Gefördert durch:

Bundesministerium für Wirtschaft und Energie

aufgrund eines Beschlusses des Deutschen Bundestages

Experimental Physics I

JLU NEUE WEGE. SEIT 1607.

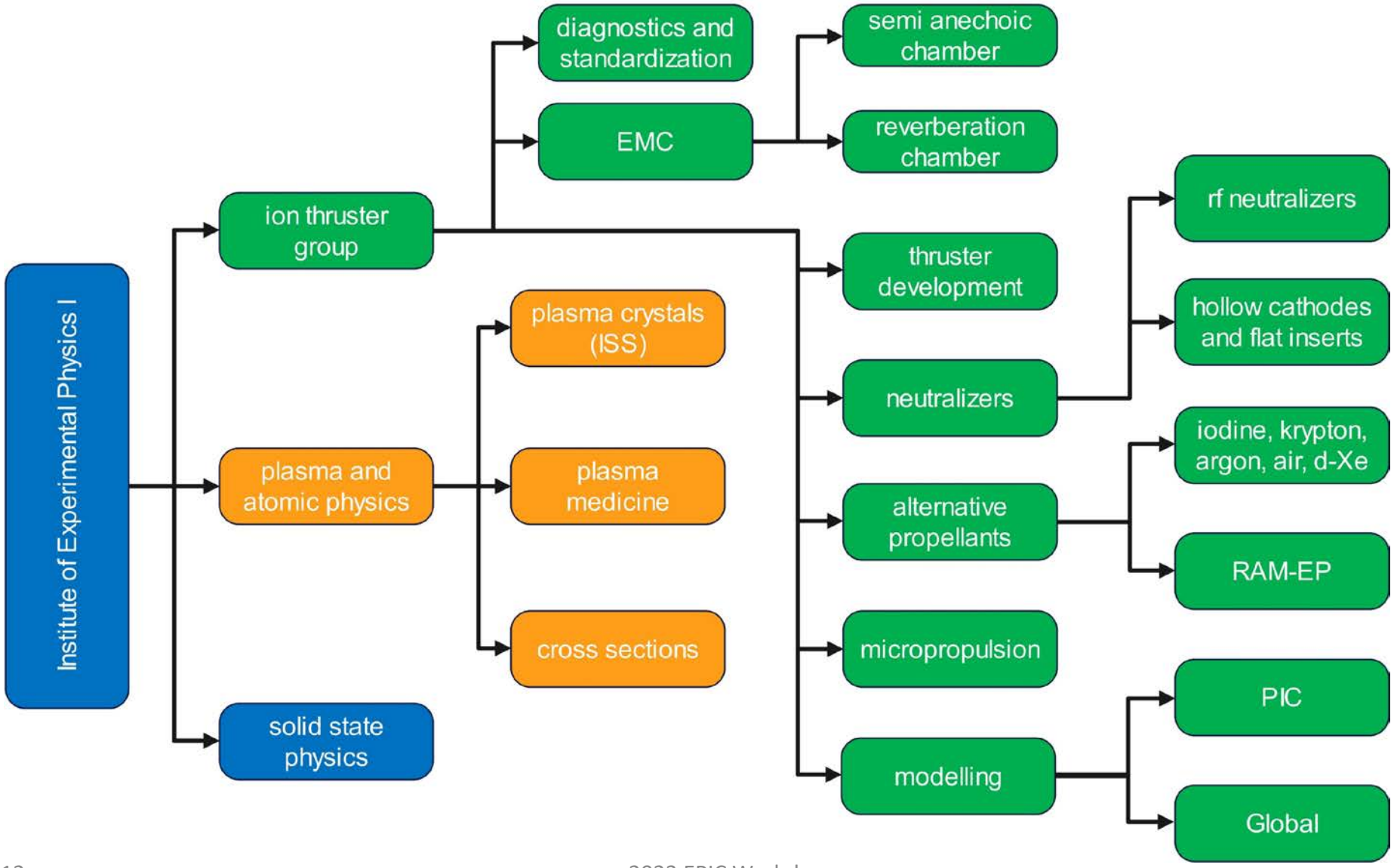
JUSTUS-LIEBIG-UNIVERSITÄT GIESSEN

Peter J. Klar, Kristof Holste

Current research and testing activities at JLU Giessen

2023-05-12 – EPIC Workshop 2023, SRC H2020, Città della Scienza, Naples, Italy

Research at IPI of JLU



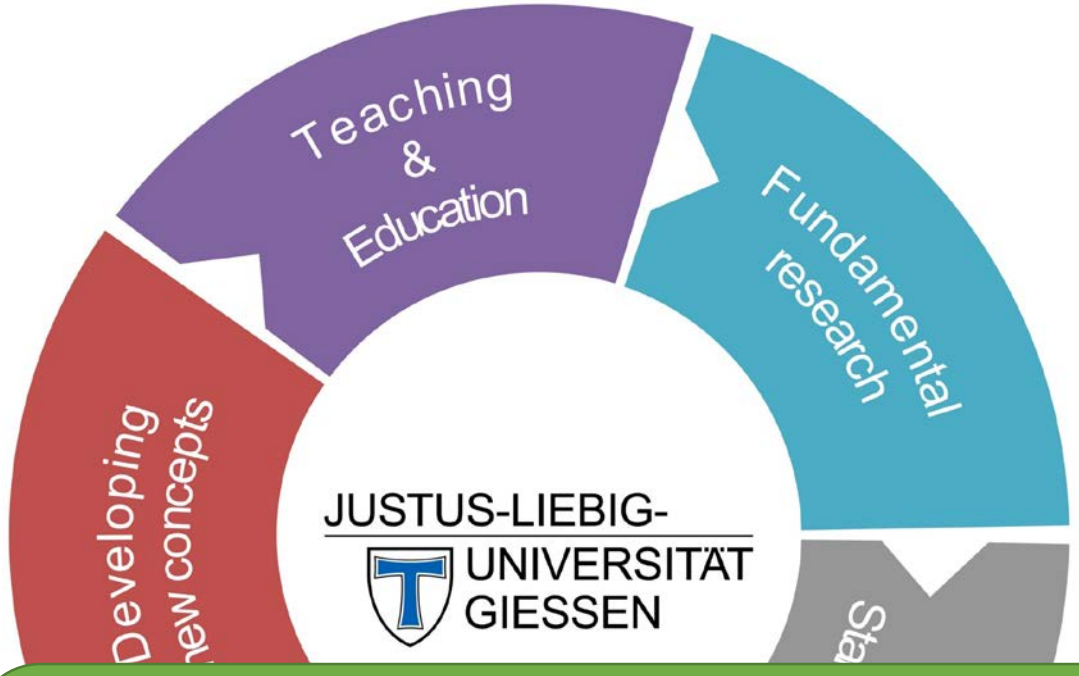
EPIC projects with JLU participation

iFACT

e⁻ NEMESIS

GIESEPP
Medium Power

Contribution in EPIC



We see ourselves as scientific scouts in such projects conducting and leading cutting edge research

GIESEPP Medium Power

diagnostics development & testing
modelling of grid erosion

iFACT

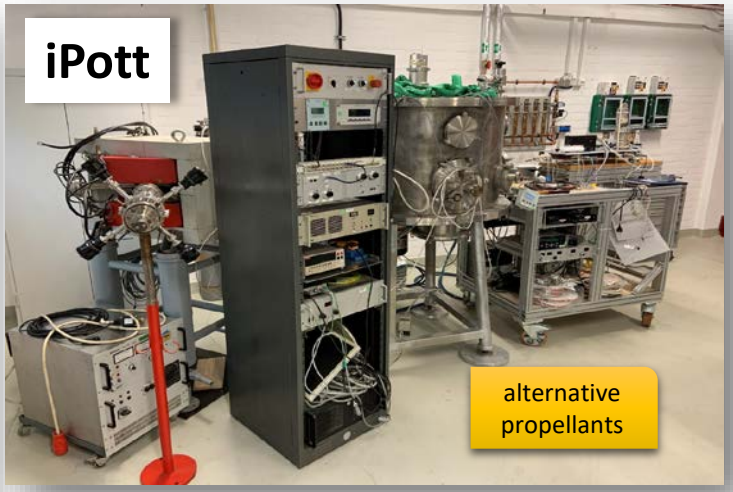
materials compatibility
materials characterization
alternative propellants

