# The Energy Frontier

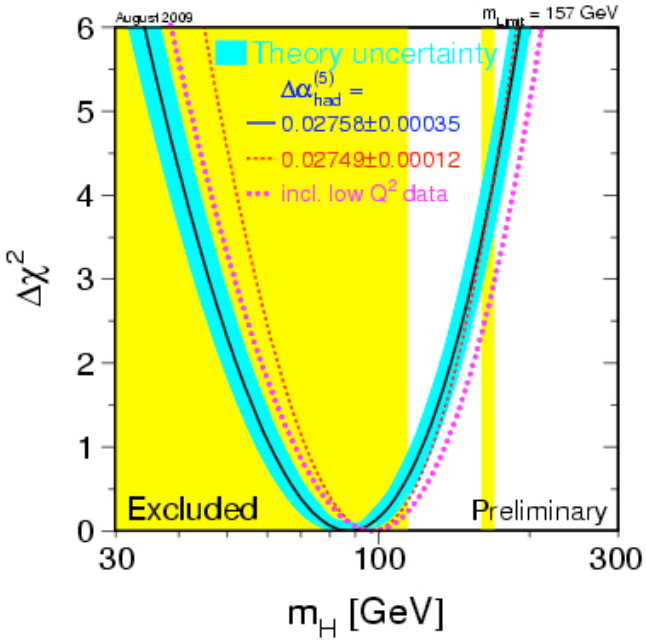
R. Kehoe (Jan. 25, 2010)

Main interests:
-origin of mass
-cosmological implications
-gravity, dark matter

- **Can produce highest mass particles:**
  - E.g. W, Z, top quark discoveries
  - Smallest distance scales probed

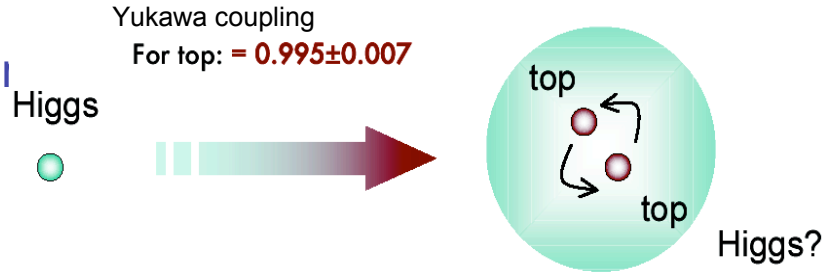
- **Requires proton machine**
  - ppbar (FNAL) 2 TeV with 10-12 $fb^{-1}$ by 2012
  - pp (LHC) 7 TeV with 0.2 $fb^{-1}$ by 2011
    - 14 TeV with 1 (several?) $fb^{-1}$ by 2013
  - Physics reach depends on energy and luminosity
  - Next 3 years should be very competitive between these two programs
    - Some specific topics remain important at Tevatron afterwards
      - e.g. top quark mass
  - Signature of proton collisions: jets
    - Accepting this opens up many interesting channels:
      - top, SUSY, Higgs…

# Top Physics at DØ




- **Production and decay of top quark pairs**
  - Events with 2, 1 or 0 leptons
    - SMU concentrated on 2 leptons
      - Phys. Rev. D 80:092006 (2009)
      - Phys. Lett. B 655:7 (2007)

