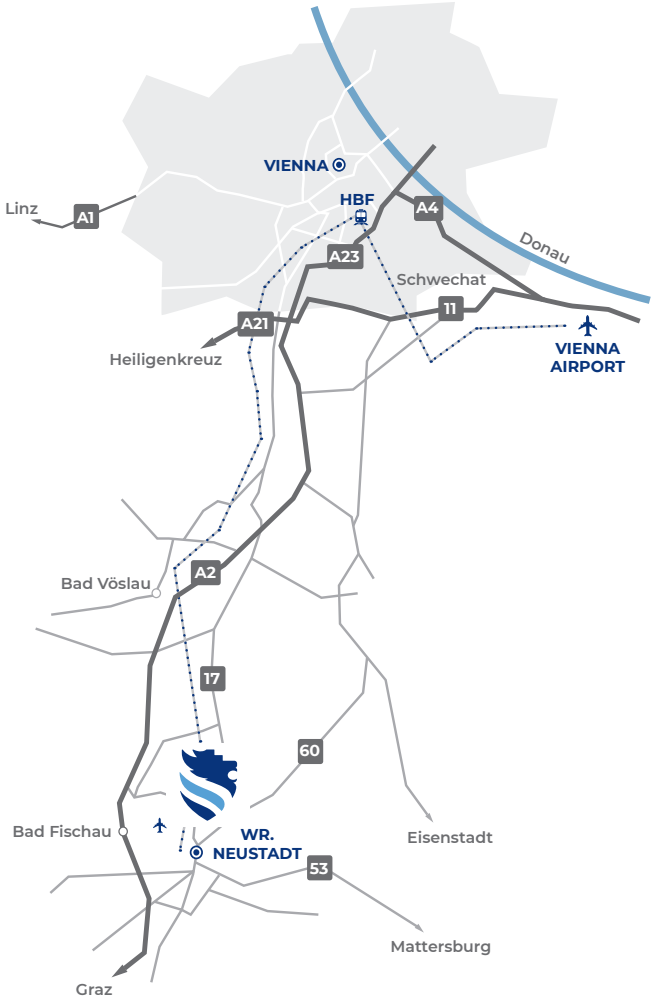
ABOUT FOTEC

FOTEC Forschungs- und Technologietransfer GmbH is the research and technology subsidiary of the University of Applied Sciences in Wiener Neustadt. The company was founded in 1998.

Our interdisciplinary team of experts carries out industrial and funded research and development projects. The execution of such projects is done in close cooperation with the University of Applied Sciences Wiener Neustadt, especially with the departments of Mechatronics, Microsystems Engineering, Business Engineering and Aerospace Engineering.

FOTEC serves orders from industry and also takes on technological and scientific challenges within the framework of national and international research and cooperation projects. These are enabled and supported by the national funding agency FFG, the European Space Agency ESA and the European Commission.



HOW TO REACH US

FOTEC resides in the city of Wiener Neustadt
in the direct vicinity of the University of Applied Sciences,
40 km south of Vienna.

CONTACT

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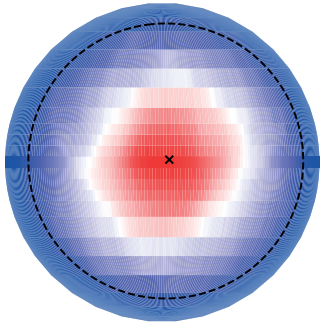
FOTEC
Research Subsidiary of
— FH Wiener Neustadt —

PLASMA DIAGNOSTICS

DIGITAL FARADAY CUP

A Faraday cup is a probe used in plasma diagnostics to measure the ion current density of an ion or electron beam. The major component of the probe is the collector which measures the current induced by impinging charged particles. By moving the probe through the beam, a current density distribution can be recorded.

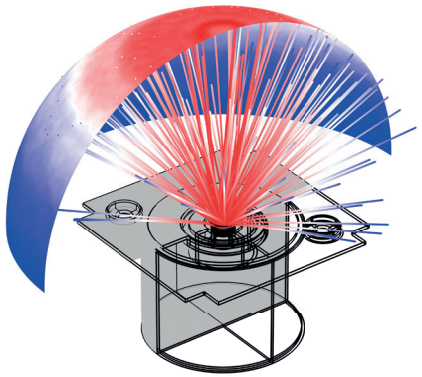


2D beam profile of a FEEP crown emitter measured with the DFC system

Differently from conventional designs, the measurement and control electronics of FOTEC's Digital Faraday cups (DFCs) are directly integrated into the Faraday Cup head. This avoids the use of long cables to carry EMI sensitive analogue signals and increases the SNR significantly.

SIMULATION MODEL

A particle simulation model for FEEP thrusters was developed using the DFC measurement system. Thanks to the good accordance between test measurements and simulations, this model is used to predict the beam properties for different geometries and operating points.



Ion trajectory simulation model

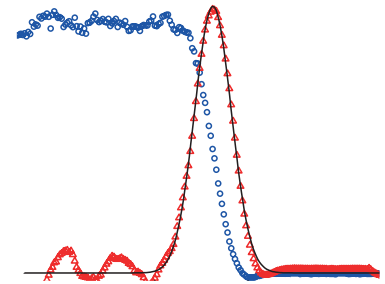
DIAGNOSTICS FACILITY

FOTEC's 14 m³ vacuum facility with a length of 3 m and an inner diameter of 2.2 m is used for performance, qualification and endurance test campaigns of electric propulsion systems.

The vacuum facility is equipped with a diagnostic boom which rotates at 1 m distance from the thruster to cover the entire plume. 23 DFCs and one RPA allow 2D mapping of the beam profile of an electric thruster.

RETARDING POTENTIAL ANALYSER

A Retarding Potential Analyser (RPA) is used to analyse the energy distribution of charged particles. FOTEC developed an RPA optimized for high-energetic low-density ion beams.
It consists of a grid system with four electrodes. The main electrode is the retarding electrode which separates charged particles of different kinetic energies.



Measured ion current density (blue) and derived energy distribution (red) of a FEEP crown emitter

PERFORMANCE

PROPERTY	DFC	DFC SYSTEM	RPA
Measurement	Current density	2D scan	Energy distribution
Particle species		Ions & electrons	
Particle energy	-	-	< 10 kV
Current density range		< 3.8 µA/cm²	< 12.7 µA/cm²
Accuracy		± 5 pA/cm²	±1.3 %
Sampling frequency		7 - 3520 Hz	6 - 3000 Hz
Electronics		Integrated, 12 V supply	-
Spatial resolution	-	Horizontal: 0.1° Vertical: 4 - 12°	-
Typical scan time	-	5 min	10 min

REFERENCES

- N. S. Mühlich et al., IFM Nano Thruster performance studied by experiments and numerical simulations, J. Phys. D: Appl. Phys. 54 (2021) 095203, DOI: 10.1088/1361-6463/abc84c.
- N. S. Mühlich et al., High-precision Digital Faraday Cups for FEEP Thrusters, IAC-21-C4.6.13.
- N. S. Mühlich, et al., Retarding potential analyser development for low density FEEP Thruster beam diagnostics, IEPC-2019-445.