Lepton + Jets + Missing E_T

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A quick physics turn-on?

❑ One year of low-luminosity LHC running expected to give 10 fb^{-1}. What physics is accessible with that much data?
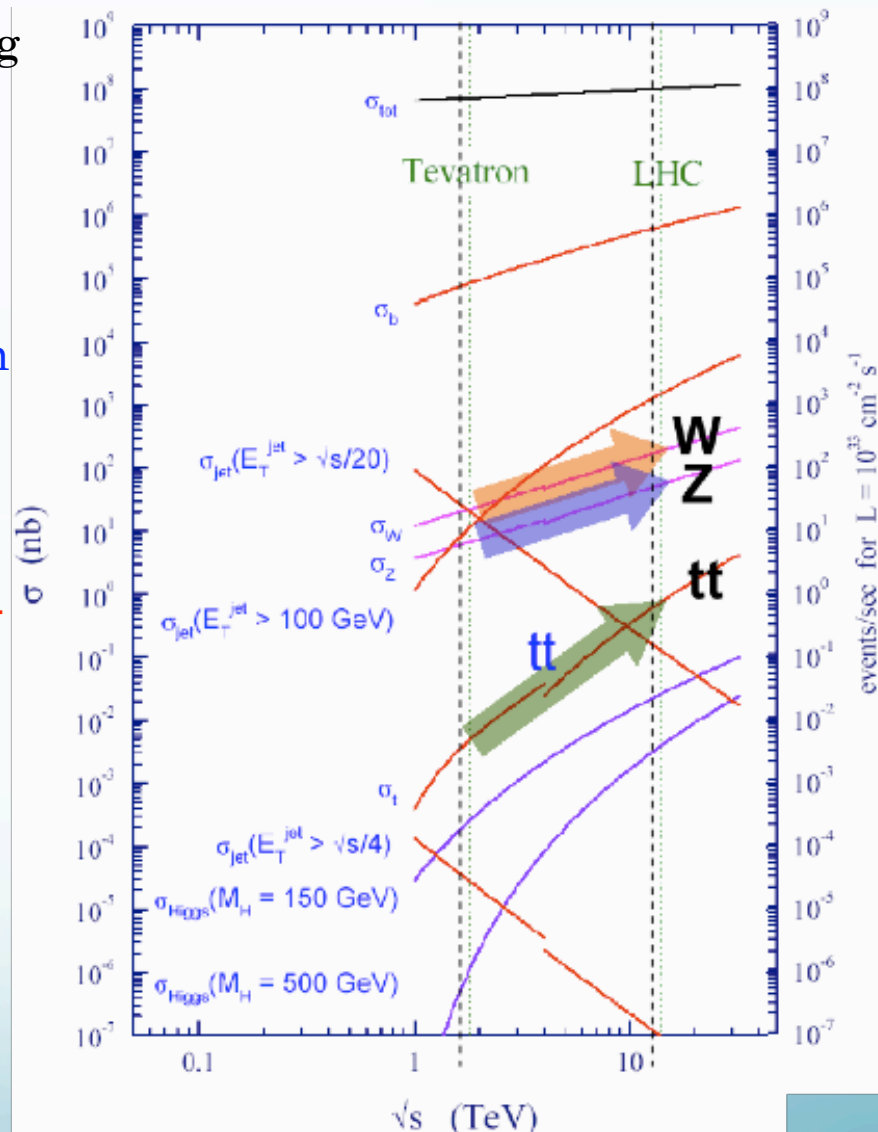
✓ 10^9 W events
✓ 10^7 tt events
✓ tt/W much larger at LHC than Tevatron

❑ By 2010, enough data (hopefully!) to

✓ Fully test the standard model
✓ Understand control samples for beyond-standard model searches.

❑ And long before that (e.g. 0.1-1.0 fb^{-1})

✓ Understand physics objects, jet-energy scale, b-tag efficiency.
✓ Do a lot of helpful standard-model physics.

Lepton + Jets + MET

❑ One of the most promising signatures for early discoveries at the LHC comprises of a high transverse momentum isolated lepton (electron or muon), several jets, and large missing transverse energy MET.

❑ For example at the LHC, the SUSY production will be dominated by strongly interacting *squarks* and *gluinos*, which have long decay cascades with jet emission. Leptons are produced in decays of *charginos* or *neutralinos* and the final state consists of leptons + high p_T jets + MET.

❑ Top quark pair production will be significant, and in many cases the major Standard Model (SM) background to such searches.

❑ Therefore, to study various aspects of top production is an important link in probing physics beyond the SM.