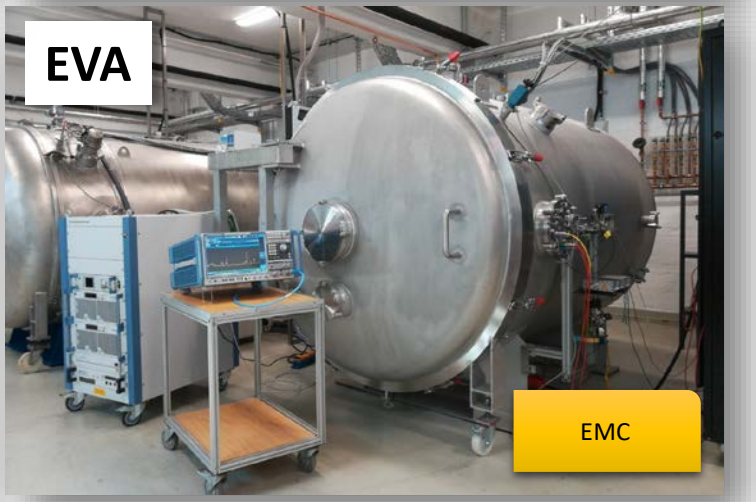
NEMESIS

materials compatibility
materials characterization
alternative propellants
cathode development & testing

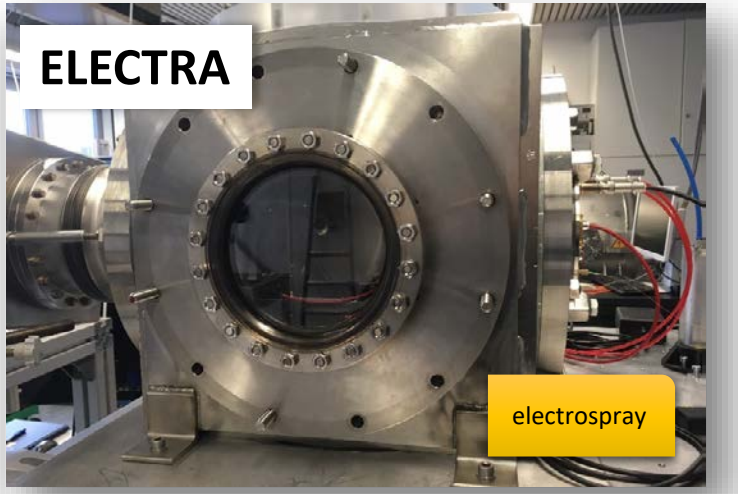
diagnostics development & test facility

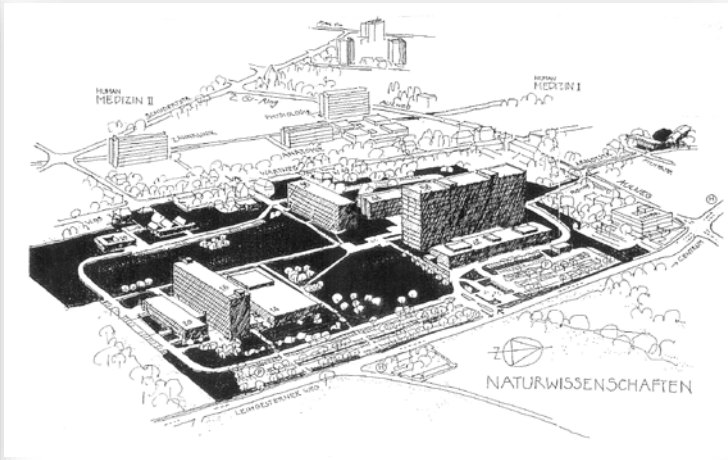
EP test facilities at JLU Giessen





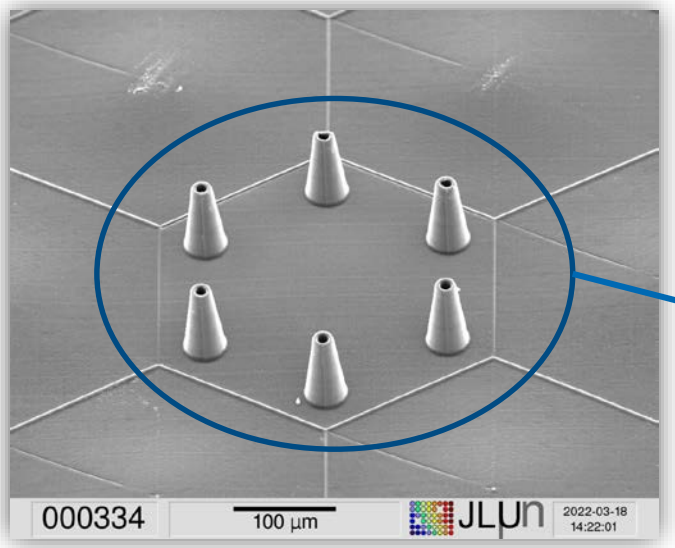
Test facilities at JLU

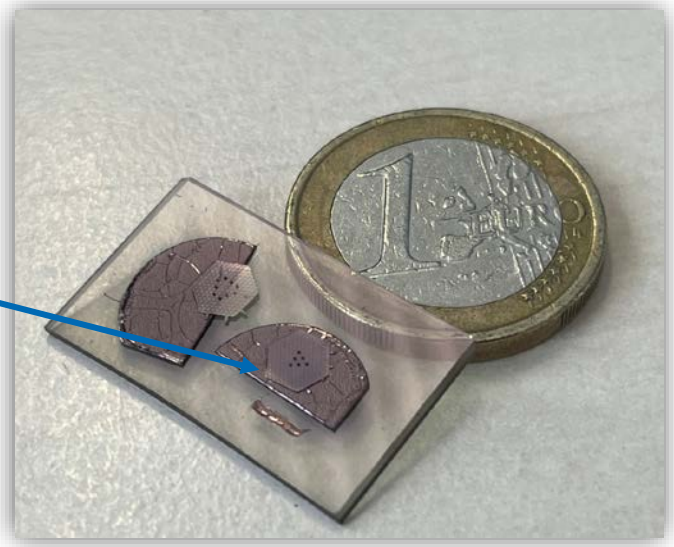




Developing new concepts

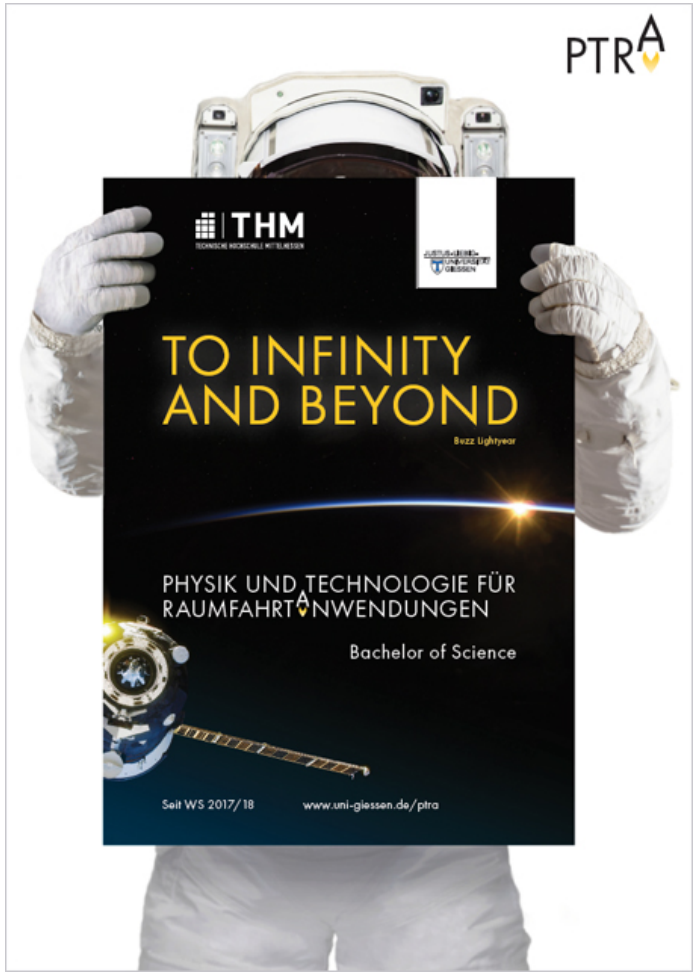
- probing various materials as propellant
- testing new plasma generation methods
- optimizing electrides C12A7:2e- with chemical methods
- miniaturize electrospray emitters to the µm scale





