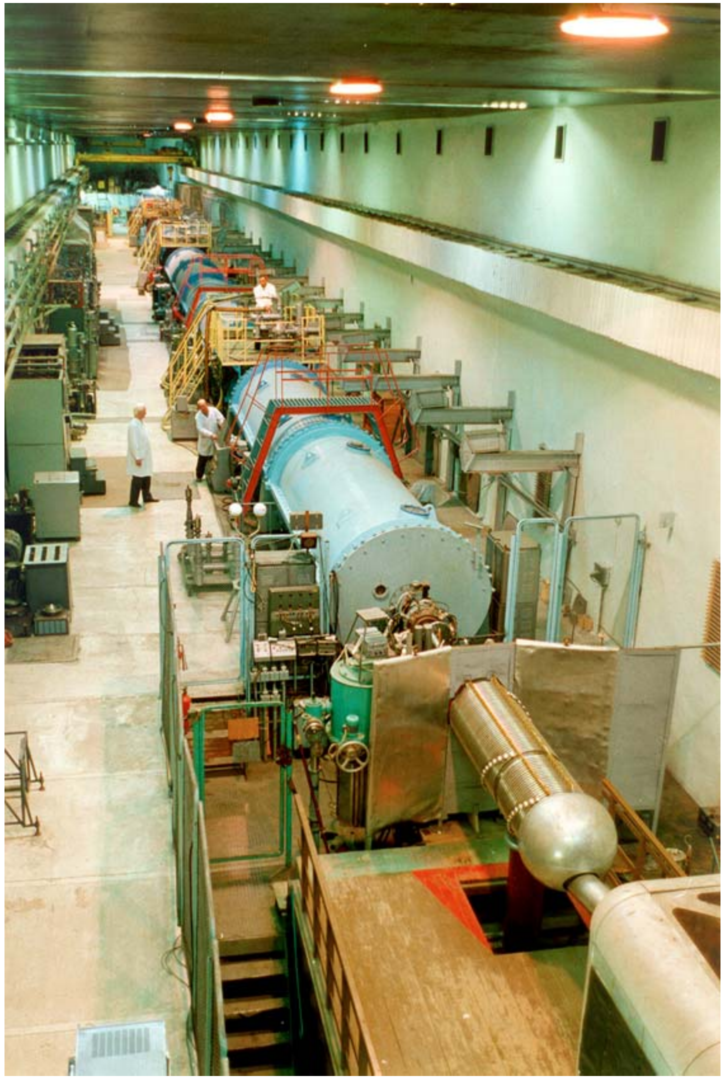
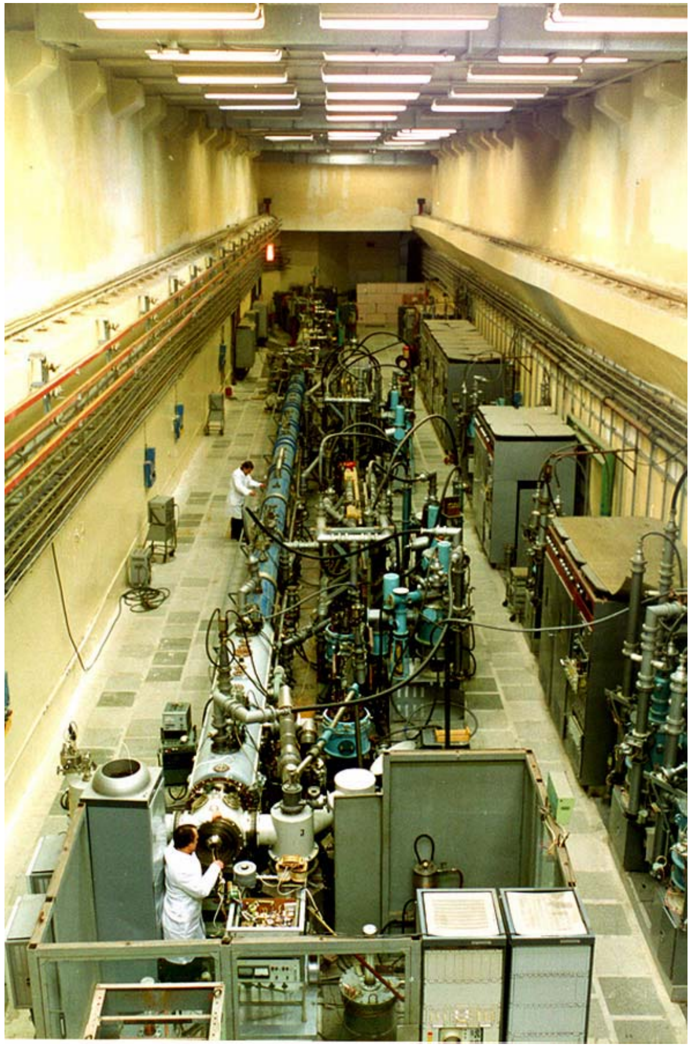
Prof. Dr. Vladimir Alexandrovitch Teplyakov

