An Entropic Argument for the Swampland Distance Conjecture

José Calderón Infante

Instituto de Física Teórica UAM/CSIC, Madrid

Based on ongoing work with A. Castellano, A. Herráez and L.E. Ibañez

21st String Phenomenology Conference, Liverpool, 05/07/2022

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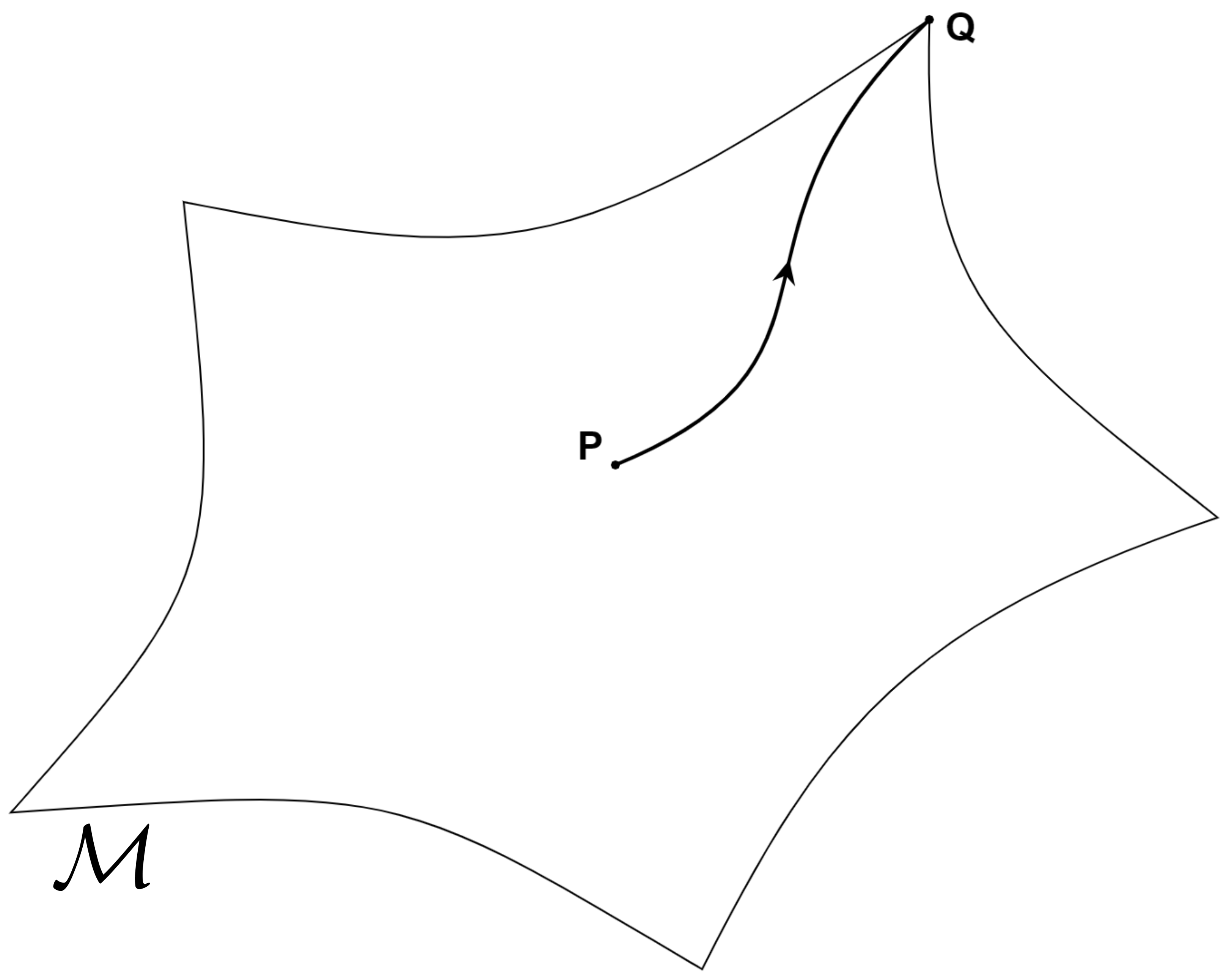

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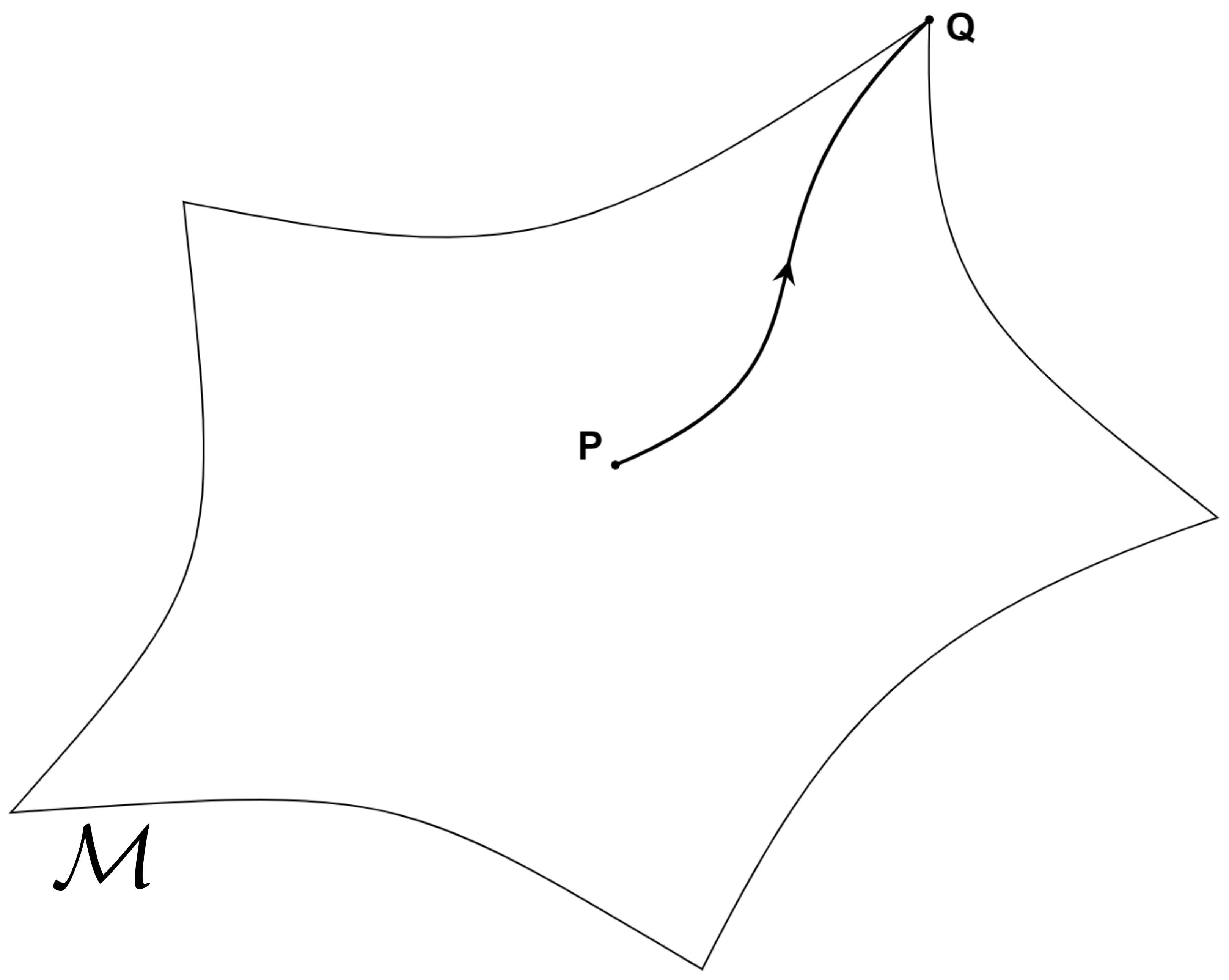

