Introduction to the Workshop Series

Eduardo do Couto e Silva

Instrument Analysis Workshop 1

SLAC, June 7 , 2004

Welcome and Thanks

- Some people came to this Workshop assuming that
  - This is an I&T meeting (FALSE)
  - This is an SAS/offline meeting (FALSE)
  - Something good may be happening, but they do not have a clear idea of what it is (TRUE)
  - The weather was going to be nice (TRUE)

- ….This is the beginning of an important effort within the LAT Collaboration
  - To support Flight Integration and
  - To develop ownership of the LAT Instrument

Thanks for your support !

Goals for this Workshop Series

Prepare for Instrument Data Analysis by…

- Familiarizing LAT Collaborators with the
  - LAT instrument
    - Front-End Electronics
    - Trigger and Data Acquisition
    - Data Analysis Software
  - Data taking plans during LAT integration using
    - Cosmic rays
    - Van de Graaff photons
- Creating a forum to
  - exchange knowledge between all subsystems and “hardware and software oriented people”
- Using simulated and real Data to exercise
  - reconstruction algorithms (mostly with real data)
  - data analysis tools to provide feedback to software developers
- Developing expertise to
  - uncover and quantify any instrumental effects that could have an impact on the LAT science data
  - start the work that will evolve into the Science Operations Group of the ISOC
  - create a core and trained group to participate in the beam tests analysis effort (after instrument delivery)

Develop ownership of the LAT instrument

The Workshop Series

This proposal will be reviewed and discussed Tuesday afternoon

- **Instrument Analysis Workshop 1 (June 7-8, 2004)**
  - **Kick off meeting**
  - **Homogenize the knowledge from people who will do the data analysis**
  - **Assign "projects" using Monte Carlo simulated data**
- **Instrument Analysis Workshop 2 (September, 2004 - TBR)**
  - **Discuss results from projects assigned during Workshop 1**
  - **Discuss results from projects derived from REAL data collected with the Engineering Model 2 (ACD, CAL and TKR)**
  - **Develop a list of instrumental effects that could have an impact on science data analysis**
  - **Pretty much "our Readiness Review" for Flight Integration**
- **Instrument Analysis Workshop 3 (November, 2004 - TBR)**
  - **Analysis of real data from the first two towers**
- **Instrument Analysis Workshop 4 (Summer, 2005 - TBR)**
  - **Analysis of real data from XX-towers (TBD)**
- **"Instrument Analysis Workshop 5" – Collaboration Meeting (Full LAT- TBD)**
  - **LAT Data Analysis (and to validate Monte Carlo simulation)**

Goals for This Workshop

- **The focus is on simulated data from the first Two Towers**
  - **Educate people on behavior and/or performance of**
    - TKR Front-End Electronics
    - CAL Front-End Electronics
    - Trigger and Data Acquisition system
    - Reconstruction software
  - **Provide hands-on experience**
    - With SAS/I&T analysis files and tools
  - **Use the knowledge acquired during the workshop to**
    - Complete MC projects that will be due ~ 6 weeks later (TBR)
    - Provide input to data taking plans for LAT integration

Who are the people sitting next to you?

You may fit in one or more categories

- **Software Oriented**
  - Familiar with SAS tools
    - C++
    - ROOT
    - SAS infrastructure
    - Want to do data analysis but are not sure what to look for in the instrument

- **Hardware Oriented**
  - Know about
    - C++
    - ROOT
    - SAS infrastructure
    - Terribly busy building the instrument, and are having a hard time to get started on the data analysis

- **Data Analysis Oriented**
  - Ready to analyze any data
    - But are not sure of
      - » what tools to use
      - » where the data are
      - » what to expect from the instrument

