



# Brane Tilings

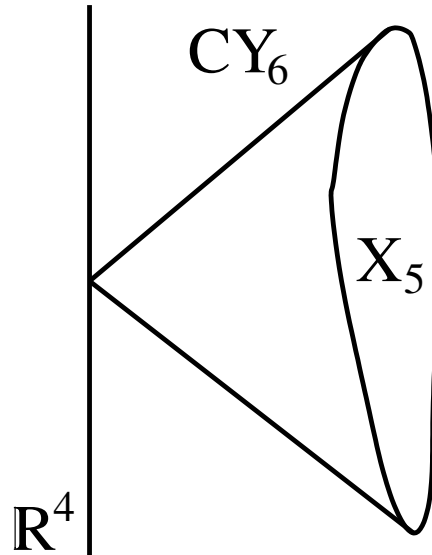
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# Introduction

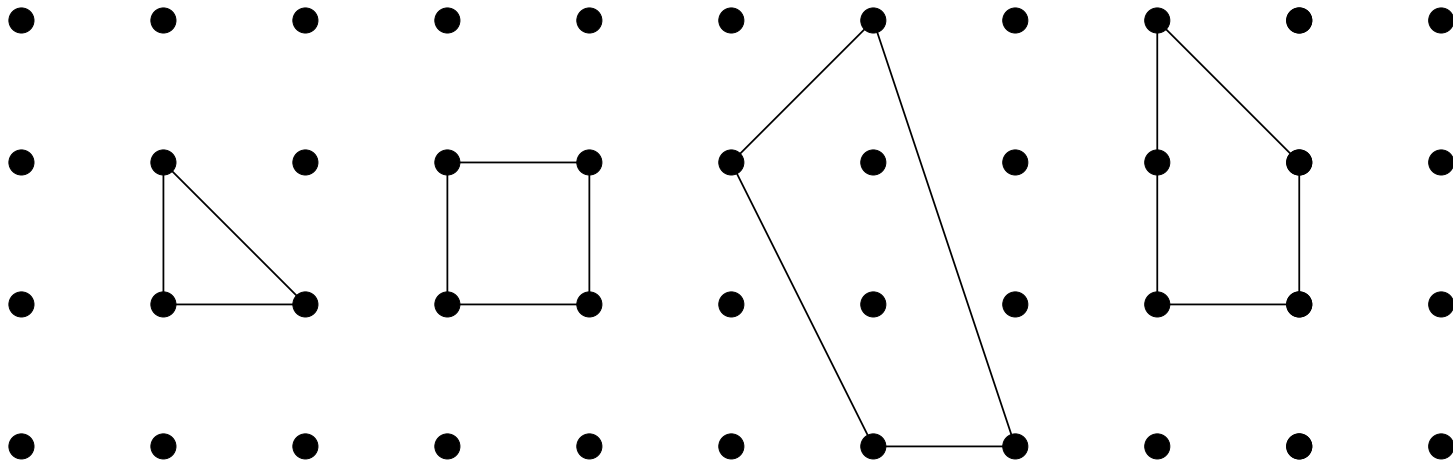
- probing non-compact toric Calabi-Yau singularities with D3-branes



- $X_5$  is a Sasaki-Einstein manifold
- SUSY gauge theory on the world-volume of the D3-brane(s)
- toricity  $\Rightarrow$  topology of  $CY_6$  can be described by means of the toric diagram

