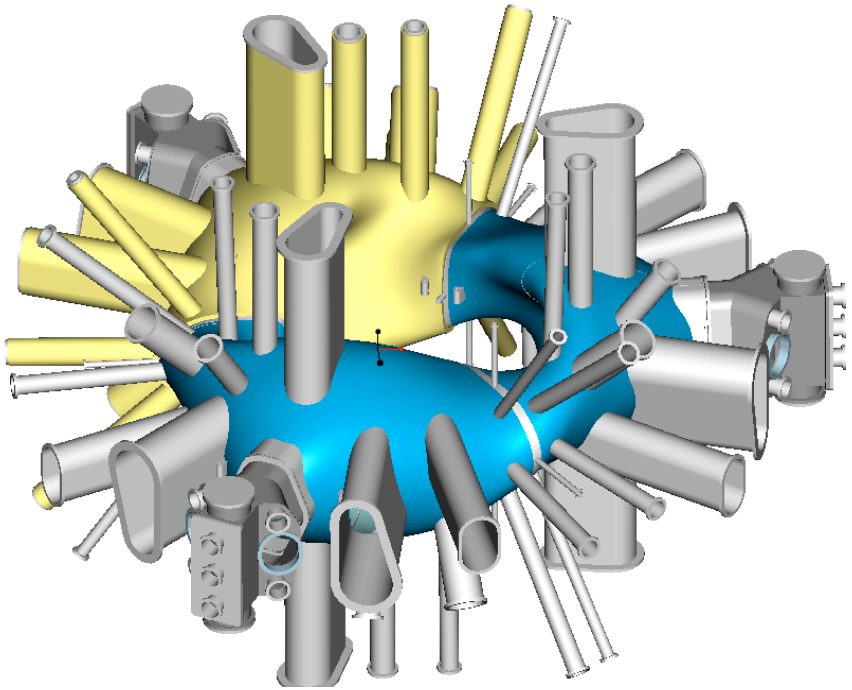
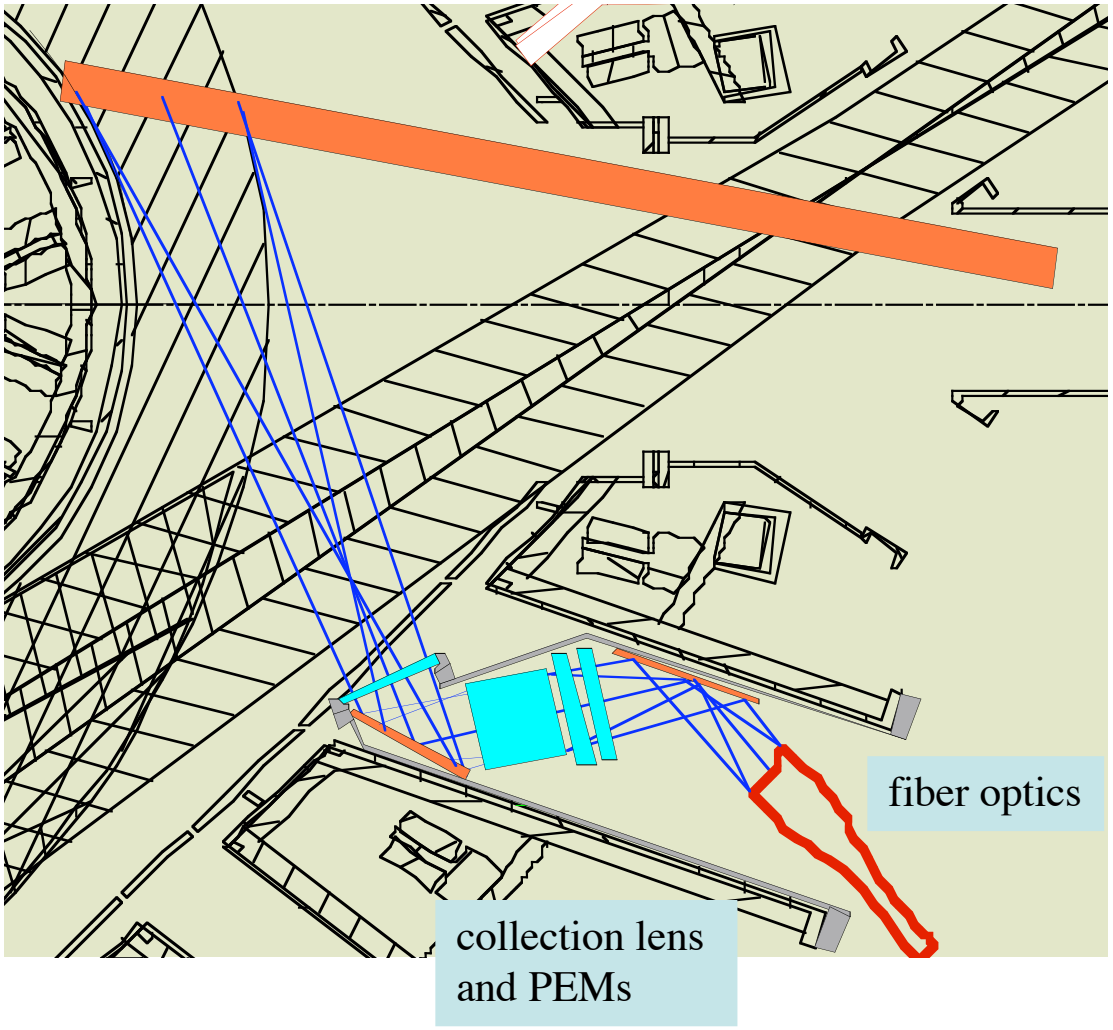
An Urgent Task is to Optimize Port Orientations