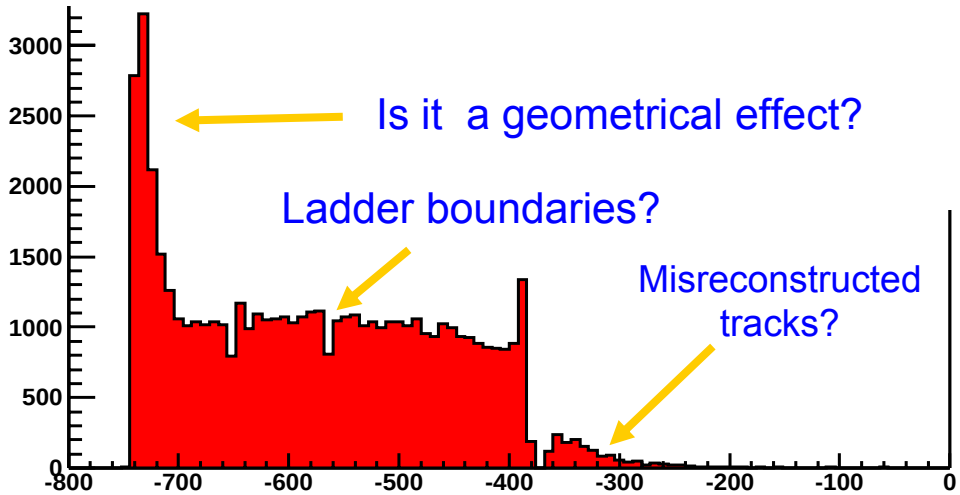
- **Information Oriented**
  - Want to learn more about the Instrument
    - May not do data analysis
    - Knowledge will benefit their work in the LAT

- **Experts**
  - Know all about it
    - Please talk to me, I have lots of work for you!

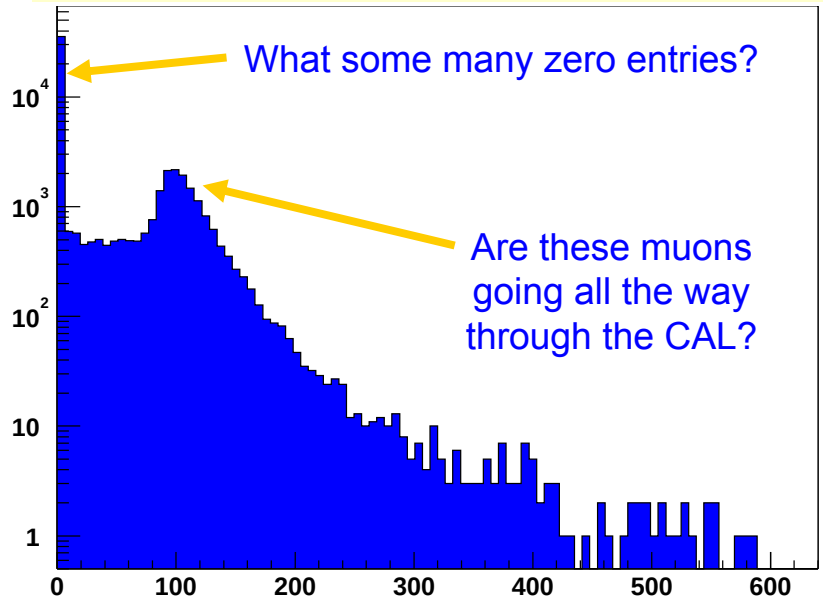
The challenge was to design an agenda that would benefit everyone

The Agenda (1)

Position of the Reconstructed Tracks (mm) in the TKR for 3-in-a-row triggers occurring in one Tower only



Sum of the Energy (MeV) in the CAL for 3-in-a-row triggers occurring in one Tower only

