

Overview of the DTT diagnostic systems



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Centro Ricerche ENEA Frascati

DTT Consortium (DTT S.c.a r.l. Via E. Fermi 45 I-00044 Frascati (Roma) Italy)



The Divertor Tokamak Test facility



DTT (Divertor Tokamak Test) is a fully **superconducting medium** size **tokamak**, currently **under construction** in the **ENEA** research **center** in Frascati, Italy

DTT main design parameters

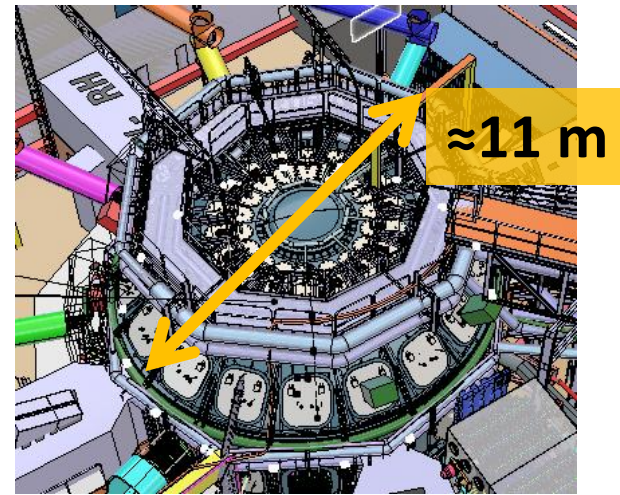
Parmeter	Units	
Major radius, R	m	2.19
Minor radius, a	m	0.70
Volume, V	m^3	35
t_{pulse}	s	100
Plasma current, I_p	MA	5.5
Toroidal field, B_T	T	5.85
P_{sep}/R	MW m^{-1}	15
Total power, P_{tot}	MW	45
P_{ECRH}	MW	29
P_{ICRH}	MW	6
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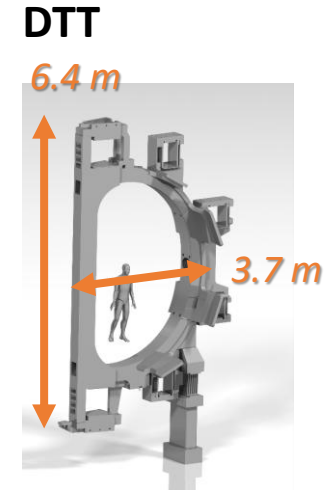


DTT status of design:

[[F. Romanelli et al 2024 Nucl. Fusion 64 112015](#)]

Physics basis for DTT:

[[F. Crisanti et al 2024 Nucl. Fusion 64 106040](#)]



DTT TFC:

Nb3Sn coils

$B_{max} = 11.9$ T

$I_{turn} = 42.5$ kA

$T_{turns} = 84$

$R = 2.19$ m

$B_{plasma} = 5.85$ T

DTT Research Plan: project goals and experimental phases

The **DTT [Research Plan](#)** : written in **collaboration** with **more than 100 scientists** from **European** institutes & laboratories.



It poses the **basis** for the project **goals, scientific program** and future **upgrades**.

[[G. Giruzzi et al 2026 Nucl. Fusion 66 116017](#)]

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DTT ultimate goals

- **reproduce** the **level** of **divertor heat loads** expected in **ITER** and **DEMO** ($P_{SEP}/R \approx 15 \text{ MW/m}$) -> **high-performance** plasma **core** concomitantly with **large** Scrape Off Layer **energy flux**
- study advanced **heat exhaust solutions** in **fusion-relevant** environments

DTT Research Plan: project goals and experimental phases

DTT reference scenarios

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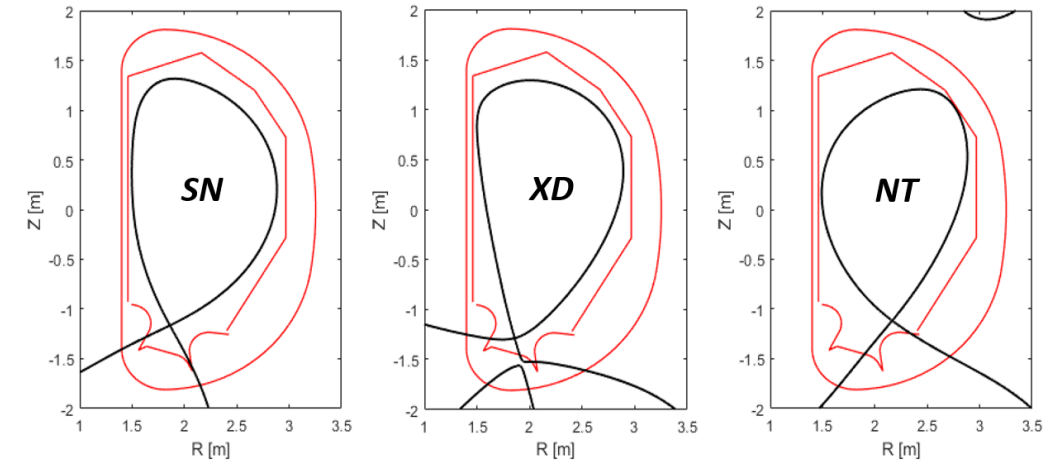
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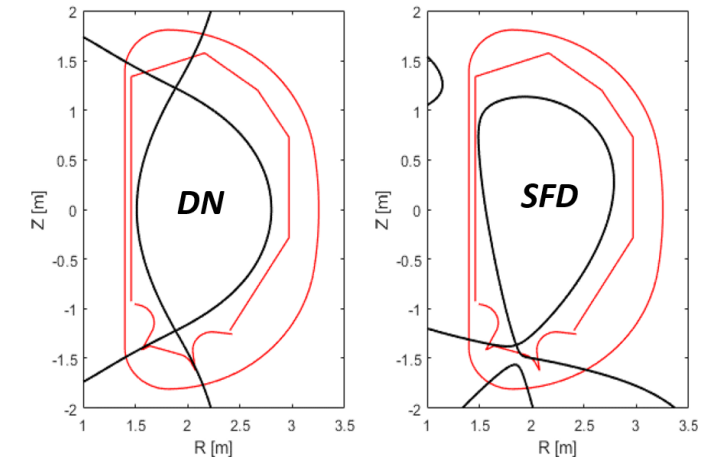
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Future scenarios, not yet optimised



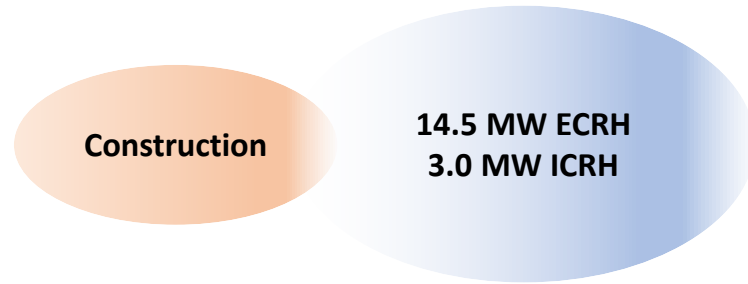
DTT can realise all the **alternative divertor** configurations studied for **DEMO**

[[H. Reimerdes et al 2020 Nucl. Fusion 60 066030](#)]