Teaching & Education

Joint Bachelor and Master course with THM
„Physics and Technology for Space Applications“



Fundamental research

RESEARCH Open Access

Corrosion of metal parts on satellites by iodine exposure in space

Check for updates

Ion thrusters for electric propulsion: Scientific issues developing a niche technology into a game changer

Cite as: Rev. Sci. Instrum. 91, 061101 (2020); doi: 10.1063/5.0010134
Submitted: 8 April 2020 • Accepted: 18 May 2020 •
Published Online: 24 June 2020

View Online Export Citation CrossMark

Combination of optical emission spectroscopy and multivariate data analysis techniques as a versatile non-invasive tool for characterizing xenon/krypton mixed gas plasma inside operating ion thrusters

Cite as: J. Appl. Phys. 131, 053301 (2022); doi: 10.1063/5.0074412
Submitted: 8 October 2021 · Accepted: 11 January 2022 ·
Published Online: 2 February 2022

View Online Export Citation CrossMark

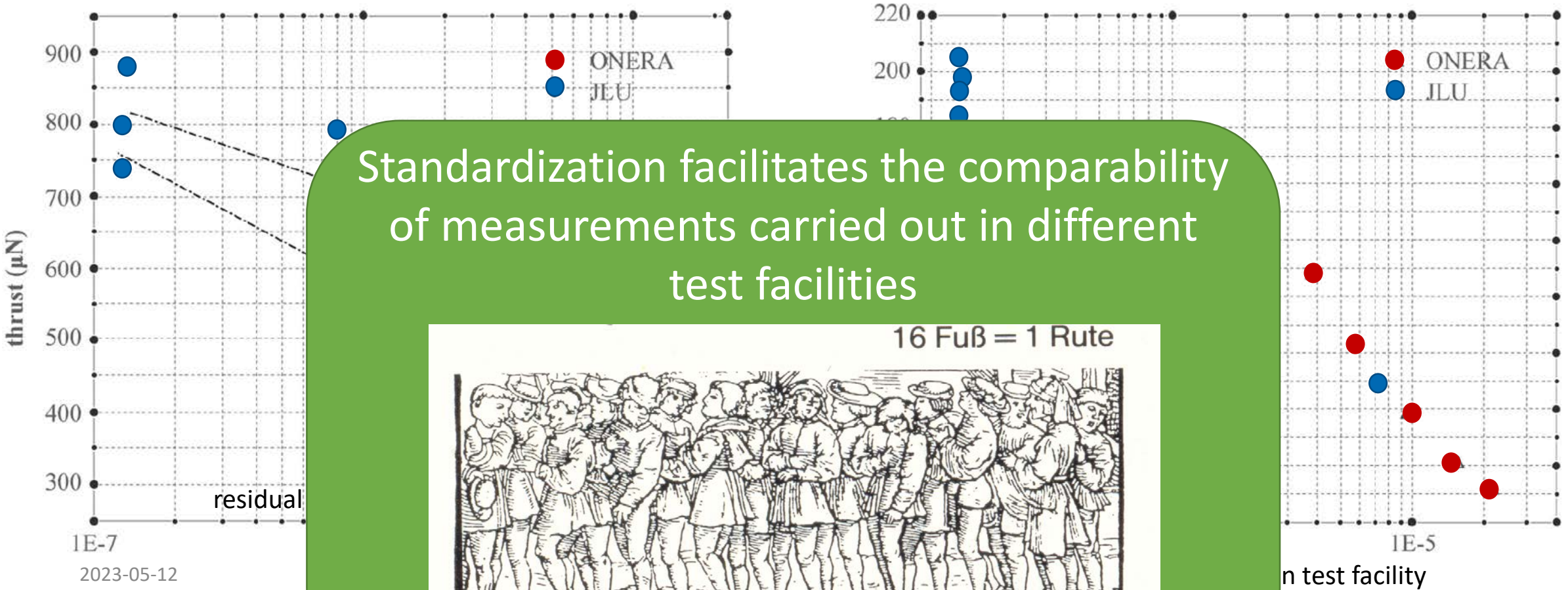
Diagnostics & standardization

- Faraday cups and probes (ion beam distribution)
- Retarding potential analyzer (ion beam energy)
- Electrostatic mirror analyzer (ion beam energy)
- ExB probe (ion beam momentum)
- 90° dipole magnet (ion beam momentum)
- Langmuir probes (plasma potential and temperature)
- Emissive probe (plasma potential)
- Various optical spectrometers (standard, Echelle)
- THz spectroscopy (plasma refractive index)
- EMC (antennas, signal generator, spectrum analyzers)
- Neutral flux probe
- Thrust balance & force probe

Why is standardization important?

same thruster may show a different behaviour in different test facilities

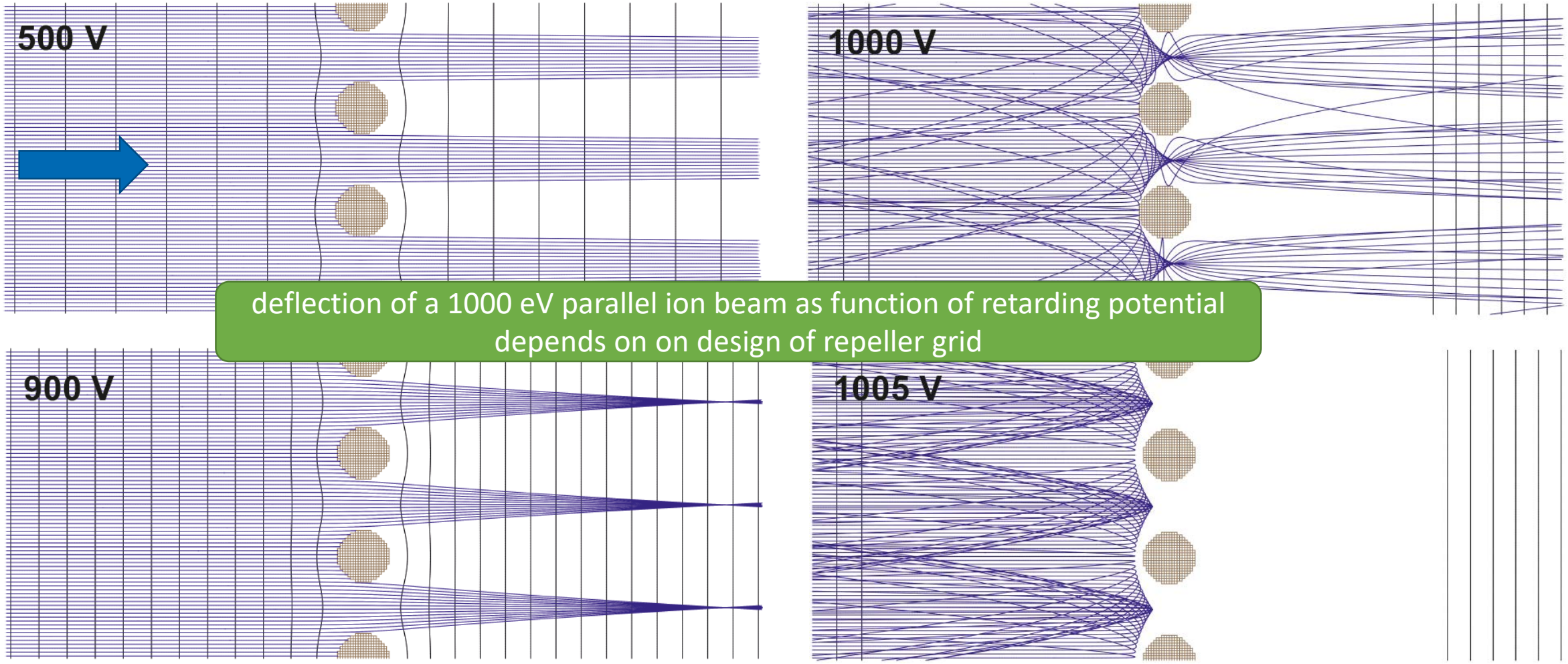
Holste et al. Rev. Sci. Instrum. (2020)



