

EXPLORING A UNIVERSAL PATTERN IN THE EXCESS HEAT CAPACITY OF DISORDERED AND PARTIALLY ORDERED SOLIDS

Understanding **the complexities of amorphous solids** presents a **formidable challenge** in the scientific realm. In contrast to well-ordered and rigid crystalline materials, amorphous materials exhibit a more elusive and irregular nature. Despite many robust theories explaining the properties and behavior of crystalline systems, the inherent disorder in the structure of amorphous solids introduces complexity to the fundamental physics governing their characteristics.

Originally identified as genuine amorphous solids and later accompanied by diverse disordered crystals, glasses consistently display low-temperature properties, including specific heat, thermal conductivity, acoustic and dielectric attenuation, among others. Surprisingly, these properties manifest with remarkable similarity across various types of glasses, distinguishing them from their crystalline counterparts. The prevalence of these uniform "anomalies" in glasses and other disordered solids remains a highly debated topic in condensed matter physics, reflecting the ongoing discussion surrounding the phenomena of glasses and other disordered materials. In the scientific literature, the descriptors "**anomalous**" and "**universal**" are almost **equally frequently** employed to characterize the distinctive features exhibited by amorphous and glassy solids. This choice of terminology sparks debate, especially when considering the ubiquitous presence of non-crystalline solids in natural and artificial environments. Some argue against labelling this behavior as anomalous, particularly when juxtaposed with the predictable behavior of crystals according to Debye's theory. This viewpoint gains support with the continually increasing **discovery of "classical glassy" properties in various types of crystals**, underscoring the evolving nature of our understanding.

The **quest to unravel** the exceedingly microscopic characteristics of the excitations accountable for the aforementioned "glassy anomalies," along with the pursuit of physical equations or models that describe them, has steered an exhilarating journey over more than the last five decades. Notably, the exploration is enriched by the inclusion of **the boson peak**, a controversial yet essential feature influencing the low-energy dynamics of glasses, which corresponds to excess heat capacity over the Debye predictions. This enigmatic element introduces a next-level layer of complexity, fostering ongoing intrigue and investigation in the field. Therefore the pursuit of the solution connected to this particular anomalous feature, showing **its universality, in diverse classes of materials** should shed light on fundamental mechanisms and shared manners that transcend the unique properties.