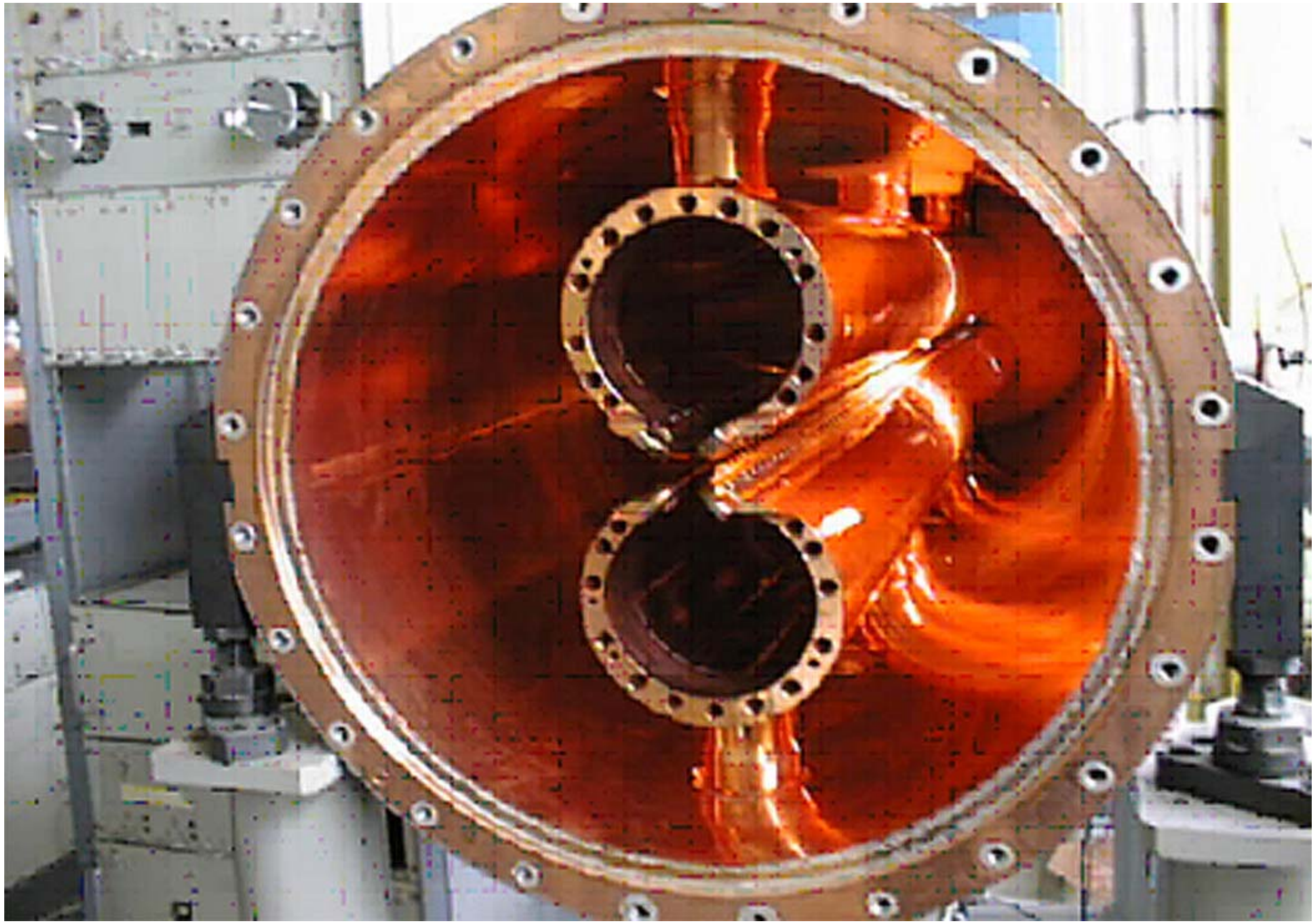
I-100



URAL-30



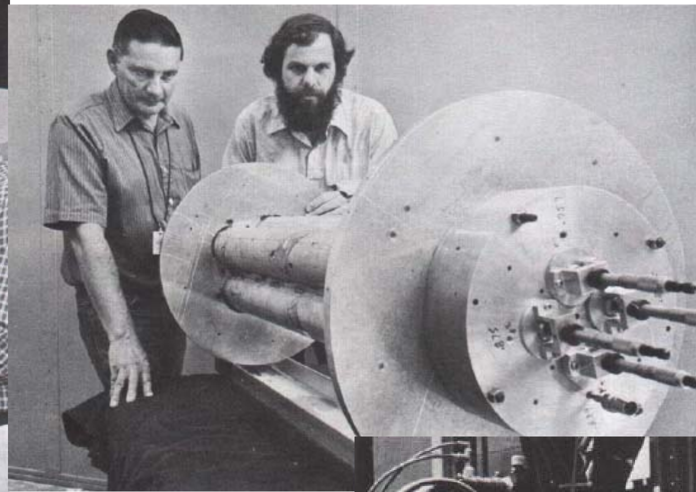
Teplyakov URAL-30 2-H Resonator Structure