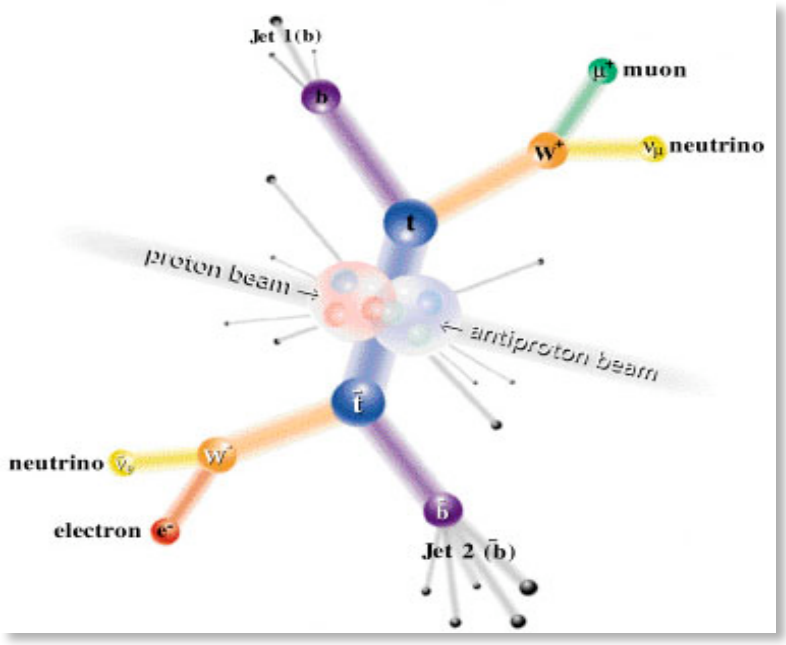
- **Importance of top mass**
  - Fundamental (unpredicted) parameter
  - Electroweak symmetry breaking
  - New strong dynamics?

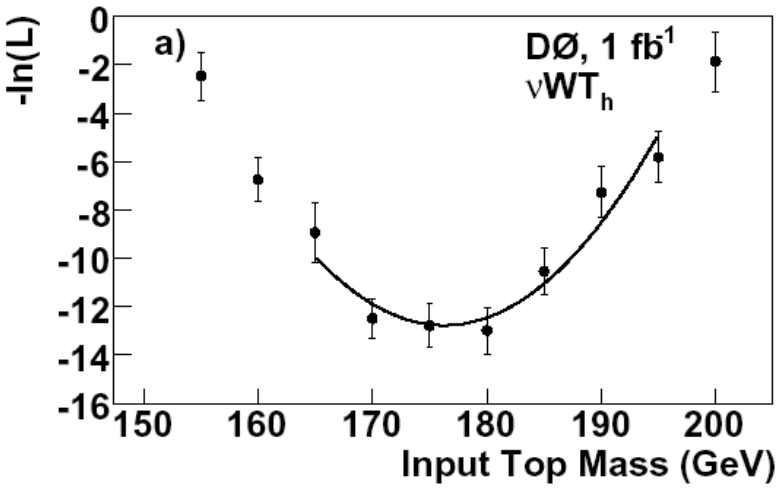



- **Review:** Kehoe, Narain, Kumar, Int. Journ. Mod. Phys. A Vol. 23, Nos 3&4, 353-470 (2008)

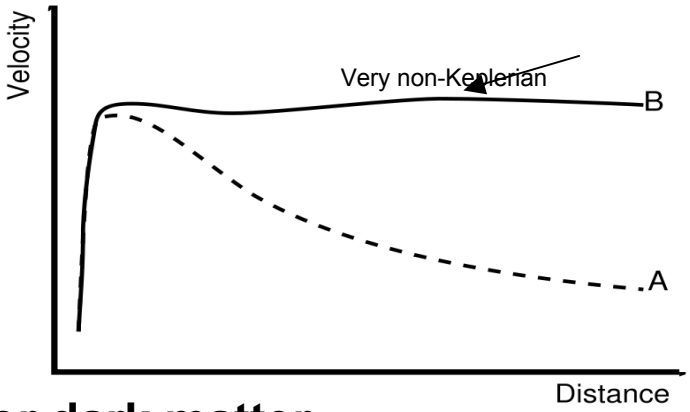
# Top Mass in Dilepton Events

- **main elements of analysis**
  - kinematic reconstruction
  - Multi-parameter likelihood
  - Data-based methods
    - Phys. Rev. D 76:052006 (2007)
    - Phys. Lett. B 626:55 (2005)
- **ongoing effort (Renkel, Ilchenko)**
  - Optimization of kinematic reconstruction and likelihood
  - Jet energy calibration (main systematic uncertainty)
  - Monte Carlo production and systematics
- **For the future**
  - Current uncertainty (1 $fb^{-1}$): 4.8 (statistical) and 2.0 (systematic) GeV
  - In 10 $fb^{-1}$ main improvement will be in dilepton channels:
    - total uncertainty 1.3% alone



