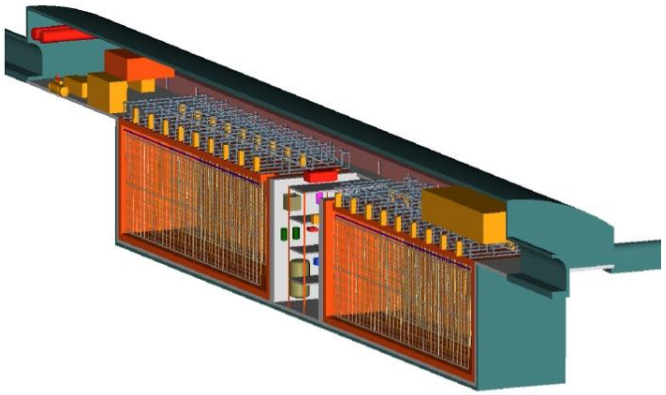
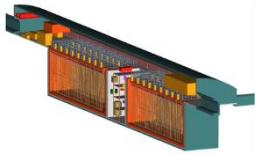
Europe in LBNE

LBNE



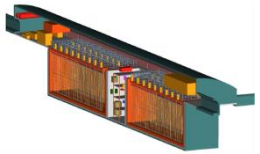
Alfons Weber
University of Oxford
STFC/RAL



European Collaborators

LBNE

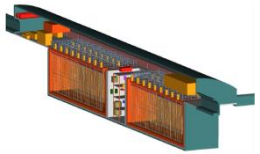
- UK
  - University of Cambridge
  - University of Lancaster
  - University of Liverpool
  - University College London
  - University of Manchester
  - University of Oxford
  - University of Sheffield
  - University of Sussex
  - University of Warwick
  - (Rutherford Appleton Lab)
- Italy
  - Catania Group
  - Gran Sasso
  - Gran Sasso Science Inst.
  - Milano
  - Milano & INFN Bicocca
  - Padova
  - Pavia
  - Napoli



UK Programmatic Review

LBNE

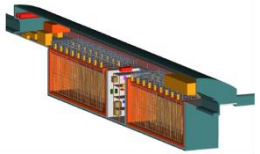
- Every few years STFC undertakes a programmatic
  - Critical look on current activities
  - Find a balanced approach to the future under different funding scenarios
- Output
  - Roadmap
  - Define (broadly) priorities and funding lines for next 10 years in particle physics, astronomy and nuclear physics
- Finished last summer
  - Result to be released soon
- Expected general consensus (CEO)
  - Neutrinos are VERY important
  - Priority as high as LHC upgrades



