Vision Statement: Frontiers in Correlated Matter

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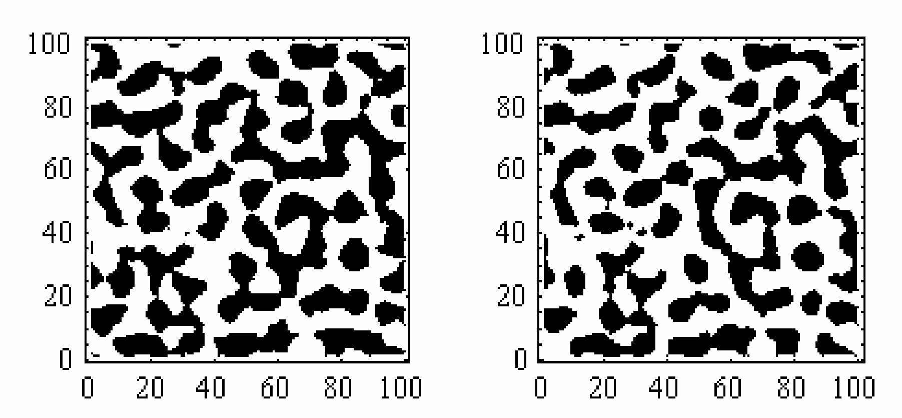
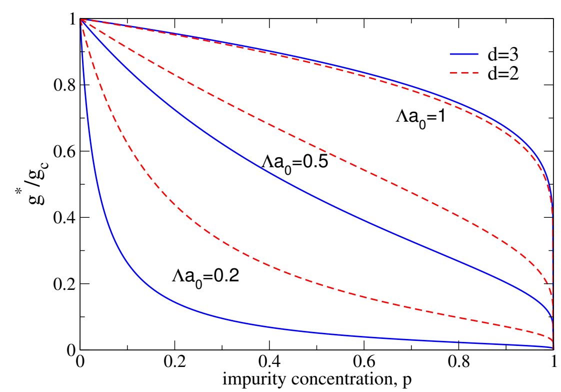
- Strong and local interactions competing with delocalized collective excitations cause a number of open problems in correlated matter research (heavy electron quantum phase transitions, cuprates, organics… but also ordinary water or structural glasses).

- Often, strong and local interactions make theories “number dependent”, i.e. not universal. There is of course nothing wrong with this, except for the fact that predictions are hard to make and are often ambiguous (see cuprates or classical liquids (with few exceptions in either case))

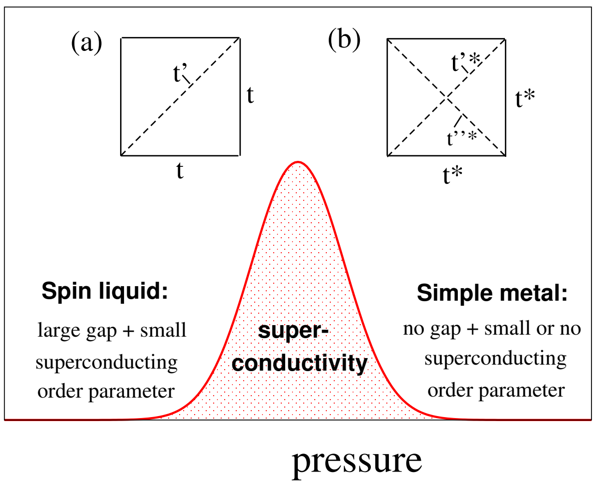


glassiness in frustrated phase separation
(Schmalian, Wolynes (2001)



Quantum Griffiths behavior in metallic Heisenberg systems
(T. Vojta, Schmalian, (2004)

• The situation is a better in systems with a well defined role of disorder (infinite randomness behavior or self generated glasses (see Fig.1 with an image of a self generated glass formed via frustrated phase separation or Fig.2 with a Quantum Griffiths behavior in metallic Heisenberg systems).
• Other exceptions are systems with strong frustration (see superconductivity in a spin liquid tuned via pressure, Fig.3).



Superconductivity in a frustrated system close to a Mott transition is located between a spin liquid and simple metal regime (Liu, Schmalian, Trivedi (2004)

• These simplified systems serve as the unstable fixed points for more realistic and harder problems.
• This might lead to a controlled mean field theory for strongly interacting systems, coupled to critical degrees of freedom
(what else do we need?)