



# The role of ATOMKI in world leading Underground Nuclear Astrophysics Experiments

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HUN-REN ATOMMAGKUTATÓ INTÉZET

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# Research infrastructure at ATOMKI



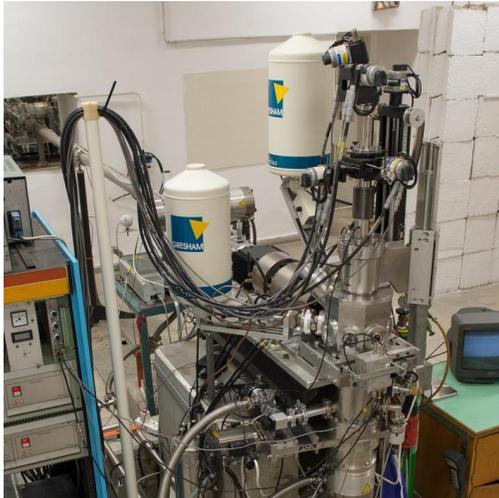
1985--MGC-20E Cyclotron



1971--5MV Van de Graaff



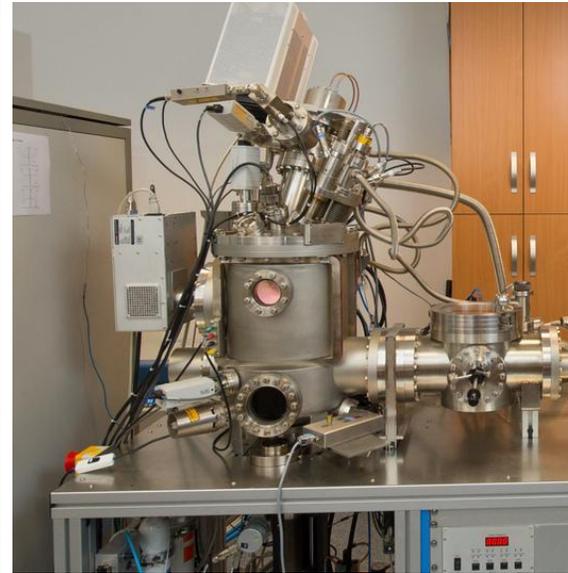
# Surface science and analysis



Ion Beam Analysis  
(IBA)



X-ray Photoelectron  
Spectroscopy (XPS)



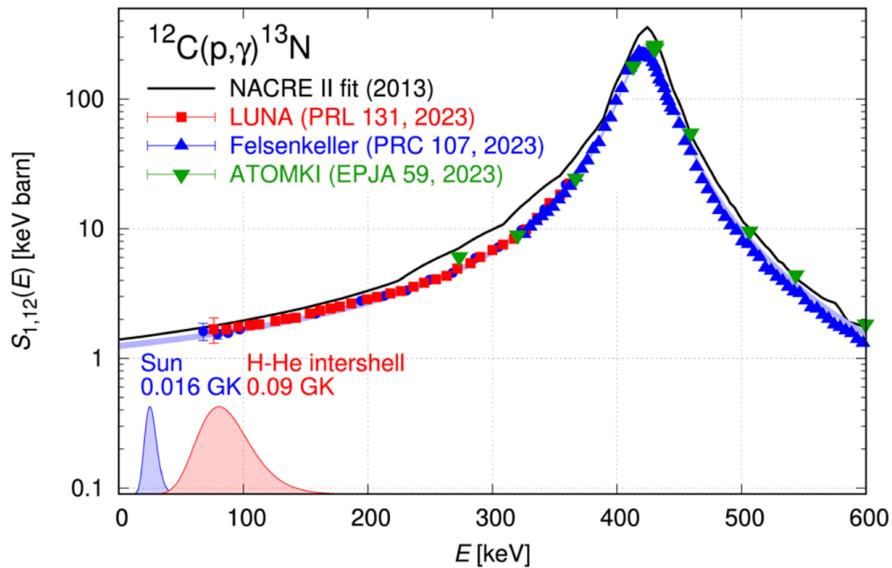
Secondary neutral-particle/ion  
mass spectrometry SNMS/SIMS



