

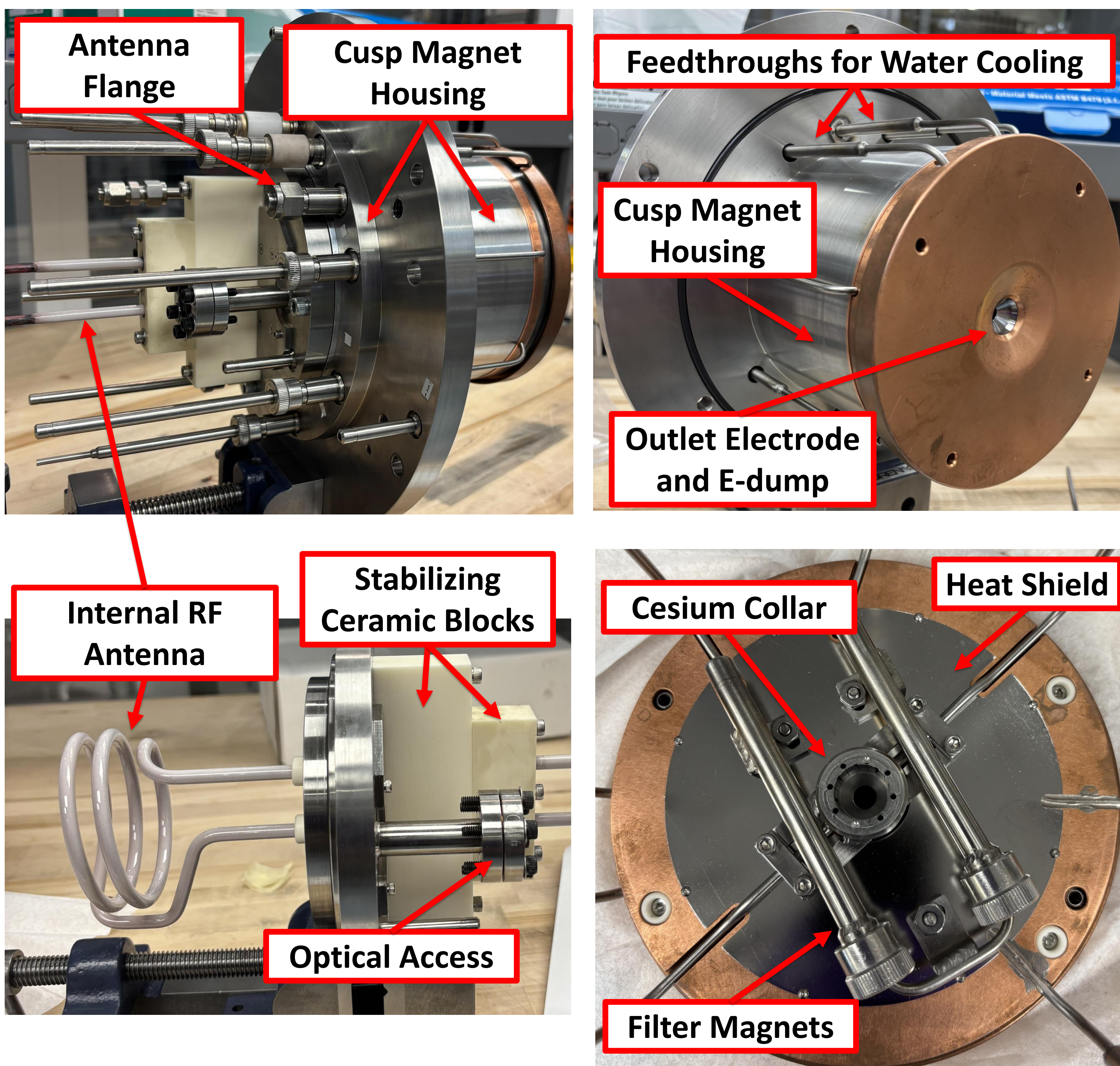
Status of the Internal RF Antenna Negative Ion Source for LAMP

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The LANSCE Accelerator Modernization Project (LAMP) will replace the front-end of the existing LANSCE accelerator, from ion sources through the end of the 100-MeV drift-tube linac. LAMP requires higher peak H- beam currents, and longer lifetimes, than provided by the existing LANSCE H- ion sources. The project has constructed an SNS-style multicusp cesiated source with an internal RF antenna. This source operates in two modes: a 13.56MHz CW mode to ignite the plasma and a 2MHz mode which provides a high-power, pulsed plasma. In this paper, we discuss the commissioning status of the 13.56 MHz plasma including the matching network. We also discuss future steps, including the commissioning of the 2 MHz matching network.

