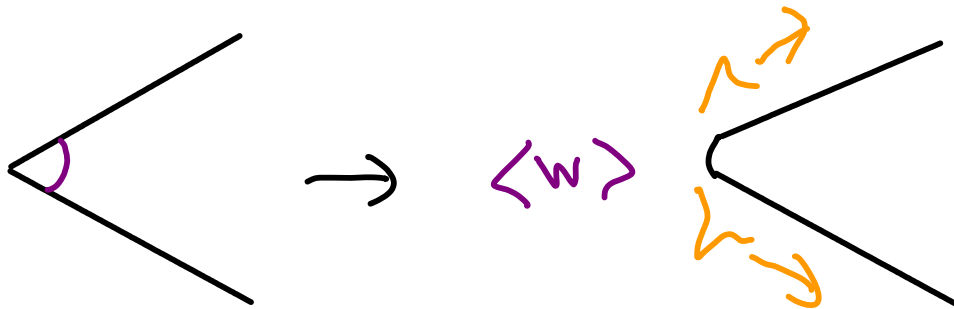


50th Anniversary of ST

Early (and ongoing) lessons:

ST, even perturbatively in g_s not just glorified QFT or GR: shares crucial properties like causality, but introduces 'stringy nonlocality' where needed, including singularities, topology change (& long-range interactions near horizons).



Large-radius GR_d emergent from more basic worldsheet $CFT_{\text{Effective}}$. Includes topology-changing and even D -changing transitions visible in the classical theory.

Dualities => more unified, intricate checks, but less globally predictive

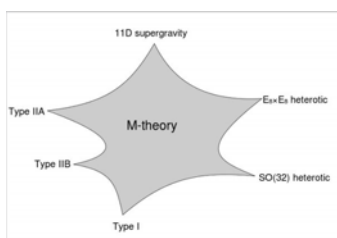
Abstract QG successes:

BPS BH entropy counts, AdS/CFT (including its implication of BH unitarity)

Λ : ST plausibly fits with interpretation as selection effect. Mechanisms for inflation (UV sensitive!), some observationally testable.

Spinoffs/interplay:

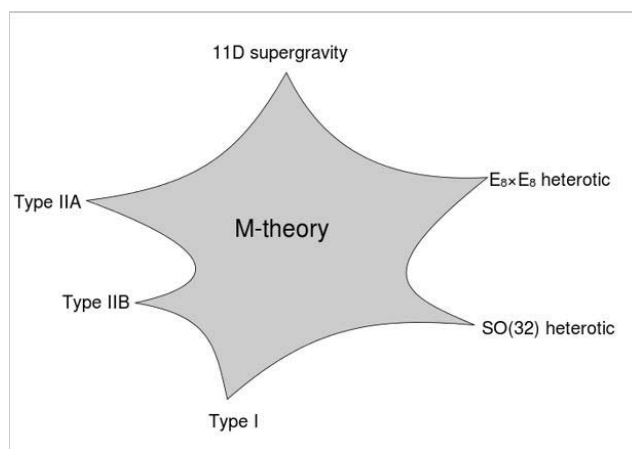
- Particle physics: SUSY as a possibility (but note: not generic in ST!), hidden sectors,...
- Cosmology: Inflation mechanisms inform EFT & data analyses
- CMT: AdS/CMT, hydro, 3d dualities, chaos
- Abstract QFT: SUSY gauge theory dualities, non-Lagrangian, bootstrap, amplitudes,.....
- Math



Role of SUSY:

*Determines strong coupling behavior of appropriate quantities

*Extended SUSY => large-radius GR protected from quantum corrections (not realistic, but good QG models).



*Bottom-up hints (WIMP miracle, SUSY GUT unification, hierarchy): circumstantial, but very interesting idea to test.

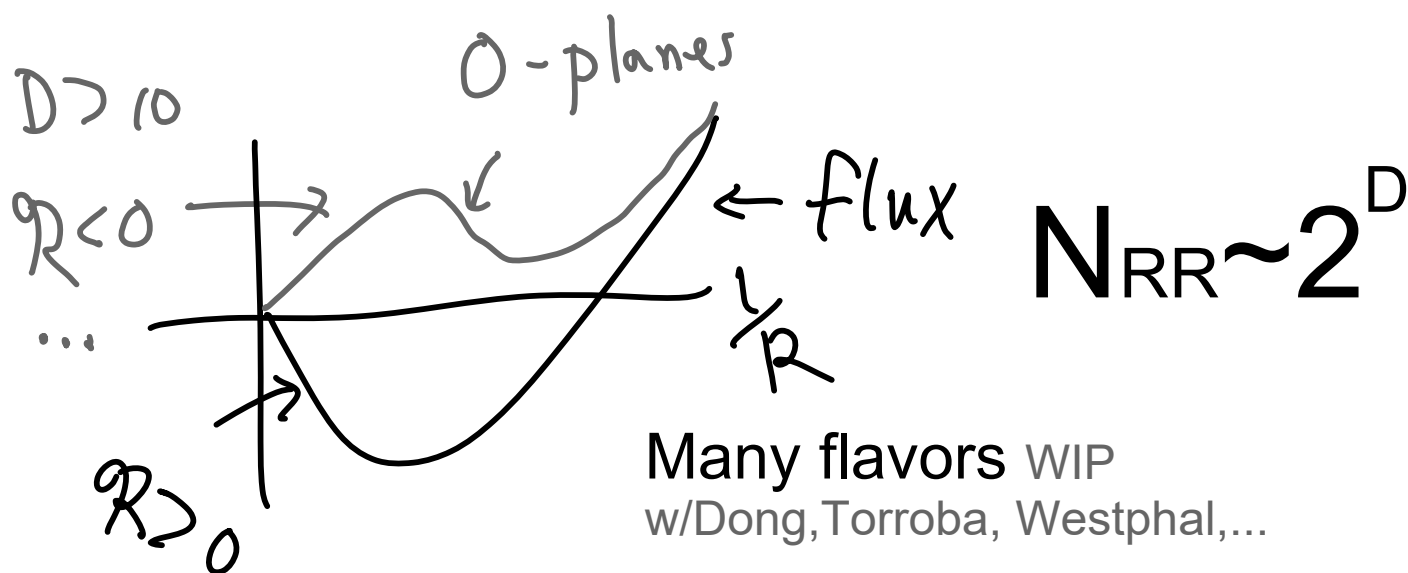
We learn spherically symmetric physics problems first, but don't elevate that to principle of nature. It is possible that SUSY is analogous.

