Baryons and Mesons in Holographic QCD

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Some features of QCD

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- Due to its non-abelian nature, QCD behaves as a free theory at very high energies, Asymptotic freedom.

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Some features of QCD

- At low energies the coupling constant becomes large. Perturbation Theory breakes down.
- In this regime we do not know how to compute hadron physics from QCD.
- It's even difficult to describe hadron physics frome effective theories due to mass scales.

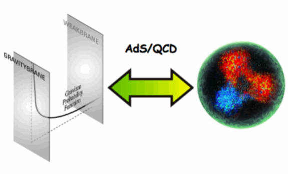
Gravity/Gauge duality

In this situation we can make use of the Gravity/Gauge duality.

- The Gravity/Gauge duality is a tool that allows us to do computations even when the Perturbation Theory does not work.
- It states that any strongly coupled CFT can be related to a higher dimensional theory of gravity that is weakly coupled.

Holographic QCD

- We can make use of this duality in order to describe QCD at low energies (Holographic QCD).



- The dual theory is a 5D AdS space with the following metric.
  $ds^2 = a^2(z)(dx_\mu dx_\nu \eta^{\mu\nu} - dz^2)$
  Where $a(z) = \frac{L}{z}$ is the warp factor.

The 5D Model

- We consider a slice of 5D AdS space with a $U(2)_L \times U(2)_R$ gauge symmetry broken down to $U(2)_V$ by the boundary conditions.
- The model has two gauge fields, $\mathcal{L}$ and $\mathcal{R}$, associated to the Left-Right symmetry and a Scalar field, Φ. It has 5 free parameters; M_5, M_{bulk}, M_q, ξ, L.
- AdS/QCD tells us that:
  - $\mathcal{L}$,$\mathcal{R} \leftrightarrow <j_L^\mu>, <j_R^\mu>$
  - $\Phi \leftrightarrow <\mathcal{O}>$
- We have to match the model with QCD via the AdS/QCD relations.

Results

- ***Meson sector***

	Experiment	AdS_5	Deviation
m_π	135MeV	134MeV	0.6%
m_ρ	775MeV	783MeV	1.0%
f_π	92MeV	89MeV	3.6%
f_ρ	153MeV	149MeV	2.7%

- ***Baryons***

	Exp	AdS_5	Deviation
M_N	940 MeV	1130MeV	20%
$\sqrt{< r^2_{E,S} >}$	0.79fm	0.88fm	11%
$\sqrt{< r^2_{M,S} >}$	0.82fm	0.92fm	12%

- The total Root Mean Square Error (RMSE) is about **25%**