The MAST Upgrade Plasma Control System

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New features of MAST-U include:

Many new PF coils for divertor control studies

Different combinations of the same coils used to control different plasma shape parameters

– complex to manage

Many new gas injection locations for flexible multi-purpose applications

Multiple source gases, up to 6 gas species in simultaneous use. Any injection location can be used for any of several simultaneous gas control tasks
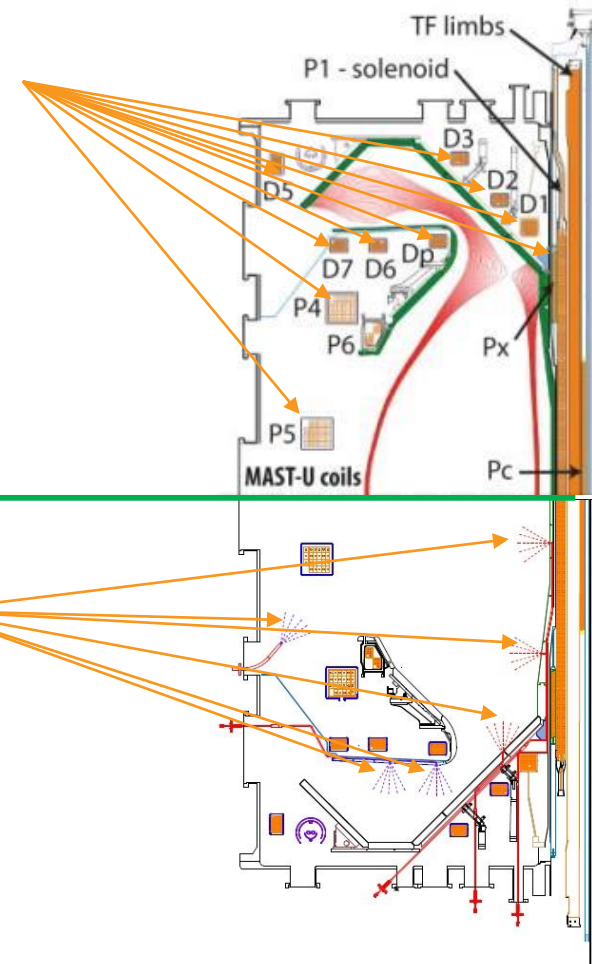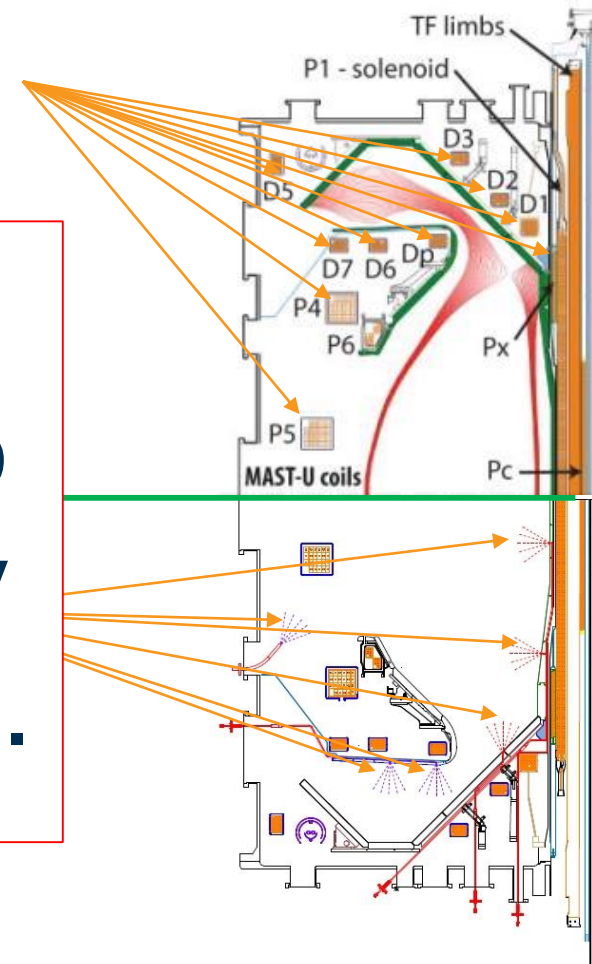
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Different com...
different plas...
– complex to ...

Common Concern:
Many actuators need to be used simultaneously in multiple control tasks.

Multiple sour...
use. Any injection location can be used for any of several simultaneous gas control tasks

PCS based on General Atomics:

- Categories are placeholders for execution of interchangeable functions

- Each category has its own time segments (phases)

category →→→ **pulse duration** →→→

System	(Single immutable function and global data)			
PF control	pre-magnetise	breakdown	ramp-up	flat-top
Gas control	inactive	prefill	density control	density + XYZ
Category X	inactive	function A	function B	function A

- Care needed when exchanging data between categories

- Data has global scope – ensure only one category writes to any item

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Architecture decisions for MAST-U PCS:

For each of PF coils and gas:

- Define a functional chain of categories to break down complexity

Virtual actuator change requests

Control aspect 1

Control aspect 2

Control aspect 3

Control aspect 4

Virtual to physical actuator mapping

Physical actuator change requests

Actuator collective controller

Plant voltage demands

Multiple control categories running in parallel…

…driving virtual actuators.

Separate category defines virtual actuators and maps to physical

Separate single actuator manager category that owns the plant