Open-Moduli Infinite-Distance Limits in Six-Dimensional F-Theory

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work together with Seung-Joo Lee and Timo Weigand

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String Pheno 2023

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QUANTUM UNIVERSE

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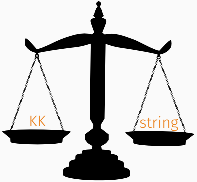

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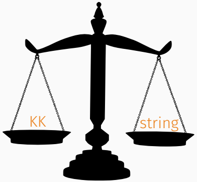

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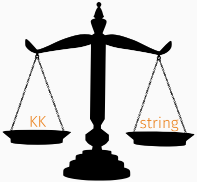

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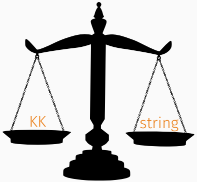

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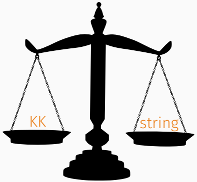

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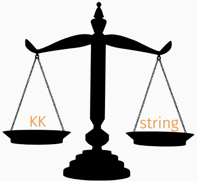

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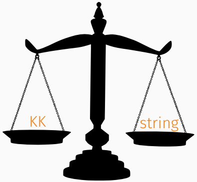

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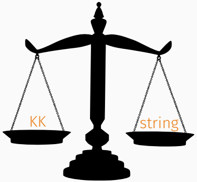

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$\text{codim}(\Sigma)$	$\text{ord}(f,g)_\Sigma$	Interpretation
1	$(\geq 4, \geq 6)$	∞-distance
2	$([4,8),[6,12))$	SCFTs
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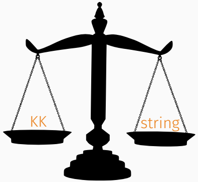

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Goal of this work

Understand the geometry and physics of the infinite-distance non-minimal singularities of CY_3.

We restrict to single infinite-distance limit degenerations:

$$\text{degeneration curves do not intersect} \quad \Leftrightarrow \quad Y_0 = \bigcup_{p=0}^{P} Y^p, \quad Y^p \cap Y^q \cap Y^r = \emptyset, \quad p, q, r \text{ distinct.}$$

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Genus zero degenerations

Genus zero curves compatible with single infinite-distance limit degenerations:

- Case A: $\mathcal{C} = h$ or $\mathcal{C} = h + nf$ (horizontal model).
- Case B: $\mathcal{C} = f$ (vertical model).
- Case C: $\mathcal{C} = h + (n+1)f$ for $n \leq 6$ or $\mathcal{C} = h + 2f$ for $n = 0$.
- Case D: $\mathcal{C} = 2h + bf,$ with $(n, b) = (0, 1), (1, 2)$.

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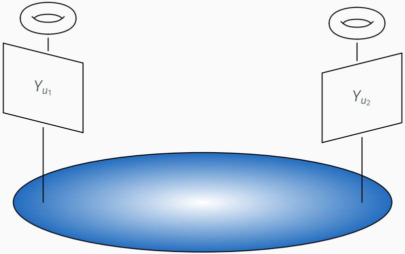

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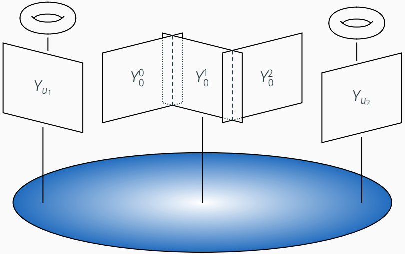

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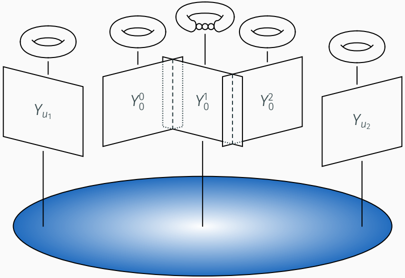

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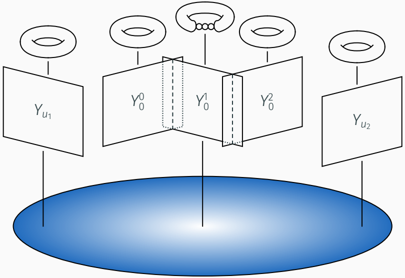

