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## New, High Efficiency RF Sources

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Several new, high efficiency, RF sources are available or in development at frequencies from 325 MHz to 1.3 GHz and higher. If successfully developed, these new devices will represent lower cost alternatives to conventional RF sources. The primary focus is RF power production at higher efficiency and lower cost than currently available from conventional vacuum electron devices and solid-state sources. All devices are predicted to achieve more than 80% efficiency and provide lower acquisition and/or operating costs. A magnetron system with phase and amplitude control was successfully tested, producing 100kW at more than 80% efficiency. This system was developed for superconducting accelerators requiring fast feedback control of the RF power. The cost is estimated at \$1 per watt. A multiple beam power grid tube was recently completed, providing sufficient beam power to generate 200 kW of RF power from 325 to 500 MHz at an estimated cost of 50 cents per watt. This device, if successfully tested, will provide a dramatically more compact and lower cost alternative to solid state systems now being used in this frequency and power range. Simulations predict 150 MHz of mechanical tuning range, and RF power generation up to 1 GHz may be feasible. Final assembly is in progress on a 100 kW CW, 1.3 GHz klystron simulated to achieve 80% efficiency using a COM-based RF circuit. Seal-in should be completed by the end of October, and the tube will be baked when a station is available. Testing is scheduled for January 2023. A 700 MHz, multiple beam inductive output tube is being developed with an estimated efficiency exceeding 80%. This tube will use moly grids to avoid the availability, cost, and yield issues associated with pyrolytic graphite grids. A new input coupler is dramatically simpler and more compact than previous versions, reducing both the cost and the size of the tube. Parts procurement is in progress, and testing is scheduled for spring 2023. These new sources could significantly impact the cost of new accelerator and colliders systems, particularly those requiring many RF source or operating at high duty.

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