to the semiclassical approximation to the light-front bound-state Hamiltonian equation of motion in QCD. One can indeed systematically reduce the LF Hamiltonian eigenvalue Eq. (3) to an effective relativistic wave equation [4] by observing that each n-particle Fock state has an essential dependence on the invariant mass of the system $M_n^2 = \left(\sum_{a=1}^n k_a^\mu\right)^2$ and thus, to a first approximation, LF dynamics depend only on M_n^2. In impact space the relevant variable is the boost invariant transverse variable ζ which measures the separation of the quark and gluonic constituents within the hadron at the same LF time and which also allows one to separate the dynamics of quark and gluon binding from the kinematics of the constituent internal angular momentum. In the case of two constituents, $\zeta = \sqrt{x(1-x)}|\mathbf{b}_\perp|$ where $x = k^+/P^+ = (k^0+k^3)/(P^0+P^3)$ is the LF fraction. The result is the single-variable light-front relativistic Schrödinger equation [4]

$$\left(-\frac{d^2}{d\zeta^2} - \frac{1-4L^2}{4\zeta^2} + U(\zeta)\right)\phi(\zeta) = \mathcal{M}^2\phi(\zeta), \tag{4}$$

where $U(\zeta)$ is the effective potential, and L is the relative orbital angular momentum as defined in the LF formalism. The set of eigenvalues $\mathcal{M}^2$ gives the hadronic spectrum of the color-singlet states, and the corresponding eigenmodes $\phi(\zeta)$ represent the LFWFs, which describe the dynamics of the constituents of the hadron. This first approximation to relativistic QCD bound-state systems is equivalent to the equations of motion, which describe the propagation of spin-J modes in a fixed gravitational background asymptotic to AdS space. [4] By using the correspondence between ζ in the LF theory and z in AdS space, one can identify the terms in the dual gravity AdS equations, which correspond to the kinetic energy terms of the partons inside a hadron and the interaction terms that build confinement. [4] The identification of orbital angular momentum of the constituents in the light-front description is also a key element in our description of the internal structure of hadrons using holographic principles.

As we will discuss, the conformal AdS$_5$ metric (1) can be deformed by a warp factor $\exp(+\kappa^2 z^2)$. In the case of a two-parton relativistic bound state, the resulting effective potential in the LF equation of motion is $U(\zeta) = \kappa^4\zeta^2 + 2\kappa^2(L+S-1)$. [7] There is only one parameter, the mass scale $\kappa \sim 1/2$ GeV, which enters the effective confining harmonic oscillator potential. Here $S = 0, 1$ is the spin of the quark-antiquark system, L is their relative orbital angular momentum, and ζ is the Lorentz-invariant coordinate defined above, which measures the distance between the quark and antiquark; it is analogous to the