DTT Research Plan: project goals and experimental phases



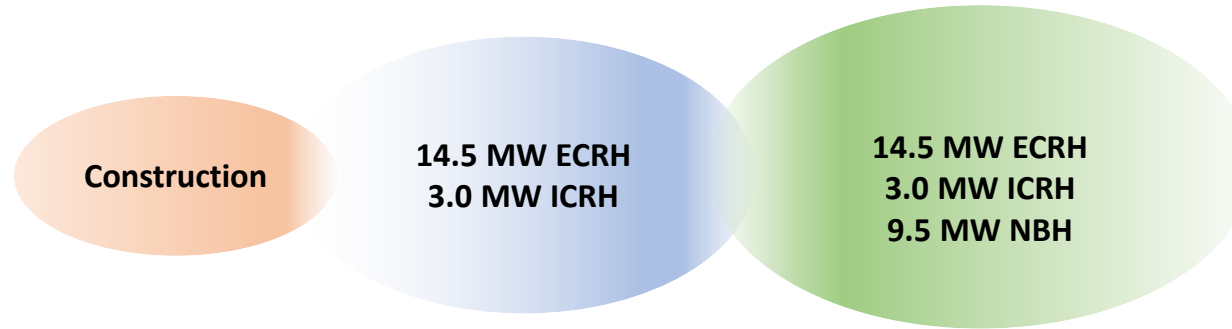
DTT Research Plan: project goals and experimental phases



PHASE-1

- **Validate** plasma **operations scanning** the initially available **technical parameters** (I_p , B_T and injected power)
- **Operate** with three main **plasma configurations**: SN, XD, NT
- Early **disruption** and **runaway** studies -> **mitigation experiments to support ITER**

DTT Research Plan: project goals and experimental phases



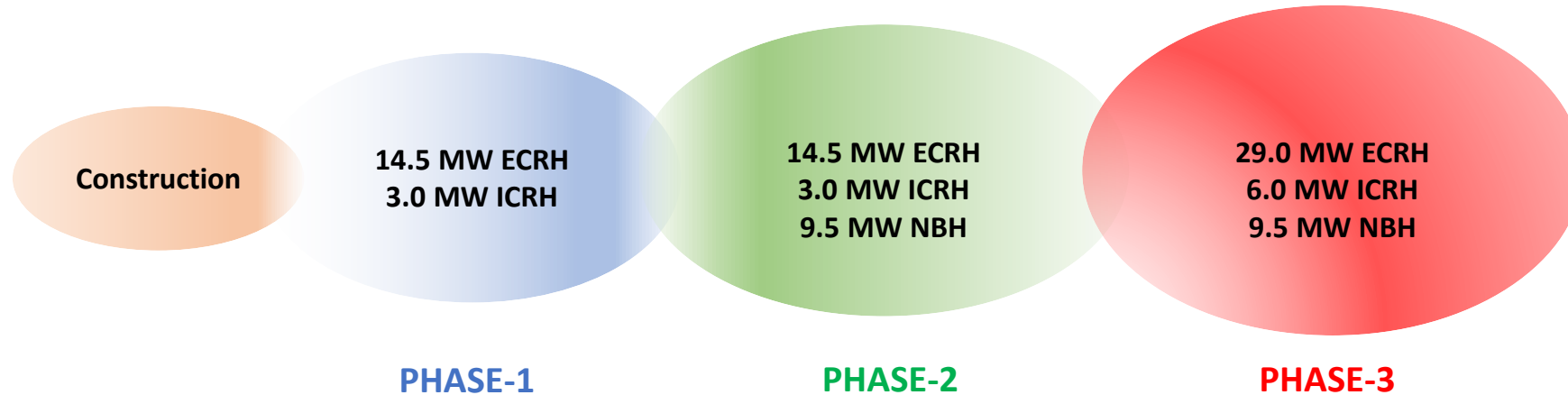
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PHASE-2

- Exploit different **divertor configurations** at higher power
- Operations at **full plasma current** ($I_p = 5.5$ MA)
- Controlled **injection** of bulk and edge **radiating impurities**
- **Divertor test modules**: **test** of different **Plasma Facing Components** and **validation** of divertor **concepts**

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 - **Divertor test modules**: **test** of different **Plasma Facing Components** and **validation** of divertor **concepts**
- **Full power** ($P = 45$ MW)
 - **Full-scale test** of DEMO-like **divertors**
 - Highly relevant **burning plasma conditions**
 - Complete **solution** (magnetic topology, divertor shape and material) for the **DEMO divertor** and, **based on** the experimental **results**, its **First Wall**

DTT Diagnostic design strategy

DTT diagnostics are **conventionally divided** into **First Plasma & Commissioning** (Early Phase-1), **Phase-1**, and **Phase-2** and **subsequent** experimental **phases'** systems



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- ❑ **Machine protection and plasma control → HIGH Priority**
- ❑ The development of diagnostic systems for **physics studies** closely **follows** the **Research Plan** (PHASE-1 & 2 equipment)

As the **First Plasma** will be shortly **followed** by an **experimental phase**, DTT has to **start operations** with a full **set** of **systems** for machine **protection** and plasma **control**

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- 2. Compliance with FW & DIVERTOR active cooling system and Remote Handling activities**

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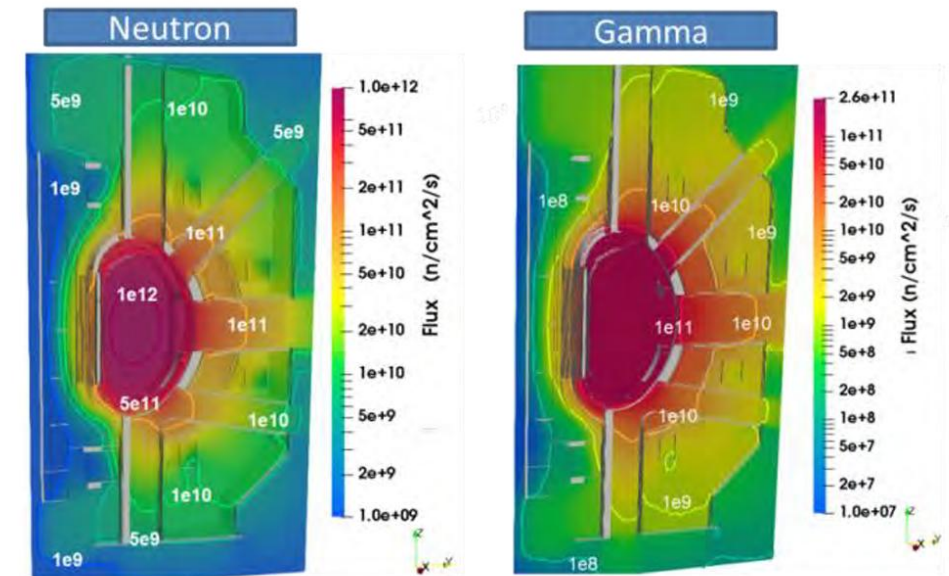
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1. **Compact machine** -> **compatibility** with **narrow** and **crowded spaces**
2. **Compliance** with FW & DIVERTOR **active cooling** system and **Remote Handling** activities
3. **Ability** to **withstand** thermal loads during both **plasma** and **baking operations**, EC stray radiation and high levels of **neutron flux and fluence**



see [R. Villari et al, [FED 155, 111551 \(2020\)](#)] and [A. Colangeli et al, [FED 171, 112690 \(2021\)](#)] for details

DTT phases: Phase-1

Phase 1) “high-level **commissioning** and **divertor** modules **testing**”: comprises DTT **First Plasma**, **early operational** phase and **initial scenarios** testing.



