

Classification of Rank 2 $N=2$ Superconformal Field Theories

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hep-th/0504070 hep-th/0510226

Conformal Field Theories(CFTs)

- CFTs are scale invariant field theories.
 - Only describe massless degrees of freedom.
 - They are interesting because they characterize different “phases”.
 - Once CFTs are understood we can perturb away from them with relevant operators (e.g. mass terms) to understand general scale dependent field theories.

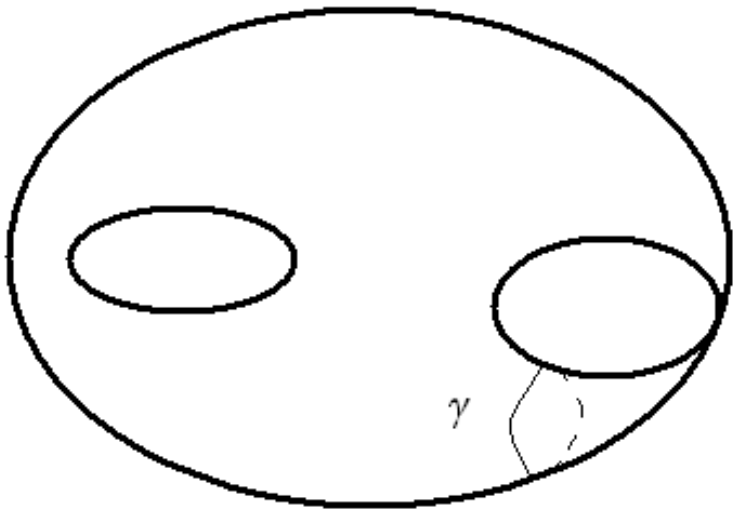
Why do we Classify?

- Sharpen Restrictions on Effective Actions for $N=2$ supersymmetric theories.
- Standard Lore (Seiberg-Witten Theory):
 - Higgs Branch is hyper Kahler geometry with no quantum corrections.
 - Coulomb Branch is rigid special Kahler geometry with quantum corrections.
- In rank 1 case this is sufficient.
 - Minahan and Nemeschansky
 - [hep-th/9608047](#)
 - [hep-th/9610076](#)

The Rank 2 Case

- The rsk geometry is not sufficient.
 - We found an infinite number of solutions to the rsk geometry condition.
 - Most of which are not physical.
- This means that there is some new physical condition that must be imposed.

Z-Consistency



$$|Z| \leq M$$

- The genus 2 Riemann Surface encodes the effective couplings.
- When a cycle is pinched we know from Seiberg-Witten Theory that we have new massless modes.

$$Z_{(\gamma)} \longrightarrow 0$$

The Classification

- As to date all physical solutions are conformal.
- We have found the $SU(3)$, $SU(2) \times SU(2)$, $SO(5)$ and the G_2 as well as many without Lagrangian descriptions.
- This classification is far from complete.