UK Activities

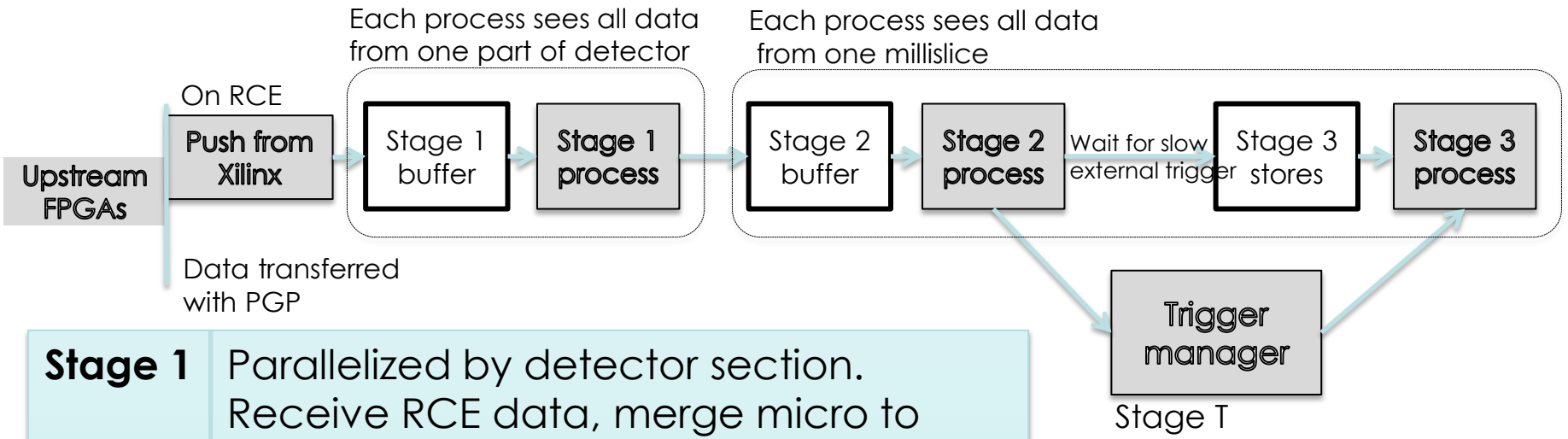
LBNE

- SoI was accepted by STFC
- Proposal for preparatory phase
  - together with HK
  - To be submitted in spring 2014
- Areas of interest/activities
  - DAQ
  - 35t prototype
    - Operation
    - HV monitoring
  - R&D TPC components
    - APA, Could be installed in LAr1-ND
  - Software
    - LAr reconstruction: PandoraPDF
    - Neutrino generator: GENIE



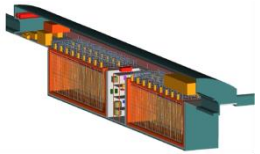
HL DAQ Design

LBNE



Stage 1	Parallelized by detector section. Receive RCE data, merge micro to milli-slice, route to correct stage 2, per-view trigger processing
Stage 2	Parallelized by milli-slice. With overlaps. SN trigger caching. Complete trigger calculation in milli-slice and overlap.
Stage T	One process in detector, arbitrate spill, calibration, and detector triggers.
Stage 3	Parallelized by milli-slice. Buffer data during trigger decision. Receive trigger decisions, splice milli-slice to event.

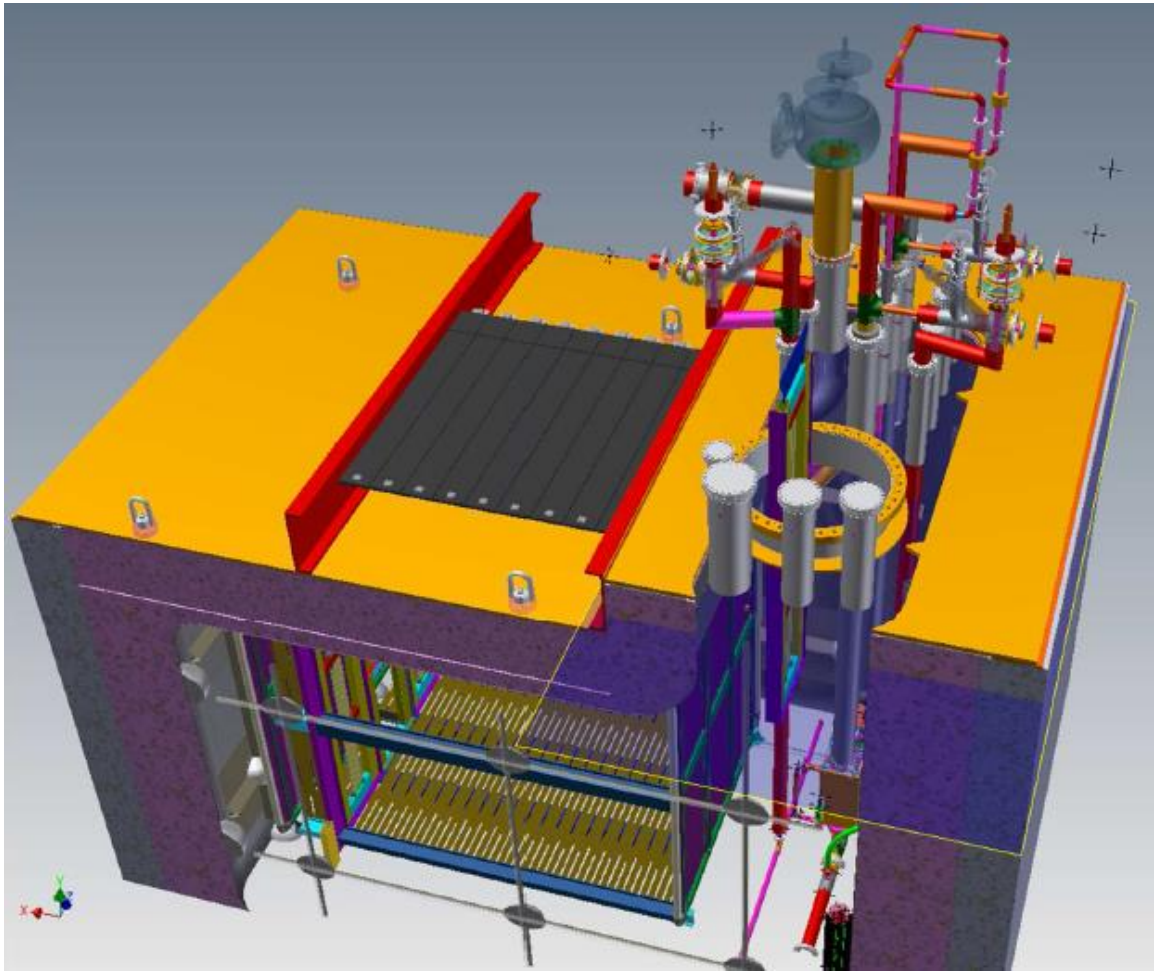
Each stage pushes data to the store of the next stage where it waits in queues.