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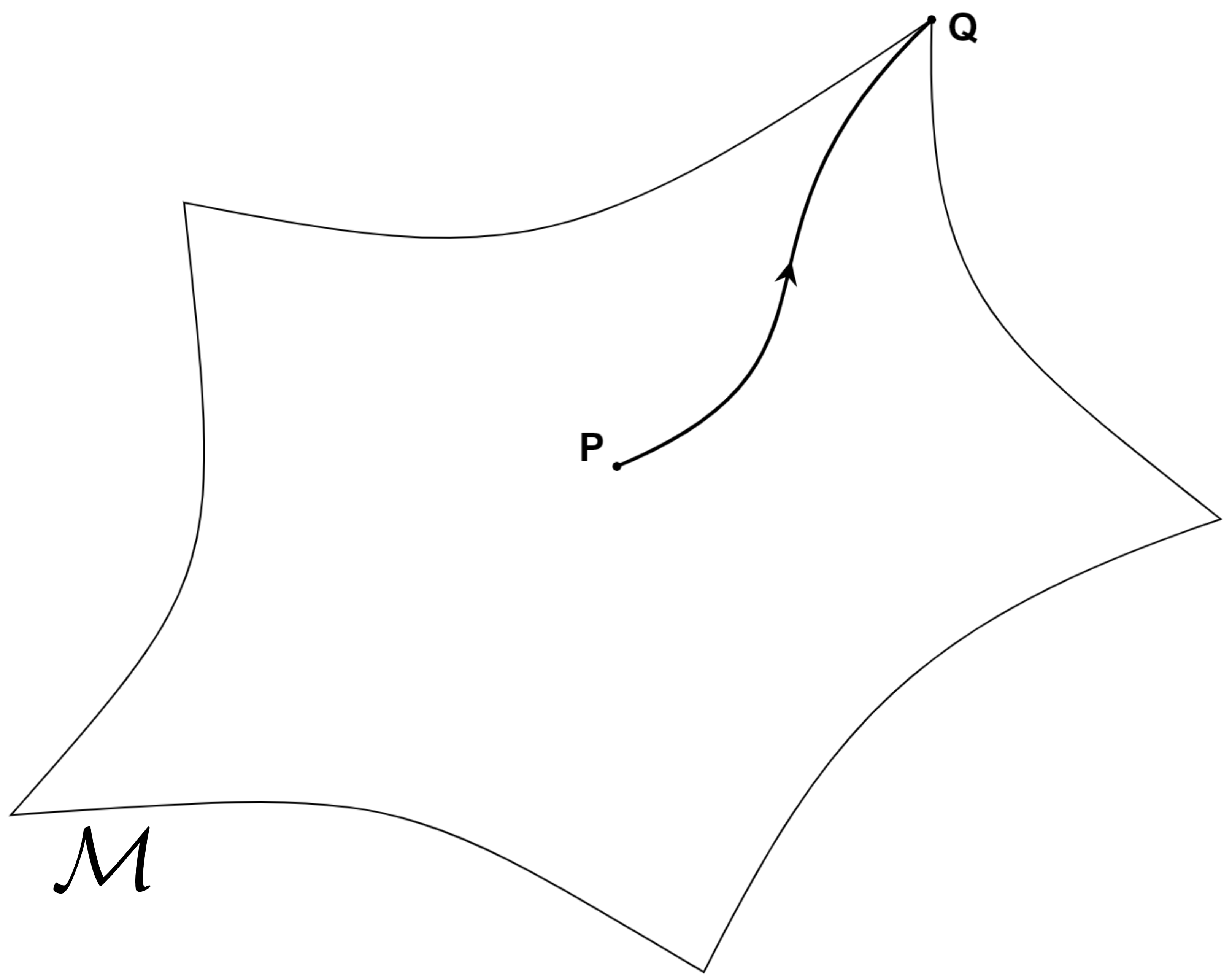

