# 4D to 3D reduction of Seiberg duality for SU(N) susy gauge theories with adjoint matter: a partition function approach

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# 1 | Introduction

# 2 | Physics

## 2.1 Introduction

Supersymmetric quantum field theories enjoy an enlarged group of symmetries compared to other field theories. Since the symmetry group is a non trivial combination of internal and spacetime symmetries, they have many unexpected feature and new techniques were found to study them.

Many of the new tools found are available only for supersymmetric theories, making them the theater for exciting discoveries in physics.

## 2.2 Four dimensional dualities

BUUUUU

### Seiberg Duality

This is the duality originally found by Seiberg [1].
**POSSO DIRE ALTRO!!**
The electric theory is a $SU(N_c)$ supersymmetric non-chiral gauge theory with $N_f$ flavours global symmetry group $SU(N_f) \times SU(N_f) \times U(1)_B \times U(1)_R$. The charges of the matter content of the theory are summarized in the table below.

| | $SU(N_c)$ | $SU(N_f)_L$ | $SU(N_f)_R$ | $U(1)_B$ | $U(1)_R$ |
|---|---|---|---|---|---|
| $Q$ | $N_c$ | $N_F$ | 1 | 1 | $\frac{N_f-N_c}{N_f}$ |
| $\tilde{Q}$ | $\overline{N_c}$ | 1 | $\overline{N_F}$ | $-1$ | $\frac{N_f-N_c}{N_f}$ |

Table 2.1: Charge of matter content of the electric theory

The *R-Charge* is fixed by requiring that the *R-Symmetry* is non anomalous.
**Da spiegare meglio.**
What really happens is that $U(1)_A$ symmetry (which is anomalous) mixes with the classical (anomalous) $U(1)_{R'}$ R-symmetry. Their mixing result in a non anomalous $U(1)_R$ R-symmetry and the disappearance of $U(1)_A$.
The triangular graph corresponding to this anomaly constrains the R-charge of the quarks

imposing

$$R_{gaugino}T(\mathrm{Ad}) + \sum_{fermions\ f} (R_f - 1)T(r) = 0$$

$$N_c + \frac{1}{2}\,2N_f(R_Q - 1) = 0 \quad \rightarrow \quad R_Q = \frac{N_f - N_c}{N_f}$$

The magnetic theory is a theory with the same global symmetries as the electric theory, but the gauge group is now $SU(N_f - N_c)$ and in addition there are $N_f^2$ fields, that we will call mesons. Dual quarks will be represented as $q, \tilde{q}$ and mesons as $M_{\tilde{j}}^{i}$ The charges for the magnetic theory are given by

| | $SU(N_c)$ | $SU(N_f)_L$ | $SU(N_f)_R$ | $U(1)_B$ | $U(1)_R$ |
|---|---|---|---|---|---|
| $q$ | $N_c$ | $N_F$ | 1 | $\frac{N_c}{N-f-N_c}$ | $\frac{N_c}{N_f}$ |
| $\tilde{q}$ | $\overline{N_c}$ | 1 | $\overline{N_F}$ | $-\frac{N_c}{N-f-N_c}$ | $\frac{N_c}{N_f}$ |
| $M_{\tilde{j}}^{i}$ | 1 | $N_f$ | $\overline{N_f}$ | 0 | $2\frac{N_f-N_c}{N_f}$ |

Table 2.2: Charge of matter content of the magnetic theory

### Kutasov-Schwimmer duality

## 2.3 3D dualities

### Aharony duality

### Kutasov-Schwimmer duality

# 3 | Math

# 4 | My work

# 5 | conclusions

# 6 | Appendix

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