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Electronic pair alignment and roton feature in the warm dense electron gas

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The study of matter under extreme densities and temperatures as they occur e.g. in astrophysical objects and nuclear fusion applications has emerged as one of the most active frontiers in physics, material science, and related disciplines. In this context, a key quantity is given by the dynamic structure factor $S(q,\omega)$, which is probed in scattering experiments – the most widely used method of diagnostics at these extreme conditions. In addition to its crucial importance for the study of warm dense matter, the modeling of such dynamic properties of correlated quantum many-body systems constitutes one of the most fundamental theoretical challenges of our time. Here we report a hitherto unexplained roton feature in $S(q,\omega)$ of the warm dense electron gas [1], and introduce a microscopic explanation in terms of a new electronic pair alignment model [2]. This new paradigm will be highly important for the understanding of warm dense matter, and has a direct impact on the interpretation of scattering experiments. Moreover, we expect our results to give unprecedented insights into the dynamics of a number of correlated quantum many-body systems such as ultracold helium, dipolar supersolids, and bilayer heterostructures.

References

[1] T. Dornheim, S. Groth, J. Vorberger, and M. Bonitz, Phys. Rev. Lett. **121**, 255001 (2018)
[2] T. Dornheim, Zh. Moldabekov, J. Vorberger, H. Kählert, and M. Bonitz, arXiv:2203.12288