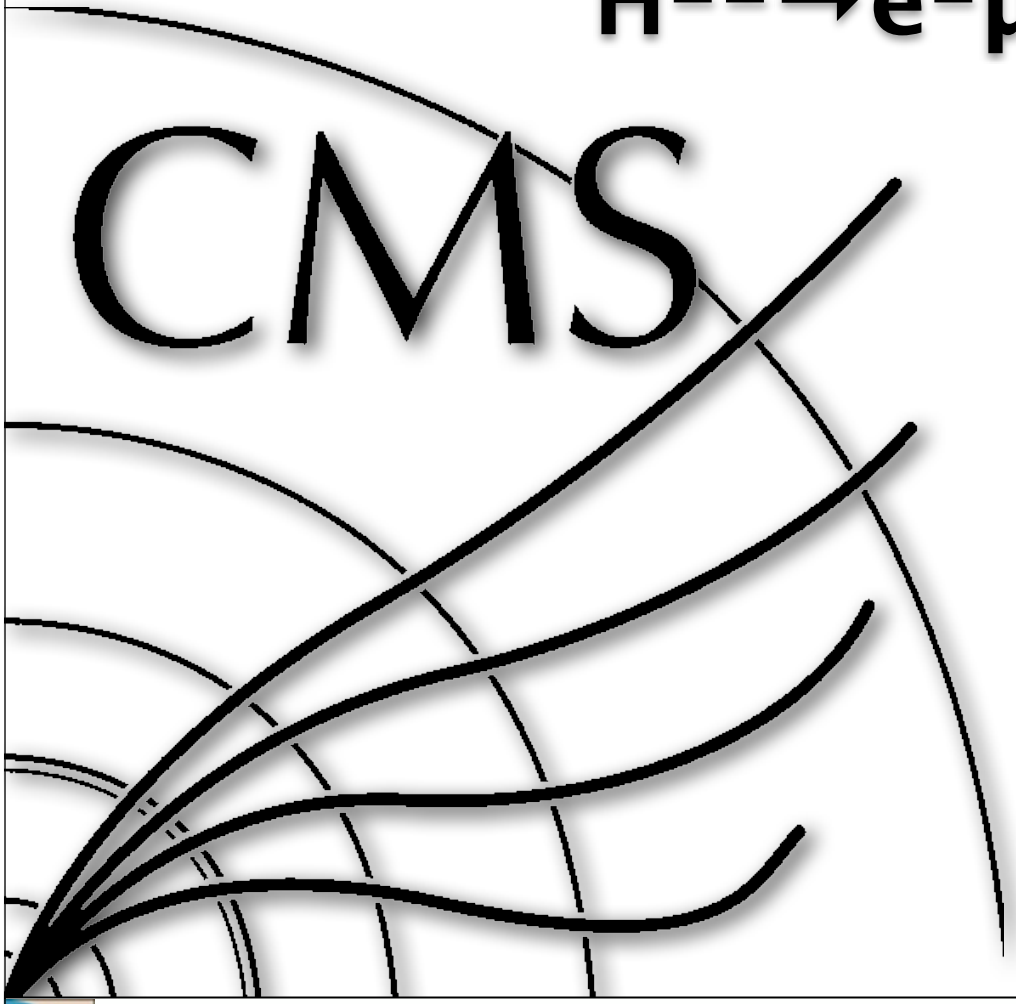
$H^{\pm\pm} \rightarrow e^{\pm}\mu^{\pm}$ channel study



DH Working Meeting
John Goh (SKKU)
2010.06.30

Works done in 2XY era

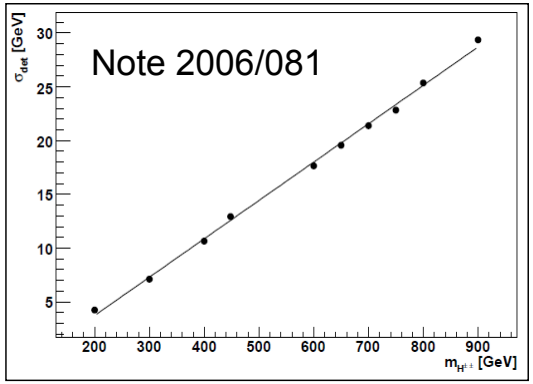
- Many things were ongoing since 2XY era
- Basic setup for the analysis
  - MC production test at local cluster to Tier2 including dataset publication
  - Common PYTHIA parameters
  - Generator level studies
  - Trigger studies
  - Cut based study, MVA analysis
  - Statistical interpretation : limit calculation without systematic study
- Good results, nice exercises to start real analysis

