Minicolloque MCPG10 ☒ Oral ☐ Poster

Quantum vacuum physics in dielectric media with dispersion and dissipation

Sascha Lang[a,b*], Ralf Schützhold[a,c,b], and William G. Unruh[d]

a. Helmholtz-Zentrum Dresden-Rossendorf, Bautzner Landstraße 400, 01328 Dresden, Germany
b. Fakultät für Physik, Universität Duisburg-Essen, Lotharstraße 1, 47057 Duisburg, Germany
c. Institut für Theoretische Physik, Technische Universität Dresden, 01062 Dresden, Germany
d. Department of Physics and Astronomy, University of British Columbia, Vancouver V6T 1Z1, Canada

* email : s.lang@hzdr.de

Over the last decade, much work has been spent on incorporating dispersion into the theory of analogue gravity phenomena in dielectric media. Using the established `Hopfield model` with multiple energy bands nowadays allows for describing materials with quite complicated dispersion relations. However, quantum electrodynamics in realistic dielectric environments is generally also affected by dissipation.

In Kramers-Kronig type dielectrics, dissipation obviously becomes relevant close to the medium resonance. Yet, by acting on the incoming quantum vacuum fluctuations, it could also have an effect on analogue gravity experiments yielding quantum radiation at much lower frequencies.

In this contribution, we add dissipation to the established `Hopfield model` by explicitly coupling the medium to an environment field that can carry away energy and information. We also consider a mechanism that converts quantum vacuum fluctuations into real excitations and relies on the interplay of dispersion and dissipation.

[1] S. Lang, R. Schützhold, W. G. Unruh, „Quantum radiation in dielectric media with dispersion and dissipation", Phys. Rev. D **102**, 125020 (2020)

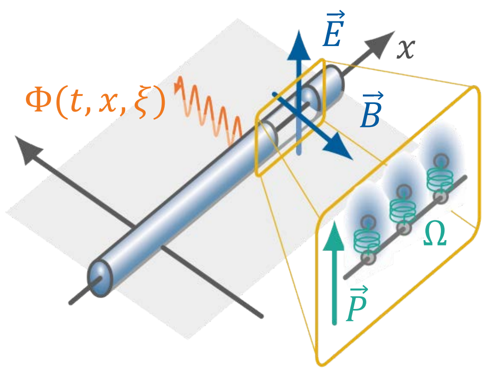

Figure 1 : To add dissipation to a 1+1 dimensional dispersive but non-dissipative Hopfield dielectric, we couple and environment field $\Phi(t,x,\xi)$ to each matter oscillator in the medium.