Beyond the Energy Frontier

Advancing Precision Measurements and Exploring the Unknown

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Particle Physics

You are Here

Astrophysics

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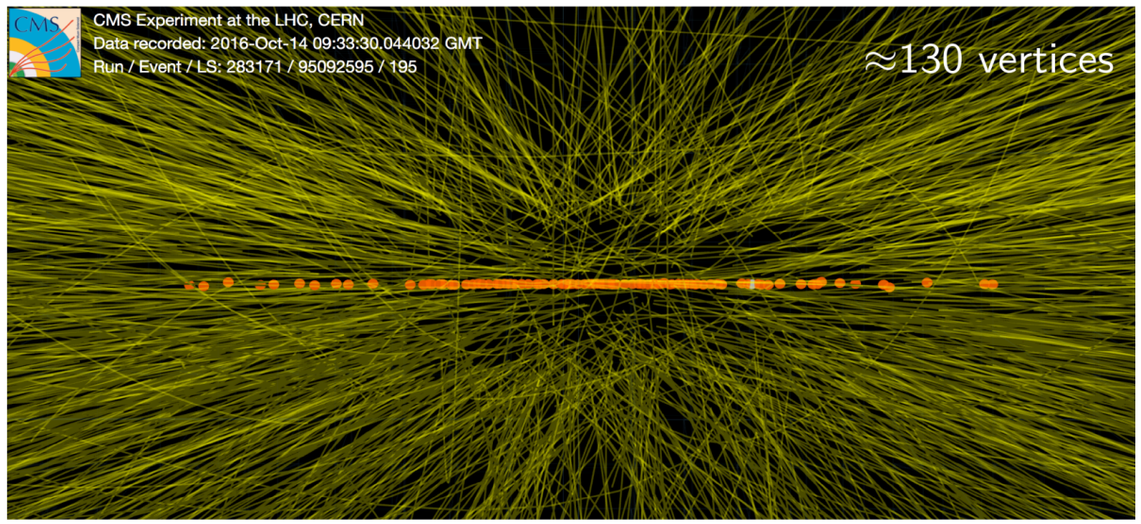
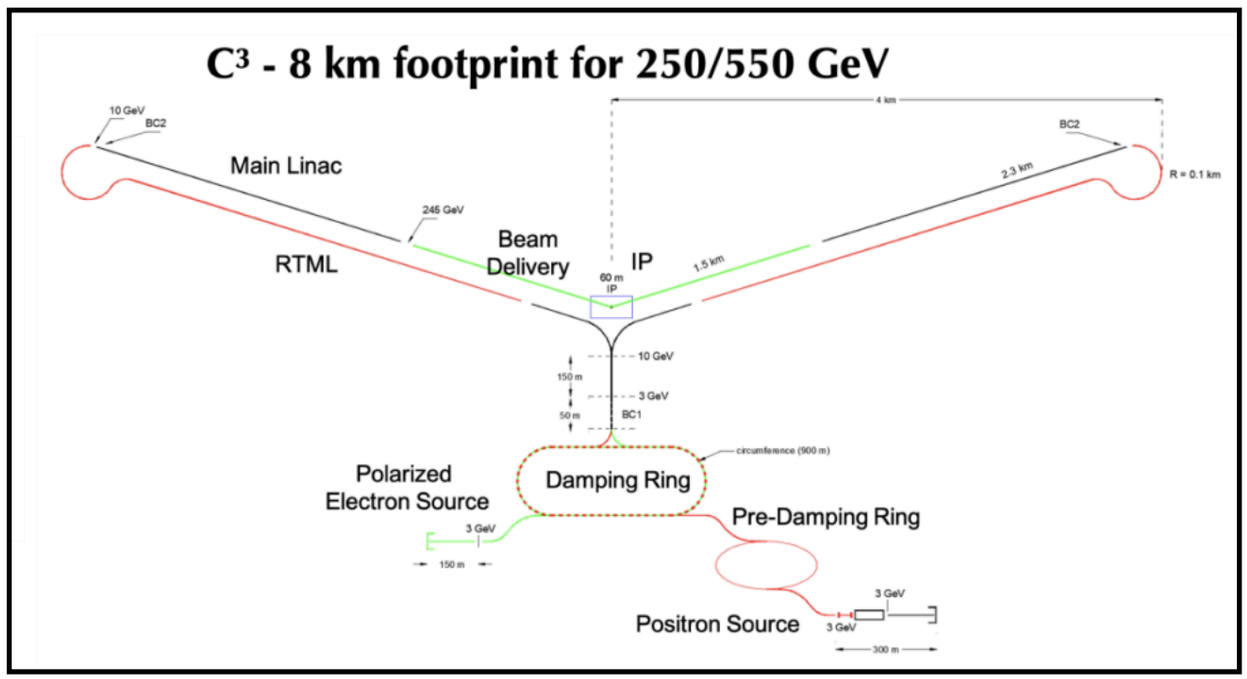
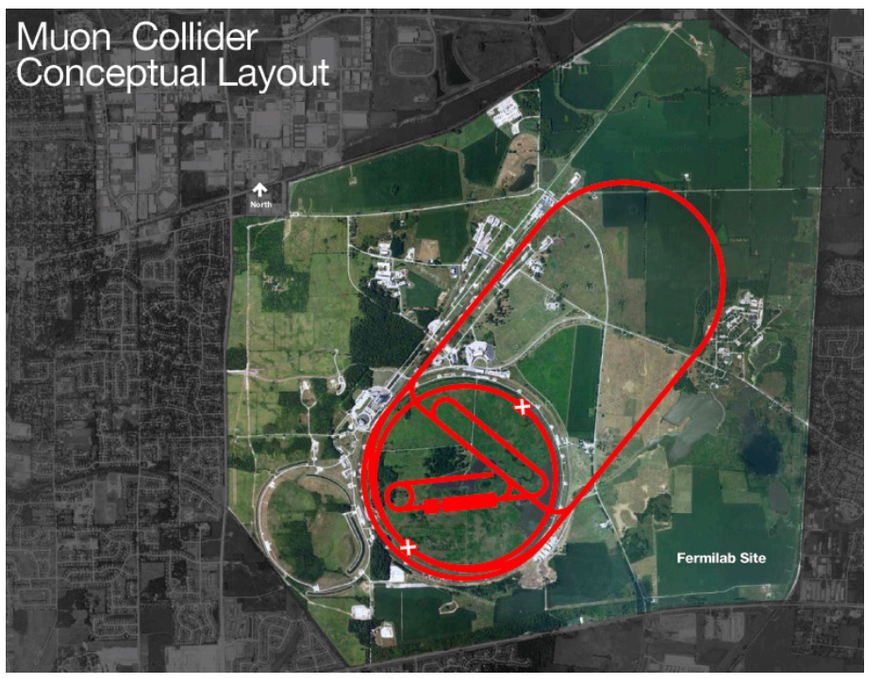
The Energy Frontier Recommendations



