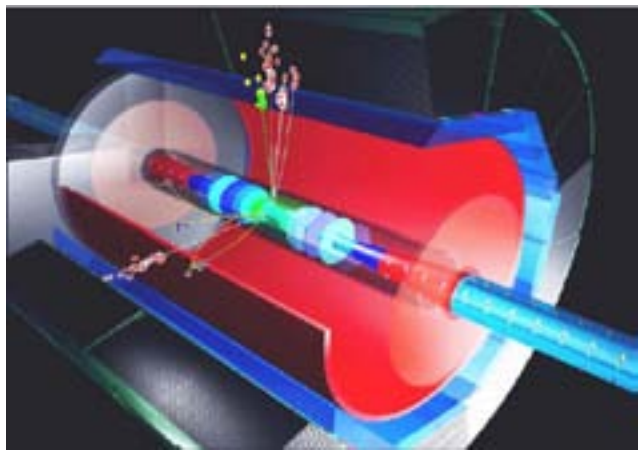
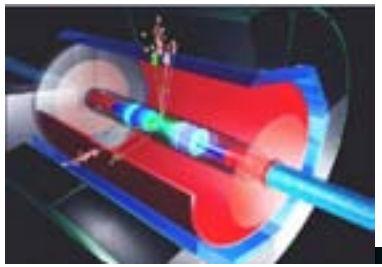


ECAL HCAL optimization

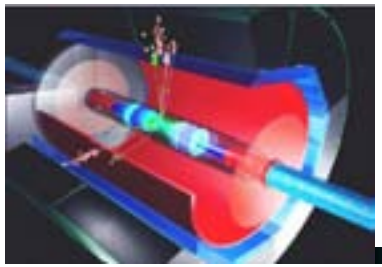
Felix Sefkow
DESY
CALICE collaboration

ALCPG workshop at Snowmass
August 23, 2005



A few thoughts

- Generalities
- Absorber material

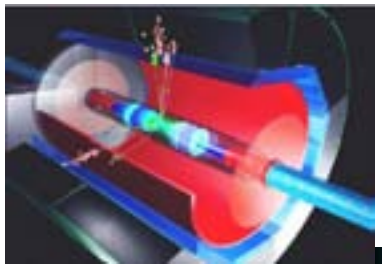


Optimization

- Wanted: d Φ / d € = d physics / d cost

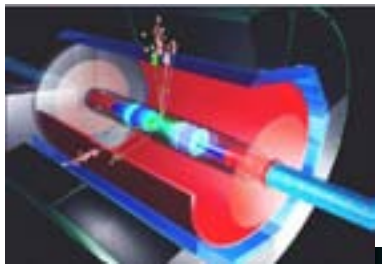
- Must factorize: d physics / d cost
  = d physics / d detector performance
  * d detector performance / d technology
  * d technology / d cost
- e.g. W Z separation, particle separation power, granularity
  - Jet energy driven by different components for different processes

- PFLOW decomposition studies extremely useful!



Physics

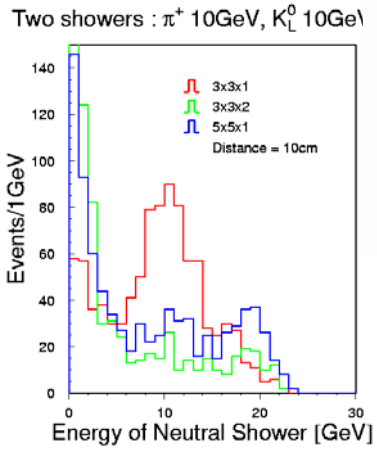
- The most prominent physics cases for ultimate PFLOW performance involve high $\sqrt{s}$ and E_jet
  - Higgs self coupling, WW vs ZZ, …
- Optimize PFLOW for high energy jets!
  - Present studies focus on the Z peak
  - I guess at 1 TeV the influence of the confusion term will be larger – and that of the low p_t loopers smaller
- Don't forget missing energy performance
  - Importance of leakage, dead material and hadron energy resolution might be different
  - Maybe trivial, but should be looked into

