Necesidades de Cálculo para los del Grupo Tilecal

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for the TileCal group

Valencia/ATLAS meeting, 24/09/07

Overview

- Overview of Activities and Requirements from the TileCal group
- Overall Considerations w.r.t. the Tier3
- Express and Calibration streams
- Towards a Distributed Analysis Model for a Tier3
  - Xrootd/PROOF

Overview of Activities

- The following are the activities that are/will drive the computing needs of the group
  - ROD production and commissioning
    - TDAQ issues & Pre-Rod production
  - TileCal commissioning
    - Hadronic Calibration
      - Optimal filtering & Tails in MET
    - Level2 Muon trigger
      - CSC Trigger muon note
  - Physics Analysis
    - MSSM Higgs with $H/A \rightarrow \mu\mu$
      - CSC note HG8. Thesis of A.Ruiz
    - MSSM Higgs with $H/A \rightarrow \tau\tau$
      - CSC note HG7. Thesis of C.Solans
    - Inclusive SUSY with lepton veto
      - CSC note SUSY5 & SUSY3 Thesis of X.Poveda

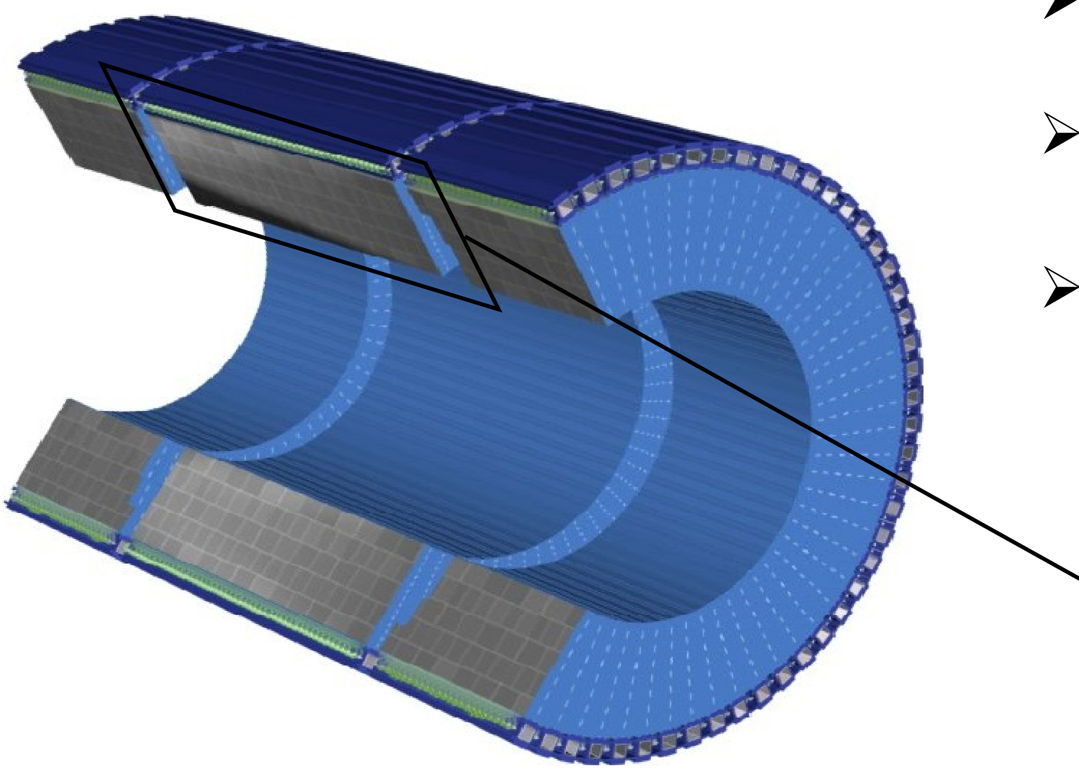
Work within the ATLAS TileCal Community

Work within the ATLAS Higgs Working Group

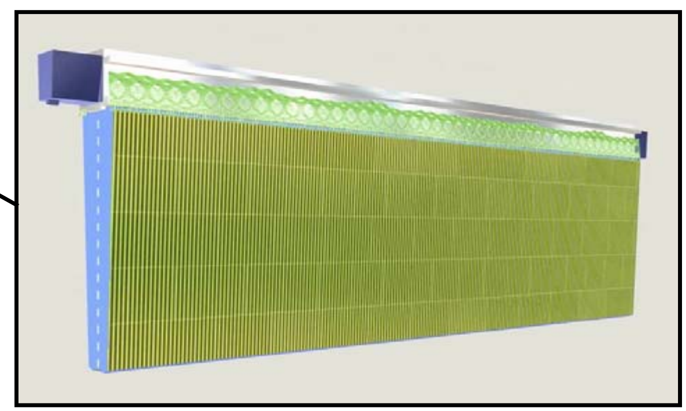
Work within the ATLAS SUSY Working Group

El Calorímetro Hadrónico TileCal

Calorímetro de muestreo formado por hierro (material pasivo) y tejas de plástico centelleador (material activo)