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DTT experimental phases: I_p , B_T and installed heating power

Parmeter	Units	Phase-1	Phase-2	Phase-3
Plasma current, I_p	MA	≤ 4	≤ 5.5	≤ 5.5
Toroidal field, B_T	T	≤ 5.85	≤ 5.85	≤ 5.85
P_{ECRH}	MW	≤ 16	16	32
P_{ICRH}	MW	≤ 4.75	4.75	9.5
P_{NBH}	MW	-	10	10



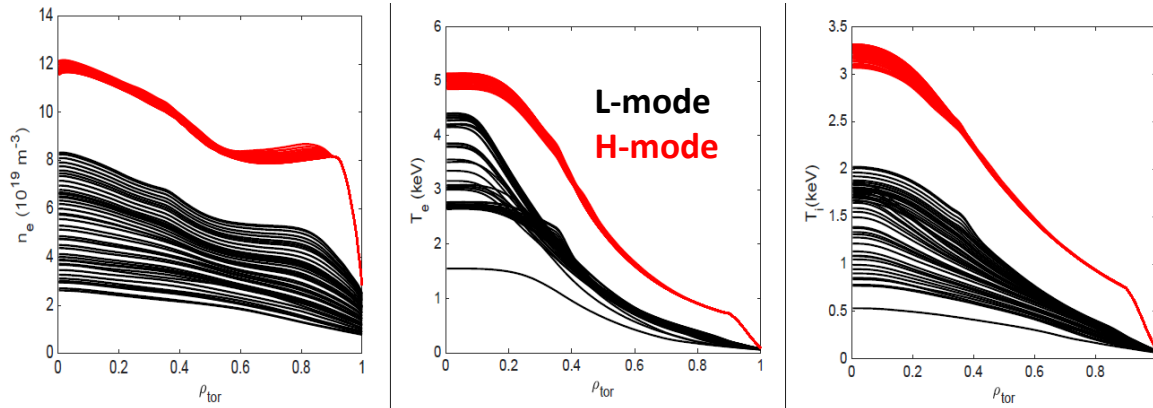
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A SN scenario - **ASTRA-TGLF** simulations, see [[N. Bonanomi et al 2025 Nucl. Fusion 65 016005](#)]

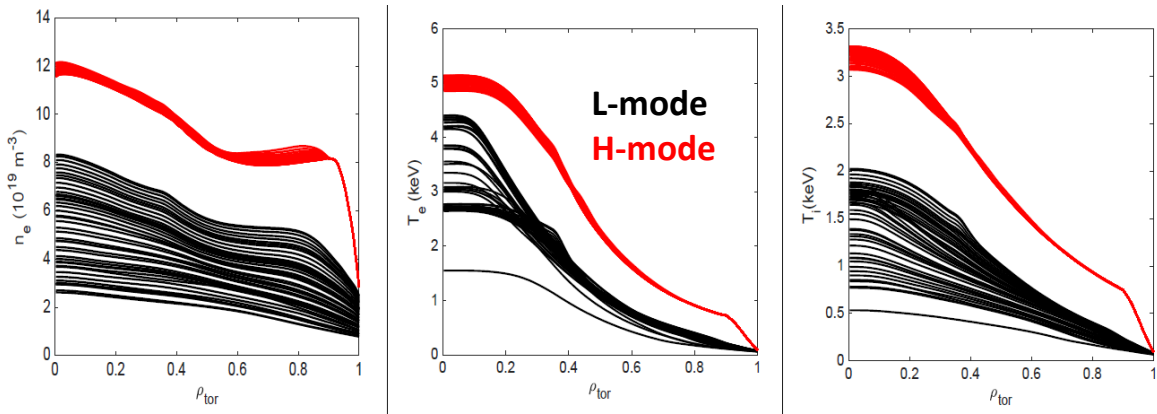
Scenario	I _p (MA)	B _T (T)	divertor	Installed Power (MW)		
				ECRH	ICRH	NBH
Phase 1						
A	2	3	SN/XD	8	0	0
A NT	1.5	3	NT	8	0	0
B	2	3	SN/XD	16	4.75	0
B NT	1.5	3	NT	16	4.75	0
C	4	6	SN/XD	16	4.75	0
C NT	3	6	NT	16	4.75	0

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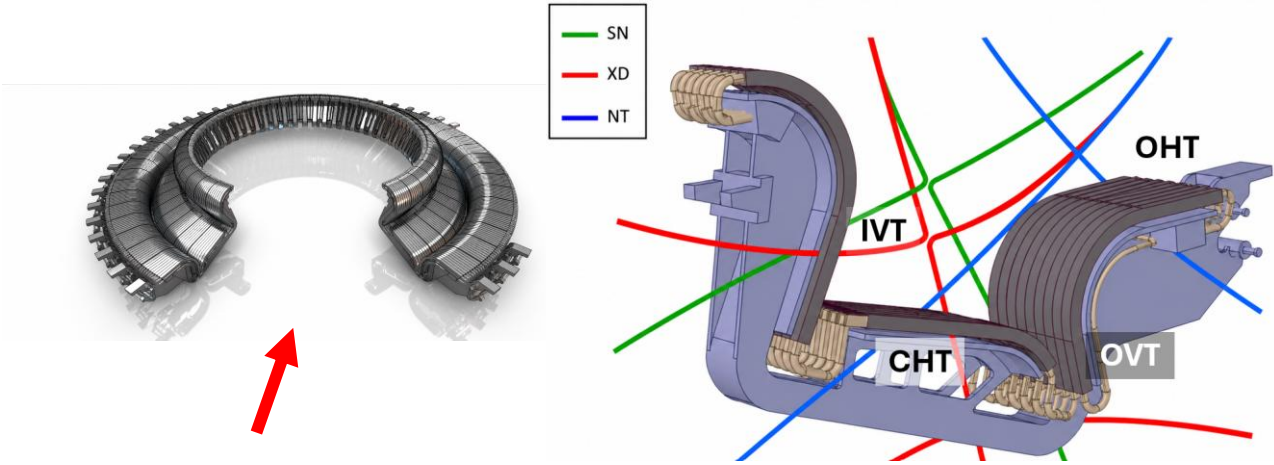
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Operations will start with an **ITER-like divertor**



54 actively cooled modules - design completed in **2024** within **EUROFusion WPDIV-IDTT** activities

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DTT phases: Commissioning & exp. Phase-1

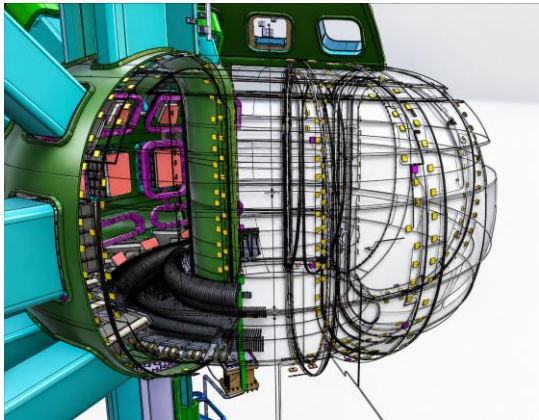
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DTT phases: Commissioning & exp. Phase-1

