STATUS OF THE SPP RFQ PROJECT

THPP067

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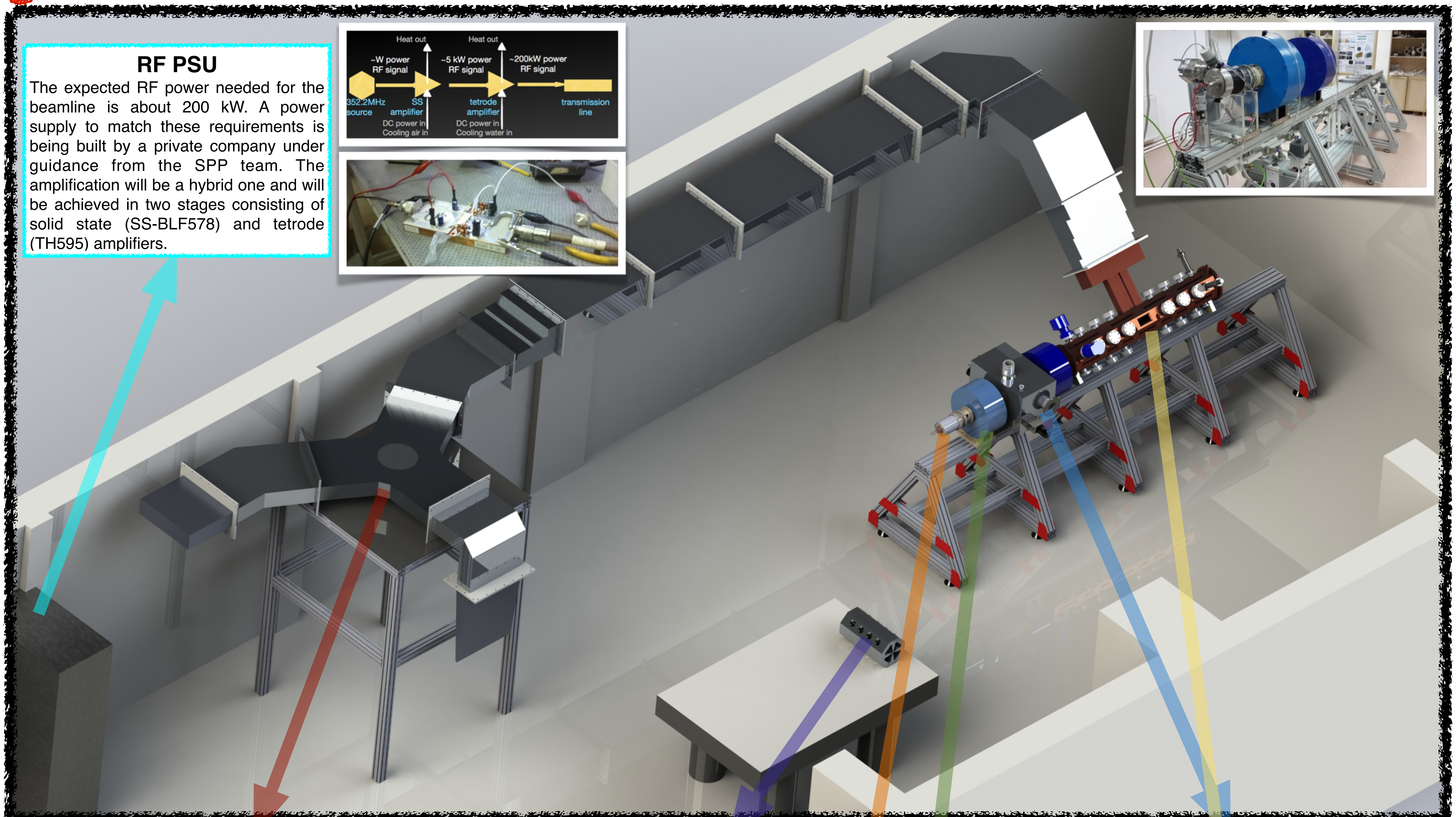
Abstract

The SPP project at TAEK will use a 352.2 MHz 4-vane Radio Frequency Quadrupole (RFQ) to accelerate H+ ions from 20 keV to 1.5 MeV. With the design already complete, the project is at the test production phase. To this effect, a so called "cold model" of 50 cm length has been produced to validate the design approach, to perform the low power RF tests and to evaluate possible production errors. This study will report on the current status of the low energy beam transport line (LEBT) and RFQ cavity of the SPP project. It will also discuss the design and manufacturing of the RF power supply and its transmission line. In addition, the test results from some of the LEBT components will be shown and the final RFQ design will be shared.

