Summary of the top/detector group *(introduction)*

(from ~45 page Snowmass report of the top/detector group)

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The report is available on SVN of Assembla and

https://www.assembla.com/code/detectors_top/subversion/nodes/

and the top-group SVN

Questions:

- How well can top quarks be reconstructed at low energies and high energies?

- What algorithms are available? Can they be improved?

- What is the impact of such improvements on physics questions discussed in the previous bullets?

- What is the energy resolution, identification and misidentification efficiency for each?

- What is required from the detector to be able to provide this?

- How can top quarks be used to improve b-tagging or jet energy resolution and other detector calibrations?

“white” paper

Reconstructing tops at the upgraded LHC and at future accelerators

Summary of “Top algorithms and detectors”
High Energy Frontier Study Group

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1 Introduction

The long-awaited measurements of top quarks and their properties by ATLAS [1] and CMS [2] have proved the LHC to be the world's top factory. The Standard Model (SM) top-quark studies at the LHC include[1] reconstruction of the total and differential $t\bar{t}$ cross sections [3–11] top-quark mass measurements [12–14], cross sections of invariant masses of $t\bar{t}$ pairs, charge asymmetry [15] and single-top measurements [16]. A number of searches have been performed aimed to find heavy resonances decaying to $t\bar{t}$ pairs [17, 18].

A snapshot of the top-quark cross section and top mass measurements is given in Fig. 1. These current results indicate that:

[1]We give only the most representative or recent references which are only needed to make our point, without attempt to collect a comprehensive list of references from ATLAS and CMS.

MC samples using Delphes 3X

https://atlaswww.hep.anl.gov/snowmass13

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1	baumgart/	Madgraph+Pythia6. Top coupling to gluons is modified by an axial form factor. pp at 8 TeV (M.Baumgart)	74.98 GiB	2013-06-21 07:49
2	dijets_pt1500mod/	HERWIG++. Dijets (pT(jet)>1500 GeV). pp for 14 TeV. coarse and fine CAL geometry	3.83 GiB	2013-06-28 06:09
3	dijet_pt650/	HERWIG++. Dijets (pT(ME)>650 GeV). 14 TeV, pp. 96,000 events.	23.38 GiB	2013-06-01 21:31
4	dijet_pt1500/	HERWIG++. Dijets (pT(ME)>1500 GeV). 14 TeV, pp. 96,000 events.	23.83 GiB	2013-06-19 22:54
5	httbar/	PYTHIA8. Higgs (all decays)+ ttbar. 14 TeV, pp. 96,000 events	24.94 GiB	2013-05-31 19:56
6	jahreda/	Madgraph+Pythia6 samples for Higgs+top studies (J.Adelman)	8.98 GiB	2013-05-27 14:54
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9	ponyisi/	Madgraph+Pythia6 samples for Higgs+ttbar. Delphes 3.09. pp for 14 TeV (P.Onyisi)	134.70 GiB	2013-05-28 20:57
10	promc/	Delphes outputs in the PROMC format	43.67 GiB	2013-06-03 22:18
11	promc_truth/	MC truth events in the PROMC format for requested events	22.33 GiB	2013-06-27 20:35
12	singl_top_tW_chan/	Madgraph+Pythia. Single top (tW-channel). 14 TeV pp. Sigma=0.062+/-0.02 pb	29.46 GiB	2013-06-28 21:10
13	singl_top_t_chan/	PYTHIA8. Single top (t-channel). 14 TeV, pp. 96,000 events. Sigma=182+/-3 pb	21.18 GiB	2013-06-19 11:05
14	TruthRecords/	MC truth events in the ProMC format. README	35.22 GiB	2013-06-24 09:21
15	ttbar/	HERWIG++. ttbar (all decays). 14 TeV, pp. 96,000 events.	21.69 GiB	2013-06-01 19:40
16	ttbar_pt650/	HERWIG++. ttbar (all decays, pT(t)>700 GeV) 14 TeV, pp. 96,000 events	23.62 GiB	2013-06-01 19:40
17	ttbar_pt650cal2/	HERWIG++. TTbar (all decays, pT(t)>700 GeV). Fine CAL segmentation. pp collisions at 14 TeV.	23.74 GiB	2013-05-27 15:02
18	ttbar_pt1500mod/	HERWIG++. TTbar (pT(t)>1500 GeV). pp for 14 TeV. coarse and fine CAL geometry	4.01 GiB	2013-06-05 21:23
19	ttbar_pt1800/	HERWIG++. TTbar (all decays, pT(t)>1500 GeV) for pp collisions at 14 TeV.	22.00 GiB	2013-06-01 19:40
20	ttbar_pt3000mod/	HERWIG++. TTbar (all decays, pT(t)>3 TeV) for pp collisions at 33 TeV.	5.08 GiB	2013-06-10 11:28
21	ttbar_W/	MG5+Pythia6 for ttbar+W pp at 14 TeV, pp. 200k events. sigma= 0.478+-0.001 pb	25.30 GiB	2013-06-29 12:15
22	ttbar_Z/	MG5+Pythia6. ttbar+Z events. pp at 14 TeV. 200k events. sigma=0.656 +- 0.002	25.84 GiB	2013-06-29 12:21
23	zprime3000/	PYTHIA8. Zprime to ttbar (all decays) for pp collisions at 14 TeV.	24.78 GiB	2013-05-31 19:58

1-page conclusions (or “Physics opportunities”)

- **High-luminosity runs at the LHC will be unfavorable for many high-precision SM measurements that require reconstruction of jets with transverse momenta below 100 GeV.**
  - JES (μ>100) > 2x JES (2010/2011 data). See detailed discussion later
- **Uncertainties for top reconstruction that use low-pT jets will be >2 larger for μ=140 compared to μ=0**
- **Future LHC runs should have large enough statistics to reach the highly-boosted regime for top-quark reconstruction where the resolved approach becomes ineffective.**
  - almost trivial conclusion but qualitatively studied using the Snowmass detector simulation
- **Top-jet mass resolution and the efficiency of jet substructure algorithms for top-tagging degrade with increasing pT (jet).**
  - jet mass resolution a factor 2 worse for pT(jet)>1.6 TeV compared to pT(jet)>0.8 TeV
- **The t quark mass can be measured to a precision of better than 40 MeV where systematic studies have shown that the statistical error is the dominating error.**
- **A major asset of the linear collider are the polarized beams & no pileup for jets**