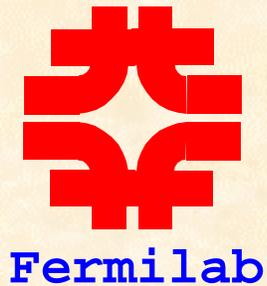


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# Recycler BPM Front-end

Duane C. Voy  
voy@fnal.gov



# General Issues

Pilot Test: operates identically to old system

Installation & Commissioning: operates similarly to existing system

- \* Ultimately: event driven system

Support ring and transfer line detectors

Transfer line specifications identical to 2.5 MHz bunched beam Flash

- \* All measurements provide position and intensity proportional (sum signal) data

- \* All measurements support multiple beam “flavors”

Readout provided for all settable parameters

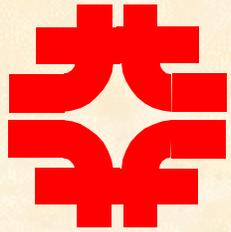
Detailed status provided for each measurement and for overall BPM operation

## References:

“Recycler BPM Embedded Software Description” – Old System

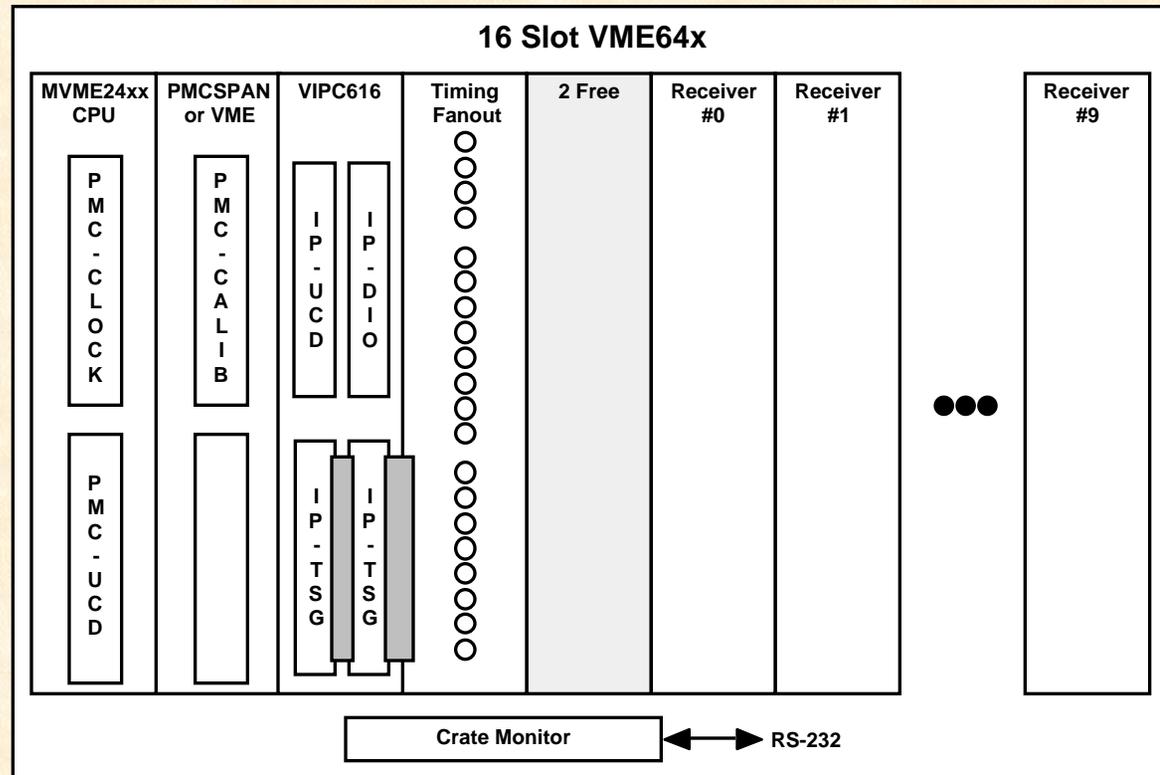
“Recycler BPM Front-end Technical Requirements” - **TBC**

