Higgsing and Superpotential Deformations of ADE Superconformal Theories

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We study large classes of renormalization group flows, driven by scalar expectation values or mesonic superpotential terms, away from the conformal fixed points of the $4d$ supersymmetric gauge theories with ADE-type superpotentials. The a-maximization procedure allows us to compute the R charges and to check the a-theorem conjecture. For a theory obtained by Higgsing the D_{k+2} theory, we use the magnetic dual description proposed by Brodie to determine the parameter region where the resulting theory is at a non-trivial conformal fixed point.

New CFT points discaverd are summarized as follows:

$$
\begin{array}{ll}
\widehat{M} & W = Q_i X Q^i \\[4pt]
M^{\widehat{M}}_{(0,0)} & W = Q_i Q^i \\[4pt]
M^{\widehat{A}}_{(4,0)} & W = Q_i X Q^i + tr X^2 \\[4pt]
M^{\widehat{D}}_{(0,1)} & W = Q_i X Q^i + tr X^2 Y \\[4pt]
M^{\widehat{E}}_{(1,0)} & W = Q_i X Q^i + tr Y^3 \\[4pt]
M^{\widehat{E}}_{(0,1)} & W = Q_i X Q^i + tr X^3
\end{array}
\tag{1}
$$

$$
\begin{array}{ll}
M^{\widehat{E}}_{(k,0)} & W = Q_i X^k Q^i + tr Y^3, \qquad k = 0,1,2,3 \\[4pt]
M^{\widehat{E}}_{(l,1)} & W = Q_i X^l Y Q^i + tr Y^3, \qquad l = 0,1 \\[4pt]
M^{\widehat{E}}_{(4,0,0)} & W = Q_i Q^i Q_j Q^j + tr Y^3
\end{array}
\tag{2}
$$

$$
M^{\widehat{A}}_{(4,k)} \qquad W = (Q_i X^a Q^i) Q_j X^b Q^j + (Q_j X^a Q^i) Q_i X^b Q^j + tr Y^2,
\tag{3}
$$

$$
\begin{array}{ll}
M^{\widehat{D}}_{(0,k,2)} & W = \sum (tr X^a Y) Q_j X^b Y Q^j + tr X Y^2, \\[4pt]
M^{\widehat{D}}_{(0,k,1)} & W = \sum (tr X^a) Q_j X^b Y Q^j + tr X Y^2. \\[4pt]
M^{\widehat{D}}_{(1,k,0)} & W = \sum (Q_i X^a Q^i) Q_j X^b Q^j + tr X Y^2, \\[4pt]
M^{\widehat{D}}_{(1,k,1)} & W = \sum (Q_i X^a Q^i) Q_j X^b Y Q^j + tr X Y^2,
\end{array}
\tag{4}
$$

where the sums are over a and b with $a + b = k$.