

# Physicists propose new classification of charge density waves

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LSU Professors in the Department of Physics and Astronomy Ward Plummer and Jiandi Zhang, in collaboration with their colleagues from the Institute of Physics, Beijing, China, have published a paper in the *Proceedings of the National Academy of Sciences* (Vol. 112, pg. 2367) titled "[Classification of Charge Density Waves based on their Nature.](#)" This work is a result of a collaboration funded by the Chinese Academy of Sciences.

Charge Density Waves, or CDWs, are observed in many solids, especially in low-dimensional systems. The existence of CDWs was first predicted in the 1930s by Sir Rudolf Peierls, who prophesied that they would exist in an ideal one-dimensional (1-D) chain of atoms, lowering the energy of the system and driving a reconstruction of the lattice.

The 1940 paper by Frisch and Peierls described how one could construct an atomic bomb from a small amount of uranium-235. In 1959, Walter Kohn, who received the Nobel Prize in 1998, pointed out that the origin of a CDW in the Peierls' picture would result in what is now known as a "Kohn Anomaly," a simultaneous softening of coherent lattice vibrations, for example, phonon softening. This simple textbook picture of the origin of CDWs does not seem to be correct in most if not all materials.

Therefore, Plummer and Zhang propose a new classification of CDWs based upon their nature.

**More information:** Classification of charge density waves based on their nature, Xuetao Zhu, *PNAS*, 2367–2371, [DOI: 10.1073/pnas.1424791112](https://doi.org/10.1073/pnas.1424791112)

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