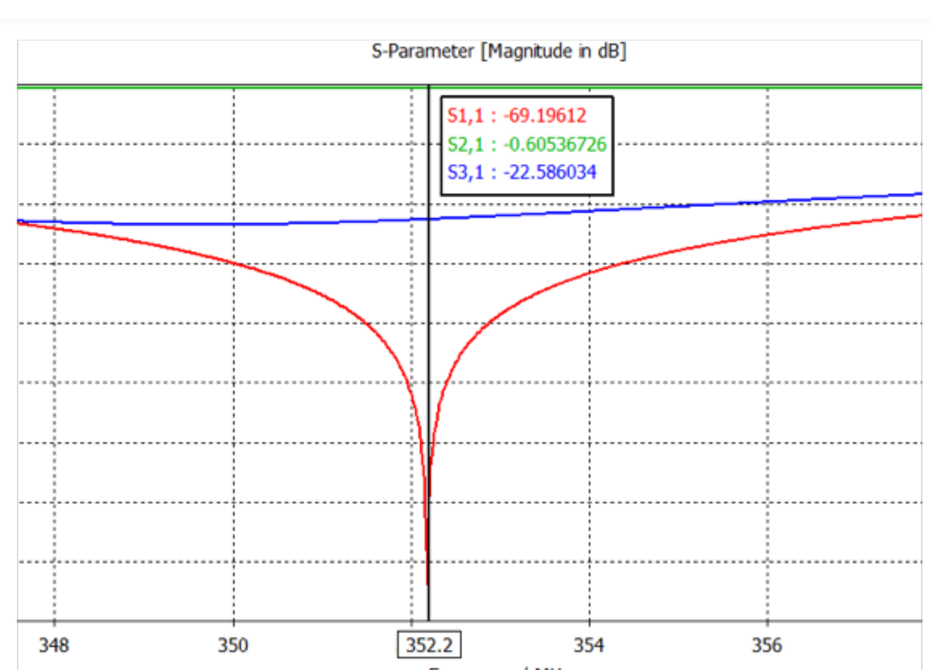
RF PSU

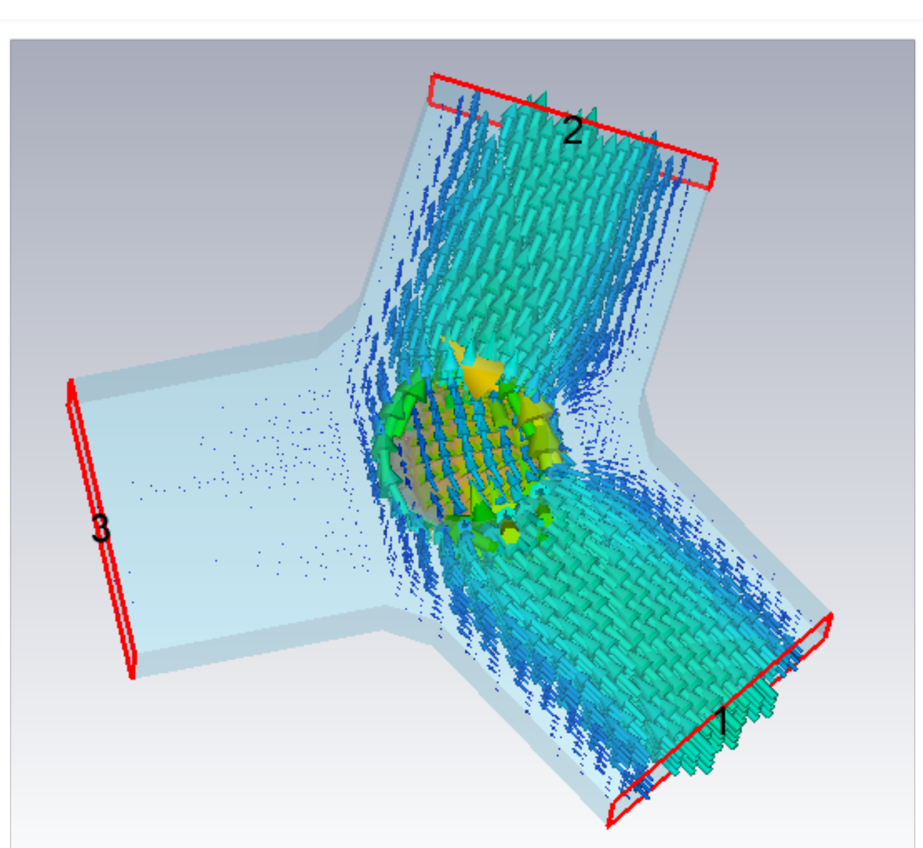
The expected RF power needed for the beamline is about 200 kW. A power supply to match these requirements is being built by a private company under guidance from the SPP team. The amplification will be a hybrid one and will be achieved in two stages consisting of solid state (SS-BLF578) and tetrode (TH595) amplifiers.



