‘Exact’ spectrum generators across strong dynamics

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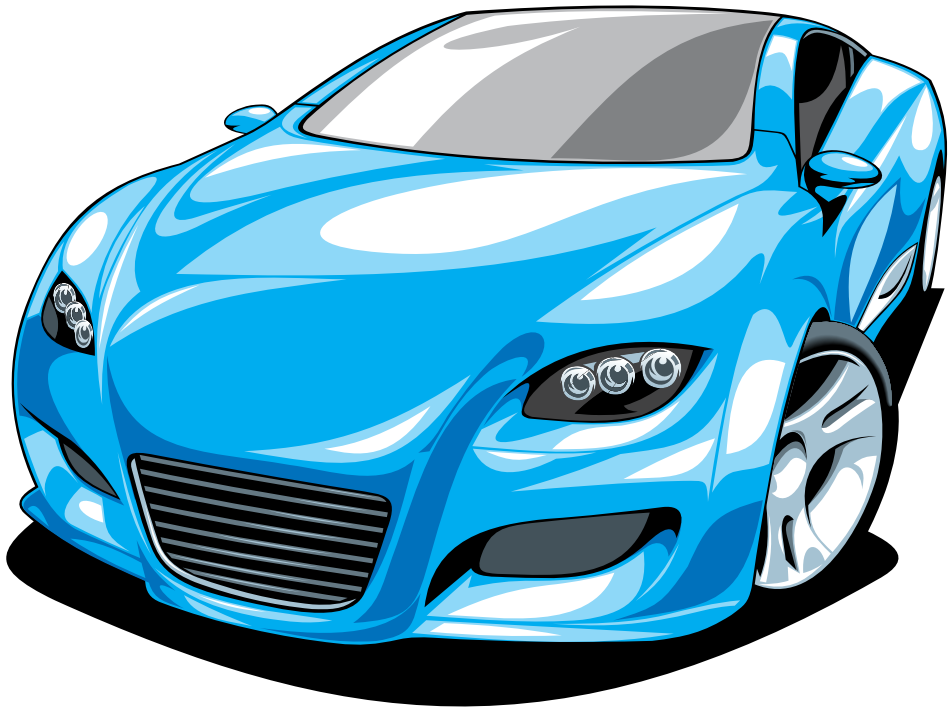
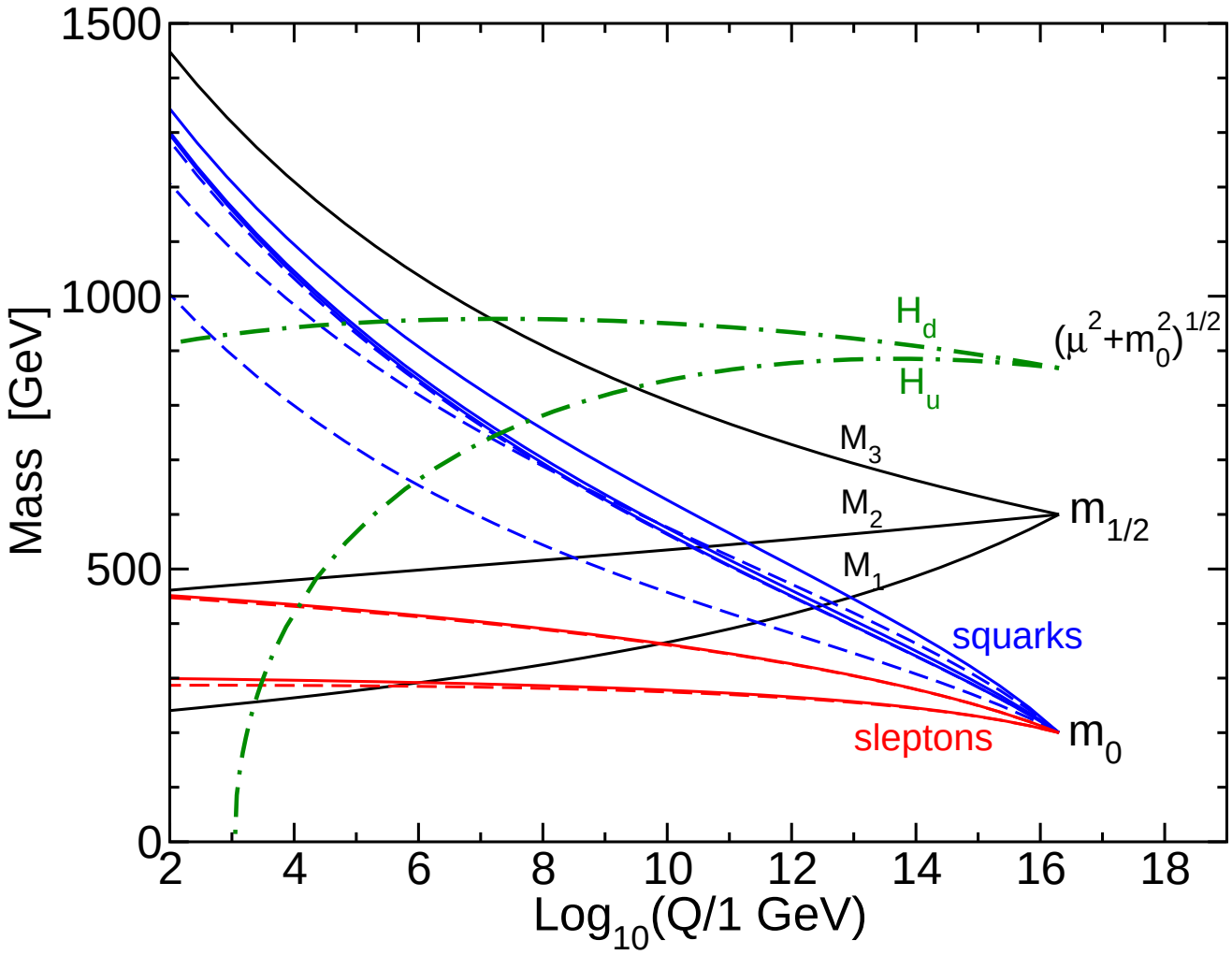
Across the TeV Frontier 2012, Cargese

