$$\mathrm{M}\ /\,\mathbb{T}^k\ \text{comp/no winding}: \quad \not{\mathcal{Z}} = 0$$

$$\frac{1}{2}\ \text{BPS} \iff \text{rat}_q^p \begin{cases} \frac{1}{2}\ \text{BPS} \iff \text{sphere}\ C \\ \text{dual}\ \frac{1}{2}\ \text{BPS} \iff \text{union}\ C \cup \widetilde{C} = \ \text{anti-canonical} \end{cases}$$

$$\text{brane tension}\ = \exp \overline{C}$$

$$\begin{bmatrix} \text{H} \\ 4 \end{bmatrix} \boxminus \begin{bmatrix} k \\ 0 \end{bmatrix} = \begin{bmatrix} 1\text{H-k} \\ 4 \end{bmatrix}$$

$$\mathbb{P}^2_k$$

$$\mathbb{Z}^{1:k} = \mathbb{Z} < C_0 : C_1 \cdot\cdot C_k >$$

$$\text{el}\ +\ \text{mg}\ = d - 2 = 11 - k - 2 = 9 - k$$

$$-K = 3\,C_0 - C_1 - \cdot\cdot - C_k$$

$$\deg_C = -K|C$$

$$C + \widetilde{C} = -K$$

$$p + q = \deg_C + \deg_{\widetilde{C}} = -K| - K = K|K = 9 - k$$

pos roots

$$3\leqslant k\leqslant 9\colon\quad 4\frac{-1}{8-k}=4\frac{2}{5}\boxminus\frac{3}{k-3}={}_{9-k}^{0}\mathrm{rat}\begin{cases}C_0-C_{ij\ell}\\ 2C_0-C_{K\llcorner ij\ell}\end{cases}\quad\begin{cases}\not{0}_{ij\ell}\\ \overline{*\not{0}}_{-ij\ell}\end{cases}\begin{matrix}0\\ 9-k\end{matrix}\begin{cases}M_2^+/\mathbb{T}_{ij\ell} & \mathrm{wrap}_3M2\\ M_5^+/\mathbb{T}_{K\llcorner ij\ell} & \mathrm{wrap}_{k-3}M5\end{cases}$$

$$2\leqslant k\leqslant 8\colon\quad 4\frac{0}{7-k}=4\frac{2}{5}\boxminus\frac{2}{k-2}={}_{8-k}^{1}\mathrm{rat}\begin{cases}C_0-C_{ij}\\ 2C_0-C_{K\llcorner ij}\end{cases}\quad\begin{cases}\not{1}_{ij}\\ \overline{*\not{1}}_{-ij}\end{cases}\begin{matrix}1\\ 8-k\end{matrix}\begin{cases}M_2^+/\mathbb{T}_{ij} & \mathrm{wrap}_2M2\\ M_5^+/\mathbb{T}_{K\llcorner ij} & \mathrm{wrap}_{k-2}M5\end{cases}$$

$$1\leqslant k\leqslant 7\colon\quad 4\frac{1}{6-k}=4\frac{2}{5}\boxminus\frac{1}{k-1}={}_{7-k}^{2}\mathrm{rat}\begin{cases}C_0-C_i\\ 2C_0-C_{K\llcorner i}\end{cases}\quad\begin{cases}\not{2}_i\\ \overline{*\not{2}}_{-i}\end{cases}\begin{matrix}2\\ 7-k\end{matrix}\begin{cases}M_2^+/\mathbb{T}_i & \mathrm{wrap}_1M2\\ M_5^+/\mathbb{T}_{K\llcorner i} & \mathrm{wrap}_{k-1}M5\end{cases}$$

$$0\leqslant k\leqslant 6\colon\quad 4\frac{2}{5-k}=4\frac{2}{5}\boxminus\frac{0}{k}={}_{6-k}^{3}\mathrm{rat}\begin{cases}C_0\\ 2C_0-C_K\end{cases}\quad\begin{cases}\not{3}\\ \overline{*\not{3}}_{-}\end{cases}\begin{matrix}3\\ 6-k\end{matrix}\begin{cases}M_2^+ & M2\\ M_5^+/\mathbb{T}_K & \mathrm{wrap}_kM5\end{cases}$$

$$H\subset K\colon\quad H=(ij\ell)\colon\quad H=(ij)\colon\quad H=(i)\colon\quad H=\varnothing$$

$$\overline{C_0-C_H}\,|\,\overline{2C_0-C_{K\llcorner H}}=2C_0\,|\,C_0=2$$

$$-K|\overline{C_0-C_H}=\overline{3C_0-C_K}\,|\,\overline{C_0-C_H}=\overline{3C_0-C_H}\,|\,\overline{C_0-C_H}=3-|H|=0/1/2/3$$

KK related

$$\begin{cases}0 & 0\\ 3C_0-C_K=-K & 9-k\end{cases}\begin{cases}\not{0} & \mathrm{dila}_e\\ \overline{*\not{0}}_{-} & \mathrm{dila}_m\end{cases}$$

$$\mathrm{rat}^1_{8-k}\begin{cases}C_i & 1\\ 3C_0-C_{K\llcorner i}-2C_i & 8-k\end{cases}\begin{cases}\not{1}^i & 1\\ \overline{*\not{1}}_{-i} & 8-k\end{cases}\begin{cases} & \mathrm{MM}_e\\ & \mathrm{MM}_m\end{cases}$$

$$\mathrm{rat}^0_{9-k}\begin{cases}C_j-C_i & 0\\ 3C_0-C_{K\llcorner ij}-2C_j & 9-k\end{cases}\begin{cases}\not{0}^j_i & 0\\ \overline{*\not{0}^j}_{-i} & 9-k\end{cases}\begin{cases} & \mathrm{KK}_e\\ & \mathrm{KK}_m\end{cases}$$