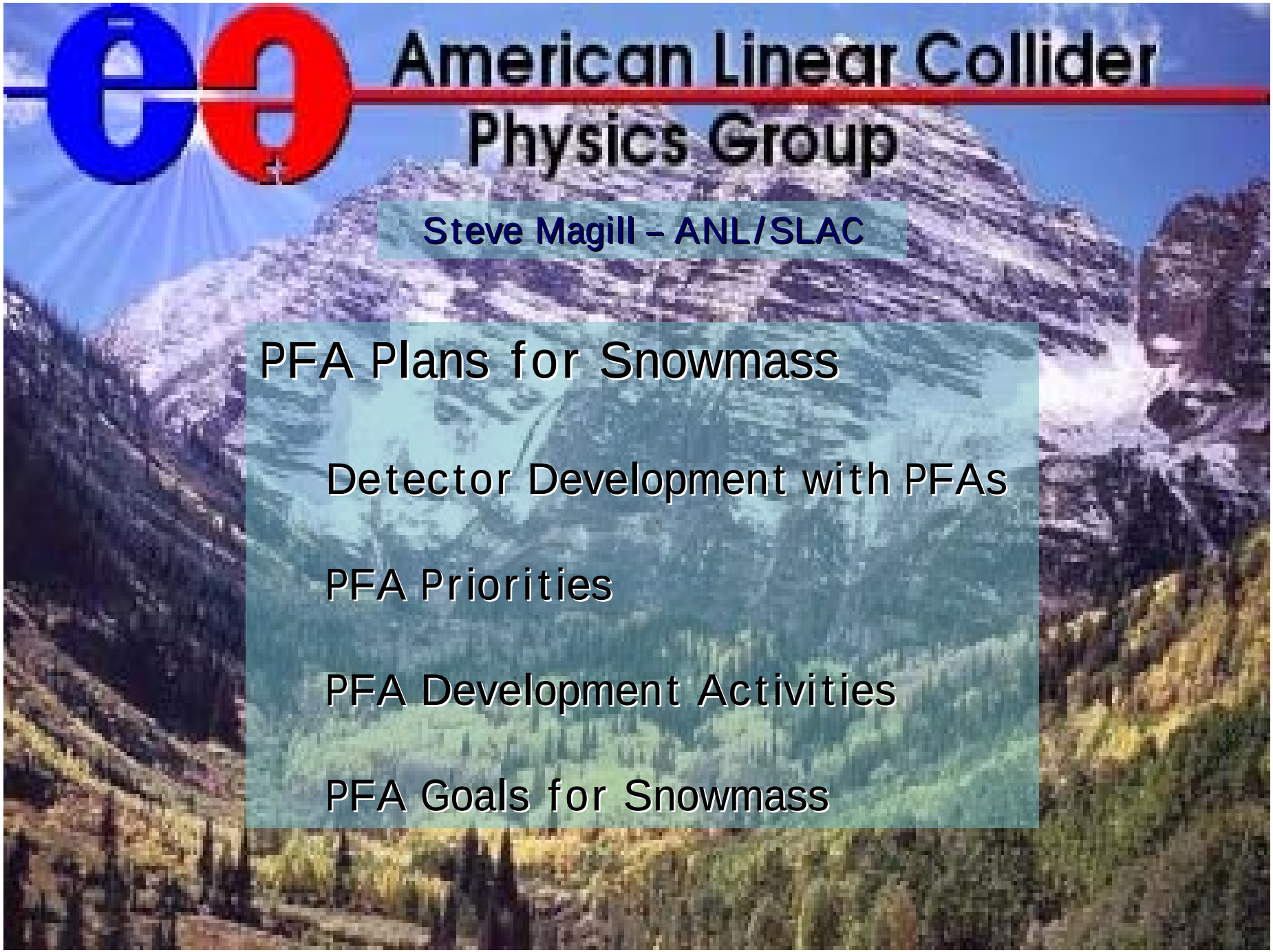
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PFA Plans for Snowmass
Detector Development with PFAs
PFA Priorities
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Detector Development With PFAs

Evaluation of Detector Concepts

Perfect PFA initial evaluation – shows limits (goals) of detector performance, provides standard for real PFA and algorithm tests
Full (real) PFA performance for physics processes
Partial PFA performance – e.g., charged/neutral hadron shower separation alone can be used to test and optimize segmentation, granularity, B-field, sub-detector radii, etc.

