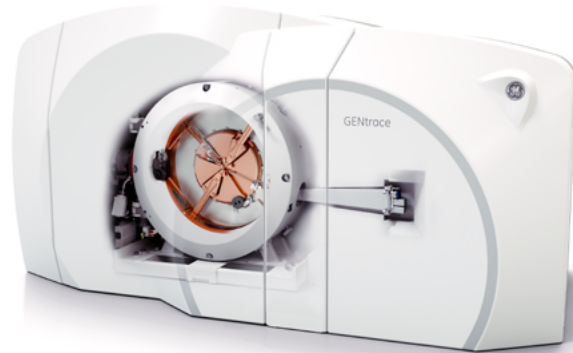




GENtrace™ cyclotron

Data Sheet



Overview

The GE Healthcare GENtrace cyclotron is a compact, automated, single-particle cyclotron designed for fast, easy and efficient production of PET isotopes. It offers the ability to meet your clinical needs and flexibility for your research programs.

The GENtrace cyclotron is a negative ion cyclotron using GE's industry leading vertical mid-plane design, giving you the benefits of a compact footprint and easy maintenance.

The PET isotope that can be produced by the GENtrace cyclotron is fluorine-18. This system is also designed to support future production of carbon-11*. For efficient conversion into finished PET precursors and tracers, we recommend transferring these isotopes to either a FASTlab™ 2 or TRACERlab™ FX2 chemistry processing system.

Primary benefits

Fully automated

The entire sequence of producing the PET isotopes is fully automated. Similar to the workflow required for the operation of a generator (e.g. Tc-99m), the technician will

only need to select the desired isotope and the amount of activity required. The control system automatically prepares the cyclotron and the targets, tunes the beam and manages the target irradiation.

Reliability and production capacity

The GENtrace cyclotron is optimized for in-house hospital operation. The production capacity of the cyclotron is sufficient for at least twelve doses per production. A second production can be initiated immediately after the first production. Several technical innovations and improvements have been introduced to further increase the ease-of-use and reliability. These include the introduction of a hydrogen gas generator, a piezoelectric beam extraction driver and a turbo molecular vacuum pump.

Lower dose to personnel

The vertical mid-plane design of the cyclotron and quickrelease components assist in significantly reducing the radiation dose to maintenance personnel. The reduction in potential exposure is further facilitated by the separation of the targets from the cyclotron magnet by a short beam pipe. The beam pipe, an industry first innovation, enables separate access to one

area of the cyclotron while protecting the service technician from potential exposure from the other area.

Serviceability

The GENtrace cyclotron has been designed to give you reliable and robust production for at least 6 months of usage before maintenance is required†. The target, ion source and extraction system have redundancies and technical features built-in to minimize downtime for service interventions.

Remote connectivity for support and data analysis is accessible through GE OnLine Center.

System configuration

Magnet

The design and composition of the GENtrace cyclotron magnet system offers simple and robust operation. The iron in the magnet yoke also acts as a part of the radiation shielding. The magnet is water-cooled by a closed-loop cooling water system. Hardware interlocks continuously monitor the cooling waterflow and temperature. This improves the stability of the ¹⁸F-fluoride production and increases the reliability and uptime of the overall system.

Radiofrequency (RF) system

The RF system consists of two interconnected dees, which form a resonator and an RF Power Generator.

Within the vacuum chamber, the RF system accelerates particles to the desired energy. This operation is automatically regulated by the accelerator control system.

Ion source

The ion source for the GENtrace cyclotron is mounted internally in an adjustable position. The design is of the Penning Ionization Gauge (PIG) discharge type with cathodes heated by the discharge.

The ion source is designed for fast exchange, also including a GE designed mechanism for precise alignment after maintenance interventions. A precise alignment is critical for an optimal beam regulation and long life time of the ion source.



Ion source

Beam extraction

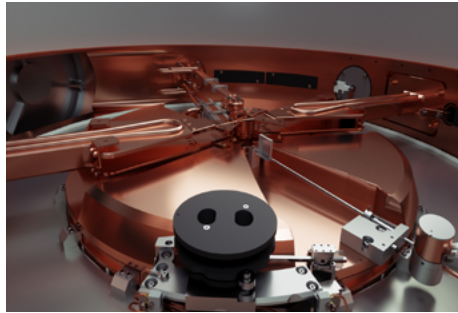
The GENtrace cyclotron has a unique beam extraction system based on a piezoelectrically driven mechanism. This enables accurate beam regulation which is critical for positioning the beam precisely into the target.

The entire extraction foil carousel is made of graphite, a material selected for its stability in high vacuum and temperature conditions.

Eight carbon foils within the carousel ensures system redundancy and longevity.

Beam diagnostics

The beam current is continuously monitored by the beam diagnostic system to fully automate the start-up, tuning and operation of the beam.