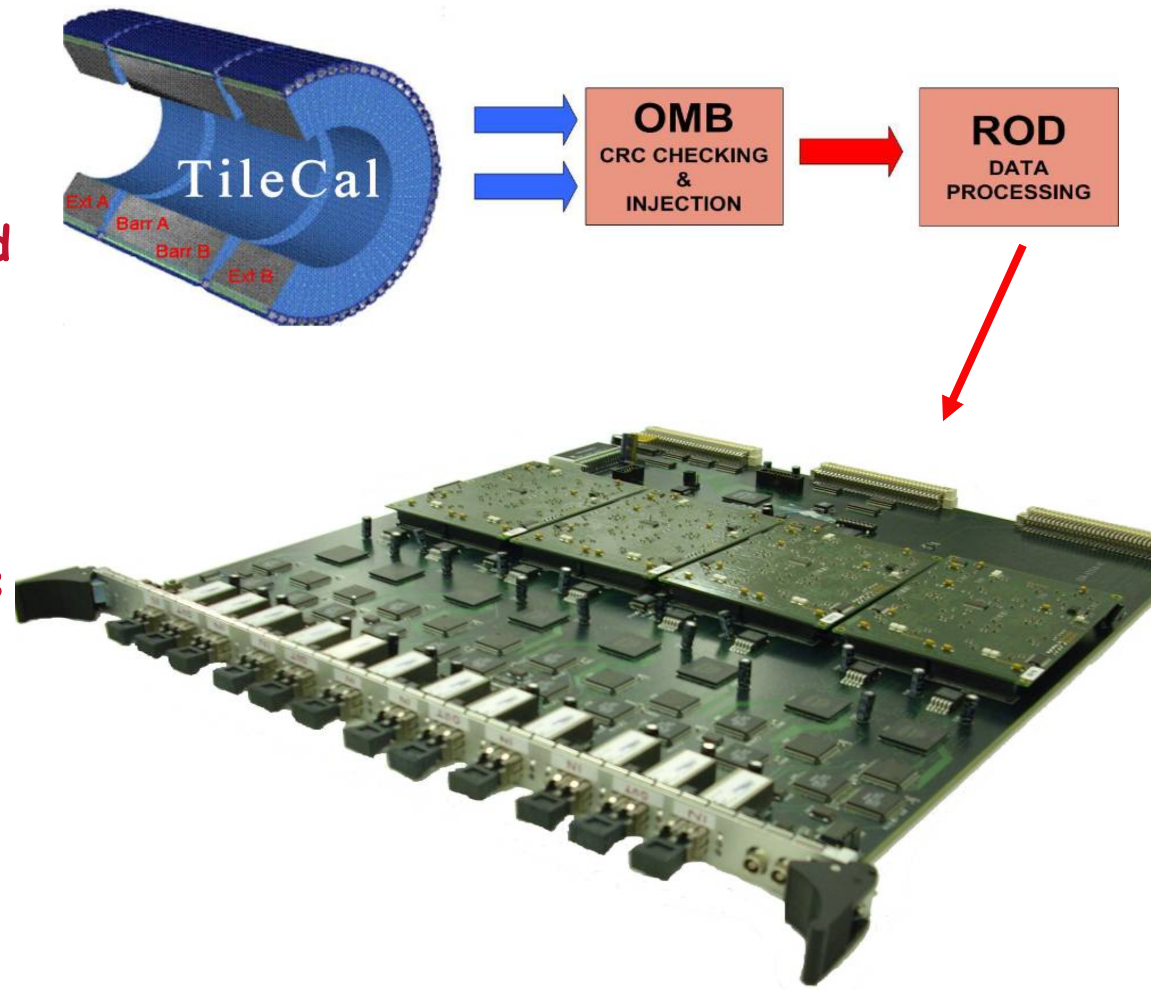
- 1 barril central y 2 barriles extendidos
- 4 particiones de lectura: EBA, LBA, LBC y EBC
- 64 módulos por barril



Hardware Contribution to TileCal

Back-End electronics

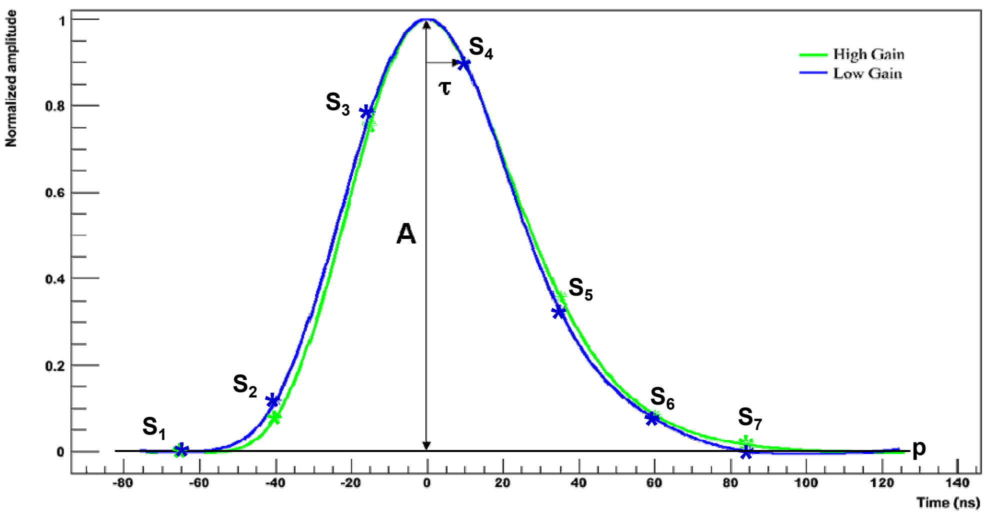
- **Read-Out Drivers**
  - System installed in the ATLAS cavern
  - Maintenance of firmware and DSP code.
  - Software and TDAQ
  - Commissioning phase.
- **Optical Multiplexer Board 9U**
  - TileCal back-end electronics upgrade to avoid radiation data corruption at high luminosity and ROD injector for tests.
  - Software and TDAQ
  - Production phase.