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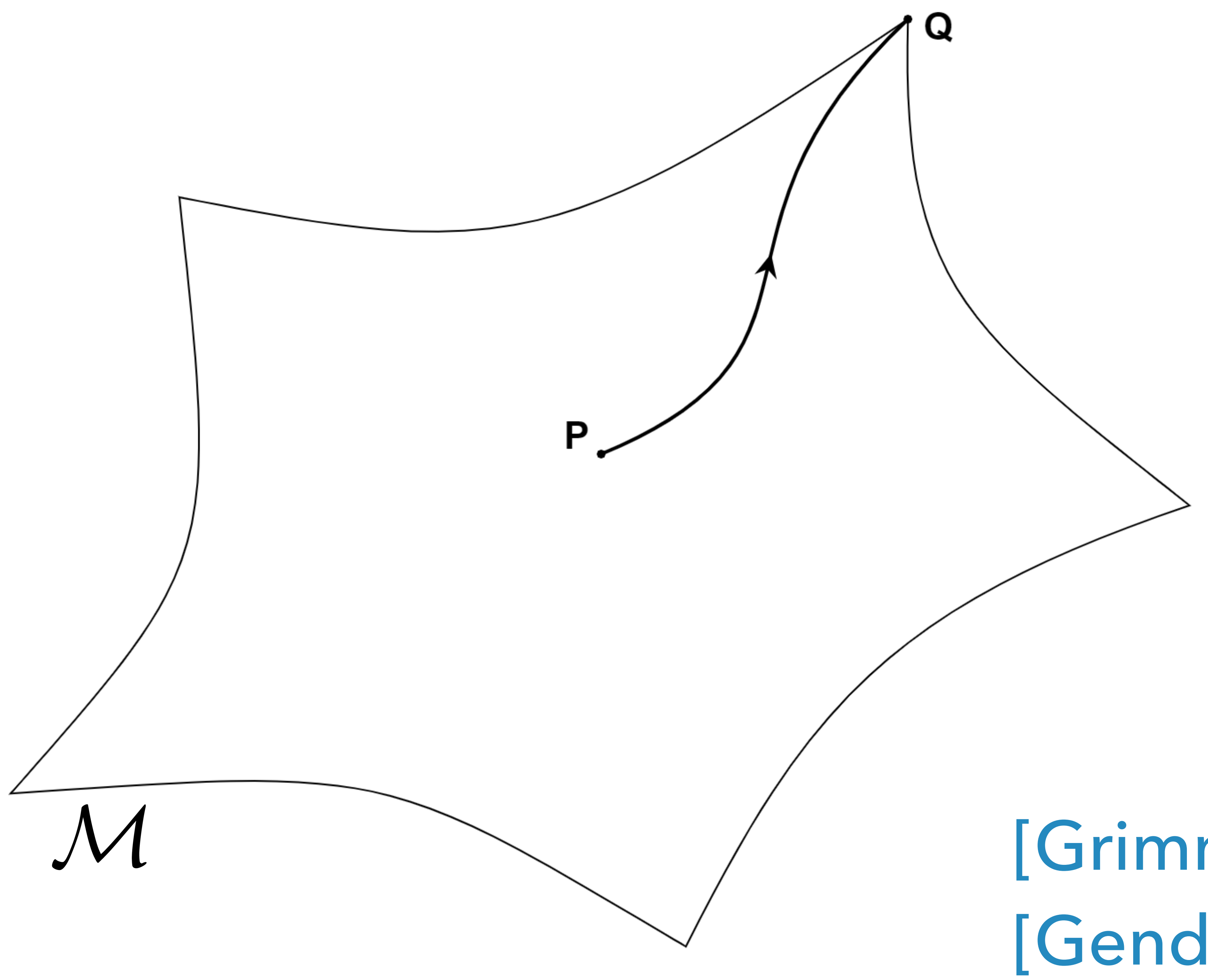

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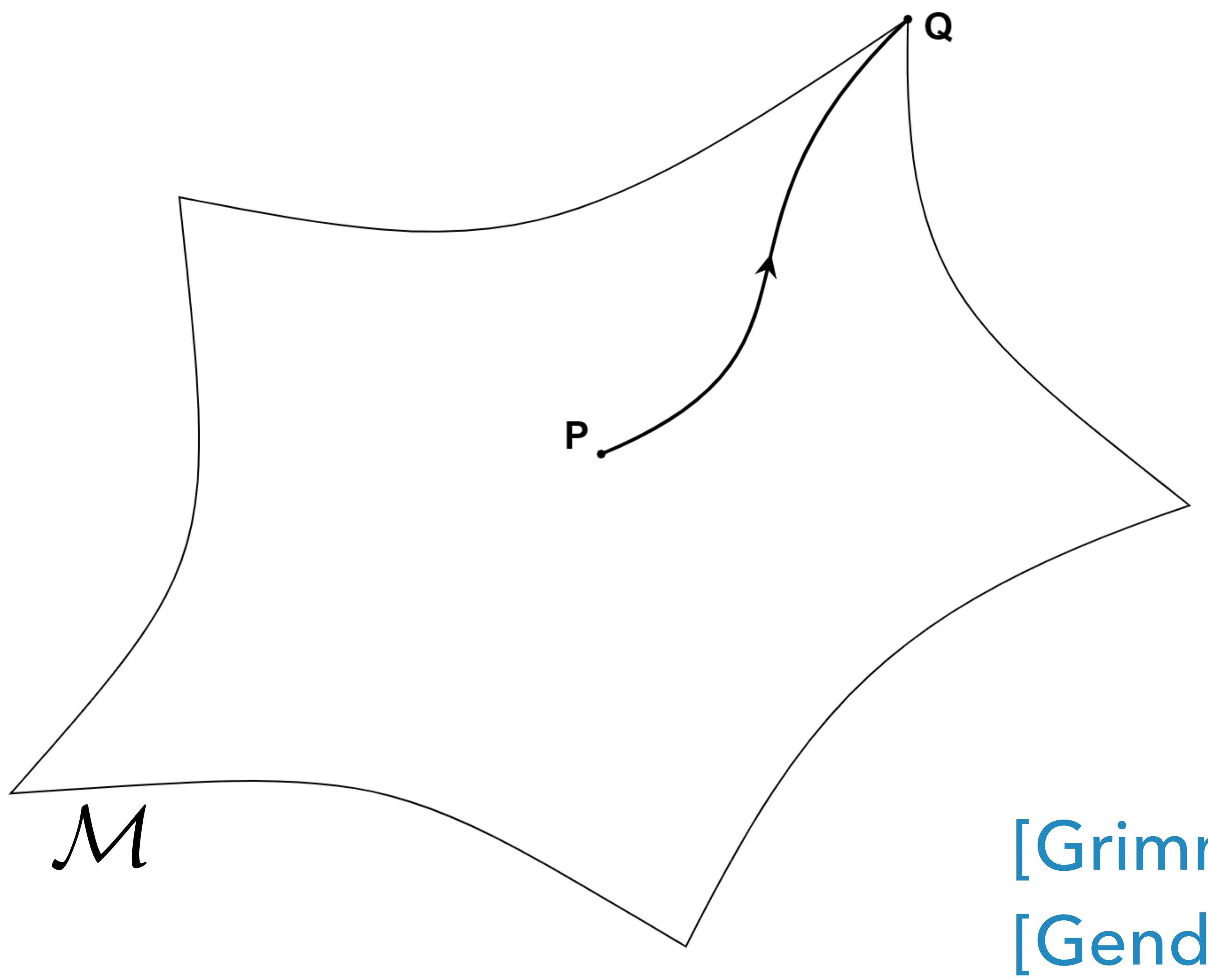

