Progress on ECR2

D.P. May, F.P. Abegglen, G.J. Derrig, and R.S. Olsen

A new aluminum plasma chamber has been designed, machined and installed in the ECR2 ion source. This replacement plasma chamber (Fig. 1) has no water-to-vacuum seals and has a different

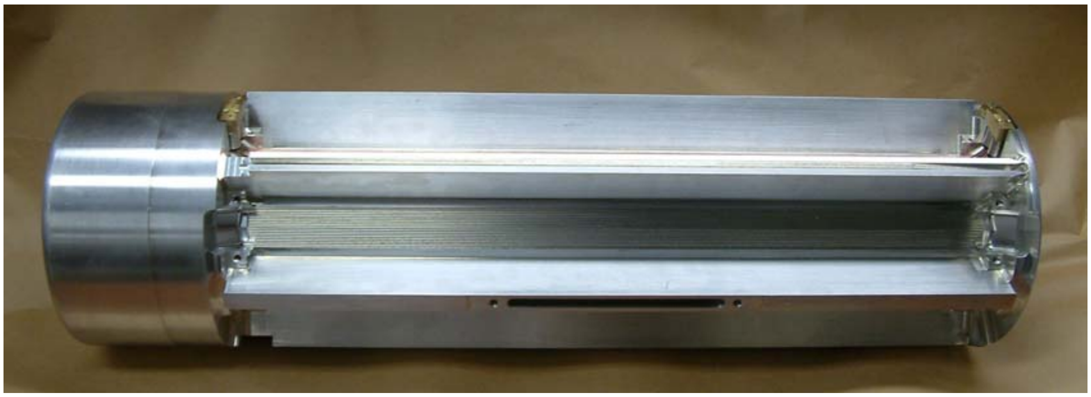

Figure 1. The newly machined plasma chamber. Grooves are machined into the bottom of the magnet channels. Three ports are machined radially between the channels.

concept for water-cooling. Figure 2 shows a cross-section through the chamber and one magnet pole. Eighteen copper tubes, each with an inner diameter of 0.7 mm and an outer diameter of 1.8 mm, lie between the aluminum of the plasma chamber wall and each of the six magnet bars. All eighteen tubes

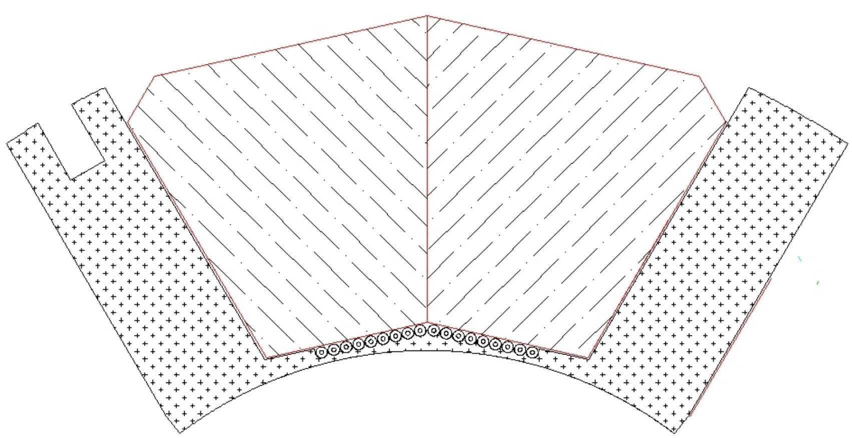

Figure 2. Cross-section through magnet channel showing the eighteen copper tubes interposed between the aluminum plasma chamber and the Nd-Fe-B bar. Each tube has an outer diameter of 1.8 mm and an inner diameter of 0.7 mm.

were soldered into a copper fitting for connection to a water fitting. The tubes were positioned into parallel grooves in the aluminum along the face of the bars (Fig. 3). They were flow tested and then potted in place using a thermal epoxy. A sheet of 0.25 mm stainless steel was positioned over the tubes and then the Nd-B-Fe bars were inserted into their channels.