DSP Reconstruction algorithms

- **Optimal filtering**
  - Energy, time and χ^2 reconstruction at ROD level
- **Second level trigger algorithms:**
  - Muon tagging algorithm.
  - Total transverse energy sum for a Missing E_T estimation.
- **DSP code maintenance and developing:**
  - Operating system
  - Histogramming
  - TTC synchronization

Algoritmo de Filtrado Óptimo



- Obtiene la amplitud y fase del pulso mediante el uso de una media ponderada de las muestras digitales
- Los coeficientes de estas combinaciones se escogen de modo que contribución del ruido a la resolución energética sea mínima

- **OF1:** $A = \sum_{i=1}^{n} a_i (S_i - p)$ $\qquad \tau = \frac{1}{A} \sum_{i=1}^{n} b_i (S_i - p)$
- **OF2:** $A = \sum_{i=1}^{n} a_i S_i$ $\qquad \tau = \frac{1}{A} \sum_{i=1}^{n} b_i S_i$

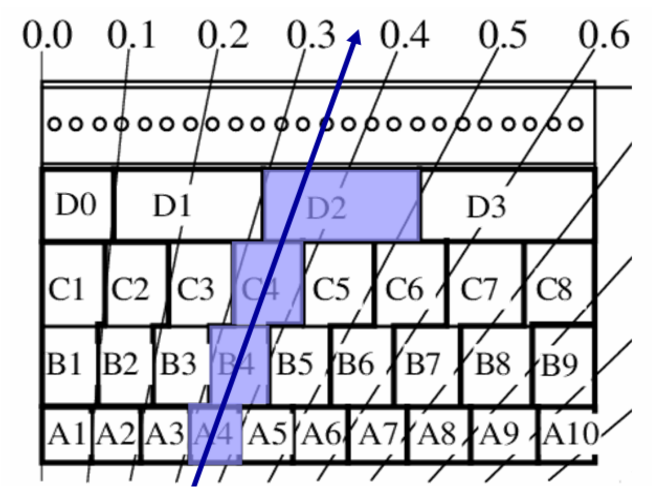
- Algoritmo implementado en el entorno software ATHENA (usado para tareas offline en ATLAS) y en funcionamiento

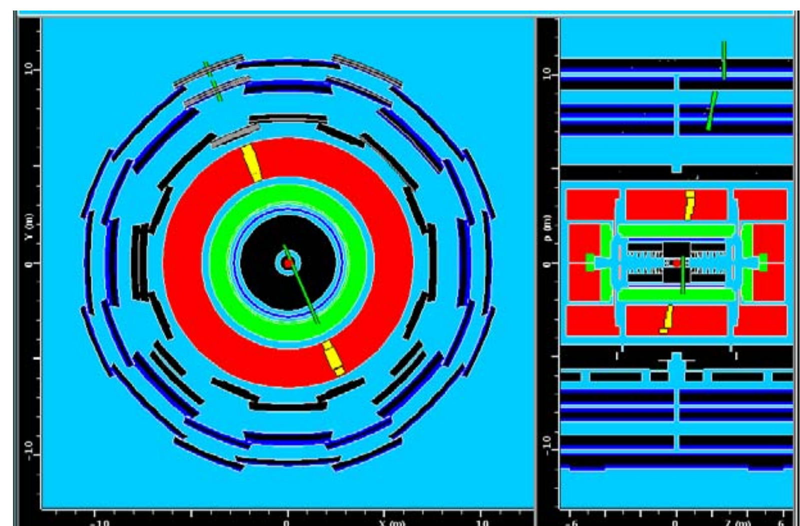
Algoritmo de Identificación de Muones

- Muon ID para el LVL2 utilizando los DSPs
- El algoritmo empieza con una búsqueda de candidatos a muones en las celdas de la capa más externa. Un candidato a muón se define cuando la energía de una celda es compatible con la deposición típica de un muón, mediante la condición:

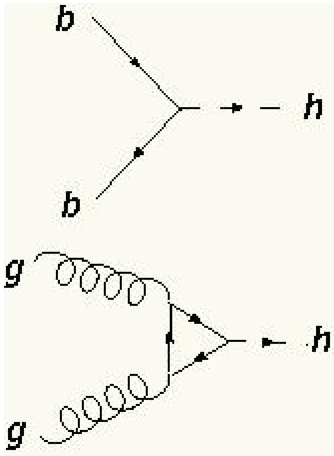
$$E_{inferior} < E_{celda} < E_{superior}$$

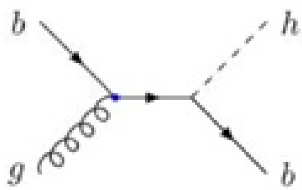
Suceso de cósmicos en el M4 con algoritmo integrado en HLT

