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Design and Activation of a Frequency Tunable 200 GHz Gyrotron

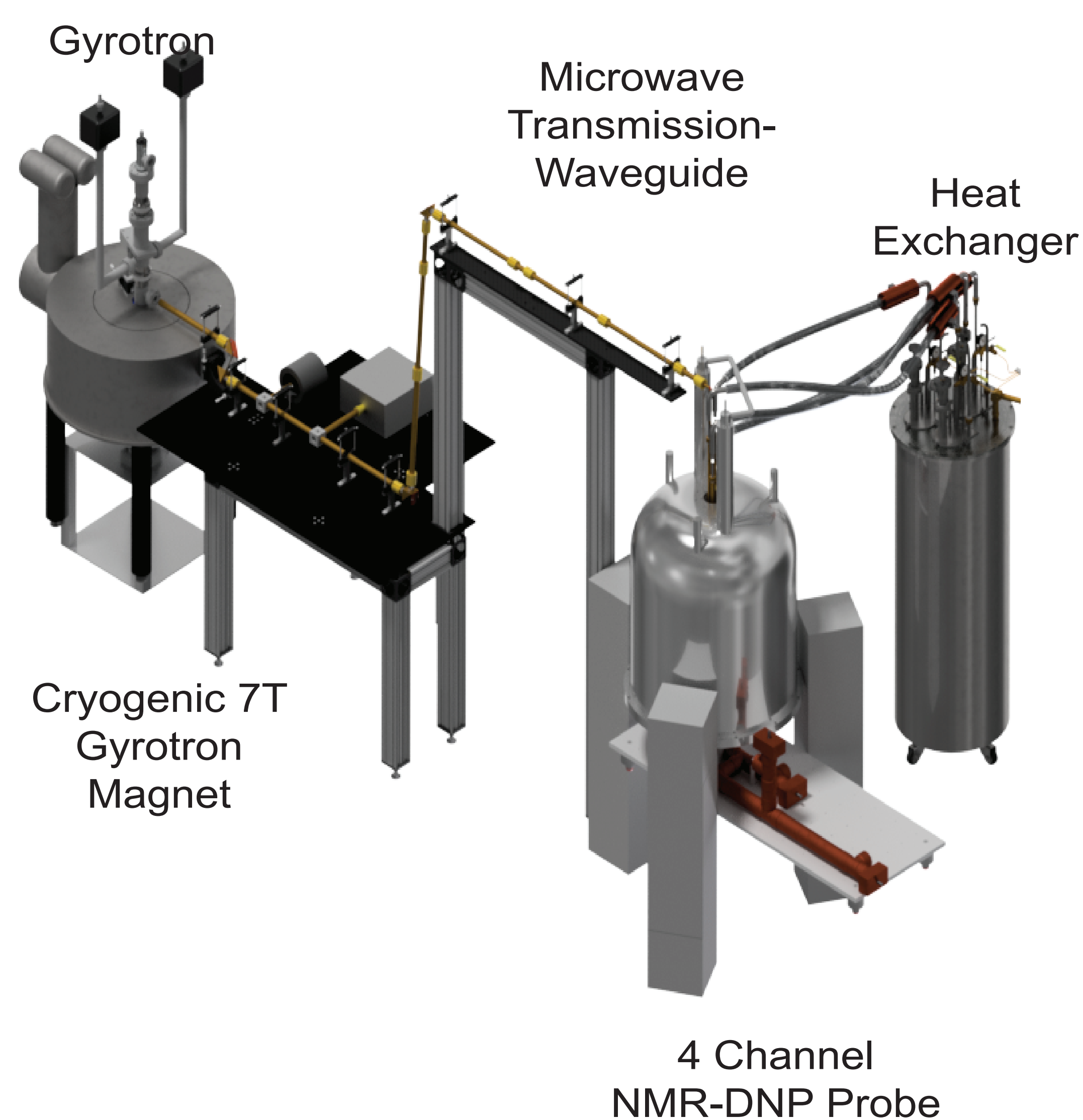
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Background and Motivation

Dynamic Nuclear Polarization (DNP) when combined with Nuclear Magnetic Resonance (NMR) yields high sensitivity spectra while decreasing sample acquisition time. DNP transfers polarization from electron to nuclear spins, giving a strong enhancement of NMR signal. DNP requires high power, high frequency microwave power provided by gyrotrons.