- **Magnetic diagnostics**
 - Essential for **machine protection**
 - Have to be **installed during the assembly** due to their location

see **G. Artaserse «Overview of DTT magnetic diagnostic»**, poster, this conference – 20/10/2026



Commissioning & Early Phase-1 Equipment

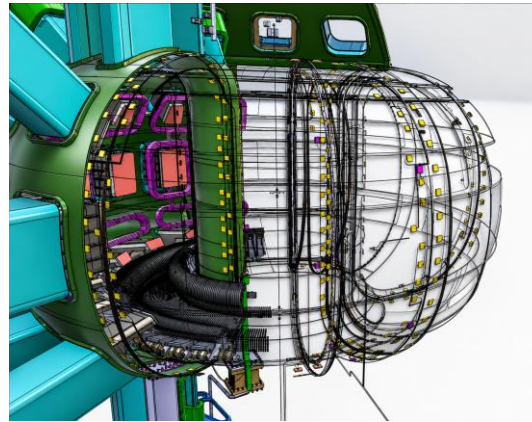
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- Optical systems: breakdown & characterisation**

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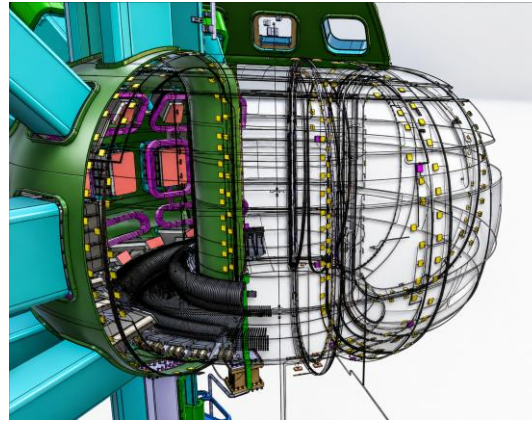
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see G. Artaserse «Overview of DTT magnetic diagnostic», poster, this conference – 20/10/2026



- Optical systems: breakdown & characterisation**

- ECE and interferometers*** for cross-calibrations and **benchmark** measurements (n_e , T_e)
- ECE & SXR for $q = 1$ surface reconstruction**

*see D. Fiorucci et al. 'Progress on the DTT Interferometric and Polarimetric Diagnostics', this conference

Commissioning & Early Phase-1 Equipment

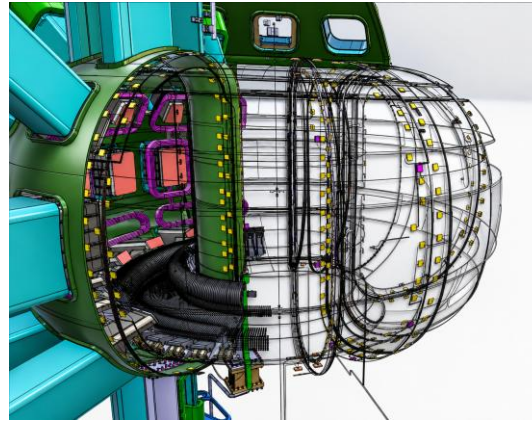
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- ECE & SXR for $q = 1$ surface reconstruction**

- REs detection and control** from the beginning

*see D. Fiorucci et al. 'Progress on the DTT Interferometric and Polarimetric Diagnostics', this conference

Neutron production monitored from Day-0 -> early calibrations and MCNP model validation**

**see [D. Marocco et al, FED 202 114308 (2024)], [V. Anagnostopoulou et al FED 222 115537 (2026)] & D. Marocco et al. 'Neutron and runaway electron diagnostics for first plasma DTT operation', this conference

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In-Vessel diagnostics: divertor modules

The **RH sectors** (1, 5, 10 and 15) will **host** DTT divertor **test modules** -> **extractable** and **replaceable**

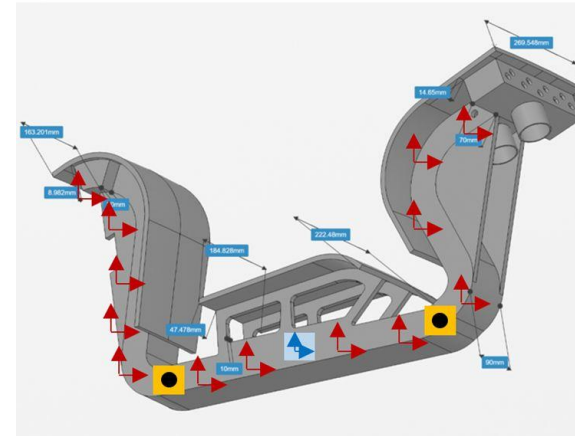
The **cassettes** mounted on these sectors will be **instrumented** with **magnetic diagnostics** (Hybrid Hall probes, Mono and Bi-axial Pick-up coils, Current Shunts and Rogowski coils), as well as **Langmuir probes, thermocouples, strain** and **deformation sensors**.

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Magnetic sensors

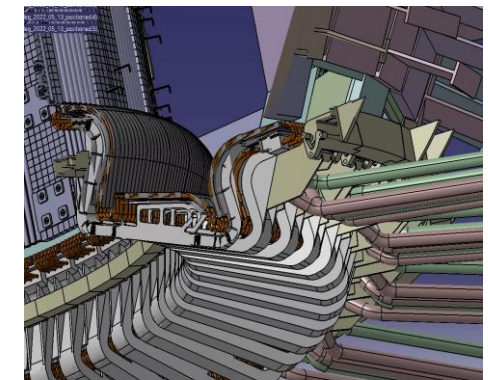
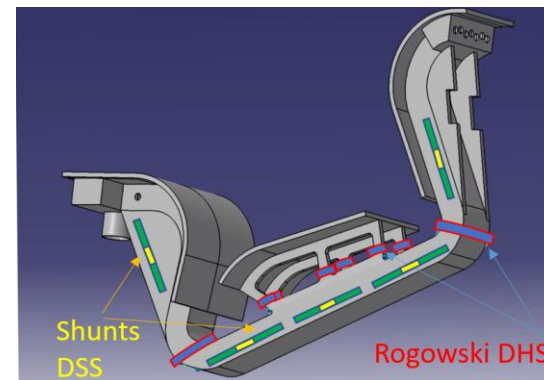


↗ Bi-axial Pick-Up Coil

■ Mono-axial Pick-Up Coil

▣ Hybrid Hall probe

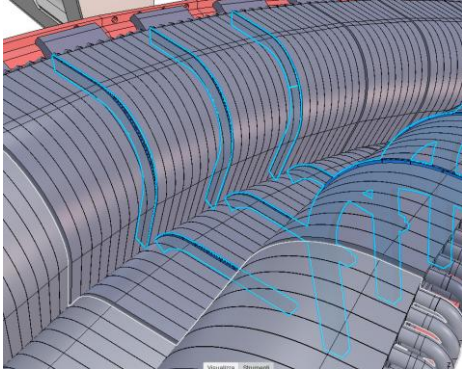
Sensor's **topology** and **number** optimised for **X** and **strike point reconstruction** & **plasma control**