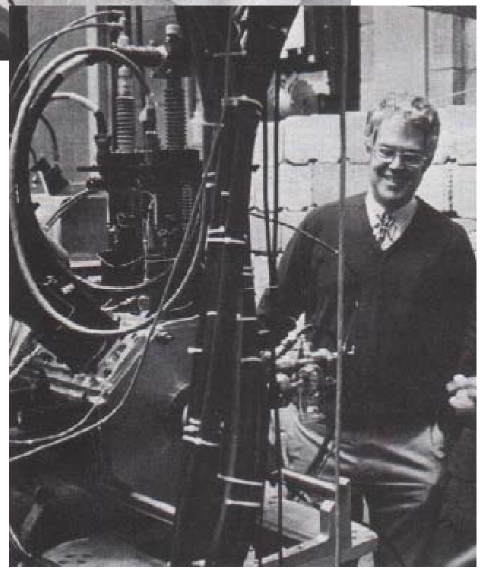
Los Alamos Proof-of-Principle RFQ

Dick Stokes, Bob Jameson, Tom Wangler, Don Swenson

Arlo Thomas, Jim Potter



Ed Knapp

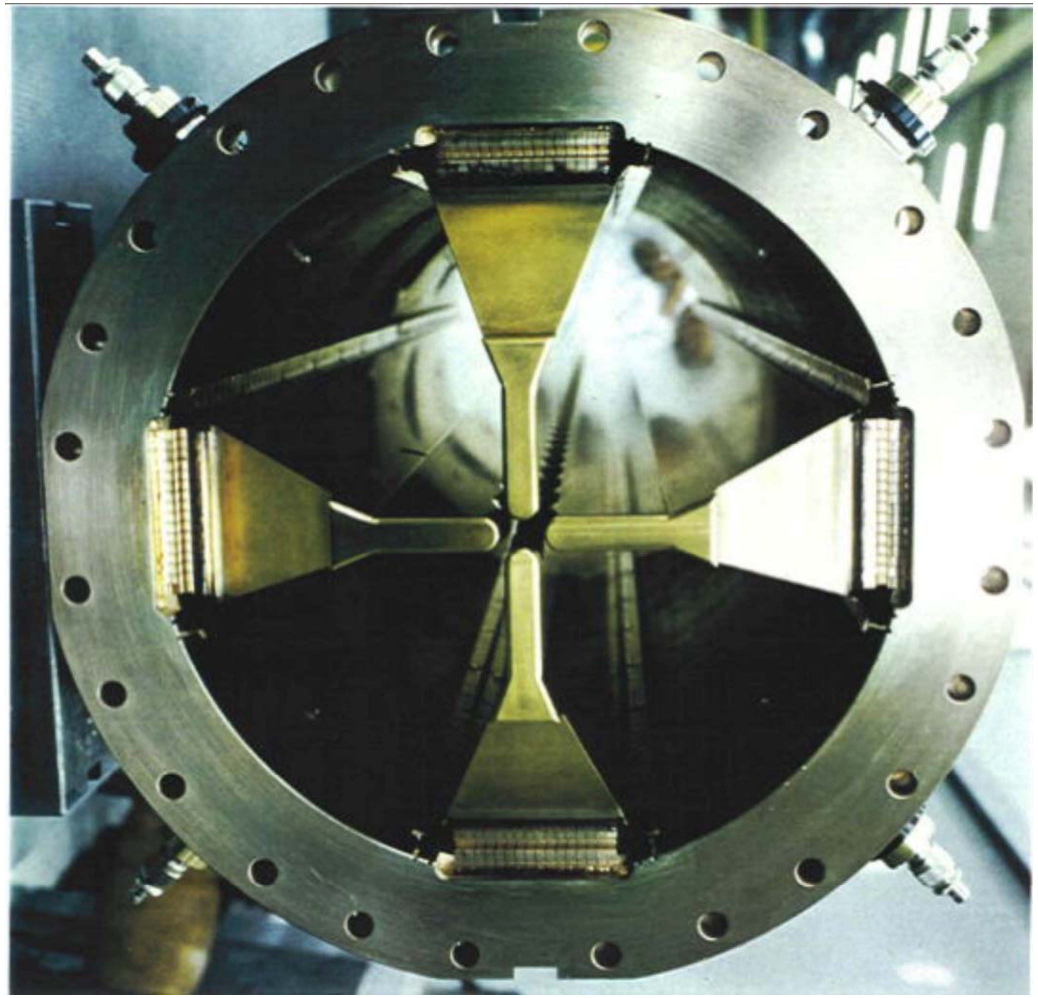


Los Alamos Scientific Laboratory "atom", July/August 1980
John T. Ahearne (Ghost-written by R. A. Jameson)

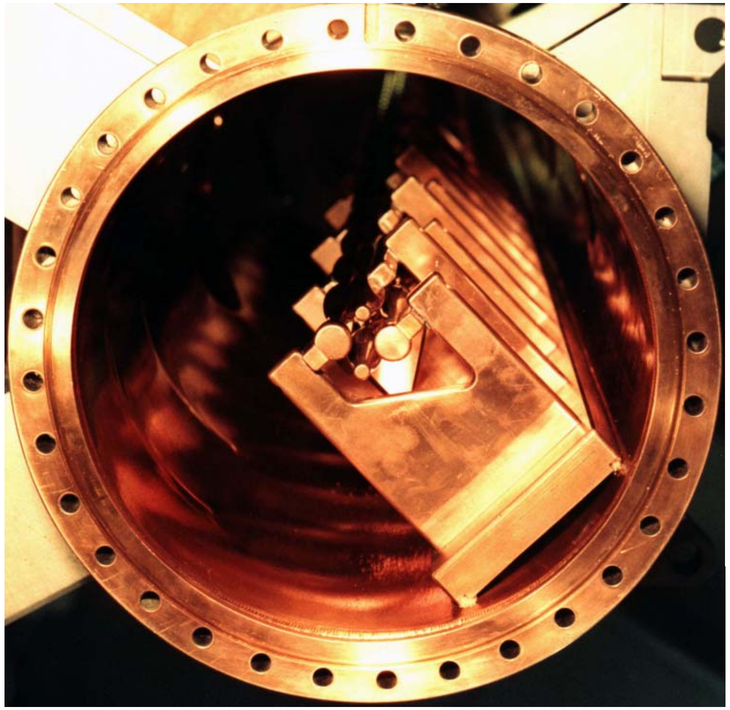
Kapchinsky, Andreev, Teplyakov

CERN RFQ-1

Gold-plated



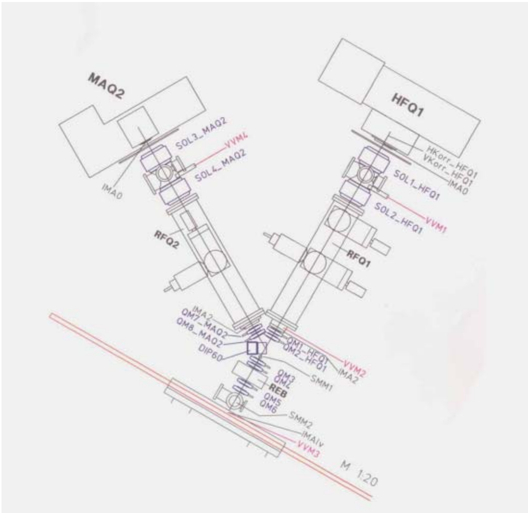
DESY RFQ1



Prof. Dr. Alwin Schempp starts a long series of RFQs, now approaching 40, for many different applications.