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Lots of evidence…

- String theory:
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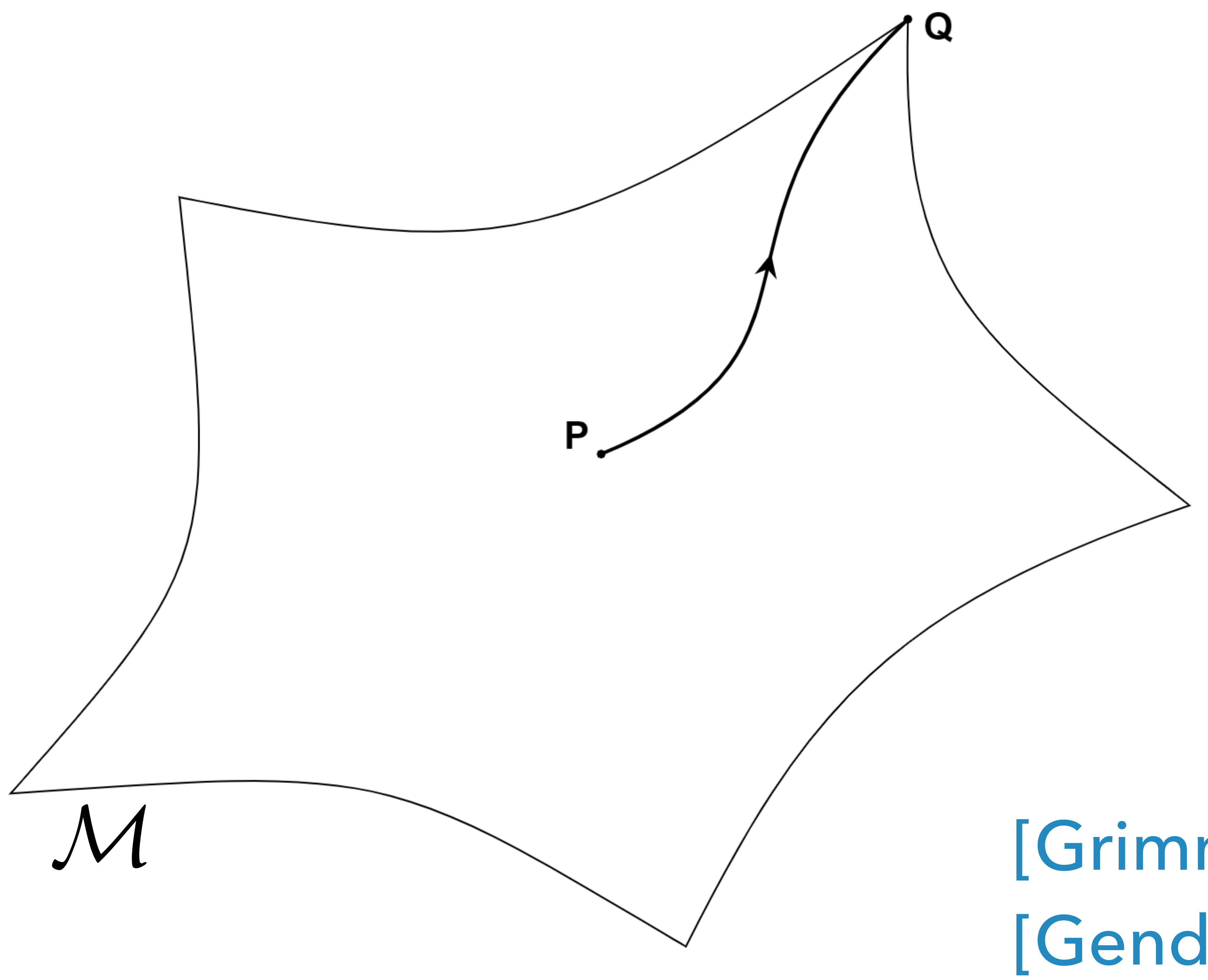

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…but no general bottom-up rationale!

See [Hamada, Montero, Vafa, Valenzuela '21] for an argument in the presence of weakly coupled U(1) at infinite distance

Covariant Entropy Bound and Towers of States

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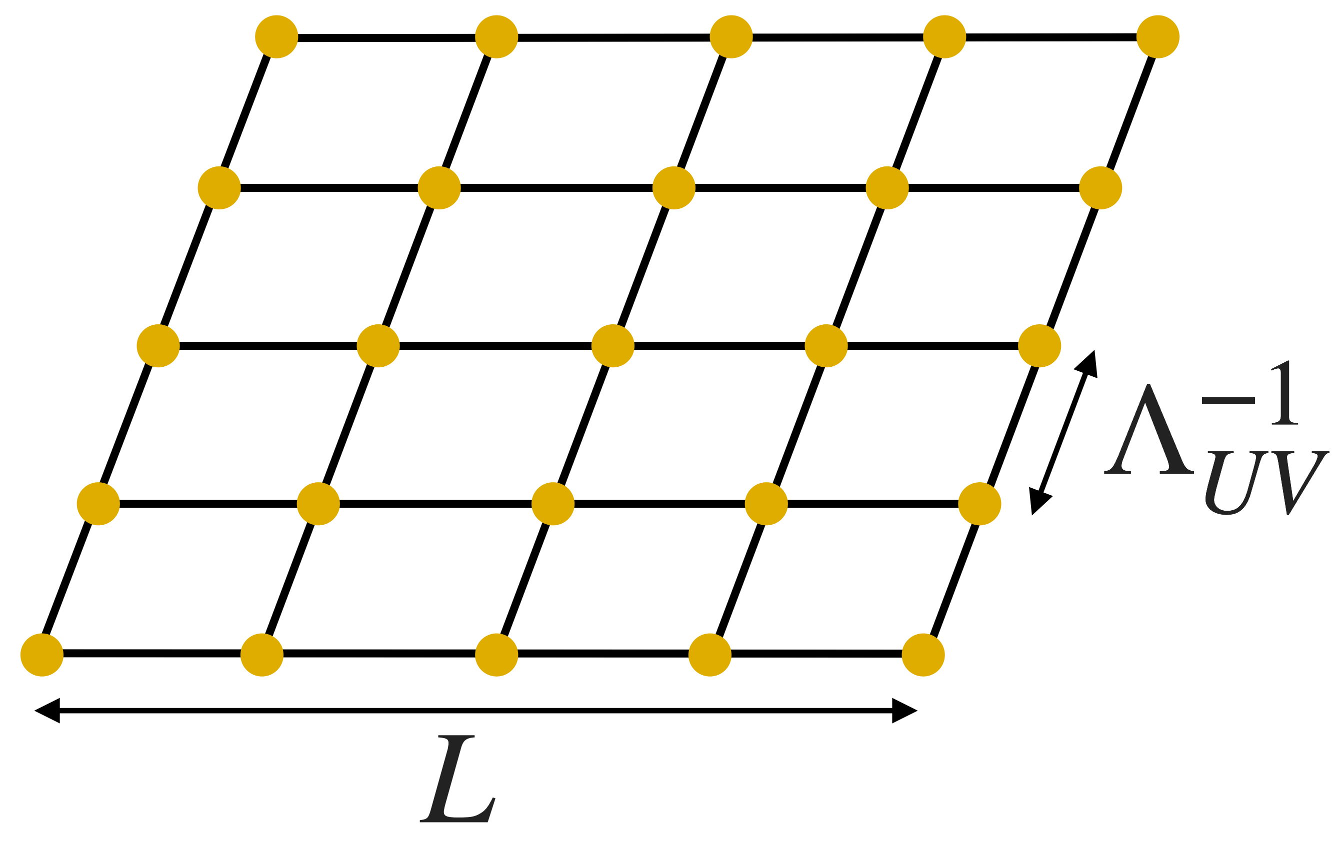