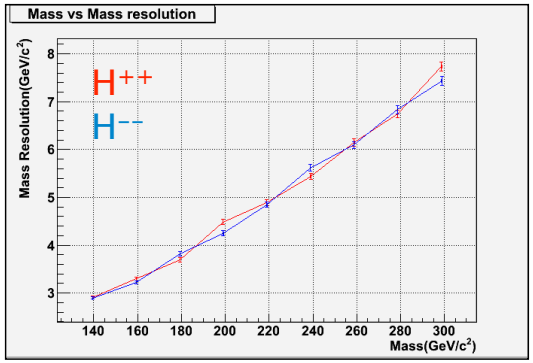
2XY analysis in eμ channel

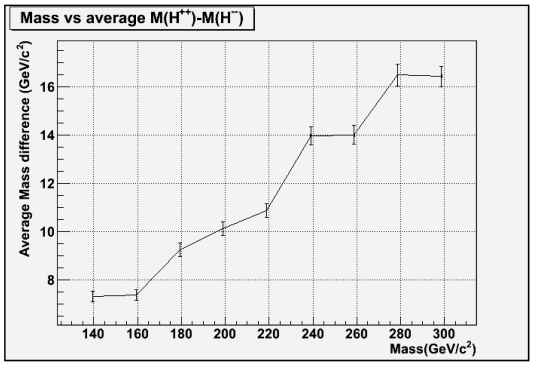
- Set-up basic codes, 4-mu channel as a starting point
  - Jongseok studied 4-muon channel so far, even got (preliminary) statistical interpretations
  - Obviously, 4-mu channel is most clean and probable
  - So we can start from 4-mu channel, synchronizing results from different methods
    - This will be changed to unified code base, at least SKKU group
- Basic analysis scheme
  - Started from private codebase, PAT based
  - Minimum mass difference candidate selection or mass difference significance as a cut
  - Quick scan on various cut variables, but not finished
    - Due to SW upgrade and lack of background samples, etc
  - Precut variables defined by 4-mu study, common sense, guess - studies were planned

Results from 2XY : Mass resolution

- The mass resolution increases (almost) linearly with respect to the Higgs mass
- The slope of curve looks similar to the 2006/081 study
  - Previous one is slightly steeper than this result, but more MC samples could be needed, especially in high mass region
    - Actual shape of dilepton mass depends on lepton flavor combination – different behavior of electrons/muons : mass fit functions to be studied
- Mass difference can be used in candidate selection
  - If we require on-shell conditions, H-- should have same mass (up to decay width & detector resolution)
    - Additional cut variable or best candidate selection



