Chiral phase transition of QCD low-energy model in a constant magnetic field

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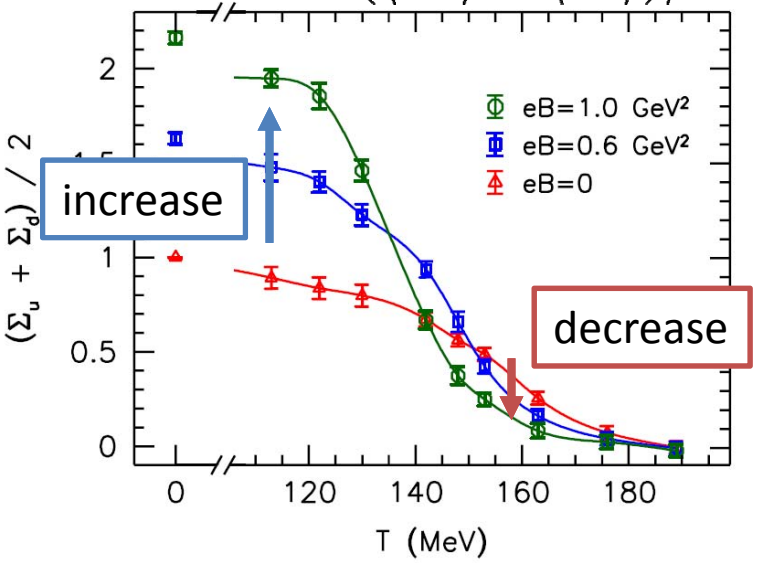
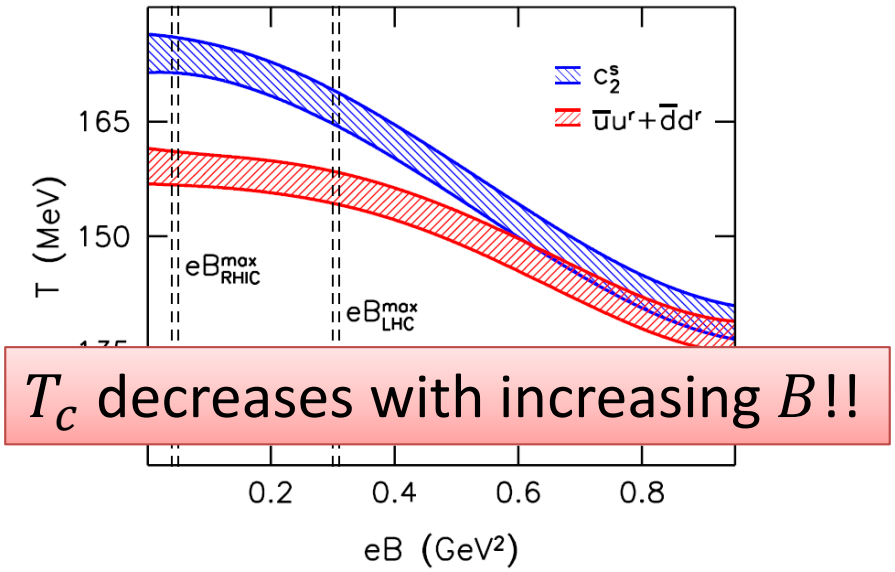
Chiral Condensates in an external magnetic field B

- Magnetic Catalysis
  - Chiral condensates increase with increasing magnetic field B.
  - It is confirmed by lattice QCD simulations at low temperature or large pion mass.
- Lattice QCD Simulation at physical pion mass

Chiral Cond. $(\langle\bar{u}u\rangle + \langle\bar{d}d\rangle)/2$



Chiral-restoration Temp. T_c



T_c decreases with increasing B!!

Bali, Bruckmann, Endrődi, et al. (2011,2012)

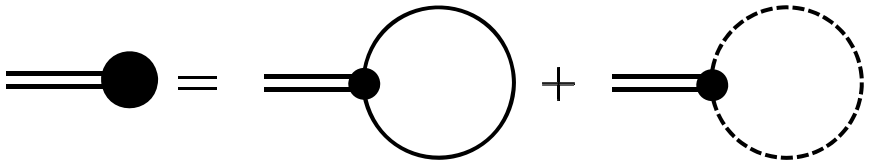
- Magnetic Inhibition
  - The mean-field analyses of the traditional effective models of QCD cannot explain the MI.

"Dimensional Reduction" via Neutral Pion π^0

Fukushima & Hidaka (2012)

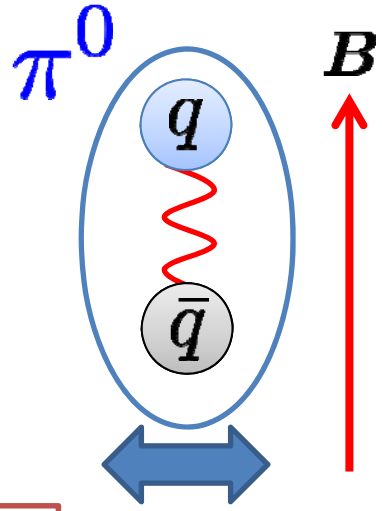
- The dimensional reduction via π^0 is expected to bring about the magnetic inhibition.
- To see this, we have to include the effect of compositeness that π^0 consists of a pair of quark and antiquark.

Fukushima and Hidaka use the consistency equation:



Quark loop Meson loop

Meson self energy is given by the quark loop.



π^0 feels B.

- We attempt to include this compositeness by using the Non-Perturbative Renormalization Group.