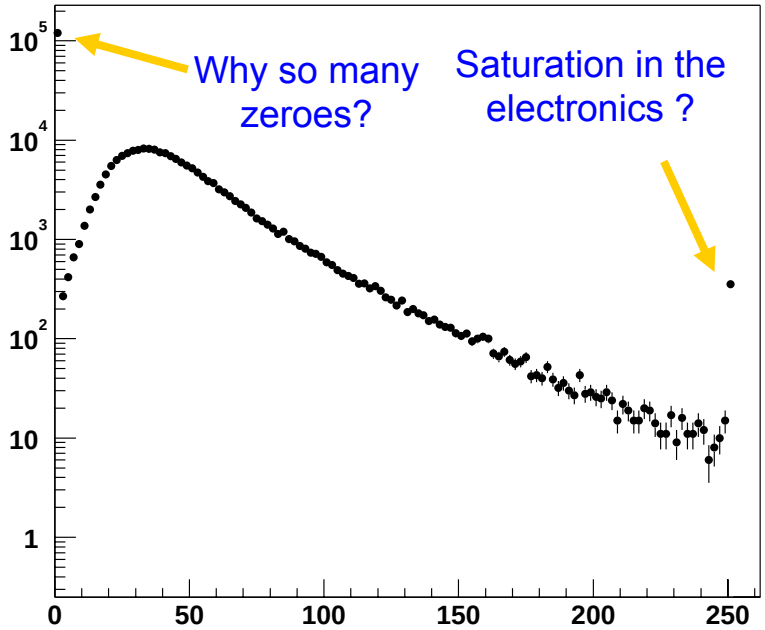


Stay tuned for the following talks…

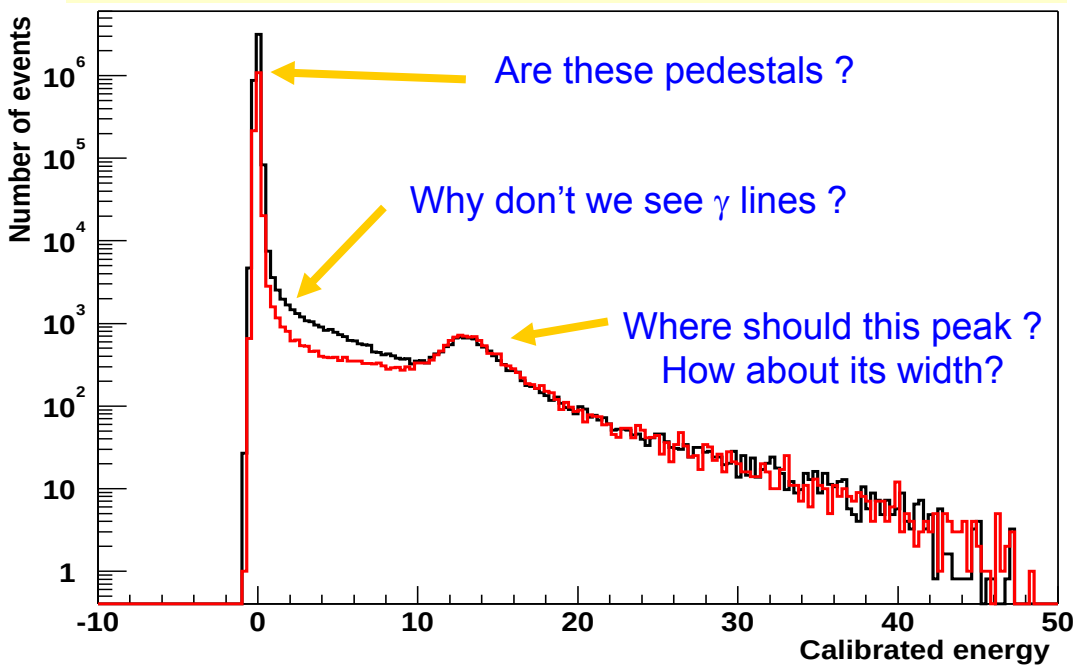
Overview of TKR Reconstruction – Tracy
Overview of CAL Energy and Position Measurement – Sasha
Two Tower Reconstruction – Leon
Description of the Geometry – Anders
Description of Cosmic Ray and VDG sources – Xin
Overview of TKR SAS analysis during LAT integration – Bill

The Agenda (2)