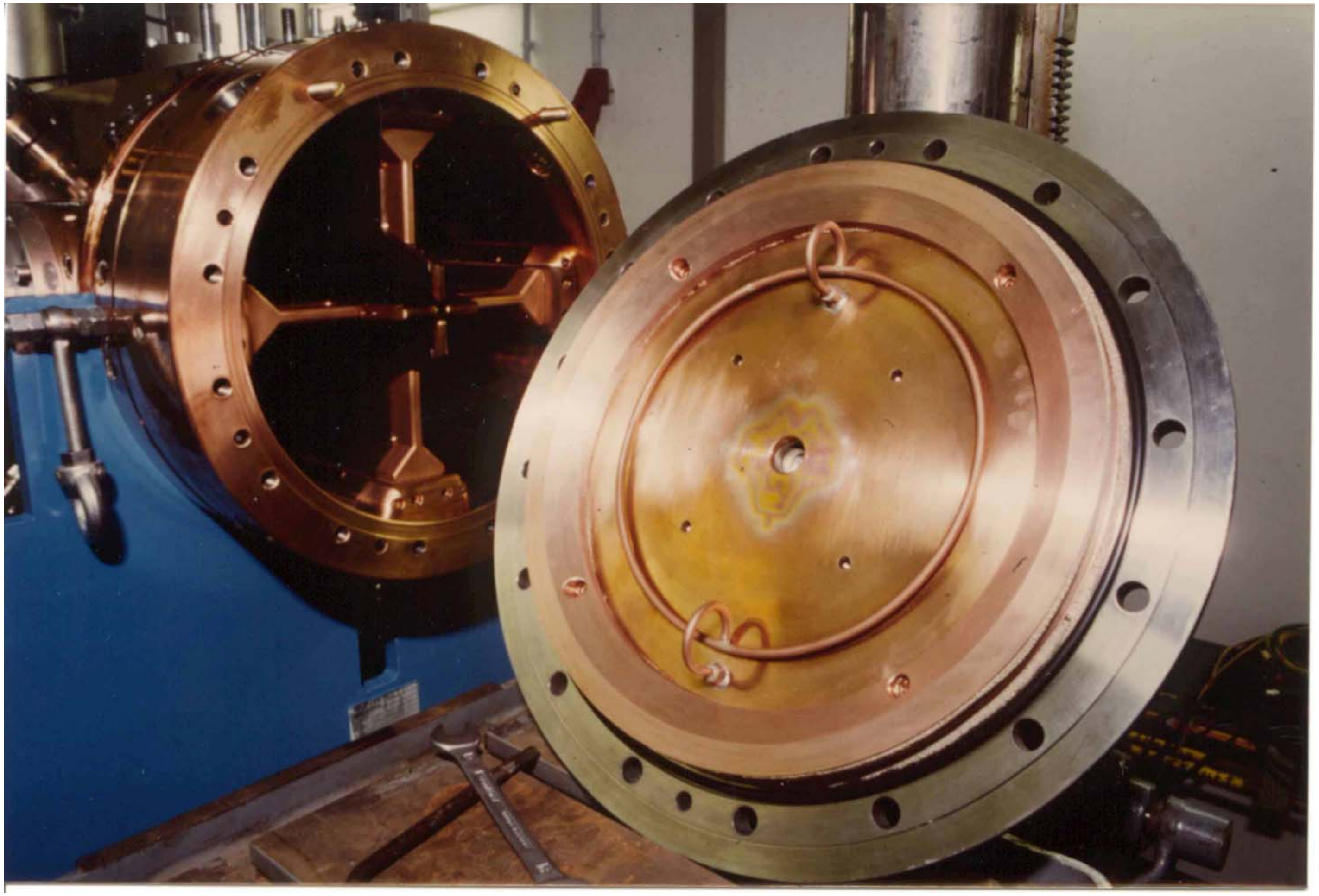
SUSE RFQ-MSI-Stockholm

DESY H$^-$ - Injectors (750keV)
MA/RF sources / 4-Rod-RFQs (20/50mA)



