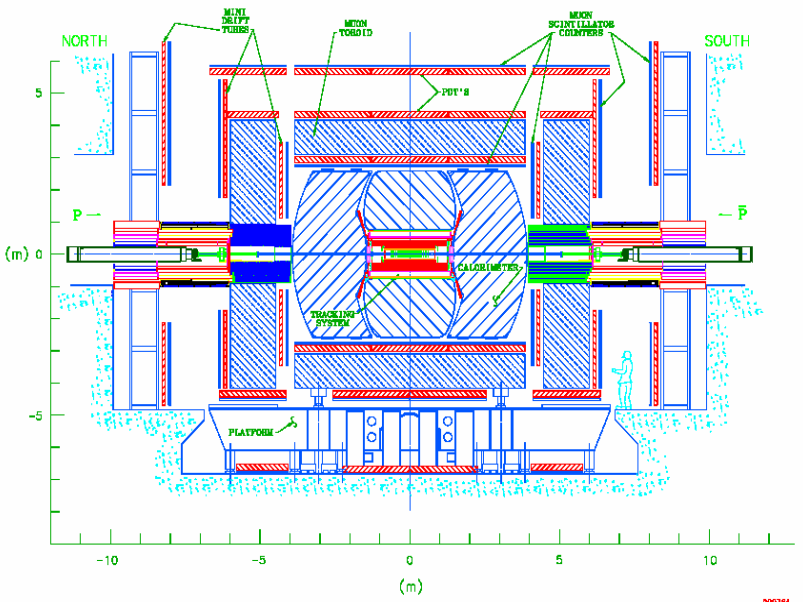
Commissioning a Large Detector: A Personal Perspective

- **DZero History & Milestones**
  - Proposed 1983
  - Complete 1991
  - Commissing 1991-1992
  - Run I May 1992-1996
  - Top Discovery Feb 24 1995
  - Upgrade 1996-2001
  - Commissioning 2001-2002
  - Run II 2002-2009



Stages & Durations

- Several phases, not distinct, overlapping
- Commissioning
  - Technical (pre beam, ~2 yr)
    - Subsystem/Software Installation and Verification
    - Integration & Timing
  - Physics Commissioning (not necessarily sequential, ~1 yr)
    - Survey & Calibration
    - Trigger Definitions
    - Definition/Evaluation of Particle Identification
- Discovery(?)
    - Primarily luminosity, manpower dependent
- Consolidation(~4 yrs)
  - Improved surveys & tools, calibration

Commissioning

- Intense, frustrating, iterative, but ultimately rewarding phase. Not necessarily beam or manpower limited, but "expertise or specialist limited"
- Pre- Beam (2 yrs): Data integrity, Rate Studies, Noise Studies, Calibration Runs, Software convergence
- With Beam (6-12 mo)
  - Luminosity needed for "fundamentals"
    - Timing
    - Survey: i.e. magnet off/on for tracking
    - Calibration: i.e. em/hadronic response (vs azimuth)
    - Trigger: i.e. calibrations, efficiencies, rates
  - Luminosity to acquire "candles" or resonances
    - Lepton ID (electron, muon) & efficiency
    - Overall EM and Hadronic energy scale
- Analysis to complete definition of objects (12-24 mo)
    - B & τ ID
    - First pass jet energy scale and resolution
    - Missing Et: really sensitive to noise, cracks, nonlinearities – prone to surprises!

The Extreme Example: Jet Calibration

- **Since DZero had no magnetic tracker → Developed in-situ technique.**
  - **For Run I took approximately three-four years from 1992-1996.**
  - **Even with experience, Run II a similar time scale (new calorimeter electronics, new luminosity regime)**
- **Step 1: EM calibration (1-2 year)**
  - **Based on resonances to understand linearity**
  - **Dependent on definition of electron ID which involved test beam, tracking, calorimetry**
  - **Relative calibration between test beam and detector to tune ID, sampling weights (several years, most difficult)**
  - **Azimuthal calibration which required understanding of trigger biases, significant analysis**
- **Step 2: Measurement of hadronic response (2 years)**
  - **Dependent on a well-understood, robust jet algorithm**
  - **Based on photon-jet and jet-jet balance, ID and systematics understood**
  - **For Tevatron statistics limited**
- **Step 3: Other effects (1-2 years)**
  - **Offset (calorimeter noise)**
  - **Showering correction between parton→particle→calorimeter levels**
  - **Underlying event - ever increasing luminosity!**

DZero Run I Physics Output Experience

- **~ Six months required to establish tools for first results/searches. From DPF, Nov. 1992:**
  - ***W and Z Decays to Electrons/Muons in/at D0***
  - ***Top Quark Search in D0 from Lepton+ Jets Mode***
  - ***Two Jet Energy and Rapidity Distributions***
  - **...**
- **~ Two years for results requiring all object ID and decent understanding of backgrounds, consistent with first three DZero pubs:**
  - ***First Generation Leptoquark Search in pbarp Collisions at sqrt s = 1.8 TeV*** **Phys. Rev. Letters {72} 965 (1994)**
  - ***Search for the Top Quark in pbarp Collisions at sqrt s = 1.8 TeV*** **Phys. Rev. Letters {72} 2138 (1994)**
  - ***Rapidity Gaps between Jets in pbarp Collisions at sqrt s = 1.8 TeV*** **Phys. Rev. Letters {72} 2332 (1994)**
  - **...**
- **Multiyear for full understanding of detector and precision results.**
  - ***Measurement of the W Boson Mass Phys. Rev. Letters 77, 3309 (1996).***
  - ***The Inclusive Jet Cross Section in pbarp Collisions at sqrt (s) 1.8 TeV.*** **Phys. Rev. Lett. {82} 2451 (1999)**
  - **...**

Comments on "LHC physics…" viewed from DZero Record:

- **If discovery requires**
  - **first pass identification of muons & electrons, possible in the first 6 months of running.**
  - **full panoply of objects, something like two+ years.**
  - **final calibration of all objects, it will be a multi-year process.**
  - **For scale: DZero current b-tagged all-jets analysis similar to preprint is now in progress.**
- **Final comment: requires a careful, thoughtful balance between immediate and long term goals.**