“Recycler BPM Front-end Technical Specification” – **TBC**

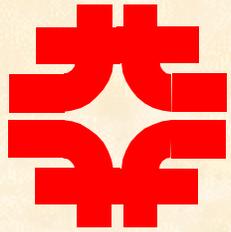


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# Recycler BPM Front-end\*

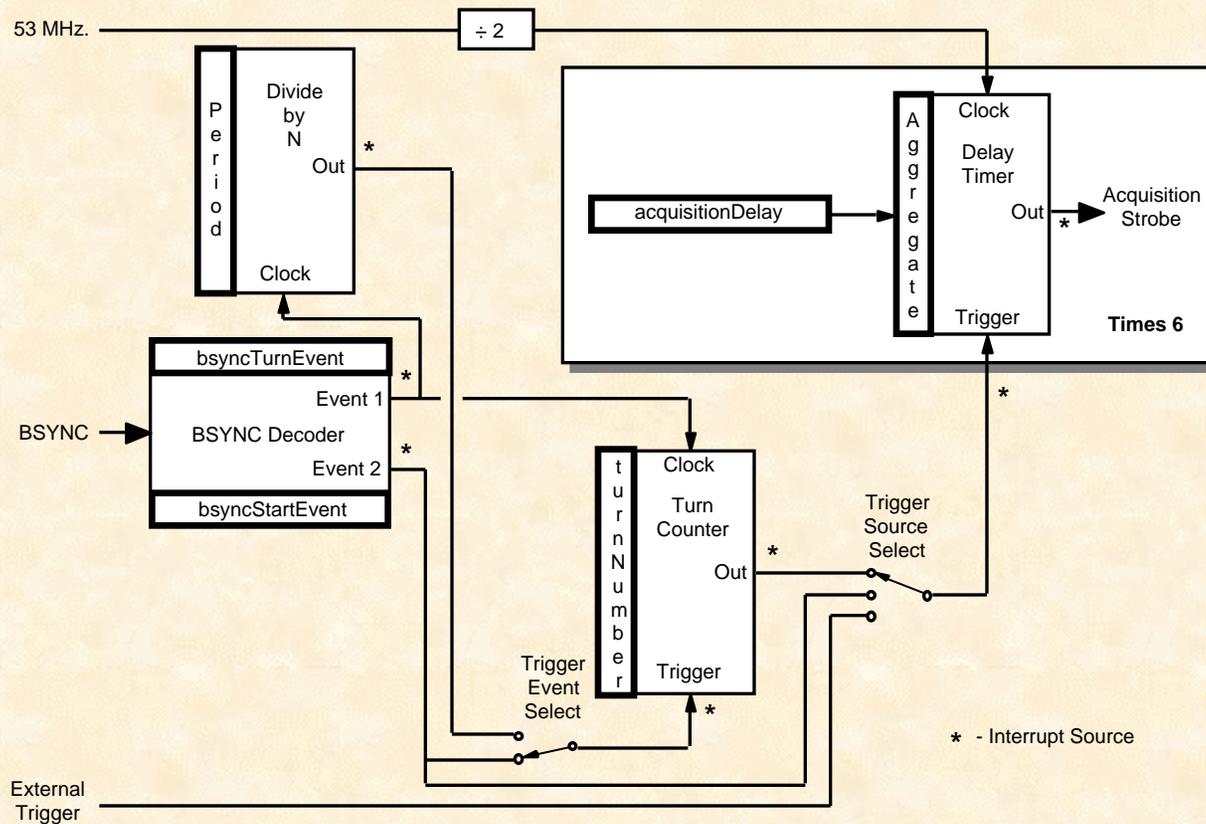


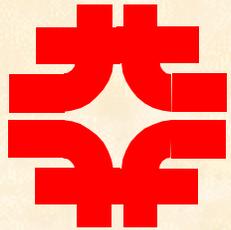
\* Not drawn to scale.