- Port extensions in existing designs:
  - lie in radial planes
  - have axes which are in line with magnetic axis
  - have uniform cross-section
  - have lengths defined by cryostat outer boundary
- These constraints could be relaxed to improve diagnostic access.
- This should be done with specific diagnostics in mind.
- This task is complicated since reorienting one port generally affects five others. (to preserve stellarator symmetry)



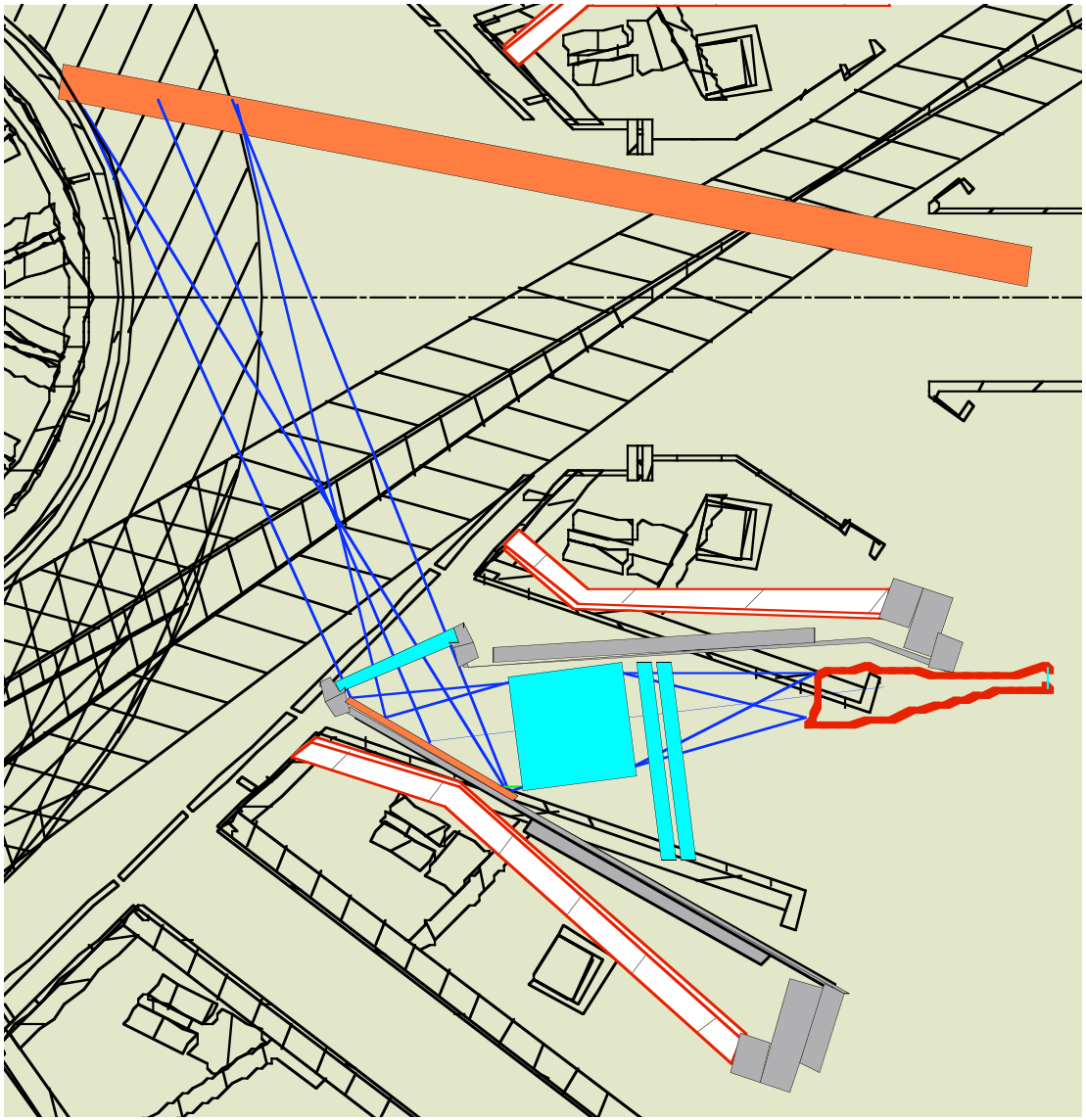
CDR Port Design - Re-entrant CHERS/MSE Viewing Concept

- Views diagnostic neutral beam in geometry optimized for good spatial resolution
  - Requirement for sightlines to be tangent to flux surfaces as they pass through DNB defines unique viewing position near a modular coil.
- 5” clear aperture - Optical throughput a significant issue in active spectroscopy-particularly with DNB.
- View requires 2 mirrors
- PEMs would have to extend vertically, blocking other diagnostics at this port.