# Toric diagram

- describes the topology of the 6d Calabi-Yau manifold

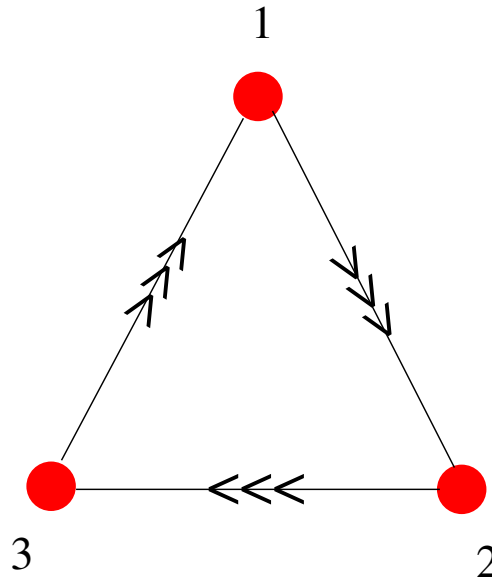


hep-th/9711013 LV

Fulton: Introduction to Toric Varieties

# Quiver graph

- describes the field content of the  $\mathcal{N} = 1$  gauge theory



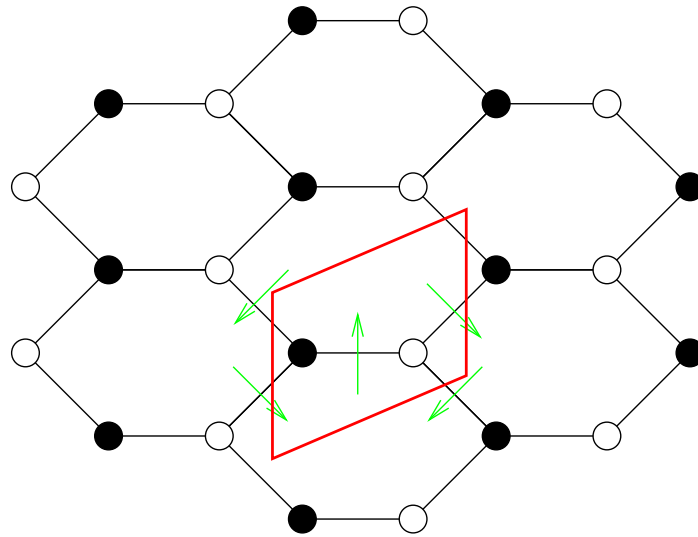
- nodes =  $SU(N)$  gauge groups
- arrows = bifundamental fields [hep-th/9603167](https://arxiv.org/abs/hep-th/9603167) by DM
- ...and the superpotential?

**QUESTION:** What is the connection between the Calabi-Yau and the quiver gauge theory?

# Brane tilings

$$CY_6 = \mathbb{C}^3$$

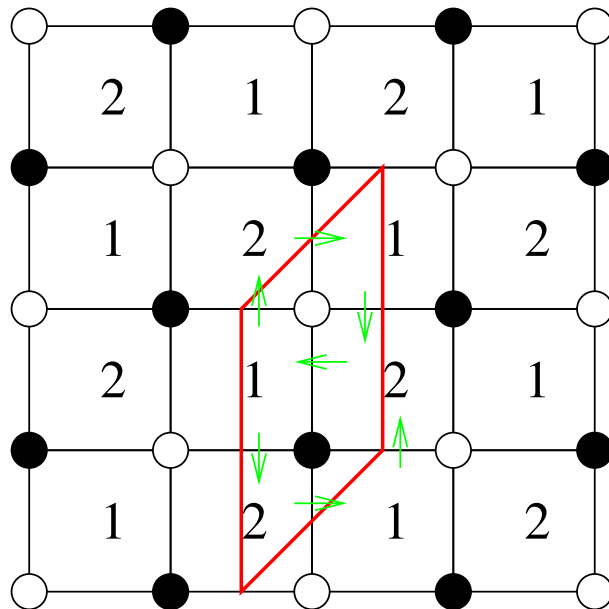
- brane tiling: NS5 & D5-branes



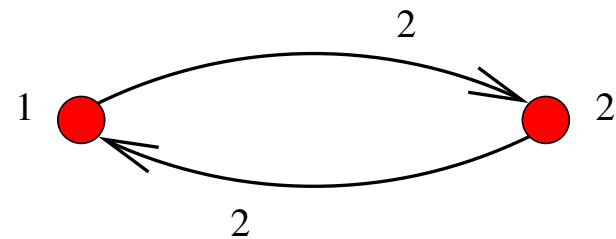
- faces = gauge groups
- edges = bifundamentals [hep-th/0504110](https://arxiv.org/abs/hep-th/0504110) by FHKVW
- nodes = superpotential terms

