From Test Stand to M-Test: The Detector Design Process

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Fermilab Test Beam Facility

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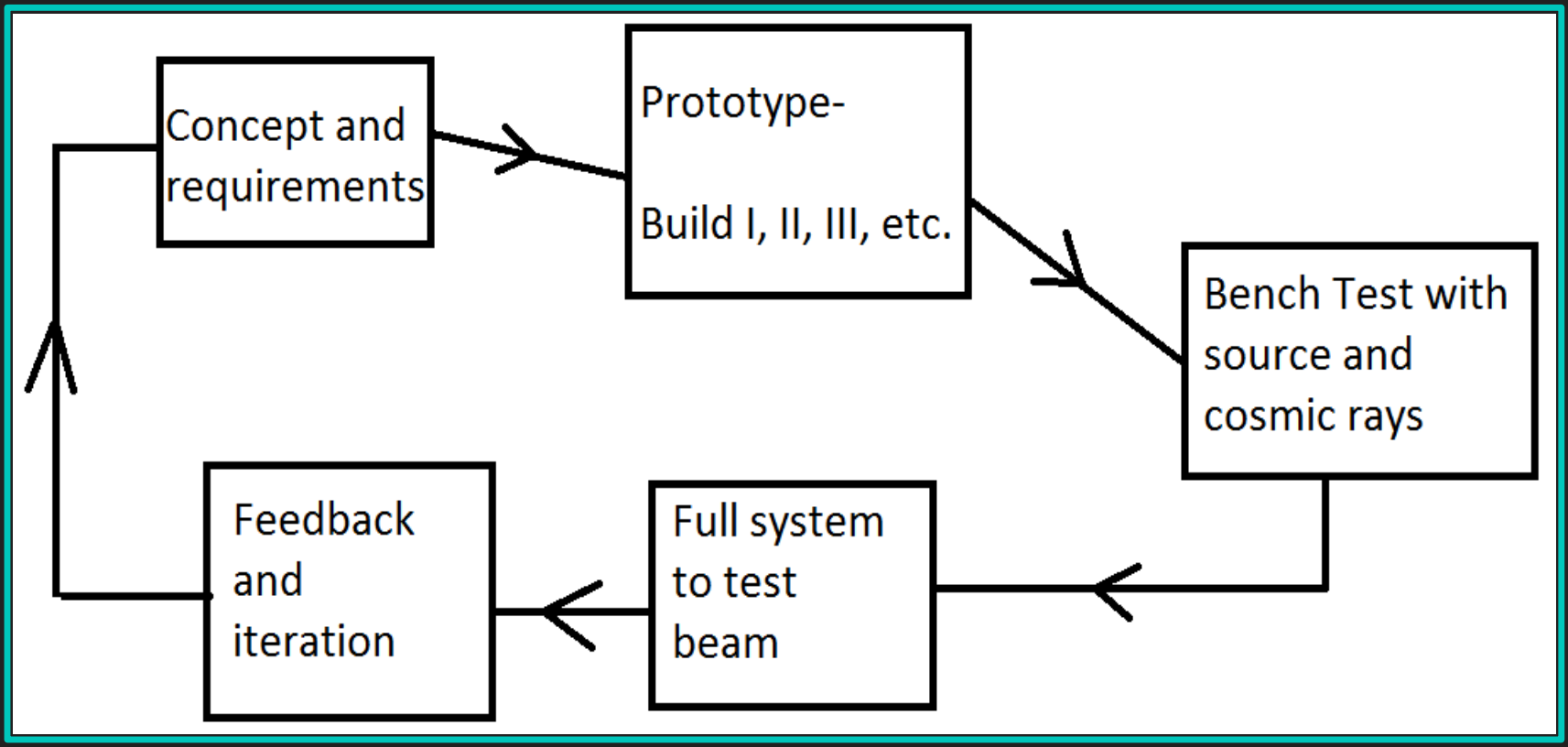
Outline