HL-LHC



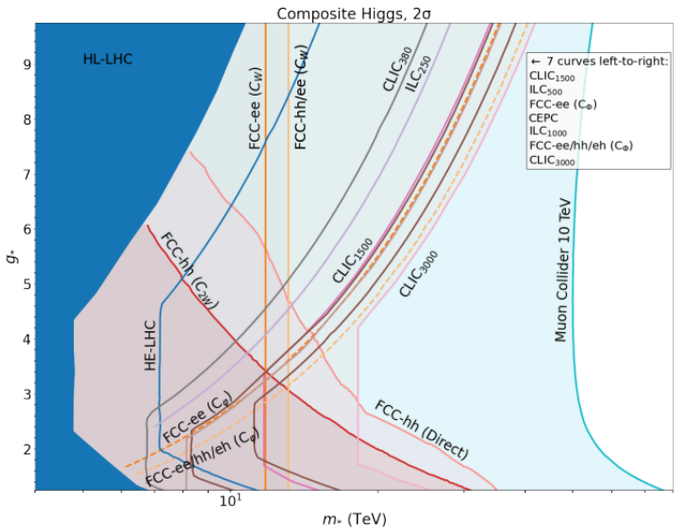
Higgs Factory

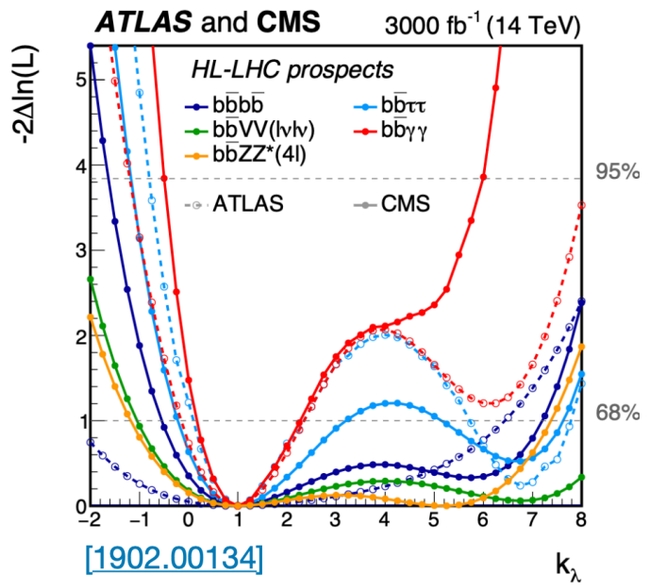


Multi-TeV Facility

Energy Frontier: Physics Reach

This is a sampling of a spectacular program worth 1000s of PhDs in particle physics





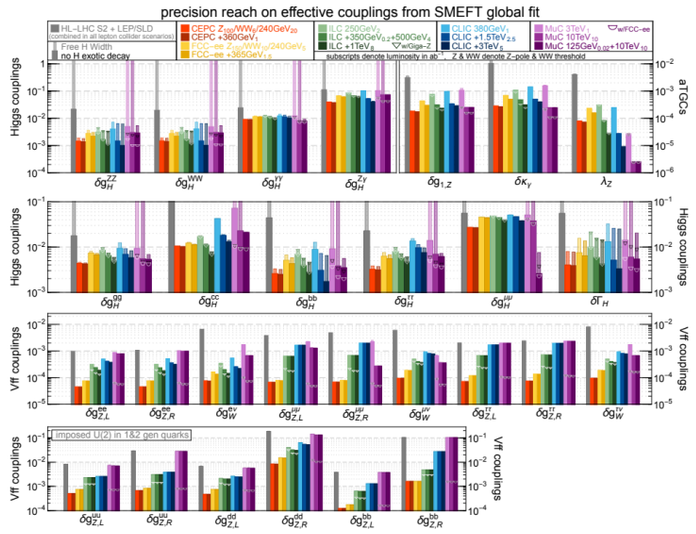


Figure 1-21. *Precision reach on Higgs and electroweak effective couplings from an SMEFT global analysis of the Higgs and EW measurements at various future colliders. The wide (narrow) bars correspond to the results from the constrained-Γ_H (free-Γ_H) fit. The HL-LHC and LEP/SLD measurements are combined with all future lepton collider scenarios. For e^+e^- colliders, the high-energy runs are always combined with the low energy ones. For the ILC, the (upper edge of the) triangle mark shows the results for which a Giga-Z run is also included. For the Muon Collider, three separate scenarios are considered. The subscripts in the collider scenarios denote the corresponding integrated luminosity of the run in ab^{-1}.*

Figure 1-30. *Exclusion (2-σ) sensitivity projections for future colliders. Plot based on Refs. [81, 411].*