Physical Vapor Deposition  
(PVD)

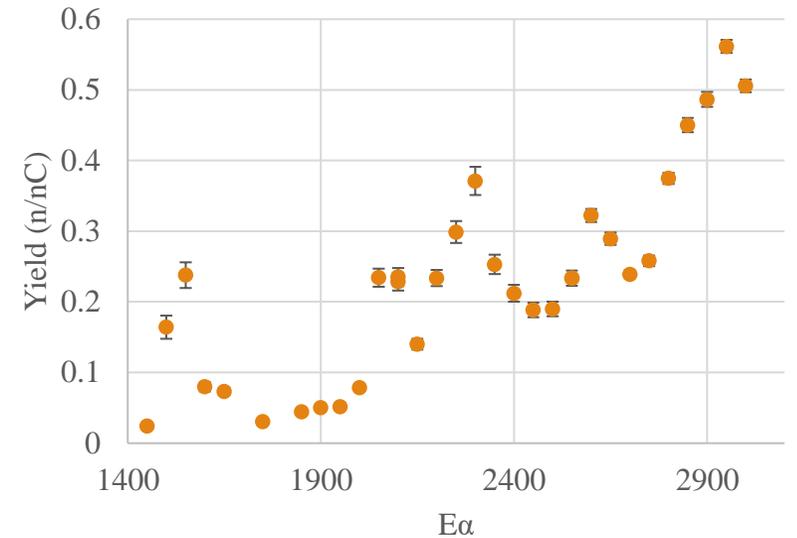
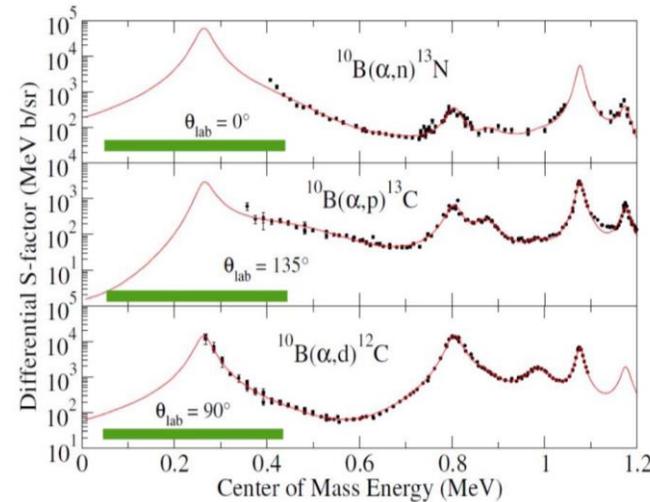
# Study of nuclear reaction towards higher energy

- Benchmarking experiments
- Improving theoretical description of the reactions



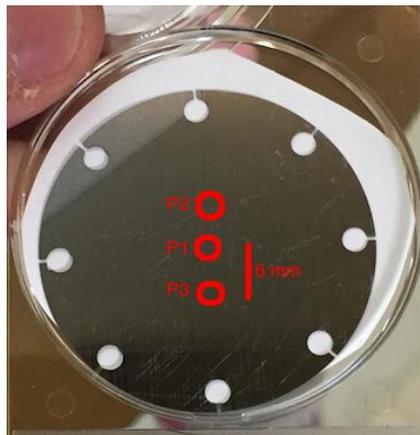
[https://www.nupecc.org/lrp2024/Documents/nupecc\\_lrp2024\\_web.pdf](https://www.nupecc.org/lrp2024/Documents/nupecc_lrp2024_web.pdf)

Gy. Gyürky et al., Eur. Phys. J. A (2023) 59:59  
 L. Csedreki et al., Nuclear Physics A 1037 (2023) 122705  
 J. Skowronski et al., Phys. Rev. Lett. **131**, 162701  
 J. Skowronski et al., PHYSICAL REVIEW C **107**, L062801 (2023)