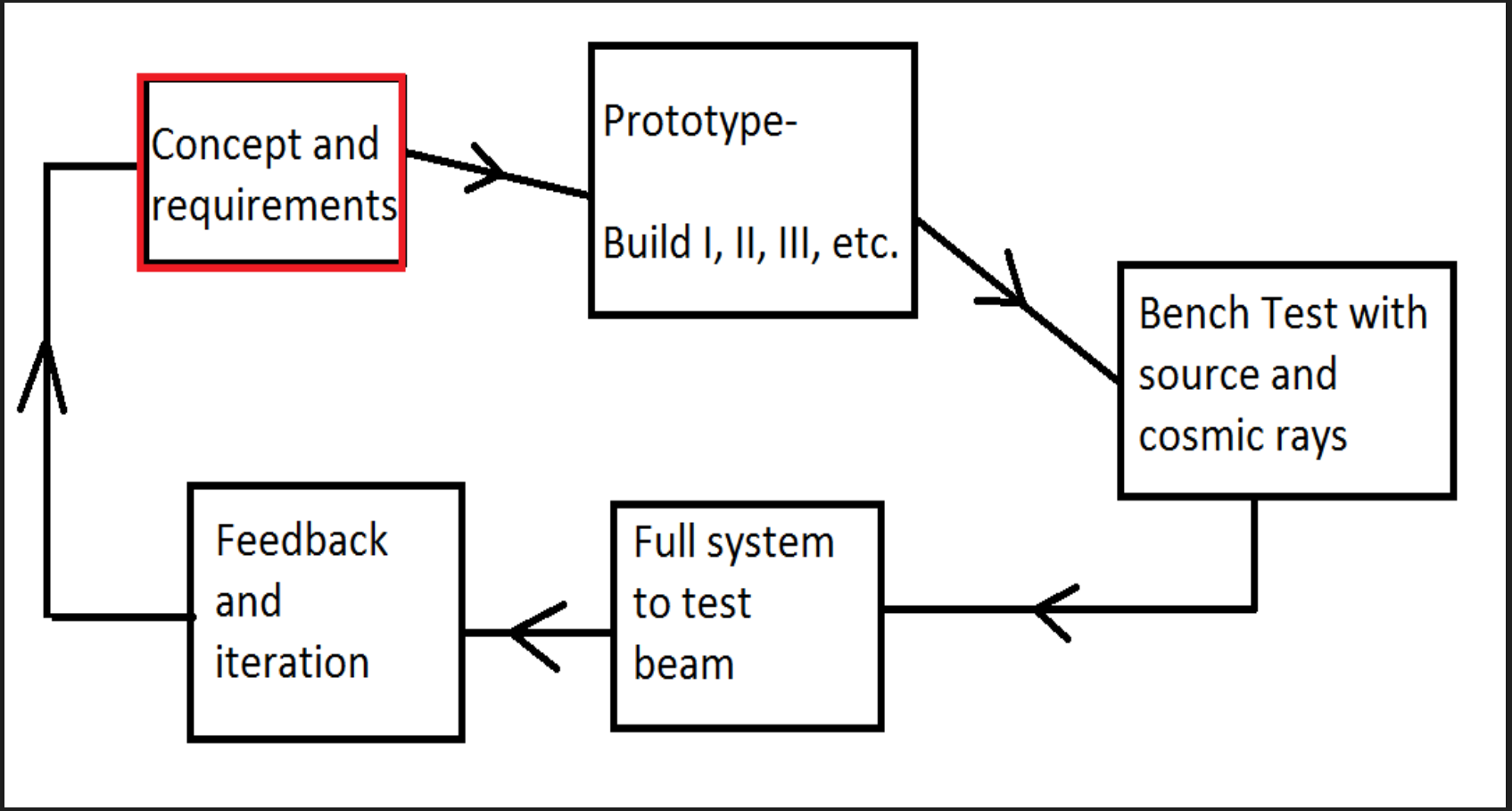
- Test Beam Facility
- Test Stand
- Lead-Glass Calorimeter
- Maximum Integrated Data Acquisition System [MIDAS]
- Slow Controls
- Future Work

Test Beam Facility (FTBF)



- Two beams
  - M-Test – for shorter experiments
  - M-Center – recommissioned for LArIAT
- Available for the use of all experiments
- Provides a calibrated and understood beam and optional detectors
- Offers round the clock data collection and analysis (December-June)

