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*Homological conjectures, perfectoid spaces, and singularities in all characteristic.*

The homological conjectures have been a focus of research in commutative algebra since 1960s. They concern a number of interrelated conjectures concerning homological properties of commutative rings to their internal ring structures. These conjectures had largely been resolved for rings that contain a field, but several remained open in mixed characteristic—until in 2016 Yves Andre proved Hochster’s direct summand conjecture and the existence of big Cohen-Macaulay algebras, which lie in the heart of the homological conjectures. The main new ingredient in the solution is to systematically use the theory of perfectoid spaces, which leads to some further developments on related topics. Using integral perfectoid big Cohen–Macaulay algebras, we define mixed characteristic analogs of rational/F-rational and log terminal/F-regular singularities from equal characteristic, and they have applications to the study of singularities when the characteristic varies. We define analogs of multiplier ideals and adjoint ideals and prove adjunction type formulas, which lead to new forms of the Briancon–Skoda theorem in mixed characteristics (this is based on recent work with Karl Schwede, Kevin Tucker, Joe Waldron, and Jakub Witaszek). We give a brief survey on these results and methods. (Received September 13, 2019)