A. Schempp

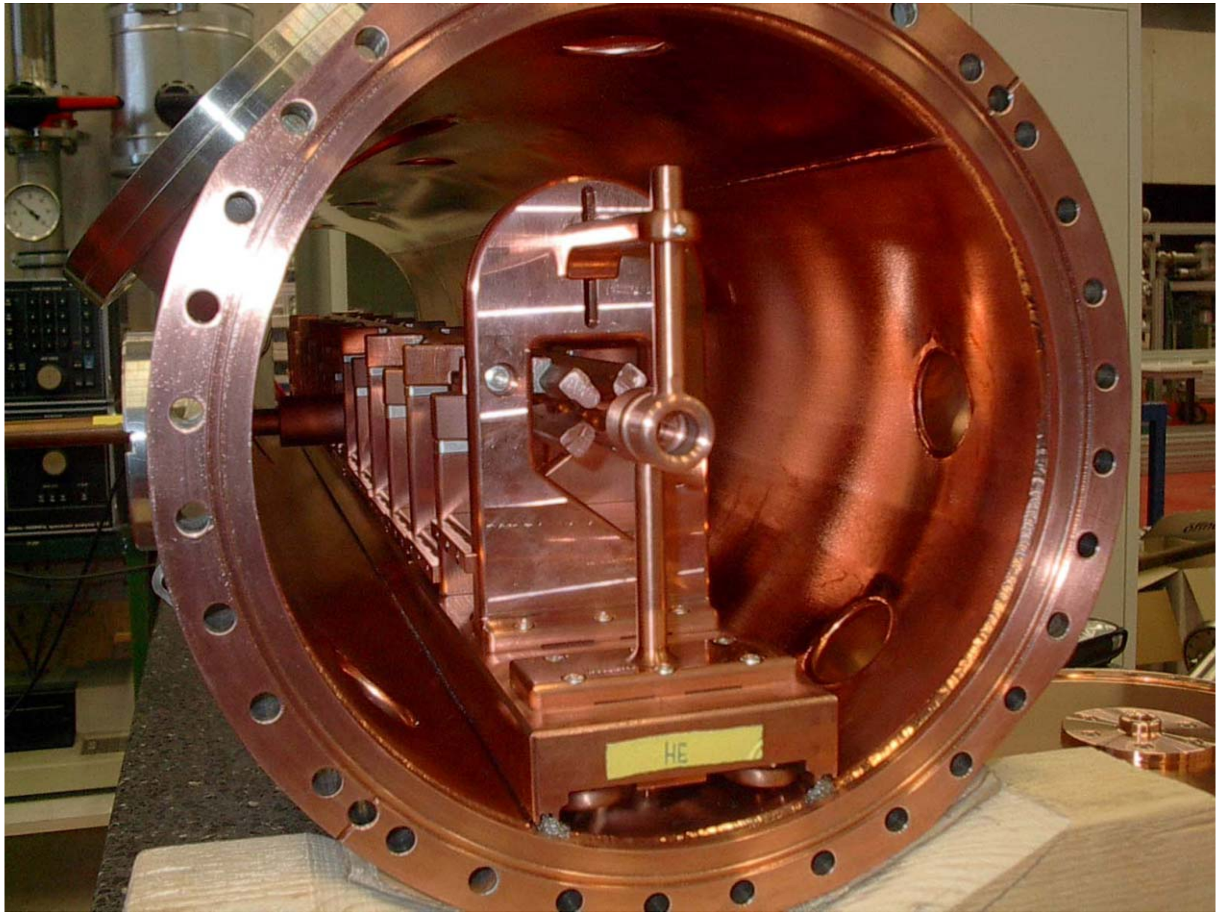
DESY 4-Vane Resonantly Coupled RFQ



A. Schempp

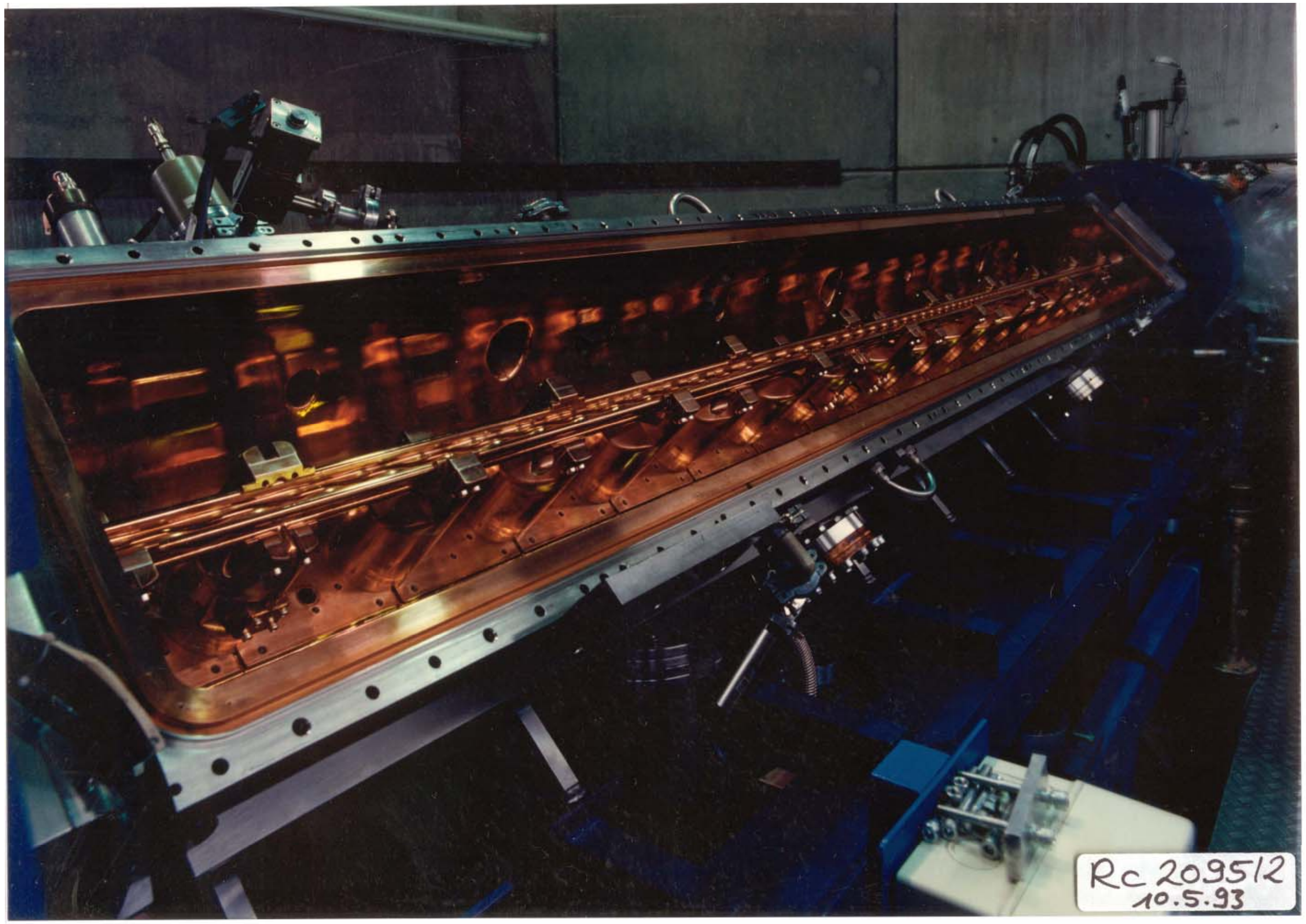
Medical RFQ - 216 MHz

Rebuncher Drift Tube for Following Linac



A. Schempp

GSI HLI RFQ



A. Schempp

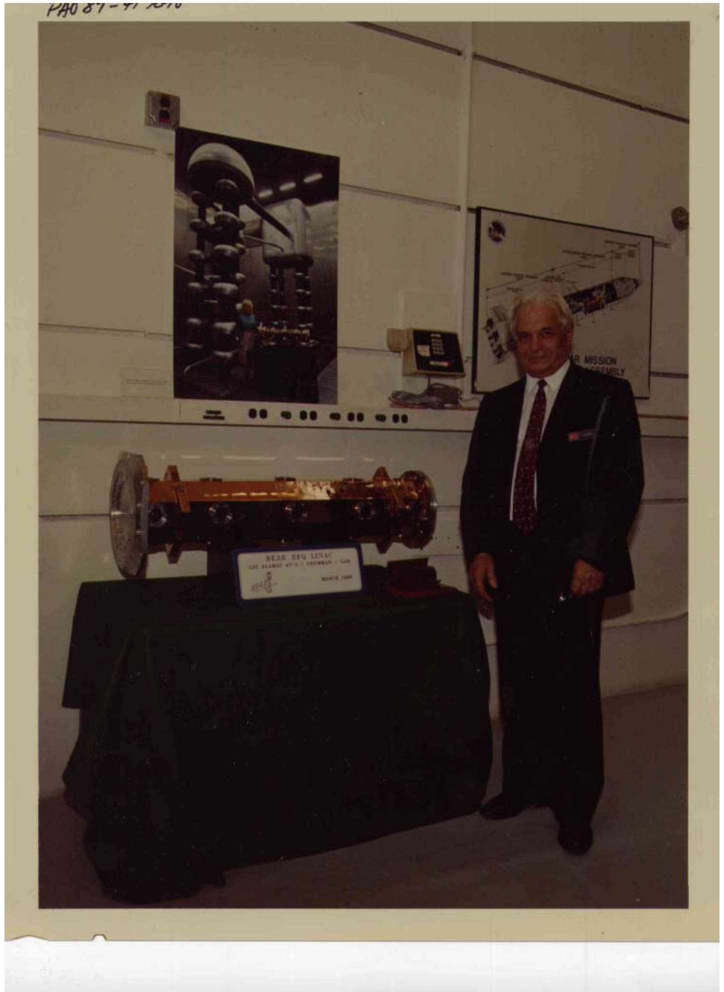
Los Alamos continues to tackle difficult RFQ applications

- Fusion Materials Irradiation Test 100 mA 2 MeV CW deuteron RFQ - prototype built and operated. Predecessor of LEDA and IFMIF.

