CMS Early Physics Topics - Which Need Coverage ?

P.Sphicas
LPC JTERM IV
Aug 03, 2009

- **CMS Physics commissioning**
  - **Introduction**
  - **Schedule [machine and CMS]**
  - **Some expected results with ~10 pb-1**
  - **Physics commissioning before beam**
  - **Physics commissioning with early beam**
  - **Outlook**

What will the first LHC run be like?

- Most people […] seem to be of the opinion that the most important thing is to start as soon as possible
- The higher the collision energy, the longer one would want to run
  - ideal scenario: run at 14 TeV for two years non-stop ☺
  - realistic scenario: run at 10 TeV [or slightly less] for up to nine months
- There is a minimum number of accumulated Number of evts (or integrated luminosity); this depends on energy
- The exact duration of the run can be decided once estimates for the following are available :
  - the actual energy…
  - the "doubling time"
  - the plan over several years [length of future shutdowns, leading to close to design energy] .
  - the maximum attainable luminosity v/s energy
- Clearly, things may well change in light of experience gained once we have started.

Independently of the [precise] machine schedule

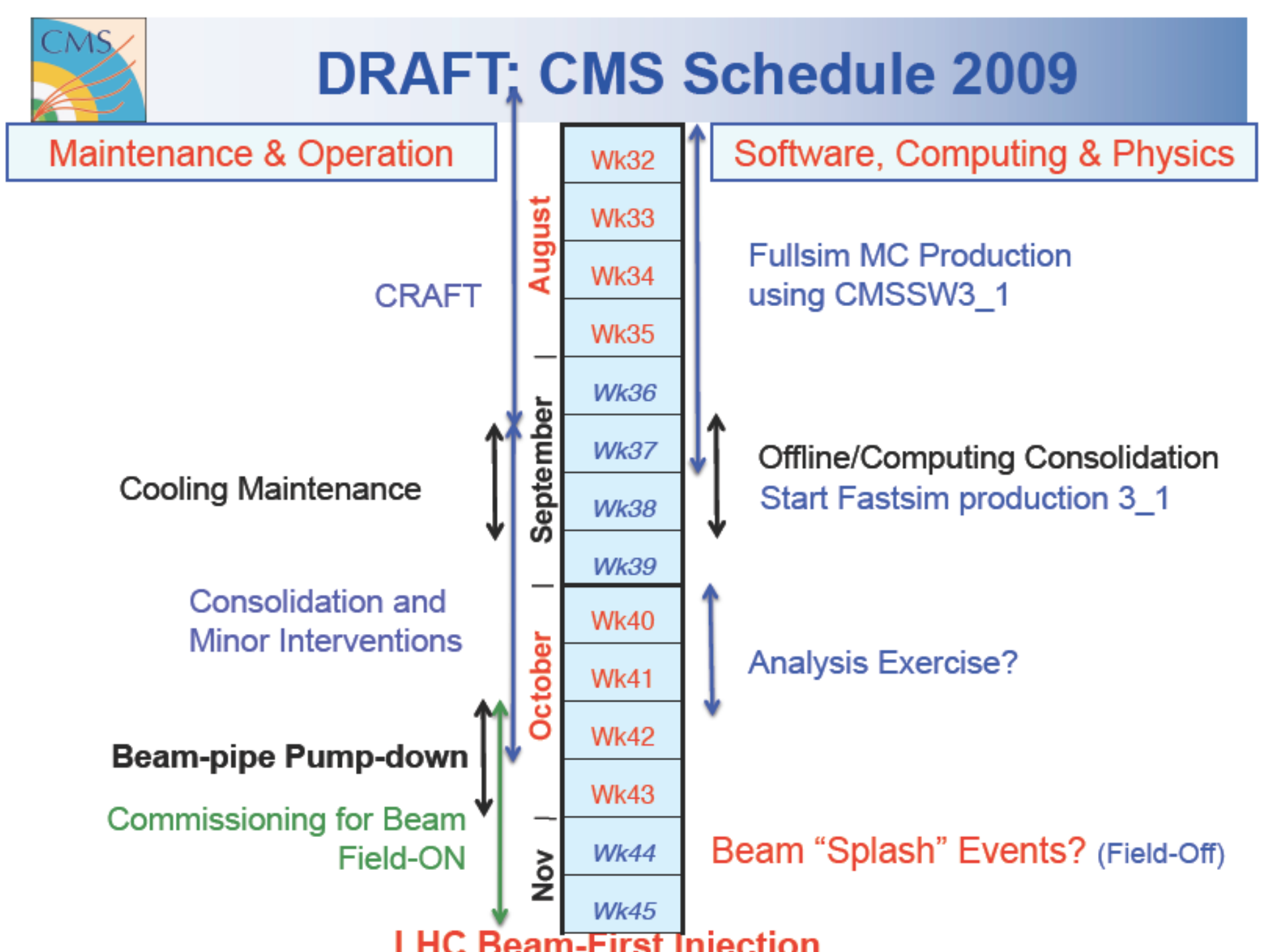
- **Our success will be determined by the level of integration and communication in the DPG-POG-PAG chain, with the first link DPG-POG being the most important one for the pre-beam and 1pb-1 periods**

- **It is extremely important to view – and label! – work in this area as the "highest priority physics tasks" – and to recognize them as such**
  - **Understanding the basic detector response**
  - **Understanding the basic physics object reconstruction**
  - **And the interplay between the two**
    - **Are the three [by far] most important tasks for the next ~five to six months**
    - **They are also pre-requisites to "physics measurements"**

Schedule

With emphasis on next few months

DRAFT: CMS Schedule 2009



Physics: between now and end 2009

Prepare Oct tests

Oct tests

Anticipate detector-level plots

WK32 WK33 WK34 WK35 WK36 WK37 WK38 WK39 WK40 WK41 WK42 WK43 WK44 WK45 WK46 WK47 WK49 WK50 WK51

August | September | October | November | Decem

Physics Week

Phys Days

HCP2009

CMS week

Major goals for Sep Physics Week

- **Present paper drafts**
  - **This will dominate the "PAG" part of the agenda**
- **Finalize/present plan of work for the start-up for each POG**
- **Prepare/discuss the data access and skim strategy for each group**
  - **Along with this: present the planned tests of each group [for the October exercise]**
- **Early look at 3_1 data.**
  - **Should be arriving in Aug. Prodn will finish by end Sep.**

Post Phys Week

- **From 3rd week in Sept:**
  - Final preparations for October tests: 2 weeks
  - October tests ["exercise"]: 2 weeks
  - Summary/review during Phys Days: 1 week
- **Finish all this by WK 43 [End October]**

- **Three weeks in October/mid-Nov:**
  - More CMSSW_3_1 samples
  - Fastsim production
  - Potential samples for "other energies"
  - Potential re-reco of 3_1 samples
    - Event mixing from 3_3 onwards… [pileup]
  - Fixes to any plans that did not work out during tests

Some early physics topics

Physics signals with up to ~10 pb^{-1}

QCD: Low P_T physics

- **"Study of Charged Hadron Multiplicity in Minimum Bias pp Collisions at 10 TeV and 900 GeV"**

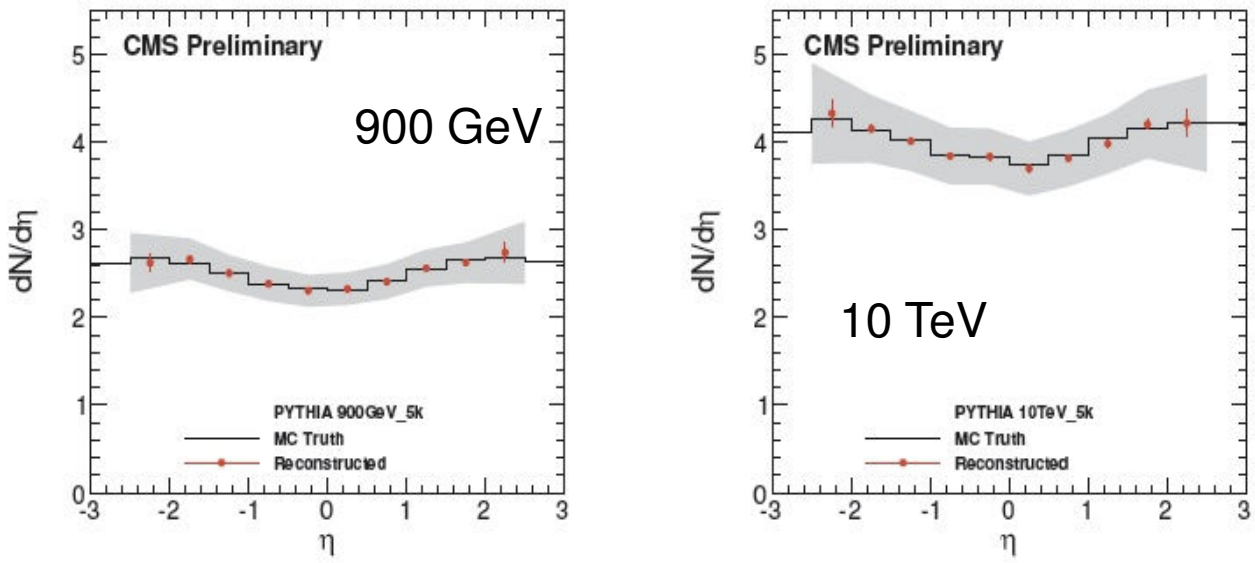


Figure 7: The measurement of $dN/d\eta$ in p+p at 900 GeV(left panel) and 10 TeV(right panel). Error bars show statistical errors using 5k events. The shaded area corresponds to 7.5 - 13.5% systematic error band.