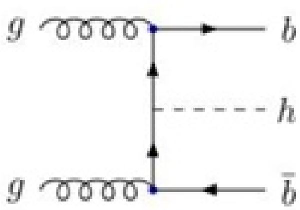


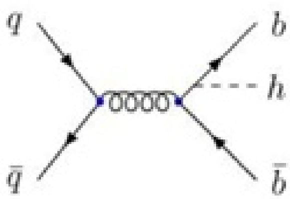


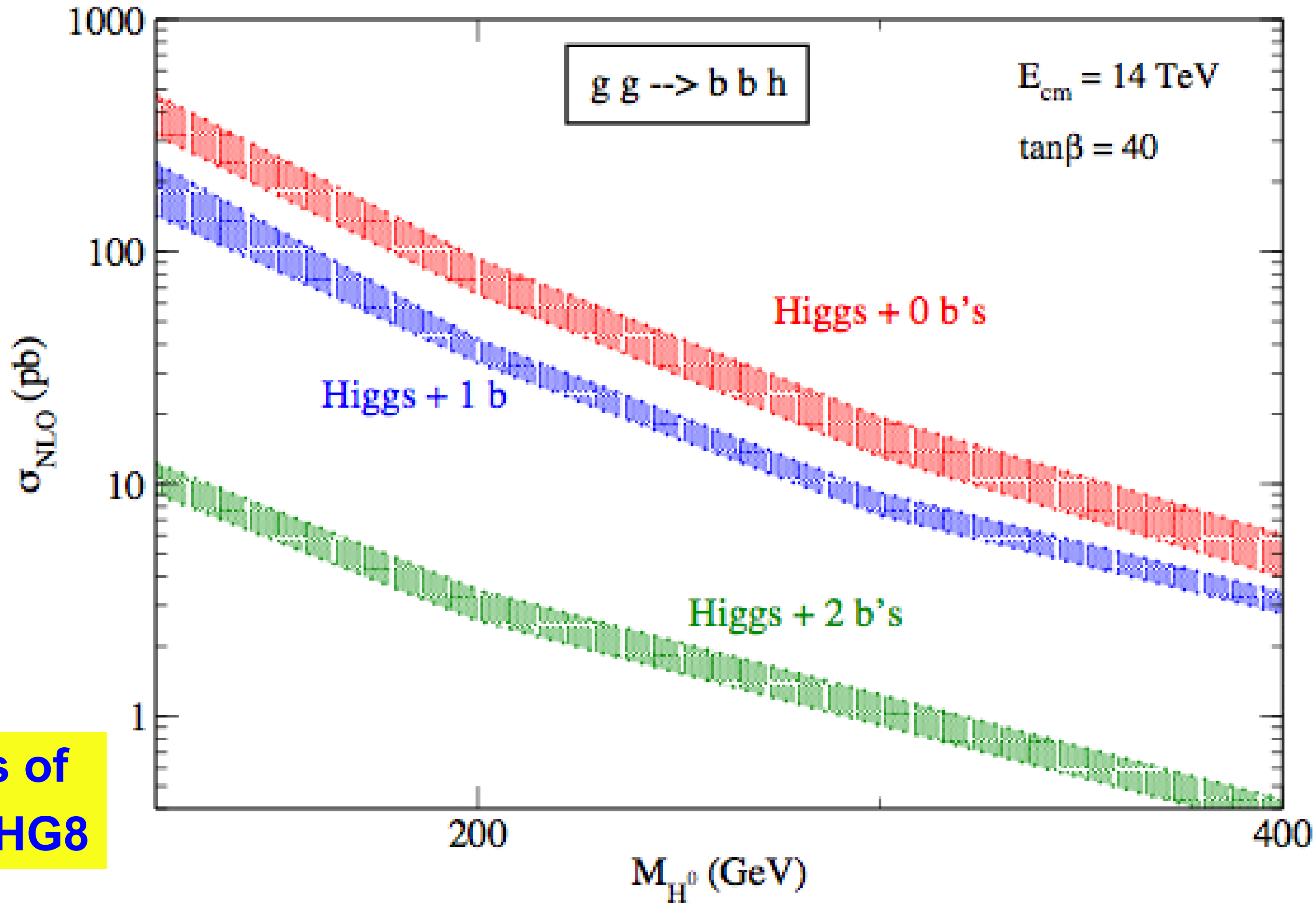
MSSM H/A→ττ,μμ







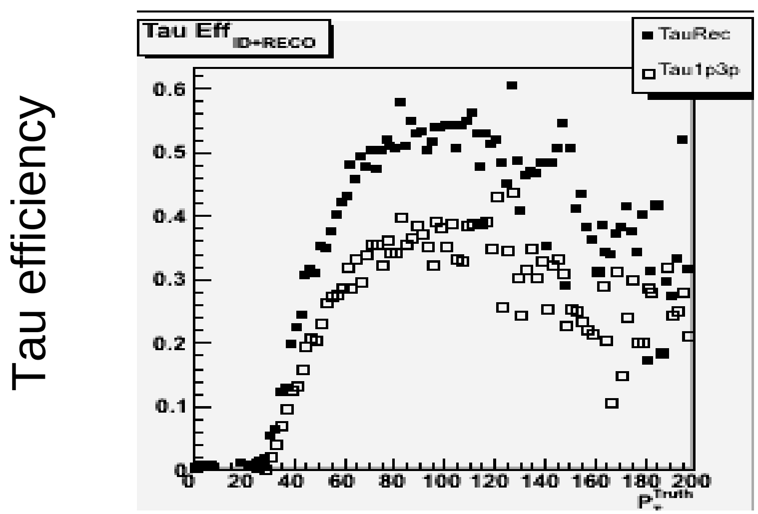


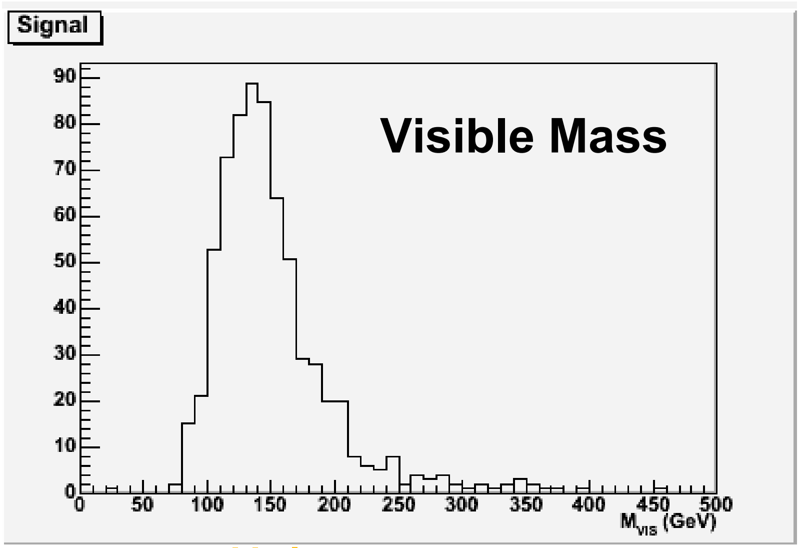


We are co-authors of CSC Notes HG7 & HG8

MSSM H/A$\rightarrow\tau\tau\rightarrow$lh

- Address "year-one" analyses when detector understanding is not advanced
- Evaluate classification of events according to jet multiplicity, $\Delta\phi(l\tau)$
- Investigate performance of Tau Reconstruction algorithms
  - TauRec vs Tau1p3p
- Investigate CDF visible mass definition vs. the collinear approximation