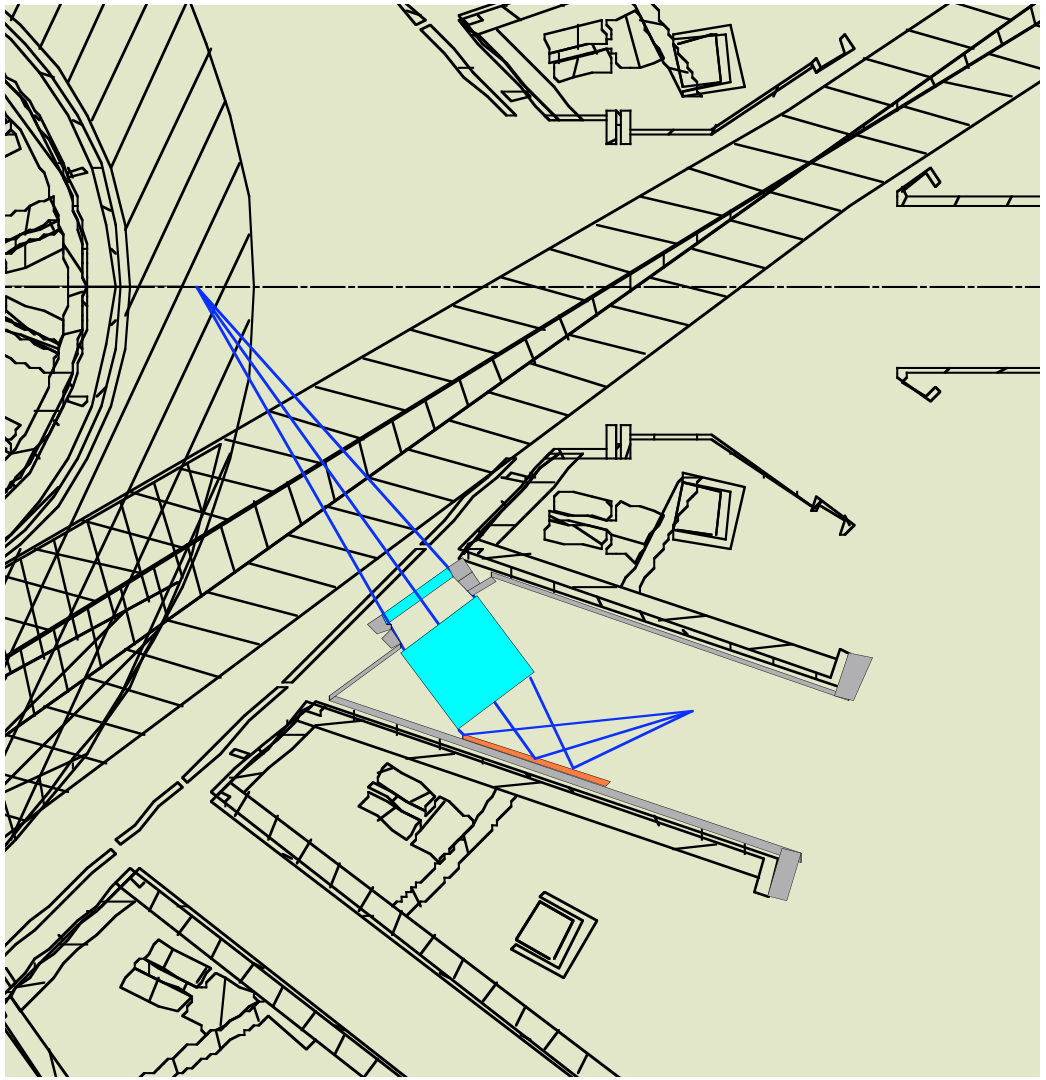
Optimized Port Design
Better CHERS/MSE Viewing Concept

- More optimized port, shown in white, fans out to take full advantage of space available.
- 7.5” viewing aperture □ x 2 increase in throughput
  - Very expensive to obtain x2 increase in signal other ways (e.g. higher current DNB)
  - Would definitely extend the range of applicability
- PEMs can be horizontal, permitting other diagnostics at this port.
- Only 1 mirror needed.