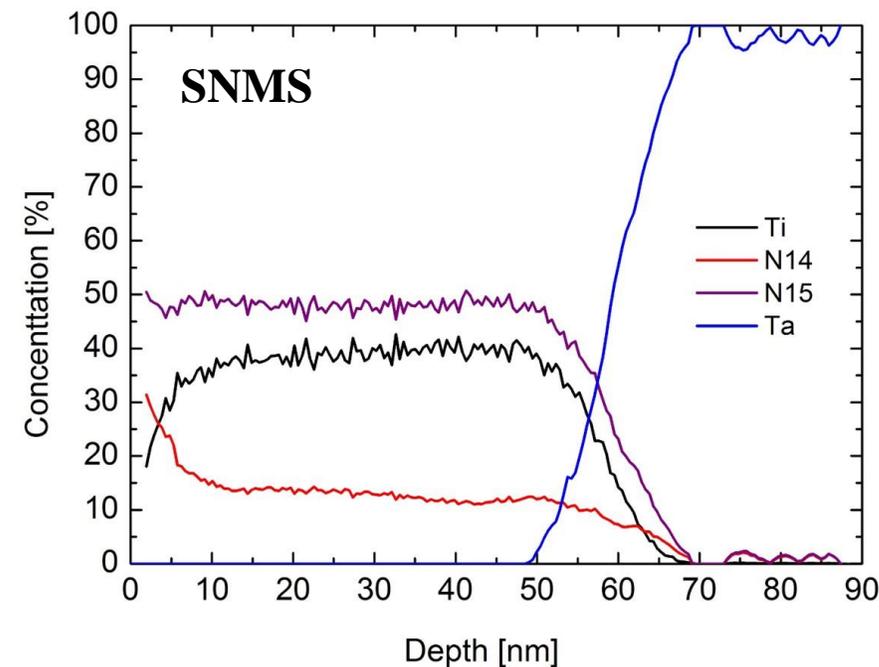
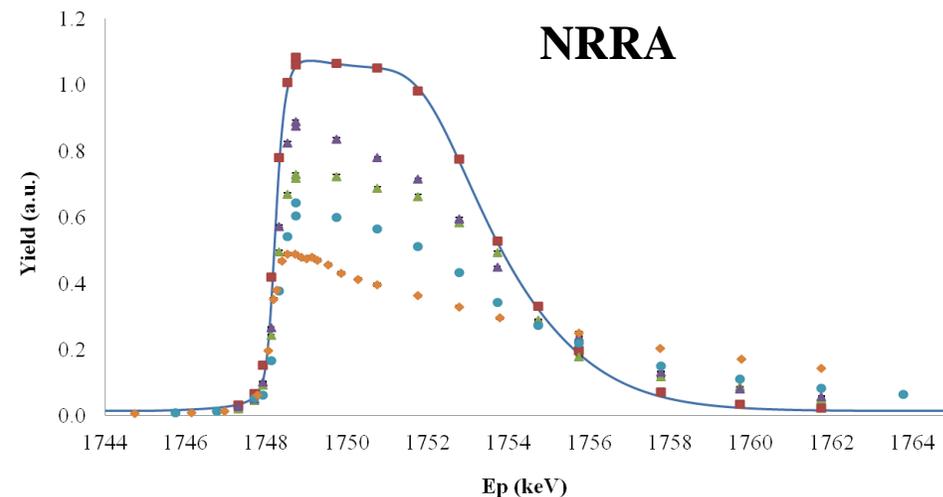
Q. Liu et al., PHYSICAL REVIEW C **100**, 034601 (2019)  
 A.Gula et al., PHYSICAL REVIEW C **107**, 025805 (2023)