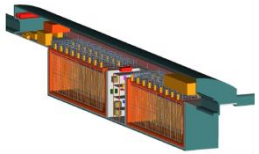
35t Prototype

LBNE

- Membrane cryostat and cryogenics now finished
- Goal is to demonstrate LBNE technology
- Two phases
  - 1st is a purity demonstration
  - 2nd has LBNE TPC and photon detectors
- Essential for TDR

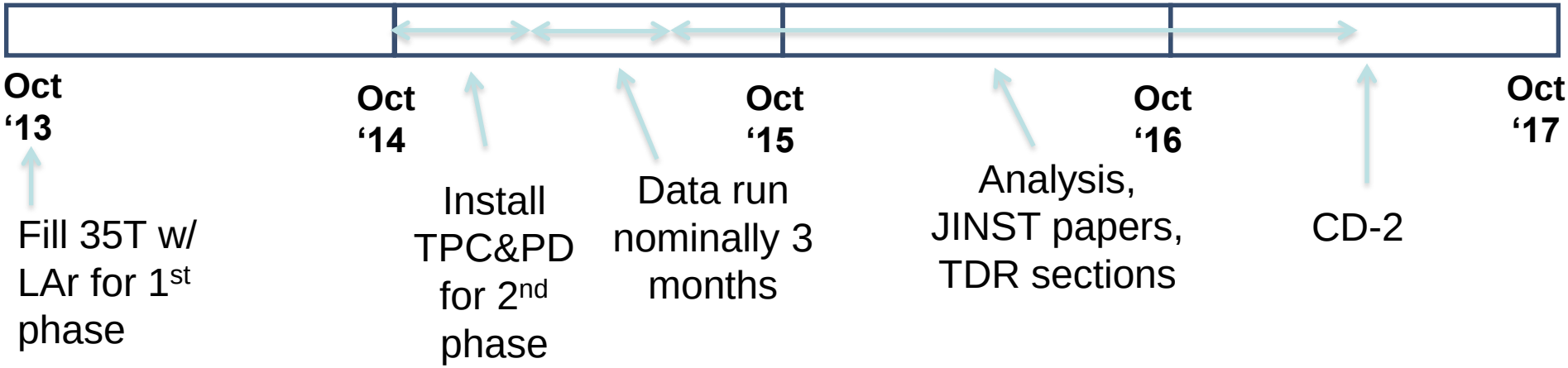


- Cosmic rate in 6 m^2 ~ 600 Hz
- Drift time ~1.5 ms
- TPC: 2.2 x 1.8 x 2 m^3

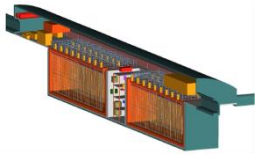


Timeline

LBNE



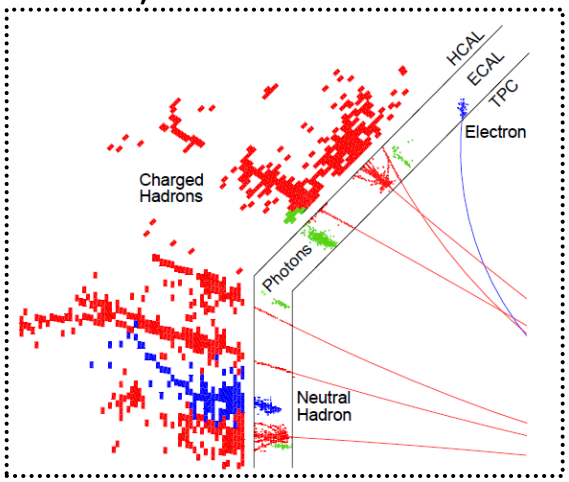
- Status
  - Commissioning Nov '13
  - 70% filled Dec '13
  - 2 msec lifetime achieved
  - Now 100% filled
- UK contributions
  - Operations
  - Software testbed
  - Analysis of cosmics
  - HV breakdown camera