- Extraction of backgrounds using data-driven methods
- Extraction of signals by means of fits
  - Developing a fitter following the CDF experience





SUSY Inclusive 0-lepton

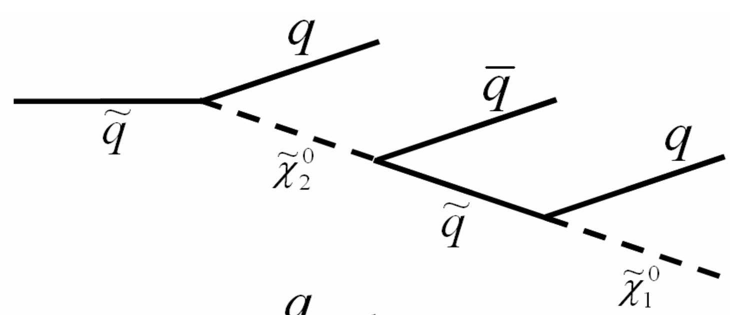
- **Production:**

$$qg \to \tilde{q}\tilde{g} \qquad qq \to \tilde{q}\tilde{q},\, \tilde{g}\tilde{g}$$

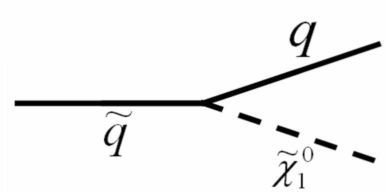
$$q\bar{q} \to \tilde{q}\bar{\tilde{q}} \qquad gg \to \tilde{g}\tilde{g},\, \tilde{q}\bar{\tilde{q}}$$

- **Decay:**

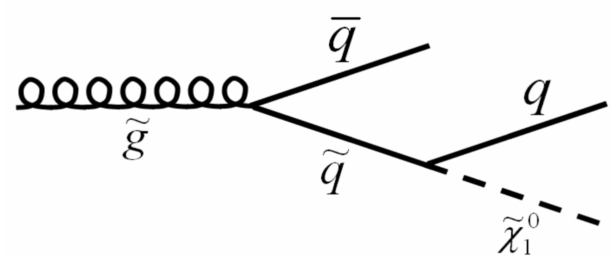
$$M_{\tilde{q}} > M_{\tilde{g}} : \begin{cases} \tilde{q} \to qq\bar{q}\tilde{\chi}_1^0 \\ \tilde{g} \to q\bar{q}\tilde{\chi}_1^0 \end{cases}$$