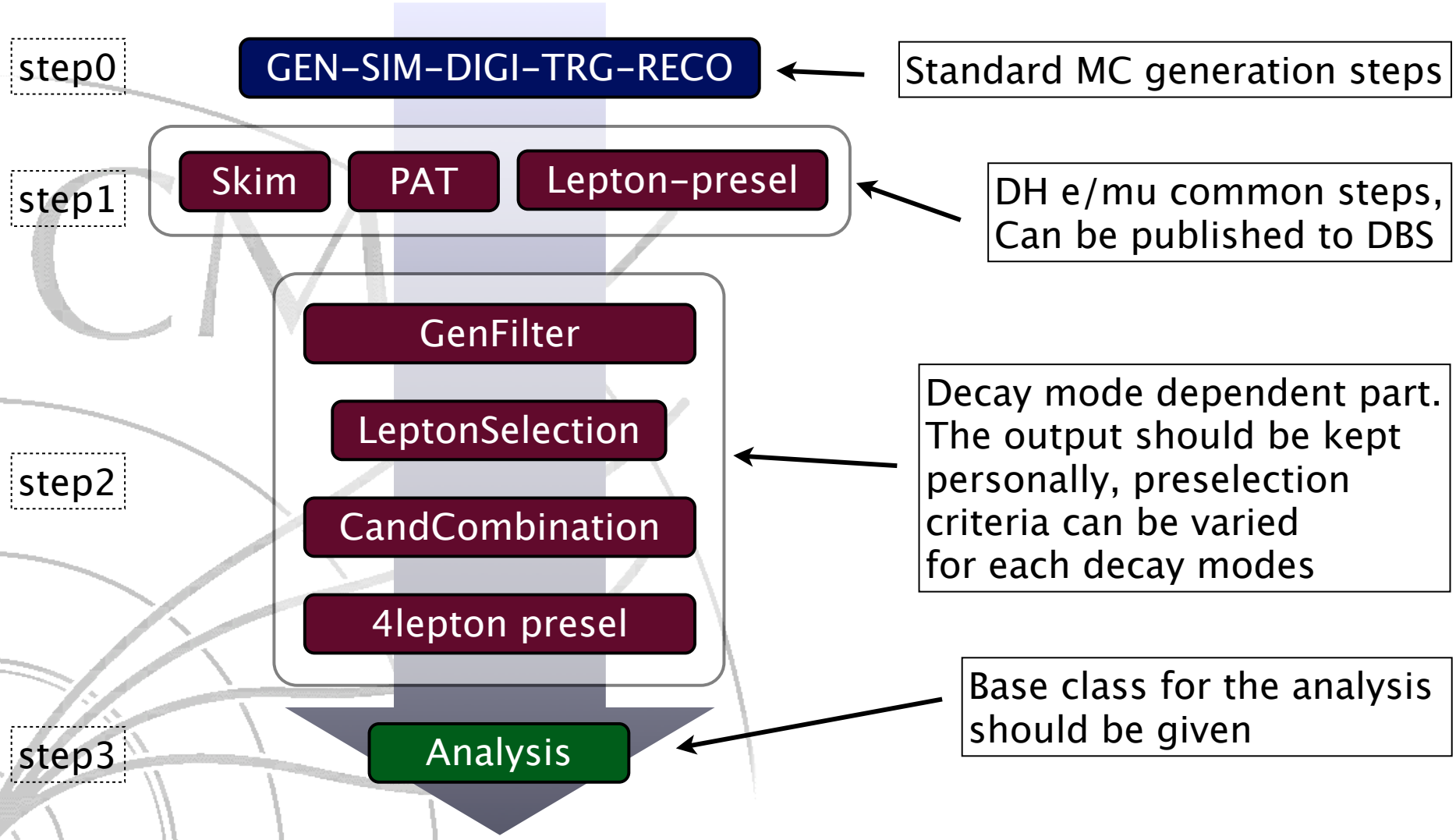




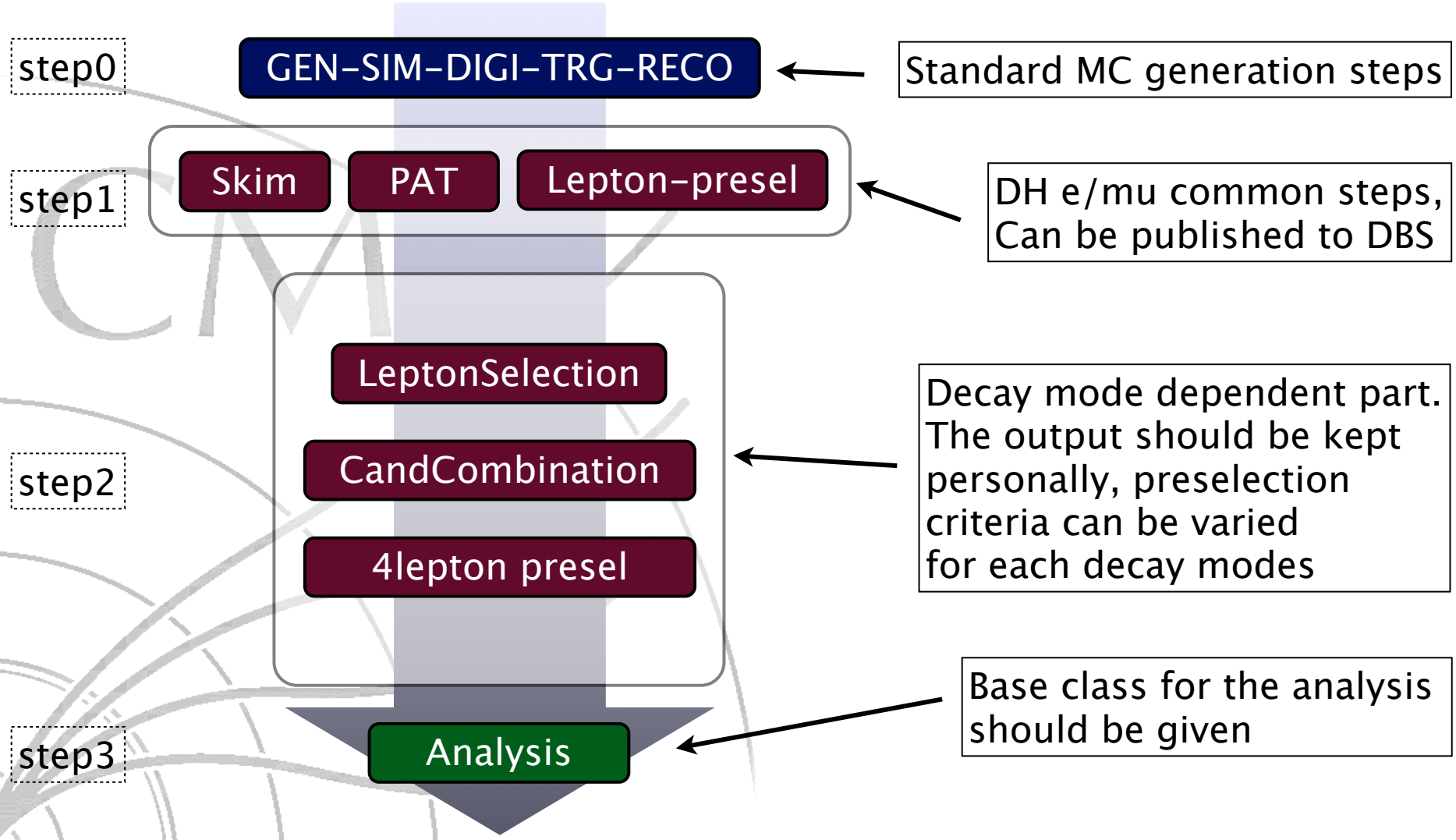
Switching to 3XY analysis

- The real data is coming with new energy values and new SW versions
  - Moving to 3XY release is mandatory
  - Early actions moving to 3XY started, including common framework / workflow setup
- Also there were long discussions on collaboration
  - Many efforts by Estonian group
  - Also many helps from Nicola
  - Common analysis framework setup, sample generation and handling
- Setting up common analysis framework
  - Focused on electron/muon channels, no taus for SKKU people
  - Aiming to provide common MC selection, pre-selection criteria, etc
    - Fortunately, we agreed to use common MC signal samples, generated/ hosted by Estonian T2
    - Korean T2 also available, some background samples already hosted + trying to store skim samples there

Proposal for workflow (MC, Signal)



Proposal for workflow (MC, Bkg)



Missing blocks

- Trigger studies
  - Here we did not made decision which trigger paths to be used, so I omitted event filtering in this dataflow
    - User should filter by checking HLT bit for now
    - Should be plugged in somewhere in step1 or step2 : one should ask dependency on decay mode
  - Trigger studies should be done independently in this dataflow
    - MC based study of course, but also data based one
    - Using HZZ trigger path is most trivial and clear, but HWW also possible choice (Estonian group strategy). We need cross-checking
- Workflow for real data
  - Lack of experience on dealing with real data
  - In practice, where/how to store files for continuously increasing dataset?
  - MC matching removal, Primary dataset decision, EventContent decision, etc