  - DAQ



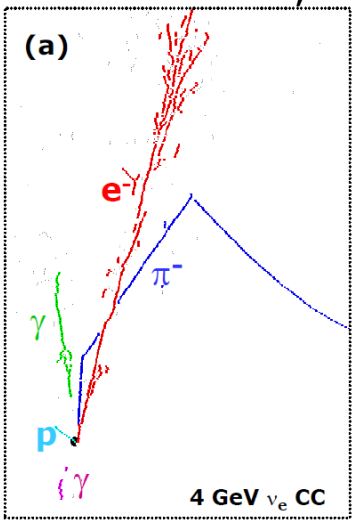
LAr Reconstruction

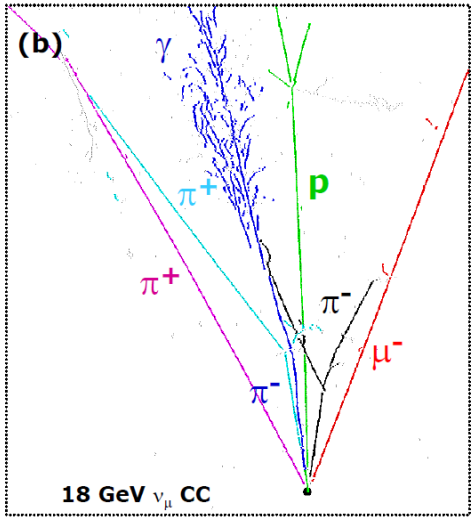
LBNE

CLIC, arXiv:1209.4039



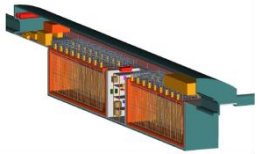
LBNE, arXiv:1307.7335





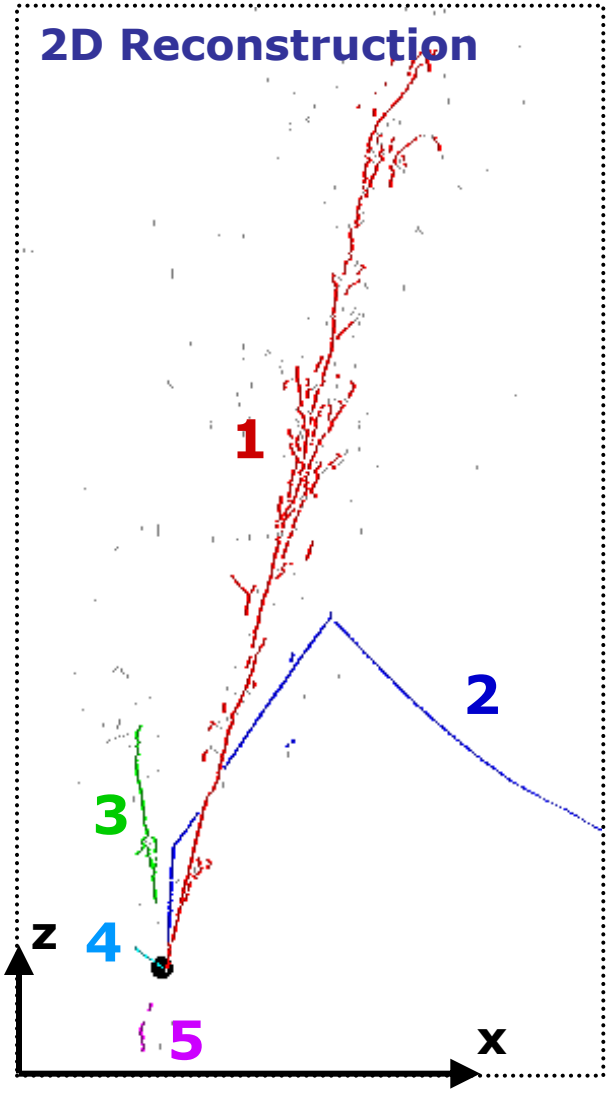
- **PandoraPFA is a set of software tools developed for fine-grain reconstruction.**
  - Initially applied to linear collider.
  - Has become central to ILC/CLIC physics studies.
- **Tools are fast, flexible and reusable**
  - readily applicable to automated event reconstruction in LAr
- **Developing pattern recognition algorithms for MicroBooNE and LBNE.**
  - Reached advanced stage
  - Chain of 3D algorithms in place.