# Target production and characterization



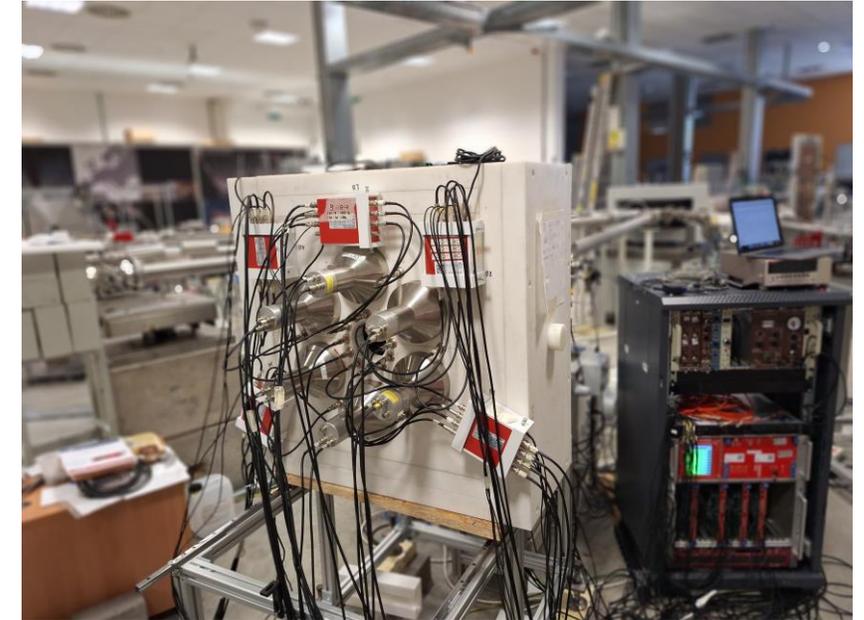
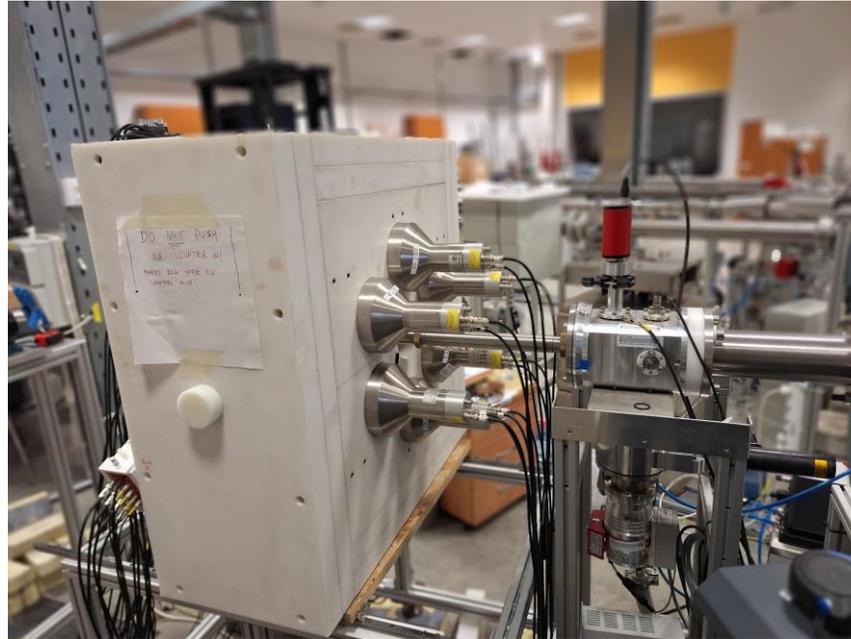
- **Homogeneity test**
- **Composition analysis**
- **Target degradation monitoring**

Material	Reaction
Lithium	${}^6\text{Li}(p, \gamma){}^7\text{Be}$
Boron	${}^{10}\text{B}(\alpha, n){}^{13}\text{N}$ ; ${}^{10}\text{B}(\alpha, d){}^{12}\text{C}$ ; ${}^{10}\text{B}(\alpha, p){}^{13}\text{C}$
Carbon	${}^{12,13}\text{C}(p, \gamma){}^{13,14}\text{N}$ , ${}^{13}\text{C}(\alpha, n){}^{16}\text{O}$
Sodium	${}^{23}\text{Na}(p, \gamma){}^{24}\text{Mg}$
Magnezium	${}^{24,25,26}\text{Mg}(p, \gamma){}^{25,26,27}\text{Al}$
Aluminium	${}^{27}\text{Al}(p, \gamma){}^{28}\text{Si}$