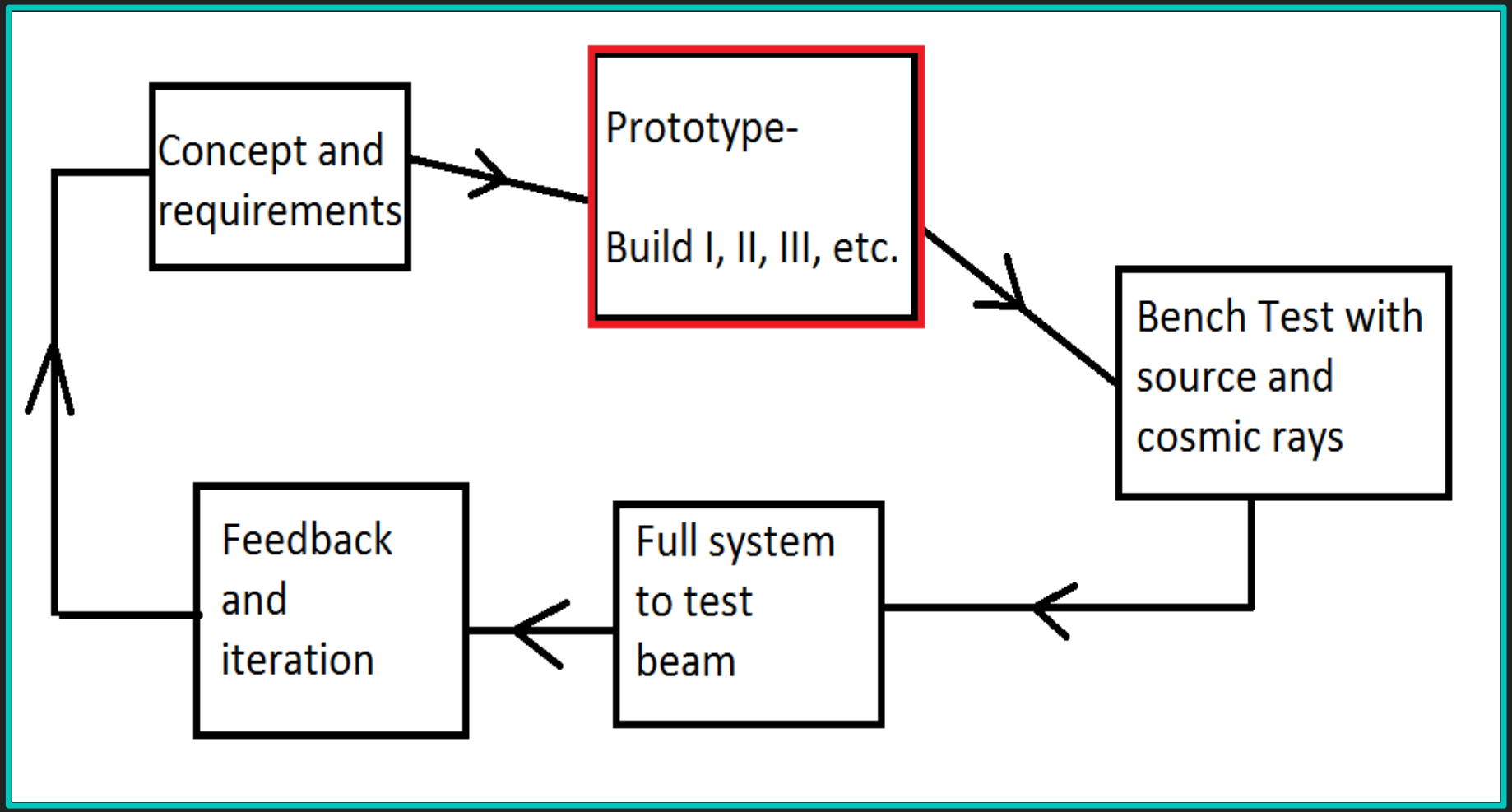
Detector Design Process



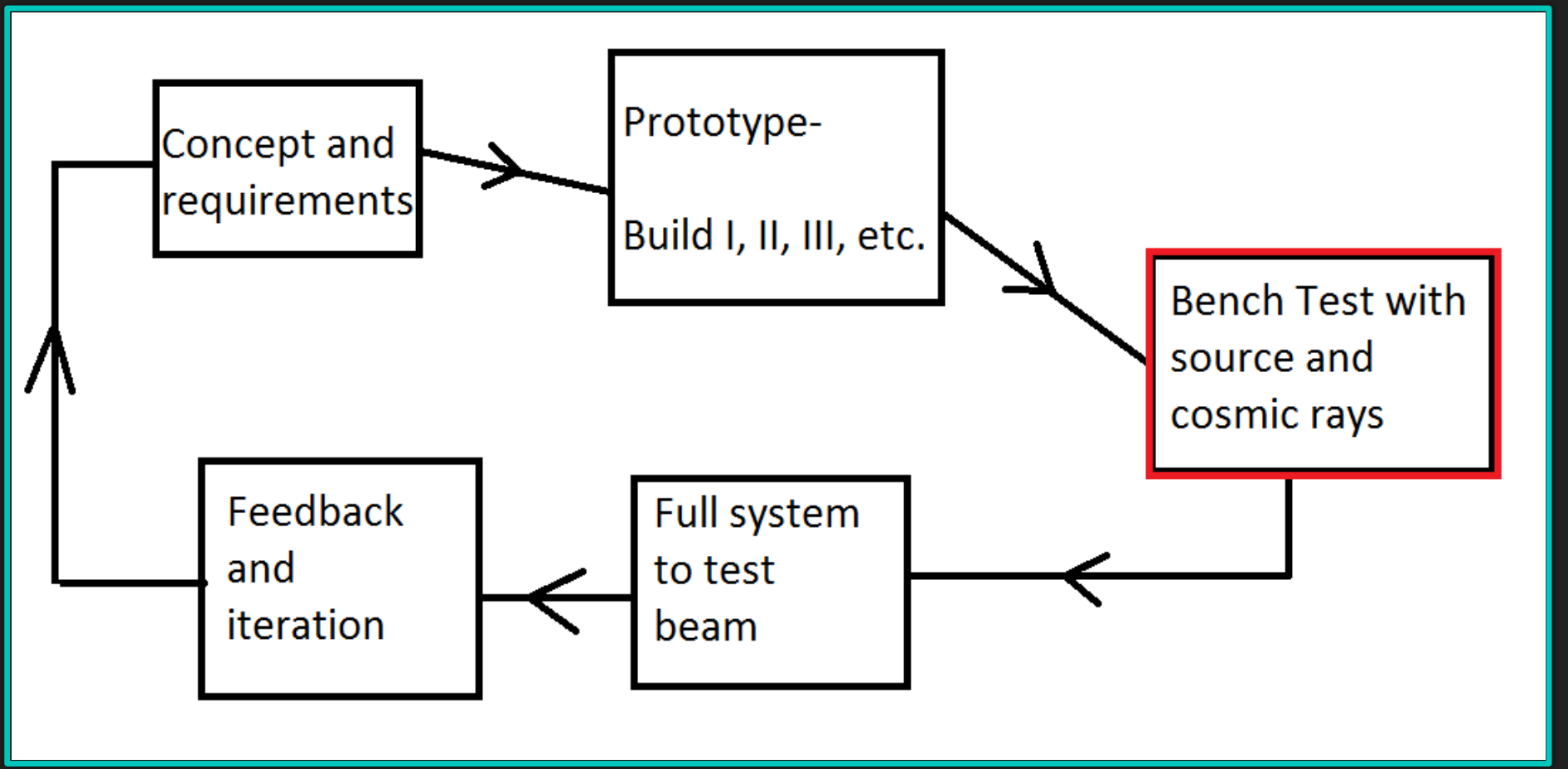
- Goals
  - Functional particle detectors
  - Stable DAQ
- Hardware
  - Particle detection
  - Equipment monitoring
- Programming
  - Linux
  - C & C++