# Examples

$$CY_6 = \text{conifold}$$



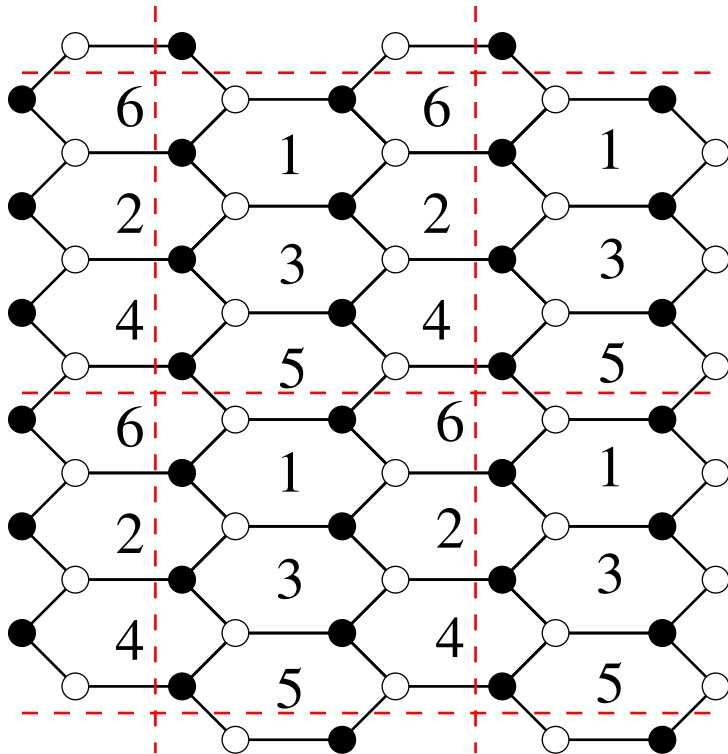
**brane tiling**



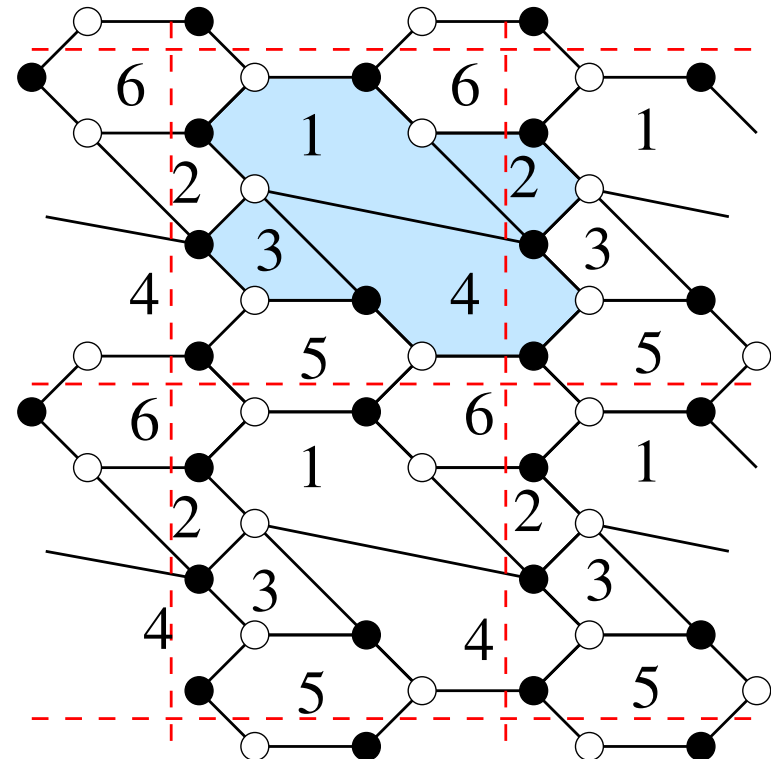
