)	Heavy element synthesis related cross section determination with solid target
T. Szücs, et al.: *Cross section of ^{3}He(α,γ)^{7}Be around the ^{7}Be proton separation threshold*, Phys. Rev. C **99**, 055804 (2019)	Solar fusion related reaction study using a thin windowed gas cell target

Recent nuclear astrophysics related results from the cyclotron with external users

• **The users can use the previously offered:**
  • **Target preparation site**
  • **Detectors**
  • **Irradiation sites**
	• **OR we are open to provide only the beam, and with agreement of the technicalities the user can bring and use their own:**
	  • **Targets**
	  • **Detectors**
	  • **Irradiation chamber**
	  • **Etc.**	

Z. Korkulu, et al.: *Investigation of α-induced reactions on Sb isotopes relevant to the astrophysical γ-process*, Phys. Rev C **97**, 045803 (2018)	G. G. Kiss, et al.: *Astrophysical S-factor for the $^{3}He(\alpha,\gamma)^{7}Be$ reaction via the asymptotic normalization coefficient (ANC) method*, Phys. Lett. B **807**, 135606 (2020)	R. Buompane, et al.: *Test measurement of $^{7}Be(p,\gamma)^{8}B$ with the recoil mass separator ERNA*, Eur. Phys. J. A **54**, 92 (2018)
Users brought only the target material, prepared the target, made the irradiation and counting by us. 1 day irradiation per point, few day preparation, several weeks of counting	Users brought the targets, beam gas and detectors; we provided the scattering chamber and the beam. 3 days beamtime with 2 days preparation	Users brought the targets, we produced the ^{7}Be at the vertical beamline. 4 days beamtime with 1 day preparation

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Atomki booklet (2014) ed. Mátyás Hunyadi

MAP

I	›	Administration and management
	›	Section of Electron Spectroscopy and Materials Science
	›	Section of Atomic Collisions
II	›	Section of Environmental and Earth Sciences
	›	ECR Laboratory
III	›	Low-temperature Physics Laboratory
IV	›	Apartments
V	›	Tandetron Laboratory
	›	Mechanical workshop
VI	›	Laboratory for Materials Science and Surface Physics
	›	UD - ATOMKI Department of Environmental Physics
	›	Section of Electronics
VII	›	Hertelendi Laboratory of Environmental Studies – AMS Laboratory
VIII	›	Section of Theoretical Physics
	›	Library
	›	Cafeteria
IX	›	Laboratory of Electrostatic Accelerators
	›	Section of Ion Beam Physics
X	›	Garage
XI	›	Stores
XII	›	Cyclotron Laboratory
	›	Section of Experimental Nuclear Physics
	›	Section of Cyclotron Applications
	›	Lecture Hall
XIII	›	Electric supply
XIV	›	Guest house