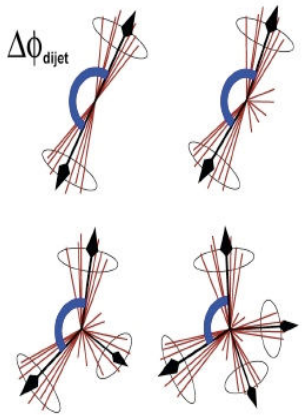
Early analysis using 5k events!

Uses "tracklets" (hits in 2 consecutive layers of pixel detector)

Shown to be robust to (reasonable) misalignment/hit inefficiency scenarios

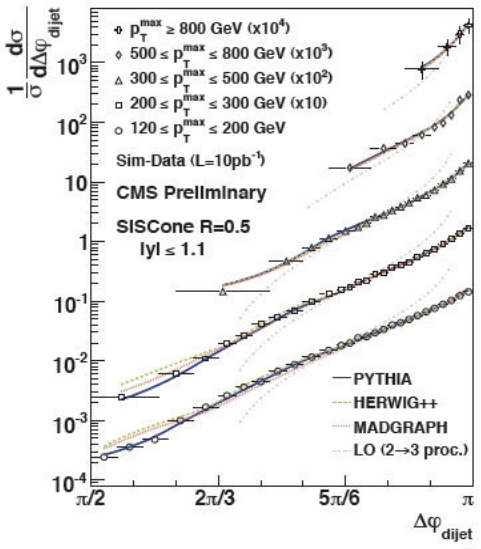
Important startup analysis for Heavy Ion program

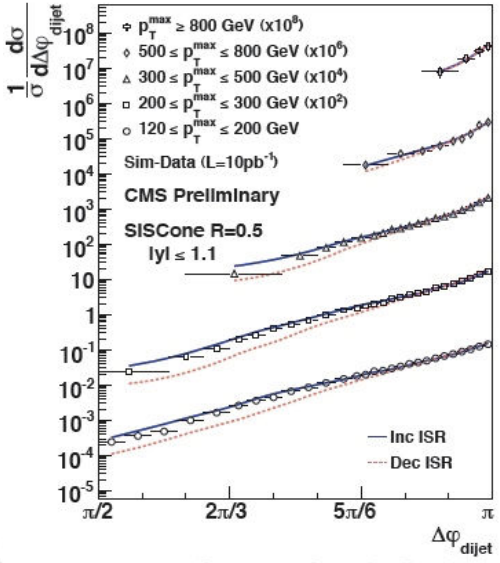
QCD: Early Jet Measurements

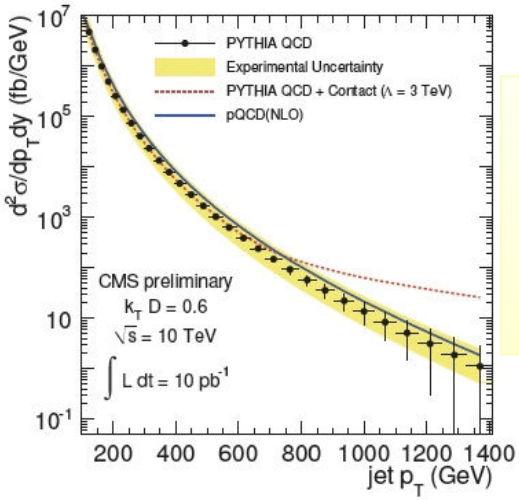


Azimuthal decorrelations:

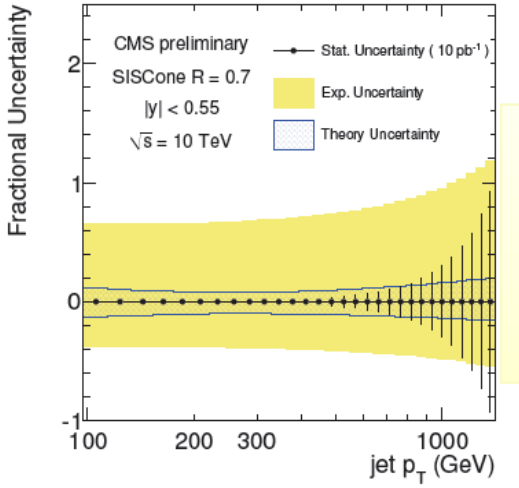
Input for MC tunes
Sensitive to NLO/ISR







Inclusive jet cross-section measurement (k_T) for 10 pb^{-1} data



Inclusive jet cross-section uncertainties (SISCone) for 10 pb^{-1} data

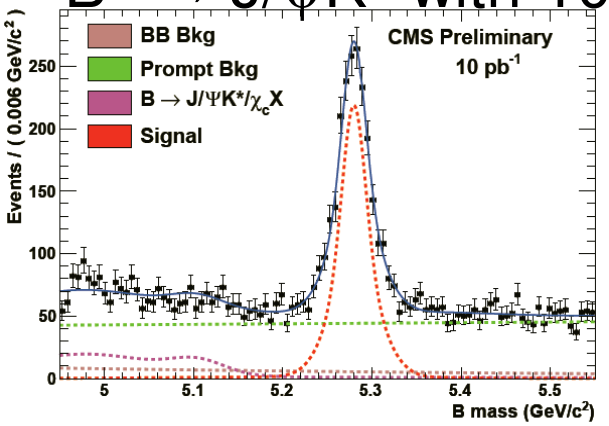
B physics

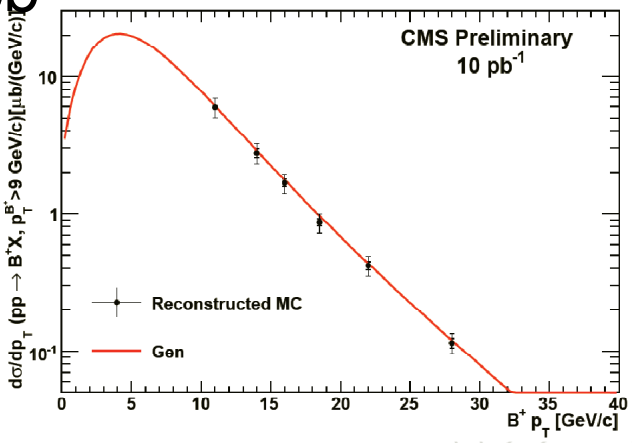
Exclusive B production with early data:

- $B^{+(0)} \rightarrow J/\psi K^{+(*0)}$ cross section and lifetime ratio
- expect $\sigma(\tau_+/\tau_-) \sim 5\%$

(BPH-09-001, approved on June 16)

