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Abstract for an Invited Paper
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Charge fractionalization and gauge-gravityduality[1]

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We discuss zero temperature phases of compressible quantum matter, i.e. phases in which the expectation value of a globally conserved $U(1)$ density, Q, varies smoothly as a function of parameters. Provided the global $U(1)$ and translational symmetries are unbroken, such phases are expected to have Fermi surfaces, and the Luttinger theorem relates the volumes enclosed by these Fermi surfaces to $\langle Q \rangle$. We distinguish three compressible states: Landau's Fermi Liquid (FL), the fractionalized Fermi Liquid (FL*) and the non-Fermi Liquid (NFL). The motivation for this classification stems from the fact that compressible phases seem to be the rule rather than the exception in theories studied in the context of gauge-gravity duality. We argue that the three compressible phases we identify are indeed present in two paradigmatic supersymmetric gauge-theories underlying the duality. We then describe a gravity theory with an asymptotic electric flux dual to a zero temperature gauge theory at finite chemical potential. The flux can be sourced either by explicit charged matter in the bulk, by an extremal black hole horizon, or both. We argue that these three cases show important similarities with the three compressible states of matter. By tuning a relevant parameter we can study zero temperature phase transitions between the three phases in the dual description. The work I present was done in collaboration with S. Sachdev and S. Hartnoll.

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