DNP-NMR Instrumentation

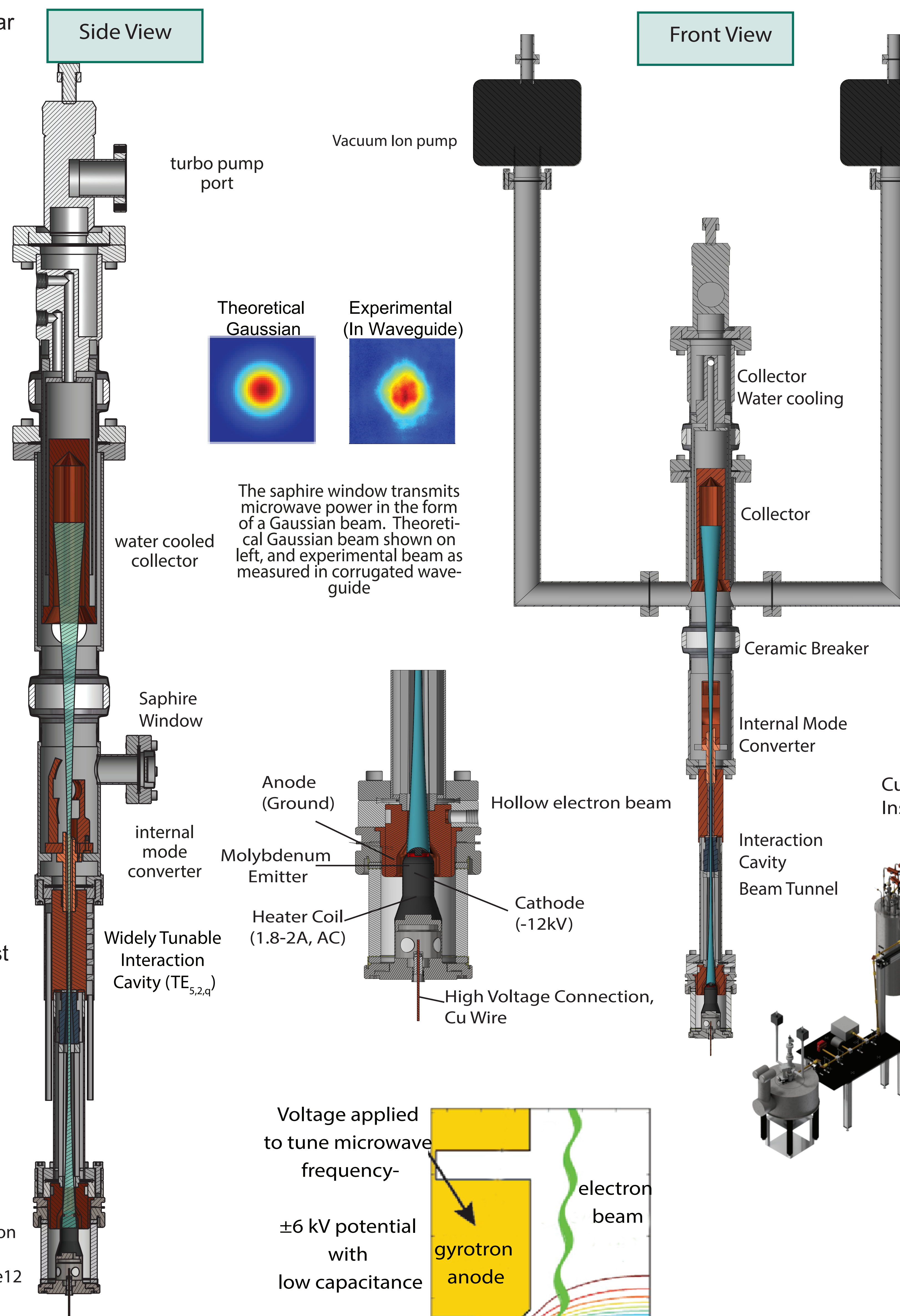


Using custom built DNP-NMR spectrometer, higher sensitivity spectra of the structure and interactions of Protein Kinase C (PKC) with agonists can be obtained more rapidly. The novel fast frequency sweeping gyrotron will allow even higher resolution spectra than previously demonstrated.

