Precise predictions for the Large Hadron Collider

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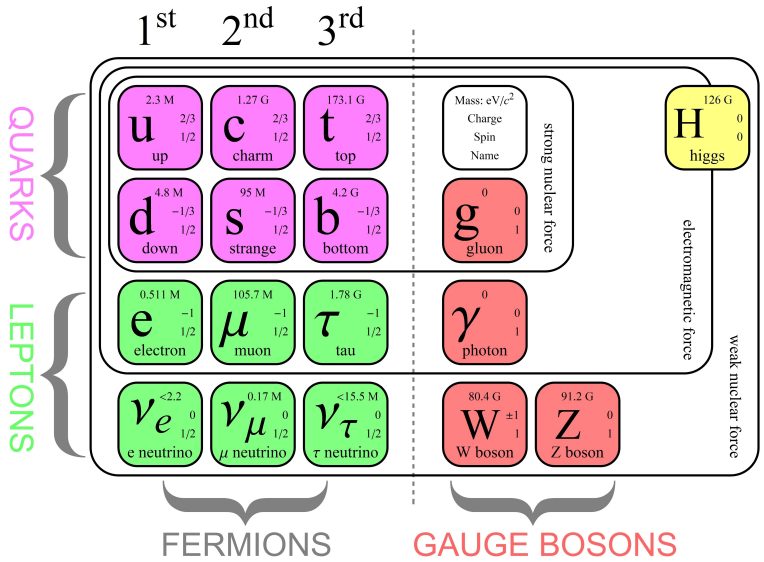
The Standard Model of Particle Physics



The Standard Model describes all phenomena observed at collider experiments.

All fields have been observed.
Higgs boson discovery at the LHC in 2012.

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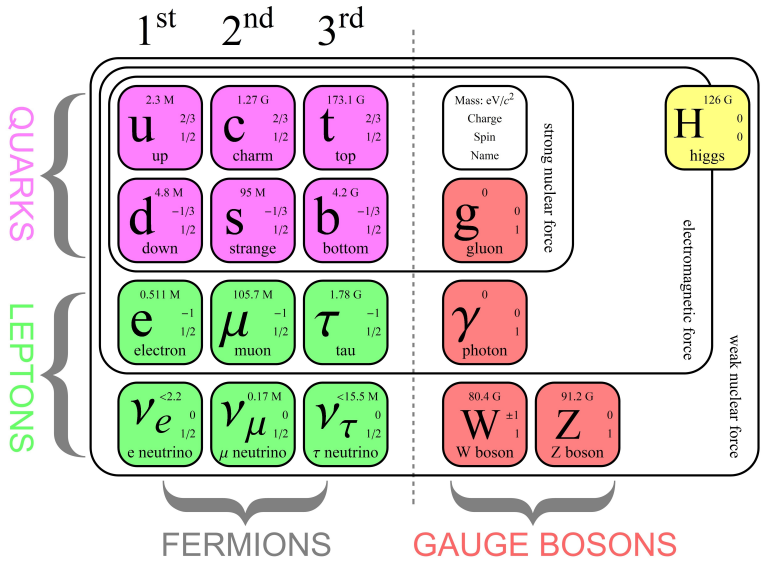

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$$SU(3)_c \times SU(2)_L \times U(1)_Y$$