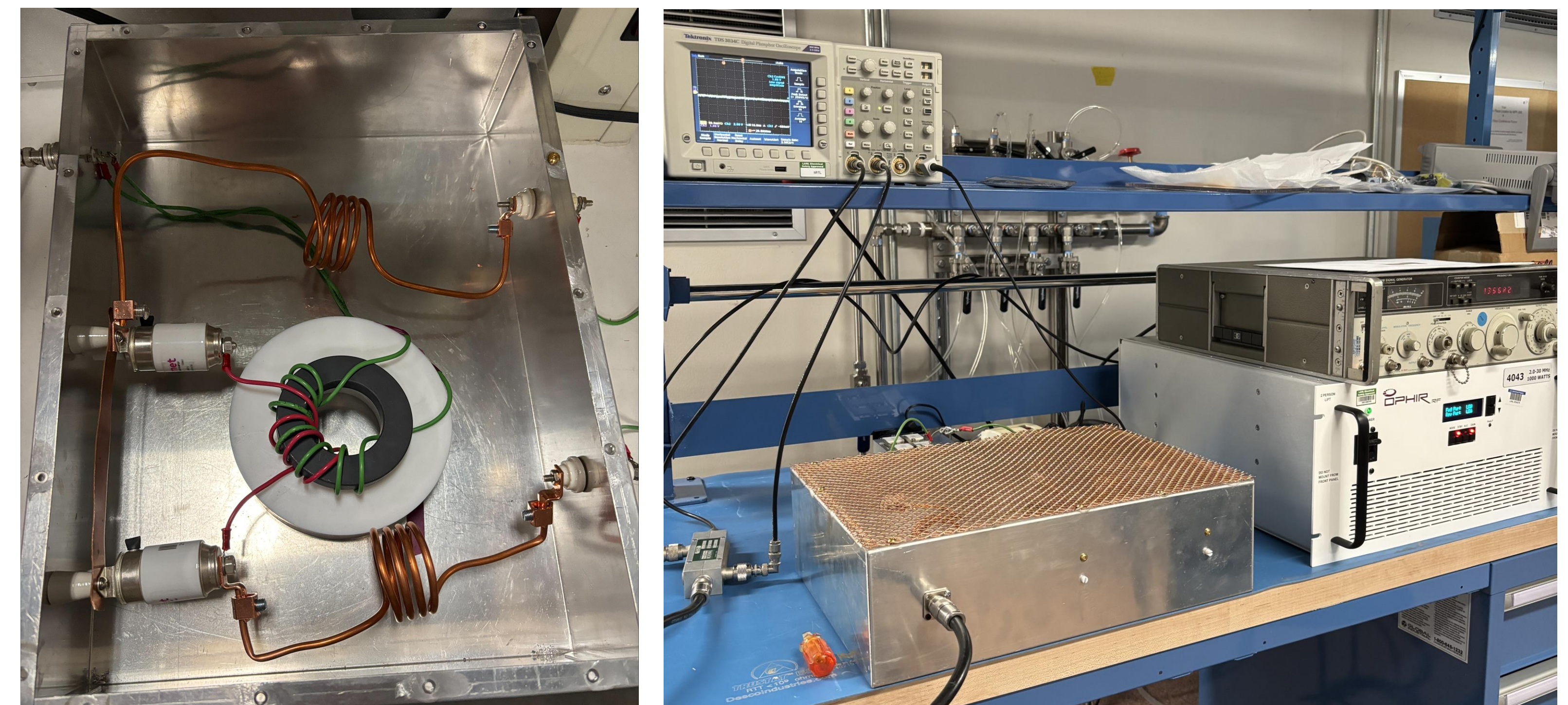
The H- source design is based off the functioning source at the Spallation Neutron Source (SNS).

The SNS internal RF antenna design was selected as the LAMP H- source due to its high achievable current and reliability [1].



The 13.56MHz has been tested up to 200W.

To generate low-power plasma, the 13.56MHz matching network is driven at 100 – 300W. Testing in this power range is ongoing. The design of the 13.56MHz network consists of an 8:4 transformer made in-house, two variable capacitors, and two 0.8μH inductors.