Standardization facilitates the comparability of measurements carried out in different test facilities

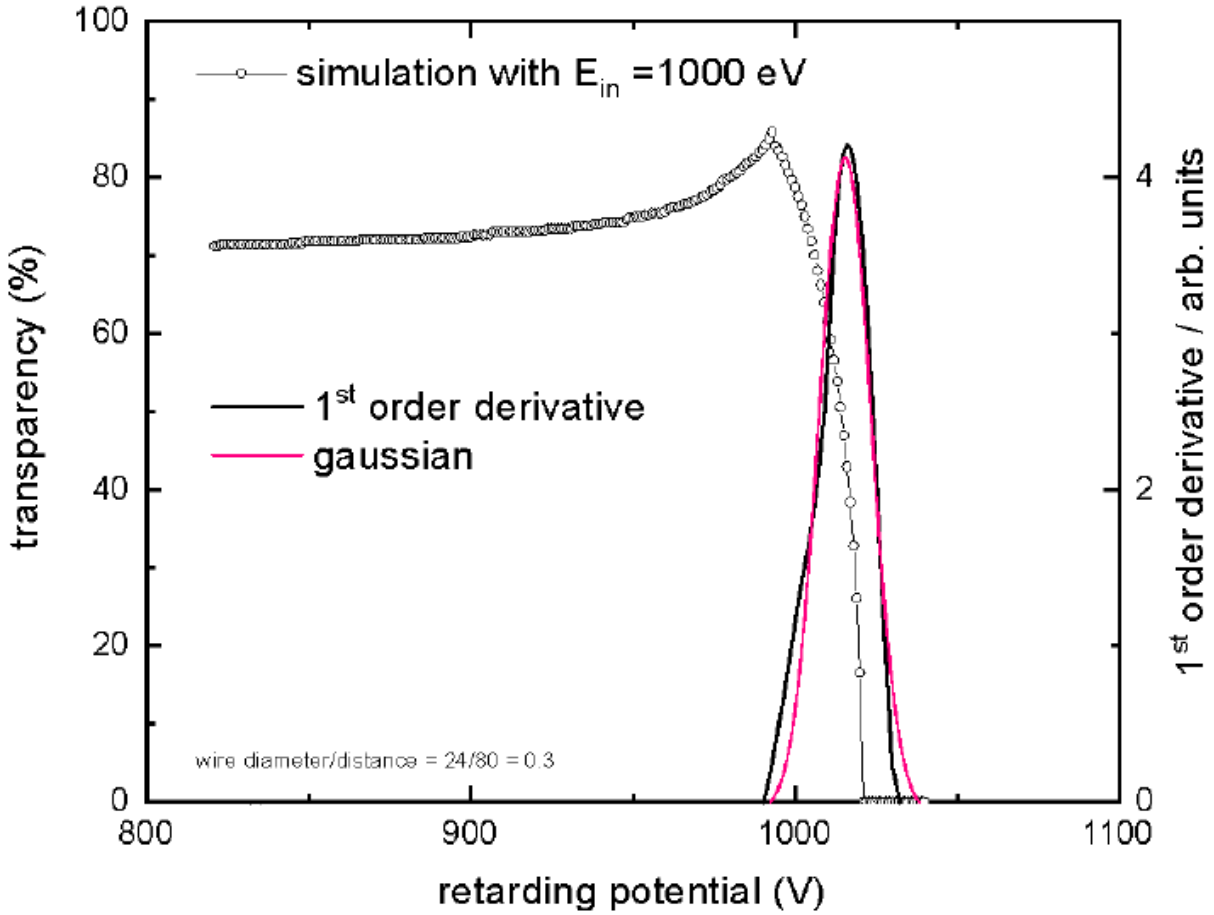
Approach to standardize RPA measurements

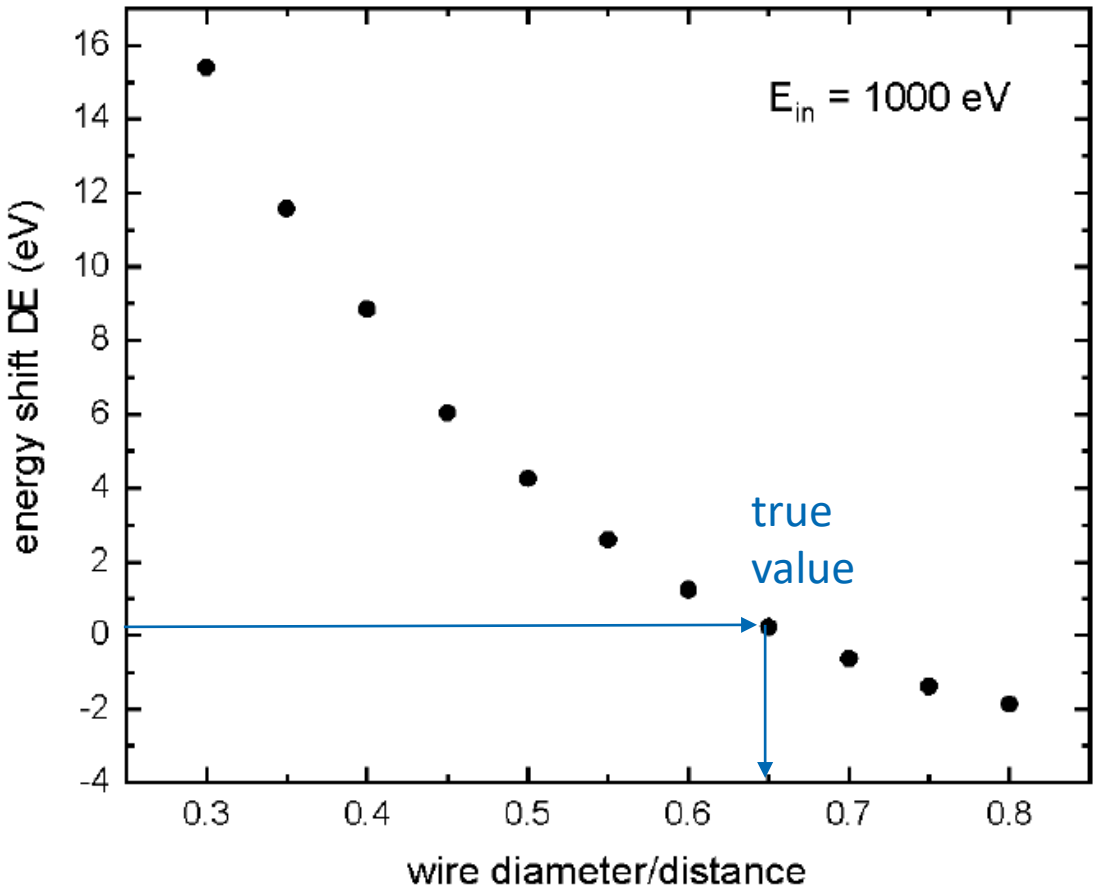
Identify the problem



deflection of a 1000 eV parallel ion beam as function of retarding potential depends on on design of repeller grid