# Search for New Physics at ATLAS



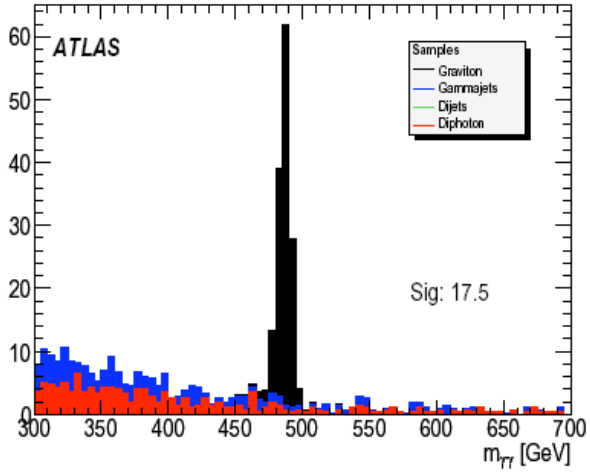

Generally need 1 or more fb-1

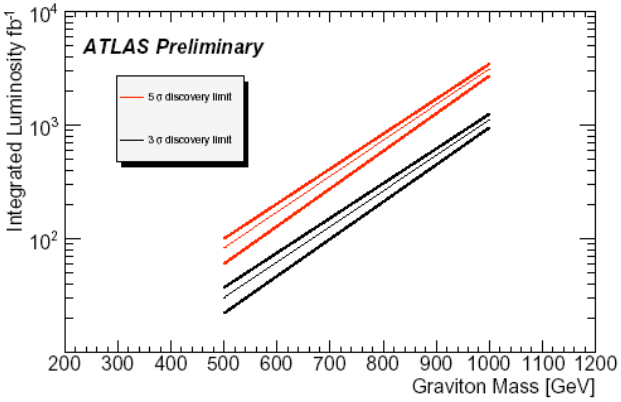
- **Strong indirect experimental evidence for dark matter**
  - Supersymmetry?
    - R-parity conserving models
    - Jet+leptons+Etmiss signatures (e.g. ATL-PHYS-COM-2008-167)
  - Model independence is valuable (we're doing this on D0)
- **Strong theoretical motivation for Higgs particle**
  - Higgs -> tautau, WW, ZZ (e.g. COMnote)
  - Jet signatures very interesting

- **Gravity not well understood**
  - Graviton search very interesting in early data, and further
  - Discovery potential in ~0.2 fb-1: beats Tevatron
    - Higher masses cannot be reached by the Tevatron

# Search for Graviton → 2 Photons

- **An extra-dimension model**
  - Attempts to understand hierarchy problem
  - Randall-Sundrum provides two photon signature
    - distinguishes it from other high mass resonances
- **Strengths of search**
  - Excellent energy resolution and photon fake rates
  - Quick sensitivity to high masses: good use of LHC energy
- **Effort so far (Hadavand, Dindar)**
  - First demonstration of full analysis sensitivity in 14 TeV collisions
    - ATL-PHYS-INT-2009-046 (2009).
  - 7 TeV parameter (mass, coupling) sensitivity
  - First data checks



# ATLAS Software

- **Online monitoring**
  - Responsiveness and efficiency important
  - 'Gatherer' in High Level Trigger system integrates results
- **Data Quality**
  - Software framework to analyze monitoring output
    - Online and offline instances
    - Several components: algorithms, data interfaces, display GUI
- **Calorimeter/Jets data quality**
  - Low-level components: clusters, towers
  - Expect migration toward jet/Etmiss performance and calibration