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High Temperature Superconducting RF cavity

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High Q cavities are an essential component for rf pulse compression. In order to reduce cavity losses and increase compatibility with applications requiring long fill times, we are interested in developing compact superconducting cavities that operate at high temperature (~80 K). We are designing and planning to measure an RF cavity at 11.424 GHz that will include High Temperature Superconductor (HTS) tapes attached to inner cavity surfaces. The cavity uses a TM011 mode and has been designed with eight separate facets. This allows each facet to have a flat surface where the HTS tapes can be applied. A TE10 to TM01 mode converter will feed the cavity through a coupling aperture designed to give the correct value of loaded Q. The cavity Q is designed to allow a fill time (1 exponential step) of 1 microsecond, corresponding at 11.424 GHz to QL = 71,779. The design assumes the HTS surface conductivity is 11.02e9 S/m, which is 190 times that of copper. The TM01 waveguide has been shown in simulation to function correctly even with a small physical gap at the input. The facets can also have small gaps since the wall current for the TM01 mode is axial. That is also important since wall current does not cross gaps between HTS tapes. Cavity tuning is planned by separating the facets with wedges. Addition of the HTS tapes will increase the cavity resonant frequency, so pushing apart the facets will lower the frequency. We only need to stay within the bandwidth of a klystron, which is about 10 MHz. The cavity and mode converter will be cooled with a He compressor in vacuum. Performance of the cavity will be characterize between 4K and the transition temperature of the superconductor at ~90K.

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