

WF ANALYSIS based on SIEGLINDE

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- **TWR Data 2003**
- **Teragrid: Merging and Filtering**
- **Strategy of a WF analysis**
- **Sieglinde: comparison with Muon-DAQ**
- **Some MC data (Signal and BG)**

IceCube Collaboration Meeting in Berkeley, March 2005

TWR data 2003

- Entire data set 2003 (**over 15 TB**) to **SRB system**
- TWR DAQ data filtering? :
 - TWR-reader and Siegliende: but TWR-reader wasn't available yet.
 - **Merging L1-filter Muon-DAQ data with TWR-DAQ data**
- Muon DAQ data filtered at L1 by the Zeuthen group
 - **Solution**: entire TWR - data (filtering – processing –merging) done using **TeraGrid**
 - **Not trivial work**: a lot of effort to develop new set of scripts to process 15TB of data in a reasonable amount of time.

THE TERAGRID CLUSTER

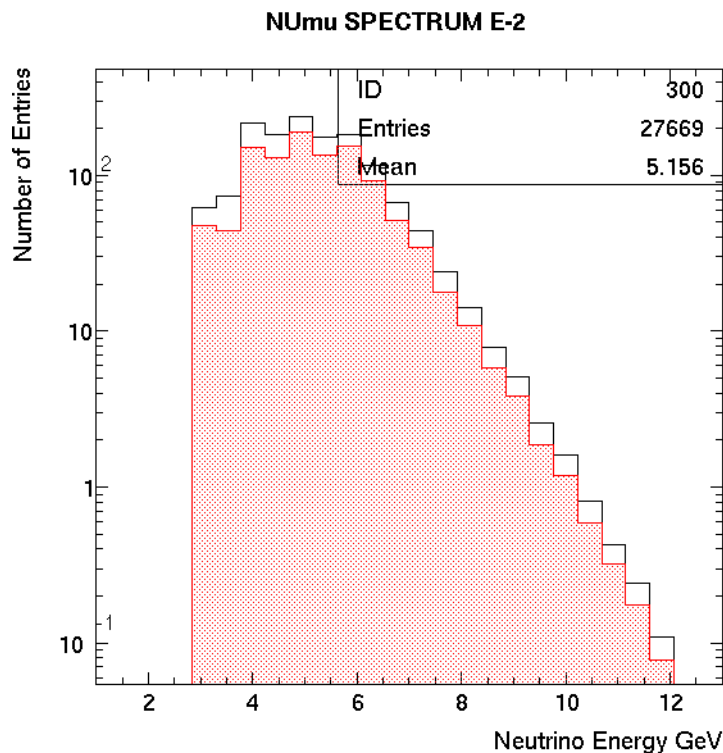
COMPONENT	DESCRIPTION
Architecture	Linux Cluster
Access Nodes	quad-processor ECC SDRAM memory: 8 GB 2 nodes (8 processors)
Compute Nodes	dual-processor ECC SDRAM memory: 4 GB 256 nodes (512 processors)
Processor	Intel® Itanium® 2, 1.3 GHz Integrated 3 MB L3 cache Peak performance 10.4 Gflops
Network Interconnect	Myrinet 2000, Gigabit Ethernet, Fiber Channel
Disk	1.6 TB NFS
Operating System	Linux 2.4.19-SMP (SuSE SLES 8.0)
Compilers	Intel: Fortran77/90/95 C C++ GNU: Fortran77 C C++

WF data 2003

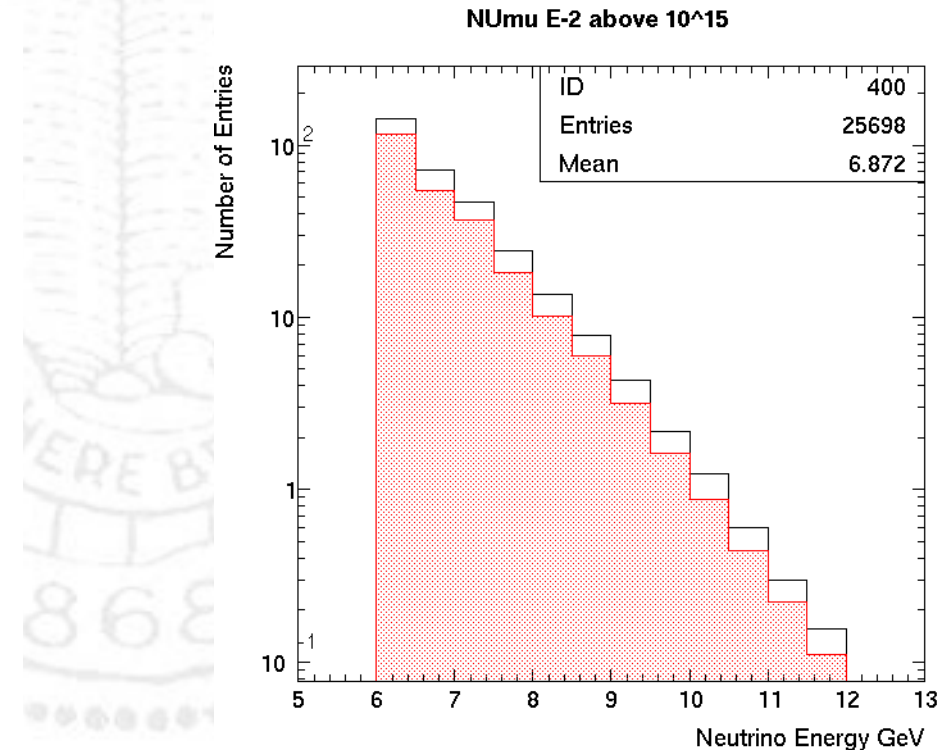
- Merging L1 muon DAQ data:
 - Deficit of 25-30% of merged events due to different trigger configuration (only amab-Tr)
 - Merging an event -> same GPS time and OM-hits configuration
- All L1 data 2003 merged: ~ 3TB (uncompressed)
- 20% of data available online:
 - <http://www.ps.uci.edu/~silvestri/DATA-PROCESSING-2003.html>