Rogowski coils wrapped around the **divertor cassette** structure

In-Vessel diagnostics: divertor modules

Embedded: Langmuir Probes and Thermocouples



High spatial and time resolution

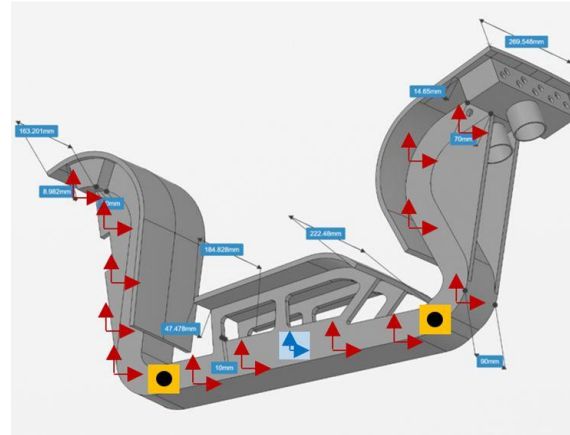
≤ 10 ms, 1 – 5 cm

Compatible with long pulse and high heat load

The **RH sectors** (1, 5, 10 and 15) will **host** DTT divertor **test modules** -> **extractable** and **replaceable**

The **cassettes** mounted on these sectors will be **instrumented** with **magnetic diagnostics** (Hybrid Hall probes, Mono and Bi-axial Pick-up coils, Current Shunts and Rogowski coils), as well as **Langmuir probes, thermocouples, strain and deformation sensors**.

Magnetic sensors

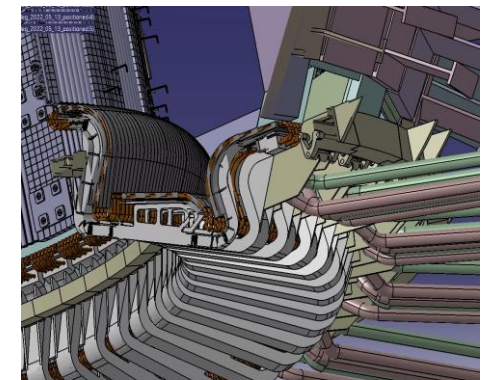
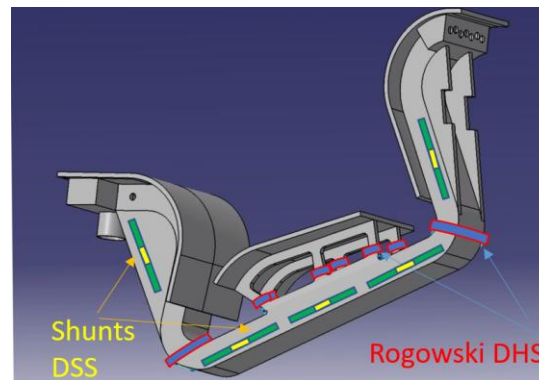


↗ Bi-axial Pick-Up Coil

■ Mono-axial Pick-Up Coil

▣ Hybrid Hall probe

Sensor's **topology** and **number** optimised for **X** and **strike point reconstruction** & **plasma control**



Rogowski coils wrapped around the **divertor cassette** structure

Experimental Phase-1 equipment

Many systems **already installed** for the **Commissioning & Early Phase-1**, though **some** with a **reduced** number of **lines of sight**

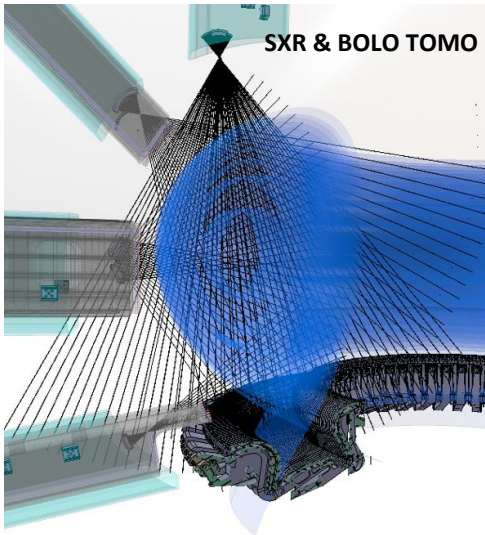
Experimental PHASE-1 Equipment

Scattering techniques and Spectroscopic Measurements	
	Bolometer Tomography – full configuration
	SXR Tomography – full configuration
	Visible Multi-Spectral Imaging System
	Divertor Imaging VUV Spectrometer
	X-ray Crystal spectrometer
	Laser Blow-Off
	Diagnostic Neutral Beam Injector
	Charge Exchange Recombination Spectroscopy
	Motional Stark Effect
	Beam Emission Spectroscopy
	Thomson Scattering Edge & Divertor
Interferometric and Microwave Techniques	
	Vertical Interferometer/Polarimeter – full configuration
	Divertor Interferometer
	Turbulence and n_e Profile Reflectometry
Plasma-Wall Interaction	
	IR cameras - divertor
	Gas Puffing Imaging
	Reciprocating Langmuir Probe
	Sample Introduction System
	Laser Induced Breakdown Spectroscopy
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☐ Upgrade diagnostics to full configuration



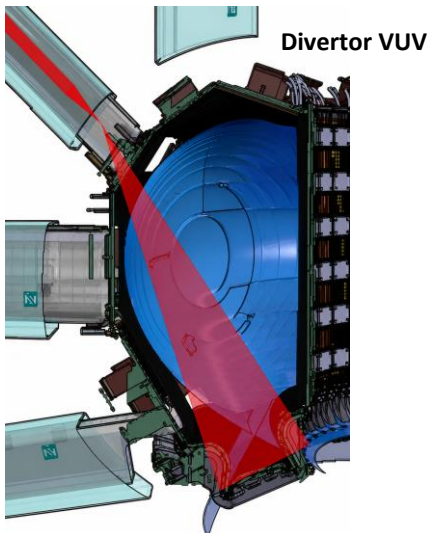
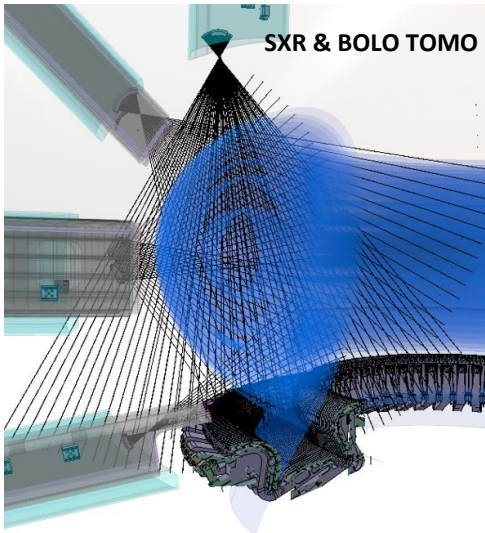
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- ❑ New systems to expand machine probing capabilities



