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A Renormalization Group Approach to Ordered Phases in Music
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The organization of sounds into music has always been a fundamental part of human experience, and the desire to understand how this organization arises motivates the field of music theory. Explanations of musical ideas are often informed by historical experience, but Berezovsky has previously shown that musical harmony can be described in analogy to the thermodynamics of physical phase transitions. In the same way physical systems minimize their energy and maximize entropy, harmony in music can be treated as a tradeoff between minimizing dissonance and maximizing pitch variety. Berezovsky's model uses a mean-field approximation to describe interactions between the multitude of tones in a musical system; however, this work utilizes renormalization group (RG) theory as a more sophisticated treatment of the many degrees of freedom. With this new approach, we build on the mean-field results and explore in more detail how new phases emerge on a variety of fractal lattices. For D=2, we see a BKT transition, but an intermediate phase emerges for D>2. By connecting the results to known systems of tuning and pitch organization, we further demonstrate the strength of this physical analogy and draw conclusions about the methods and reasons humans use for composing and performing music.

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