Time-over-Threshold (counts) in the TKR for 3-in-a-row triggers – EM DATA



CAL Energy Spectrum (MeV) for the VDG Low energy Photon beam ON (OFF) – EM DATA

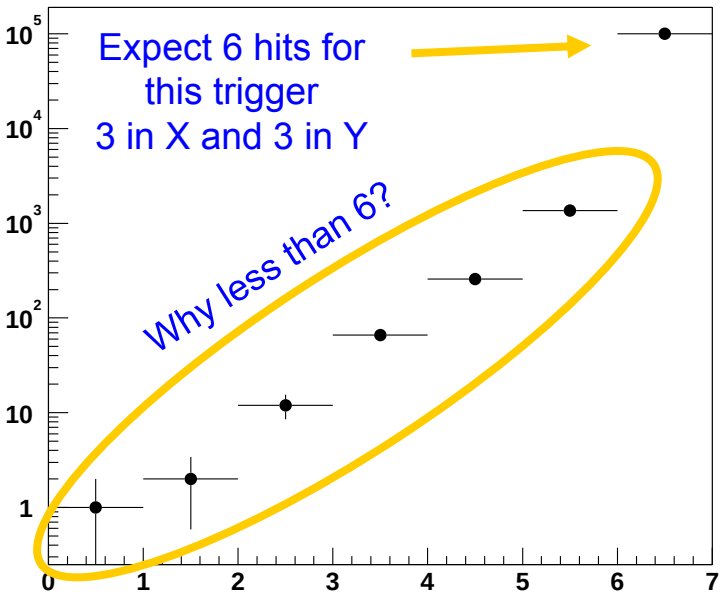


Stay tuned for the following talks…

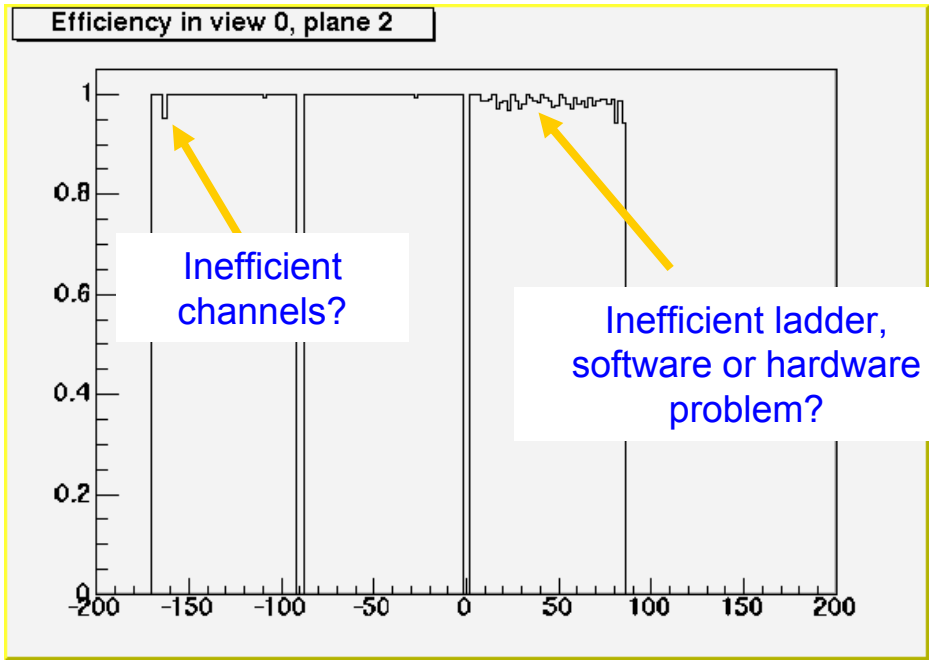
TKR detector and Front end-electronics: which "knobs" to turn?
Mutsumi
CAL detector and Front end-electronics: which "knobs" to turn?
Eric
Overview of VDG set-up and accelerator Gary

The Agenda (3)