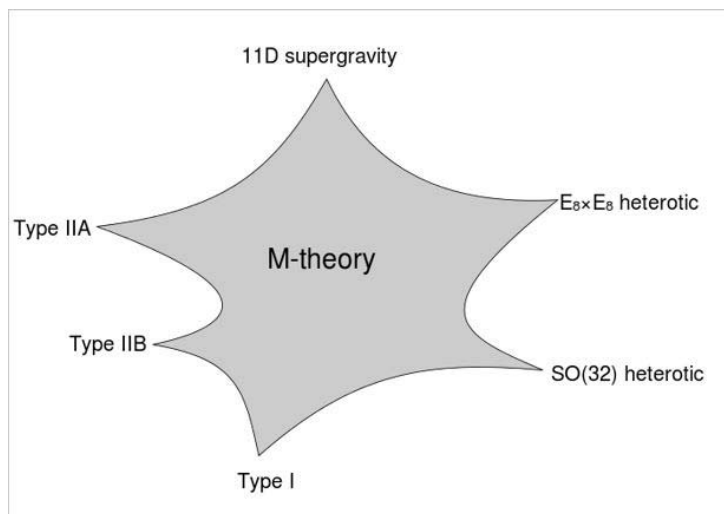
String theory generically has positive scalar potential and broken

SUSY: also very basic features of the observed universe.

If QCD a string theory, no SUSY at any

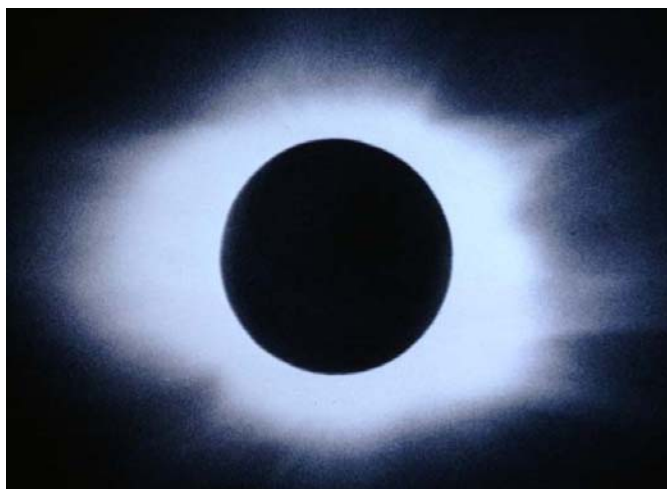
scale At face value, a high-D theory of RR axions. Understanding the theory requires understanding this limit, still in progress.





(11d SUGRA initially missed by string theorists)

Given generic positive V and connections (visible at string tree-level), the star is much richer:



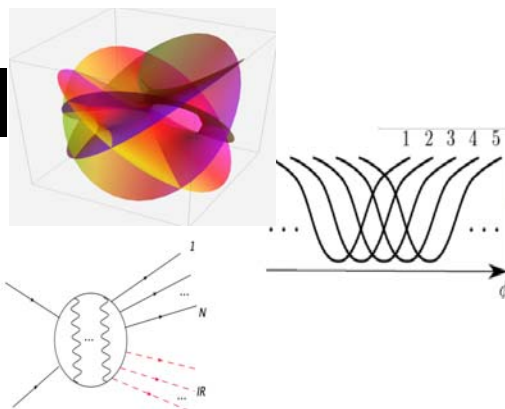
Hellerman/
Swanson;
McGreevy, ES,
Starr; Green,
Lawrence, Morrison,
Aharony,...

*dS/inflation not a small deformation of AdS or Minkowski. Not necessarily a small deformation of SUSY: competing terms w/large cancellations.

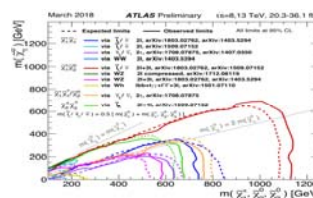
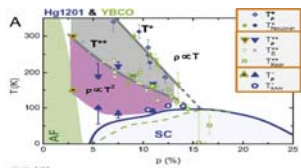
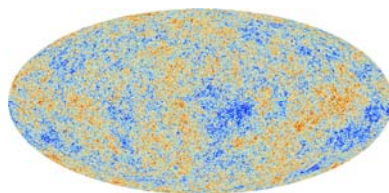
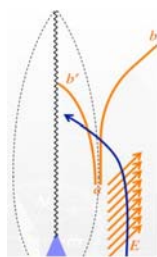
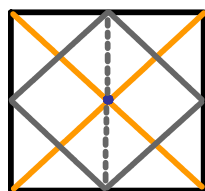
*Once we introduce cosmo. solutions from *any* starting point (CY + flux, negative curvature, D,...) we encounter initial singularity question.

Future hopes: ST framework for BH and cosmological horizons; advance the connections:

mathematical
structures



thought empirical
expt's observations



Already some spinoffs,
but much more to study.