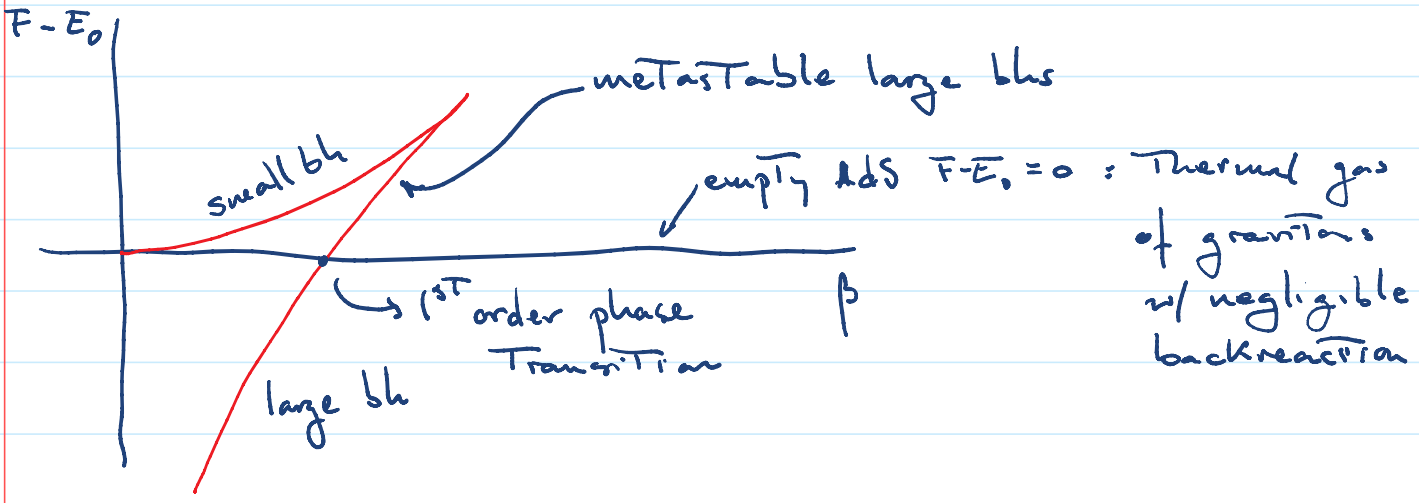
Hawking-Page phase transition

We can now analyze the canonical phase structure



"Swallowtail" characteristic of 1st order phase Transition

Hawking-Page, at $r_H = L$ where

$$F_{BH} = F_{AdS}$$

For $\beta < \beta_H$ bh becomes preferred phase

$\beta > \beta_H$ Thermal gas " "

Latent heat: $\Delta S = S_{BH}(r_H = L) = \frac{\Omega_{d-1}}{4G} L^{d-1}$

This has the features of a confinement/deconfinement Transition:

- at low Temperatures, the only states that are excited are gravitons, which are dual to "glueballs", ie states that are singlets of SU(N), which are $O(1) = O(N^0)$ in number. (color-neutral)
- The $O(N^2)$ gluons are not excited separately so we

interpret this as a theory where all the color degrees of freedom are confined

- at high temperatures, $T > T_{HP}$, the dominant phase has large entropy, $S \sim N^2$, and therefore all the gluon degrees of freedom (and fermions and scalars) are deconfined and excited. This is then similar to a quark-gluon plasma

Here we described a transition between empty global AdS and a bh in AdS w/ spherical boundary.

It is also possible to work with Minkowski bdry, and describe a similar confinement/deconfinement transition between the AdS black brane (w/ $k=0$) and a "confining AdS soliton" geometry

(It requires the boundary to have a spatial compact circle, ie $\mathbb{R}_t \times \mathbb{R}^{d-2} \times S^1$)