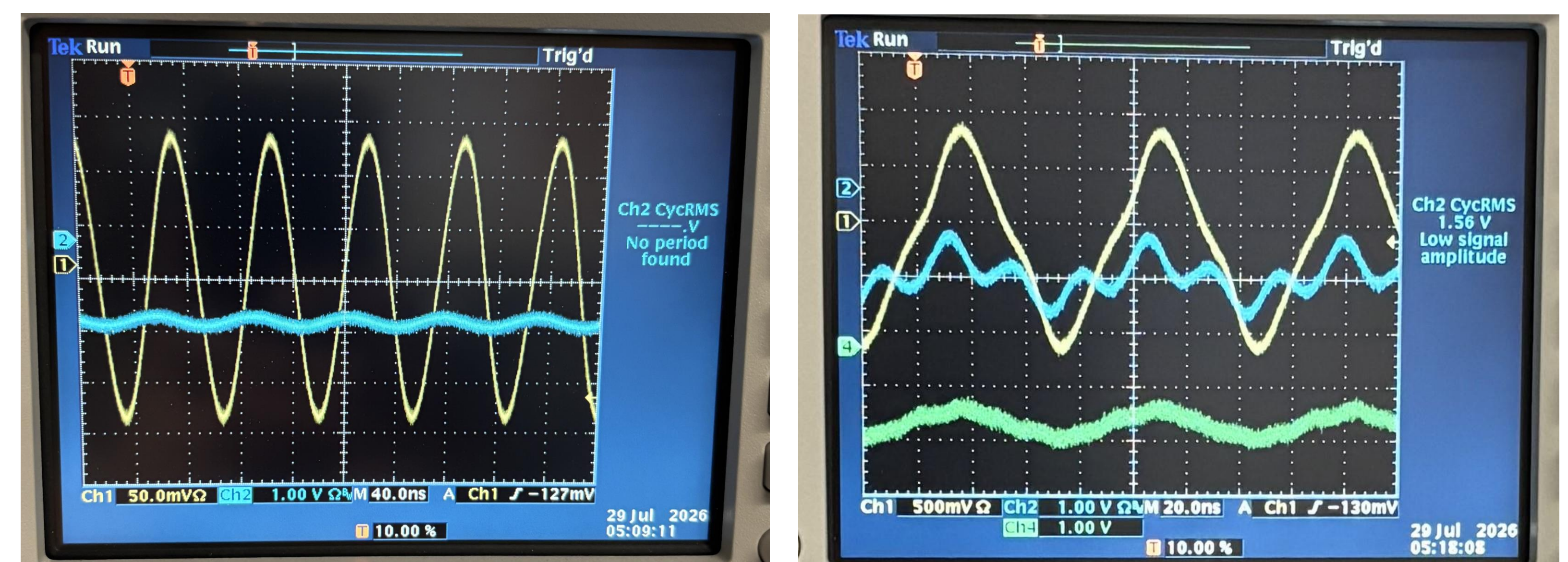


13.56MHz matching network.

Testing configuration for the 13.56MHz matching network.

Initial testing shows that the transformer is heating during operation, causing the system to de-tune.

AS the RF power was increased, the transmitted power (shown in yellow in the images below) began to distort. Additionally, the reflected power (shown in blue) began to drift and increase as the system de-tuned. To solve this issue, we are exploring different cooling options.