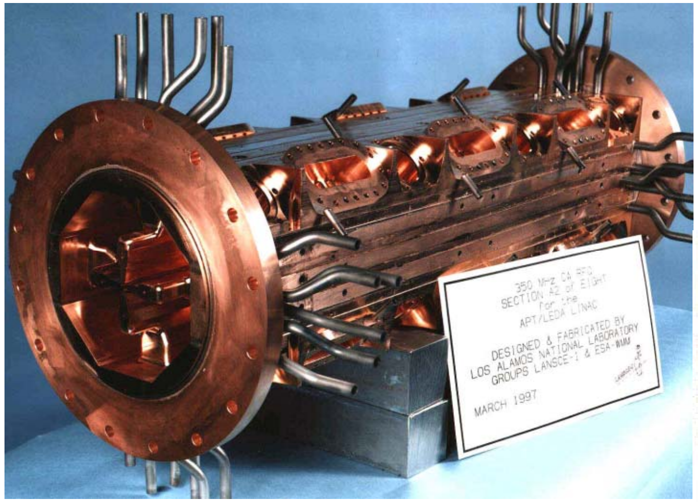
- Strategic Defense Initiative High-Brightness High-Power CW H- RFQ. Attainment of high-brightness strongly favors higher frequency. Prototype built and operated. BEAR (Beam Experiment Aboard Rocket) successfully operated.

Prof. Teplyakov with the BEAR RFQ

(Beam Experiment Aboard Rocket - LANL)