Detector Design Process

- Building scintillators
- Attaching scintillator to photomultiplier tubes

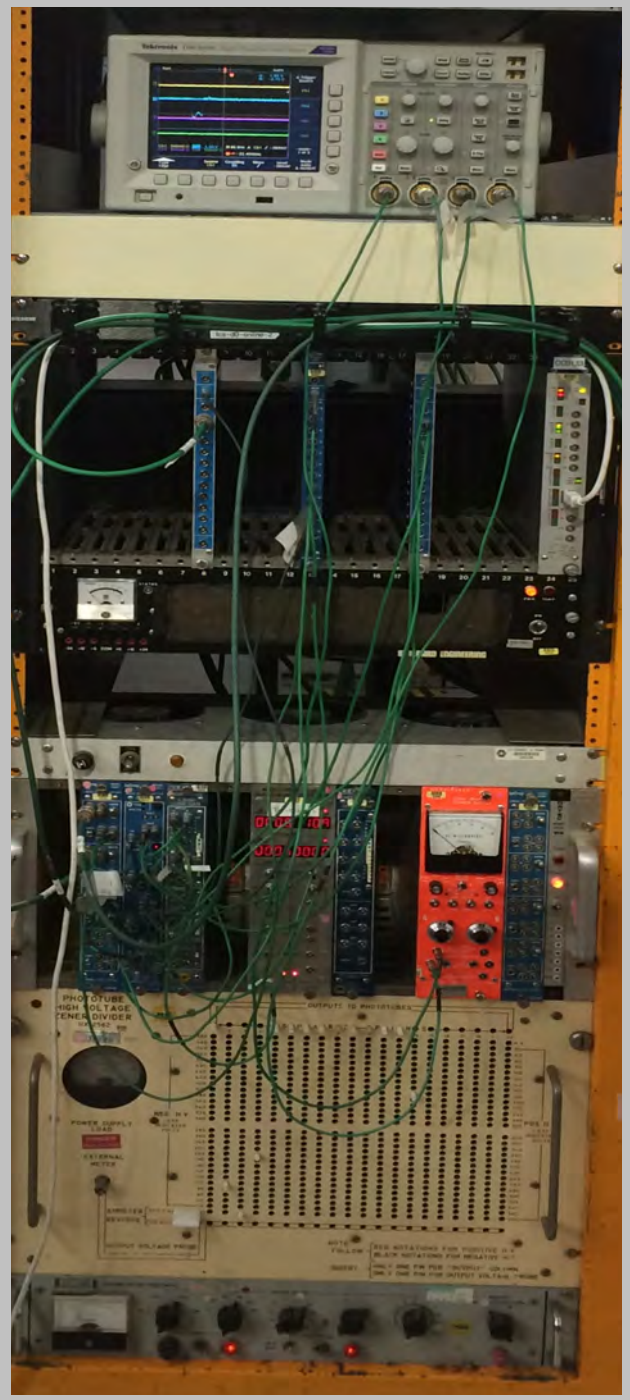


Detector Design Process



- Test Stand
  - Hardware
    - Scintillator
    - PMT
  - Lead Glass Calorimeter
    - Calibration
- Data Collection
  - Manual
  - Digital

Oscilloscope →



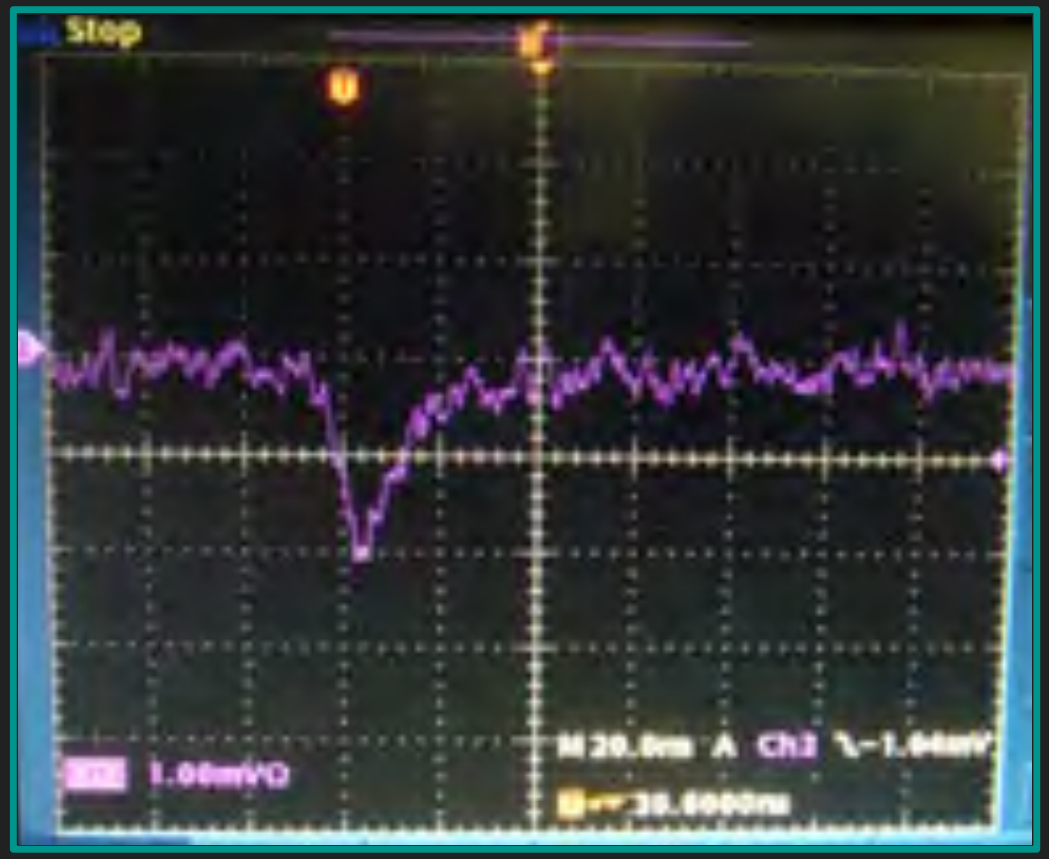
← CAMAC CRATE

NIM CRATE →

← HIGH VOLTAGE

Test Stand with Manual Collection

- Manual Data Collection
  - Nuclear Instrumentation Module (NIM) logic
    - Modules don't require digital data communication
    - Discriminator – picks the useful signals
    - Logic gate – "and" gate acts as a coincidence counter
  - Scintillators
    - Detects charged particles – produces photon
    - Light tight to increase efficiency
  - Photomultiplier Tubes (PMTs)
    - Absorbs photon to emit an electron
    - Detect very weak signals – amplified by photocathode
    - Characterized based on optimal HV



