

# Control System Status

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NATIONAL LABORATORY



# The NSTX Control Group

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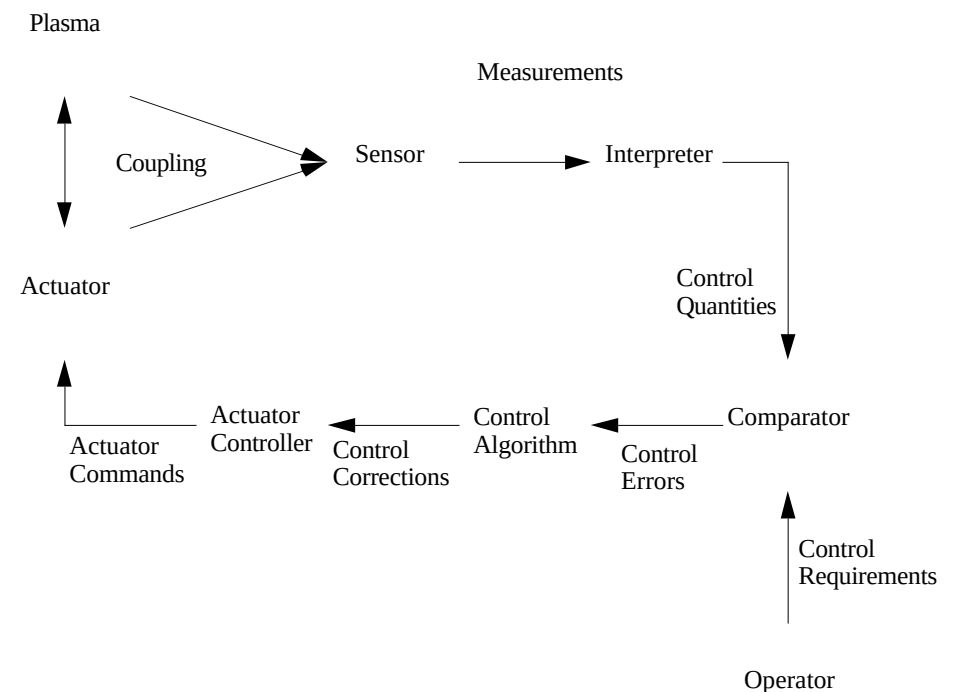


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# Control System Basics



- General control loop has many stages
- Physics has input via the interpretation of measurements and the control algorithm



# NSTX Control System Development Plan

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- Shape control - Three steps
  - Day 0 - Coil current control (no plasma feedback)
  - Day 1 - R, Z,  $I_p$  control (preprogrammed shape)
  - Day 2 - Full shape control based on rtEFIT and isoflux concept
- Gas control - Three steps
  - Preprogrammed valve voltage
  - Preprogrammed gas flow
  - Density feedback
- RF control ?
- NBI control ?