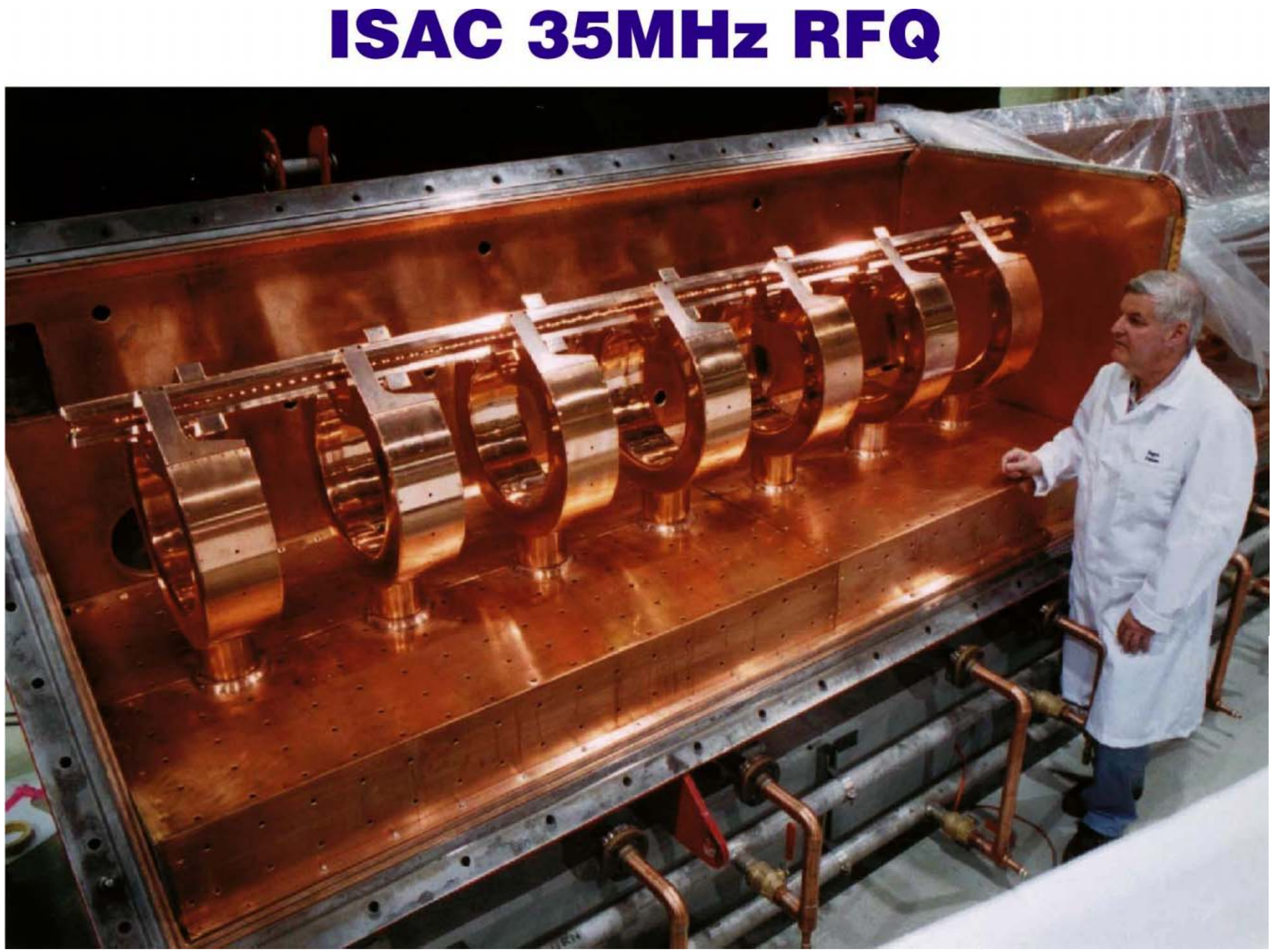
LEDA 100mA CW H+ RFQ



One section

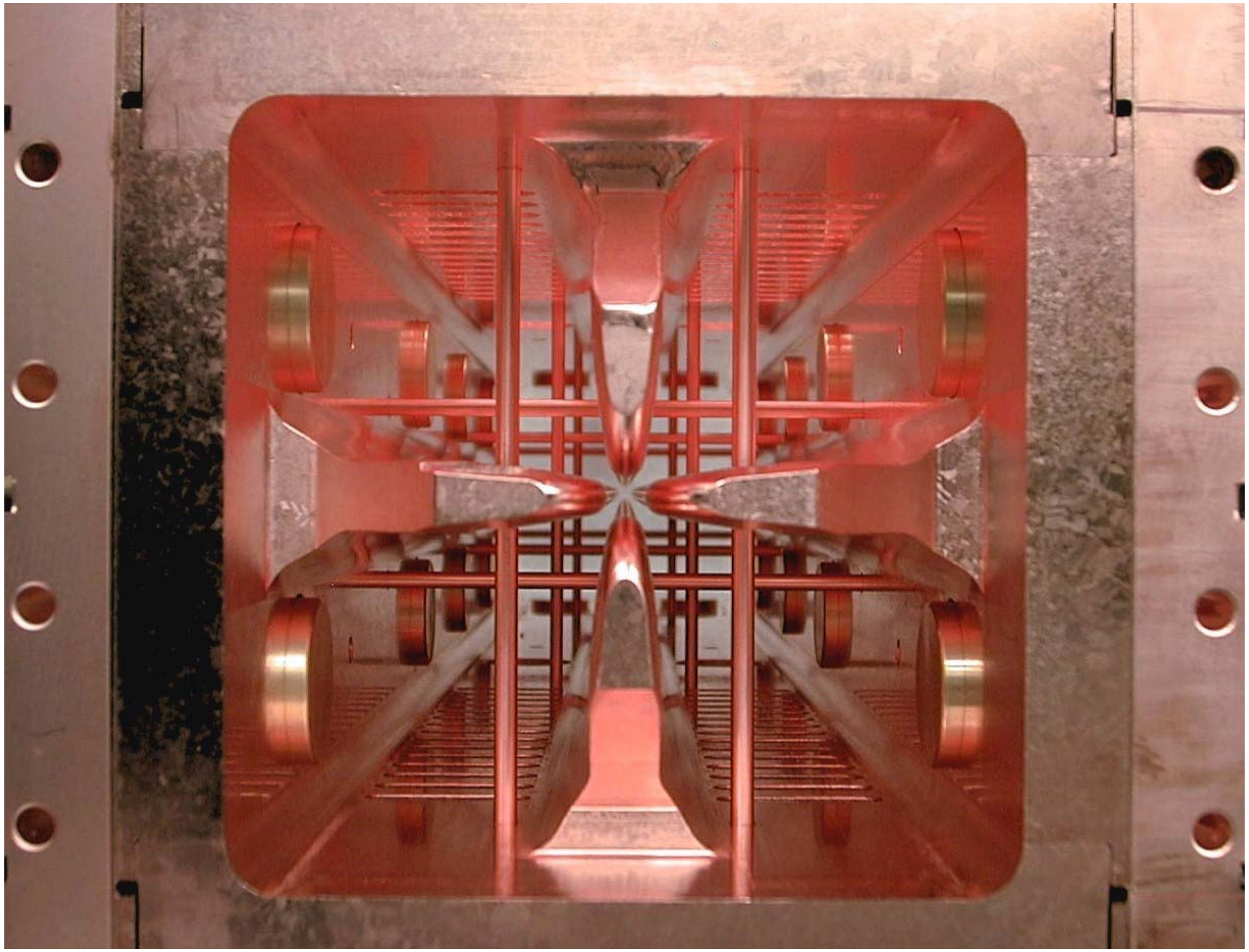
LEDA Radio-Frequency Quadrupole (RFQ) accelerator with injector rolled back