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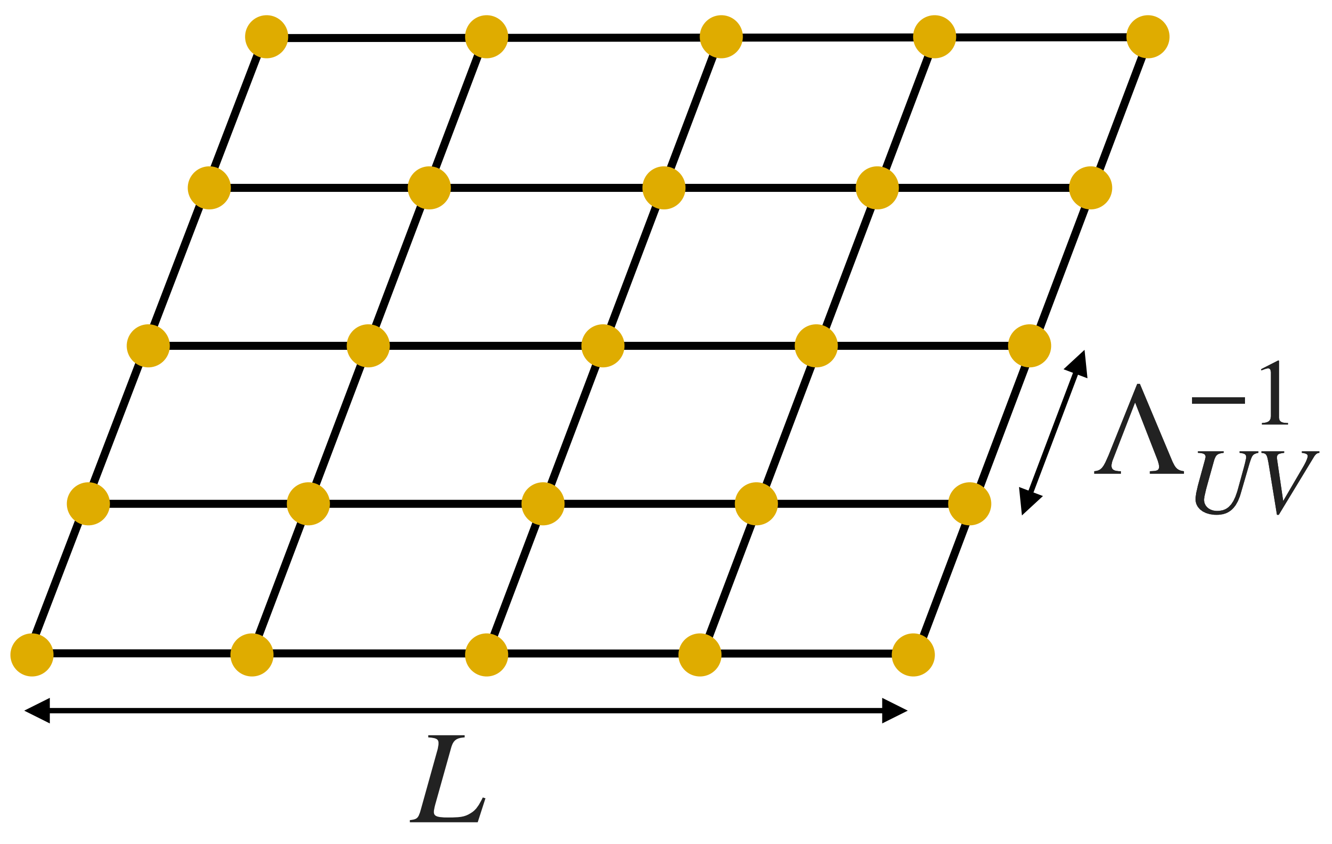