How useful are the L1 merged WF data

- Standard Zeuthen L1-filter = multiple streams
 - Problem? Was the HE-filter a too hard cut? **YES**
 - Only 45% (ANIS) signal survives ($\sim 1\%$ BG) (data)
- **BUT:** Considering all streams? **76% of signal passes and $\sim 80\%$ signal above 10^{15} eV.**



ANDREA SILVESTRI



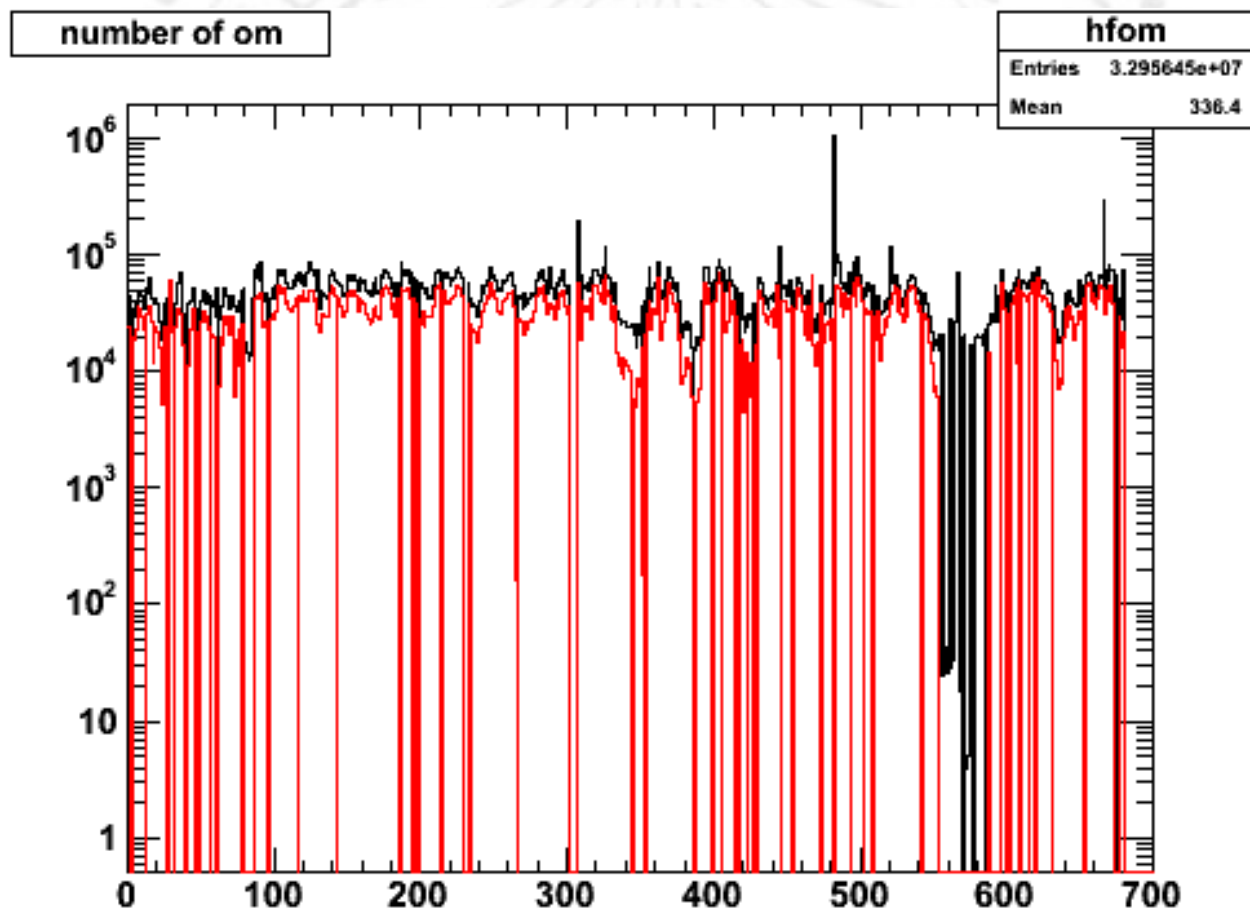
ICECUBE COLLABORATION MEETING MARCH 2005

Comparison Muon-TWR data

- **Analysis goals:**
 - Comparison of key variables for both DAQs
 - Are the TWR-DAQ and Muon-DAQ equivalent?
 - **If yes, great!**
 - If not let's try to understand what causes the discrepancies
 - **Assumption (for possible discrepancies):**
 - ❖ Data 2003: Multiplicity = 24
 - ❖ Operating Muon DAQ OMs ~ 620
 - ❖ Operating TWR DAQ OMs ~ 575
 - ❖ TWR DAQ fragmentation of WFs
 - ❖ Muon DAQ trigger, the same for TWR DAQ.
 - ❖ BUT: TWR additional threshold algorithm to find the peaks.
- **Comparison with EXP. – data, BG-MC and Signal-MC data.**

