What quantum analogues teach us about the universe: a caustic point of view

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A major conceptual issue with astrophysical black holes is the `transplanckian problem' where the event horizon seems to connect low energies to infinitely high ones. This problem can be cured by introducing dispersion which violates Lorentz symmetry, but the nature of the dispersion depends on high energy physics which we do not know. An analogue event horizon can be made in a Bose-Einstein condensate flowing faster than its speed of sound, but can a low energy condensate really simulate high energy physics? I claim it can! The connection is provided by singular waves near event horizons and the fact that these take on universal forms which are generalizations of the caustics known in optics and described by catastrophe theory. In this talk I will aim to take you from the humble rainbow through to the concept of a quantum catastrophe that describes waves near event horizons.