

# Gell-Mann-Oakes-Renner relation in external magnetic fields at zero temperature

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We present results of chiral condensates, masses and decay constants of neutral pseudo scalar mesons in (2+1)-flavor QCD in the presence of external magnetic fields at zero temperature. We discuss the validity of Gell-Mann-Oakes-Renner relation in a wide region of magnetic field strength  $eB$  up to around  $3.5 \text{ GeV}^2$ . The simulations were performed on  $32^3 \times 96$  lattices using the Highly Improved Staggered Quarks (HISQ) action with a single lattice cutoff  $a=0.117 \text{ fm}$  and  $m_\pi \approx 220 \text{ MeV}$ . Sixteen values of  $eB$  along the  $z$  direction up to around  $3.5 \text{ GeV}^2$  have been applied in the simulation.

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