Circulator

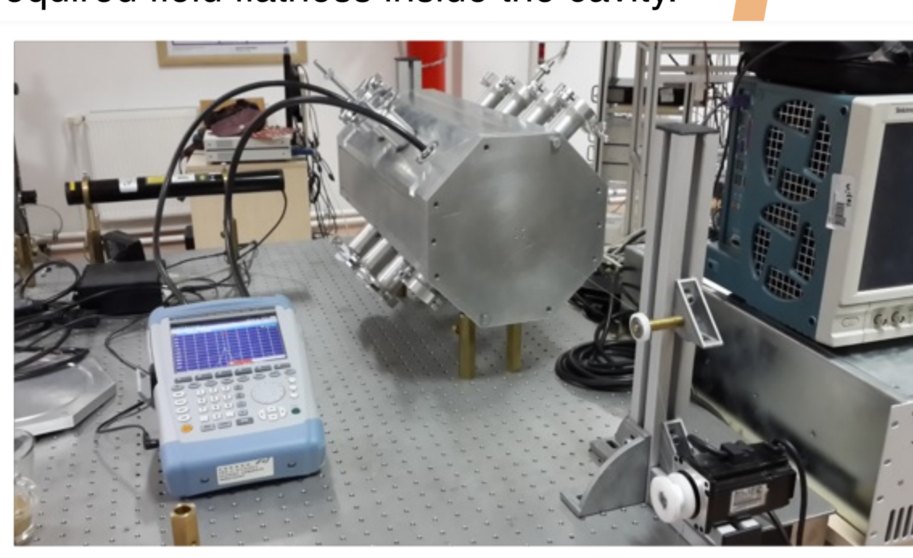
After considering stripline, full height (FH) and half height (HH) models, the preliminary circulator design is made with the last option. The circulator itself is selected to operate in above resonance mode and a set of commercially available Yttrium based garnets are scanned to find the optimum material, geometry and bias field to apply. So far, the results show that over 90% power transmission can be achieved with about 1% or less return and isolation losses. Further optimization of the circulator design and the procurement of the ferrite material are ongoing.





Cold Model Tests

50 cm length Aluminium cold model is produced to perform the low power RF tests, to gain experience of production of RFQ vanes and evaluate possible production errors. Desired cavity resonant frequency, 352.2 MHz, was obtained at the RF tests. Also the effect of the tuners on resonant frequency is studied (tuning range: -100/+400 kHz). The bead-pull tests are ongoing to tune and obtain required field flatness inside the cavity.