Workflow organization

- We've been started to collect wishlist, organize modules, source codes, development area
  - CVS already set up : UserCode/HiggsAnalysis/DoublyChargedHiggs
  - Filling up missing blocks
- Needed features and status
  - Step1/Skim
    - Implementation by HZZ group already in CMSSW : HiggsAnalysis/Skimming
    - Possible to give HLT conditions (to be applied after HLT decisions done)
  - Step1/PAT
    - Configurations already in CMSSW
    - Some modification needed to process Summer09-rereco samples
  - Step1/Lepton preselection
    - Fully customizable module already in CMSSW : PATMuonSelector and PATElectronSelector
    - Cut selection via StringCutParser interface
  - Step1/EventContent (More description in backup)
    - Use (patEventContent+patExtraAodEventContent+goodPatLeptons)

Workflow organization

- Needed features and status
  - Step2/GenFilter
    - Implemented a fully configurable Gen level event filter module : DHGenEventFilter.cc in UserCode/JHGoh
    - Alternative choice by Mario (I don't know details)
  - Step2/Decay mode dependent Lepton selection
    - PAT*Selector still working here. Users should give feedback on the cut values based on their cut studies
  - Step2/Candidate combination
    - There's standard module "Cand*Combiner" but I made a module "DileptonProducer" to extend to cover vertex fitting
    - No 4-lepton combination here
  - Step2/4-lepton preselection
    - This is missing block
    - A RECO based event filtering module is needed which should be fully configurable

Common steps

- Checkout source trees and build

```
cmsrel CMSSW_3_5_6_patch1
cd CMSSW_3_5_6_patch1/src
cmsenv
cvs co -d HiggsAnalysis/DoublyChargedHiggs UserCode/JHGoh/HiggsAnalysis/DoublyChargedHiggs
cvs co HiggsAnalysis/Skimming
scram build
```

- Process step1 : Common selection step

```
cd ${CMSSW_BASE}/src/HiggsAnalysis/DoublyChargedHiggs/test/commonSelection
## Write your crab.cfg, create, submit, publish
crab -create; crab -submit; crab -get; crab -publish; crab -clean
```

- Process step2 : Candidate building and selection

```
cd ${CMSSW_BASE}/src/HiggsAnalysis/DoublyChargedHiggs/test/candSelection
## Prepare some place files to be stored. For me, I prefer this directory structure
rfmkdir -p ${CASTOR_HOME}/HiggsAnalysis/DoublyChargedHiggs/${CMSSW_VERSION}/PAT/DBLH-m100
rfchmod 775 ${CASTOR_HOME}/HiggsAnalysis/DoublyChargedHiggs/${CMSSW_VERSION}/PAT/DBLH-m100
## Write your crab.cfg, create, submit
crab -create; crab -submit; crab -get; crab -clean
```

- Process step 3 : Do the analysis

Output from 1st step

DBS instances cms_dbs_ph_analysis_02 HELP

find dataset where dataset like *DBLH*jhgoh* and dataset.status like VALID* Search Reset

DBS discovery :: Adv. search :: Results

Found 10 results. Show all View results: grid | list mode

/DBLH-m100-AllChan-MC_3XY_V18/jhgoh-DBLH-m100-AllChan-MC_3XY_V26_356_HZZSkimPat-6929b9db06426e79b16aaa3cae2a9aa3/USER

Created 18 Jun 2010 02:58:29 GMT, contains 7122 events, 5 files, 1 block(s), 395.5MB, located at 1 site (show, hide), LFNs: cff, py, plain , $\int L$=N/A

Release info , Block info , Run info , Conf. files , Parents , Children , Description , PhEDEx , Create ADS , ADS , crab.cfg