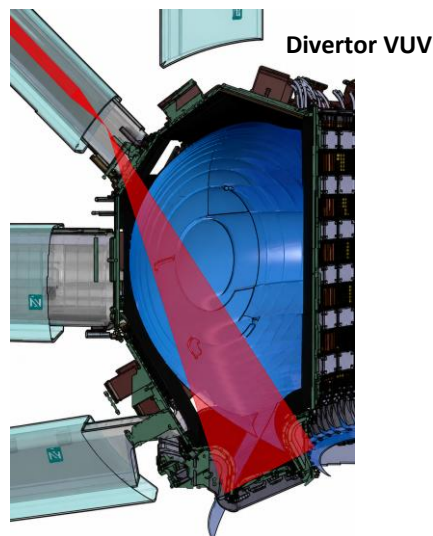
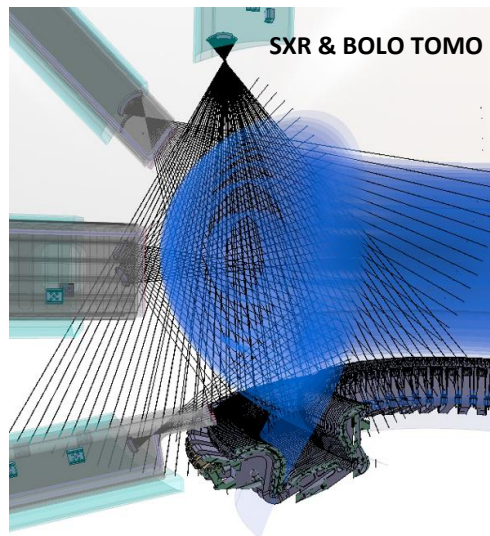
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Major Upgrade: Diagnostic Neutral Beam Injector

➔ Beam-based diagnostics: CXRS, MSE, BES

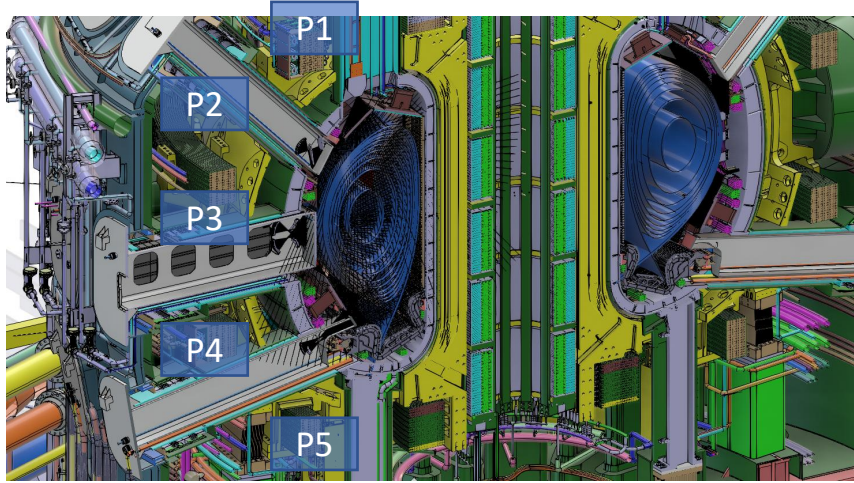
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- Physics of **transport**
- Plasma **rotation**
- **Turbulence** dynamics
- **Power exhaust**
- **Detached** scenarios

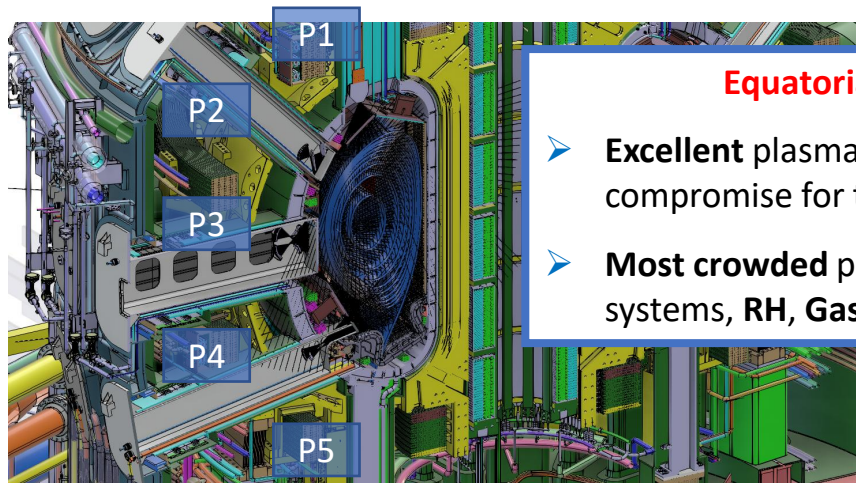
In-Duct diagnostics

Five Vacuum Vessel (VV) port entrances, distributed over **18 sectors**, are available in DTT



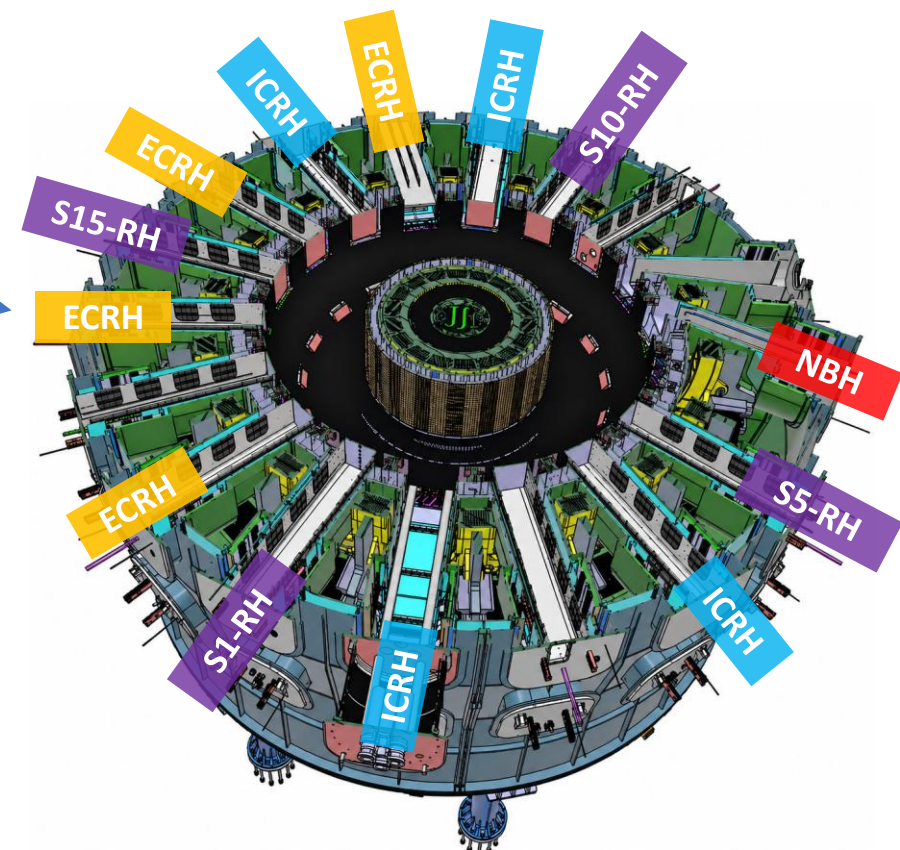
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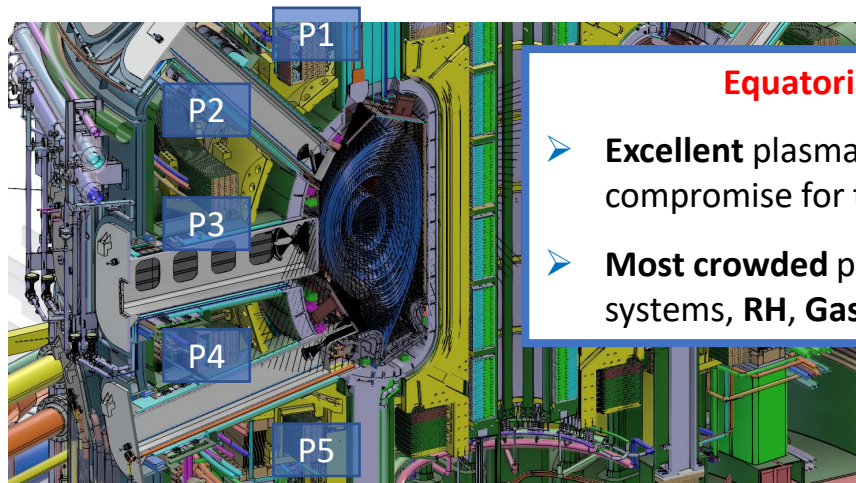
Equatorial ports (Port 3)