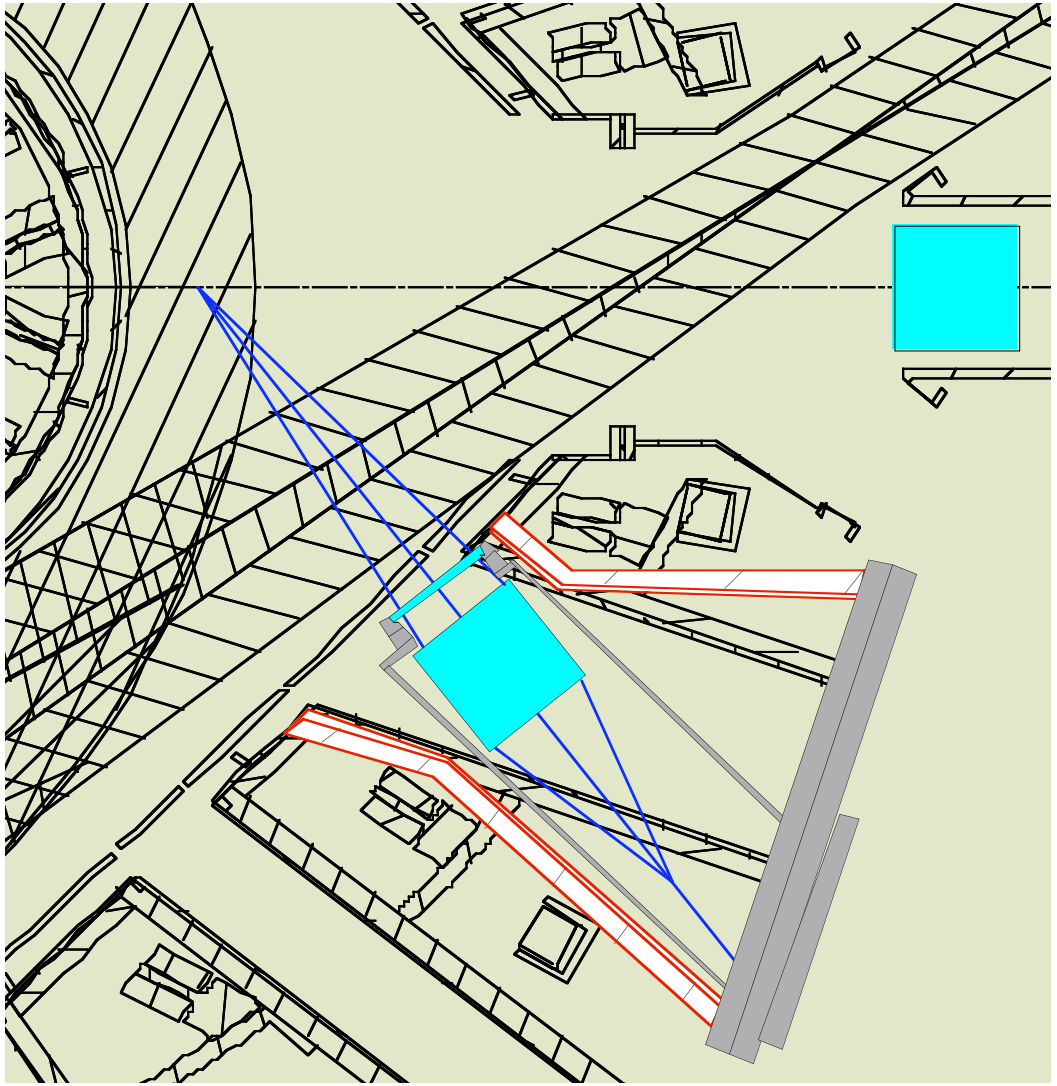
CDR Port Design - MPTS Concept

- Views vertical laser beam
- 6.3” clear aperture
- 1 mirror needed



Optimized Port Design
Better MPTS Viewing Concept

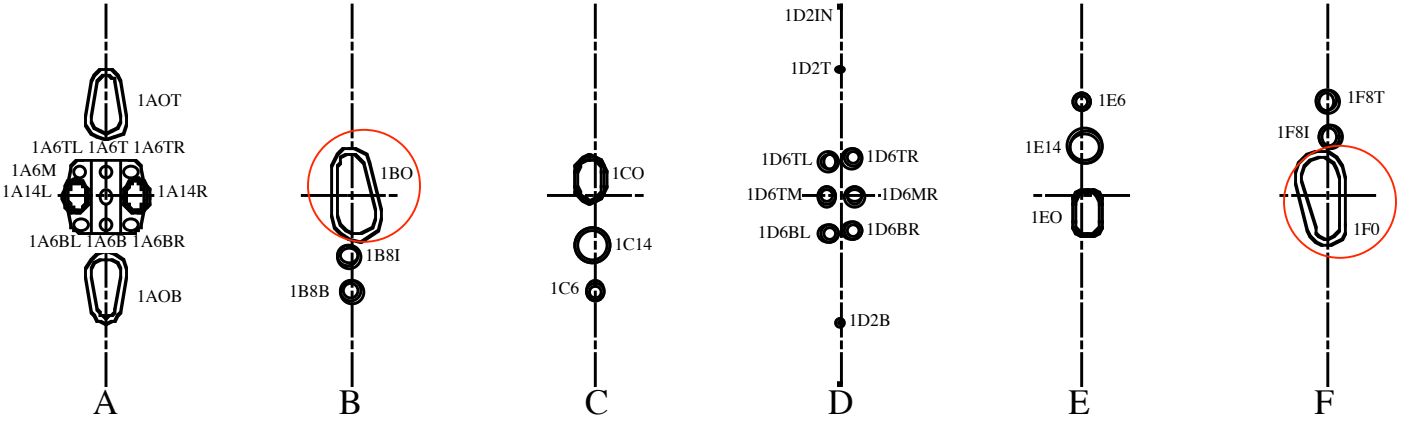
- With optimized port extension (white) can accommodate larger straight-thru system
- 8” clear aperture
  - Factor of 1.6 increase in throughput is worth a lot compared to other ways of increasing signal (e.g. laser energy)