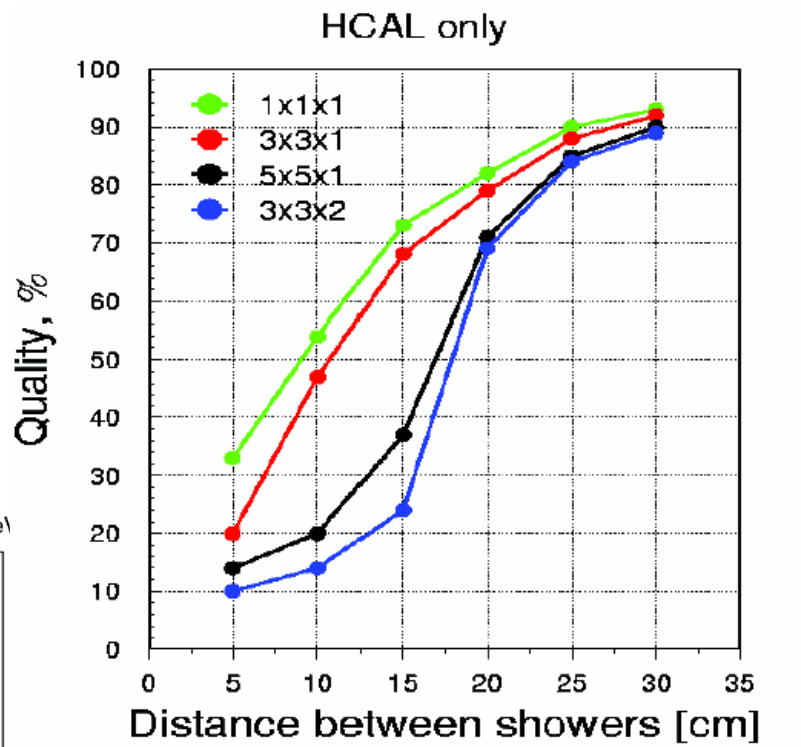


Benchmarking

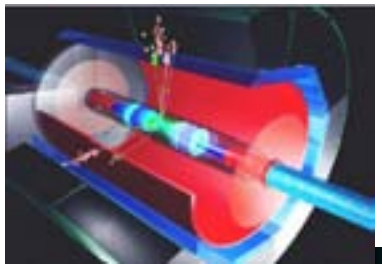
- Physics performance depends on many efefcts
  - Jet algorithm, ISR,…
- … which we do not control and which wash out detector effects

- Need detector benchmarks
- Example: shower separation
  - proved very useful guidance for HCAL granularity





Here: Quality = fraction of neutral hadrons with E_{reco} within 3 σ

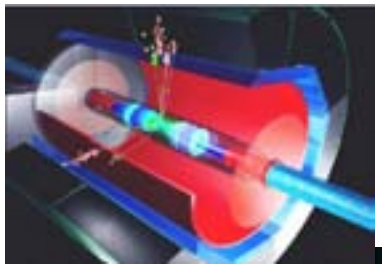


Cost

- In some lucky cases performance saturates
- In most cases, however, dependences are more or less linear in the sensible range

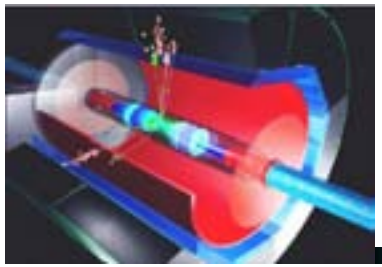
- No optimization without parametric cost model
  - R&D groups – start cost review now
  - Limited realism without technology prototypes (ECAL module “0”)

- Engineering input – see absorber material discussion



HCAL absorber material

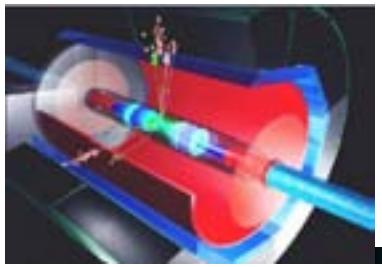
- Au, Pt, U, W, Pb - better than steel?
- Uranium implies high threshold term due to noise
- W and Pb: need enineering input
  - mechanical supports for non-Fe introduce dead material
  - hadron resolution, leakage, loss off pattern recognition performance
- need to adapt granularity to benefit from Moliere Radius
  - Cost prohibitive (# channels ~ R_M^2)
  - Or not necessary? Better imaging with same granularity?