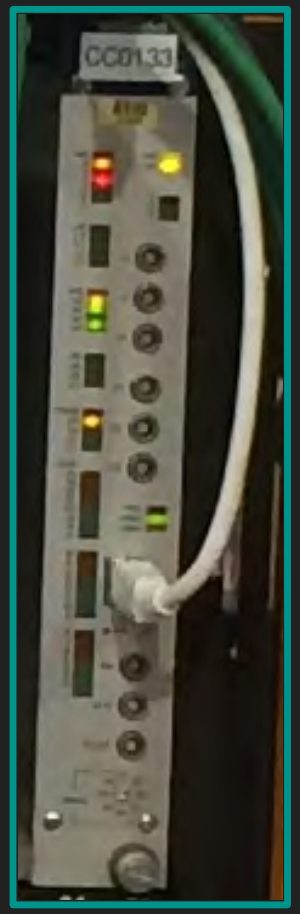
COINCIDENCE

SCINTILLATOR 2

SCINTILLATOR 1

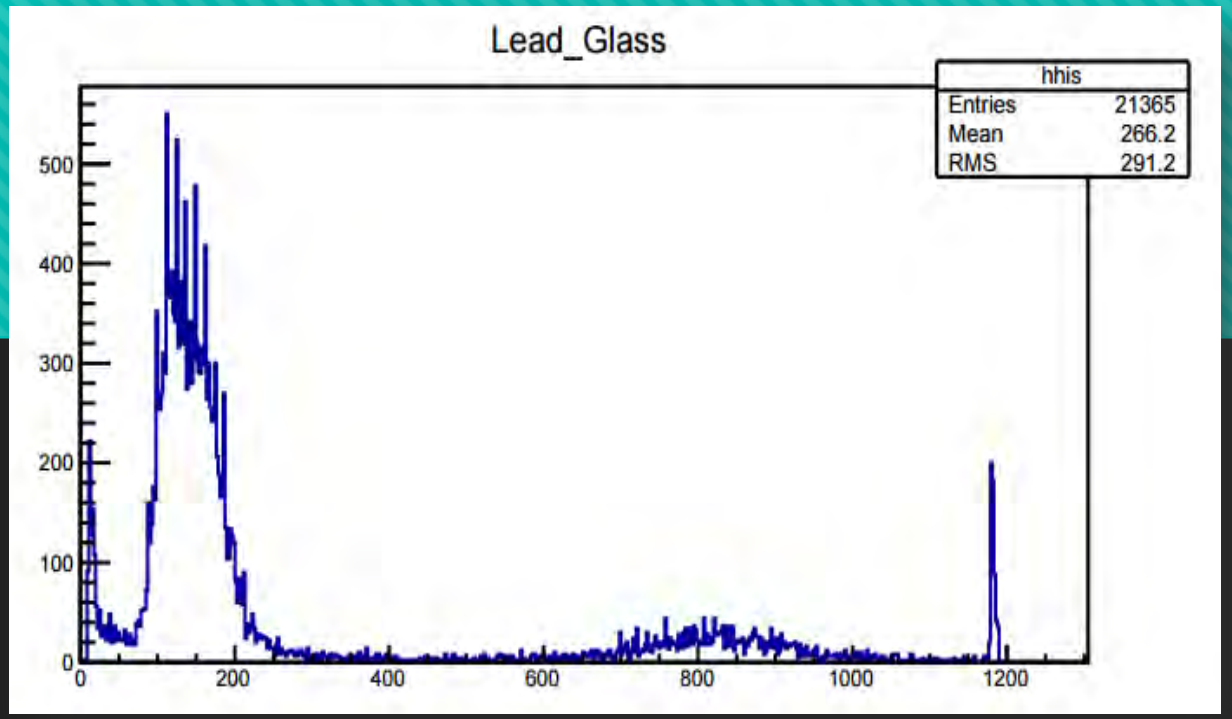
LEAD GLASS CALORIMETER

Test Stand with Digital Collection



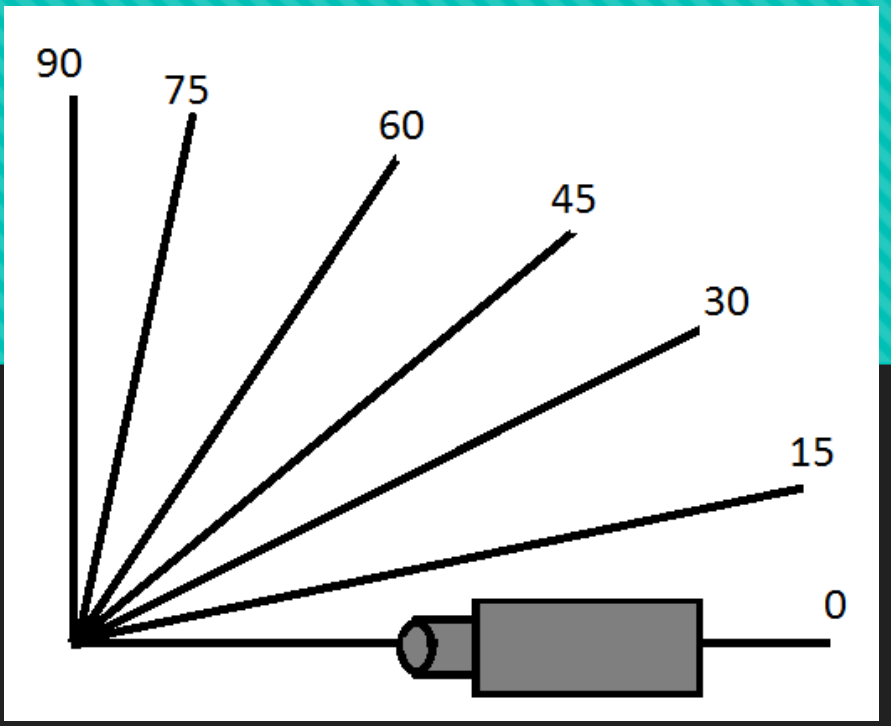
- Digital Data Collection
  - Computer-Aided Measurement and Control (CAMAC)
    - Crate controller – interfaces with a PC with USB cord
    - Fits 25 single-slot modules
    - 1 gate and 12 ADC inputs per module