Number of hits-in-a-row in the TKR for 3-in-a-row triggers – EM DATA



Reconstructed Track position in the TKR for 3-in-a-row triggers – EM DATA

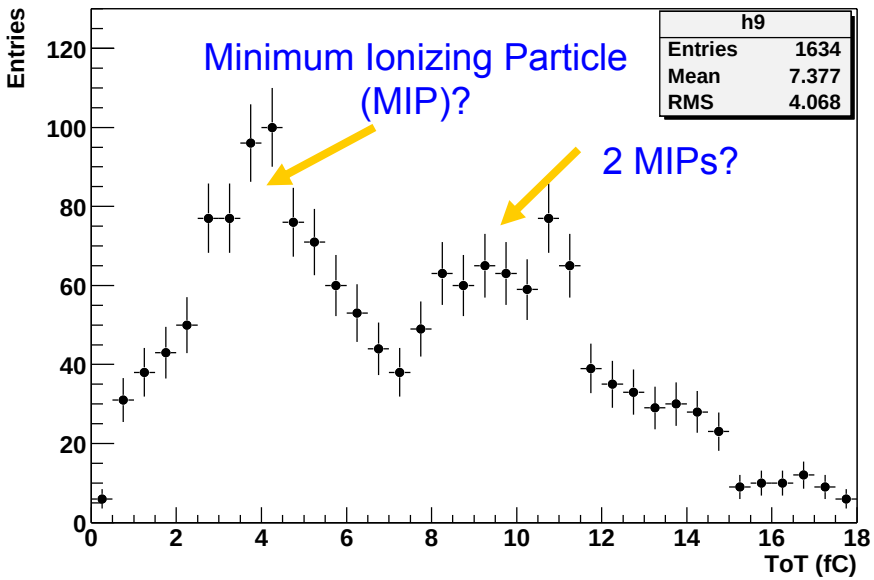


Stay tuned for the following talks…

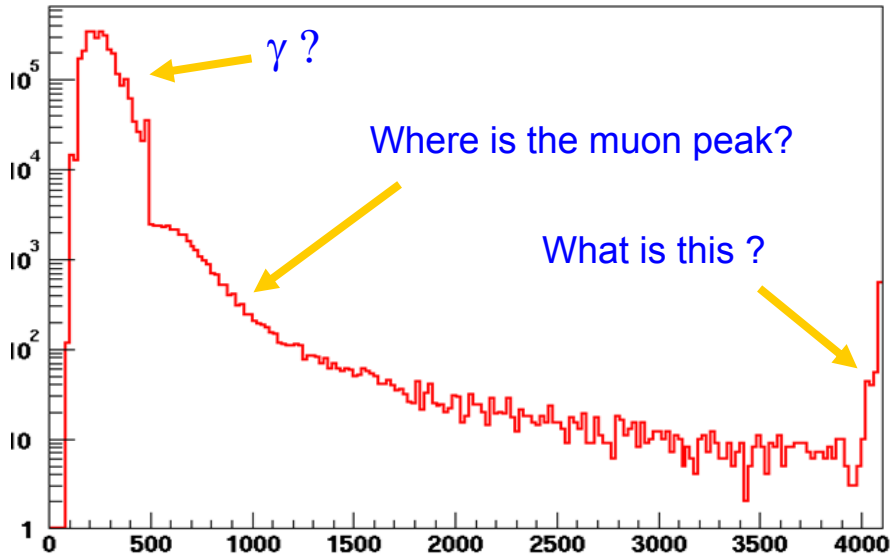
Overview of Trigger – Gregg/JJ
Trigger Event Contribution and Diagnostics – Gregg/JJ
Deadtime modeling and Power Density Spectrum - Warren

The Agenda (4)

Time-over-Threshold (fC) in the TKR for 3-in-a-row triggers – EM DATA



CAL Energy Spectrum (COUNTS) for the VDG Low energy Photon beam ON – EM DATA



Stay tuned for the following talks…

Overview of CAL Energy and Position Measurement – Sasha
TKR detector and Front end-electronics: which "knobs" to turn? Mutsumi
Overview of Calibrations during LAT integration – Eduardo
Overview of SAS Calibration Infrastructure – Joanne
Data Taking configurations during LAT integration – Eduardo

Tutorials and Discussion

Work in progress, need feedback from USERS to improve tools…

- **Analysis Files**
  - **High level variables (merit ntuple)**
  - **Low level variables per layer, trigger primitives (SVAC file)**
- **File Formats**
  - **ROOT**
  - **FITS**
- **Visualization software**
  - **ROOT**
  - **HIPPO**
- **Event Display**
  - **FRED**