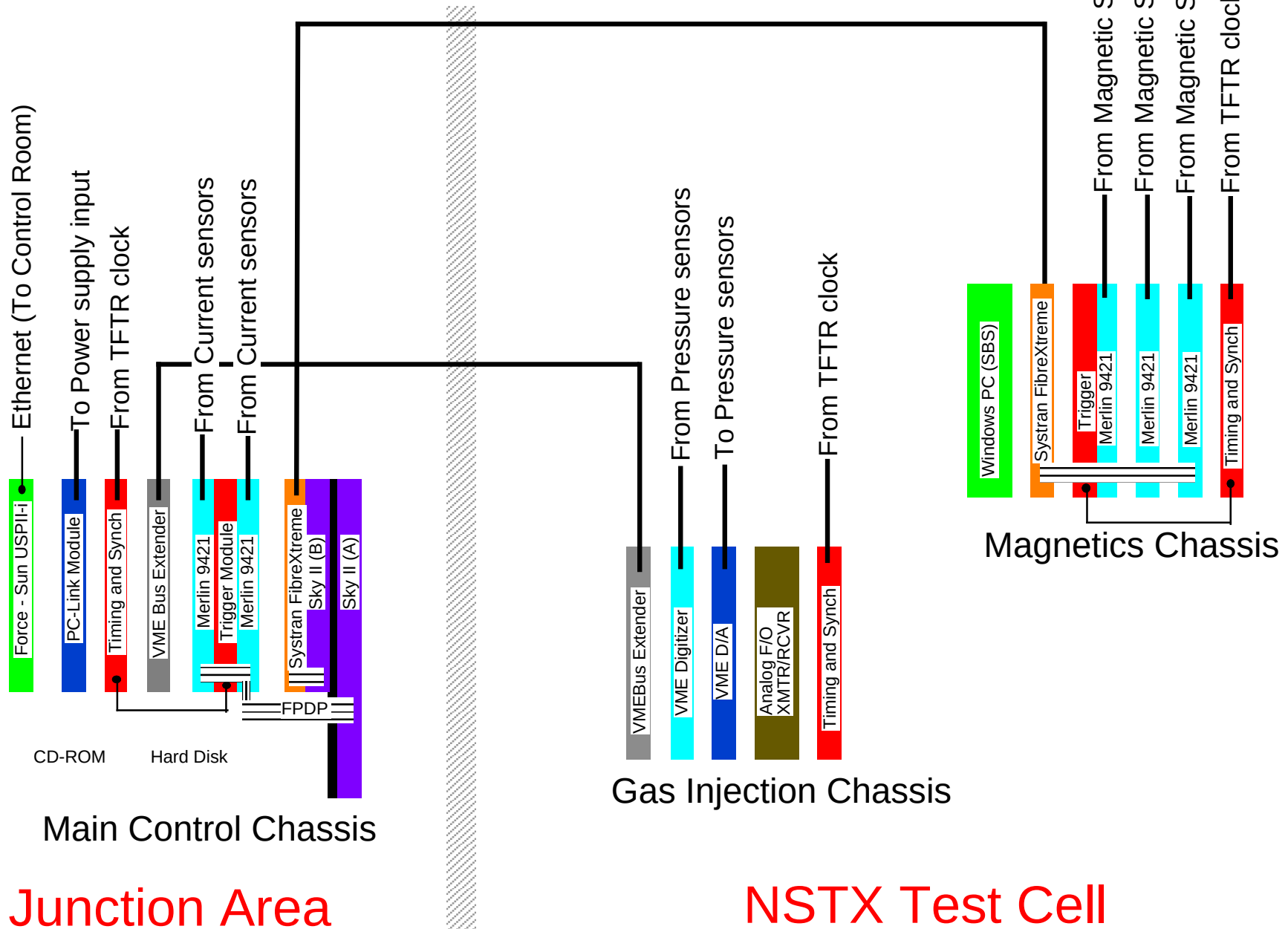
# New NSTX Hardware Capabilities

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- 8 - 333MHz G4 processors
- 160 channels of fast real time data acquisition
  - $\sim 5\mu\text{s}$  transmission delay
  - Low latency
- Gas injection control
  - 7 data channels, 4 controlled valves
  - Plenum pressure control
  - Potential for density control (with real-time density signal)
  - Shot restore capability

# Control System Block Diagram



# Software Development status

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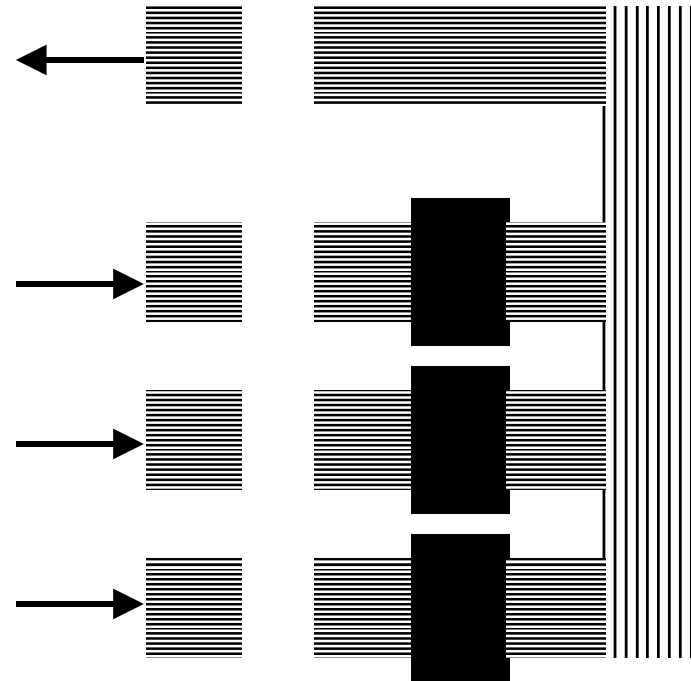
- PCS updated
  - Simulation mode supported
  - Multiple processors supported
- rtEFIT to be available during the coming run
  - Already demonstrated for NSTX offline
- CHI control to be attempted during coming run
  - R, Z,  $I_p$  control algorithm (similar to existing ohmic algorithm)
- New gas injection control category under development

# FIMM to allow data acquisition expansion



- FIMM  $\Rightarrow$  FPDP  
(Front Panel Data  
Port) Input  
Multiplexing  
Module
- Can be daisy  
chained to allow  
arbitrary number  
of data stations
- Board designed  
with prototype  
under  
construction