    - Requires digital communication amongst modules
  - Lead Glass Calorimeter
    - Can't take data manually
    - Digital collection helps with calibration process

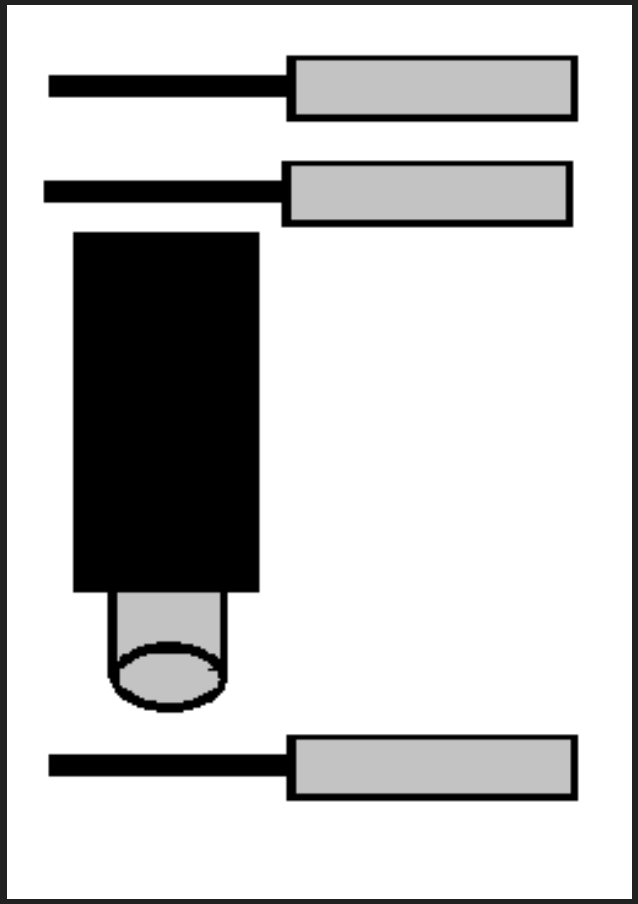
Lead-Glass Calorimeter



- "Passive" material [lead] for stopping for stopping and absorbing the particle [because it has high-density]
- "Active" material [glass] where the signal is created [because it's sensitive]
- Connect to MIDAS DAQ with a frontend file