**quiver**

# Examples

- constructing  $Y^{p,q}$ 's by putting "impurities" into the lattice



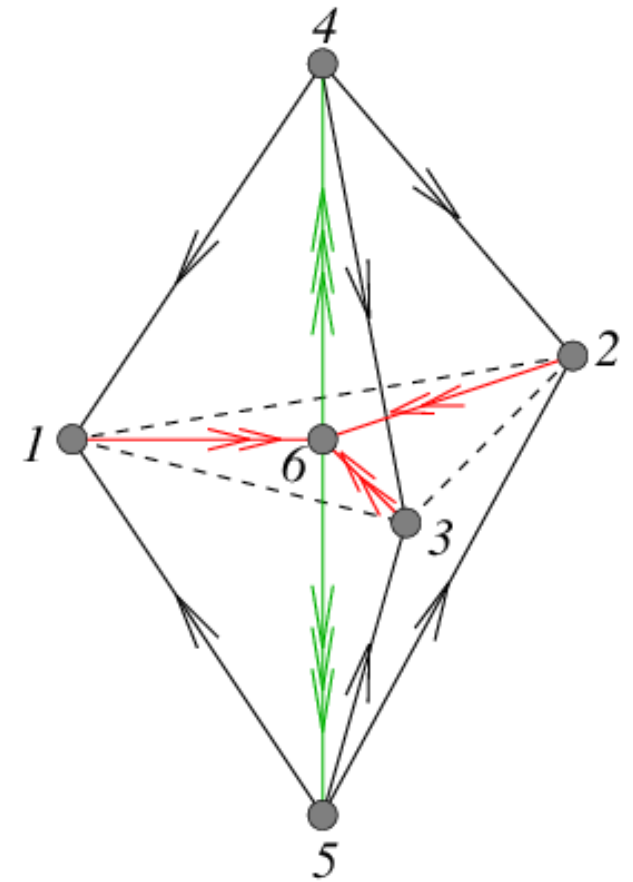
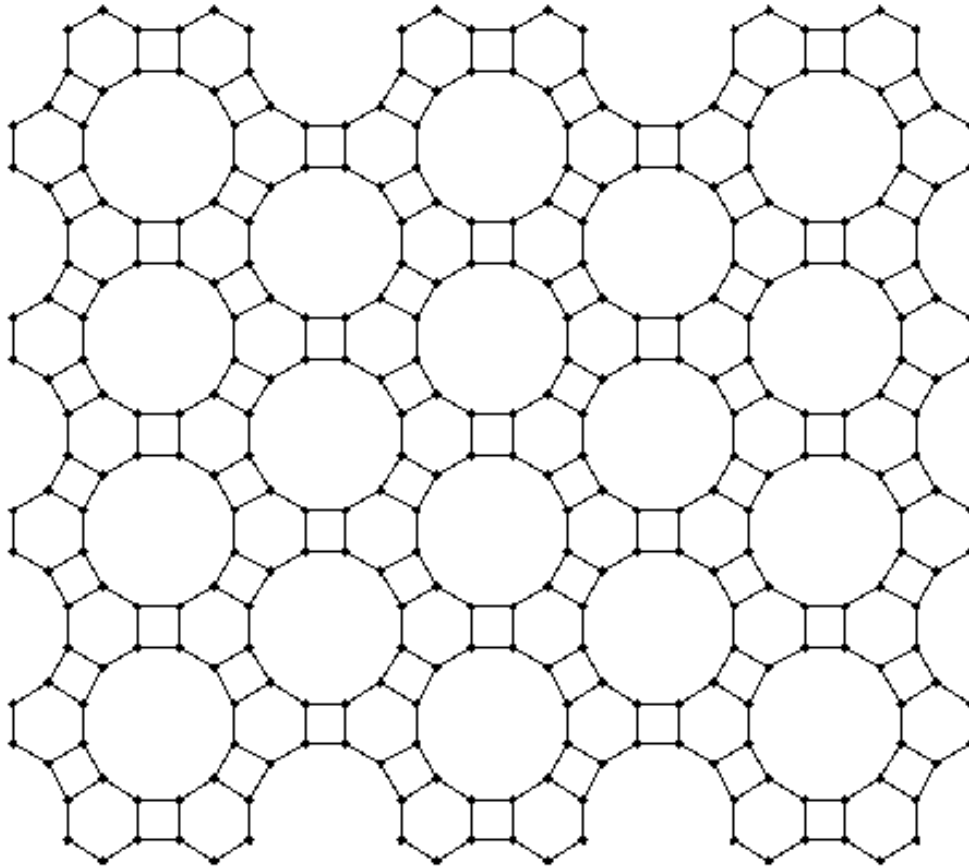
$Y^{3,3}$