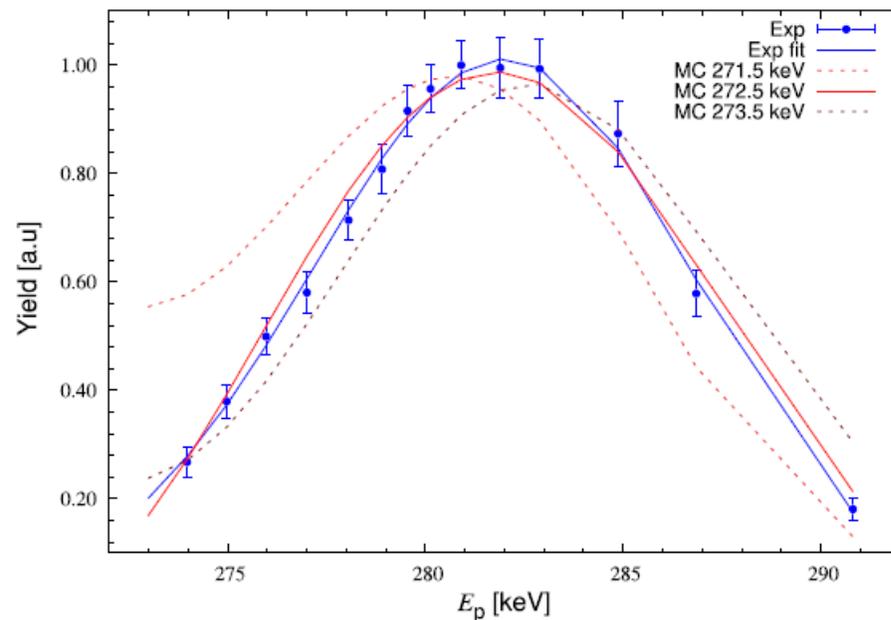
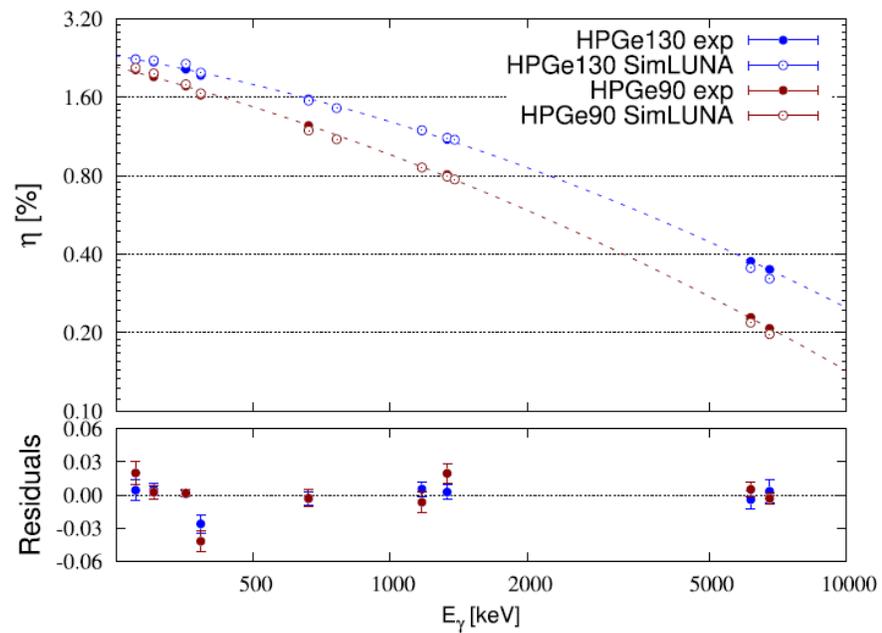
