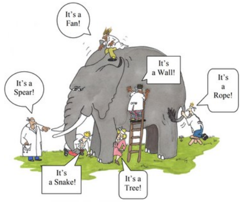
Thoughts on Future Calorimetry

Issues are generally well known for increasing precision of calorimetry.

- **Cost/performance**
  - Reality looms over over most discussion for industrial scale instrumentation.
  - For R&D purposes, assume these issues get better with time.



- **Signal collection / active volume / granularity**
  - Speed/Efficiency of charge collection, light collection
    - Metalenses, designer optical impedance and filter technologies
    - Direct integration with (in)organic scintillator block fabrication?
  - (Effectively) Large area sensors
    - Integration of light concentrators/AR optics into sensors
    - How to go beyond silicon wafers? New printable electronics technologies? Much room for exploration for thin film tech, eg huge industrial base already existing forOLED displays.

Thoughts on Future Calorimetry

- **Signal Readout**
  - Dynamic range for ECAL
    - 10MeV—100GeV @ higgs factor, O(13-14 bits)
    - ~50–100MeV--10TeV @ super large hh machine, O(15-16 bits)
  - Readout and sensor integration, ADC/TDC
  - Fight the tyranny of FPGA resource limits: fast, controlled-latency interfaces to CPU/GPU for L1 triggers
    - Move more towards computing HW model for R/O, reduce dependence on old tech due to long lead times

- **Calibration/operations**
  - Stability
    - Possible radiation resistance
  - Embedding calibration hardware at cell level

Thoughts on Future Calorimetry

- **Synergies**
  - PFA optimized, huge channel counts
  - High resolution / PFA balanced, more moderate channel counts / optimal E resolution
  - Exploit specific capabilities of calorimeters
    - Time spectrum of shower development
      - New paradigms for DAQ, eg continuous readout w/ RT analysis in larger time windows following L1 triggers
      - LLPs
      - (partial) collection of neutron afterglow to improve hadron resolution
  - Improvements on GEANT performance, materials and physics modeling