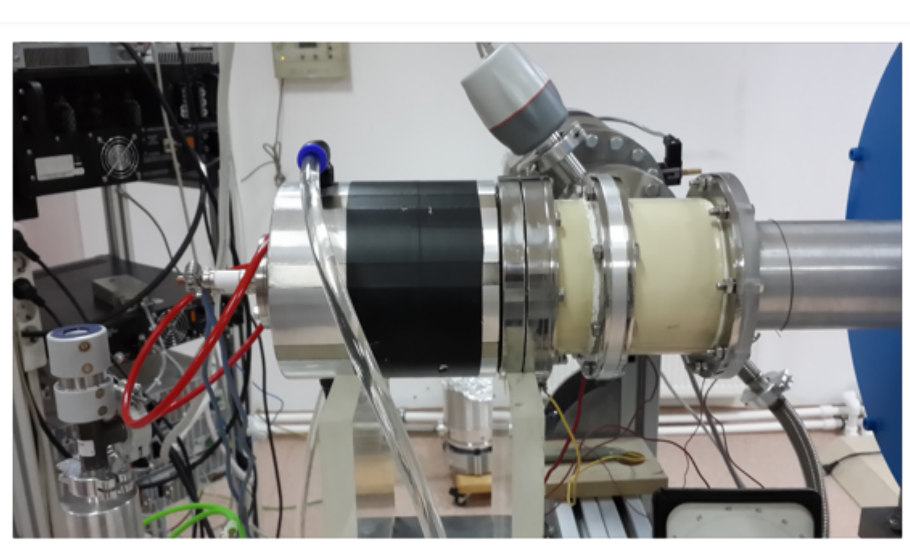


Solenoids

The stability (magnetic field) tests are done for LEBT solenoids. Measured time required for Sol-M and Sol-L to reach steady state are approximately 111 and 105 minutes respectively.

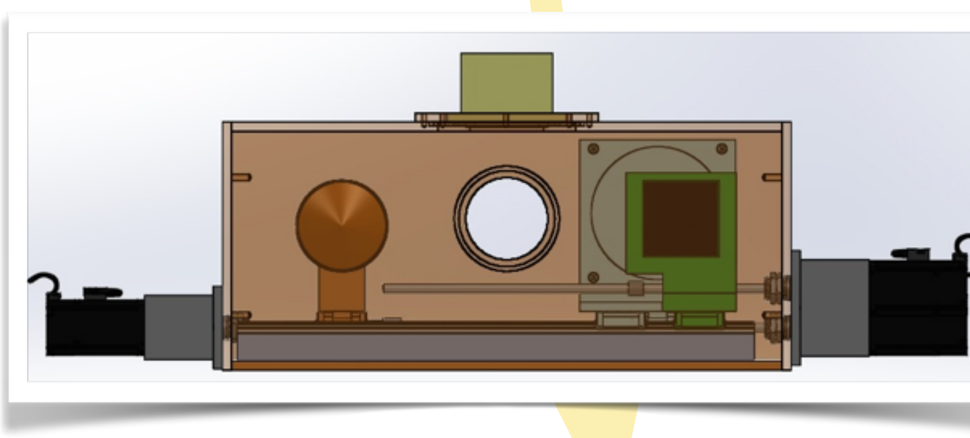
Ion source

Current and stability tests are performed with a simple Faraday cup (FC) for two different ion source configurations (RF antenna and DC filament).



Measurements box

The measurements box will be located between the two solenoids and it will contain a FC, a pepper-pot filter for emittance measurements and a scintillator screen. All components will be motor controlled such that they can be pushed in and out of the beam independently.



RFQ

Beam Dynamics

It was decided to follow a two step approach: step-1) construction of an Al + Cu coated RFQ from a single Al piece machined on a 120 cm CNC to help fulfill the project goals; step-2) after securing of a proper brazing furnace, construction of a two section OFE Cu RFQ.

Design	L (cm)	E_{out} (MeV)	T_{tot}/T_{acc} (%)
A	119.0	1.3	99.0/94.1
B	164.6	1.5	99.7/96.2

Electromagnetic

The 2D electromagnetic design is modified after discussions on cooling and machining of the RFQ with CNC experts. Therefore, the vanes were thickened to 14 mm at 35 mm from the beam axis to provide sufficient space for cooling channels and also a vane base width increased by approximately 5 mm to reduce the mechanical vibrations.

Design	F (MHz)	Q (#)	P_{SF} (W/cm)
Prior	352.2	10342	126.0
Current	351.0	10499	121.5

Outlook

The project aims to obtain the first MeV range protons by the end of 2015. For the MeV level diagnostics, current measurement by an ACCT and energy measurement by a spectrometer is planned. These components will also be home designed and built. The ACCT prototype is ready and the construction of the wire chamber for the spectrometer is ongoing.

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