Calorimeter Calibration



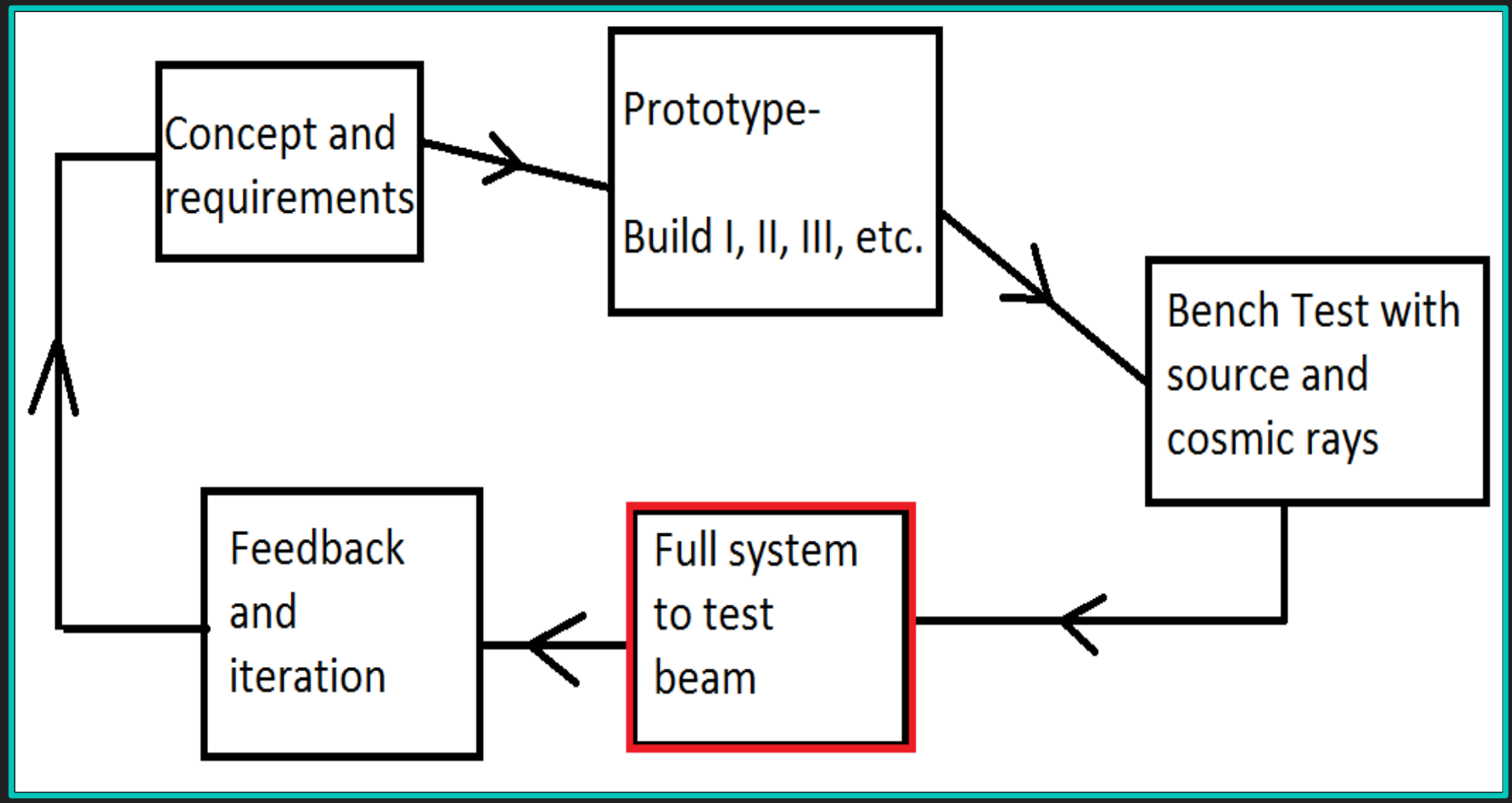


Calculated E loss [MeV] – Pedestel [MeV] = Calibration Constant

- Use a known source [Cobalt 60, Cesium 137, cosmic rays, etc.]
- 3 scintillators – confirm particle path
- Alter geometry -- Confirm calibration constant

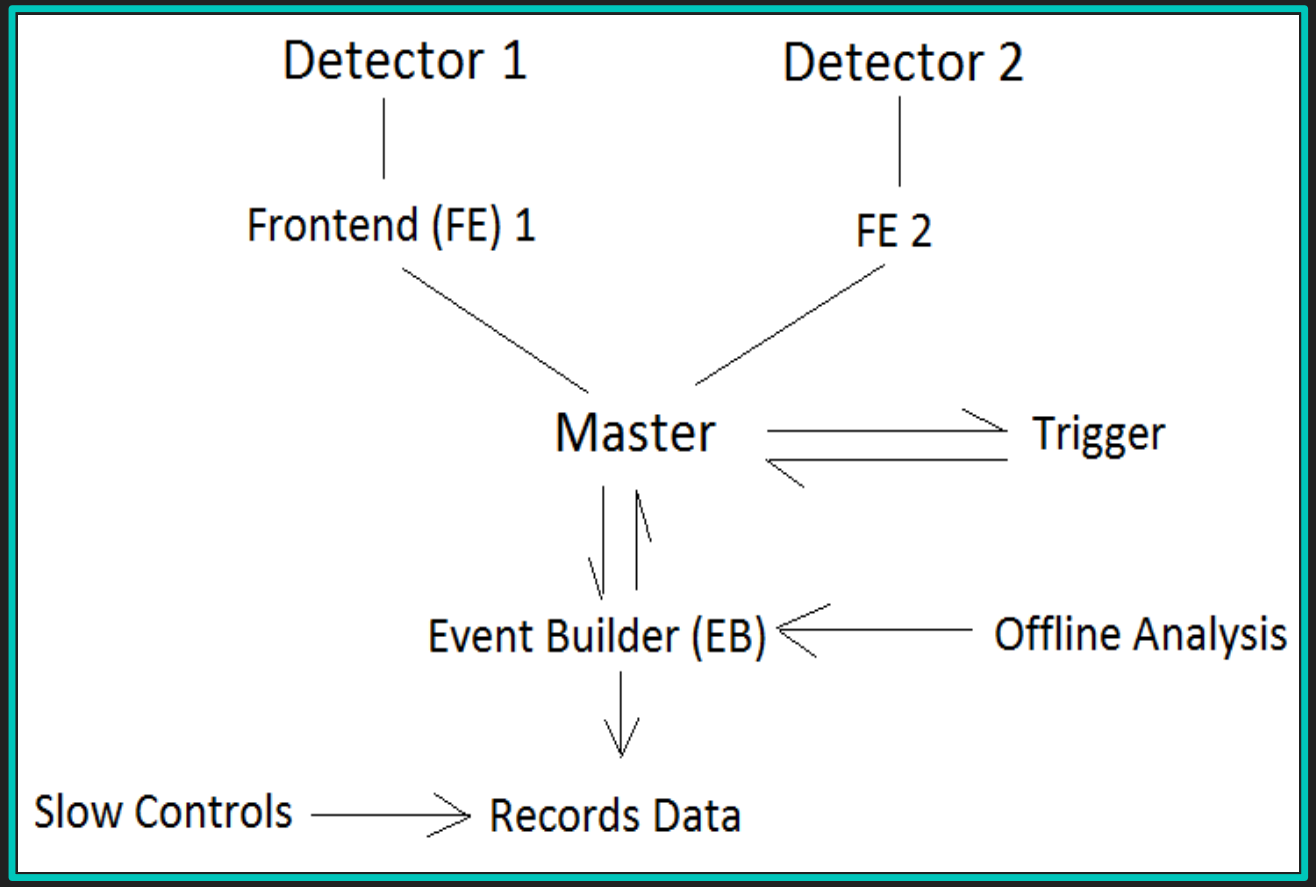
Detector Design Process

- MIDAS
  - Hardware
    - Wire chambers
    - Calorimeters
    - Time of Flight
    - Cherenkov
    - Slow Controls
  - Data Acquistion
    - Frontends
    - Event Trigger
    - Event Builder