Tutorials
(close to lunchtime – both days)

Explanation of variables and MC files
Download and install tools
Plot variables and use event display

Detailed Discussions
(Tuesday after 2:30 pm)

Discussions and assignment of projects

Monte Carlo Projects

- We will present a preliminary list of projects in the next slides and we will review and discuss them tomorrow afternoon
- THINK about them throughout the Workshop
  - Do they make sense?
  - Did we forget something important?
- EXPLORE the subject you are interested in
  - Discuss with other people
  - Ask questions (we are here to learn!)
- COMMIT to a given subject
  - Do not need to work alone get your institution involved
  - Plan to work with other groups if you find it more effective

Monte Carlo Projects (1)

After long discussions with Bill…

Preliminary list, we will review it on Tuesday afternoon

- **TKR**
  - **Internal Tower metrology**
    - **How precise were the trays manufactured?**
      - » **Distribution of residuals of center of every SSD w.r.t nominal positions**
      - » **Systematics with respect to ladder orientation**
      - » **Intra-tray alignment (e.g. are trays twisted w.r.t. each other?)**
  - **Inter tower alignment issues**
    - **How are they related to the metrology survey?**
      - » **Compare numbers from alignment procedure to those from metrology at SLAC**
    - **Does the track fit matches where it was supposed to start?**
      - » **See Leon's talk**
  - **System Performance**
    - **Subsystem Performance**
      - » **Calculate the tracking efficiency of each tower using track segments**
      - » **Calculate residuals by comparing CAL and TKR locations**
    - **Imaging**
      - » **Make positive and negative images of the ACD tile (to explore ACD efficiency AND the tracking inefficiency and check the coordinate system oriented correctly)**
      - » **Make positive and negative images of the CAL layers (to expose uniformity of response of the CAL)**
      - » **Make image of TKR layers to identify location of shorted strips and broken wirebonds See Bill's talk**

Monte Carlo Projects (2)

Preliminary list, we will review it on Tuesday afternoon

- TKR
  - Hardware related and/or need real data
    - Measure hit inefficiencies from high noise level
    - Count the number of latched triggers corresponding to the number of trigger requests issued
    - Trigger combination biases
    - Study the TOT behavior (resolution, uniformity, linearity, saturation)
    - Study configuration settings effects (pattern recognition) ? (e.g. time delays, GTRC splits)

Monte Carlo Projects (3)

Preliminary list, we will review it on Tuesday afternoon

- **CAL**
  - **Performance/Calibrations**
    - » **What is the tracking efficiency?**
    - » **Can we image the CAL layer by layer (using TKR)?**
    - » **How well do we find MIPs (e.g. at several angles, within a tower, across towers)?**
    - » **How do the results from each of the ends of the same crystal compare (e.g. TKR used for muon peak location, how accurate is it)?**
    - » **What is the light output of tracks crossing diodes?**
  - **Hardware related and/or need real data**
    - **What is the correlation between first two lower gain ranges?**
    - **What is the effect on the data from hit inefficiencies, high noise level and large gain variations?**
    - **What are the effects to the data when zero suppression is applied?**
    - **How do configuration settings affect the data analyses (e.g. pattern recognition) ? (cross talk and nonlinearities)**

Monte Carlo Projects (4)

Preliminary list, we will review it on Tuesday afternoon

- **EVT – not details of a subsystem but results from a combined system**

  - **Performance**
    - » **What is a "clean" muon definition?**
    - » **What are the "zoo" events in Monte Carlo ?(high multiplicity hit and track, "vees" in cosmic rays?)**

  - **Hardware related and/or require real data**
    - » **Can we find gamma rays from showers?**
    - » **Can we find π^0?**
    - » **What are the "zoo" events in DATA ?(high multiplicity hit and track, "vees" in cosmic rays, neutron events)**
    - » **Can we find Z>1 tracks in the Ground?**