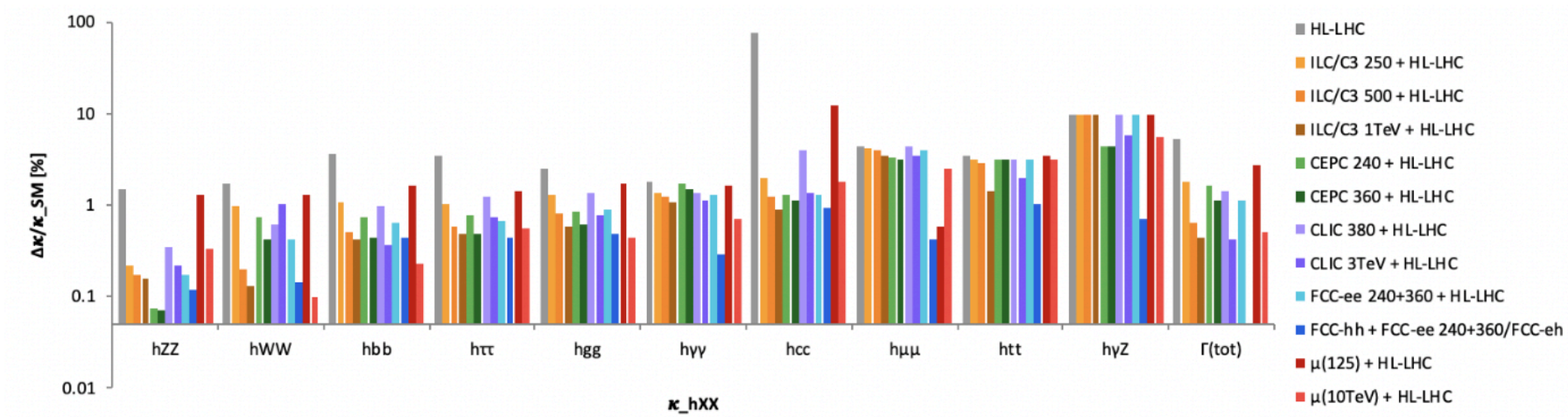
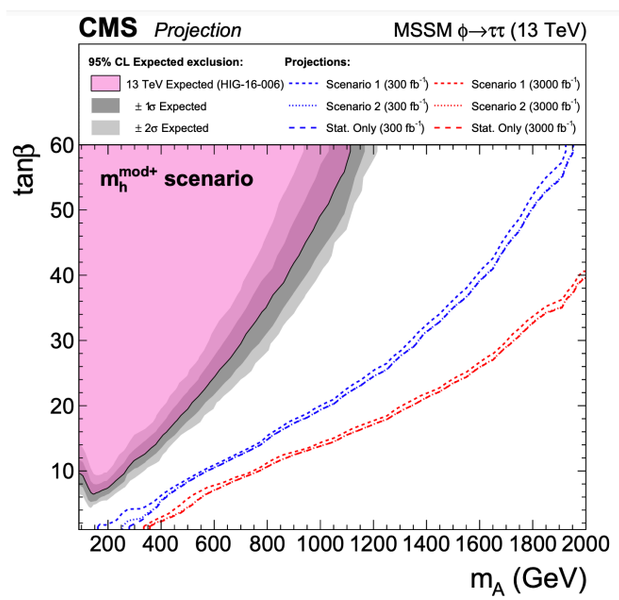


FIG. 20: Relative Higgs coupling measurements in % when combined with HL-LHC results. All values assume no beyond the Standard Model decay modes of the Higgs boson. The energies and luminosities are those defined in Table IV A.



Energy Frontier: Physics Reach

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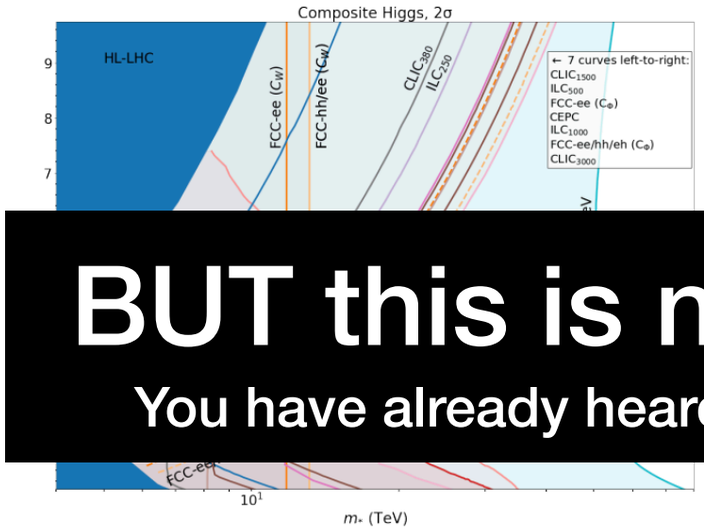