$B^+ \rightarrow J/\psi K^+$ with 10pb^{-1}



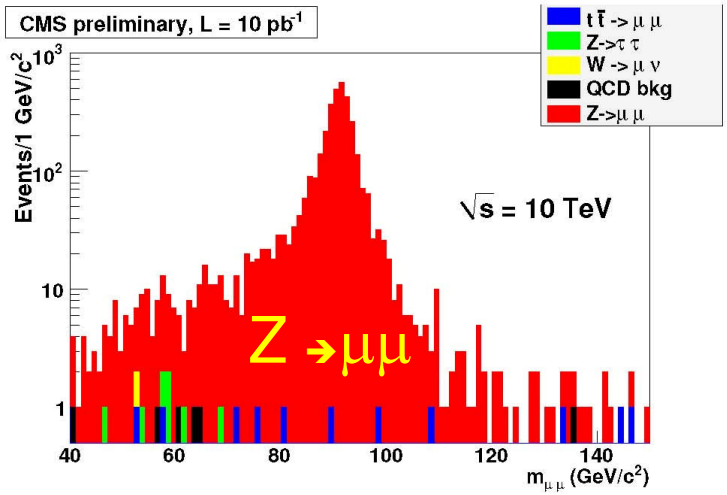


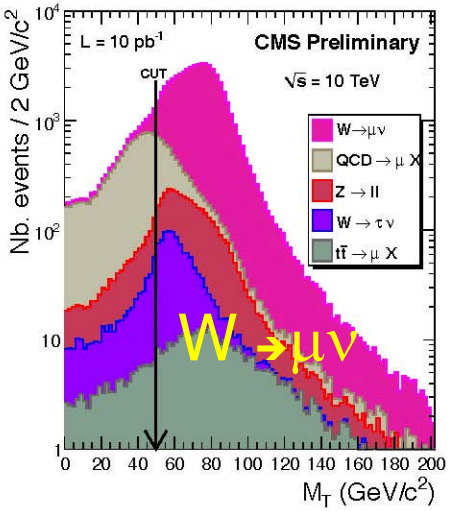
- **Dimuon production in the J/ψ and Υ mass regions (~1 pb^{-1})**
- **J/ψ and b-hadron production cross sections (1-10 pb^{-1})**
- **Upsilon production cross section (10pb^{-1})**

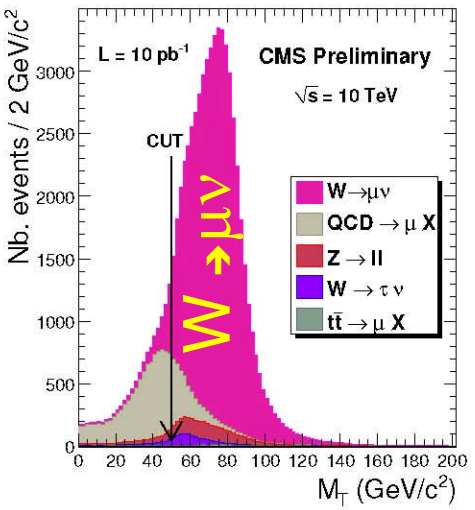
- **Differential production cross sections and lifetime ratio for exclusive decays of B+ and B0 mesons (10 pb^{-1})**
- **cross section for open-beauty production (10pb^{-1})**
- **azimuthal correlations in bbbar production (10pb^{-1})**
- **angular and momentum correlations between b and bbar (10pb^{-1})**

EWK: W/Z at 10pb^{-1}

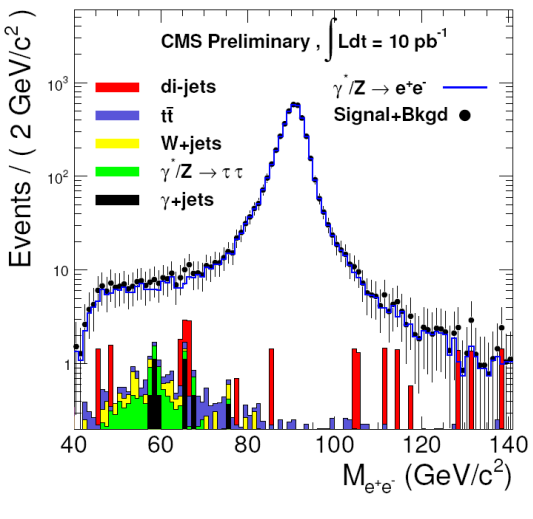
- **Will probably be the first mass peak in CMS [competition with the J/psi]**
  - **Will be used for a host of detector and muon/tracking studies**
  - **Expect ~400/pb^{-1} Z→mumu**
    - **Signals very clean. Very probably: J/psi, Upsilon and Z peaks our earliest "PR plots"**