Approach to standardize RPA measurements

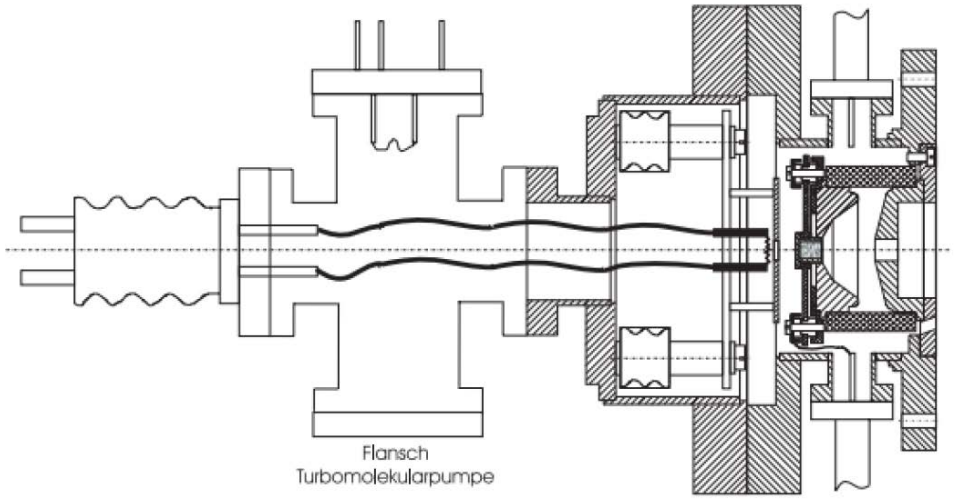


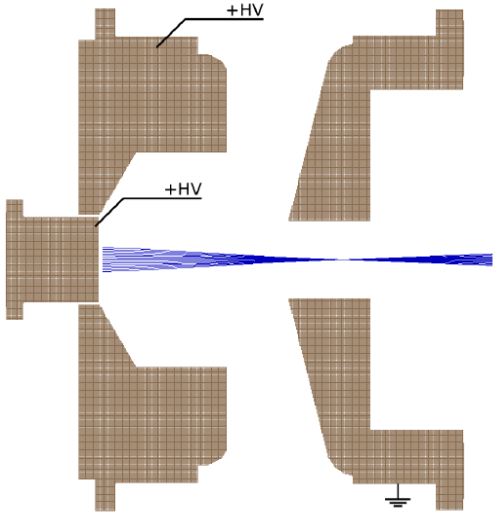


Careful design of the RPA is essential and needs validation

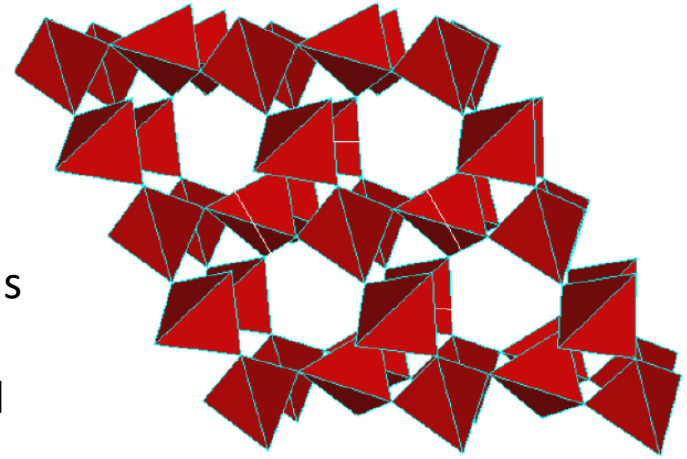
Approach to standardize RPA measurements

1) **Reference ion source (with almost monoenergetic beam)**



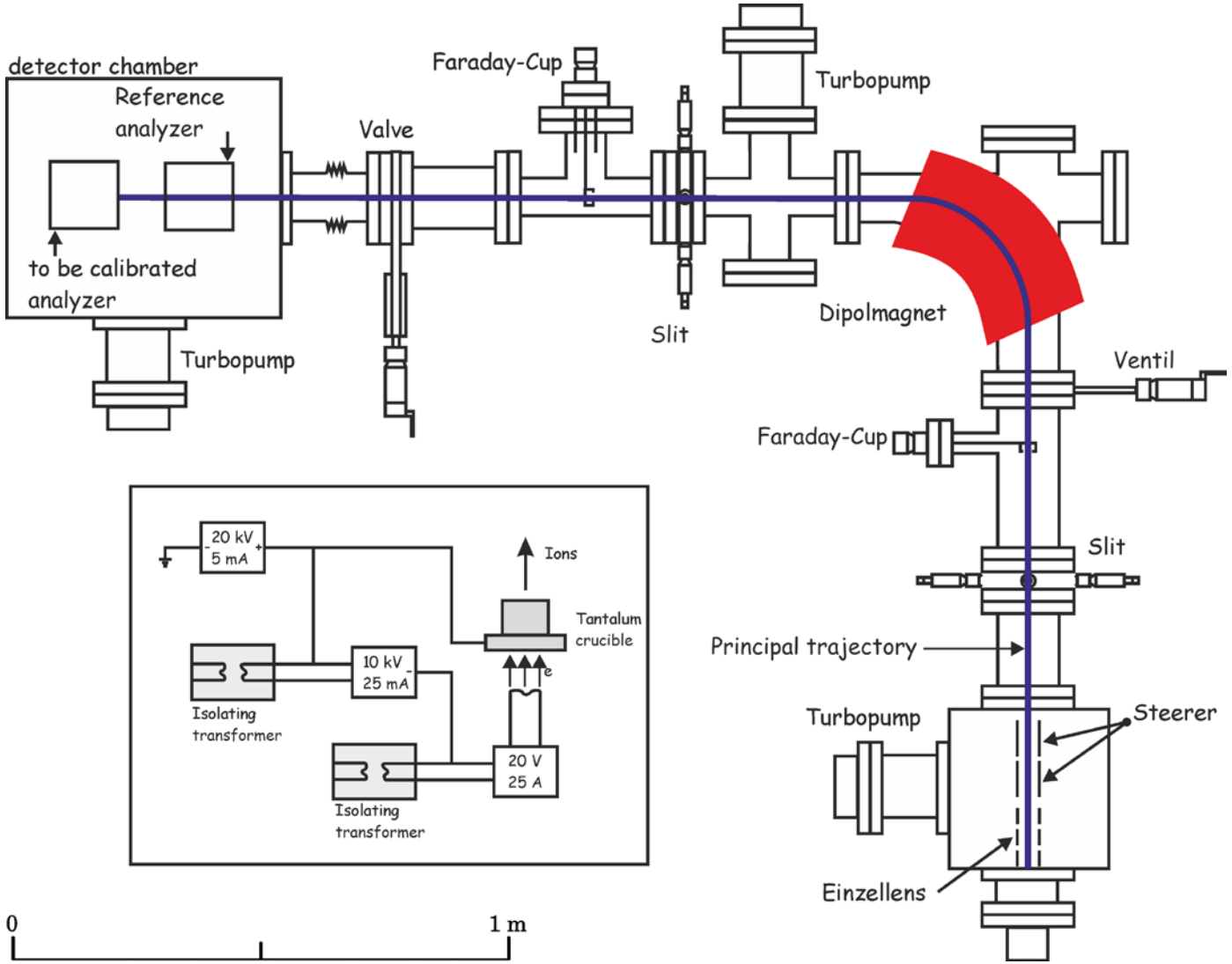


- alkali aluminosilicate ion source
- no plasma offset
- one charge state (99%)
- one dominant ion (95%)
- ion energy relatively homogeneous
- thermal uncertainty < 1 eV
- contact potentials to be measured