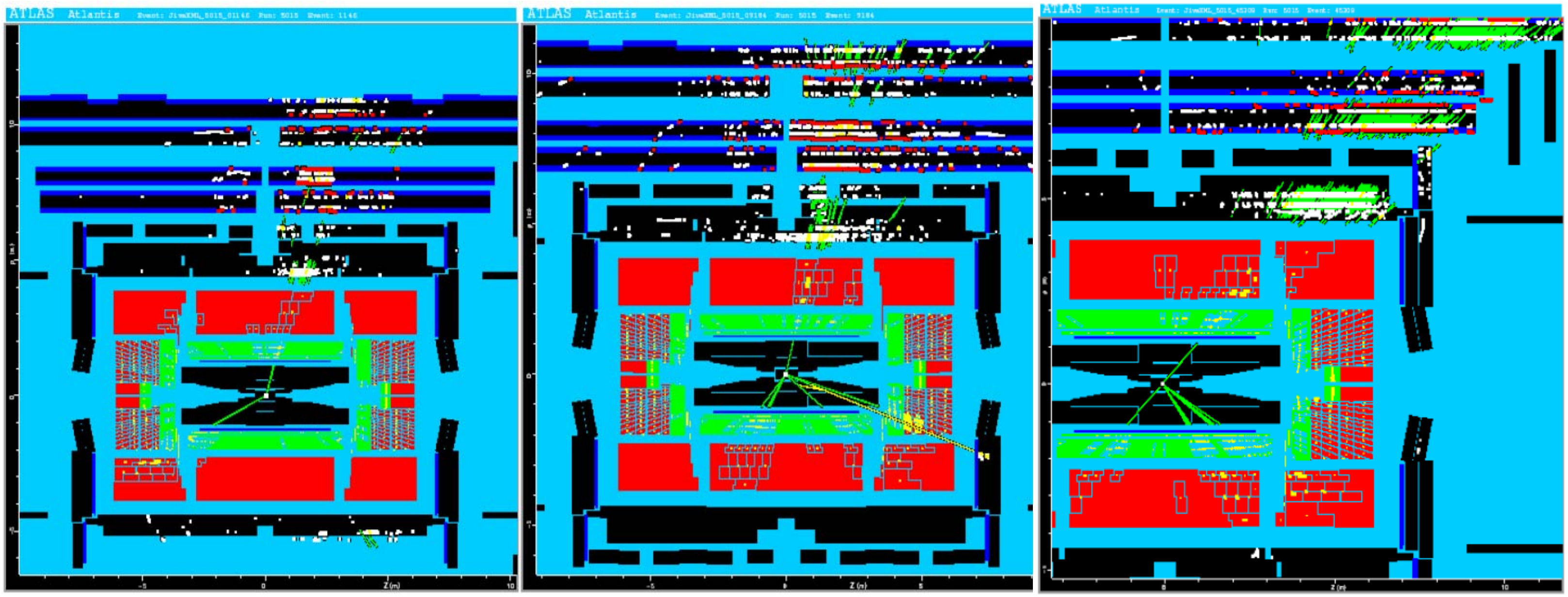
$$M_{\tilde{q}} < M_{\tilde{g}} : \begin{cases} \tilde{q} \to q\tilde{\chi}_1^0 \\ \tilde{g} \to q\bar{q}\tilde{\chi}_1^0 \end{cases}$$



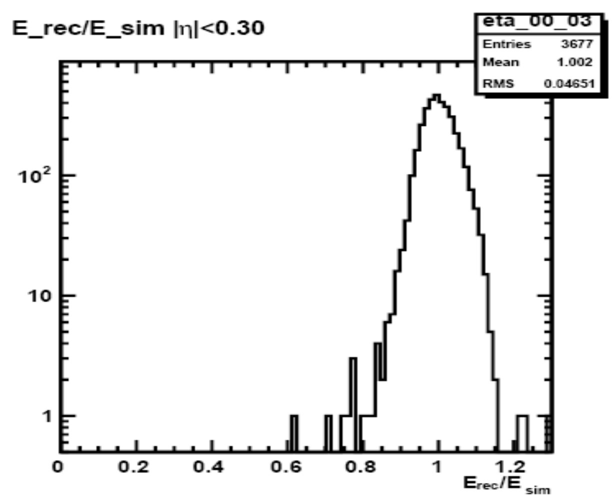
We are co-authors of CSC Notes SUSY3 & SUSY5

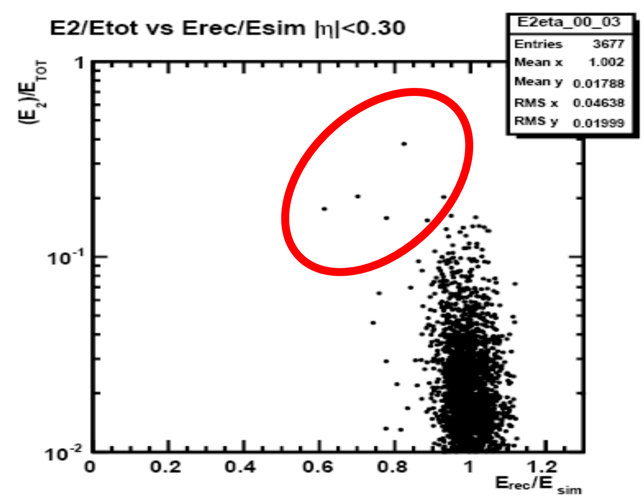


Suppression of fake MET



- Developing combined TileCal/Muon chamber algorithm for flagging jets with potential punch-through





Overall Computing Requirements

- Data availability in IFIC (and/or Spain)
  - Heavily pre-scaled calibration streams
  - Express streams (Detector/physics)

  Involves RAW/ESD data at Tier1

  - Access to all data/MC AOD

  Provided by dist. Tier2

- CPU/Storage for analysis
  - O(10) cores + >1TB per person

  Provided by Tier3 + opportunist usage of Tier2 (?) and resources across grid

Data Streams

- Spain is participating in the M4 data distribution. This is excellent practice for data taking.
- Need to define what calibration and express streams the group would like to have replicated in Spain
  - On the one hand, as TileCal experts the groups needs calibration streams. Need Spain to allocate corresponding resources
    - TileCal community is in the process of defining the composition and specifics of calibration streams
  - At the same time, due to physics interests and for the sake of competitiveness, the group also needs access to express streams. This is an effort that needs to be coordinated with the rest of the Valencia groups, and possibly other Spanish institutes, since the Tier1 needs to be involved

Express Streams

- **Preliminary list of signatures for the Express Stream**
  - **List still under discussion and**

Streams interesting for Physics/Detector performance preferences of the group

	Decay or signature	Motivation
	$Z \to l^+l^-$	calibration and data quality
	minimum bias	data quality
	lepton pair with high mass	alert on rare events
	$B \to \mu^+\mu^-$	alert on rare events
	≥ 3 high p_T leptons	alert on rare events
☑	lepton + jets + ETmiss	calibration
	$W \to l\nu$	calibration and data quality
☑	large missing E_T	alert on rare events
	lepton with large p_T	alert on rare events
☑	large ΣE_T	alert on rare events
	large M_{eff}	alert on rare events
	high multiplicity of trigger objects	alert on rare events