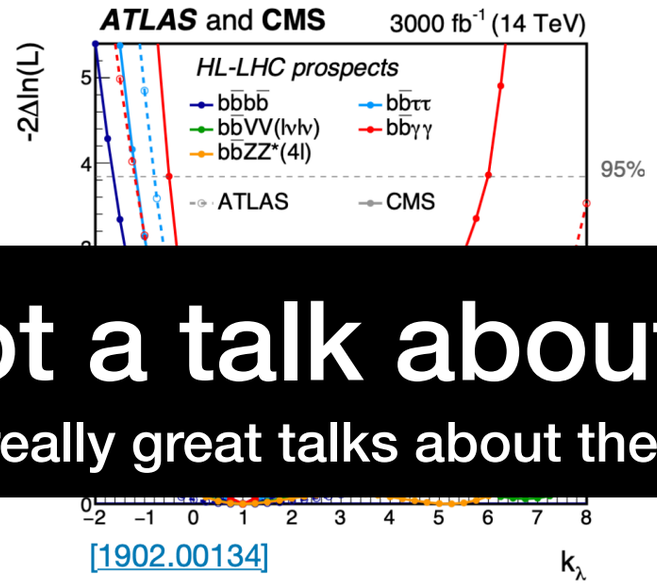

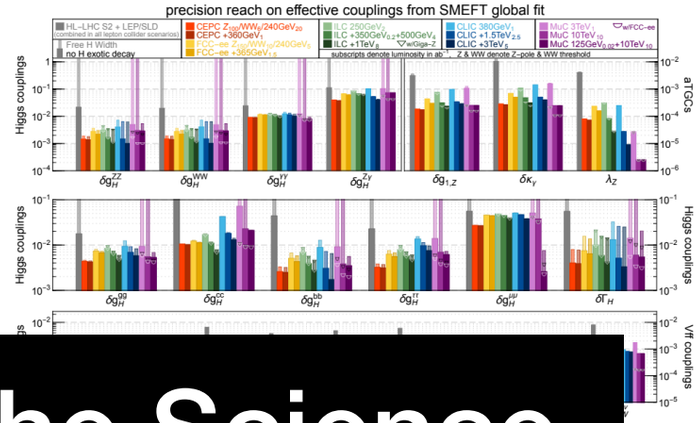

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BUT this is not a talk about the Science

You have already heard really great talks about the scientific opportunities

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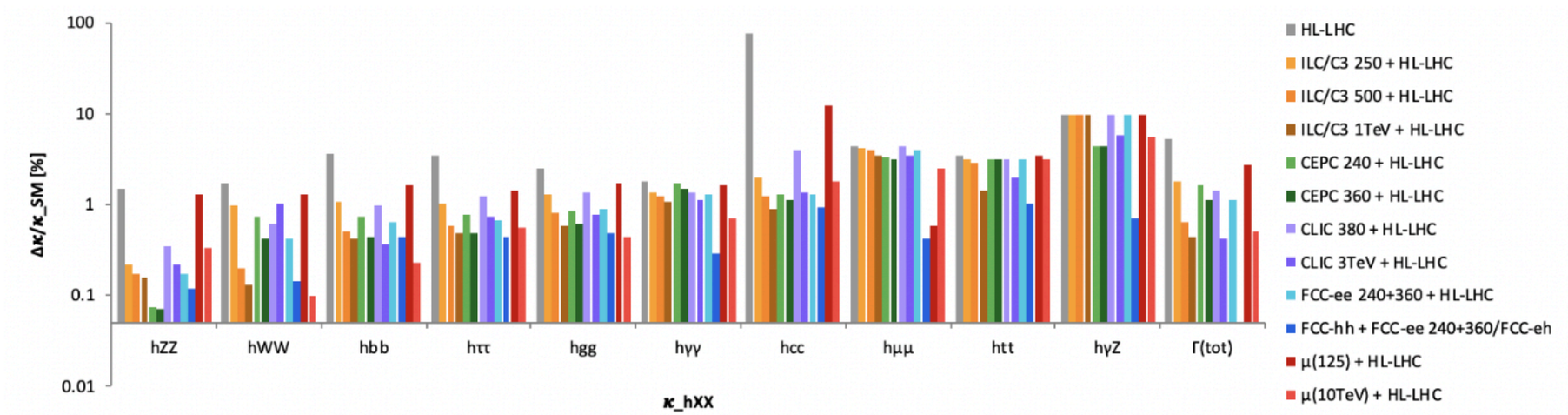