QCD

unbroken gauge group

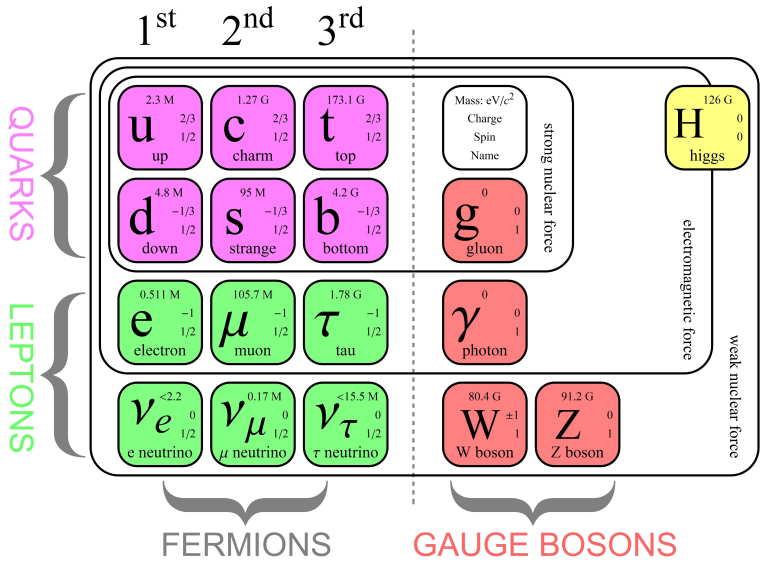
α_s

EW theory

spontaneously broken gauge group
massive W/Z bosons, $U(1)_{\text{QED}}$ remains

α

The Standard Model of Particle Physics



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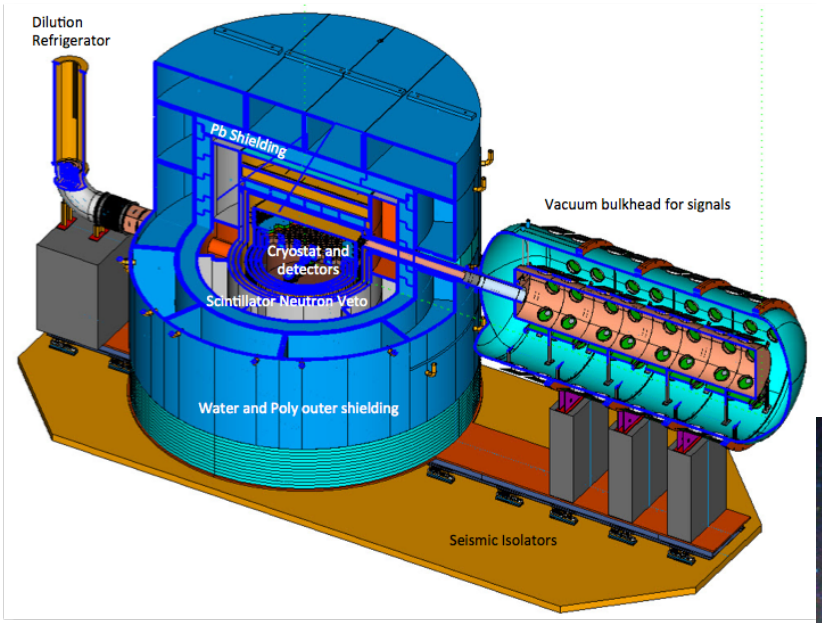
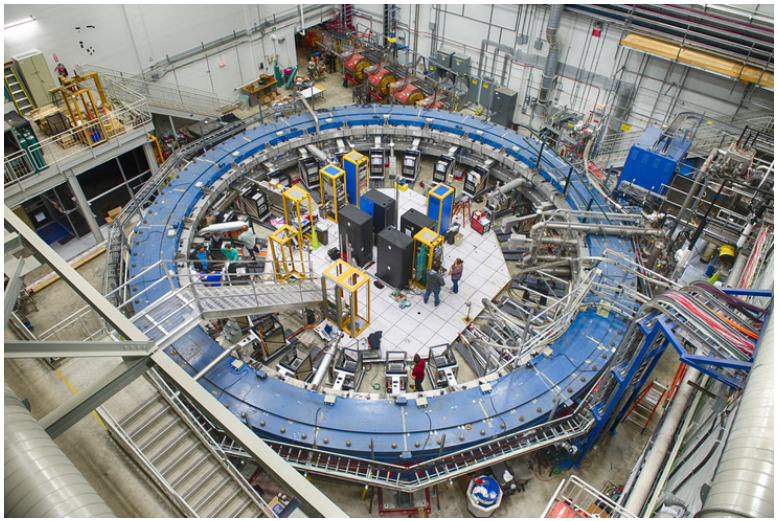
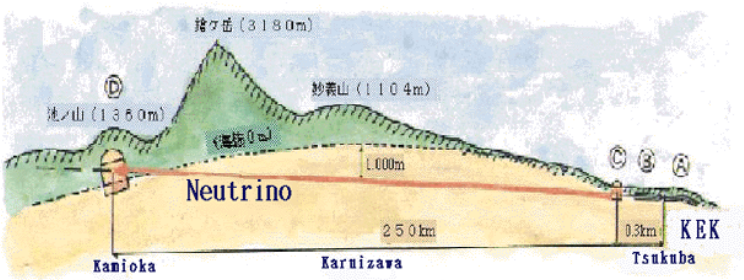
But it is incomplete, as it includes neither dark matter, neutrino masses nor gravity.
Signs of new physics are sought beyond the currently accessible data.

