The tensor family in a nutshell

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A brief history of tensor models and T(G)FT

- Tensor models as a discretization of Euclidean quantum gravity

  [1991: Ambjorn,Durhuus,Jonsson; Sasakura]

⋮

- Discovery of a large-N expansion

  [2010: Gurau; + Rivasseau, Bonzom ...]

  Melons

  [2011: Bonzom, Gurau, Riello, Rivasseau]

⋮

- Melons (and tensors) are rediscovered in the SYK model

  [2015: Kitaev; 2016: Witten; Klebanov, Tarnopolski]

- 3d quantum gravity as a topological lattice gauge theory

  [1992: Boulatov]

⋮

- Group Field Theory ← Spin Foams ← LQG

  [2000: Reisenberger, Rovelli]

  Slowly GFT takes a life of its own [Oriti]

⋮

- A Laplacian on the group is introduced in GFT and tensor models

  [2011: Ben Geloun, Bonzom] [2011: Ben Geloun, Rivasseau]

  and insights from TM are absorbed in GFT $\rightarrow$ TGFT or TFT

⋮

Tensor field theories: one name for two different things

Tensor field: $\phi_{abc}(x)$, $x \in \mathbb{R}^d$,
$a, b, c \in (1 \dots N)$
global (internal) symmetry $(O(N)^3)$

$$S = \int \mathrm{d}^d x \left(\phi_{abc}(-\partial_x^2)\phi_{abc} + \textbf{local invariants}\right)$$

- Generalization of the $O(\mathcal{N})$ model, with explicit breaking ($O(N^3) \to O(N)^3$), s.t. melonic dominance at $N \to \infty$

Goals:

- a generalization of SYK to higher dimensions
- a generalization of the $O(\mathcal{N})$/higher-spin duality?
- a controllable nontrivial nonsupersymmetric CFT in $d > 2$

  [see Harribey's review]

Tensor field: ϕ_{abc},
$a, b, c \in (1 \dots \infty)$ ∼momenta on $T^3 = (S^1)^3$
UV cutoff N

$$S = \sum_{a,b,c} \left(\phi_{abc}(a^2+b^2+c^2)\phi_{abc} + \text{invariants}\right)$$

- A generalization of the Kontsevitch model to tensors
- A QFT on T^r, with very non-local interactions

Goals:

- a constructive (nonlocal) QFT

  [Rivasseau, Vignes-Tourneret]
- a QG/cosmological interpretation of its phase transitions [Oriti et al.]