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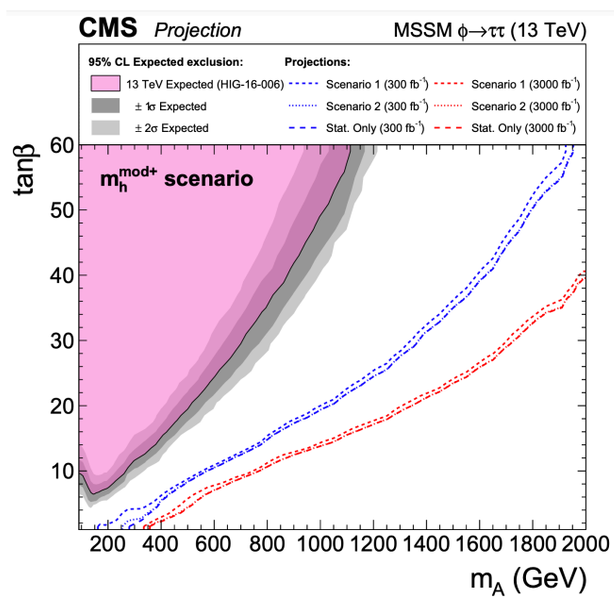


Message to Leadership: **Be kinder to yourself about the SSC**

Many esteemed colleagues maintain that the cancellation of the Superconducting Super Collider (SSC) marked the conclusion of new HEP EF Colliders in the United States

We have two options before us, either:

1.) **Acknowledge defeat:** stop the next generation from making the same mistakes

