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Characterization and Improvement of Phase Noise in the RHIC 197 MHz RF System

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The Relativistic Heavy Ion Collider (RHIC) is a high energy collider currently in operation at Brookhaven National Lab that collides both proton beams and heavy ion beams at energies of up to 250 GeV. The use of a low phase noise RF system is important to the operation of the collider, as phase noise will cause beam emittance growth as beam is circulated and collisions occur. In an effort to reduce the phase noise seen by the beam, an ultra-low phase noise source consisting of a DAC being clocked by an ultra-quiet 2 GHz clock was developed and tested for RHIC's 197 MHz RF systems. Using this source, the current High Level RF system' s phase noise performance was characterized. This source optimized noise performance at high frequency offsets, while the current RF system is optimized for low frequency offsets. It will have applications in the future Electron-Ion Collider Crab Cavities, as wideband noise is critical in limiting the transverse emittance growth of the beam.

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