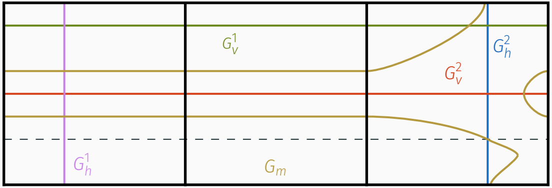

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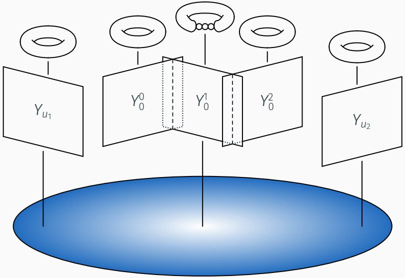
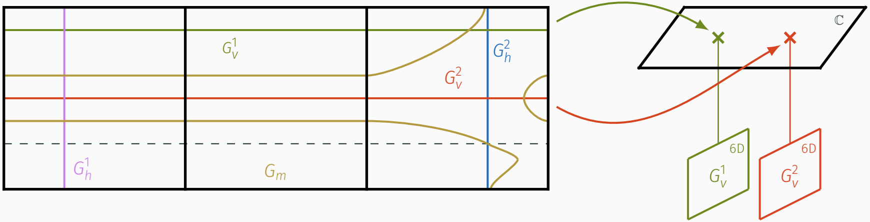
- Decompactification limits can be complicated, leading to defect theories.





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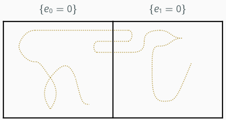

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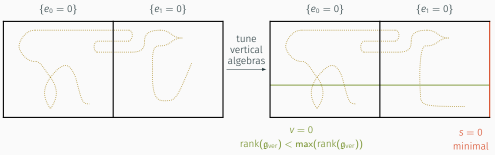

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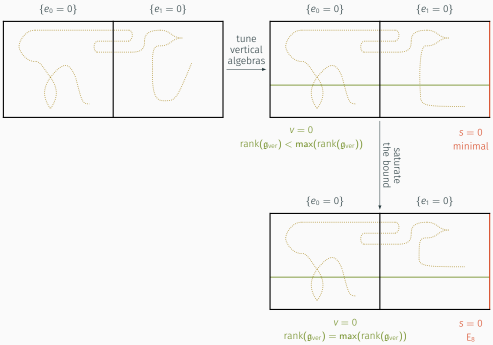

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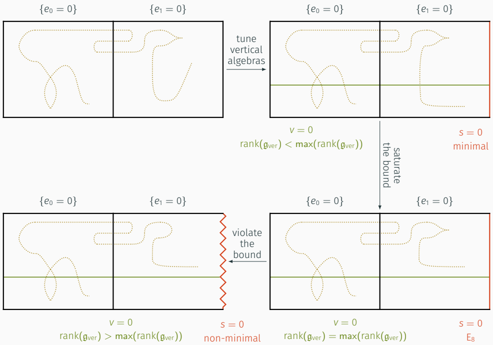

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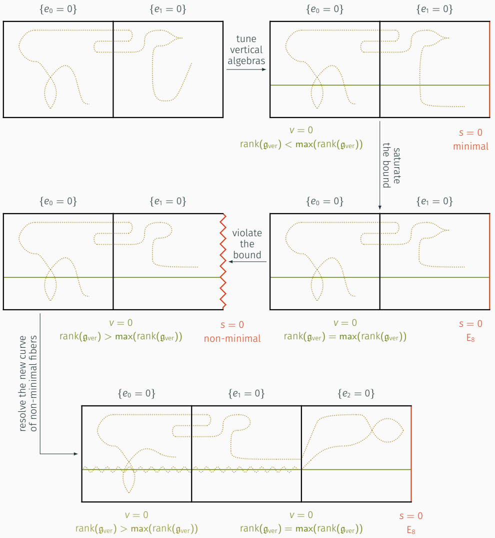

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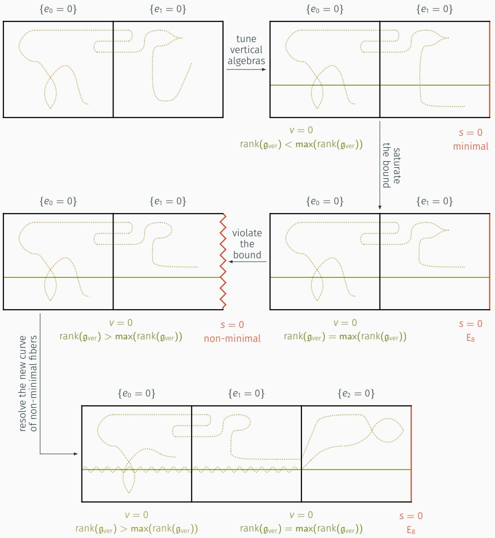
$\max(\mathrm{rank}(\mathfrak{g}_{\mathrm{ver}}))$	18	17	16	16	10

$\mathbb{F}_n$	5	6	7	8	9
$\max(\mathrm{rank}(\mathfrak{g}_{\mathrm{ver}}))$	9	8	8	4	2

$\mathbb{F}_n$	10	11	12
$\max(\mathrm{rank}(\mathfrak{g}_{\mathrm{ver}}))$	1	0	0



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Horizontal models admit global weak coupling iff they are constructed over $\mathbb{F}_n$ with $0 \leq n \leq 4$.