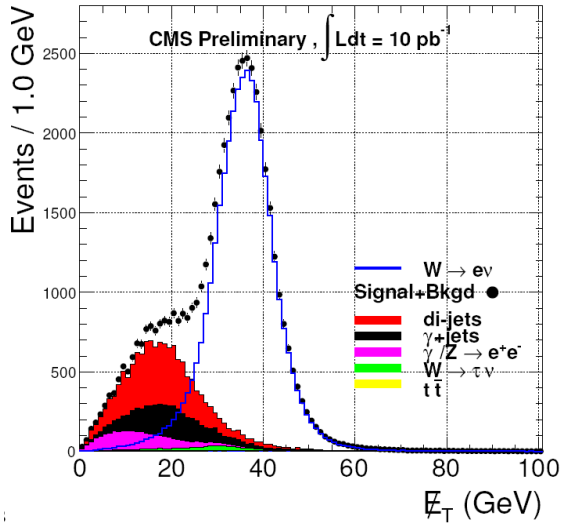


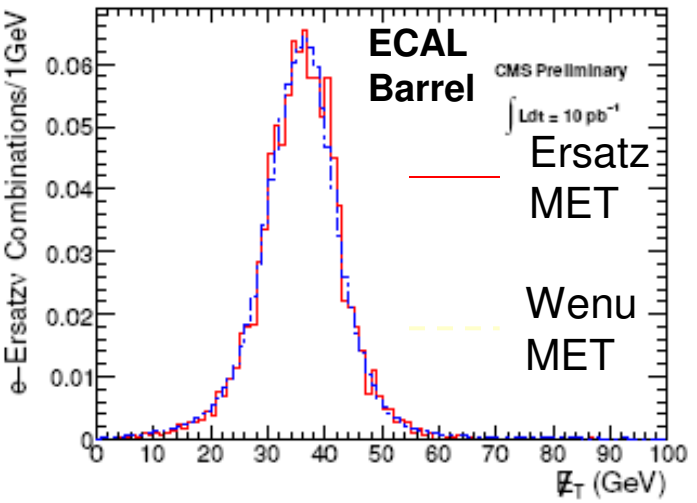




EWK: W/Z at 10pb^{-1}







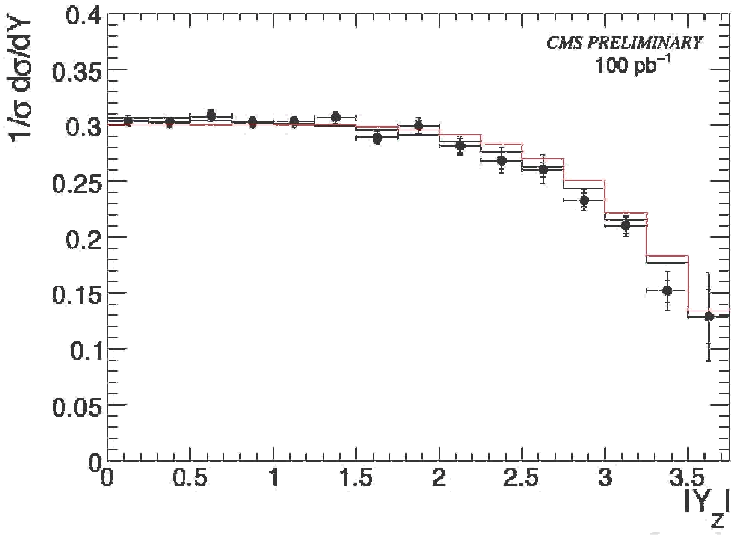
and the tables with the related numbers

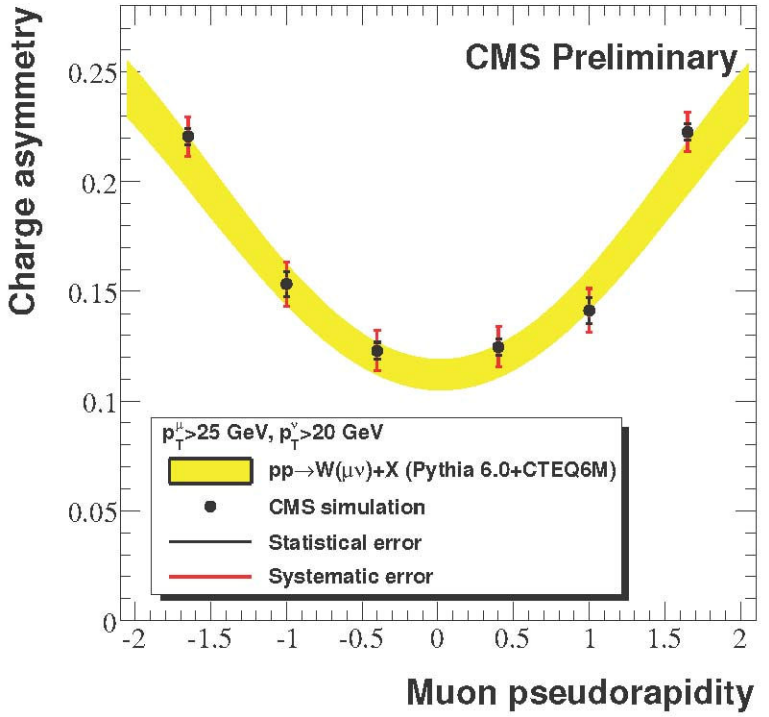
$N_{selected}$	4273 ± 65
N_{bkgd}	assumed 0.0
Tag&Probe $\varepsilon_{offline}$	90.37 ± 0.32 %
Tag&Probe $\varepsilon_{trigger}$	99.88 ± 0.016 %
Tag&Probe ε_{total}	81.57 ± 0.58 %
Acceptance	40.42 ± 0.18 %
Int. Luminosity	$10\ pb^{-1}$
$\sigma_{Z/\gamma^*} \times BR(Z/\gamma^* \to e^+e^-)$	1296 ± 23 pb
cross section used	1296 pb

$N_{selected} - N_{bkgd}$	37500 ± 453
Tag&Probe $\varepsilon_{offline}$	74.44 ± 0.59 %
Tag&Probe $\varepsilon_{trigger}$	97.17 ± 0.32 %
Tag&Probe $\varepsilon_{offline \times trigger}$	72.33 ± 0.62 %
Acceptance	36.6 ± 0.074 %
Int. Luminosity	$10\ pb^{-1}$
$\sigma_W \times BR(W \to e\nu)$	14166 ± 212 nb
cross section used	13865 pb

Pdfs: W Charge Asymmetry; Z y distribution

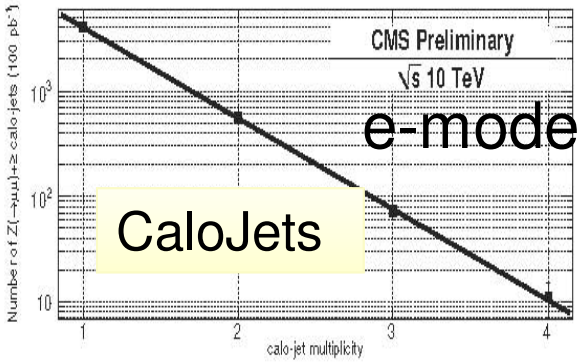
- **Z rapidity distribution: measurable "easily"**
  - **But need ~100 pb-1 to deliver info on pdfs**
- **W asymmetry:**
  - **Asymmetry begins to be comparable to PDF errors**
  - **Should begin to constrain PDF**

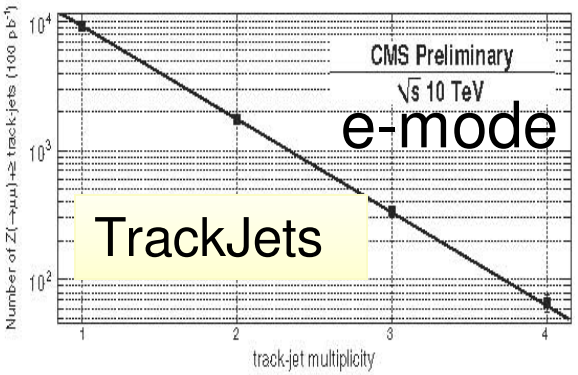


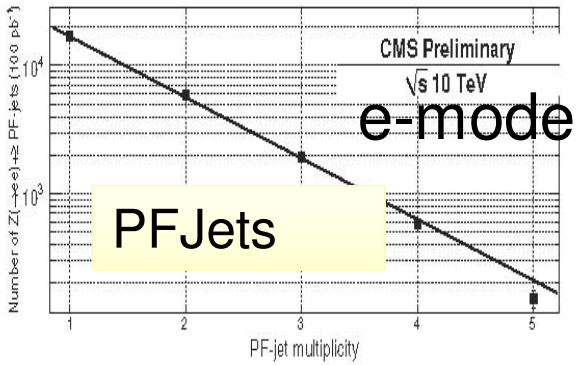


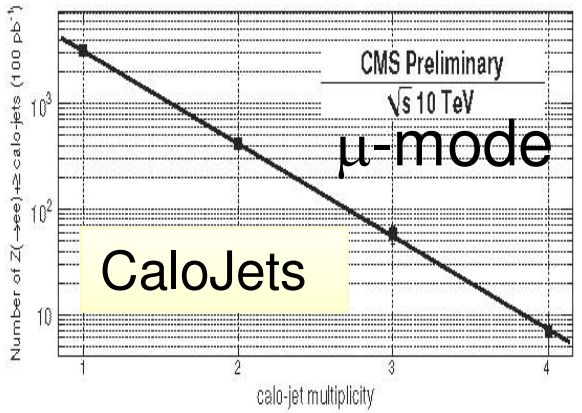
Z + Jets (n+1/n jet ratio)

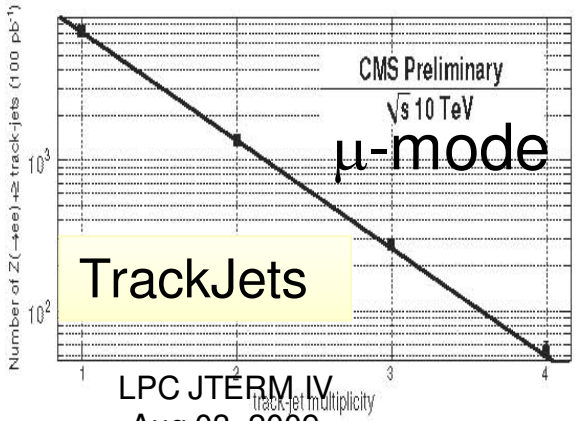
- **Predicted linear drop with N_{jet} observed for all algos**
  - **Slopes different for various algos without calibration corrections; PF Jet slope agrees with generator level slope**
  - **Electron-muon ratio is constant (as expected)**
  - **Will have hints at 10pb-1. Probably need 100pb^{-1}…**