Processing and Design

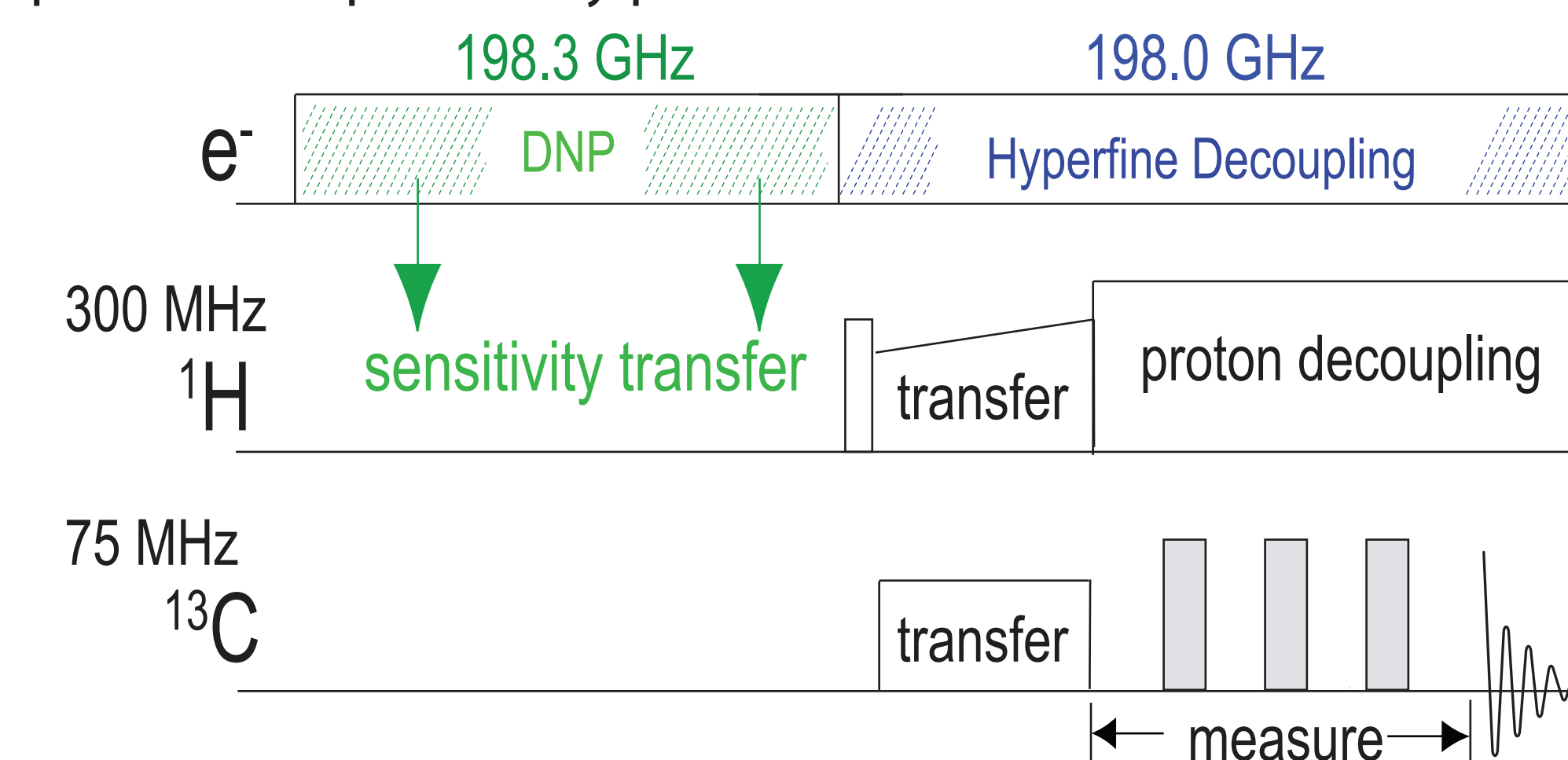
Gyrotron power is generated by a magnetron injection gun (MIG) composed of a molybdenum emitter coating a barium impregnated tungsten matrix cathode. MIG was purchased from Bridge12 and activated with a low potential (DC 5-20V) applied, Heater current 1.98A.

In this 200 GHz gyrotron, a low capacitance between cathode and anode on the MIG and a variable potential field allow electrons to be accelerated into the magnetic field at variable frequencies.