MIDAS

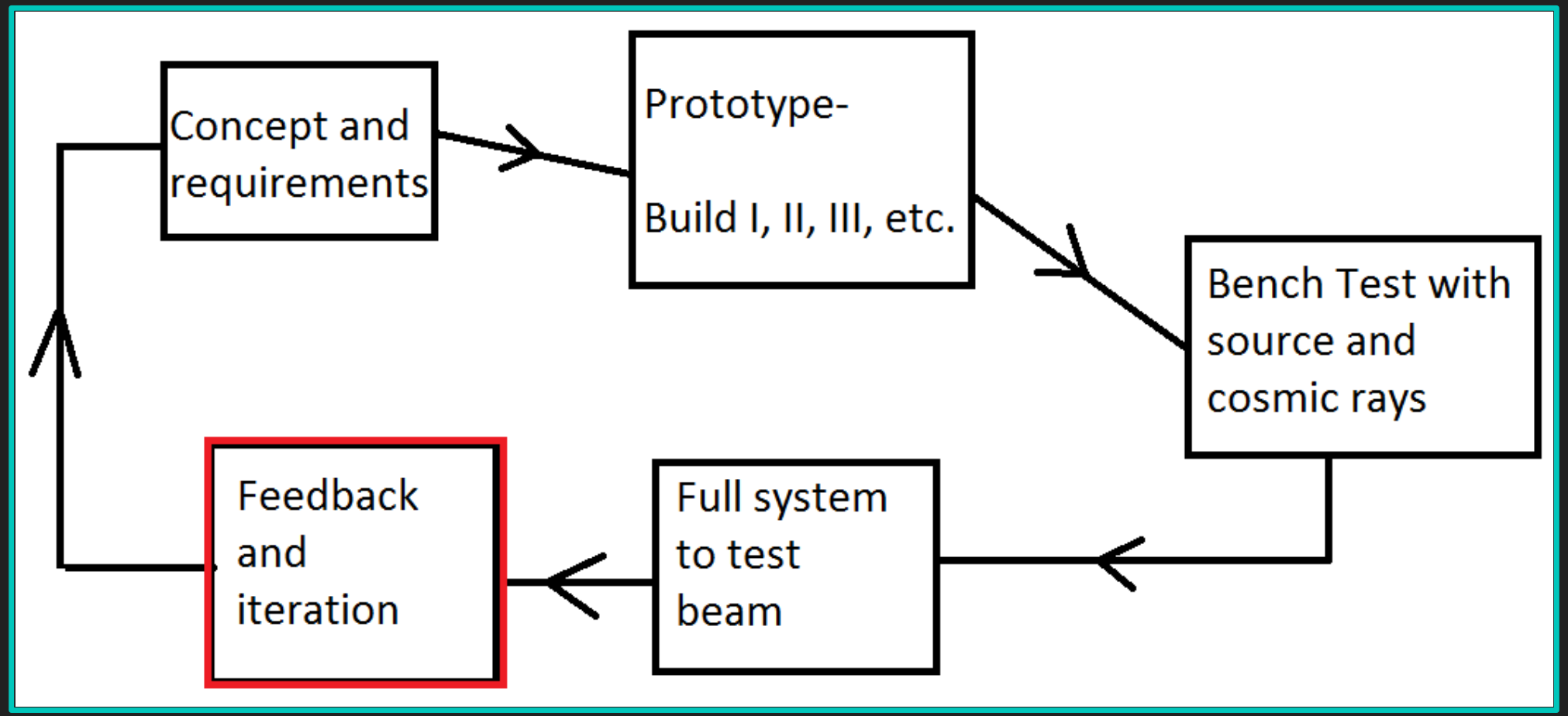
- Maximum Integrated Data Acquisition System [MIDAS]
  - Ideal for a system with many components
  - Collaboration of all of the test beam staff and interns
- Installation
  - Troubleshooting
  - Create a user friendly way to integrate many instruments



Slow Controls

- Slow Controls
  - High voltage monitoring
    - Additional installation step in MIDAS
    - Additional slave frontend with minor amendments to a general code
  - Droege's
    - Work well with ACNET -- no precedent with MIDAS
    - Droege's cannot be controlled remotely – not an issue at FTBF

Detector Design Process



Future Work

- Continue to build MIDAS
  - Additional slow control monitoring – temperature, humidity, etc.
  - Connect calibrated Calorimeter, Cherenkov, Time of Flight, etc.
- Precision calibrate the Calorimeter
  - Once successful, document and able to calibrate other detectors
  - Can place the calorimeter in the test beam for the user and to confirm what is known about the beam

Acknowledgments

- Supervisor: Mandy Rominsky
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- Intern Collaborators: Kathleen Murphy, Kevin Shuman, Amira Malik
- SIST mentors and advisors: David Peterson, Gustavo Cancelo
- SIST Manager: Sandra Charles
- SIST Committee Chair: Elliot McCrory

Reserve time at the Test Beam

- Facility dedicated to detector research and development
- Staff is excited to help users achieve their goals and make their test beam run as smooth as possible
- Contact Mandy Rominsky for scheduling time
  - rominsky@fnal.gov
  - http://goo.gl/forms/GECh9hSoXjt6jUeU2