❑ In addition, top events will be one of the main tools for the commissioning and calibration of the CMS detector. And the determination of the *ttbar* cross section will probably be one of the first physics results of CMS.

ttbar event phase space - I

- ttbar events live in some complicated multidimensional space of event requirements.
- SM backgrounds to top (e.g. W+jets, QCD) populate a separate, but not completely disjointed region.

"core" tt region

tt

event selection region

other SM

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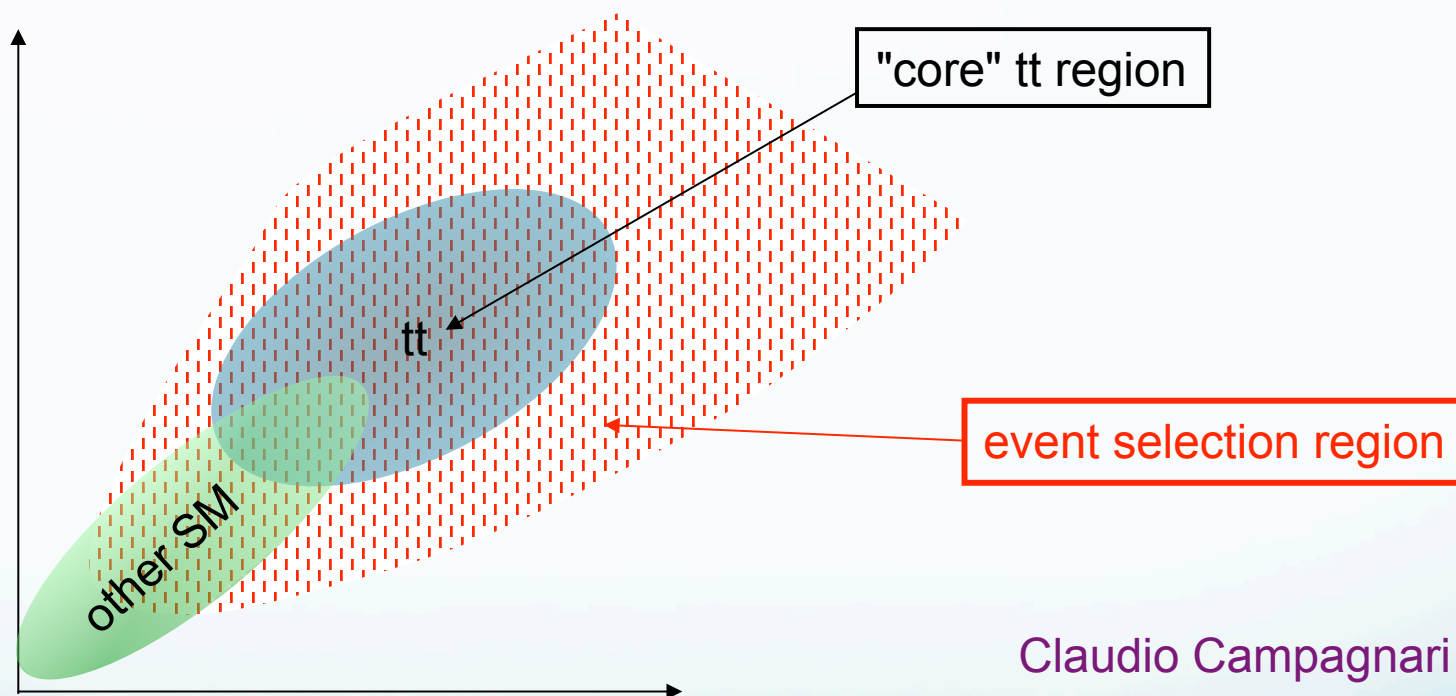
The basic event selection for tt cross-section-type analyses should encompass a SM control region and should not be limited to the core tt region.