Consider Impact of Optimizing Extensions for Select Ports

- Advantages:
  - Increased optical throughput for identified critical systems
    - More physics
  - Increased flexibility to accommodate optimized diagnostic designs not yet considered
    - NPA
    - BES
    - HIBP
- Disadvantages
  - Increased cost of extension design and fabrication
  - Increased complexity (risk) and cost of machine assembly
  - Larger port covers, seals

Preliminary Diagnostic Port Allocation



	A					B		C		D				E		F		
1AOT	div bolometer div camera	1A14L	neutral heating beam	1AOB	div. Bolometer IR camera	1BO	neutral particle analyzer	1C0		1D2T		1D2B		1E6	magnetics	1F8T	magnetics	Period 1
1A6TL		1A6M		1A6BL		1B8I	high frequency Mirnov coils	1C12		1D6TL	x-ray tomography	1D6BL	x-ray tomography	1E12	TS view	1F8I		
1A6T	divertor thermocouples	1A14R	fast tang. Xray camera	1A6B	divertor UV spectrometer	1B8B	magnetics	1C6	magnetics	1D6TR	x-ray tomography	1D6BR	x-ray tomography	1EO		1F0	CHERS/MSE & He CHERS	
1A6TR				1A6BR						1D6ML	1 mm interferometer	1D6MR	visible filterscope					
												1D2IN						
2AOT	MPTS laser, div. TS, probes	2A14L	visible camera	2AOB	MPTS laser, div. TS, thermo	2BO	MPTS view	2C0		2D2T		2D2B		2E6	magnetics	2F8T	magnetics	Period 2
2A6TL		2A6M	diagnostic neutral beam	2A6BL		2B8I		2C12		2D6TL	movable Langmuir probe	2D6BL	high frequency Mirnov coils	2E12		2F8I		
2A6T	visible filterscope	2A14R	visible camera	2A6B	visible filterscopes	2B8B	magnetics	2C6	magnetics	2D6TR	visible spectroscopy	2D6BR	UV spectroscopy	2EO		2F0	fluctuation diagnostic	
2A6TR				2A6BR	divertor visible camera					2D6ML		2D6MR	e-beam probe					
												2D2IN						
3AOT	FIR interferom/ polarimeter	3A14L	visible camera	3AOB	FIR interferom/ polarimeter	3BO	fluctuation diag. (BES?)	3C0		3D2T		3D2B		3E6	magnetics	3F8T	magnetics	Period 3
3A6TL		3A6M	X-ray crystal spectrometer	3A6BL	fast neutral pressure gauges	3B8I	fast ion loss probe	3C12	fluctuation diagnostic	3D6TL	x-ray tomography	3D6BL	x-ray tomography	3E12		3F8I		
3A6T	X-ray crystal spectrometer	3A14R	neutral heating beam	3A6B	X-ray crystal spectrometer	3B8B	magnetics	3C6	magnetics	3D6TR	x-ray tomography	3D6BR	x-ray tomography	3EO		3F0	fluorescent rod p	
3A6TR	fast IR camera			3A6BR	fast neutral pressure gauges					3D6ML	core bolometer	3D6MR	fast scanning edge probe					
												3D2IN						