- **Excellent plasma core view** and good compromise for the **divertor region studies**
- **Most crowded ports**: coexist with **Heating systems, RH, Gas & Pellet Injectors**



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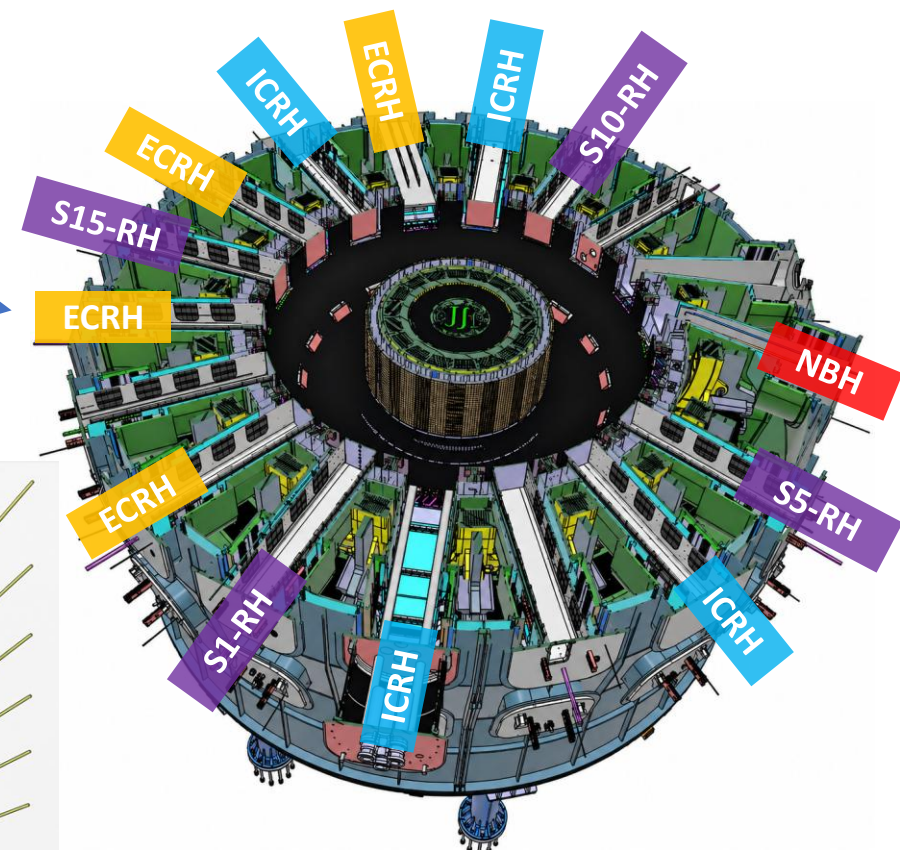
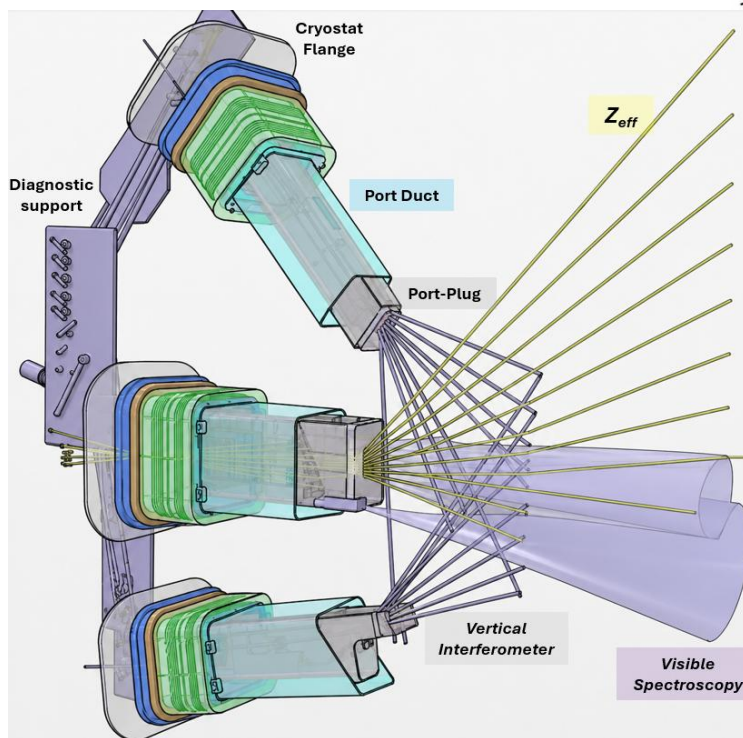


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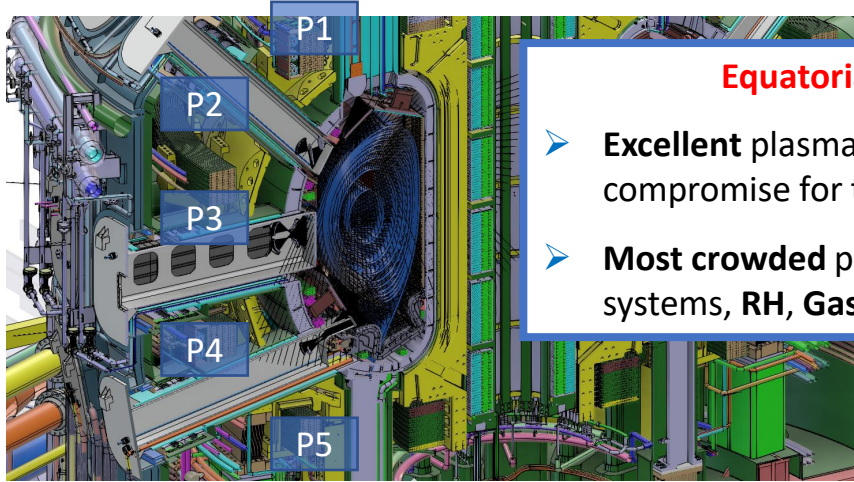
- Help **reducing neutron flux** to TF coils
- **Extractable**
- Surrounded by **heating panels** to ensure **homogeneous heating**



