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Excess Vibrational Modes in Model Glasses[1] NING XU, University of Pennsylvania and University of Chicago, MATTHIEU WYART, Harvard University, ANDREA LIU, University of Pennsylvania, SIDNEY NAGEL, University of Chicago — We performed both theoretical analysis and computer simulations to study the excess low-frequency normal modes (boson peak) for two widely-used model glasses at zero temperature. The onset frequencies for the anomalous modes from the simulations agree very well with predictions from variational calculations based on minimizing the vibrational energy cost of the lowest-frequency anomalous mode. This energy cost originates from the excess interactions per particle over z_c, where $z_c = 2d$ is the minimum number required for mechanical stability in d dimensions. The total z interactions per particle are divided into two classes: z_1 "stiff" interactions determine the structure of the anomalous mode by adding extra nodes; the remaining $z - z_1$ interactions act as a perturbation and increase the vibrational energy of the mode by increasing the restoring force for displacements. Even though both glasses studied have a high number of interactions per particle, $(z_1 - z_c)/z_c$ is always smaller than 0.6, which indicates that the physics of jamming is relevant to the study of the excess normal modes in glasses.

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