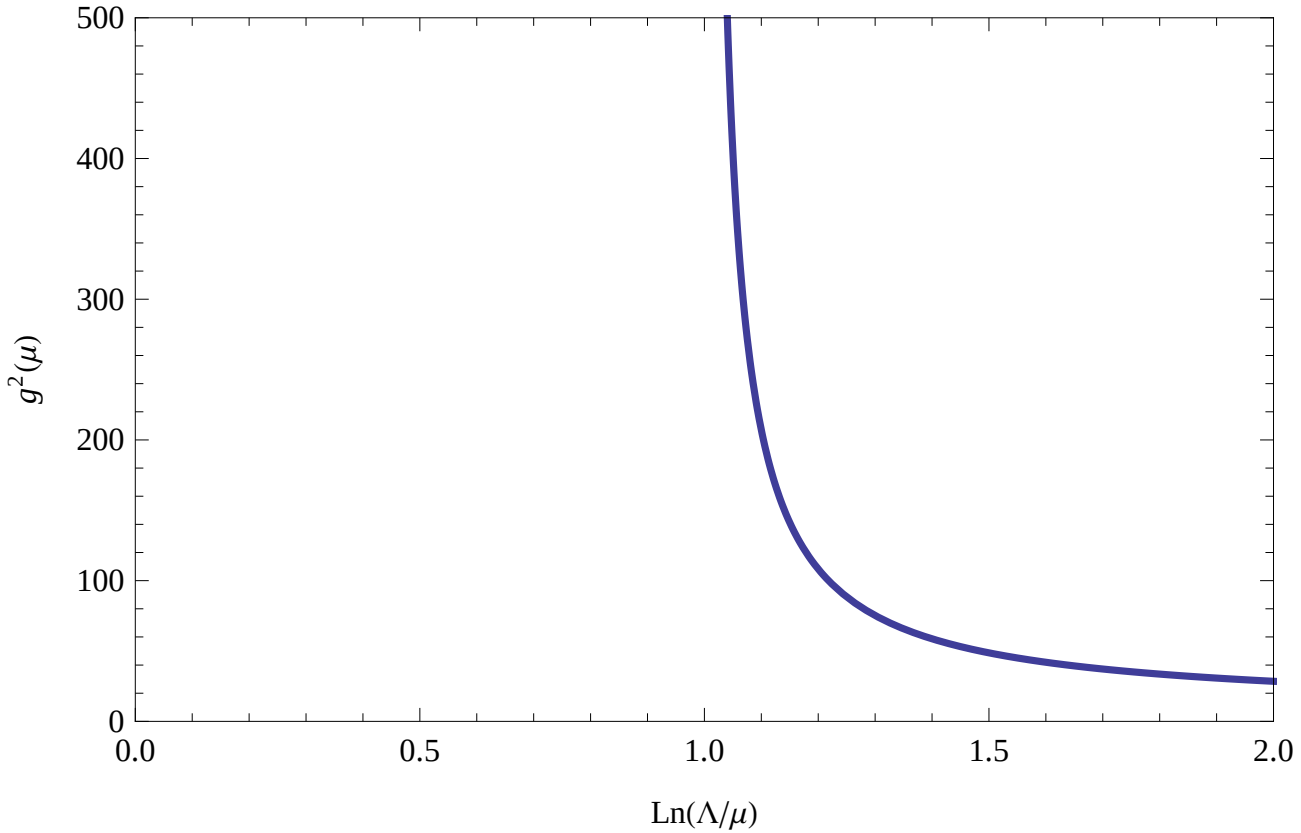
Motivating SUSY



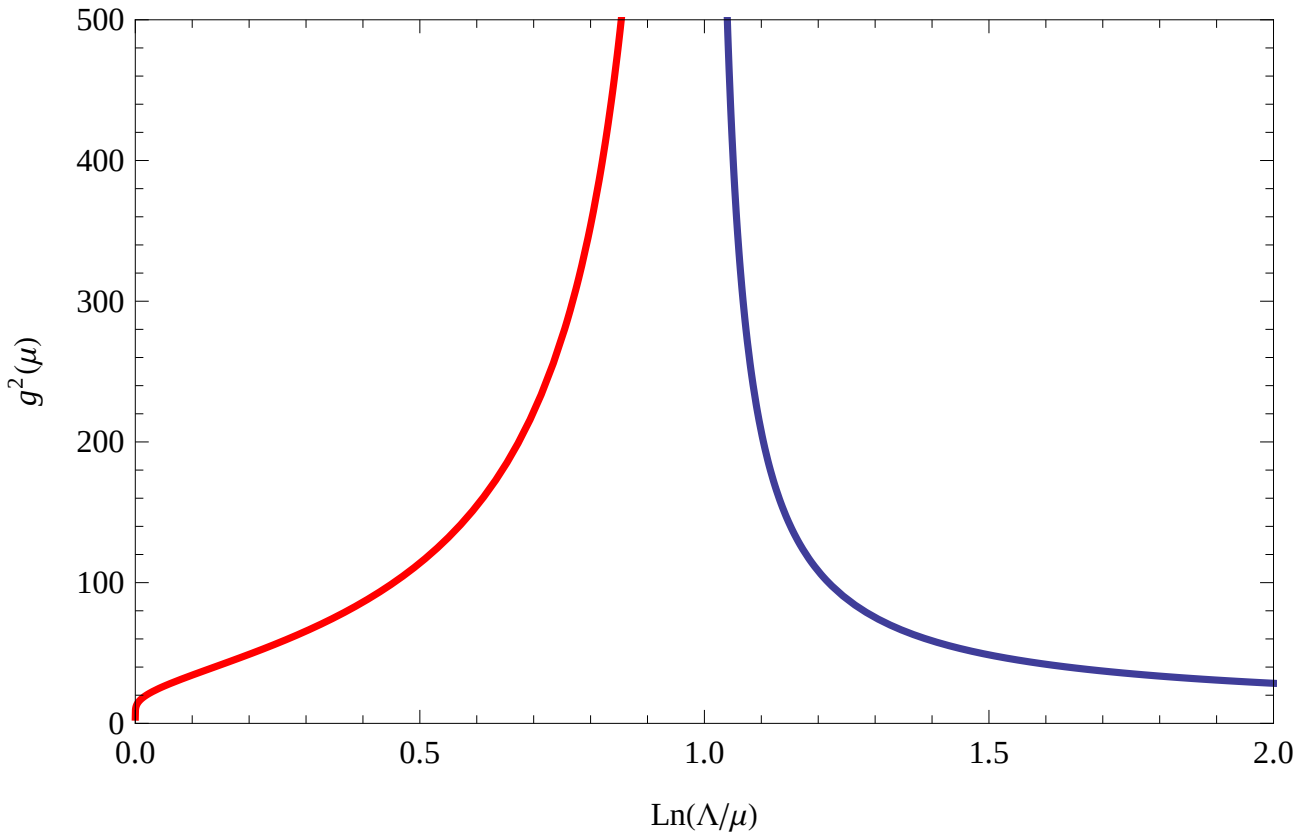


S. Martin, hep-ph/9709356

UV Theory



IR Theory



UV theory

$$\mathcal{L}_{\rm el} \sim \int d^2\theta\, \hat{S}\, \mathcal{W}_\alpha^2 + \text{h.c.} + \int d^4\theta\, F\, \hat{Z}\, Q^\dagger e^V Q$$

