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Search for O^{-1} Earthquake-like Precursors: A MaxEnt-μSR MgO Study

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We study O^{-1} earthquake-like precursor effects [1,2] by analyzing Muon-Spin-Resonance (μSR) MgO data using Maximum Entropy (MaxEnt). [3,4] Due to its presence in the Earth's crust, MgO is ideal for studying these features: O^{-1} (or positive-hole) formation results from a 2-stage break-up in an oxygen anion pair under elevated temperatures or high-pressure conditions. [2] As temperature increases above room temperature (RT) a small percentage is predicted to produce an O^{-1} state. MaxEnt analysis of transverse field (TF) (100-Oe) μSR data of a pure 3N-MgO single crystal show a broad Gaussian signal at 1.36 MHz and a sharp signal at 1.4 MHz. In MgO, the muon localizes in a vacant oxygen tetrahedron, as positive muons probe near negative O ions. For MgO, MnO and Al_2O_3, TF-μSR data show only the expected μ^+O^{-2} Gaussian signal. In MgO, an *additional* sharp 1.4-MHz signal has been seen, strongly suggesting the existence of *extended* O^{-1} states. [1,2] We have fitted MaxEnt-μSR transforms of MgO to obtain an empirical description. Their temperature dependences above RT appear to be positive-hole effects. The O-valency effects, related to earthquake-like precursors, are discussed.

Biography:

Dr. Carolus Boekema Professor Emeritus of Physics at San Jose State University (SJSU). His field of Research includes Magnetism in Cuprate Superconductors; Rare O[-1] ions in MgO (earthquake-like precursors); Modeling Frustration in Condensed Matter. He is Nominee, American Physical Society, Faculty Undergraduate Research 2017 Award, SJSU Faculty Mentor Awards 2017, 2013 & 2005; APS Far West Section **(co-Founder)** Grant support PIPD & coPI: ~1.7 M$; 111 refereed student-coauthored publications, including two Phys Rev Lett, two Phys Rev **B** Rapid Comm, and eight invited papers.