Approach to standardize RPA measurements

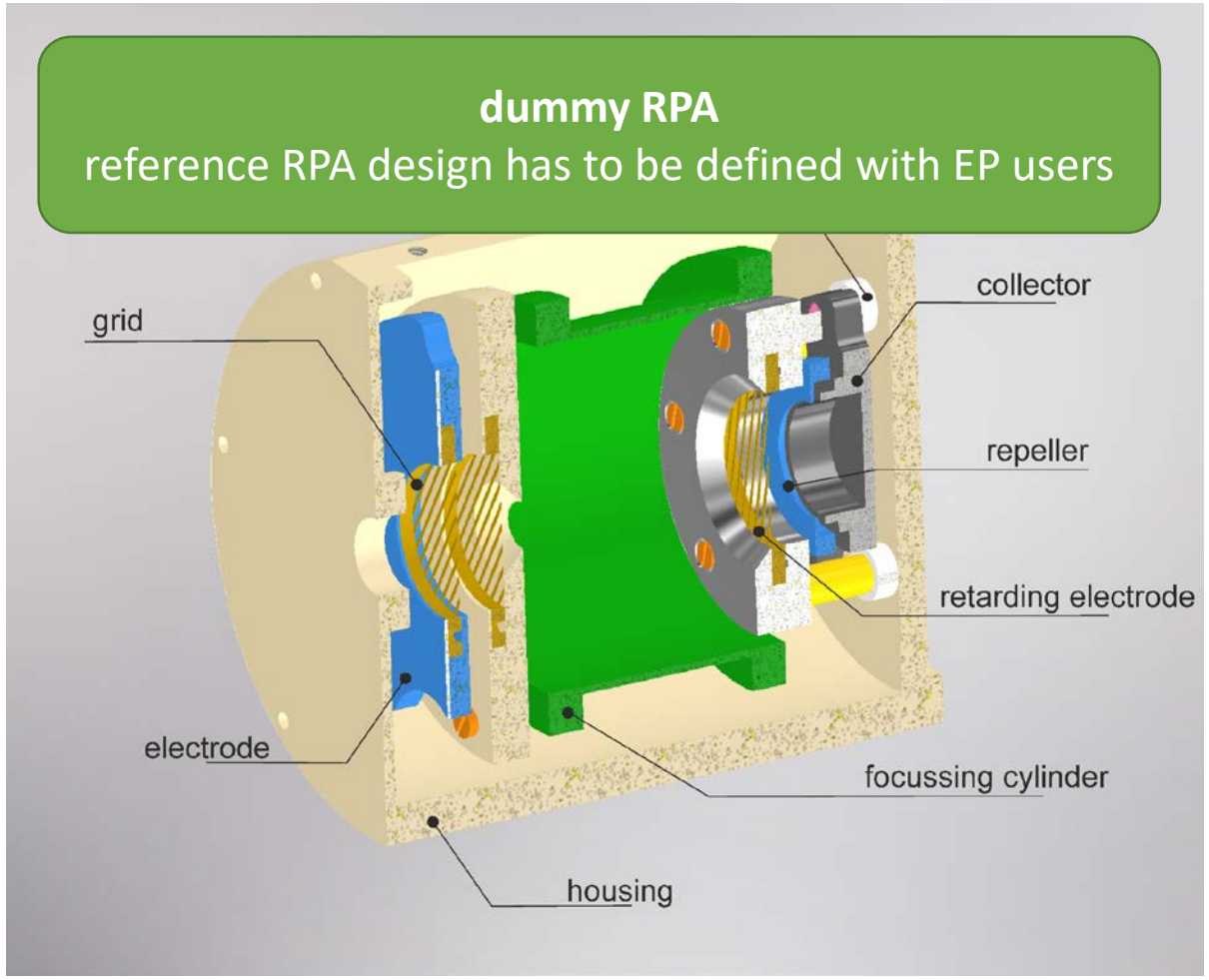
2) **Reference beam line & reference energy analyzer**



- electrostatic mirror analyzer are most suitable as reference energy analyzer
- reference analyzer may be cross-checked by calibration with ions or electrons generated in well-known processes (e. g. Auger emission)

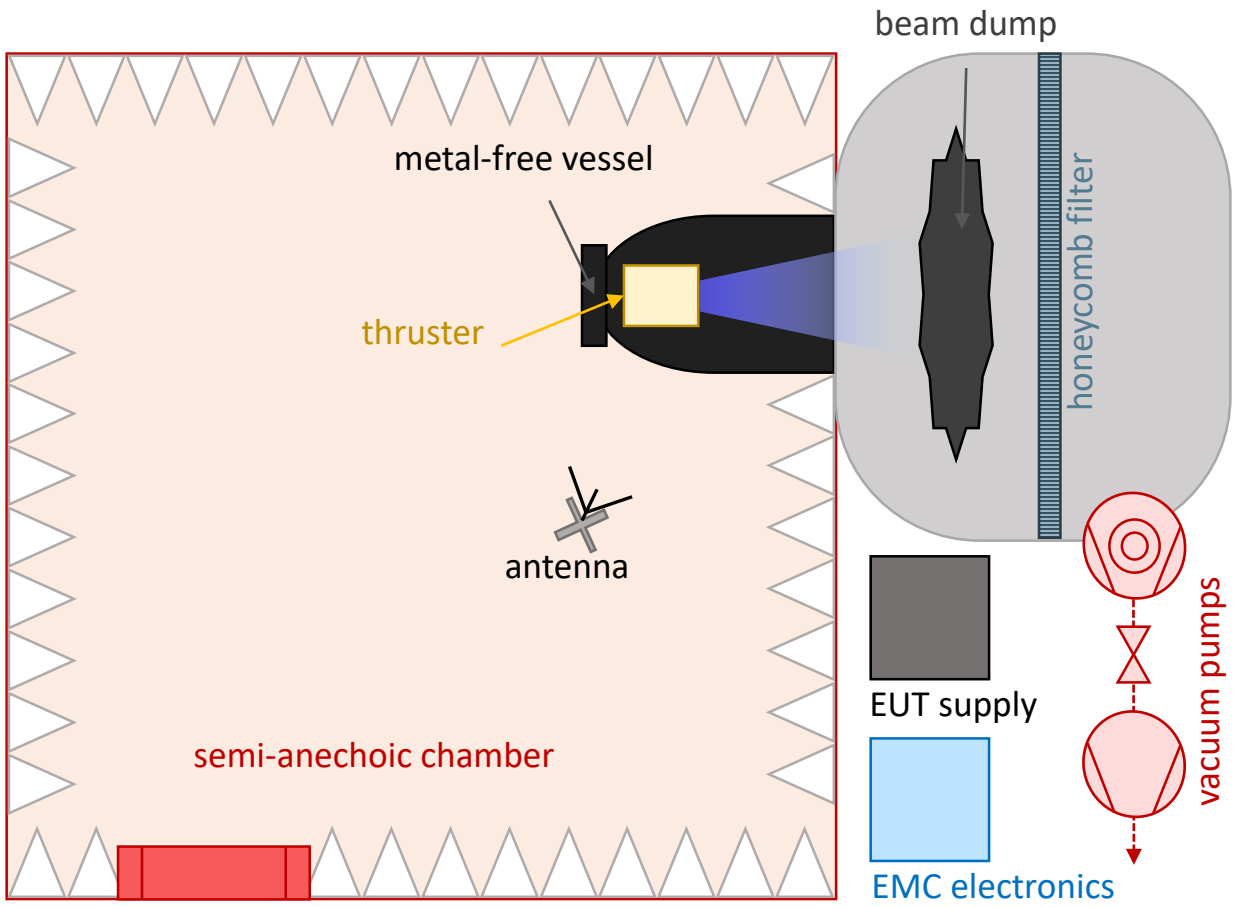
Approach to standardize RPA measurements