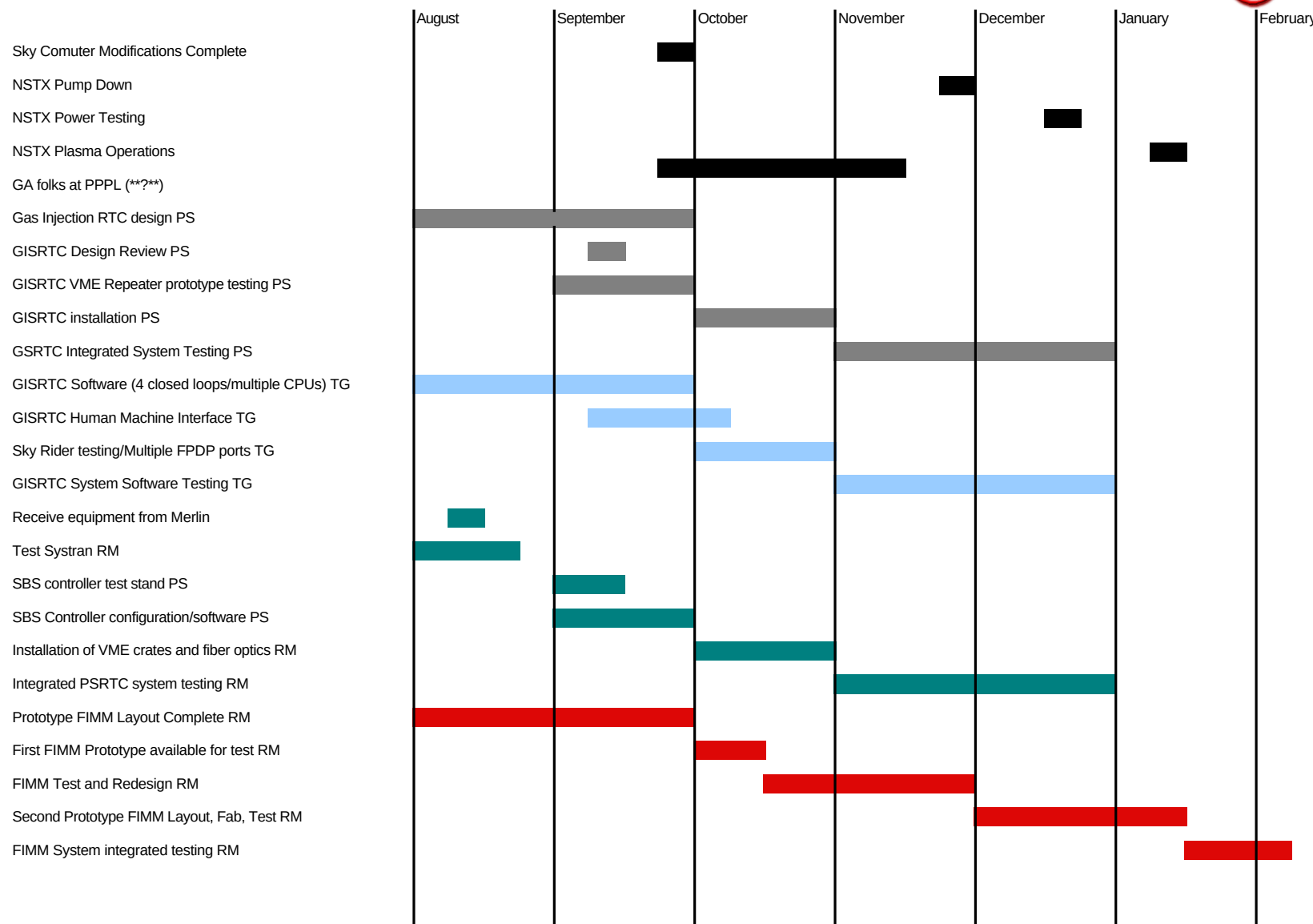
FPDP Output



FPDP Inputs



# Control system development schedule



# Future Plans



- New Measurements (all need real-time interpretation)
  - Thomson scattering
  - CHERS
  - MSE
- Full kinetic rtEFIT
- RF - real time ray tracing?
  - Current profile control?
- NBI -real time Fokker-Planck? Monte Carlo?
- Real time MHD stability calculations ?

# Summary

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- Substantial new control capability will be available by the end of this run
  - rtEFIT
  - Isoflux control
  - Gas injection control - density control?
  - Initial CHI control
- Future expansion is well posed technologically, but requires physics based input
  - Development effort required!