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Testing spontaneous localization with ultra-massive cluster interferometry STEFAN NIMMRICHTER, University of Vienna, KLAUS HORNBERGER, MPIPKS Dresden, MARKUS ARNDT, University of Vienna — Understanding the transition from the microscopic domain of quantum mechanics to our everyday classical world is still an open problem in modern physics. Collapse models are a possible way to resolve this issue by introducing mechanisms which break the quantum superposition principle above a certain mass and time scale. One of the best studied models is the theory of continuous spontaneous localization (CSL) by Ghirardi, Pearle and Rimini [1]. We show that it should be possible to test the predictions of the CSL model in the new matter-wave interferometer for heavy metal clusters that is currently built in Vienna. Extending the original Talbot-Lau setup for biomolecules, the new scheme will operate in the time-domain using three pulsed standing-wave gratings of UV laser light. We argue that this should enable us to see single-particle interference in an unprecedented mass range from 10^5 up to even 10^8 atomic mass units. Recent estimates of the strength of the CSL effect by Adler and Bassi [2,3] suggest that a breakdown of the quantum superposition principle would occur in precisely this mass regime.

[1] Phys. Rev. A 42, 78 (1990)
[2] J. Phys. A 40, 2935 (2007)
[3] arxiv eprint 1011.3767v1 (2010)

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