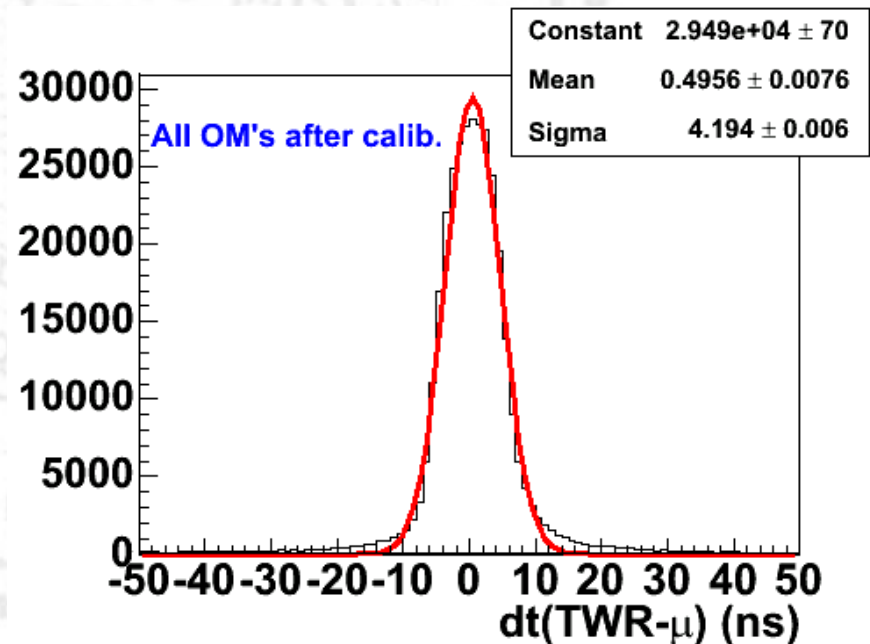
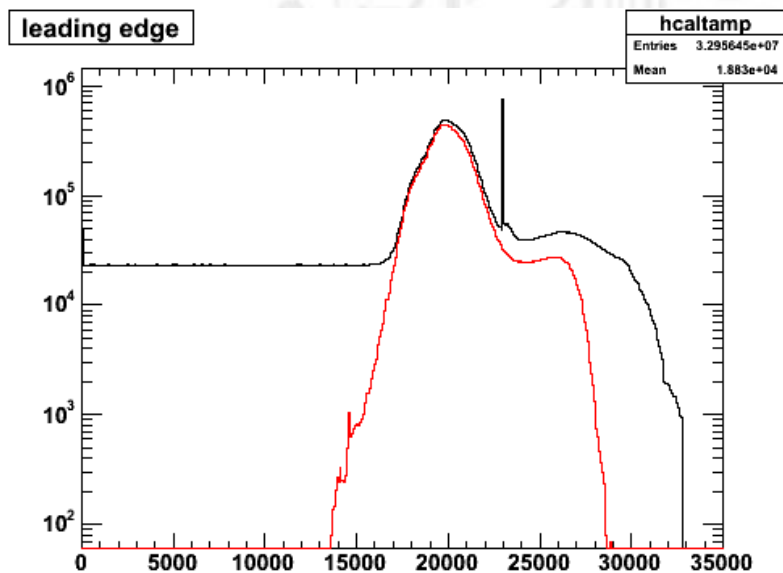
OM distribution

- All raw hits of all OMs.
- Hits missing sporadically everywhere, (TWR string 17 missing)
- **First indication: TWR-data is missing more hits than Muon-data**



Timing Resolution

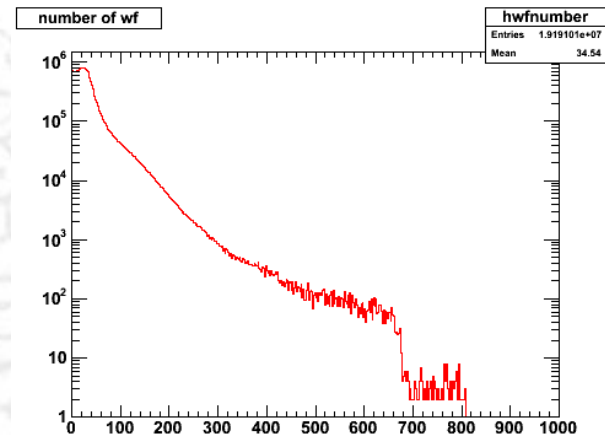
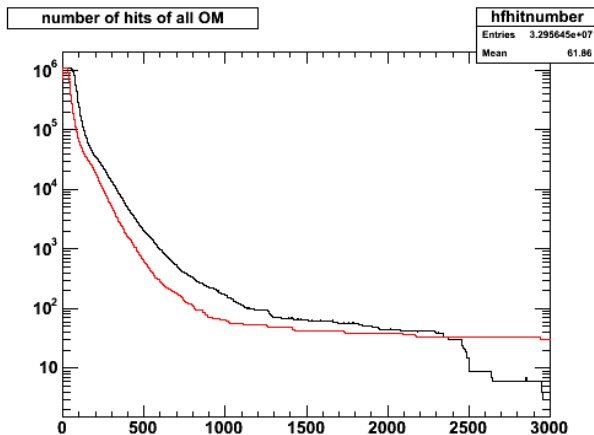
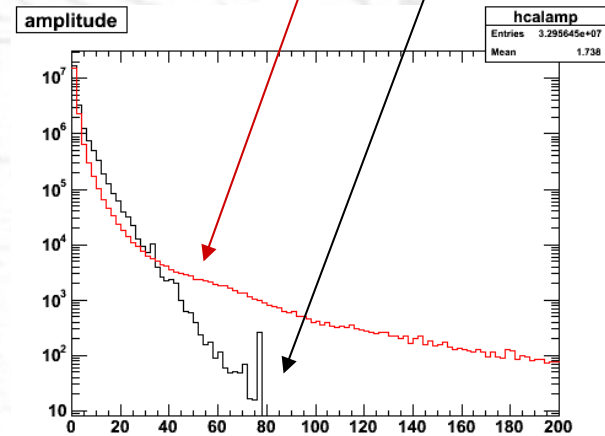
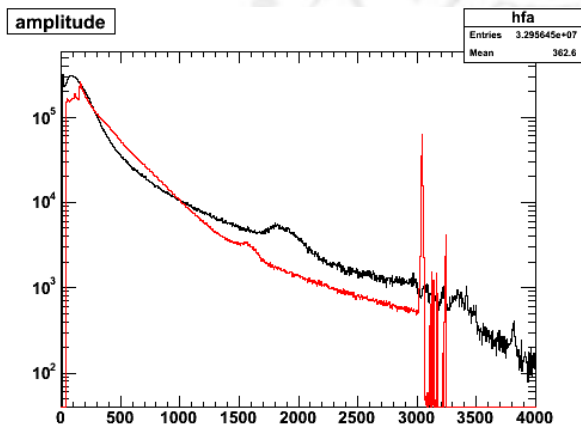
- Analysis based on sieglinde.
- Sieglinde widely developed and checked for Muon data set, **but not as well for TWR data.**
- First problems encounter on calibration: (timing calc. and alpha correction)
- **SLART** now working with TWR (Jiwoo)
- **CLASSIC** still to be updated
- **WF with SLART ~ 4 ns timing resolution**