W HCAL

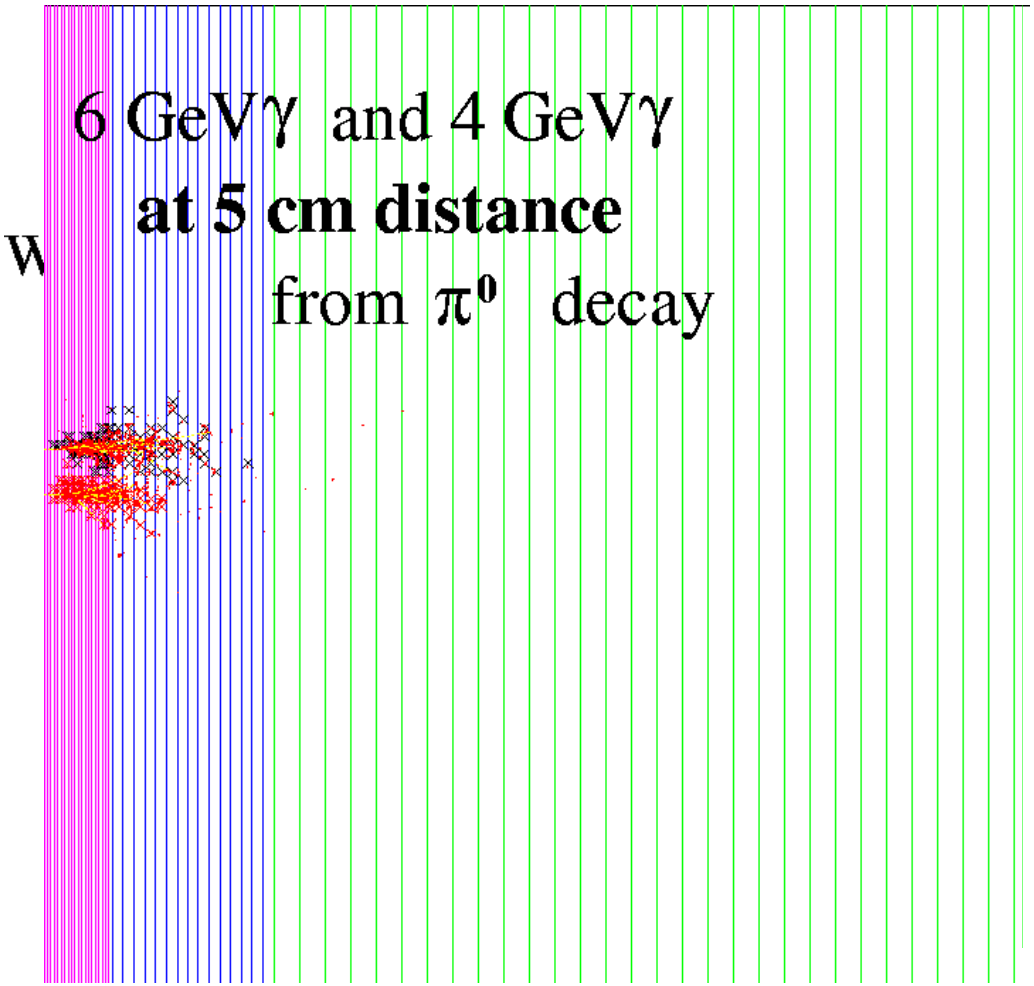
- Best method to improve HCAL performance is still to make it deeper (total hadronic interaction length)

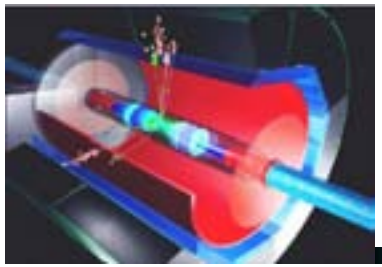
- win by making the ECAL Si section thinner?
  - intermediate W Sci section?