$$\lim_{\mu\to\infty} m_Q(\mu) = -\log(\hat{Z})\Big|_{\theta^2\bar{\theta}^2} \qquad I = \text{RG-invariant}$$

UV theory

$$\mathcal{L}_{\rm el} \sim \int d^2\theta\, \hat{S}\, \mathcal{W}_\alpha^2 + \text{h.c.} + \int d^4\theta\, F\, \hat{Z}\, Q^\dagger e^V Q$$

$$\lim_{\mu\to\infty} m_Q(\mu) = -\log(\hat{Z})\Big|_{\theta^2\bar{\theta}^2} \qquad I = \text{RG-invariant}$$

IR theory

$$\mathcal{L}_{\rm mag} \sim \int d^2\theta\, \hat{\tilde{S}}\, \tilde{\mathcal{W}}_\alpha^2 + \text{h.c.} + \int d^4\theta\, \tilde{F}\, \frac{\hat{\tilde{Z}}^2}{\tilde{I}}\, \varphi^\dagger e^{\tilde{V}} \varphi + \ldots$$

$$\lim_{\mu\to 0} m_\varphi(\mu) = -\log\left(\frac{\hat{\tilde{Z}}^2}{\tilde{I}}\right)\Big|_{\theta^2\bar{\theta}^2}, \qquad \tilde{I} = \text{RG-invariant}$$

Theories describe the same physics

$$I = \tilde{I}$$

Exact soft term mapping

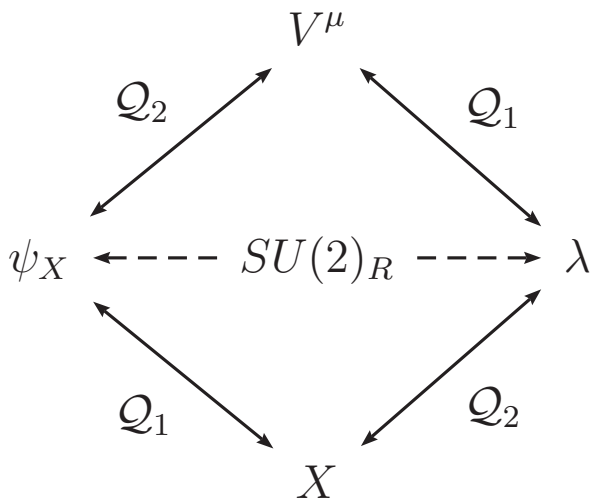
$$m^2 \left(Q^\dagger Q + \tilde{Q}^\dagger \tilde{Q}\right) \longrightarrow m^2 \frac{2N_f - 3N_c}{3N_c - N_f} \left(q^\dagger q + \tilde{q}^\dagger \tilde{q} - 2\varphi\varphi^\dagger\right)$$

N. Arkani-Hamed & R. Rattazzi, hep-th/9804068
S. Abel, & M. Buican & Z. Komargordski 1105.2885

If no SUSY... add more SUSY!

$$\mathcal{L}^{\mathcal{N}=2}_{\text{SYM}} \sim \int d^2\theta\, d^2\tilde{\theta} \frac{1}{g^2} \operatorname{Tr} \Psi^2$$

$$\Psi \sim X + \tilde{\theta} \cdot \mathcal{W} + \ldots$$



$$\frac{1}{g^2} \to \frac{1}{g^2}(1 - \ldots - m_D \theta\tilde{\theta} - \ldots) \implies -\mathcal{L} \supset m_D \chi\lambda$$

Picture: Are there other soft terms we can map across strong dynamics?

What I'm doing:

- Mathematica package for $\mathcal{N} = 2$ superspace calculations
- $\mathcal{N} = 1$ in $\mathcal{N} = 2$ language using $SU(2)_R \subset U(2)_R$ spurion

'Physics' I'm interested in

- Dualities and Cascading Gauge Theories
- Unusual approaches to BSM Phenomenology
- ...