EXP: Basic Variables

- TWR data limited at ~ 3000 mV
- **BUT: large improvement with calibrated charge compared to pADC.**
- NHits distribution and number of WF fragments.

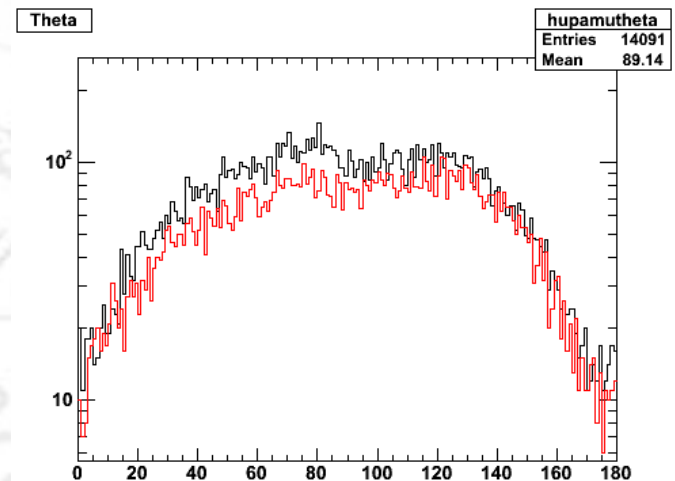
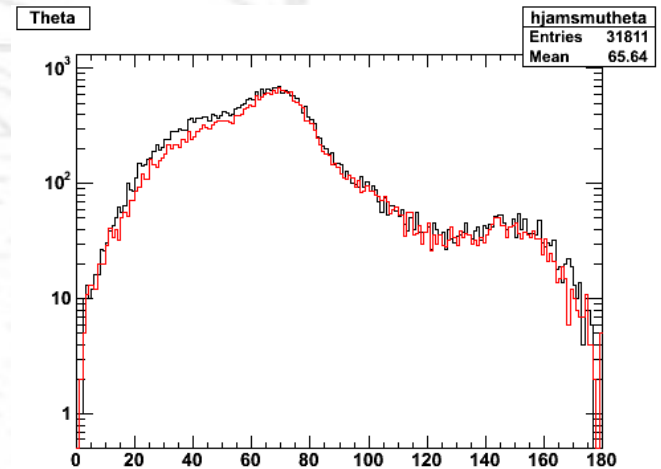
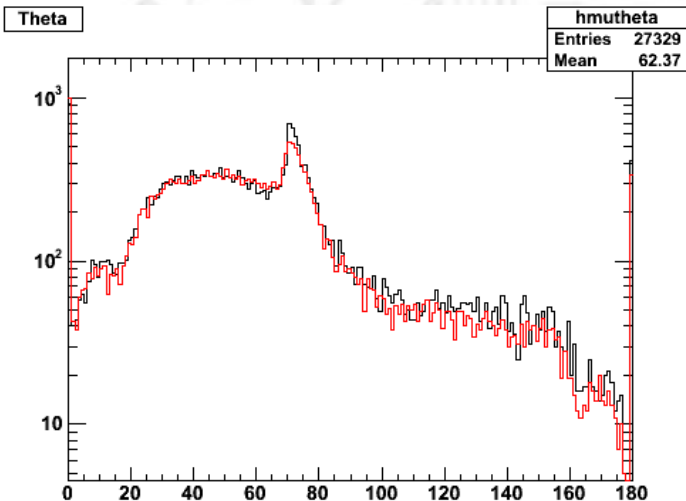
RED = WF data | BLACK = Muon data



