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The Bellotti Ion Beam Facility

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https://l.infn.it/bellotti

The Bellotti Ion Beam Facility (IBF) is a **LNGS user facility open to external scientific proposals**.
It builds up on the legacy or the LUNA Collaboration which is active at LNGS underground laboratories since more than 30 years. Bellotti IBF has been **funded as part of an "Award Project" by the Italian Ministry of Education, University and Research** (MIUR) on a **proposal originated by the LUNA Collaboration**.
Located in the **deep underground laboratory of the LNGS** (1,400 m below ground level), the Bellotti IBF allows to perform ion beam experiments in an environment characterized by a **cosmic radiation flux** that is **six orders of magnitude lower than that of the Earth's surface**.
The Bellotti IBF opens new frontiers not only in the field of **nuclear astrophysics** and **nuclear physics**, but also in **applied sciences**.

3.5 MV Singletron™ Accelerator

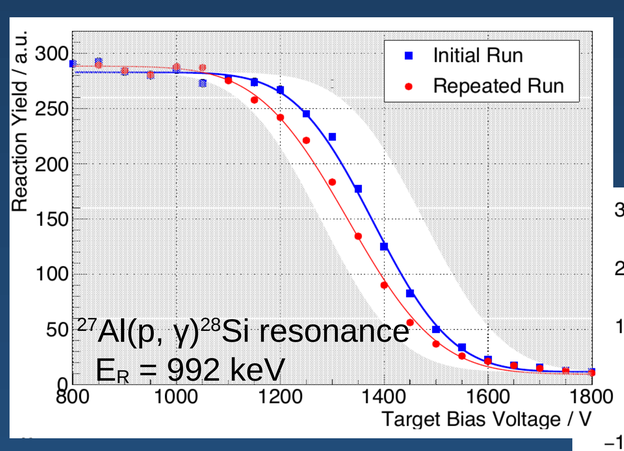
The Bellotti IBF is built around a 3.5 MV Singletron, custom-made by HVEE to meet the technical requirements put forth by LNGS in terms of
→ **ion beam intensity**, **energy definition & stability**;
→ **absence of accelerator-induced radiation** background;
→ **safety**, and **environmental protection**;
The machine is equipped with an **ECR source on the terminal**, a **GVM,** a **CPU** and a high **precision resistor chain** for Terminal Voltage stabilization.

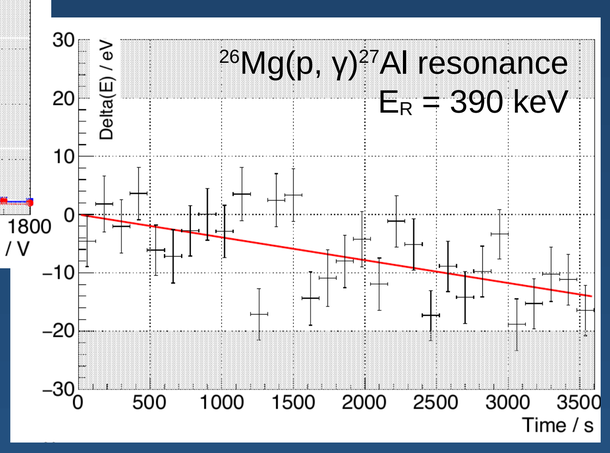
Terminal Voltage Specifications

Range	0,5 – 3,5 MV
Ripple	7,3 V @ TV = 0,3 MV
	23,4 V @ TV = 1,0 MV
	30,4 V @ TV = 3,5 MV

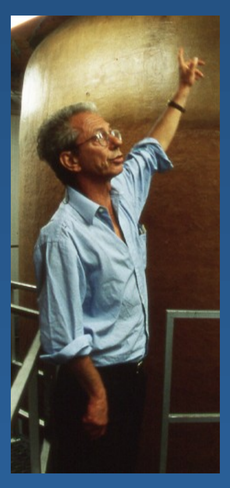
Ion Beam Characteristics

Beam Energy Intensity		
H^+	< 1 mA	
$^4He^+$	< 0,5 mA	0,3 MeV < E_{max} < 3,5 MeV
$^{12,13}C^+$	< 0,150 mA	
$^{12,13}C^{++}$	< 0,100 emA	2,0 MeV < E_{max} < 7 MeV
Beam Energy Reproducibility by repeated resonance scans (a)		
$^{25}Mg(p,\gamma)^{26}Al$ - E_{res}= 390 keV		57 +/- 9 eV
$^{27}Al(p,\gamma)^{28}Si$ - E_{res}= 992 keV		55.5 +/- 2.2 eV
Beam Energy Drift over 1 hour measured with nuclear resonances (b)		
$^{25}Mg(p,\gamma)^{26}Al$ - E_{res}= 390 keV		-13.4 +/- 2.7 eV
$^{27}Al(p,\gamma)^{28}Si$ - E_{res}= 992 keV		-18.8 +/- 6.0 eV