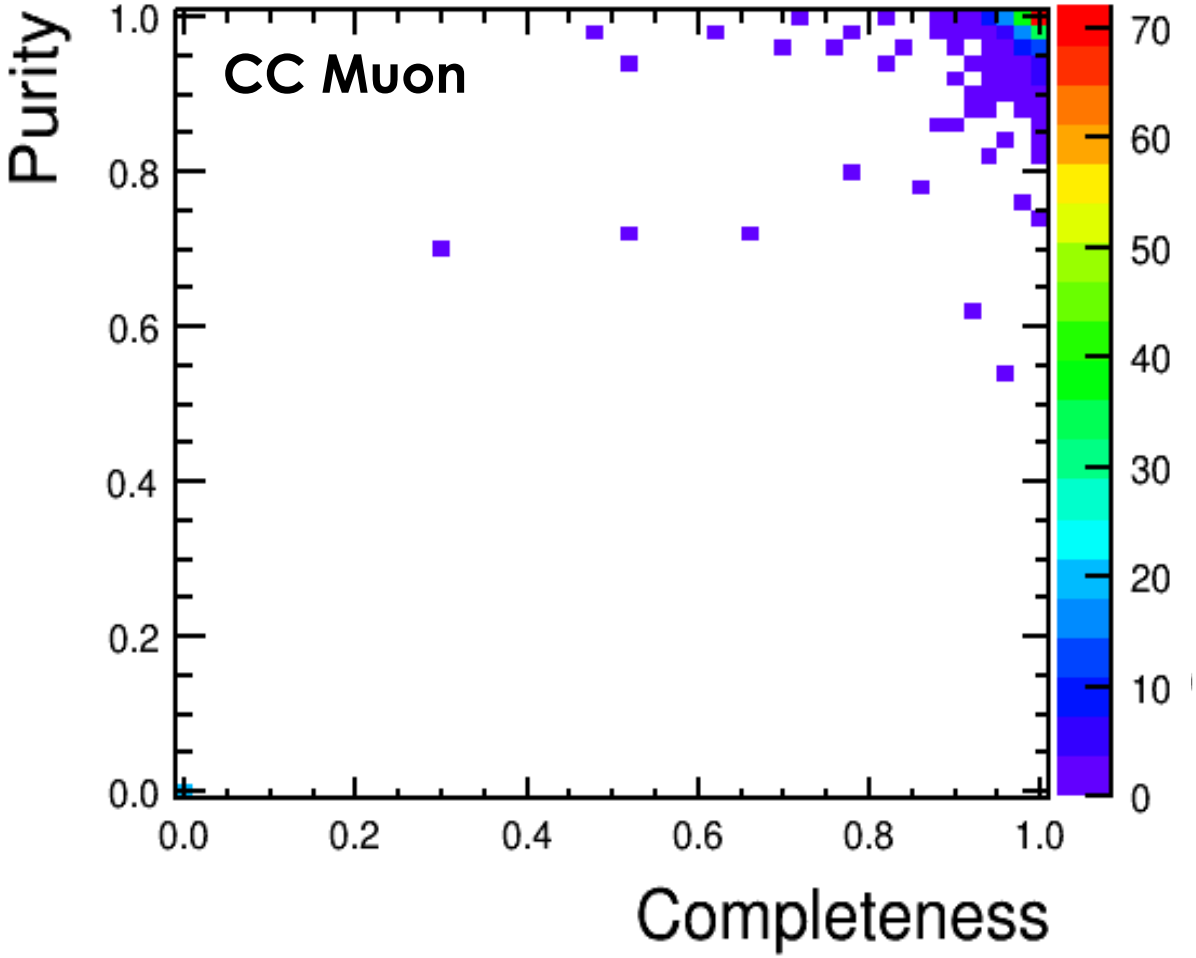
Andy Blake, John Marshall, Mark Thomson (Cambridge University)