Experimental tests







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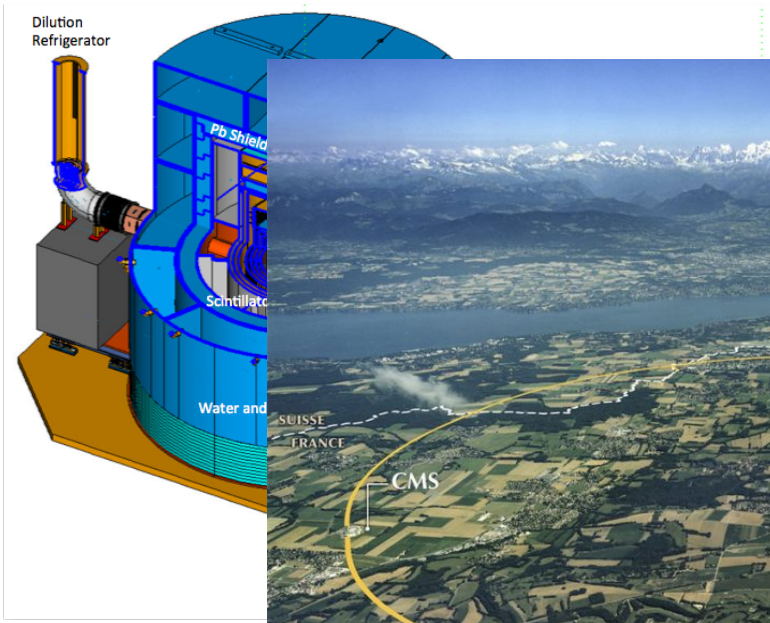
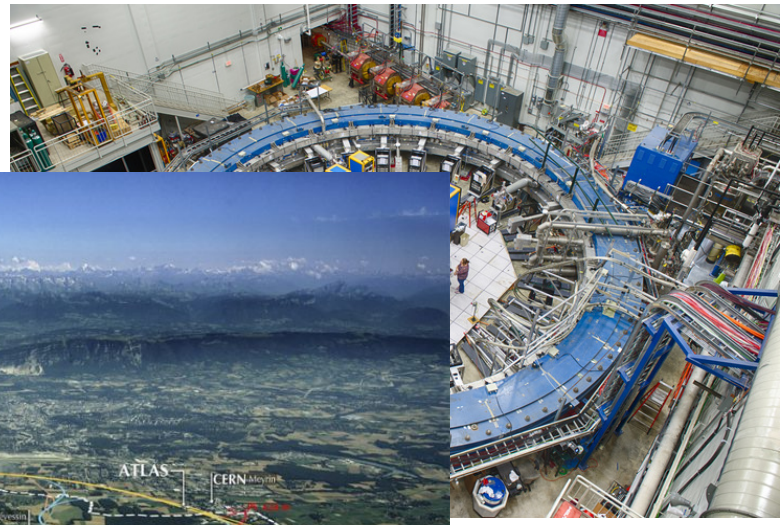
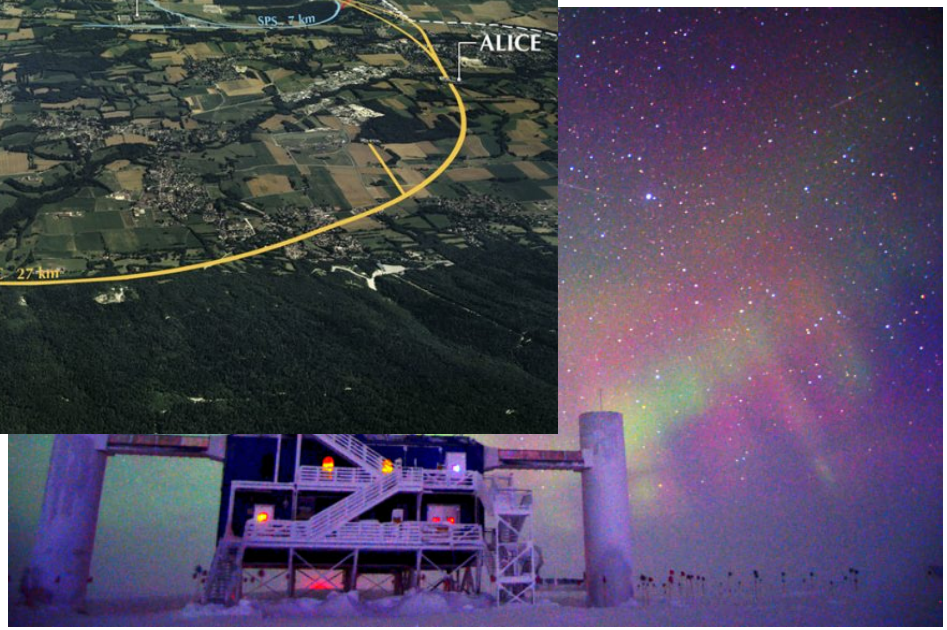