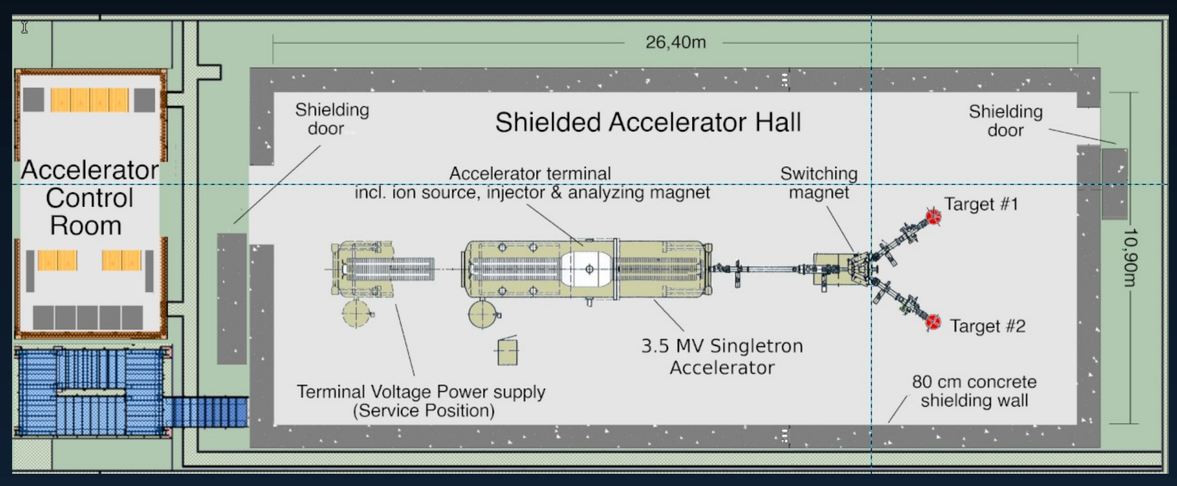




Enrico Bellotti



Enrico Bellotti was the first director of the Gran Sasso National Laboratories. In 1992, he **initiated** the installation of a small accelerator at LNGS, **LUNA 50**, on the proposal of **G. Fiorentini** and **C. Rolfs**, in order to study nuclear reactions related to the "Solar Neutrino Problem". The results went hand in hand with the LNGS-based solar neutrino experiments GALLEX and BOREXINO. These pioneering activities not only set the **basis** for the installation of the **LUNA-400 accelerator** and for the **Bellotti IBF** but for the **use of accelerators in underground laboratories in general**.



The Bellotti IBF is **located in Hall B of the LNGS underground laboratories**.

It consists of an **accelerator hall**, shielded by 80 cm thick concrete walls, and a two-storey building with a **control room** and a **user room**.

The **maximum allowable neutron flux is 2000 neutrons per second** in the accelerator hall.

This configuration ensures that the neutron flux outside the accelerator hall, which is a factor of 1000 lower than above ground, does not increase as unintended consequence of accelerator operation.

Beam Time Access

Calls for experiments are issued each year. The 1st call was successfully closed on October, 30 2023. The 2nd call closed on August 18, 2024.

Proposals may cover **nuclear astrophysics** as well as **applied sciences**.

Proposals are evaluated by a **Program Advisory Committee (PAC)** established within the LNGS Scientific Committee.

The Bellotti IBF is provisionally accepted as the 14th **Transnational Access Facility of ChETEC-INFRA** (https://l.infn.it/189)

User Support

The technical management and the operation of the accelerator is assigned to the **Accelerator Service of LNGS**.

The Accelerator Service also supports users in planning and installation of their experimental equipment.

Further Reading

- **"A High Intensity, High Stability 3.5 MV Singletron™ accelerator"**, A. Sen et al. doi: 10.1016/j.nimb.2018.09.016
- **"The deep underground Bellotti Ion Beam Facility —status and perspectives"** M. Junker et al . doi: 10.3389/fphy.2023.1291113

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