3) **Reference RPA for round-robin test**

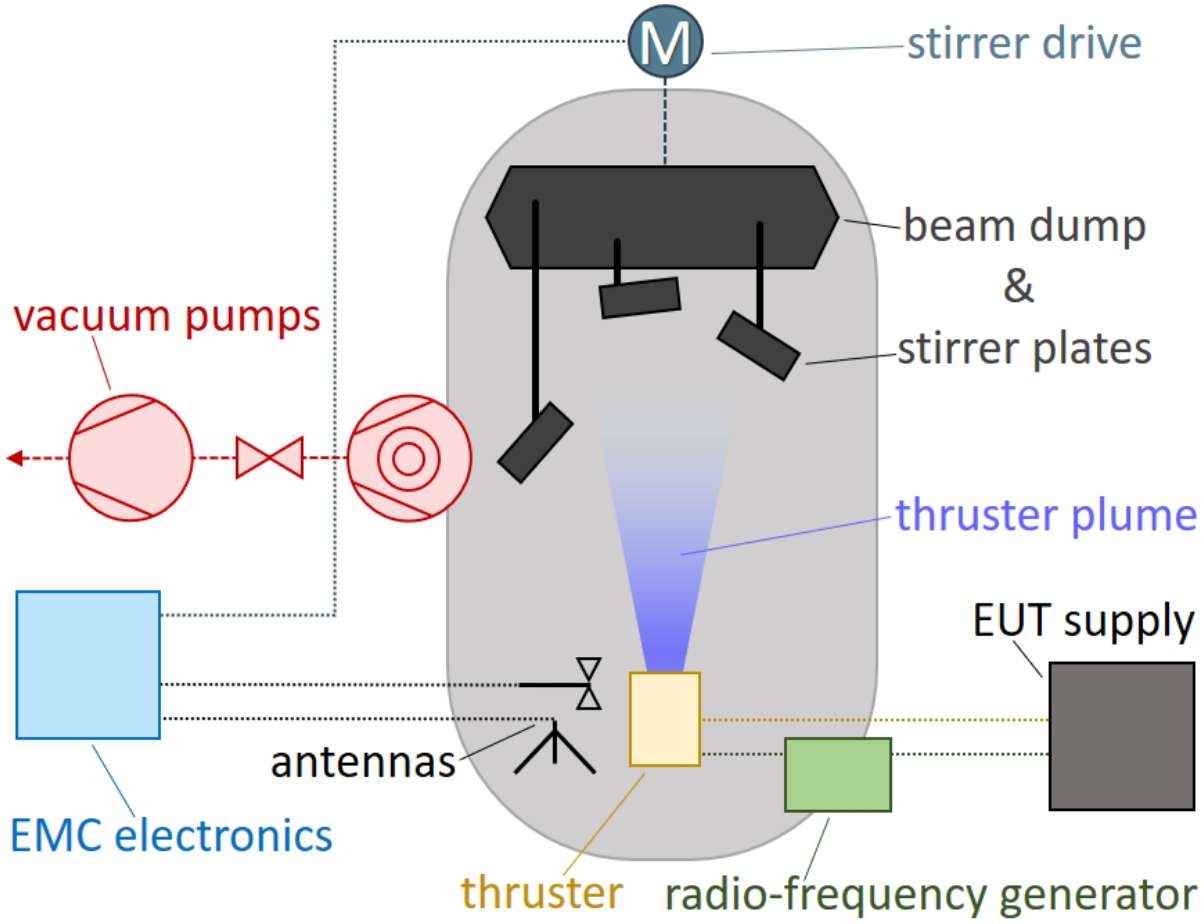


- reference energy analyzer for round-robin test to ensure comparability of measurements in different facilities
- Even better comparability through establishment of a reference ion thruster
- Reference systems must be described publicly and in detail (open source idea) to enable replication.
- Recognised energy standard for comparison of EP diagnostics should be available and maintained by a recognised institution.

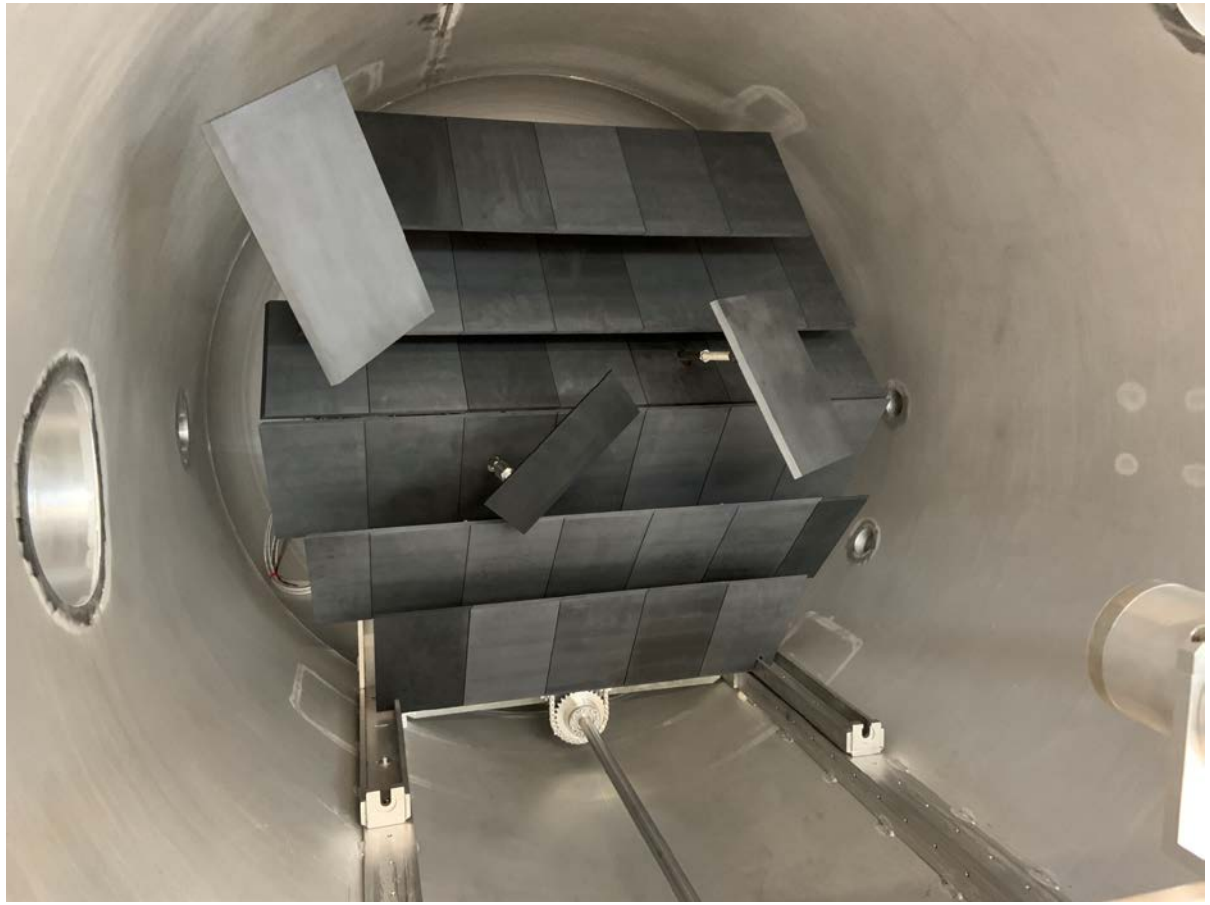
EMC – semi-anechoic chamber (SAC)

