Contribution ID: **15** Type: **not specified**

# Lorenzo Pettinari: Damping of phonons in Bose gas at low temperature

*Friday, May 8, 2026 4:40 PM (30 minutes)*

Condensed Bose gases can be effectively described in terms of quasi-particles, commonly referred to as \textit{phonons}. Their dynamics are captured by a \textit{c-number condensate Hamiltonian} consisting of a quadratic term supplemented by third- and fourth-order perturbative corrections. These additional interaction terms render the phonons unstable, giving rise to two distinct decay processes known as \textit{Beliaev} and \textit{Landau} damping. From a mathematical perspective, such decay mechanisms should manifest as a \textit{broadening} of the Bogoliubov dispersion relation in the thermodynamic limit. To validate this picture, I will present two different approaches to deriving the phonon decay rates. The first is inspired by the $W^*$-algebraic framework of Jak\v{s}i\'{c}–Pillet, employing Standard Representations and perturbative expansions of a suitably chosen vector state. The second method is based on the analysis of two-body correlation functions. Both approaches yield the same imaginary correction to the Bogoliubov dispersion relation, which in turn determines the expected broadening. Furthermore, our approaches offer a new perspective on the decay of phonons in terms of the \textit{left} and \textit{right} components of these quasi-particles. The talk is based on joint work with Jan Derezi\'{n}ski and may be viewed as a modern elaboration of the classical contributions of Beliaev, Hohenberg–Martin, and others.