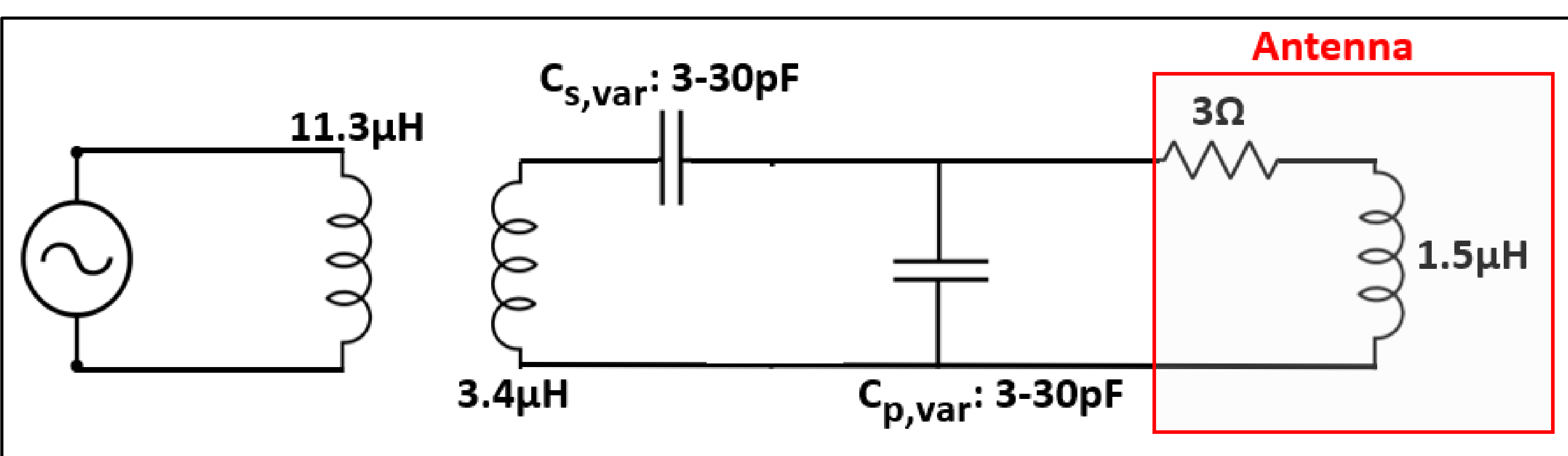


Transmitted signal (yellow) and reflected signal (blue) for the 13.56MHz matching network at 4W.

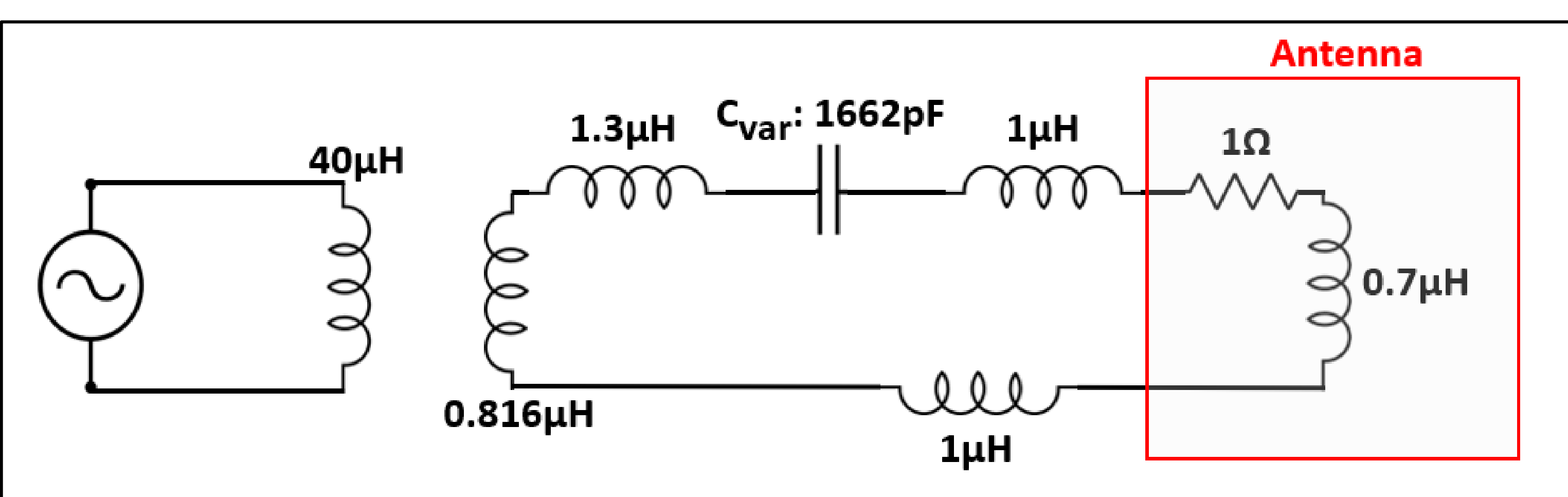
Transmitted signal (yellow) and reflected signal (blue) for the 13.56MHz matching network at 100W.

Operating the H- source requires two separate frequency matching networks.

The ion source operates in 2 frequency modes: a 13.56 MHz that provides CW beam and a 2 MHz mode which provides a high-power, pulsed plasma. The design of the 13.56 MHz matching network has been completed and is undergoing testing at 200W.



Circuit diagram of the 13.56MHz matching network.



Circuit diagram of the 2MHz matching network.

Next Steps: Begin commissioning the 2 MHz matching network.

Low power plasma testing began in September 2027. Once we confirm low power plasma, we will begin implementing diagnostics to fully characterize the plasma. In tandem, we are designing and building the enclosures required to operate at 2MHz and perform beam extraction.

Acknowledgements

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[1] R. F. Welton et al., "H- ion source research and development at the Oak Ridge National Laboratory", AIP Conference Proceedings, vol. 2373, no. 1, p. 070004, Jul. 2021. doi:10.1063/5.0057549