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Testing quantum mechanics fundamental principles with time projection chambers

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A new research project is presented. It consists in a deterministic quantum statistical model of gaseous track detectors, in particular time-projection chambers. Such detectors are indeed perfect tools to test fundamental principles of quantum mechanics: what is the solution to the Mott problem [1], i.e. the measurement of linear tracks for a spherical radioactive decay? More generally, where, when and why does decoherence take place in such detectors? Could quantum decoherence and quantum measurement be deterministic phenomena?

The model will explore the hypothesis that the microscopic state of the measurement apparatus, for instance the positions of atoms and molecules in gas detectors, could fix individual measurement results in a deterministic way [2]. It will be based on a solution of the Schrödinger equation for scattering states of the measured particle in the complex apparatus environment, with simplifying hypotheses.

First results obtained in a one-dimensional model with point interactions [3] are presented [4, 5]. Two types of localizations are identified: the first one associated with the random distribution of the detector atoms (Anderson localization), the second one associated with the state space of the detector when atom excitations are introduced in the quantum model.

These results open the way to a new calculation of the stopping power at low energy, for which experimental data would be welcome. Preliminary results from the ACTAR collaboration suggest that usual low-energy corrections [6] are not sufficient to precisely reproduce experimental data.

The difficulties anticipated to reach a fully operational three-dimensional model are finally discussed.

[1] N. F. Mott, Proc. R. Soc. Lond. A 126 (1929) 79
[2] J.-M. Sparenberg, R. Nour and A. Manço, EPJ web of conferences 58 (2013) 01016
[3] R. Carlone, R. Figari, C. Negulescu, Commun. Comput. Phys. 18 (2014) 247
[4] J.-M. Sparenberg and D. Gaspard, preprint arXiv:1609.03217 (2016)
[5] R. Ceulemans, Master Thesis, KU Leuven (2016)
[6] J. F. Ziegler, J. Appl. Phys 85 (1999) 1249

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