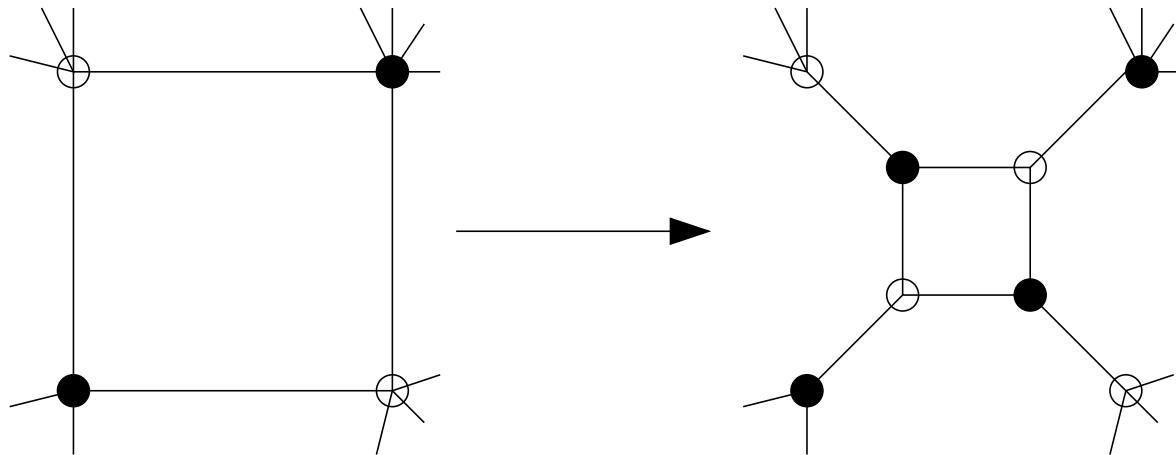
$Y^{3,2}$

# Examples

$X_5 = \mathbf{dP}_3$  model IV



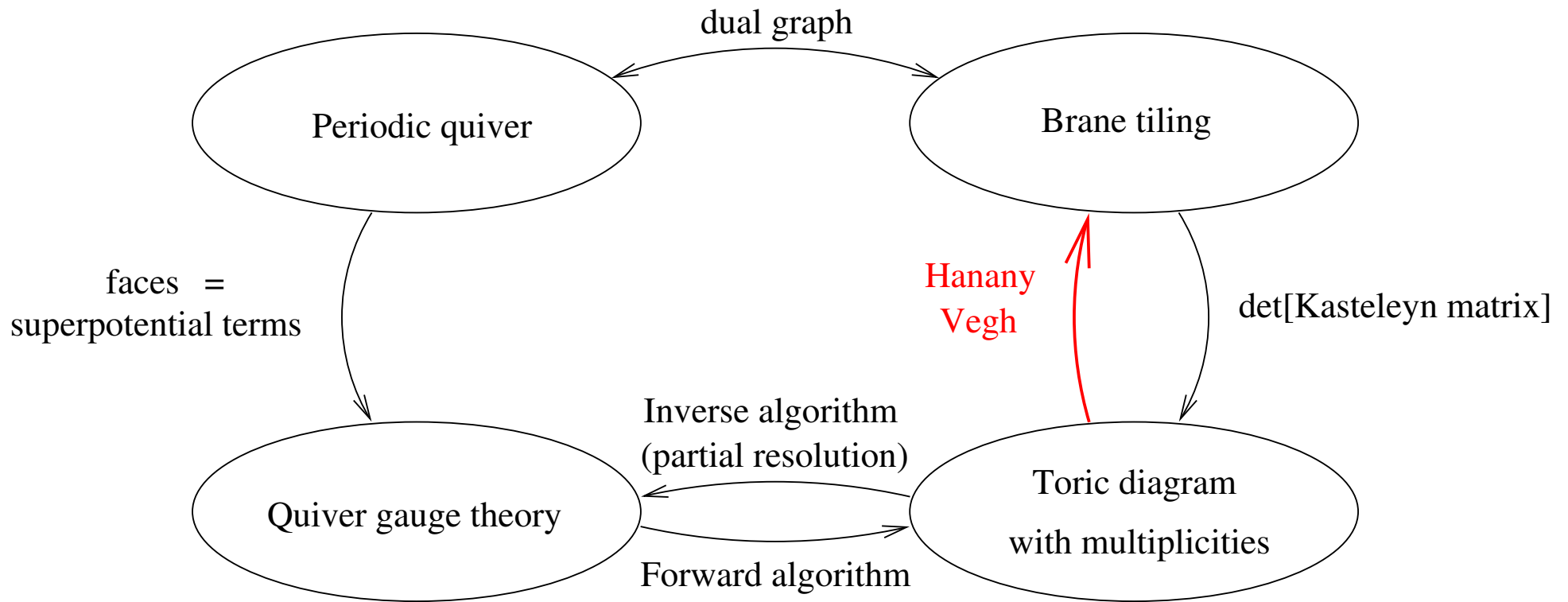
- realization of **Seiberg duality** in the brane tiling ...



...by “urban renewal”!

- R-charges of the fields are **angles** in the tiling
- **fractional branes** can be added

# Flowchart



hep-th/0504110 by Franco, Hanany, Kennaway, Vegh, Wecht

# Conundrum

- for a given quiver gauge theory

**#groups + #superpotential terms - #fields = ??**