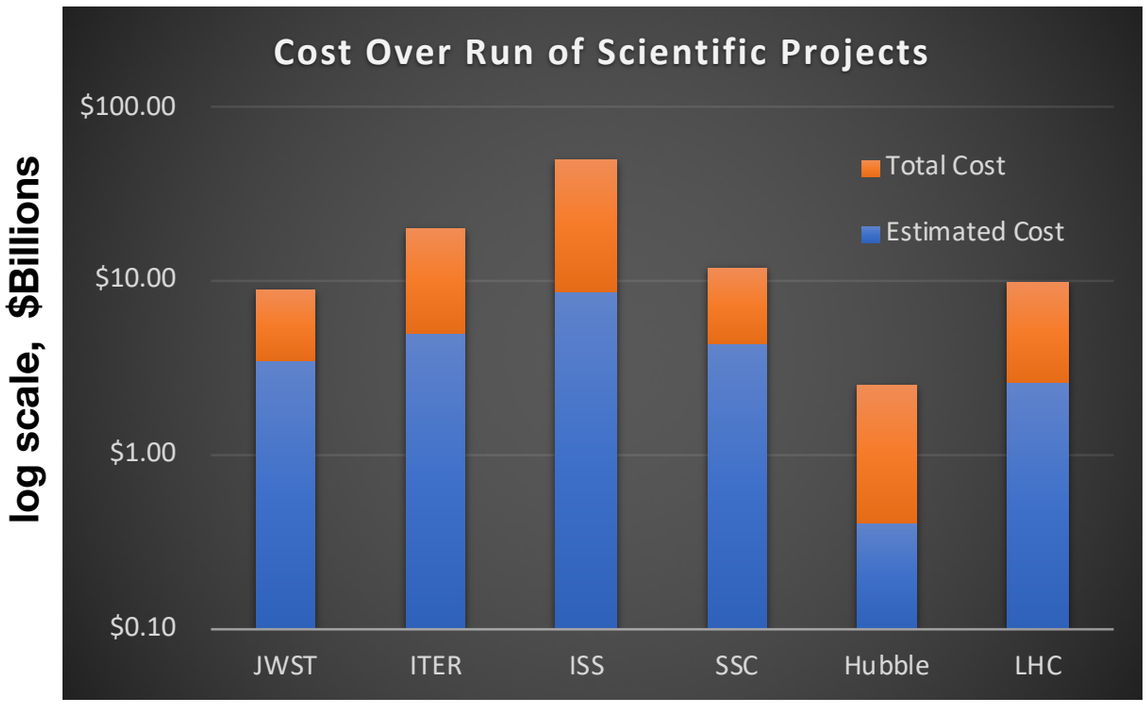
-OR-

2.) **Contemplate what might have been and learn:** had we succeeded in building the SSC, the discovery of the Higgs boson could have been achieved a decade earlier, and we would be 20 years further along on the quest to study multi-TeV phenomena

Right (log scale) : JWST, ISS, Hubble, LHC, SSC, ITER
- ALL with **significant cost overruns**

Completed projects: JWST, ISS, Hubble, LHC
- ALL considered **great successes**
- ALL **inspired the next generation** to participate in STEM

We need to think of how to manage the optics of cost overruns before they happen & advocate for the scientific opportunities



Message to Leadership: **Enable the Next Generation**

The P5 Charge:

The panel's report should identify priorities and make recommendations for an optimized particle physics program over 10 years, FY 2024–FY 2033, under the following budget scenarios:

1) Increases of 2.0 percent per year during fiscal years 2024 to 2033 with the FY 2024 level calculated from the FY 2023 President's Budget Request for HEP.
2) Budget levels for HEP for fiscal years 2023 to 2027 specified in the Creating Helpful Incentives to Produce Semiconductors and Science Act of 2022, followed by increases of 3.0 percent per year from fiscal years 2028 to 2033.

The particle physics community is more diverse than ever - full of intelligent, creative thinkers, people who are passionate and driven!

Where is the opportunity to propose exciting new large-scale projects to engage this group?!

P5 should also **propose a budget to enable the science -**

- not reduce the Science to fit the Budget

Message to Leadership: **Think Outside the Box (or at least allow us to)**

Enabling EF Collider Projects:

The US community has a longstanding history of achieving great discoveries in science - **We must continue to propose big projects and inspire the next generation STEM workforce**

1.) Collaboration AND competition with other countries (Europe, China) is good! Be prepared with exciting projects when budget opportunities arise.

2.) **Make Outreach and Engagement a real mission of the office (NASA has ~$150 million budget for STEM Engagement)**

3.) Encourage experiment/accelerator/theory to collaborate - through co-supervision of students, joint appointments, encouraging PIs to work on multiple projects

4.) Pay for the best project managers/legal teams but also admit there will inevitably be cost overruns

Early Career faculty are ready to organize and take on the job of advocacy for a future Higgs Factory and a Multi-TeV project that could go online in <30 years

We are excited to **advocate for bold new ideas**! **We are ready to advocate to congress and the public!!**

Please do not make US EF compete with US NF - Choosing between DUNE and an EF future is not good for the field!! We should be working together as a community.

The Asks:

1.) We need a **method to propose and advocate for US collider projects on the 15-year timeline** that are outside the range of current DOE budgets **(Higgs Factory!)**

2.) We need to **increase funding for accelerator and experiment R&D** to enable a faster realization of a multi-TeV experiment **(Muon Collider!) on the 25-year timeline**

3.) **We need P5 to support scientific goals and enable grass roots organizational efforts to accomplish our scientific goals:** A coordinating panel for future US-based colliders?