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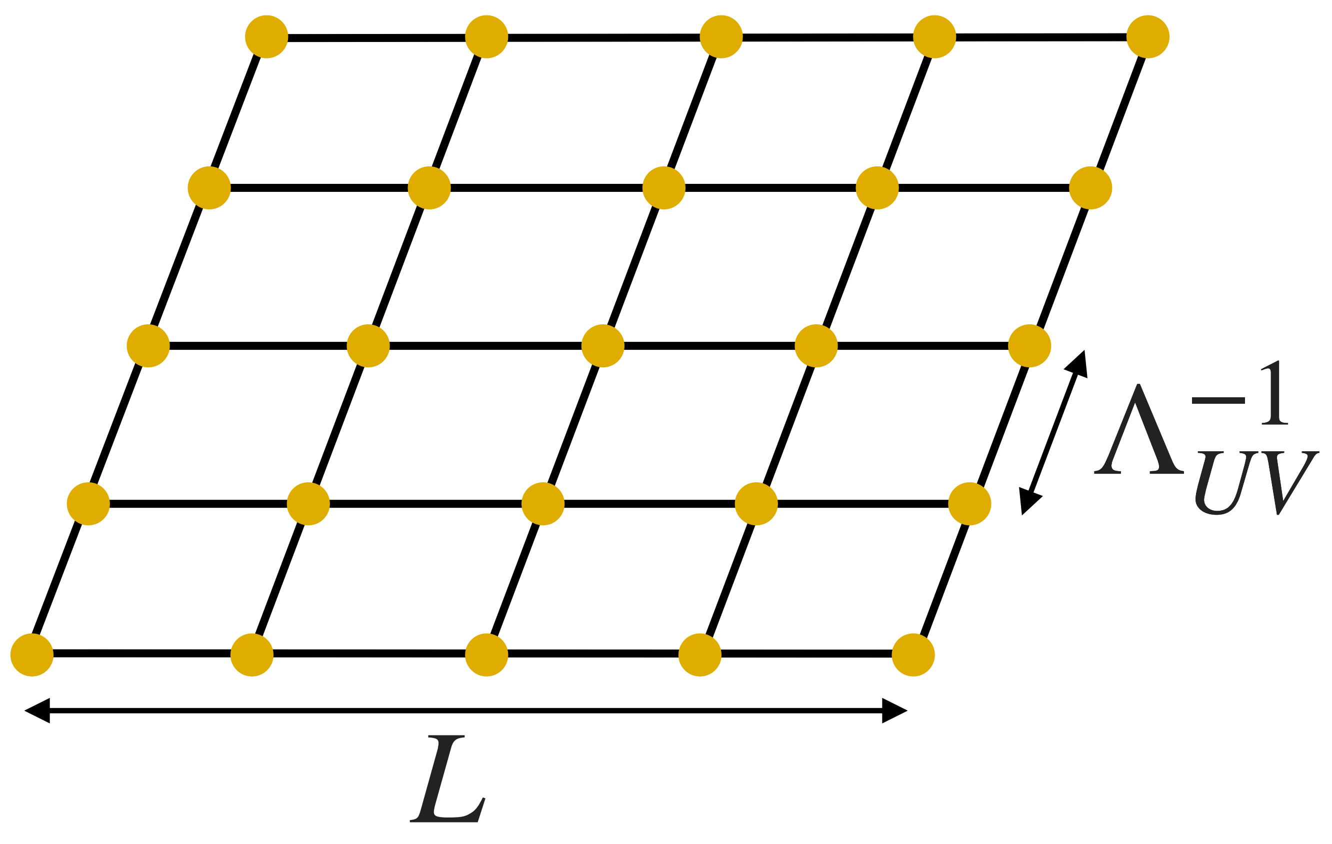

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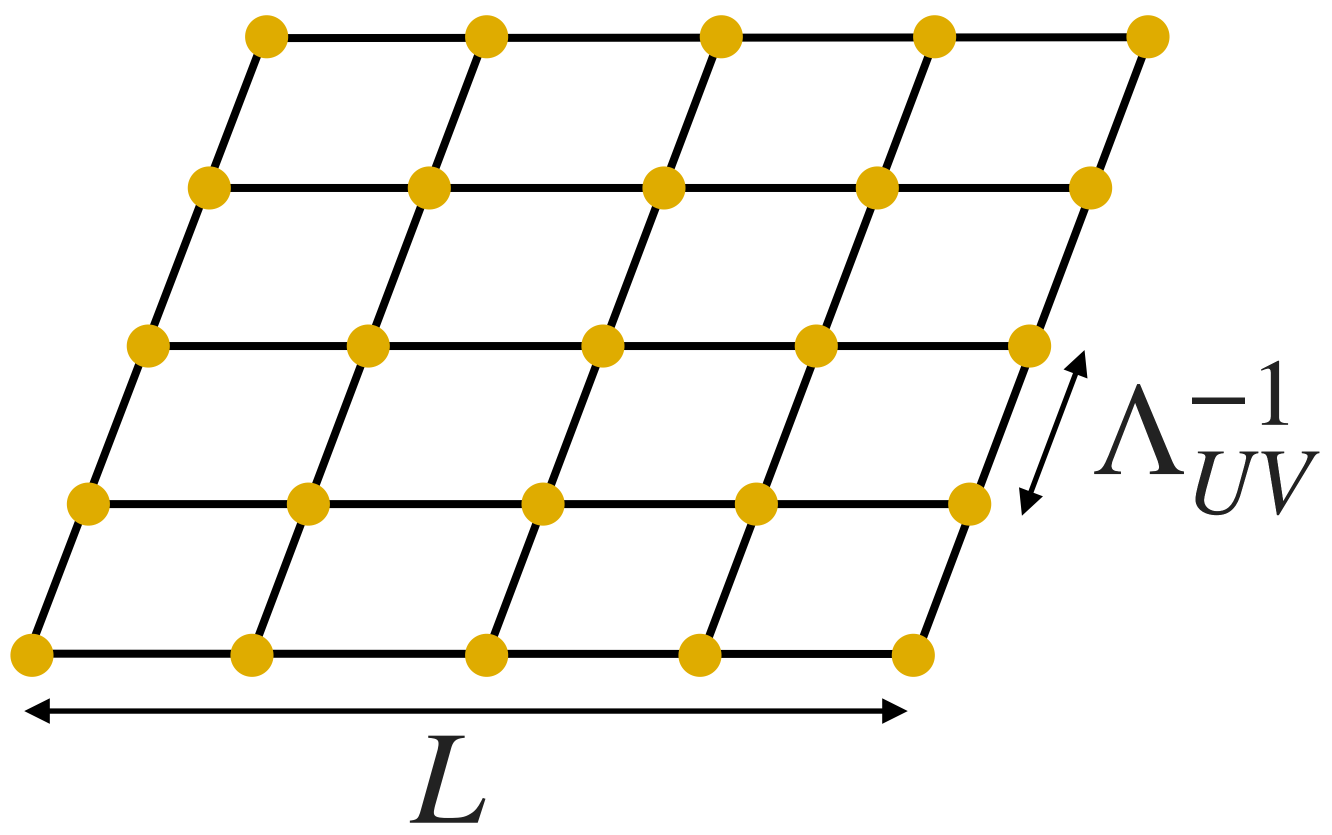