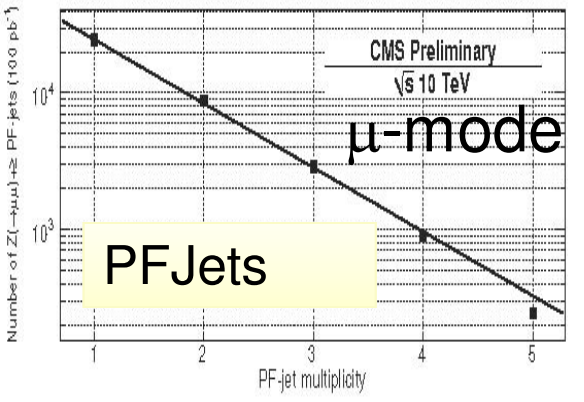






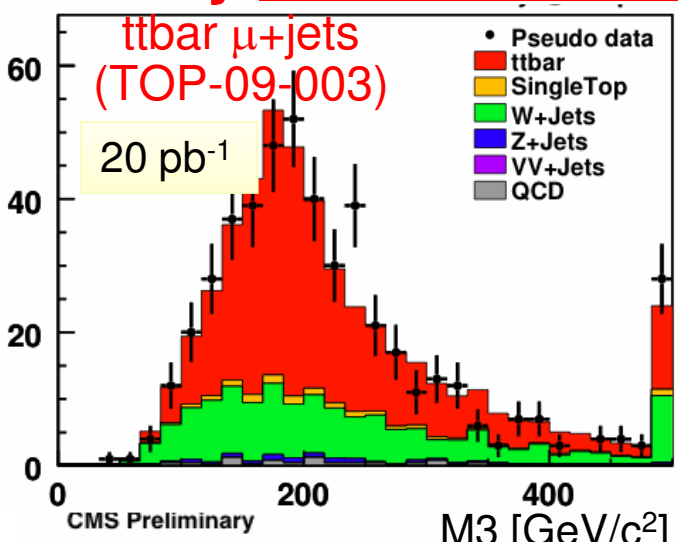


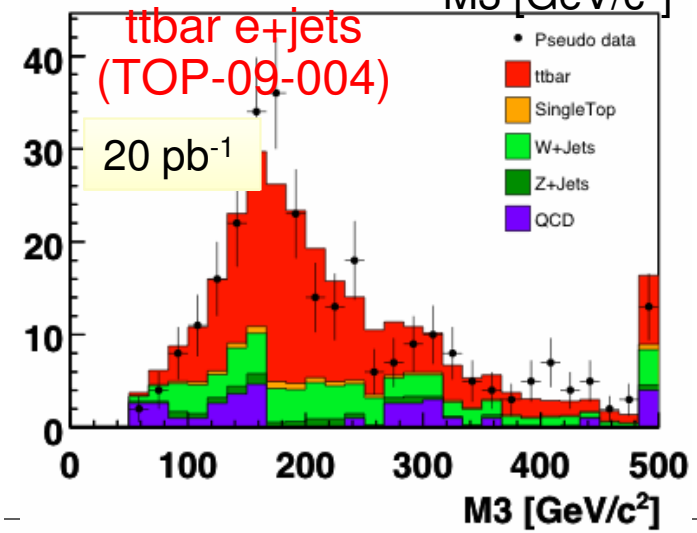




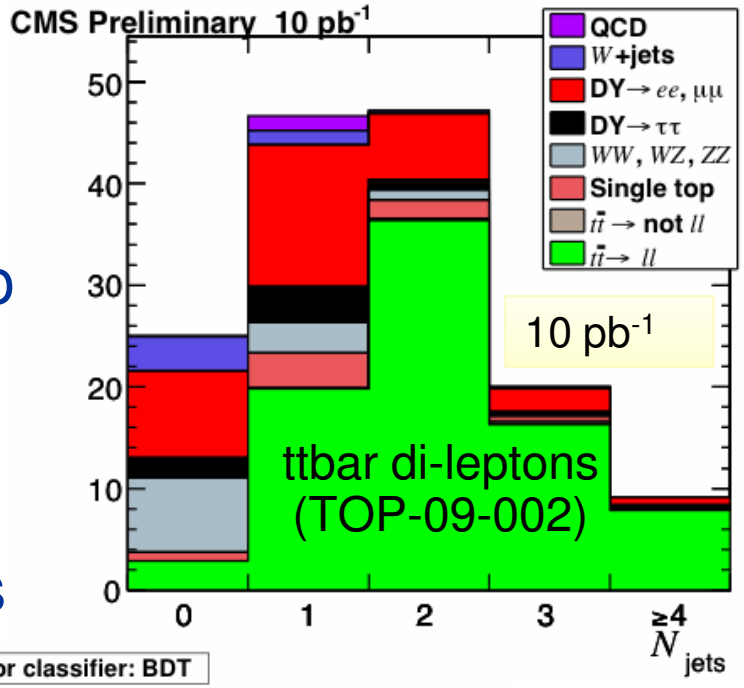
Top Studies…

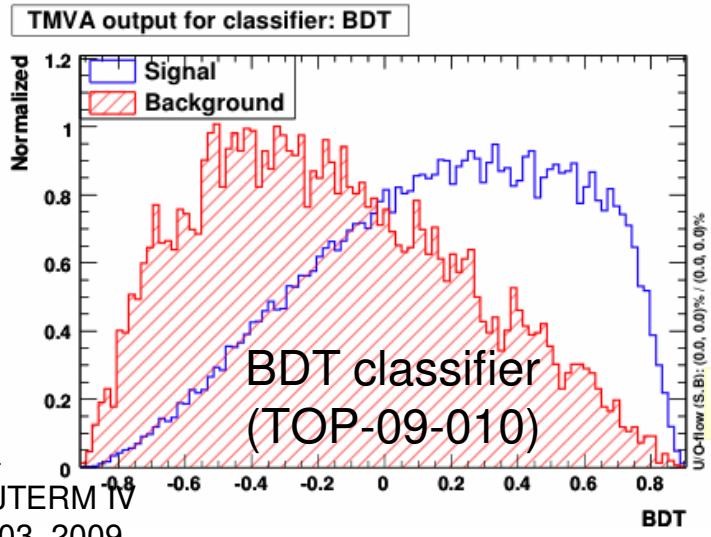
- **early ttbar cross sections:**





Mostly w/o use of b-tagging, robust selections





MVA in μ+jets:
→ improved stat. unc.

(20 pb-1)

What it takes to produce these results aka “Physics Object Commissioning”

Summer09 and pre-beam work

Independently of the [precise] machine schedule

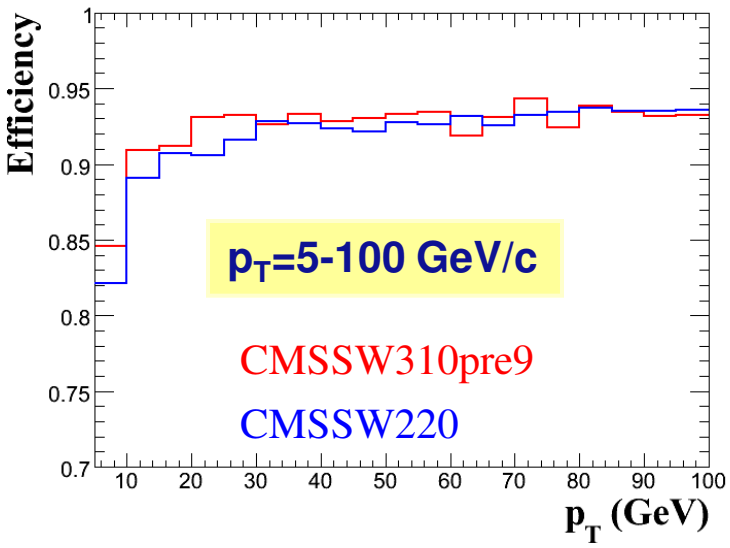
- **Our success will be determined by the level of integration and communication in the DPG-POG-PAG chain, with the first link DPG-POG being the most important one for the pre-beam and 1pb-1 periods**
- **It is extremely important to view – and label! – work in this area as the "highest priority physics tasks" – and to recognize them as such**
  - **Understanding the basic detector response**
  - **Understanding the basic physics object reconstruction**
  - **And the interplay between the two**
    - **Are the three [by far] most important tasks for the next ~five to six months**
    - **They are also pre-requisites to "physics measurements"**
- **Detailed POG plans for startup: there since June 2008. Final update at the Bologna week.**

Tracking – prebeam (Summer09)

- **Projects using LHC collision MC**
  - Development of tools to measure tracking performance in data
    - Tracking efficiency from data
    - Tracker material budget
    - Tracker momentum scale
- **Projects using CRAFT09 data**
  - Verification of cosmic track reconstruction (relative to CRAFT08)
  - Repetition of tracking analyses (efficiency, resolution studies)
  - Validation of final CMSSW 3.1 collision tracking sequence

e/γ – prebeam (Summer09)

- **Work before beam:**
  - digestion of ECAL problematic channels in clustering
  - improvements in charge reconstruction
  - understanding merged PF-e/γ electro collection
  - e-ID for low (p_T<15 GeV) electrons
  - J/Psi (and Upsilon): low E electron study?
- **Preparation:**
  - Development of both DQM and release validation, consistent with above plans
- **Use of pre-beam data:**
  - noise in ECAL isolation regions
  - studies with event mixing



Muons – prebeam (Winter09) – I

- Definition: what can be done with cosmic data to commission reconstruction and muon objects
  - CRAFT analyses: e.g. cosmics charge ratio with MTCC data
- Exercise full reconstruction chain including calibration, alignment, DB access, up to analysis tools (PAT) on the final collection of off-line muons.
  - Note this can be done with DATA as well
- Integrate muon reconstruction in HLT: validate L1 seeding for L2, L2 seeding for L3 and regional reconstruction + matching in the tracker; test on-line running of L2 and L3 algorithms (both default and cosmic tuned) in the filter farm
- Validate geometry: check for possible problems in eg. uniformity of distributions
- Validate response of the different detectors used by muon reconstruction and identification
  - verify that the result of muon isolation in both tracker and calorimeters is consistent with what expected from simulation for isolated tracks
  - muon identification: verify matching between tracker tracks in the tracker and muon hits. Check how it is affected by relative alignment. Verify that deposits in the calorimeter correspond to what expected based on the simulation.