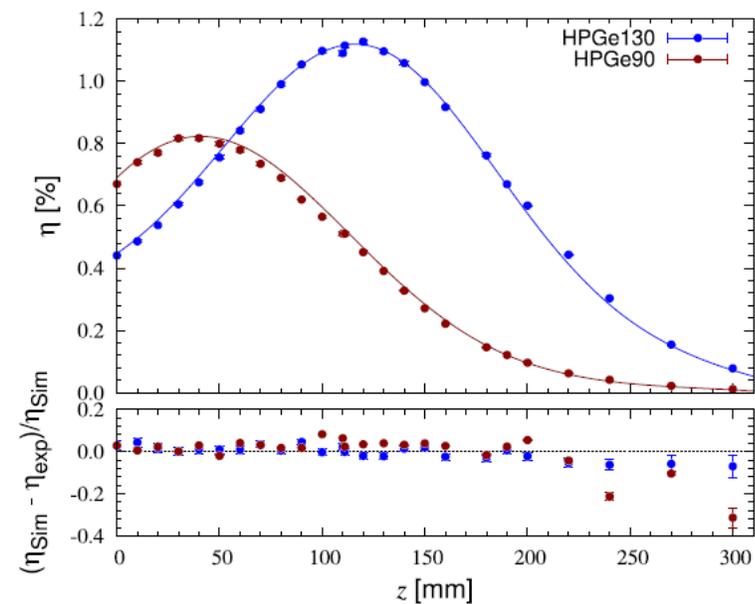
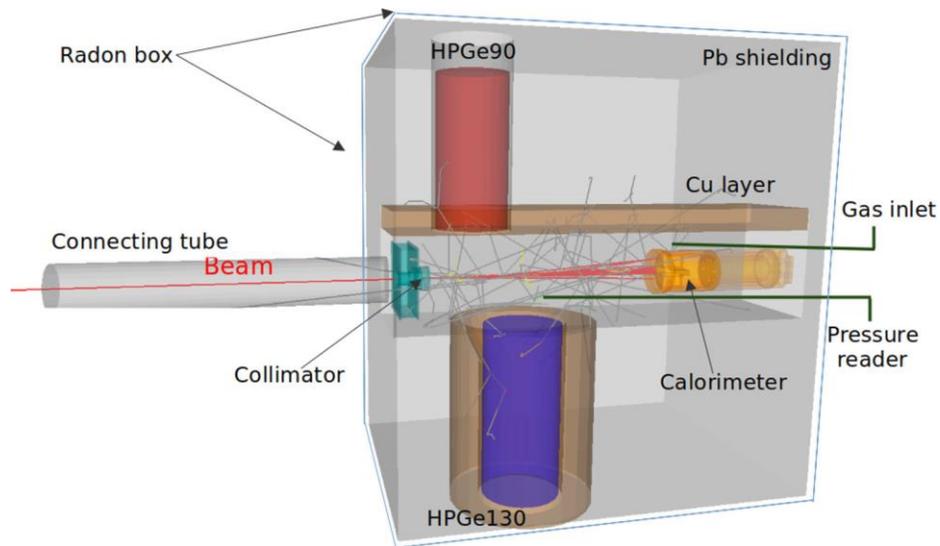


