Dileptons and chiral symmetry restoration

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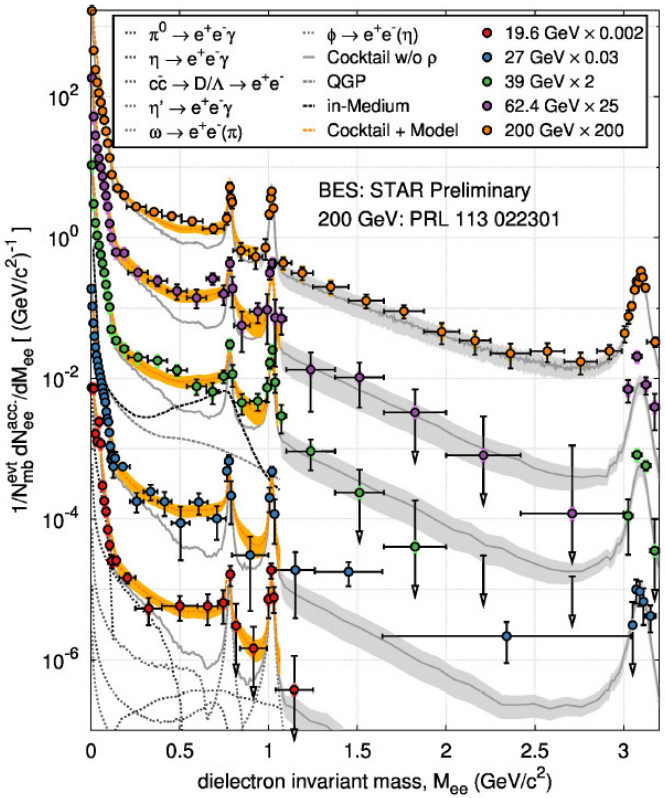
- Chiral symmetry
  - Spontaneously broken in QCD vacuum
    → Imprinted on hadron spectrum
  - Restored at finite temperature
    → Diagnose via hadron spectrum in medium

- HICs: in-medium ρ via low-mass dileptons
  - Broadening/melting consistent with data
  - Manifestation of chiral restoration?

- Need to test degeneracy with chiral partner (a_1)
  - Difficult to measure

- Theory required to unravel mechanisms



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N. Xu, QM14

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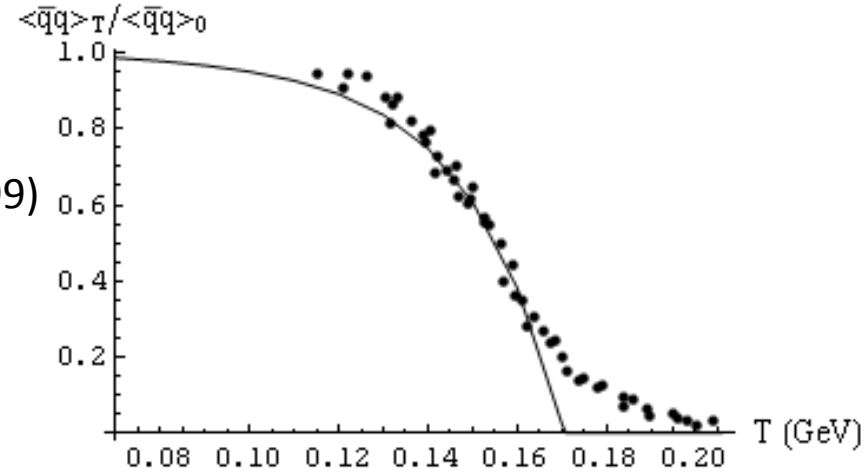
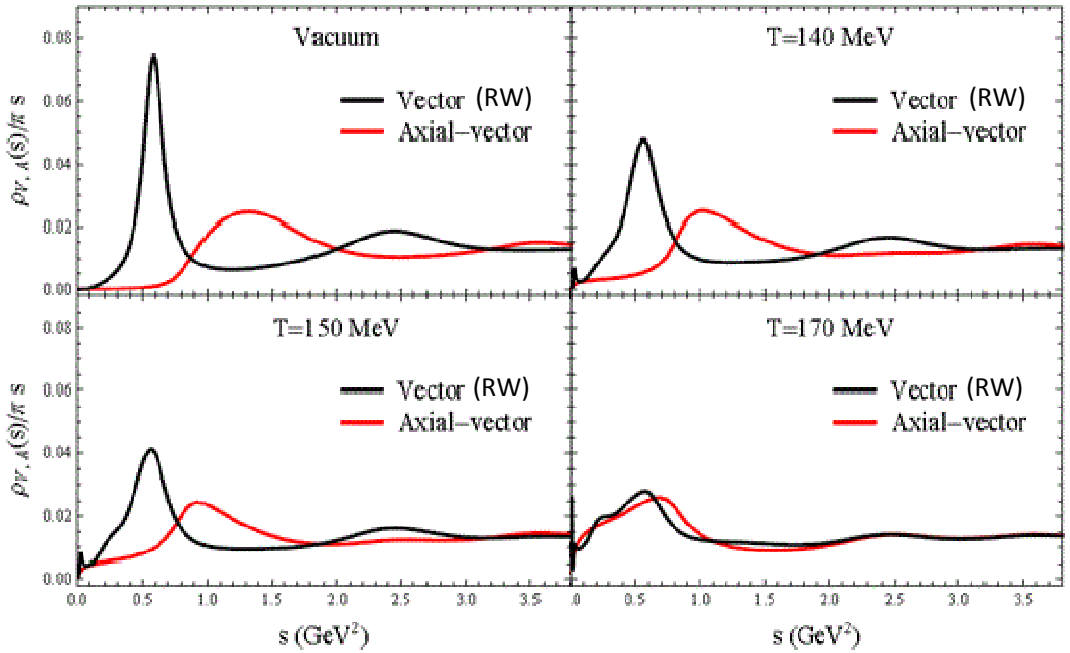
Sum Rules Analysis:

Relate ρ and a_1 properties to QCD condensates



- Inputs
  - ρ spectral function from Rapp, Wambach (99) (→ dilepton experiments)
  - Finite-T condensates from Lattice QCD / Hadron Resonance Gas

- Search for in-medium a_1 to satisfy both QCD and Chiral sum rules



- Findings
  - Mass splitting "burns off"
  - Resonances "melt"
  - Compatible with approach to chiral restoration

- Underlying mechanism?

In progress: Hadronic Effective Theory

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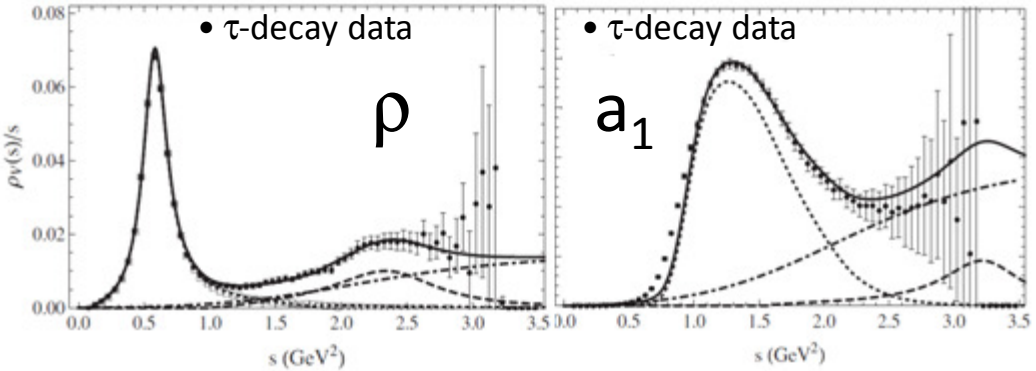
Calculate (ρ, a_1) properties and chiral condensate in one microscopic framework:

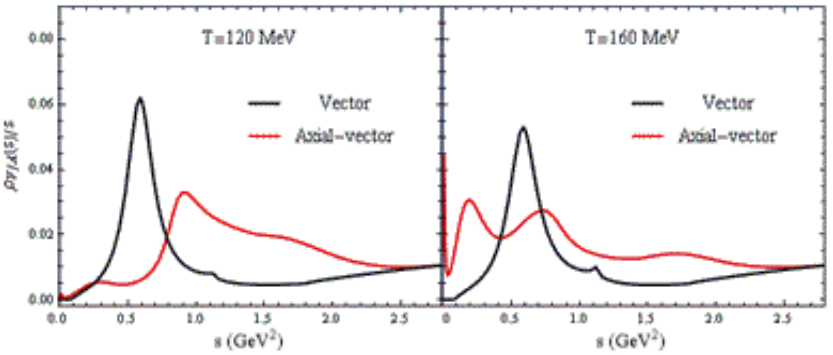
Implement (ρ, a_1) in chiral Lagrangian as gauge bosons ("Massive Yang-Mills")

Vacuum



• Achieved description of vacuum a_1 spectrum

Pion Gas



• Preliminary in medium analysis supports a_1 mass shift

Future tasks:

- Full implementation of medium effects including baryons
- Need precise low-mass dilepton data at $\mu_q \sim 0$ (RHIC/LHC)

Decisive progress in understanding chiral symmetry restoration achievable.