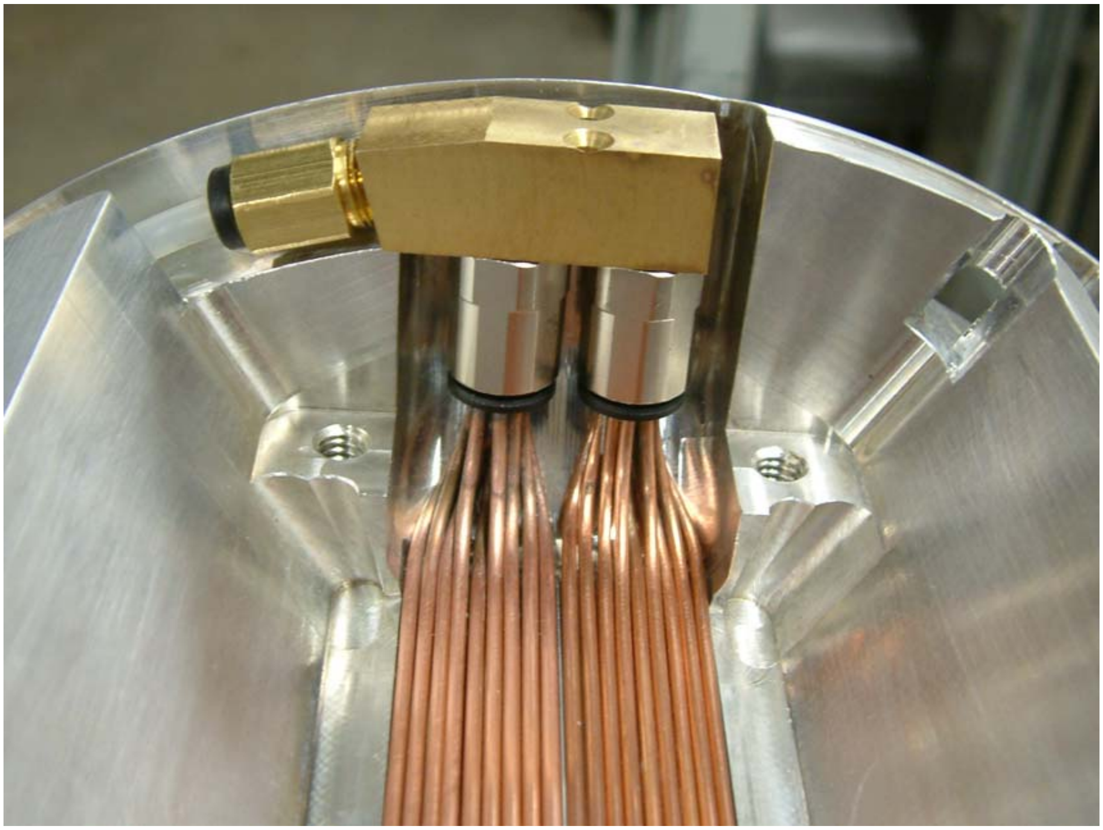

Figure 1. The copper water tubes positioned in the magnet channel with water fitting.

Before the design was finalized the concept was tested using a flat array of 18 tubes sandwiched between a thin aluminum plate and a 0.25 mm thick, stainless-steel plate. First, flow tests determined that 36 cc/sec of water would flow through the bundled tubes with a water pressure of 90 psi. Then with this flow, a 300 watt electrical strip heater was attached to the center of the aluminum plate on the side opposite to the tubes. The contact area for the heater was rectangular measuring 2.2 cm wide by 14.6 cm long. The temperature of the stainless steel directly opposite the heater was measured with water flowing as the heater power was increased. At 300 watts the temperature rise at this point was measured to be 13º C. This corresponds to small area heating of the plasma chamber using well over 1.8 kW of microwave power dissipation.

The water flow through the new plasma chamber is approximately three times the flow through the old chamber. So far the power from the 14.5 GHz microwave transmitter into the source has reached 1.5 kW on a continuous basis with no sign of excess heating to the chamber. After the installation of the new plasma chamber and Glaser lens, ECR2 has produced 239 eμA of 6+ oxygen and 131 eμA of 7+ at

10 kV extraction voltage through a 13 mm collimator onto a biased faraday cup. The microwave power level was 1.4 kW. Also at this power level the source has produced 111 eμA of $^{40}Ar^{11+}$, 50 eμA of $^{40}Ar^{12+}$ and 33 eμA of $^{84}Kr^{17+}$ (from non-isotopic gas).

Plans for the ECR2 ion source include two-frequency heating with the addition of a 11 GHz TWT transmitter capable of greater than 400 watts, the construction of a gas system making the switching between gases easier, further development of the sputtering system, and in an effort to decrease the high x-ray flux the addition of much more surrounding lead shielding.