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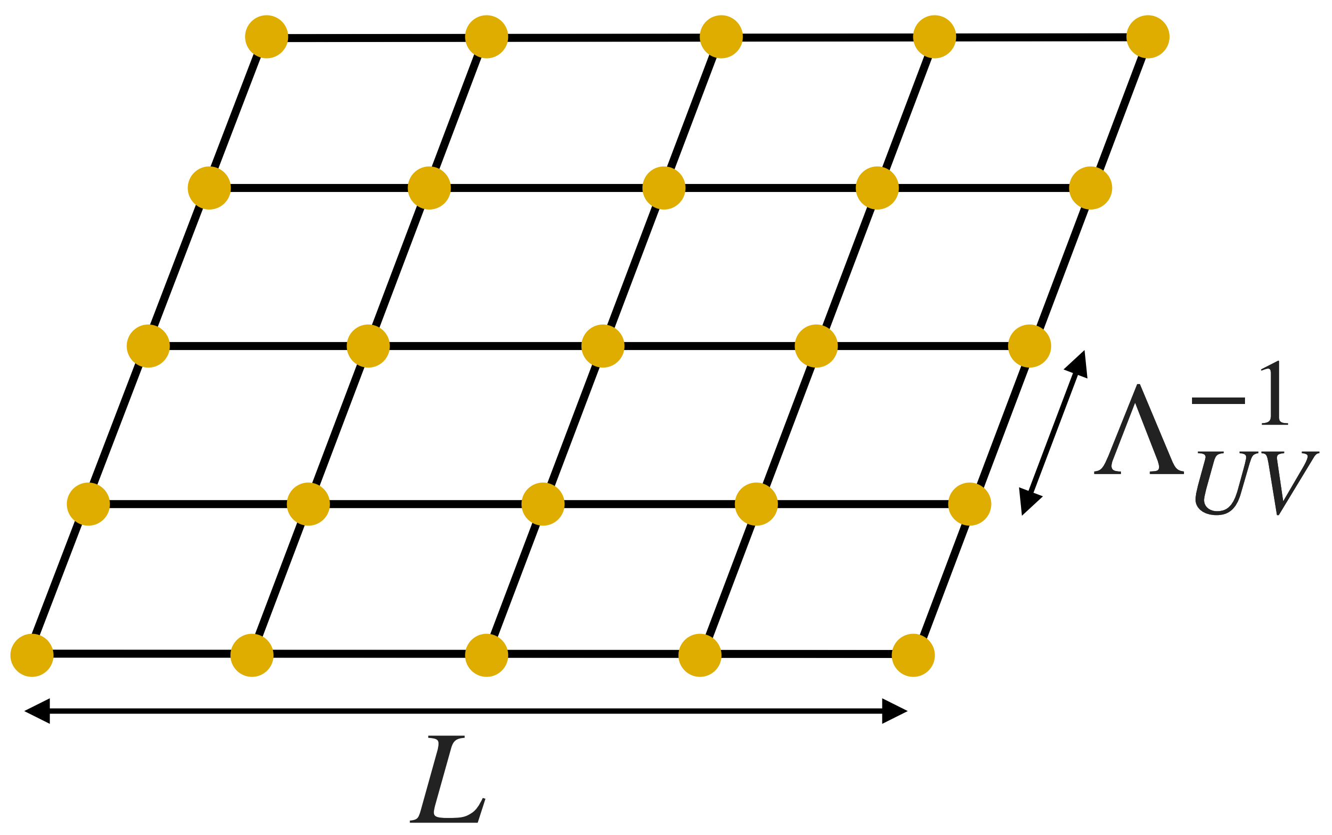

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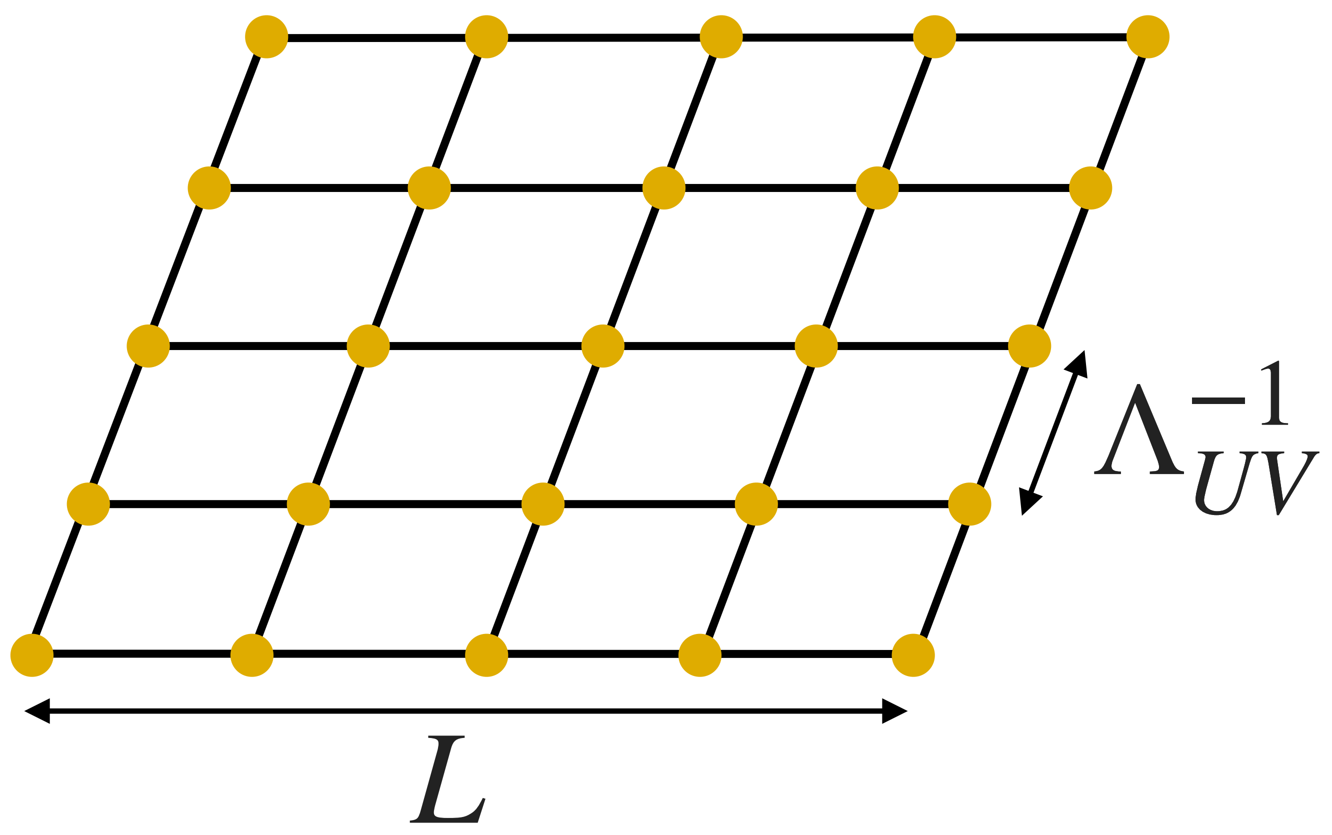