ttbar event phase space - II

- ttbar events live in some complicated multidimensional space of event requirements
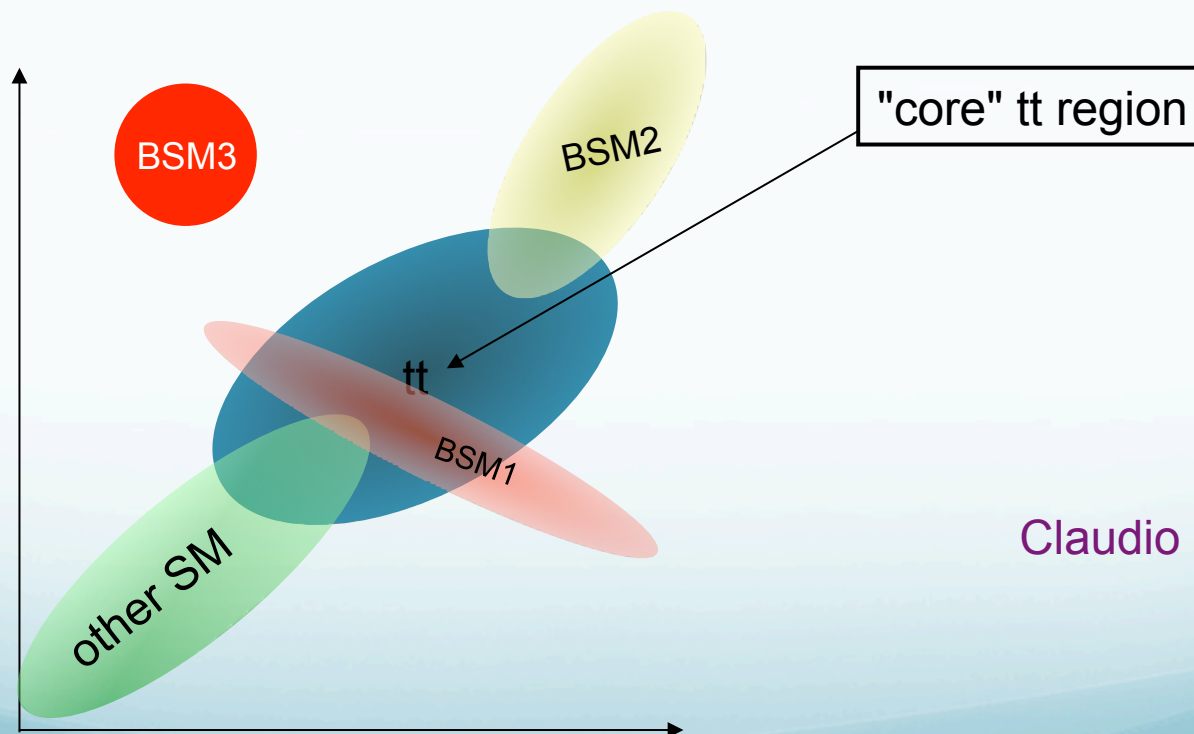- SM backgrounds to top (e.g. W+jets, QCD) populate a separate, but not completely disjointed region
- Simplifying a lot, BSM can
  - ❖ strongly overlap with the core tt region (BSM1)
  - ❖ be only affected by the tail of tt (BSM2)
  - ❖ be almost totally distinct (BSM3)

BSM3

BSM2

"core" tt region

tt

BSM1

other SM

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Using "top" as standard candle

Top pair production is an understood process with predictable cross section.

❑ At 14 TeV, *ttbar* cross section assuming a top mass of 175 ± 5 GeV is ~833 pb.

  ✓ 1 fb-1 gives ~250,000 *ttbar* lepton+jets events

  ✓ S/B ~27, ε~6.3% w/double b-tag -- "easy" to observe?

❑ In the early days of CMS *ttbar* can be used to:

  ✓ Commission & understand physics objects

    ✓ e, μ, τ, jets, MET, b-tags

  ✓ Demonstrate understanding of SM physics.