DNP with Electron Decoupling

In previous DNP experiments, strong nuclear-electron spin couplings lead to short spin relaxation times and broad NMR line shapes. Voltage tunable gyrotrons are required for fast frequency sweeps of the irradiation bandwidth used for electron decoupling experiments. Using this tunable, fast frequency sweeping gyrotron, electron decoupling experiments will be possible, leading to higher resolution NMR spectra than previously possible

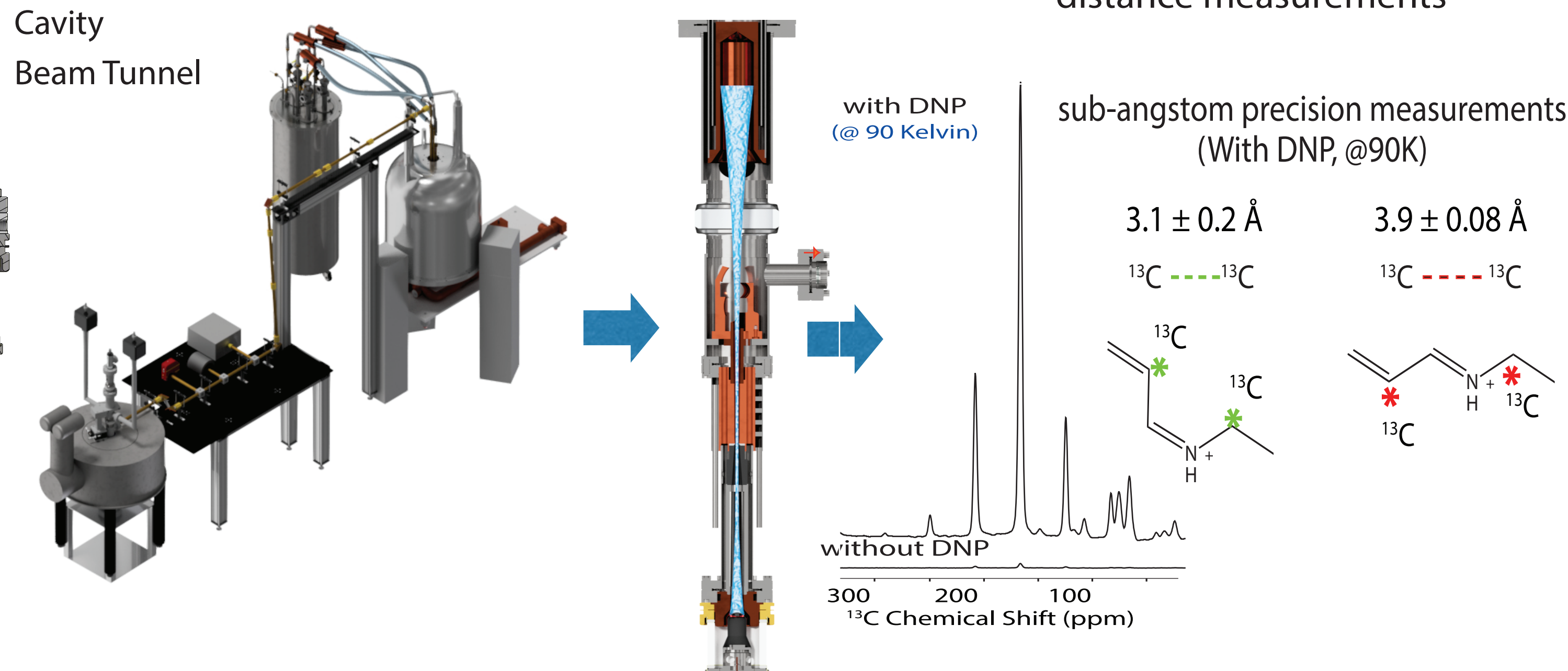


Proposed pulse sequence for electron decoupling using microwave power. Gyrotron fast frequency sweep required for adiabatic inversions of electron spins, which ultimately average strong nuclear-electron spin coupling hyperfine interaction.

Summary

Custom DNP-NMR 200 GHz Voltage Tunable Gyrotron capable of fast frequency sweeps

Electron Decoupling Better NMR sensitivity, sub angstrom precision distance measurements



Acknowledgements and References

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