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# Recycler BPM Timing Signal Generator





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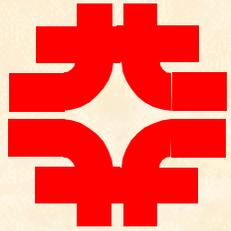
# Measurement Timing

All measurements:

- \* Armed by a control console request or a specified Tclk event  
Triggered by a specified Bsync event
- \* Delayed from specified turn marker by Mdat derived value + specified offset  
Over-write last data of same type (except Background Flash)  
Timeout in five minutes if not triggered  
Restore any interrupted Background Flash
- \* If not yet triggered are aborted by new incoming arm event
- \* One deep command buffer allows triggered measurements to complete  
All data buffers also contain relevant time-stamp, status and parameter set

Global physics parameters:

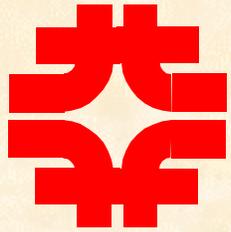
- \* proton/pbar/injection/extraction/MainInjector/Accumulator/calibration
- \* bunched/de-bunched
- \* bunch/batch/ensemble/head/tail  
Mdat type code  
global delay



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# Beam Measurements

- \* 1) Background Flash - programmable rate – 200 .. **TBD** Hz.
  - Default mode when no other measurement active
  - Quasi-continuous - momentarily interrupted by other measurements
- \* Circular buffer of 16384 elements
  - triggered by **TBD** external pulse
  - restart upon control console request
  - Fast time plot most recent values even when circular buffer stopped
  - Restart when circular buffer is reset
- \* 2) Flash - first/last turn
- \* Derived from Turn-by-turn data
- \* 3) Closed Orbit - averages 2 .. **TBD** samples
- \* Derived from Turn-by-turn data
- \* 4) Turn-by-turn - measures 1 .. 1024 consecutive turns
- \* 5) Calibration
  - Uses normal measurement data paths
  - Check of signal path and software processing
  - Store results in database
- \* 6) Diagnostic
  - Returns raw A/D counts and digital receiver I&Q values



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## \* Beam “Flavors”

2.5 MHz bunched Injected/Extracted Beam

Individual bunch – BF, CO, FL, TbT

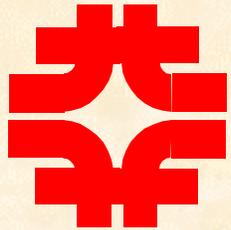
Batch average - BF, CO, FL, TbT

De-bunched Hot/Cold Beam

Head - BF, CO, FL, TbT

Tail - BF, CO, FL, TbT

Ensemble center-of-mass - BF, CO



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## \* Event Triggered Data Acquisition

Measurement armed by Tclk event (or control console request)

Measurement triggered by Bsync event

Up to 16 arm/trigger Acquisition Specifications containing:

- Tclk arm event number

- Bsync trigger event number

- Mdat address

- Global delay

- Enable/Disable flag

- Proton/Pbar/Injection/Extraction/Calibration

- Bunch/Batch/Ensemble/Head/Tail

- Timeout value

One data buffer per Acquisition Specification

Data readout via Readout Specification containing:

- Trigger event identifier

- Type of data desired

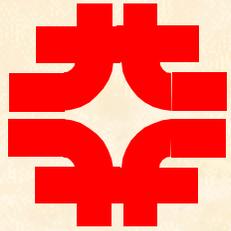
- Turn number

- Number of turns

- Channel pair (for Turn-by-turn)

References:

“Event Driven Data Acquisition for the Recycler Ring BPM”



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# Data Readout

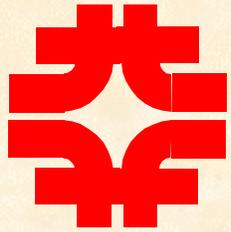
## Data Types:

- 1) Background Flash
- 2) Flash
- 3) Closed Orbit
- 4) Turn-by-turn
- \* 5) Diagnostic

## All Buffers:

Independent readout of:

- Position
- \* Intensity proportional (sum signal)
- Specified number of turns (Turn-by-turn)
- Associated status, parameter set and time-stamp



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# Application Programs

## Application Program Support Library

- \* intensity
- \* turn-by-turn on all channels
- \* event triggered capability

## Flash Application

- \* intensity
- \* event triggered capability

## Turn-by-turn Application

- \* intensity
- \* turn-by-turn on all channels
- \* event triggered capability

- \* Calibration Application

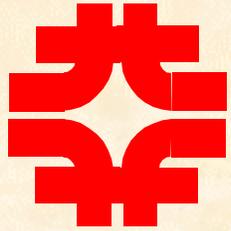
Request measurements

Analyze, display and store data - user friendly

- \* Engineering Support Application

Request and display diagnostic data

Set and readout engineering parameters



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# Software Projects

## Front-end Modules:

Main front-end – Duane Voy

- \* Digital Receiver Processing– Charles Briegel
- \* Receiver Clock – Dennis Nicklaus
- \* Calibration Waveform Generator – Dennis Nicklaus
- \* Event Triggered Data Acquisition – Duane Voy

## Application Programs:

Application Support Libraries – Brian Hendricks

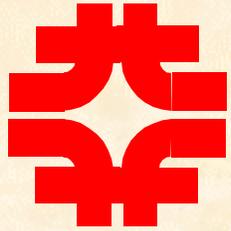
Flash Measurement – Lin Winterowd

Turn-by-turn Measurement – Ming-Jen Yang

- \* Calibration – Stephen Pordes & **TBD** - CD
- \* Engineering Support **TBD** – CD

## References:

“Recycler BPM Software Outline”



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# Software Development Plan

## 1 - Provide Functionality of Current 2.5 MHz System

- Port front-end to VxWorks 5.4 on PowerPC

- ADC software module for digital receiver

- Digital receiver clock

## 2 – Enhance Existing Functionality

- Calibration system

- Diagnostic measurement

- Intensity proportional (sum signal)

- Turn-by-turn for all channels

- Engineering parameters in ACNET

## 3 – Implement New Modes/Measurements

- Multiple digital receiver filter management

- Background Flash circular buffer

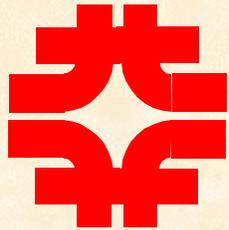
## 4 – Implement Event Triggered Data Acquisition

- Tclk event handler

- Acquisition and Readout specifications

## References:

- “Recycler BPM Software Priorities & Projects”



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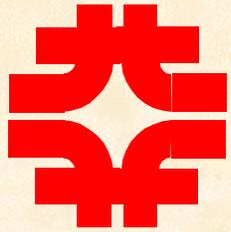
# Software Development Plan

## Front-end Software

- First Installation and Pilot Test
  - Port front-end to VxWorks 5.4 on PowerPC
  - ADC software module for digital receiver
  - Digital receiver clock
  - Local calibration signal control
  - Local diagnostic measurement
- System Commissioning
  - Calibration signal control in ACNET
  - Diagnostic measurement in ACNET
  - Engineering parameters in ACNET
- Early Operation
  - Intensity proportional (sum signal) data
  - Turn-by-turn data for all channels
  - Multiple digital receiver filter management
- Full Operation as Specified
  - Background Flash circular buffer
  - Tclk event handler
  - Acquisition and Readout specifications

## Application Software

- First Installation and Pilot Test
- System Commissioning
  - Calibration Application
  - Engineering Support Application
- Early Operation
  - Intensity proportional (sum signal)
  - Turn-by-turn for all channels
  - Multiple digital receiver filter management
- Full Operation as Specified
  - Acquisition and Readout specifications



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# Software Development Plan