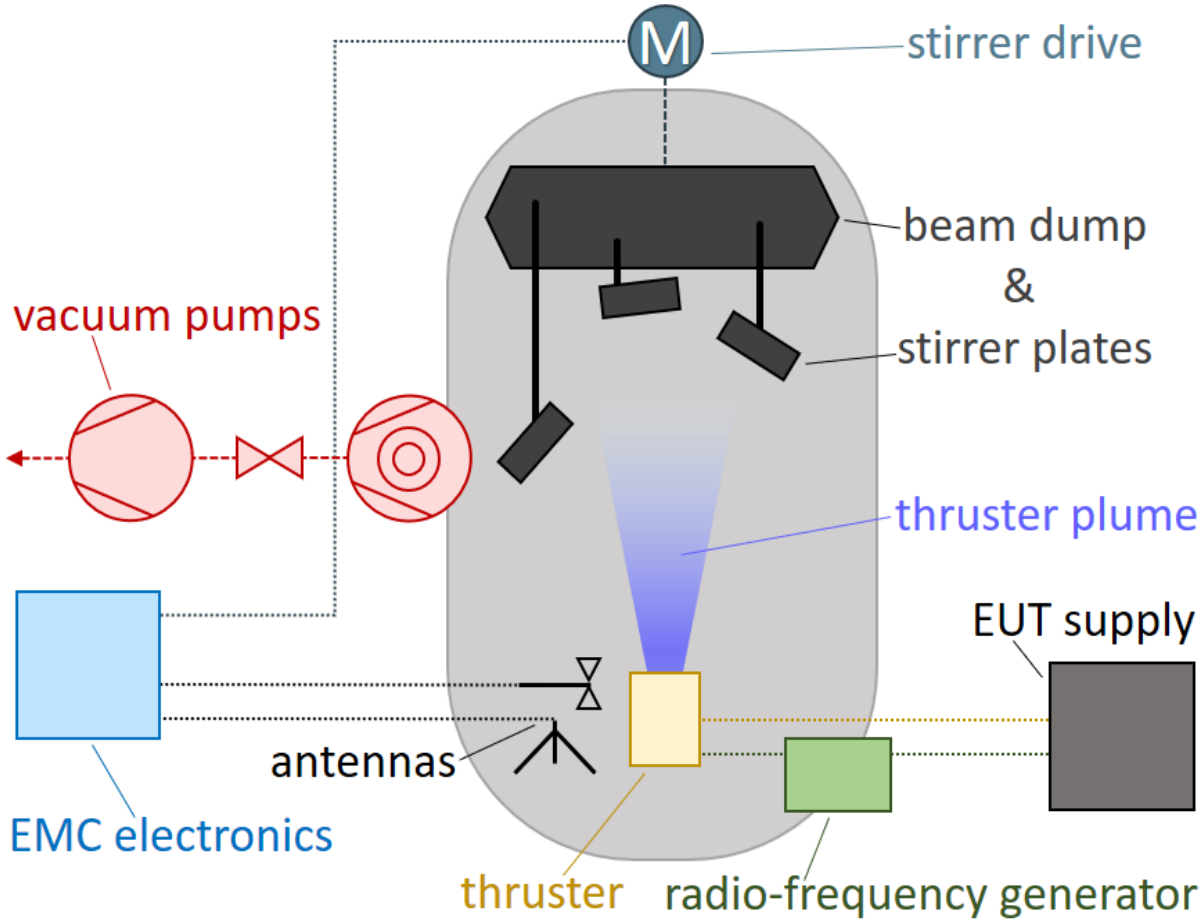


EMC – reverberation chamber (RVC)



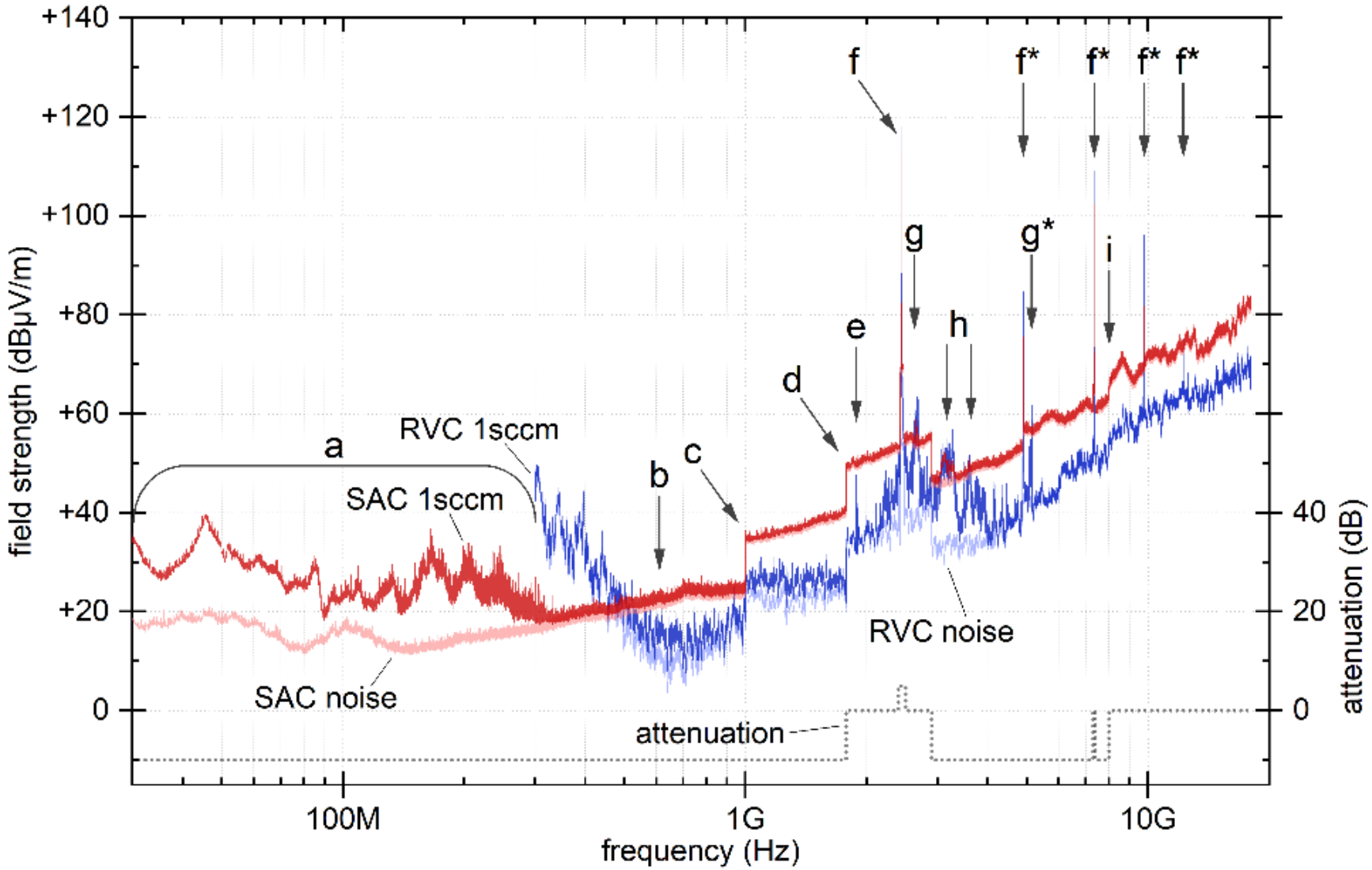
EMC – reverberation chamber (RVC)





Comparison SAC & RVC

F. Kiefer et al. (will be published in 2023)



Contact
Prof. Dr. Peter J. Klar & Dr. Kristof Holste
Institute of Experimental Physics 1
Heinrich-Buff-Ring 16
35392 Gießen
+49 641 99-33101
Peter.J.Klar@physik.uni-giessen.de ; Kristof.Holste@physik.uni-giessen.de
https://www.uni-giessen.de/de/fbz/fb07/fachgebiete/physik/institute/ipi/raumfahrtphysik/Ionentriebwerke

Thank you for your attention