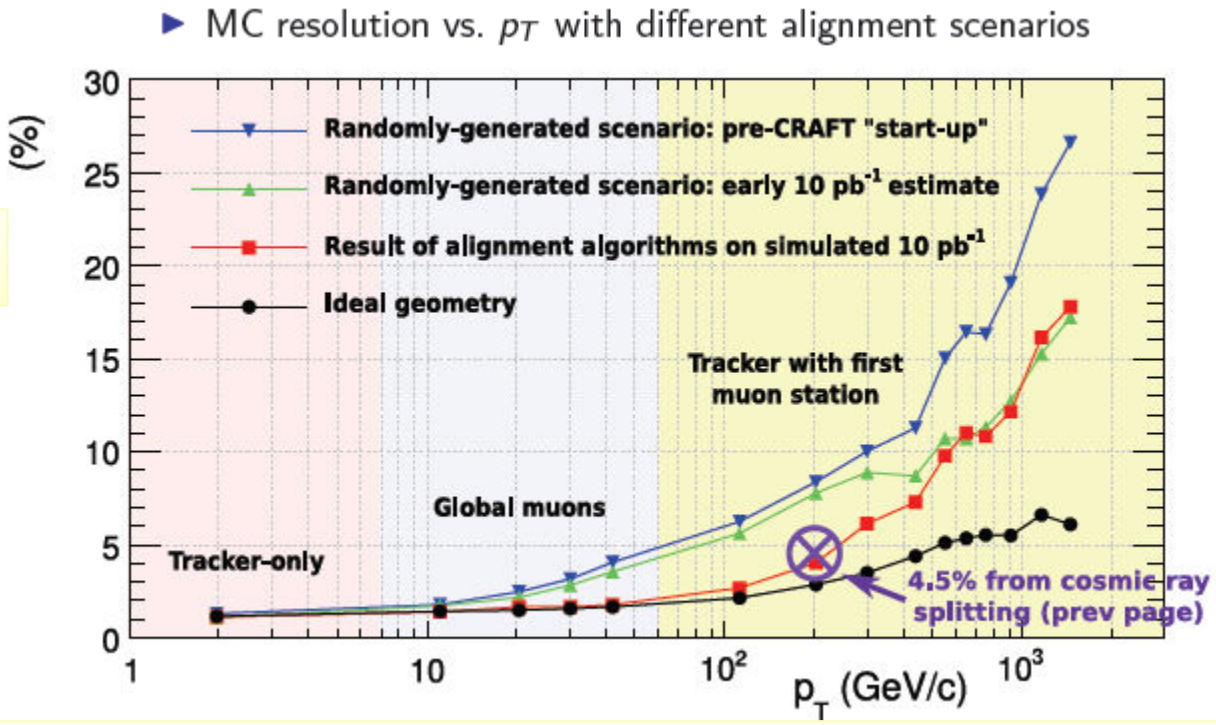
Muons – prebeam (Winter09) – II

- From original program of work [June 2008…]
- Validate alignment tools and procedures: prove that data from survey, hardware and track based alignment is applied correctly in CMSSW, e.g. improves the matching of tracker and muon tracks as well as the quality of the two individual fits
- Test extrapolation and matching between spectrometer, tracker and calorimeter
- Cosmics with field on:
  - Study energy loss and resolution by comparing e.g. the global tracks in the upper and lower parts of the detector. Interplay with alignment; description of material
  - Measure the resolution of the spectrometer by comparing e.g. tracker and muon stubs
  - Compare the momentum scale in spectrometer and tracker → First validation of field map (+alignment, material, etc)

Alignment scenarii and muon resolution

- **Monte Carlo simulations yield much better results than early estimates**
- **Cosmic-ray splitting close to MC simulations @ 200GeV**

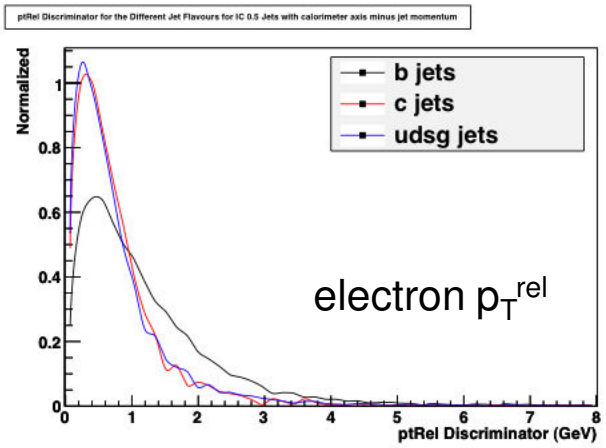
Jim Pivarski



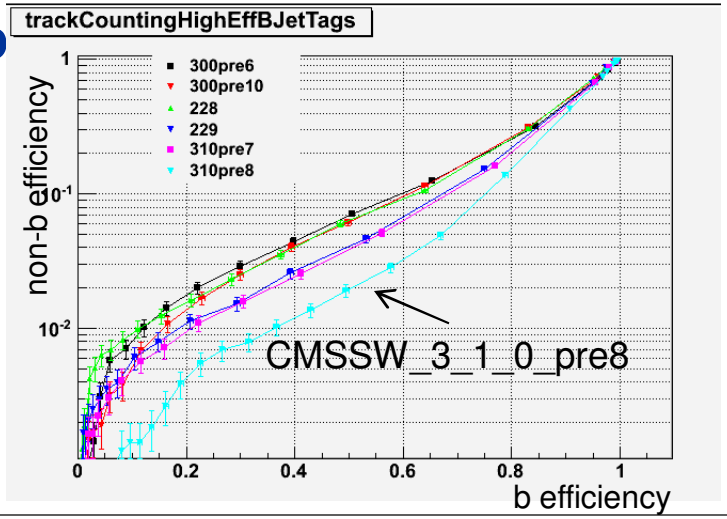
See 3rd LHC alignment workshop
http://indico.cern.ch/getFile.py/access?contribId=8&sessionId=3&resId=0&materialId=slides&confId=50502

b-tag POG: pre-beam

- **Numerous b-tag algorithms in place**
  - Method for bkg etxraction from data in place
  - Method for efficiency measurement from data in place
- **B-tag performance in the new startup alignment scenario**
  - performance with the new startup scenario is comparable to the old 10pb^{-1} assumptions
- **Understand 3_1 in detail**



b-tag validators

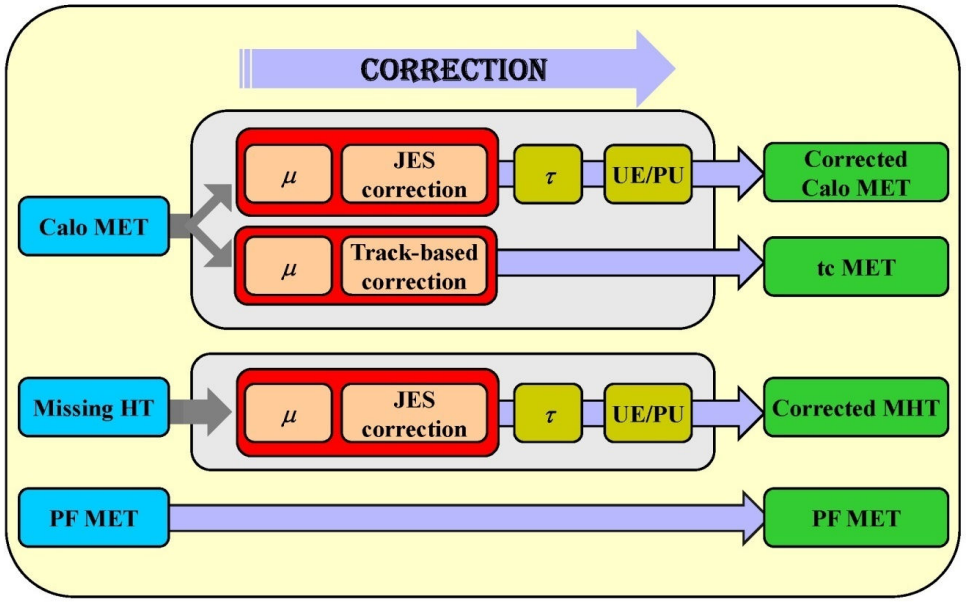


JetMET – prebeam (Summer09)