EXP: Zenith Reconstruction

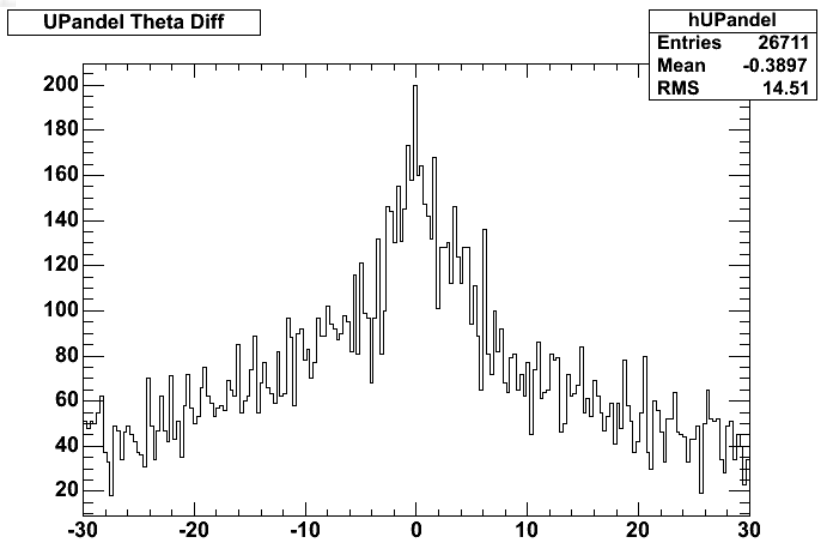
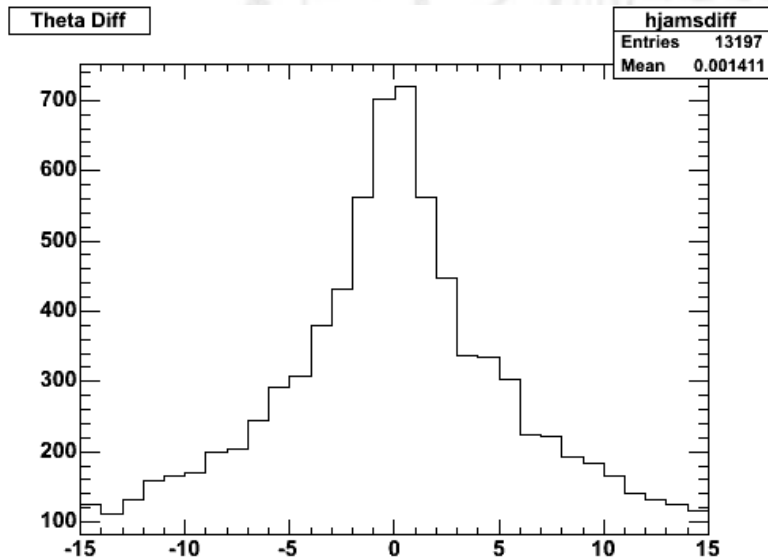
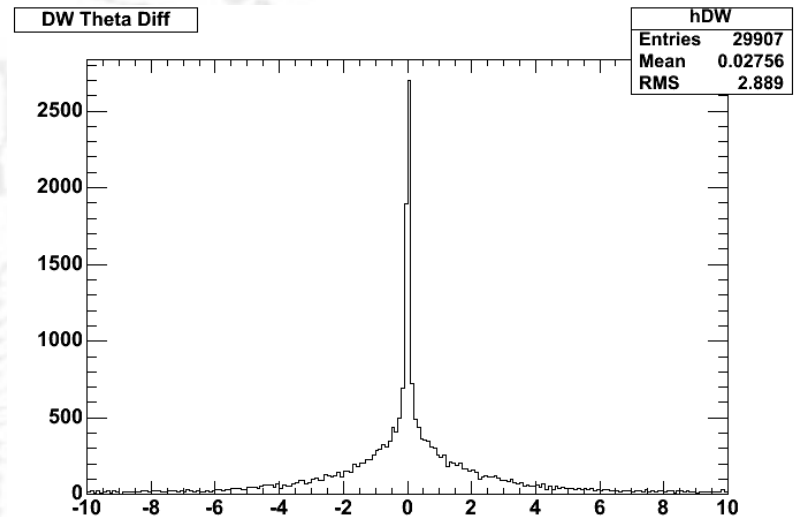
RED = WF data | BLACK = Muon data

- Sieglinde reconstruction: three methods:
 - Direct Walk; JAMS; UPandel
- Promising results for a first comparison, **but** still room for improvement



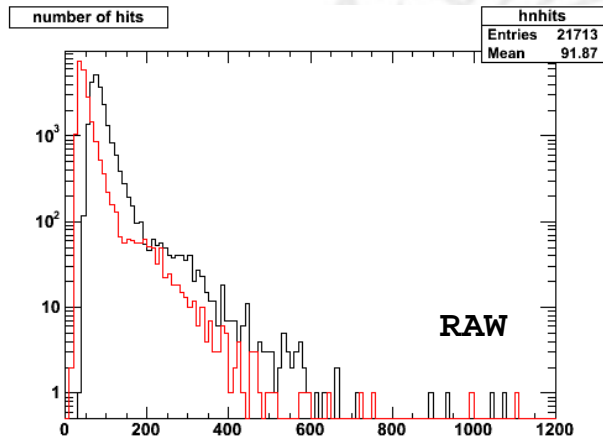
EXP: Deviation of Reconstructions

- Difference of those variables still shows discrepancies
- But we are comparing just after L1 filter