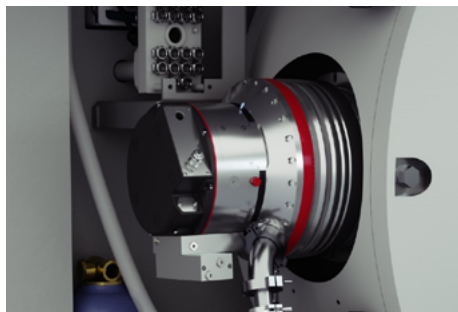


Extraction foil carousel

Vacuum system

The GENtrace cyclotron vacuum system consists of a high vacuum turbo molecular pump mounted directly on the vacuum chamber/magnet yoke and a mechanical roughing pump. This differentiates the GENtrace cyclotron from all other cyclotrons on the market today.

A clean vacuum provided by the turbo molecular pump, is key to the robust and stable beam in the GENtrace cyclotron. A dedicated vacuum system controller performs pressure monitoring, vacuum pump sequencing and system operation. The magnet yoke replaces the standard vacuum chamber and completely encapsulates the acceleration chamber which contributes to the increased reliability of the GENtrace cyclotron.



Turbo molecular pump

Target mounting and support

There are three available target positions at the end of the beam extension pipe. The extension pipe also separates the targets from the accelerator chamber which contributes to the reduction in dose to the service personnel. The mounting flange and targets permit rapid and convenient installation and removal of targets to minimize dose exposure.

Neither the liquid nor gas targets require helium cooling due to a grid-supported foil design. The elimination of the helium cooling system offers significantly improved reliability as well as maximized beam energy on target. Each target system type will be available as separate options.

User control and interface

The GENtrace cyclotron control system is equipped with an accelerator control unit and a PC client station. Additional client stations can be purchased allow control of the cyclotron from multiple locations.

To produce the tracer, the user simply selects the type of isotope and the amount of activity to start the production sequence. The control system carries out all the automated closed-loop and logical control tasks to provide unattended beam control and regulation. The operator may perform tasks away from the control system and is not required to physically supervise the production. During the production, the client station displays the system status, the amount of activity produced and when the desired activity amount will be ready for delivery.

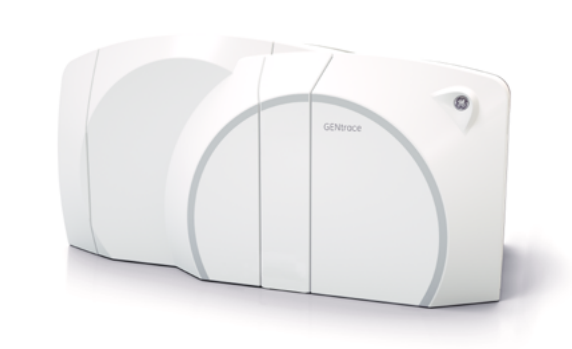
The control system functions include:

- Automatic system start-up, including sub-system verification and monitoring
- Automatic beam tuning to optimize system operation and efficiency
- Continuous monitoring of system operating parameters, with appropriate protection interlocks and warnings.
- Batch report with hard copy print out possibility.
- Data logging of operational parameters
- Remote connectivity for support and data analysis by GE On-line Center.

Cyclotron shield

The GENtrace cyclotron comes with a dedicated self-shield designed to have a dose rate of 10 $\mu\text{Sv/h}$ on the surface. This low dose rate will, in most cases, permit siting in rooms with existing walls and infrastructure in place. The modular shield design permits simple transportation into an existing building. The shield has separate doors for the accelerator and targets, reducing radiation exposure during service

and maintenance interventions. The vacuum pump is also accessible through a separate door. The cyclotron's sub-systems are uniquely housed at the rear of the shielding enabling fast and easy installation and maintenance.



GENTrace cyclotron shield

System specifications

Cyclotron	
Energy	7.8 MeV
¹⁸ F-fluoride capacity	28 GBq / 750 mCi @ 2 h production
¹¹ C-carbon dioxide	in development
Weight	6.7 metric tons
Self-shield dimensions	4.04 m x 2.27 m x 2.00 m (closed; L x W x H)
Self-shield weight	42.9 metric tons
Minimum room size	5.8 m x 6.2 m (36 m²) minimum 2.5 m clearance height
Power requirements (operation)	35 kW
Power requirements (stand-by)	2 kW

GENTrace products

S9110AA GENTrace ¹⁸F system

Shielded GENTrace cyclotron with one ¹⁸F-target system

P5110AC GENTrace ¹⁸F 16 target system

Complete target system for ¹⁸F-fluoride production, 1.6 ml fill volume

P5110AD GENTrace ¹⁸F 16 target body

Spare target body for GENTrace ¹⁸F 16 target system



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In addition, we partner with healthcare leaders, striving to leverage the global policy change necessary to implement a successful shift to sustainable healthcare systems.

Imagination at work

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