Energy spectrum of quantum horizons of equilibrium black holes

In modern day literature, equilibrium black hole horizons are described by Isolated Horizons(IH). It is completely a local notion as opposed to the global concept of event horizon. Now, even though there is a notion of classical energy associated with the IH, there is not yet any well defined Hamiltonian operator for the Quantum Isolated Horizon(QIH). We propose the most general structure possible for the Hamiltonian operator for the QIH, with explanations of the underlying physical motivations. Arguing that the known classical results must follow in the correspondence limit, namely the first law of thermodynamics for the IH, the unknown coefficients of the Hamiltonian operator are fixed, yielding the energy spectrum of the QIH. To spell out the result, the spectrum of the Hamiltonian $\hat{H}_S$ of the QIH is given by

$$\hat{H}_S|\,\{s_j\}\rangle = \eta\Gamma(3,\sqrt{3}\pi\gamma)\ell_p \sum_j \sum_{n=0}^{\Lambda} \frac{(2\pi\gamma)^n}{\Gamma\left(n+2\ ,\ \sqrt{3}\pi\gamma\right)}\ s_j {C_j}^n |\,\{s_j\}\rangle$$

where $C_j = \sqrt{j(j+1)}$, $|\,\{s_j\}\rangle$ is the spin configuration describing a quantum state of the QIH which is also a simultaneous eigenstate of the corresponding area operator; η and Λ are parameters which are required to be chosen to yield the correct temperature or surface gravity which is associated with the classical first law for the IH; ℓ_p is the Planck length and γ is the Barbero-Immirzi parameter whose value can be fixed by demanding that the leading term of the horizon entropy be given by the Bekenstein-Hawking area law.