ISAC RFQ - TRIUMF

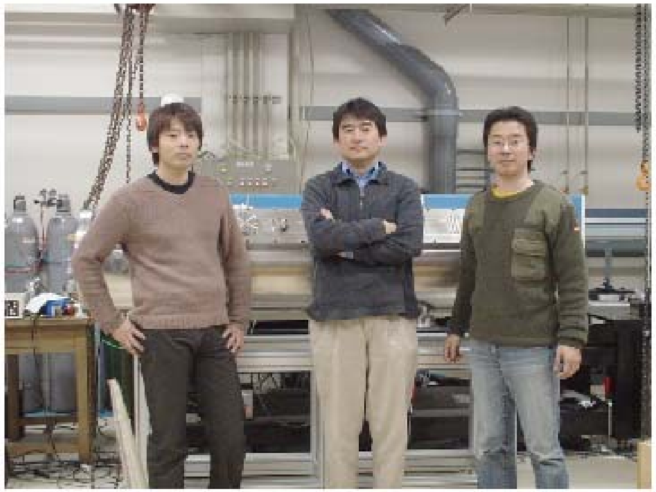


Roger Porrier

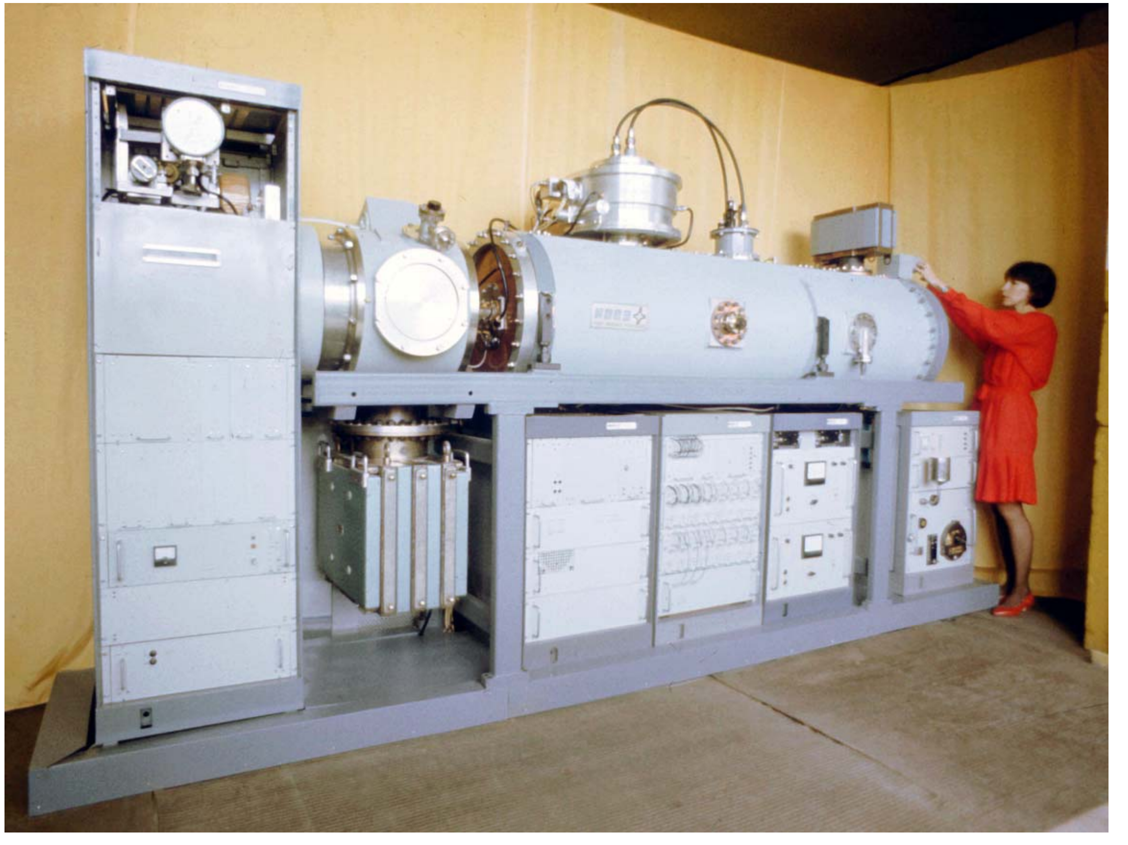
SNS RFQ - LBNL



RIKEN C4+ RFQ



DU1



DU-1 is a Proton and/or H- RFQ (demonstrator)
1MeV; 70mA; 148.5 MHz; (2H-resonator)
Total input power 2kW, 220V, 50Hz.
Pulse 100 mks, 1 Hz.

Moscow 2002

N. Lazarev, V. Teplyakov, R. Jameson

IFMIF - New Optimized Design

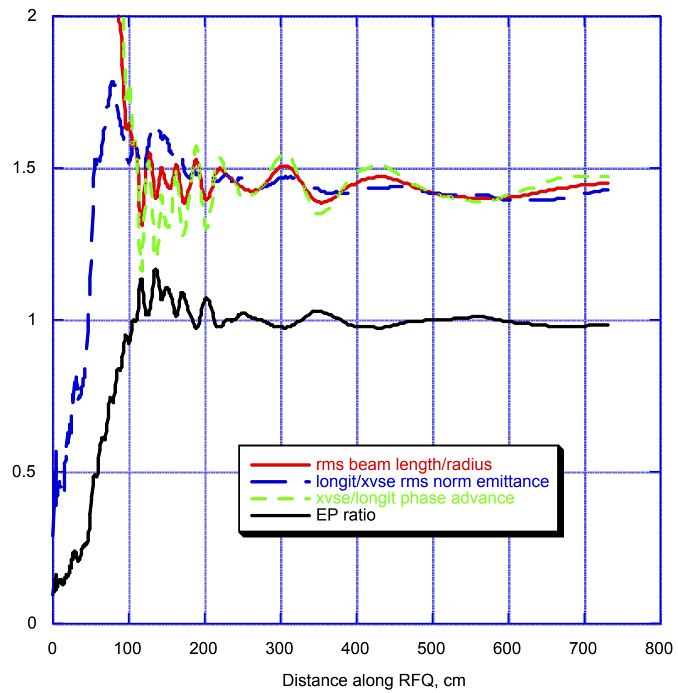
International Fusion Materials Irradiation Facility -

a component of the ITER program

125 mA, 5 MeV, 175 MHz CW deuteron RFQ

Designed from desired space-charge beam physics out to metal:

- Energy-balanced (equipartitioned) design minimizes free energy that could drive resonances.
- No crossing of major resonances.
- Multipoles, image forces, form factor adjustment, adjacent bunches, etc., incorporated in design procedure.
- Losses optimized to low energy.
- Transmission ~ 97% with multipoles, image charges, optimum injection match, no errors.



Teplyakov's Proposal for the IFMIF Accelerator RFQ

- 2.6.8.3 *Space-periodic 0.1–8 MeV linac structure*
- The IHEP Protvino group directed their attention to a 0.1-3 MeV RFQ and a 3.0-8.0 MeV RFQ using the Space-Periodic RFQ (SPRFQ) structure that IHEP has operated successfully at lower beam intensity for many years [6,63-66]. The structure uses H-type resonators inside an outer vessel. The inner part of the electrodes near the beam axis are shown in Figure 2.6.8-4; vane segments are formed on the split ends of the H-resonators, and interleaved with additional vane segments on posts standing from the bottom of the H-resonators. The detailed vane geometry provides additional transverse focusing and allows adjustment of the ratio between accelerating and focusing voltages. Capacitance is added in a controlled manner through the SPRFQ, allowing a large increase in the vane voltage, up to factors of 3-5 or more, limited by rf power loss considerations. The technique allows the SPRFQ to be considerably shorter, and total rf losses to be less.

- An experimental program to demonstrate the properties of these structures is proceeding at Protvino. Initial operation of a 1.8 MeV RFQ with 100-120 mA proton current is planned for 1996. Plans for 1997 include manufacturing of an H-resonator structure for acceleration up to 7 MeV, investigation and modeling of the SPRFQ structure, and preparation of the rf system. Commissioning with beam to 7 MeV is anticipated in 1998. These tests will benefit an IFMIF evaluation of this option for deuterons.

- The basic parameters are shown in Table 2.6.8-1 below.

Table 2.6.8-1. Parameters of the RFQ-SPRFQ design for IFMIF

Parameters	RFQ	SPRFQ
Frequency, MHz	175	175
Input energy, MeV	0.1	3.0
Output energy, MeV	3.0	8.0
Intervane voltage, kV	87.	210.
Characteristic bore radius, mm	4.2	4.2
Aperture radius, mm	4.19-3.20	4.0
Length, m	4.97	2.4
Input beam current, mA	130	126.2
Transmission efficiency, %	97.8	100
Input normalized beam emittance, π mm mrad	0.6	0.9
Output normalized beam emittance, π mm mrad	0.8	0.9
Surface field, E_{max}, $kVcm^{-1}$	280	310

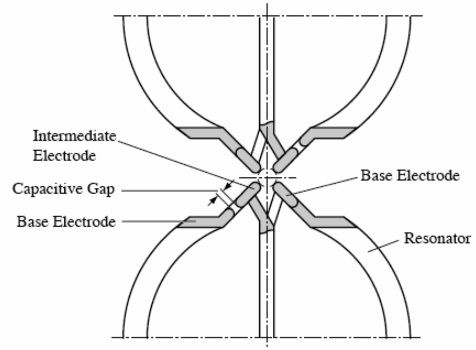


Figure 2.6.8-4. Transverse cross-section of the electrodes for the second SPRFQ.

Prof. Dr. Vladimir Alexandrovitch Teplyakov