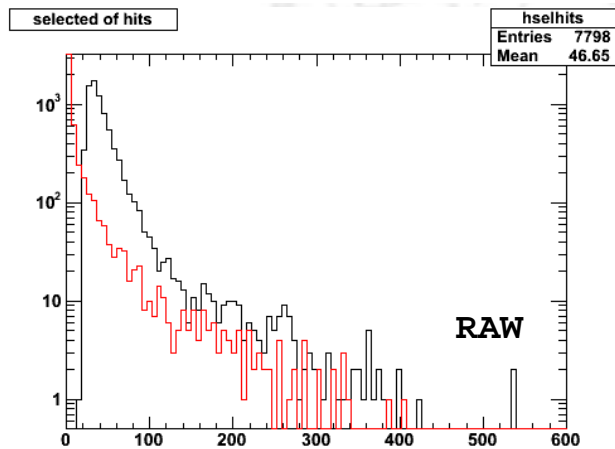
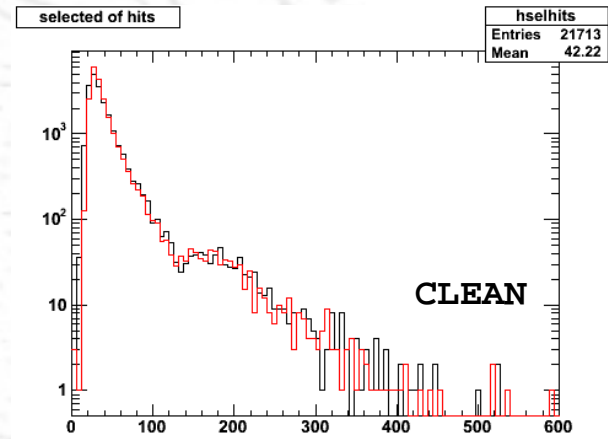


EXP & BG MC Comparison

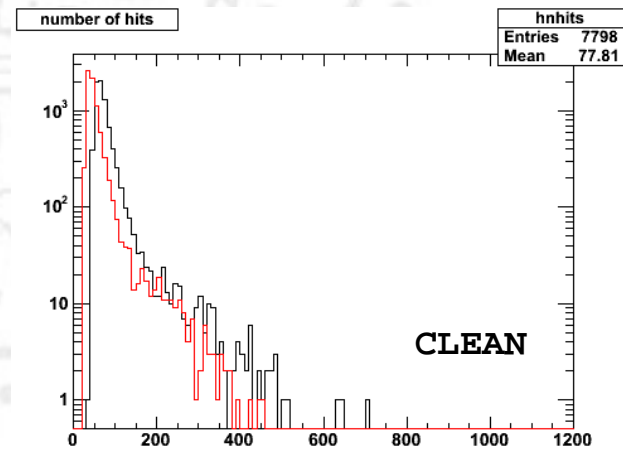
- Muon Raw NHits distribution shows a not understood shift compared to **TWR**.
- **Shift disappears after calibration and hit cleaning**
- **MC still have problems: probably just wrong calibration constants... to be investigated**



Experiment

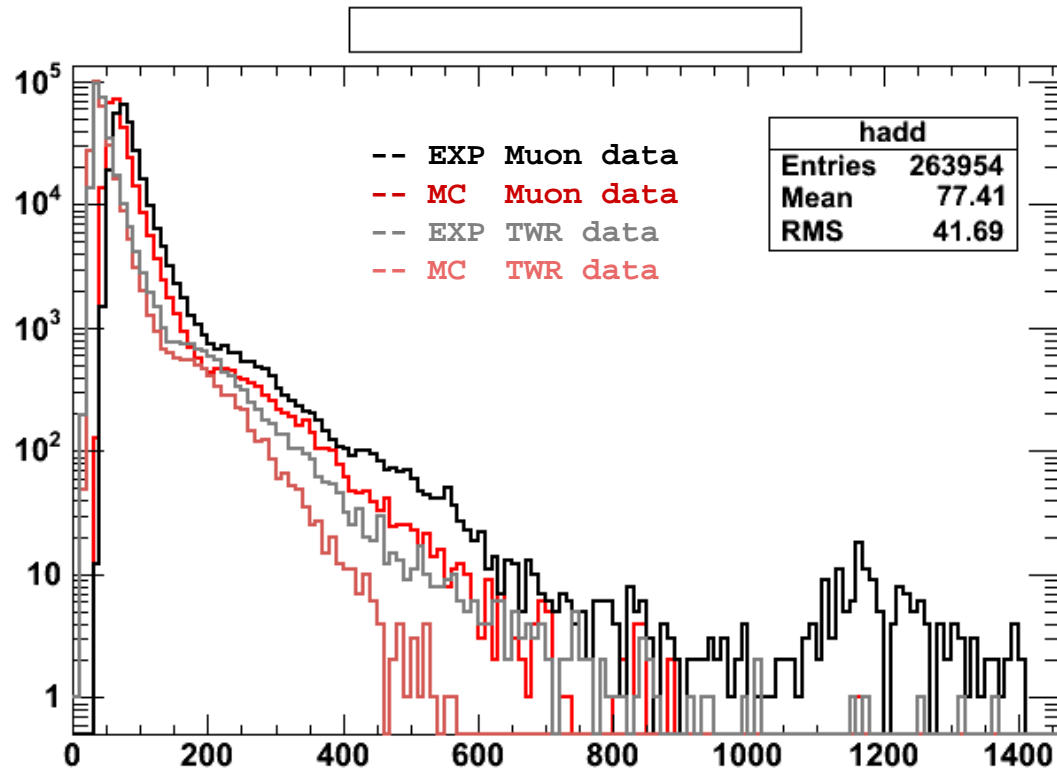


Monte Carlo



BG MC: Basic Variables

- MC generation: **DCorsica -> MMC -> AMASIM**
- **One day of generated WFs compared with ~ one day of Exp. Data.**
 - Large computing resource demanded: 1 day ~ 10000 CPU hours
- Raw NHits distribution: **MC ~ 30% deficit**



