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*Strong Coupling and Quantum Criticality in a Canonical Density Wave System*

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We present high resolution x-ray diffraction measurements on antiferromagnetic Chromium, which is known to exhibit strong coupling phenomena despite the familiar weak-coupling density wave ground state. We directly measure the spin- and charge-density wave order parameters as the magnetism is suppressed with applied pressure using diamond anvil cell techniques at the Advanced Photon Source. In the low pressure regime, the BCS-like ground state is manifest in the decades-long exponential suppression of the order parameters, while at high pressure this weak-coupling behavior is cut off by a quantum phase transition. We identify quantum confinement as the physics driving the exponential suppression of the antiferromagnetic phase. We find that Cr is unique among stoichiometric itinerant magnets studied to date insofar as the quantum phase transition is continuous in nature, allowing experimental access to the naked quantum singularity where the competition between the destabilized density wave and more strongly coupled ground states is most intense. Our results inform the growing body of evidence that weak- and strong-coupling phenomena indeed coexist in many solid state systems, such as continuously tuneable charge density waves in manganites, unconventional superconductivity in spin density wave Bechgaard salts, and charge density wave characteristics of the checkerboard order in the high- $T_C$  cuprates.

### My original version

A number of recent studies have shown that weak- and strong-coupling phenomena indeed coexist in some very interesting solid state systems, blurring the distinction between weakly and strongly coupled states of electronic matter. Examples include continuously tunable charge density waves in manganites, triplet superconductivity in spin density wave Bechgaard salts, and charge density wave characteristics of the checkerboard order in the high- $T_C$  cuprates. Here we present high resolution x-ray diffraction measurements on antiferromagnetic Chromium, which is known to exhibit strong coupling phenomena despite the familiar weak-coupling density wave ground state. We directly measure the spin- and charge-density wave order parameters as the magnetism is suppressed with applied pressure. In the low pressure regime the BCS-like ground state is manifest in the decades-long exponential suppression of the order parameters, while at high pressure this weak-coupling behaviour is cut off by a quantum phase transition. We find that Cr is unique among stoichiometric itinerant magnets studied to date insofar as the quantum phase transition is continuous in nature, allowing experimental access to the naked quantum singularity where the competition between the destabilized density wave and more strongly coupled ground states is most intense.

### Tom's revision

We present high resolution x-ray diffraction measurements on antiferromagnetic Chromium, which is known to exhibit strong coupling phenomena despite the familiar weak-coupling density wave ground state. We directly measure the spin- and charge-density wave order parameters as the magnetism is suppressed with applied pressure using diamond anvil cell techniques at the Advanced Photon Source. In the low pressure regime, the BCS-like ground state is manifest in the decades-long exponential suppression of the order parameters, while at high pressure this weak-coupling behavior is cut off by a quantum phase transition. We find that Cr is unique among stoichiometric itinerant magnets studied to date insofar as the quantum phase transition is continuous in nature, allowing experimental access to the naked quantum singularity where the competition between the destabilized density wave and more strongly coupled ground states is most intense. We are able to identify quantum confinement as the underlying physics driving the demise of the magnetism. Finally, we compare our results on Cr to continuously tuneable charge density waves in manganites, triplet superconductivity in spin density wave Bechgaard salts, and charge density wave characteristics of the checkerboard order in the high- $T_C$  cuprates in order to probe the distinction between weakly and strongly coupled states of electronic matter.