ECAL HCAL transition

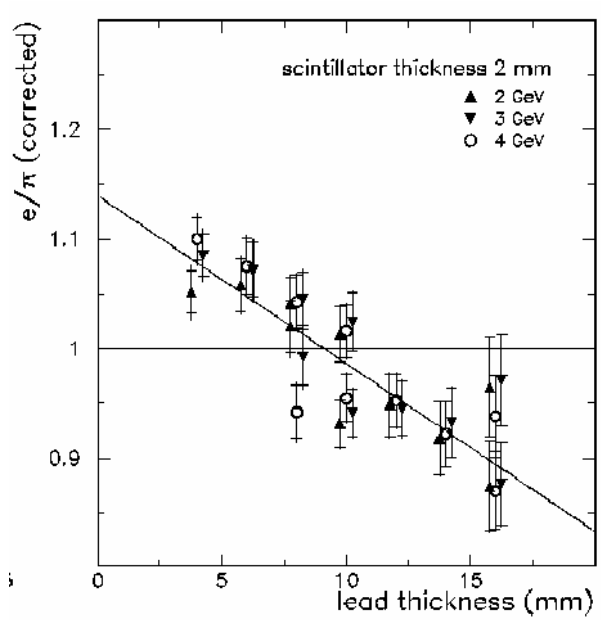
- How much ECAL?
- Can one improve the "ECAL performance of the HCAL"?
- Or arrange a smooth transition?
  - Some W in the HCAL
  - Some Scint. in the ECAL

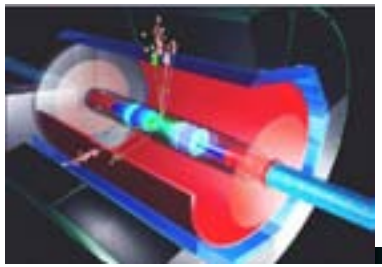




Pb HCAL

- Don't win in lambda, but in Moliere radius
  - Again: benefits without prohibitive channel count?
- And in hardware compensation
  - Saw a resurrection of hadron energy resolution
  - Driven by fluctuations
  - Optimize e / π
- In particular if ECAL is Pb, too
  - Only question is where to change from Silicon to SiPM

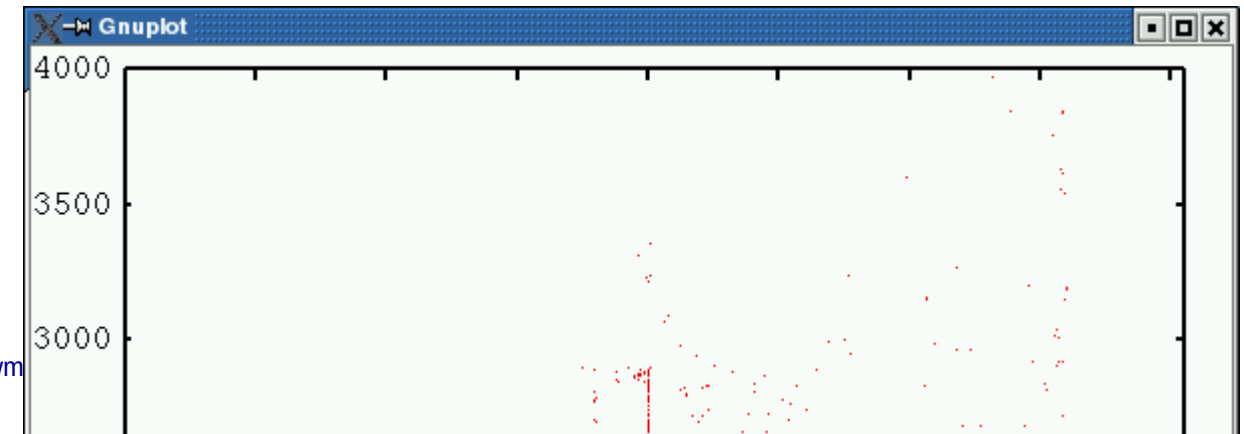


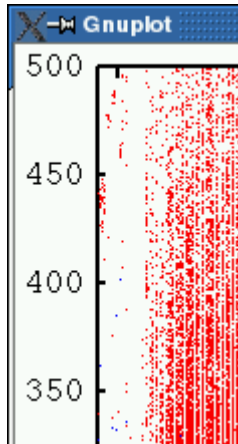


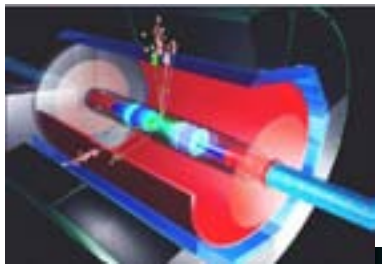
Endcaps

- PFLOW possible?
- Tracker endcap?
  - Personally, don't care for 10% X_0 – but no extra chamber, please!

- Background and occupancy?







Neutron hits

- Study by A. Vogel
- Dots sho origin of neutrons