TileCal Group and the Tier3

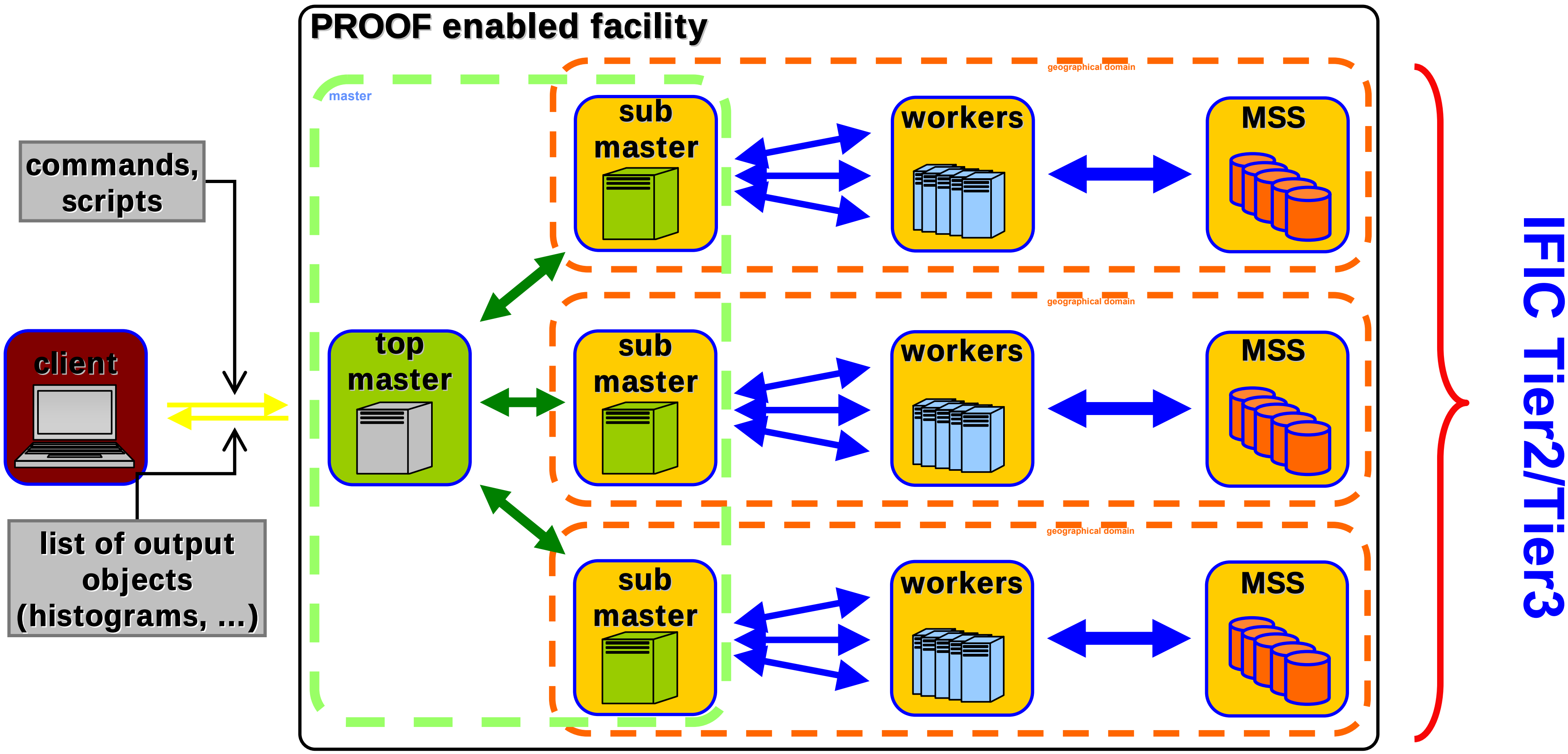
- Despite existence of ATLAS-wide distributed analysis system (by means of Ganga/Pathena, with the use of resource across the grids) it is mandatory that the group has local resource for data analysis
- Santiago proposes a very reasonable model for an analysis center: Extension of existing Tier2 facility with local resources with combined efforts of the various research groups in Valencia
  - This model is also followed in the US ATLAS. Take for instance plans for analysis center in the US ATLAS Tier1 at Brookhaven
  - In Madison the ATLAS and CMS groups share computing resource and strive for a homogeneous system (both hardware and software wise)

The Distributed Analysis Model

- When data comes it will not be possible for the physicist to do analysis with ROOT in one node due to large data volumes
  - Need to move to a model that allows parallel processing for data analysis, or distributed analysis.
- As far as software for distributed analysis goes US ATLAS is going for the xrootd/PROOF system
  - Xrootd (SLAC) is a distributed file system, maintained by SLAC which is proven to support up to 1000 nodes with no scalability problems within this range
  - PROOF (the Parallel ROOT Facility, CERN) is an extension of ROOT allowing transparent analysis of large sets of ROOT files in parallel on compute clusters or multi-core computers

PROOF in a Slide

PROOF: Dynamic approach to end-user HEP analysis on distributed systems exploiting the intrinsic parallelism of HEP data



