Role of Complexified Supersymmetric Solutions

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Reference:

M.H., arXiv:1710.05010 [hep-th], to be published in PRL

Title is changed by PRL:

Supersymmetric solutions and Borel singularities for N=2 supersymmetric Chern-Simons theories

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$^{\exists}$configurations

which formally satisfy SUSY conditions: $Q(\text{fields}) = 0$
but are not on original path integral contour.

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Let us call them

“Complexified SUSY solutions”

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Our proposal for a part of answers:

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Our proposal for a part of answers:

they provide important information
on large order behavior of perturbative series
in SUSY QFT

Preparation: Borel resummation

Borel transformation:

$$\mathcal{O}(g) \simeq \sum_{\ell=0}^{\infty} c_\ell g^{a+\ell} \quad \Rightarrow \quad \boxed{\mathcal{BO}(t) = \sum_{\ell=0}^{\infty} \frac{c_\ell}{\Gamma(a+\ell)} t^{a+\ell-1}}$$

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Borel resummation (along R+) :

$$S_0\mathcal{O}(g) = \int_0^{\infty} dt \; e^{-\frac{t}{g}} \; \mathcal{B}\mathcal{O}(t)$$

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Locations of Borel singularities determine

- Whether or not perturbative series are Borel summable
- factorial divergence of perturbative series:

$$\mathcal{BO}(t) \sim \frac{1}{t-t_0} \quad \Rightarrow \quad c_\ell \sim \frac{\ell!}{t_0^\ell}$$

Proposal

Idea:

Conjecture:

Proposal

Idea:

Bosonic solution ⟷

Fermionic solution ⟷

Conjecture:

Proposal

Idea:

Bosonic solution $\longleftrightarrow$ Pole of Borel trans.

Fermionic solution $\longleftrightarrow$ Zero of Borel trans.

Conjecture:

Proposal

Idea:

Bosonic solution ⟷ Pole of Borel trans.

Fermionic solution ⟷ Zero of Borel trans.

Conjecture:

If there are n_B bosonic & n_F fermionic solutions with action $S=S_c/g$, then

(in the same topological sector)

$$(\text{Borel trans.}) \supset \prod_{\text{solutions}} \frac{1}{(t-S_c)^{n_B-n_F}}$$

In poster:

We explicitly check

$$(\text{Borel trans.}) \supset \prod_{\text{solutions}} \frac{1}{(t-S_c)^{n_B-n_F}}$$

for SUSY observables in 3d N=2 SUSY Chern-Simons matter theories

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for SUSY observables in 3d N=2 SUSY Chern-Simons matter theories

- construct ∞ complexified SUSY sols. in general 3d N=2 SUSY theory on S^3 with Lagrangian
- comparison of their actions & Borel singularities for "1/k-expansion" (=perturbative series by inverse CS level)

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Related progress not in poster:

- Resurgence [Fujimori-M.H.-Kamata-Misumi-Sakai '18]
- SUSY breaking & complexified SUSY sols. [M.H., work in progress]
- Spectrum of complexified SUSY sols. & effective action [M.H., work in progress]

Thanks!