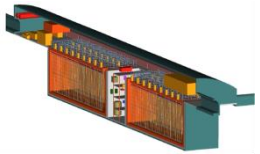


LAr Reco Performance

LBNE



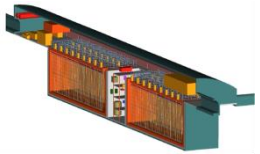




Italian Activities (I)

LBNE

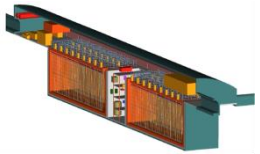
- Very interested
  - Original developer of LAr TPC technology
  - Currently 8 institutions are LBNE collaborators
  - NESSiE Collaboration
    - 6 additional Italian & other nationalities
    - Long-term interest in LBNE
  - Precise scope being discussed
  - Push technology: R&D and experiment
    - Incl. WA104 @ CERN
  - Some people propose to provide 1 complete TPC of own design
    - Need significant resources outside INFN budget



Italian Activities (II)

LBNE

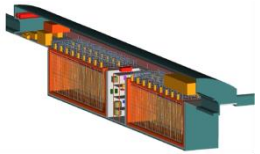
- Ongoing high level discussions
  - FNAL director ⇔ vice president of INFN
  - LBNE project & collaboration⇔ VP of INFN
    - Including President of commission 2 (Neutrinos)
  - LBNE leadership ⇔ C. Rubbia
  - 11th US-Italy Joint Commission on Science & Technology Cooperation
    - Washington, 12-13 Dec 2013
      - Chaired by DOE/HEP ass.director & VP INFN
    - LAr technology and SBL/LBL program @ FNAL
      - Major point of discussion on working level/physics
  - Further 3-way discussions
    - DOE/HEP ⇔ CERN DG ⇔ INFN president



LAGUNA/LBNO

LBNE

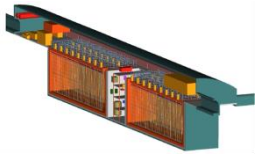
- 200 members with large cross section of European particle physicists
  - 9 CERN member states
  - 1 accession state
  - 2 observer states
- Nearing the completion of EU funded design study
  - Detailed engineering & full costing
    - Locations: Frejus, Gran Sasso, Pyhäsalmi
    - Technologies: LAr, LScint, Water Cherenkov
  - Part of which is LAr detector @ Pyhäsalmi
    - Phase I: 20 kt
    - Phase II: 70 kt
- Scientific goals & technology are very similar



LBNO-LBNE Discussions

LBNE

- Leadership agreed
  - work towards common goals would be mutually beneficial
- Task force to discuss joining forces
  - Meeting every ~2 weeks
  - 5 members from each Executive Committee
- Joint physics task force
  - Comparison of analysis
  - Common understanding of science strategy
- Common R&D centred around WA105@CERN
    - To be completed around 2017
  - Comparison 1- & 2-phase readout
  - Prototyping both LBNE & LBNO hardware
    - P.a. large membrane cryostat



Summary

LBNE

- Opportunity
  - Europe can contribute to make LBNE a better experiment
    - Underground location
    - ND detector
    - Fiducial mass
  - Valuable Expertise
    - LAr technology
      - ICARUS, LAGUNA-LBNO
    - LBL experiments
      - MINOS, T2K, OPERA
    - Electronics/DAQ, engineering, physics, software
    - Near Detectors
- Physics reach is important
  - Have to be able to do first class science to get funding