- **Big milestone in preparation for startup: group has pre-approved 11 analyses during 21X/22X round of analyses:**
  - **Jet Energy Scale (6), jet ID quality cuts, resolutions/reco efficiencies, jet + tracks and MET + tracks (tcMET) algorithms**
- **Developed in addition:**
  - **Plan (with trigger group) on JEC in triggers; including workflow**
  - **Calorimeter + JEC calibration scheme and workflow (in collaboration with ECAL/HCAL)**
  - **"Seed of a plan" for JEC central skims to ensure prompt delivery.**
- **Currently consulting PAGs on a list of prioritized jet clustering algorithms for the JetMET group to support (JEC, resolutions, efficiencies)**
  - **Baseline: SISCone [0.5, 0.7]; IC [0.5] – but mainly for HLT**
    - **Later: add others**
  - **Note: code will [of course] be on CMSSW. This is about JECs etc**

Missing ET

2 new approaches for improving calorimeter MET, using tracks (tcMET) or using particle flow objects (PFMET):



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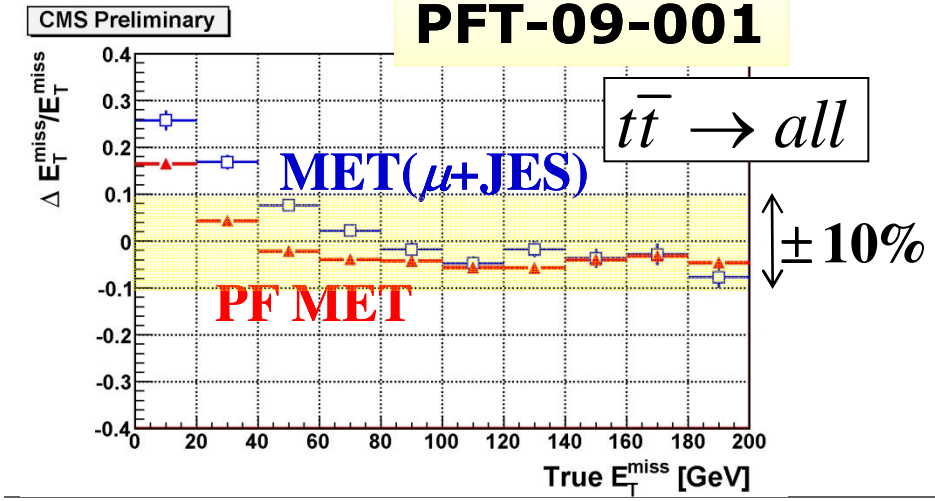
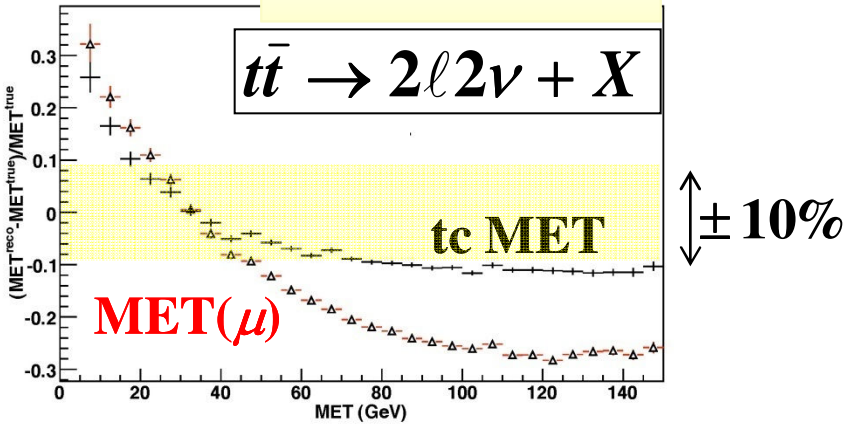


JME-09-006



P-flow (I)

- **Main elements in "commissioning" p-flow are same as for the DPGs/other POGs: tracking, muons, ECAL clusters, single-particle response**
  - **Tracking is important: charged hadrons carry ~2/3 of jet energy**
    - **Also in ID/reco of electrons and muons.**
    - **Note: does not need accurate knowledge of efficiency/purity**
  - **Clustering in calos:**
    - **Reco of stable neutrals (photons and neutral hadrons)**
    - **Separate neutrals from deposits of charged hadrons**
    - **Reco and ID of electrons and brem photons**
    - **Improve E for low-quality or high-pT tracks.**
      - **➔ Rechits responsibility of ECAL and HCAL DPGs. Set calo thresholds according to the noise level; flag (correct?) problematic channels**

P-flow (II)

- **Adapt clustering params**
  - **Simulated data:**
    - **Test channel recovery**
    - **Preshower clustering optimization**
  - **CRAFT:**
    - **Set seed threshold according to the noise level**
    - **Reconstruct first clusters corresponding to muon energy deposits.**
    - **Compare to CRAFT simulations**
  - **Test beam (electrons and pions of varying energy):**
    - **Set the rechit threshold, which influences the energy and position resolutions.**
    - **Set seed threshold. NOT to optimize seed threshold with respect to noise [may be different in collisions]. Fake cluster rate depends on seed threshold, and should be studied as a function of the particle energy and type, both in the ECAL and in the HCAL.**
    - **Tune the fast sim (transverse shower shape)**
    - **Start tuning the parameters affecting particle separation.**
      - **➔ 2 (or more) particles of different types from the real data could be overlaid in the same event. Using the electron energy deposits as photons: 2 photons (pi0), photon+charged hadron, 2 charged hadron, "simple jets", …**

P-flow (III)

- **Simulation:**
  - Compare STARTUP and IDEAL conditions
  - Test the algorithm on "real data simple jets": two (or more) particles of different types from the data (MC information NOT allowed) could be overlaid in the same event. Using the electron energy deposits as photons: 2 photons (pi0), photon+charged hadron, 2 charged hadrons, … In case it is shown that overlaying particles can allow to study the particle flow algorithm, the technique can be used in real data.
- **Test beam:**
  - Test the algorithm using real data simple jets. Compare with the simulation.

All POGs: common issues

- Preparation for MC tuning... (a largely unexplored field)
- Putting the teams together. Example from egamma:
  - Plans, software and teams for performing physics commissioning with data:
    - electron efficiency measurement
    - tuning e-ID and isolation
    - verification and tuning of SC energy measurement
    - ECAL alignment
    - photon ID/purity measurements with template method
- Single-particle response
  - Needed in numerous places [calo calib, JPT, p-flow, tcMET…]
    - Extraction of single-particle R from test-beam/collision data? How?
- September/October analysis exercise?
  - Come back to this later

Physics Object Commissioning

Work with early data, up to ~10pb^{-1}

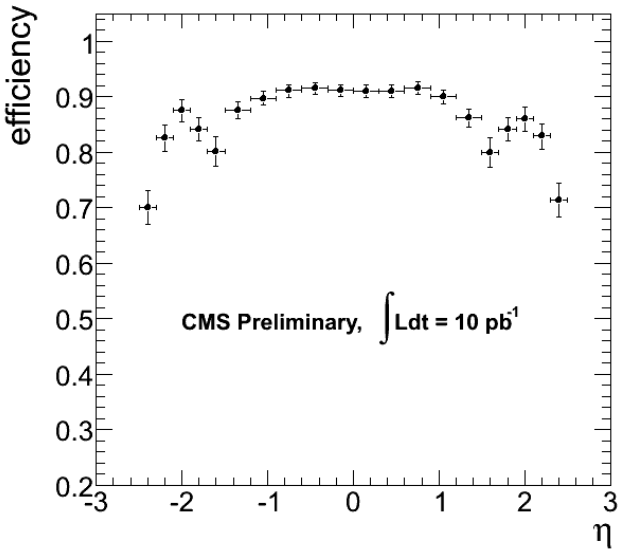
compare-check-validate and tune!