    ✓ pre-requisite for BSM searches

  ✓ Begin to understand ttbar as BG for searches

  ✓ Looking for new physics in top sample

From PTDR

semi-leptonic
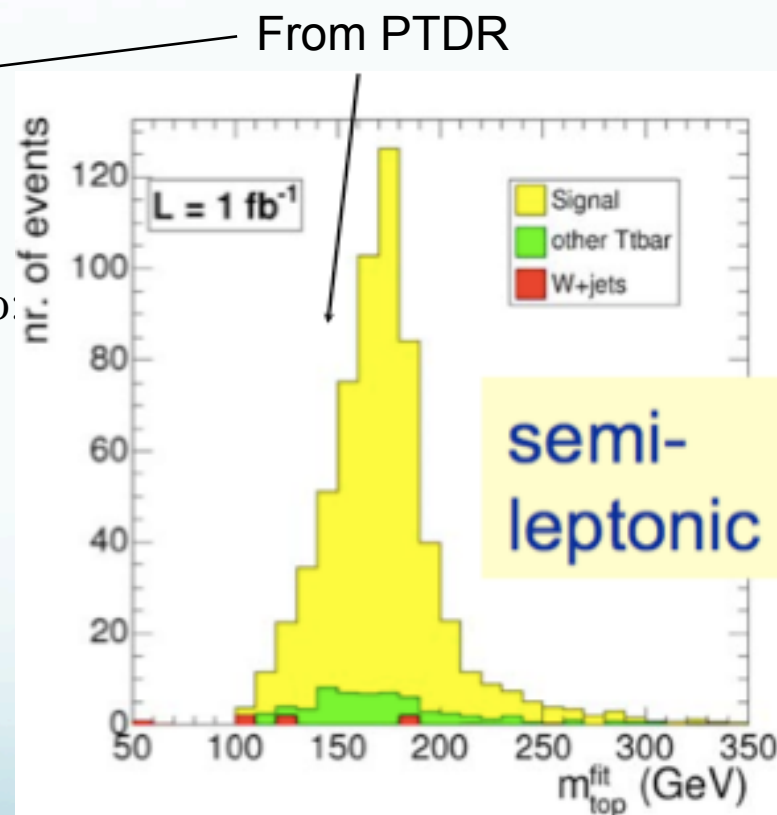
Beyond Standard Model

❑   Lots of new physics can show up in this topology. Examples from PTDR:

  ✓   Various mSUGRA points (up to $m_{1/2} \sim 700$ GeV) observable with significance ~ 30 in muon plus jets with 10 fb^{-1}.

  ✓   H → WW → lνjj through vector boson fusion, 5σ significance for 140-200 GeV with 30 fb^{-1} (so a little beyond "first" physics?)

❖ SM physics in L+J comes very quickly.

❖ Some beyond-SM physics in L+J could come just as quickly, other new stuff not far behind.

✓ We want to be ready to understand this topology quickly!

Scope of the Group

✓ We want to support and explore any work that will help us understand physics that manifests itself in L+J+MET final states

    ✓ eg. boosted top, SUSY, Exotica

✓ Estimate multijet/fake lepton backgrounds from data.

✓ Understand W+jets.

✓ Understand MET.

✓ b-tagging efficiencies and systematics.

✓ Work with complementary samples for studies of efficiency.

✓ To be ready to deal with imperfect detector at low luminosity.

We can use the experience gathered from doing this work with real data at Tevatron.

What is the group to do ?

Our goals:

- ✓ Set goals to accomplish, and set priorities
- ✓ Develop the analysis techniques that will get physics done
- ✓ Share knowledge, come to agreements on best practices
- ✓ Share infrastructure/tools, e.g. code for the common good
- ✓ Document the above in a form other than slides from talks

We want to be able to push:

- ✓ particular physics measurements and
- ✓ tools/techniques of use to many measurements

  into the relevant CMS PAG's (top, SUSY, exotica)

LJMET group is collaborating closely with the CMS PAGs and POGs

Ongoing work in LJMET group

✓ ttbar cross section via mass reconstruction

✓ ttbar cross section via templates of kinematic variables

✓ ttbar cross section via b-tagged jets

✓ Understanding QCD backgrounds to l+jets events

✓ W plus heavy flavor modeling

✓ Top partners

✓ SUSY searches in LJMET

The institutes collaborating in the LJMET efforts:
Brown, FNAL, Johns Hopkins, Maryland, Nebraska, Purdue
Calumet, UCSB, UIC

Agenda for Today

LJMET topological group

Wednesday 14 January 2009
from **10:30** to **15:30**
US/Central
at **FNAL and remote sites**
chaired by: *Ken Bloom*

Description: Connect via EVO.
The modification password for this page is "ljmet".

Wednesday 14 January 2009 |

Wednesday 14 January 2009

top↑

Time	Session	Speaker
10:30	W plus heavy flavor modeling (20')	Salvatore Rappoccio
10:50	Understanding QCD backgrounds to l+jets events (20')	Jeffrey Temple (*University of Maryland/CMS*)
11:10	break/hidden valley meeting (2h20')	
13:30	ttbar cross section via templates of kinematic variables (20')	Pratima Jindal (*Purdue University Calumet*) , Gennadiy Kukartsev
13:50	ttbar cross section via mass reconstruction (20')	Dan Green (*Fermi National Accelerator Laboratory (FNAL)*) , Francisco X. Yumiceva (*FERMILAB*)
14:10	ttbar cross section via b-tagged jets (20')	Helena Malbouisson (*Instituto de Fisica-Universidade do Estado do Rio De Janeiro (UE)*)
14:30	Top partners (20')	Aram Avetisyan (*Department of Physics-Brown University*)
14:50	SUSY searches in LJMET (20')	Finn O'Neill Rebassoo (*Physics Department-University of California*)

There is a lot of interesting work going on.
Come and hear all about this.
Venue : WH 11 NE - Sunrise

Where to Start??

Introduce yourself to the conveners

Ken Bloom   <kenbloom@unl.edu>
Meenakshi Narain <narain@hep.brown.edu>

Join our mailing list:
lpc_lepton_j_met@fnal.gov

The LHC is a once in a lifetime opportunity.
LJMET channel provides access to a wide range of possible new physics.

Get involved !!!