BG MC: Zenith Reconstruction

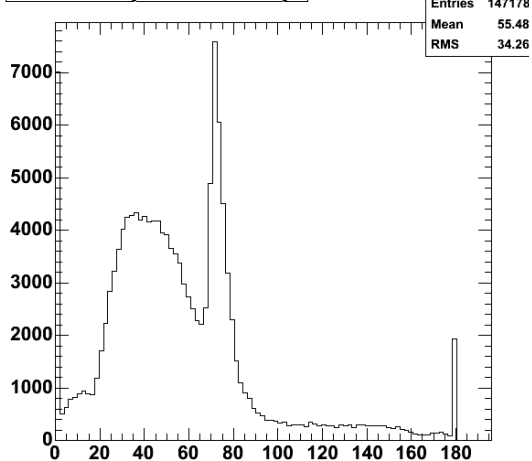
MC reconstruction still shows problems:

- Angular resolution for Muon data to be investigated at higher level
- TWR data still to be optimized: MC WFs have different baseline-thresholds:
 - now lots of hits are lost

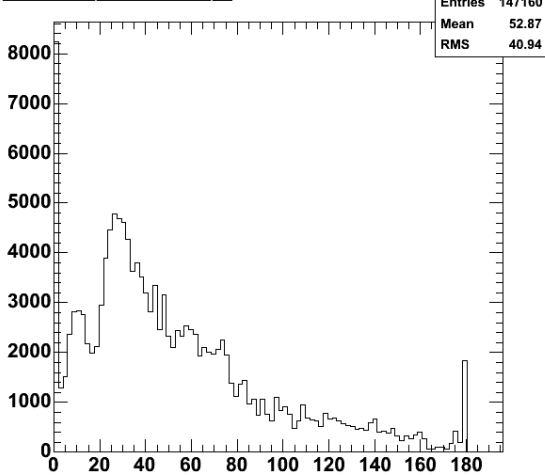
Muon data

WF data

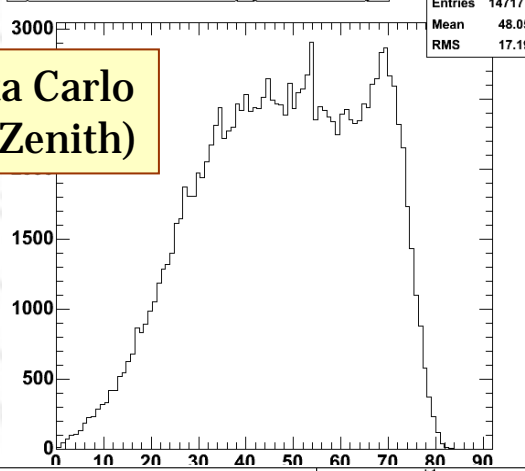
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DWwf {DWwf>0.0}

