Challenging the Standard Model with top quarks

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What is the origin of particle masses?

In the SM, elementary particles acquire mass via their interaction with the Higgs field.

Is there a specific particle that sticks out?

The top quark is special

Heaviest fundamental particle known to date + unique properties

- short lifetime
- decays before hadronizing
- does not form bound states
- few bare quark properties studied through its decay products
- couples strongly to Higgs
  - top quark Yukawa y = 1

Several open questions:
- Is the top quark generated by the Higgs boson?
- Role in EW symmetry breaking?
- Role in beyond SM physics?

Top quark properties in production and decay

- cross sections, kinematics, B, X new particles, asy., spin correlations, QCD parameters
- couplings, FCNC, branching ratios, V_{cb}, rare decays, N-flavours, new particles
- mass, width, change, lifetime

Top quark couplings

Flavour changing charged current and neutral current

Direct probe for New Physics

Observation of ttH process (not reported)
- direct access to top quark Yukawa coupling (largest!!)
- m t (ISR and FSR)
- m H (ISR)
- Direct measurement of b->c coupling in bH production via Fb

The quest for New Physics continues...

More results in: https://twiki.cern.ch/twiki/bin/view/AtlasPublic

Even more to come at the LHC and future colliders...

- Several new projects: Polarized hadronic target
- /Ht production
- Top asymmetries
- Cross-section ratios |dHt|/|uHt|, |dZt|/|uZt| & |dZtb|/|uZtb|, Newly predicted with much better precision?
- Angular distributions to study CP violation

Analysis challenges: physics modelling uncertainties

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