Tracking – early data and up to 10pb^{-1}

- **First Data:**
  - Check for anomalies in distributions of reconstructed tracks vs. eta/phi/z/#hits
  - Comparison with expected shapes from MC
  - Validation of track reconstruction from comparison w/alternative algorithms
    - Pixel seeded tracking vs. pixel-less tracking
    - CTF vs. RS tracking (at least in the barrel)
  - Reconstruction of LHC Beamline
  - Reconstruction of resonances (K0s, Lambda, J/psi, upsilon)
    - verification of mass
    - first measurements of efficiency with dimuon resonances
  - Initial detector "x-ray" with reconstructed conversions
  - Reconstruction of beam halo tracks for tracker alignment

Electrons/photons – up to 10pb^{-1}

- **Up to 10 pb^{-1}**
  - Electron efficiency measurements
  - Tuning e-ID and isolation
  - Verification and tuning of SC energy measurement
  - ECAL alignment
  - Photon ID/purity measurements with template method
  - First verification/measurements of tracker material budget (with Tracker DPG & POG)
  - MC tuning
  - Shakeout of underlying problems from ECAL reconstruction:
    - amplitude reconstruction
    - Clustering
  - and from tracking:
    - P(GSF) versus P(KF)



Muons – up to 10pb^{-1}

- **Single muons: check for possible anomalies as a function of phi, eta and instantaneous luminosity**
  - **May show problems in reconstruction and detector modelling**
- **Di-muons: Use Z, J/ψ and Upsilon to**
  - **determine efficiencies with tag-and-probe**
  - **study momentum scale and resolution**
- **Isolation: validate on-line and off-line isolation strategies; verify how they are affected by the instantaneous luminosity**
- **Alignment: test available alignment constants (from survey; hardware, cosmics) observing their result on the track fit; compute new constants from the data**

JetMET – up to 10pb^{-1} – I

- **Jet Algorithms**
  - ***Validation step:*** **Look at a large number of jet distributions (eta & phi of low Pt jets; eta/phi lego plots for tower and jet occupancies, pT distributions in each subdetector etc), with and without HO (to study the contribution of the HO to jet energies and noise) + investigate events with "too many jets", unexpected high pT. Preparatory work basically done (see PAS on jet performance).**
  - ***Jet energy resolution measurement vs Pt and eta;***
    Test data driven methods to measure energy resolutions from dijets.
  - **Commission "Jet algorithm" and "Jet ID" code with first data. Exercise tools for hot channel removal.**
  - **Jet shapes for all algorithms**

JetMET – up to 10pb^{-1} – II

- **Jet Energy corrections**
  - Validate the MC-truth JEC and estimate uncertainty from data: Look at early dijet and photon/Z+jet data and perform data-closure test to validate the MC-truth JEC; estimate a realistic uncertainty based on the observed deviation from the closure test in data. Replace earlier JEC error with this uncertainty.
  - Use data to derive factorized JEC correction:
    - Offset: Use ZB runs to estimate energies in cones at various eta due to noise and pile-up. Analyze special runs with lower/no ZS/SR to understand impact of ZS/SR on offset energy measurement. Provide input to HCAL/ECAL about level of ZS/SR needed in the special runs. Estimate effect of ZS/SR on a jet.
    - Response eta dependence: use dijet balance technique to derive, study and understand the correction from the actual collision data.
    - Response pT dependence: use gamma+jets events up to pT =~500 GeV and Z+jets events for up to pT=~100 GeV to derive and understand the correction from the actual collision data.
  - Develop, maintain code and implement jet energy correction versions in CMSSW.

JetMET – up to 10pb^{-1} – III

- **MET**
  - **MET software: continuing development/maintenance of the MET objects and algorithms in CMSSW. Automated validation tools for MET + related objects in new CMSSW releases.**
  - **MET commissioning and validation:**
    - **Triggers**
    - **Offline/Online DQM: further development to facilitate the monitoring of MET and identification of problems during data-taking**
    - **MET resolution measurement and optimization using noise, min-bias, inclusive jet, single electron, single muon triggers**
    - **MET clean-up: tools, including hot cell removal**
    - **MET Corrections: data-driven Type I**

JetMET – up to 10pb^{-1} – IV

- **And of course,**
  - **Double "jet work" for JPT and p-flow jets**

B-tag – up to 10pb^{-1} – I

- **Assuming 10^{32} HLT table:**
  - ~2 M Jet events (1,2,3,4 etc HLT paths)
  - ~400 k Jet + mu
- **Expected activities:**
  - Follow / monitor tracking validation.
  - Follow / monitor jets validation
    - Not specific btag POG activities; but extremely important at startup to understand our baseline. Need close contact with DPG & POGs to ensure the quality of the needed objects.
- **Specific bTagging activities:**
  - Software chain validation: process all events offline (a-la T0) and commission code robustness
  - Experience the CondDB infrastructure on ever changing conditions (possibly run by run)
  - Experience the calibration activities (even in a fake mode) at a chosen site, and the uploading of calibrations

B-tag – up to 10pb^{-1} – II

- **Extraction of efficiencies and data already in the first 10 pb-1.**
  - **Studies currently cover some tracker misalignment scenarios**
  - **eventually extract usable calibration data to be inserted in CondDB**
- **Given small amount of statistics from jets and jet+mu, a data-driven extraction of parameters for algorithms which need a calibration (TrackProbability, CombinedSV, SoftLeptons) seems unrealistic.**
  - **That can certainly be tried as a technical test, but most probably the first data-driven calibrations will be for TrackCounting and SimpleSV algorithms.**
- **Much depends on the quality of the data we get: if we have to rely on data with Tracker still aligned as in the Startup Scenario, the separation power b to light-quark jets will be very small and any extraction will be more difficult.**
  - **If Tracker aligns fast at the "10 pb^{-1} level", the separation power will be higher (a factor two worse than the optimal one, but still good) and any extraction from data easier.**

P-flow

- **First collisions:**
  - Control seed threshold, according to noise level.
  - Reconstruct mass of pi0s, when two photons do not merge. Compare to simulation
  - Test the algorithm using real data simple jets. Compare with the simulation and the test beam.
  - MET distribution in zero-bias events. Try to understand the tails.
- **Up to 1 pb^{-1}:**
  - Gamma + jet pT balancing for jet studies
  - MET distribution in QCD events
  - Electrons and muons with onia
- **Up to 10 pb^{-1}:**
  - Z + jet pT balancing for jet studies
  - Z mu mu + jet for MET studies
  - Z e e for electron studies

How to get [more] involved

- **Summary of previous transparencies: most of the work is of the *"compare-check-validate and tune"* type**

- **How to get [even more] involved**
  - **Identify area of interest**
  - **Talk to the conveners**
  - **Visit group twiki/web page**
  - **Talk to the conveners**
  - **Attend group meeting[s]**
  - **Talk to the conveners**

Outlook

Test all that we can ahead of time

October test, running analyses et al

- **Analysis Exercise: run the full chain from end-to-end**
  - Identify subset of first analyses – from the set of early papers – and run the full process end-to-end:
    - Skims, pat-tuples, other group-specific tasks at the designated T2. Goal: produce the final analysis plots.
    - Starting end of the analysis: presence of data at the T1s
    - Pre-requisites: T1 to T2 transfers; T2 to T2 transfers; Skims and pat-tuple registration on DBS….
  - Some very nice examples of possible tests shown today
    - Lots of food for thought
    - Clearly, need a baseline suggestion for how to handle the Monte Carlo files for this exercise. [Joe I to organize]
- **In parallel: need a meeting on PAT/AOD/"analysis" – potentially before the Bologna week**
    - First week in Sept? [Roberto T to organize]
      - ➔ Could even be after Bologna – but getting late?

Sep-Oct exercise: egamma

- **Goal for Egamma POG: "primarily to experience the analysis from the skims we want to use for electrons and photons commissioning at the startup".**
- **Possible exercises using these skims:**
  - **SuperCluster energy corrections and energy scale determination with electrons from Z->e+e-**
  - **Tag & probe using latest PhysicsTools package**
  - **Determination of signal and background PDFs for electron id variables using Z->e+e-**
  - **Determination of purity in an inclusive sample of single electrons**
  - **Determination of purity in an inclusive sample of single photons**
  - **Also considering something connected low-mass resonances; but need more work on "analysis" – understand how much background, how to optimize the selection, which trigger to use…**

Thoughts (instead of a summary)

- **It will be really exciting to get a jet cross section and a Z peak in pp collisions – even at 8 TeV.**
  - **[It'll be even more exciting at 10 TeV…]**
- **The first 10pb^{-1} will be a crucial period/chunk for the experiment**
  - **Our success will depend on the strength of the DPG-POG-PAG link(s)**
  - **Please get involved in as early a phase [of the analysis] as possible. There will be no top signal if the muons are not understood. [Or the jets, or…]**
- **There remain a lot of things we need to do before beam**
  - **Need to prepare well the "Sep-Oct test". Think of YOUR workflow. Talk to the group conveners.**