



# PHENICS proton beam specifications

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## Facility

Name	PHENICS - Protons of High Energy for Irradiation of Components & Systems
Location	Charleroi (Gosselies), Belgium
Source type	Synchrocyclotron
Source name	IBA S2C2 / Proteus®ONE

## Energy

Nominal energy	230 MeV max.
Minimum energy (without additional degraders)	70 MeV (10 MeV with degraders)
Energy selection/accuracy	70 to 230 MeV: continuous adjustment (switching in < 600ms), lower energy with degraders / Energy spread @230 MeV = 400 keV.
Energy resolution	< 1% from 70 to 230 MeV

## Time structure

Type of beam	pulsed beam
Pulse (spill) duration	7-10 $\mu$ s
Repetition rate	1 kHz (nominal, max.)
RR selection/accuracy	continuously variable from 1 kHz down to < 1 spill/minute, via user interface

## Current & flux

Instantaneous (=flux per pulse or "spill") / max. average flux (p/cm <sup>2</sup> /s)	@230 MeV: $2.18 \times 10^{12}$ (inst.)/ $2.93 \times 10^9$ (avg) @150 MeV: $1.60 \times 10^{12}$ (inst.)/ $1.54 \times 10^9$ (avg) @100 MeV: $1.16 \times 10^{12}$ (inst.)/ $6.17 \times 10^8$ (avg)
Charge per pulse	134 pC / $8.375 \times 10^8$ p+ (nominal)
Min.-max. Current	5 pA (min.)-600 nA (max), 134 nA (nominal)
Flux selection / adjustment	Current selection using the physics mode interface
User flux control	From the max value down with a factor of $10^5$
Dosimetry method / Beam counting and monitoring system, accuracy	Real-time ionization chamber

## Beam geometry

Spot shape	Gaussian
Spot size at nozzle outlet:	@ 230 MeV: 3.5 mm (1- $\sigma$ ), 8.225 mm (FWHM) @ 70 MeV: 7.7 mm (1- $\sigma$ ), 18.095 mm (FWHM)
Spot size tolerance	$\pm 10\%$ or $\pm 0.5$ mm
Spot size adjustment	up to $\pm 10$ cm diam. with diffuser (manual preselection)
Spot symmetry / Uniformity	$\pm 10\%$ / $\pm 2\%$ (10% with diffuser+collimator)

## DUT positioning & Beam scanning

Scan mode for DUT	Precision pencil beam scanning or fixed
Scan range	up to $20 \times 24$ cm <sup>2</sup> without motion
Positioner amplitude: $\geq 50$ cm in width, $\geq 40$ cm in height, $\geq 100$ cm in length	$\geq 50$ cm W, $\geq 40$ cm H, $\geq 100$ cm L
Positioner accuracy	< 1 mm from isocenter, < 0.5° on beam incidence
Positioning assistance	Lasers beams with isocenter in green
Positioner table load	max. 200 kg, including 50 kg couch
Other positioning features	Easy positioning & lock for PMMA degraders & collimators (in development)
Availability of DUT temperature setting and control, temperature regulation accuracy	No, room temperature

## Facility access

Planned opening date	Q1 2027
Access times	6 h-22 h, 5/7 days. Extra time on demand.
Access conditions	Belgian radiation protection regulations
Guaranteed uptime	98%