# Detector characterization

- Am/Be neutron sources
- Non-resonant ( $^{51}\text{V}(p,n)^{51}\text{Cr}$ ) and
- Resonant nuclear reactions ( $^{13}\text{C}(\alpha,n)^{16}\text{O}$ )



# Simulation (SimLUNA)



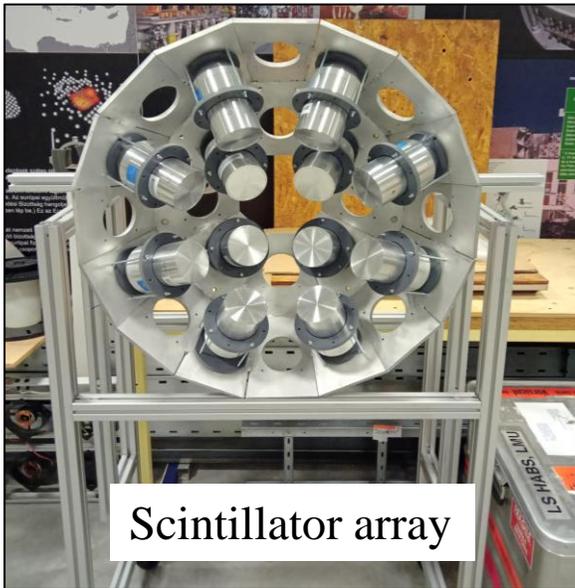


In addition to undertaking shifts in UG experiments:

- WG leader in  $^{14}\text{N}(p,\gamma)^{15}\text{O}$
- LUNA IT representative
- Campaign in  $^{12}\text{C}+^{12}\text{C}$  in the frame of ChETEC-INFRA
- Production of radioactive sources  $^7\text{Be}$ ,  $^{85}\text{Sr}$  for detector calibrations
- SimLUNA (main developer)

# Recent and future prospects

- Large efficiency, high resolution scintillator arrays
- Magnetron sputtering system to produce targets for inverse kinematics
- High intensity beamline ( $\sim 50 \mu\text{A}$ )



Scintillator array



Magnetron sputtering system

# Summary

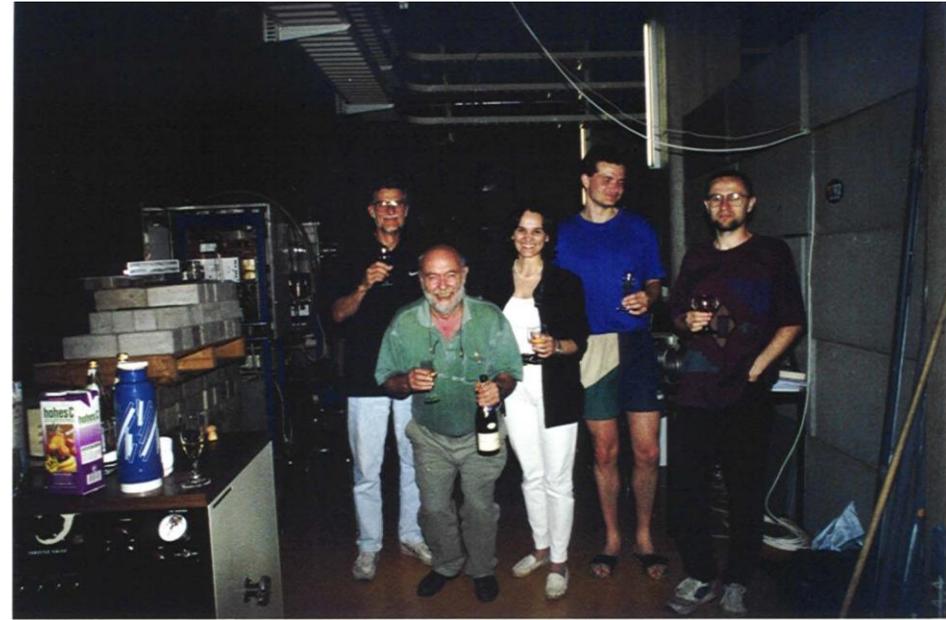
- Study of nuclear reaction at higher energy
  - Benchmarking experiments
  - Improving theoretical description of the reactions
- Based on the experimental apparatus of ATOMKI
  - Test methodology for ultra sensitive experiments
  - Characterisation of experimental apparatus
  - Target production
  - Leading role in WGs
  - Radioactive sources for low environmental measurements

# Summary

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  - Benchmarking experiments
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- **Future**

**INTERGENERATIONAL COLLABORATION!!**





Thank you for your attention!

## LUNA members at HUN-REN ATOMKI

Zsolt Fülöp  
György Gyürky  
Zoltán Elekes  
Tamás Szücs  
László Csedreki