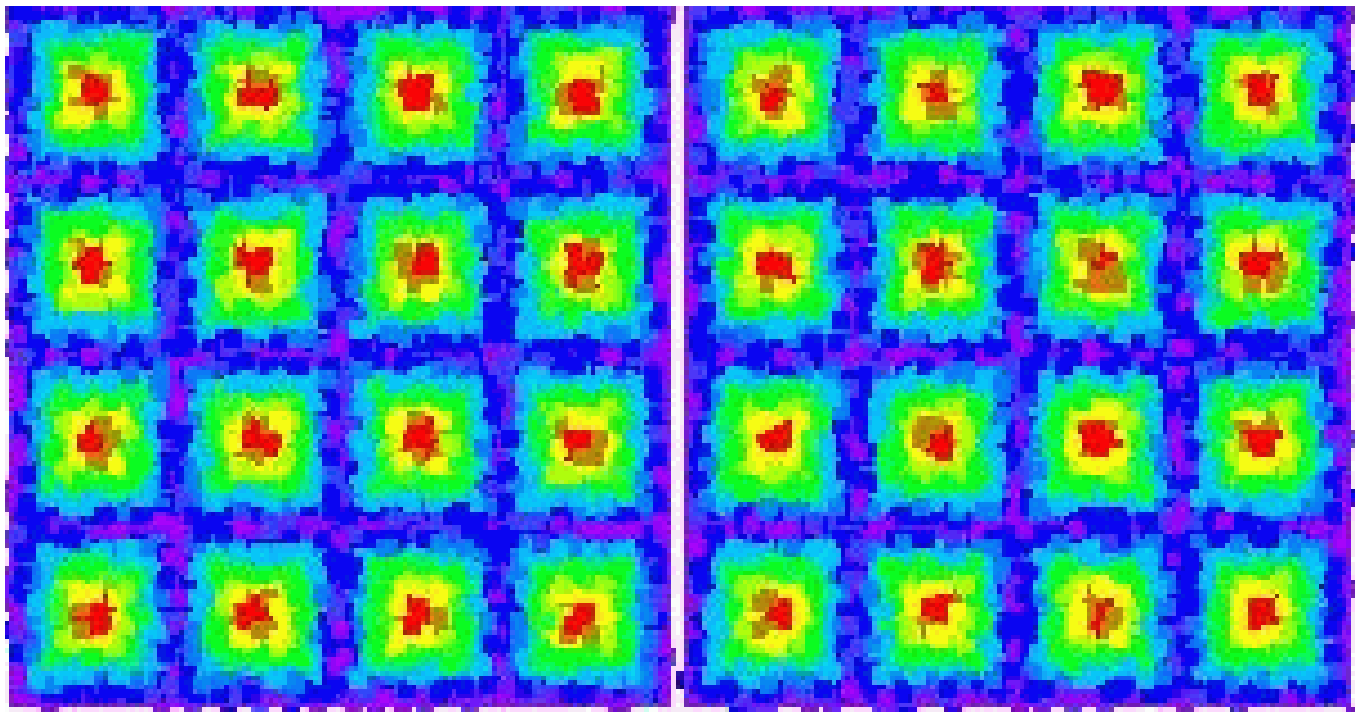
Monte Carlo Projects (5)

Preliminary list, we will review it on Tuesday afternoon

- VDG – Low energy Photons
  - Performance/Calibration
    - » Can we tell 1 from 2 MIP events? What is the effect of non linearities?
    - » How well can we measure energy for TKR events with and without CAL?
    - » Is the deadtime different between photon and cosmic ray events?
  - Hardware related and/or need real data
    - » Same as CAL and TKR lists

The LOGO

- After tutorial 1 you should be able to
  - Reproduce the logo below
  - Explain what it means



Whoever post the answer first to the Wiki, will get a prize at the group dinner…

Announcements

- Please send a copy of your talks to
  - borgland@slac.stanford.edu
- Group Dinner @ 7 pm in Hunan Garden
  - Confirm with Debbie or Diana during the Coffee break
- Group Photo
  - During one of the coffee breaks today (Monday)
- Project assignments
  - If you have to leave before the closeout session tomorrow please inform Eduardo on what projects you want to work on