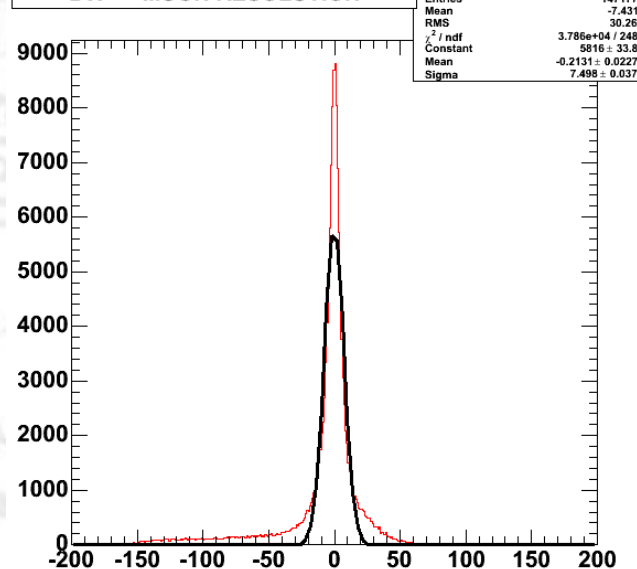


{ttheta*57.29577951} {ttheta>0.0}



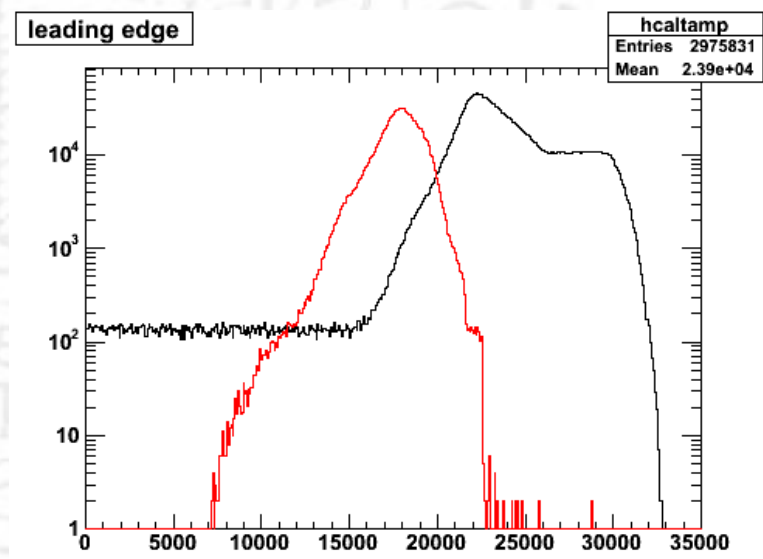
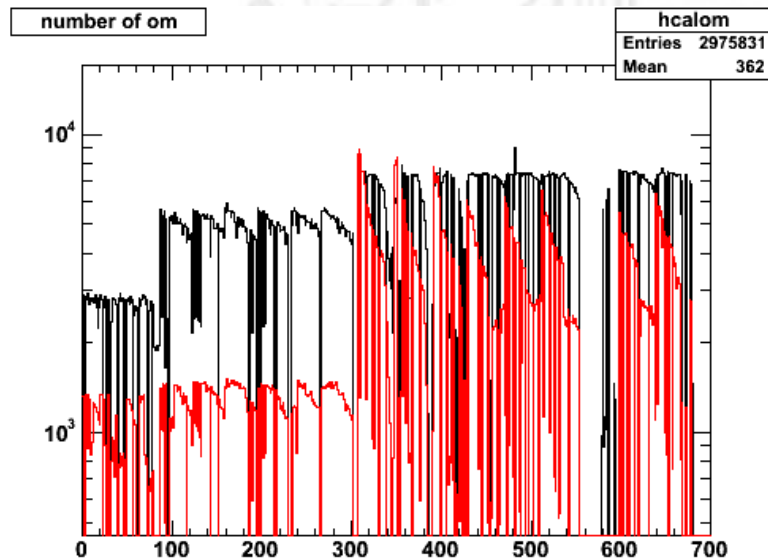
Monta Carlo
(true Zenith)

DW MUON RESOLUTION



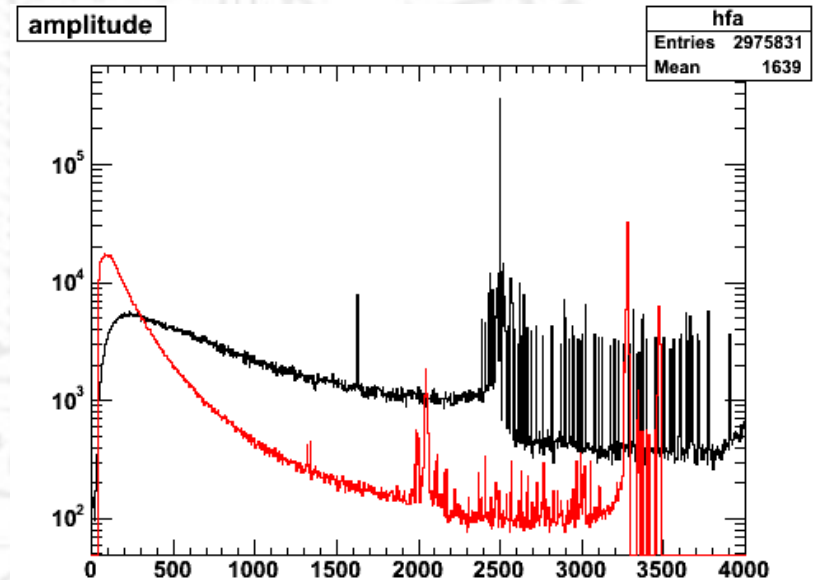
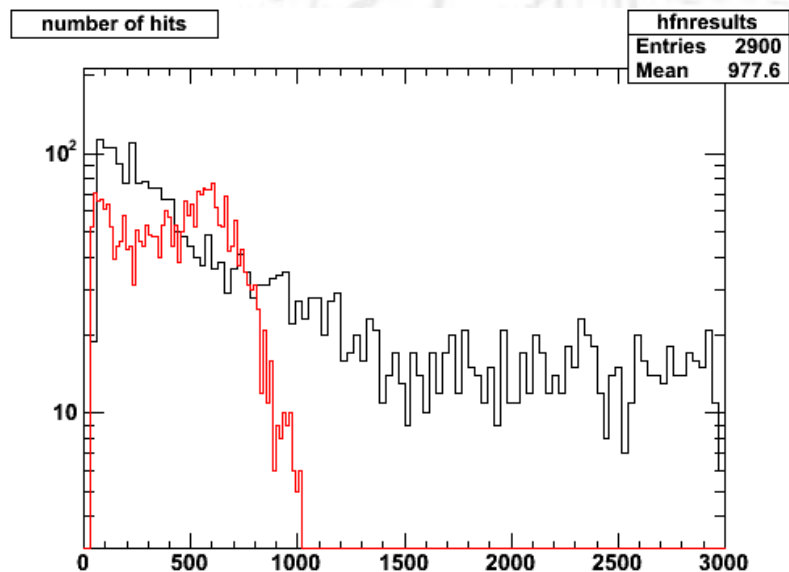
Signal MC: Basic Variables

- **Signal MC: large hits deficit on all OMs by a factor 2-4**
- Indicates that generated WFs for bright events need to be improved
 - **Displaying and comparing WF with laser data might help**
- LE time distribution: shifted by a constant value



Signal MC: Basic Variables

- Truncated hits distribution
- Large discrepancy in the amplitude as well



What Next

- **Goal: We want to trust the TWR data**
- **Some methods and strategies to prove it:**
 - **Point Source Muon data analysis 2003 ~ 1000 nu's**
 - **If TWR reco works we should be able to pull out same nu-sample, or its subsample (~ up to about 80%)**
- **MC generating WF:**
 - **BG MC -> investigate and improve angular resolution**
 - **SIGNAL MC -> improve WF generation for high energy**
- **Once TWR data understood:**
 - **More complicated and independent analyses based on WFs data → develop new tools for UHE analysis.**
- **It looks promising...**