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- Hence, they should not be present in a global weak coupling limit.

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The model then sheds a new component at local strong coupling, destroying the global weak coupling limit.

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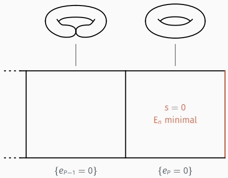

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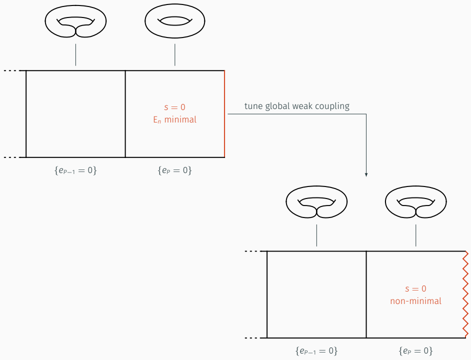

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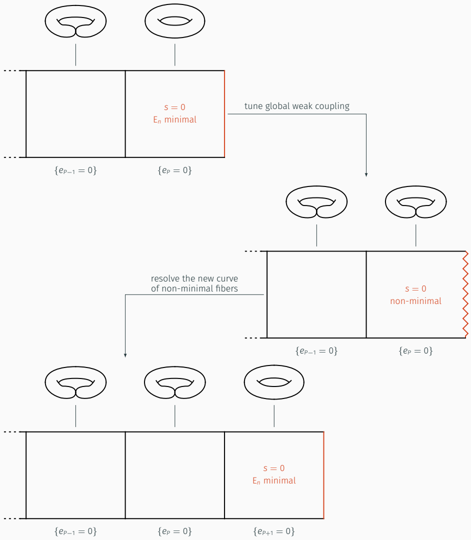

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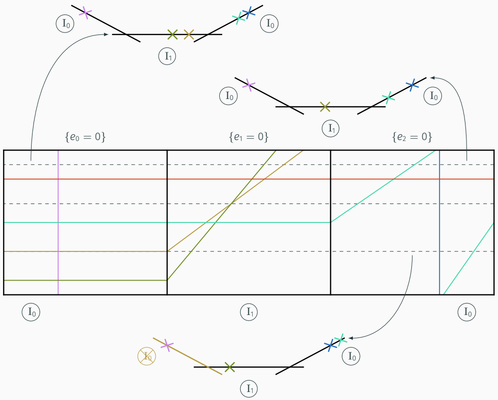
Summary



I_0
I_0
I_1
I_0
I_0
I_1
$\{e_0 = 0\}$
$\{e_1 = 0\}$
$\{e_2 = 0\}$
I_0
I_1
I_0
I_0
I_1

- Non-minimal singularities in F-theory

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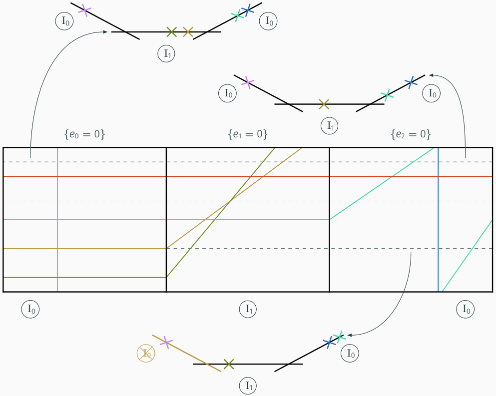
  Open-moduli infinite-distance limits



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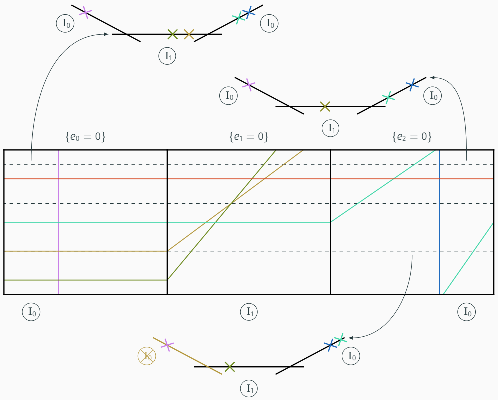

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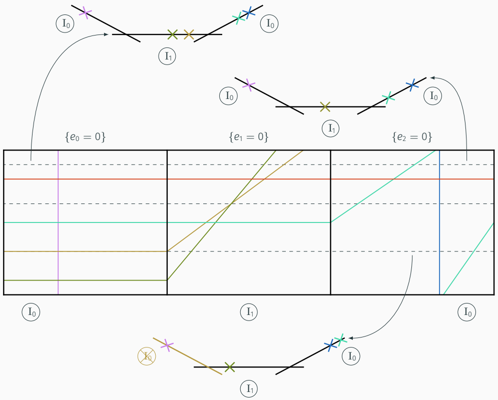

Thank you!