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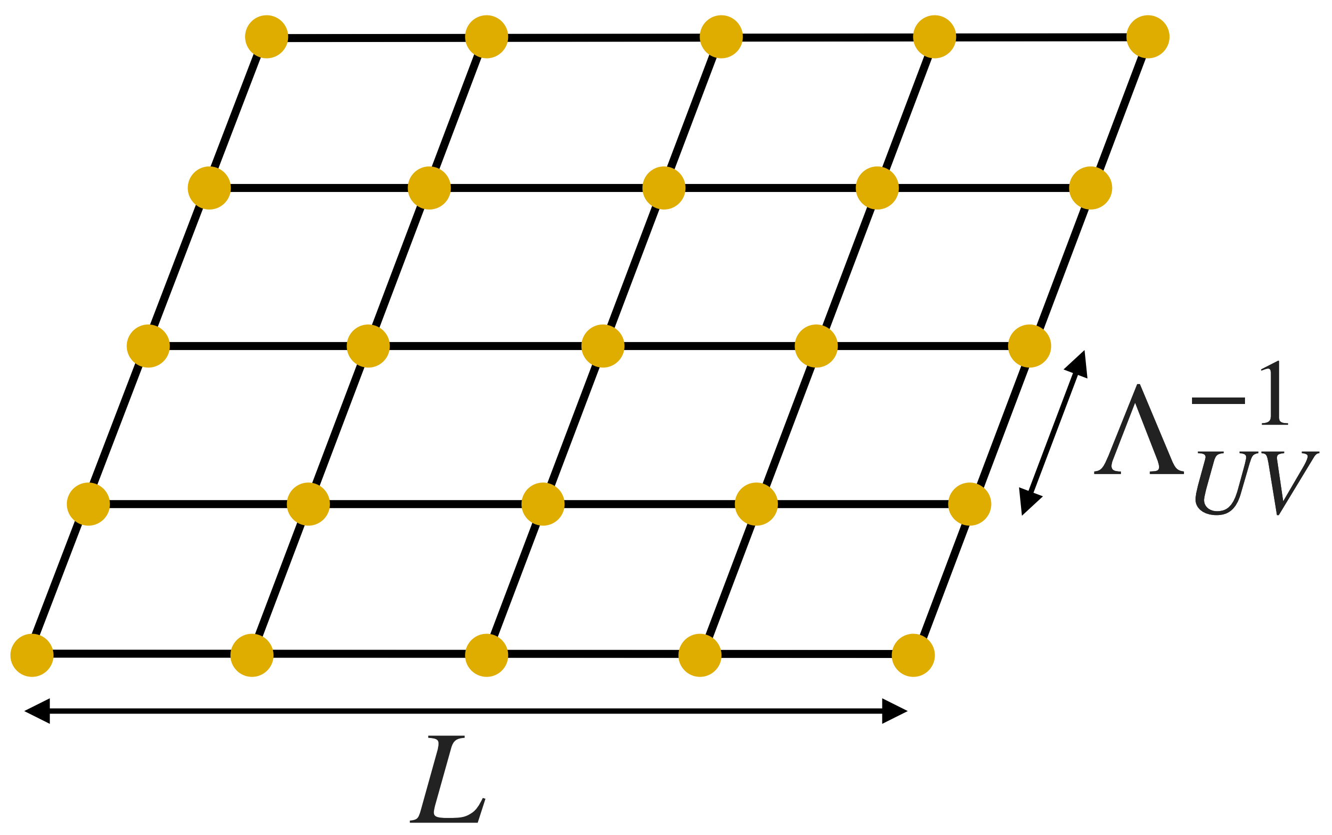

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Can we also motivate the Swampland Distance Conjecture from this perspective ?

→ We need background relating moduli space and spacetime distances!

$L \sim e^{a\Delta} \longrightarrow$ Appears naturally in the context of dynamical cobordisms

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Important! Singularity resolved in QG as the wall of nothing predicted by the cobordism conjecture!

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  … In the spirit of the Distant Axionic String Conjecture [Lanza, Marchesano, Martucci, Valenzuela '20 '21]

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Close to what we want! Not yet because we need this for $L \to \infty$

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  Bubbles of nothing and dimension changing bubbles as dynamical cobordisms! (See talk by Matilda Delgado)

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We want a bottom-up argument for the SDC ➡ Bottom-up approach

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- Equations of motion:

Moduli: $\phi''^c + \Gamma^c_{ab} \phi'^a \phi'^b + (D-1) A' \phi'^c = 0$

Gravity: $\begin{cases} (D-2)(D-1) A'^2 = |\phi'|^2 \\ A'' + (D-1) A'^2 = 0 \end{cases}$

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Relation between moduli space and geometry!

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$(D-2)(D-1) A'^2 = |\phi'|^2$ → Relation between moduli space and geometry!

$A'' + (D-1) A'^2 = 0$ → Just gives a (satisfied) compatibility condition

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- Solution(s)

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Metric:

$$\begin{cases} L \to \infty \longrightarrow \text{Flat space limit} \end{cases}$$

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$L \to 0 \longrightarrow$ ETW-brane singularity satisfying scaling relations

Expected to be resolved to walls of nothing

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EFT realization of the Cobordism Distance Conjecture in moduli space

Dynamical Cobordisms and the CEB

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Apply the covariant entropy bound to these dynamical cobordism backgrounds!

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(See talk by Muldrow Etheredge)

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$\rightarrow$ Stronger than our bound and respected in all examples ✓

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Dynamical cobordisms

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Adding a potential, relation with dS conjecture ?

Thank you for your attention