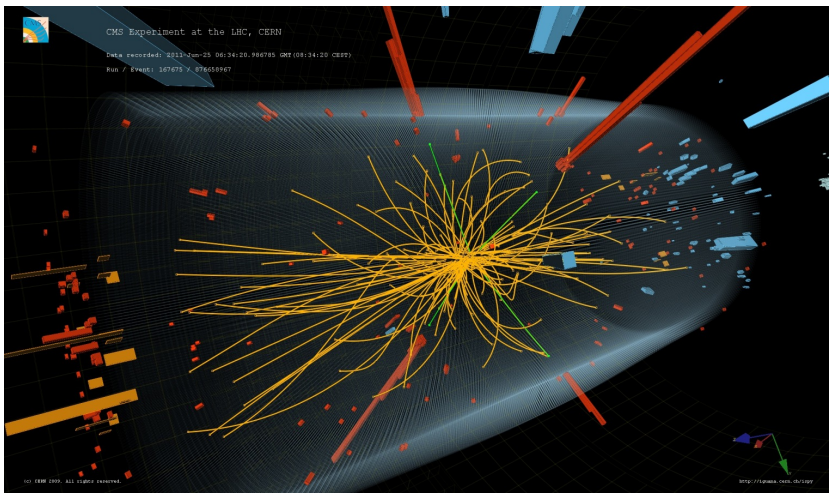


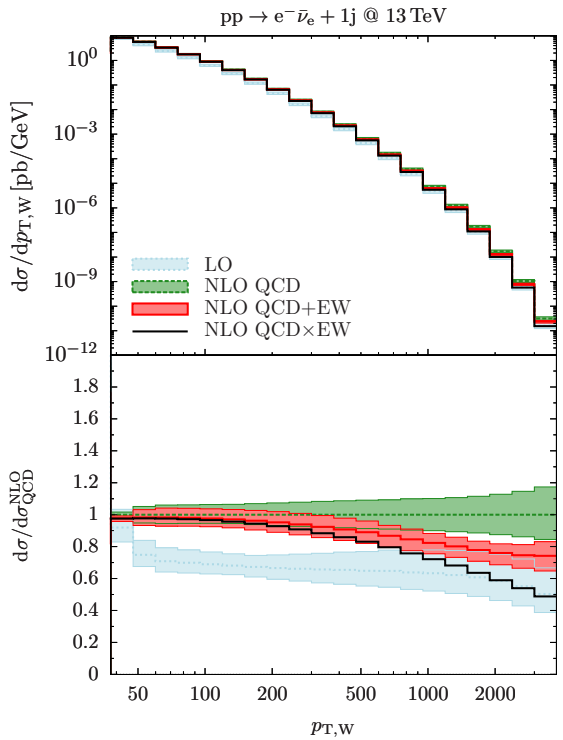


Precise predictions for the LHC – EW corrections

Precision measurements:
EW corrections, typically $\mathcal{O}(1\%)$,
needed for sub-percent accuracy

New Physics searches:
EW corrections increasing with scale of observable,
precise knowledge of their size reduces uncertainties
and increase discovery potential/exclusion bounds





Implement in Event Generators
predictions directly applicable to LHC data,
(needs description of $\mathcal{O}(100 - 1000)$ particles)