Detector Optimization

PFAs (perfect and real) can be used to optimize the absorber type and thickness, readout types, etc. – crucial for detector design at LC

Priorities for Detector Development

Use to show potential for improvement in detector design
Rank methods to efficiently reach performance goals

PFA Priorities

1) Charged/neutral hadron shower separation – hardest to do, but potential for largest improvement in detector performance

- At Snowmass :
  - *Characterize methods and compare – e.g., clustering methods vs tracking*
  - *Difference between real separation ability and perfect separation*

2) Photon finding/separation from hadrons – much easier than 1)

- Analytic shape vs simple cluster methods
- ECAL already optimized? – if so, this drops in priority
- At Snowmass :
  - *Best photon-finder for W/Si ECAL (rank options)*

3) Neutral hadron E resolution – once 1) is optimized, need sufficient E resolution for neutrals to reach PFA goals

- How to parameterize tradeoff between 1) and 3)?
- At Snowmass :
  - *What is the maximum HCAL resolution we can tolerate and still reach PFA goals?*

PFA Development Activities

Perfect PFA Definition :

1) Analytic PFA - *BotE and quick, but wrong (hadron interactions in the ECAL)*

2) Process-Dependent PFA - *correct for perfect photon/charged hadron/neutral hadron separation, but must be done for each physics process (different particle mix, energy distributions, etc.)*

For Snowmass, will have package that evaluates this for each detector concept – includes verification of sampling fractions, evaluation of single particle resolutions for photons and neutral hadrons (digital and analog), calibration of (digital and analog) hadron calorimeter using charged hadrons (like test beam).

Goal : by Snowmass, will have a Perfect PFA (2 above) evaluation of each detector concept for ZPole and 500 GeV e+e- that is available posted on web page. Package will be available in org.lcsim and run on LCIO output. Output – jet E resolutions.

PFA Development Activities

Algorithm Evaluations :

1) Cluster Algorithms - fixed-distance (cone, MST, etc.) vs tracking (nearest-neighbor, etc.) algorithms.
   Where to use various kinds, e.g., MST for photons? since hit distance from shower core is highly correlated along the shower length. Another example -> nearest-neighbor clusterer for hadrons - follows shower fluctuations better than a cone algorithm? Mip Clusters - can mip clusters be combined to make hadron showers?
2) Photon finders - Set this at Smass - Analytic vs clusterer – Do we need a fit of longitudinal and transverse shower shape or just a decent clusterer?
3) Neutral hadron E - best method for including neutrals into jet algorithm – leftover hits?, clustering?, neural net evalution?
4) Extra hits - what to do with these? dependent on analysis goal? define limits on number of hits or energy content?

PFA Development Activities

PFA Analysis Template :

Goal for Snowmass is to provide a template for PFA analysis that allows user to insert any algorithm in any position with a well-defined input (calorimeter hitmap) and output (revised hitmap, reconstructed particle, cal object, etc.).

At Snowmass, use this to combine users algorithms to help in optimization procedure.

PFA Goals for Snowmass

1) Optimization of charged/neutral separation algorithms - Can we evaluate by comparing results to perfect PFA? Answer is the neutral E resolution compared to perfect PFA. Can we rank a couple candidate algorithms in this category?

2) Can we settle on a photon algorithm? Should be easy - take 1 afternoon and evaluate all candidates - rank performance.

3) Ambitious goal - can we tell if gas will work in HCAL? Tradeoff between charged/neutral separation and neutral E resolution. In a perfect PFA detector, HCAL is a neutron detector -> scintillator, not gas?

4) Show how PFAs optimize at least 1 CAL parameter - i.e., B-field. Would like to apply to many things, but should show how to do at Snowmass so other studies could continue after.

5) Start of organization of PFA results for CALOR2006 (hosted by ANL in Chicago). We will have a session devoted to these and how they revolutionize calorimetry in HEP.