Location	Events	Files	size	LFNs
T2_KR_KNU : cluster142.knu.ac.kr	7122	5	395.5MB	cff plain

/DBLH-m110-AllChan-MC_3XY_V18/jhgoh-DBLH-m110-AllChan-MC_3XY_V26_356_HZZSkimPat-6929b9db06426e79b16aaa3cae2a9aa3/USER

Created 18 Jun 2010 07:44:31 GMT, contains 7308 events, 5 files, 1 block(s), 407.3MB, located at 1 site (show, hide), LFNs: cff, py, plain , $\int L$=N/A

Release info , Block info , Run info , Conf. files , Parents , Children , Description , PhEDEx , Create ADS , ADS , crab.cfg

Location	Events	Files	size	LFNs
T2_KR_KNU : cluster142.knu.ac.kr	7308	5	407.3MB	cff plain

/DBLH-m120-AllChan-MC_3XY_V18/jhgoh-DBLH-m120-AllChan-MC_3XY_V26_356_HZZSkimPat-6929b9db06426e79b16aaa3cae2a9aa3/USER

Created 18 Jun 2010 07:45:02 GMT, contains 7479 events, 5 files, 1 block(s), 418.5MB, located at 1 site (show, hide), LFNs: cff, py, plain , $\int L$=N/A

Release info , Block info , Run info , Conf. files , Parents , Children , Description , PhEDEx , Create ADS , ADS , crab.cfg

Location	Events	Files	size	LFNs
T2_KR_KNU : cluster142.knu.ac.kr	7479	5	418.5MB	cff plain

/DBLH-m130-AllChan-MC_3XY_V18/jhgoh-DBLH-m130-AllChan-MC_3XY_V26_356_HZZSkimPat-6929b9db06426e79b16aaa3cae2a9aa3/USER

Created 18 Jun 2010 07:44:52 GMT, contains 7656 events, 5 files, 1 block(s), 430.9MB, located at 1 site (show, hide), LFNs: cff, py, plain , $\int L$=N/A

Release info , Block info , Run info , Conf. files , Parents , Children , Description , PhEDEx , Create ADS , ADS , crab.cfg

Location	Events	Files	size	LFNs
T2_KR_KNU : cluster142.knu.ac.kr	7656	5	430.9MB	cff plain

Output from 2nd step

```
[jhgoh@lxplus316 ~]$ rfdir /castor/cern.ch/user/j/jhgoh/HiggsAnalysis/DoublyChargedHiggs/CMSSW_3_5_6_patch1/MC_Signal_EMEM
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:18 DBLH-m100
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:16 DBLH-m110
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:16 DBLH-m120
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:16 DBLH-m130
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:19 DBLH-m140
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:16 DBLH-m150
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:16 DBLH-m160
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:15 DBLH-m70
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:19 DBLH-m80
drwxrwxr-x   4 jhgoh    zh                0 Jun 24 08:18 DBLH-m90
[jhgoh@lxplus316 ~]$ rfdir /castor/cern.ch/user/j/jhgoh/HiggsAnalysis/DoublyChargedHiggs/CMSSW_3_5_6_patch1/
MC_Signal_EMEM/DBLH-m110
-rw-r--r--   1 cms003   zh          41735187 Jun 24 08:16 DHCand_1_1_47d.root
-rw-r--r--   1 cms003   zh          40322482 Jun 24 08:16 DHCand_2_1_4cp.root
-rw-r--r--   1 cms003   zh          37131025 Jun 24 08:16 DHCand_3_1_hTL.root
-rw-r--r--   1 cms003   zh          25549092 Jun 24 08:15 DHCand_4_1_IpR.root
```

Summary and Plans

- Moving to the 3XY analysis
  - Building common analysis framework for SKKU group
  - Getting wish-lists, discussions
- Stabilizing common selection procedures
  - Applied common selection procedures to the signal samples
  - Ongoing for the background samples
  - Planning application to the real data
- Implementation of base class of analysis code to be started
  - Support FWLite; check PF group's idea
  - Test code already exists, but should be generalized to various decay modes
  - Should give common interface, but not meaning the "master code"