- **Structure of PROOF pool:**
  - Redirector
  - Worker
  - Supervisor
- **Procedure of PROOF job:**
  - User submit the PROOF job
  - Redirector find the exact location of each file
  - Workers validate each file
  - Workers process the root file
  - Redirector collects the results and sends to user
  - User make the plots
- **Packetizers. They work like job schedulers.**
  - TAdaptivePacketizer (Default one, with dynamic packet size)
  - TPacketizer (Optional one, with fixed packet size)
  - TForceLocalPacktizer (Special one, no network traffic between workers. Workers only deal with the file stored locally)

Some Technical Details

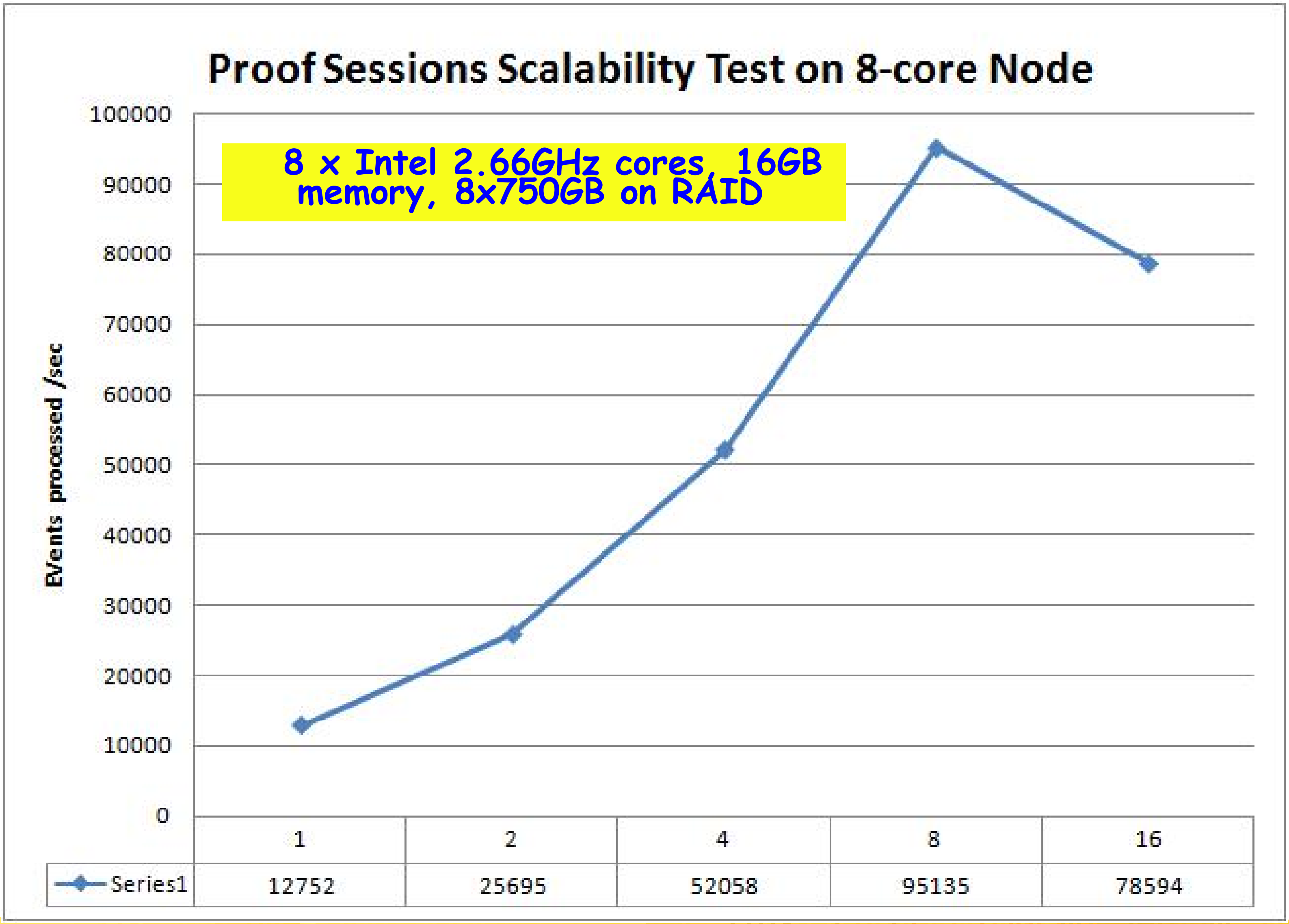
To be optimized for IFIC T3

Proof/Xrootd Tests

- The symbiosis xrootd/PROOF is being optimized in ATLAS by BNL/Wisconsin
  - Just started regular meetings. Perhaps Valencia T2 wants to join?
  - We are defining optimal proof/xrootd configurations for analysis farms corresponding to the requirements of ATLAS Tier3
- Have proven scalability with up to 100 nodes. Excellent performance for standard ROOT-based analysis codes
- Panda is also working on accommodating xrootd/PROOF for analysis jobs

- We set 3 PROOF pools for different test purposes
  - Big pool
    - 1 Redirector + 86 computers
    - 47 AMD 4x2.0GHz cores, 4GB memory
    - 39 Pentium4 2x2.8GHz, 2GB memory
    - We use just the local disk for performance tests
    - Only one PROOF worker run each node
  - Small pool A
    - 1 Redirector + 2 computers
    - 4 x AMD 2.0GHz cores, 4GB memory, 70GB disk
    - Best performance with 8 workers running on each node
  - Small pool B
    - 1 Redirector + 2 computers
    - 8 x Intel 2.66GHz cores, 16GB memory, 8x750GB on RAID 5
    - Best performance when 8 workers running on each node, mainly for high performance tests

Most Recent Performance Test



Number of sessions