see also A. Salvitti, SOFT 2026 poster

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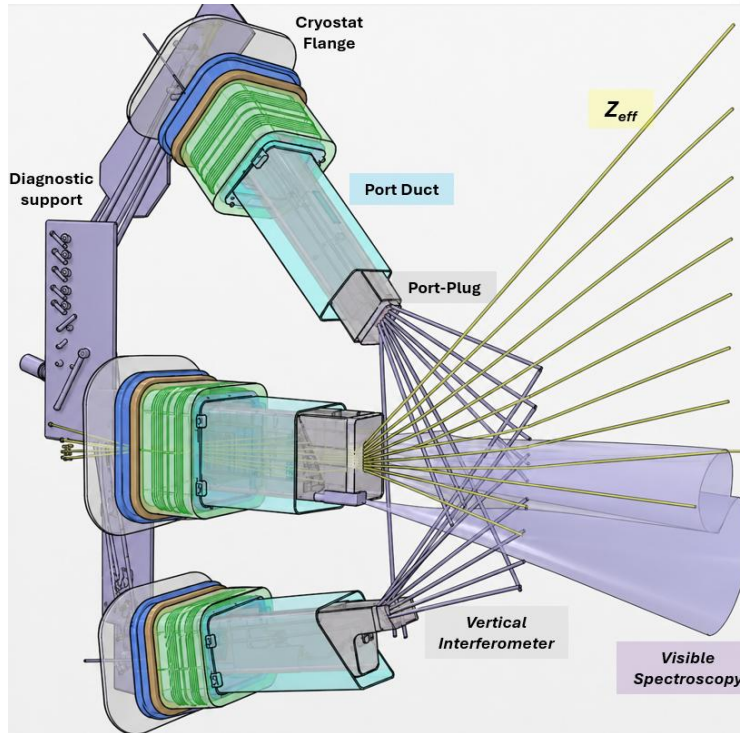


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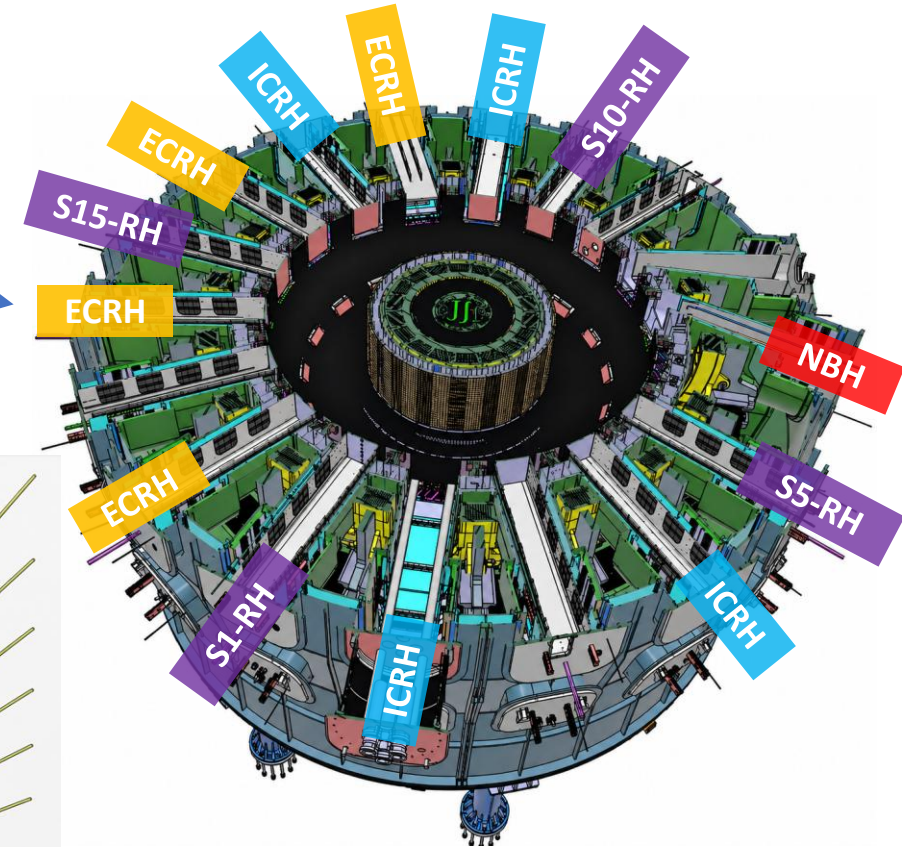
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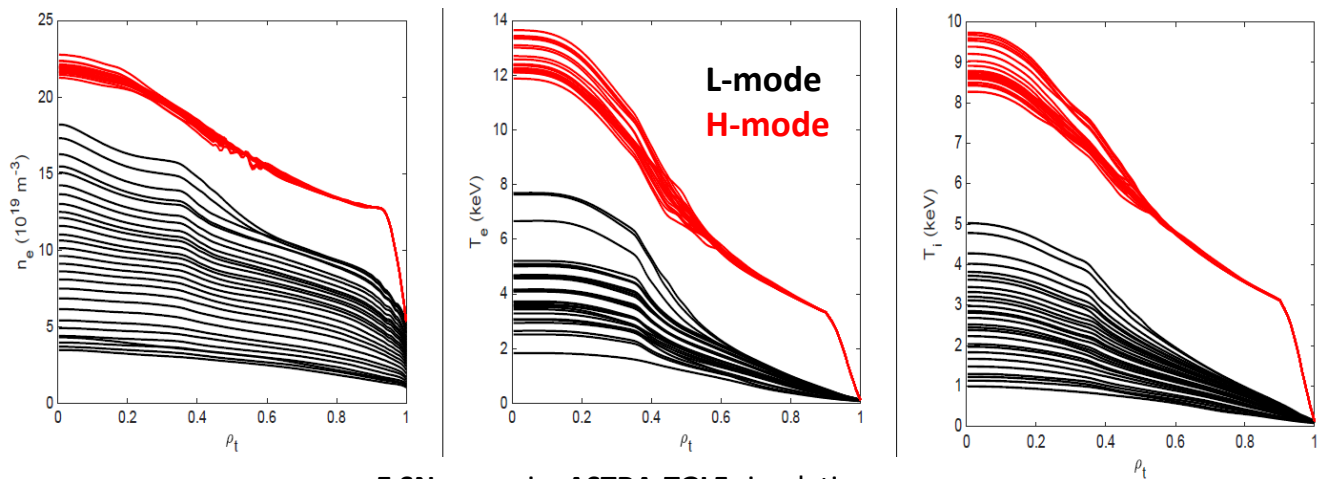
- **59/82** ports **available** for diagnostics
- **40** already **assigned**
- **19** equipped at **Day-0**

DTT phases: Phase-2 & 3

Scenario	I _p (MA)	B _T (T)	divertor	Power installed (MW)		
				ECRH	ICRH	NBI
Phase 2						
D	5.5	6	SN	16	4.75	10
D XD	4.5	6	XD	16	4.75	10
D NT	4	6	NT	16	4.75	10
D at low B _T	2.75	3	SN	16	4.75	10
Phase 3						
E	5.5	6	SN	32	9.5	10
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E NT	4	6	NT	32	9.5	10
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High-power DTT phase:

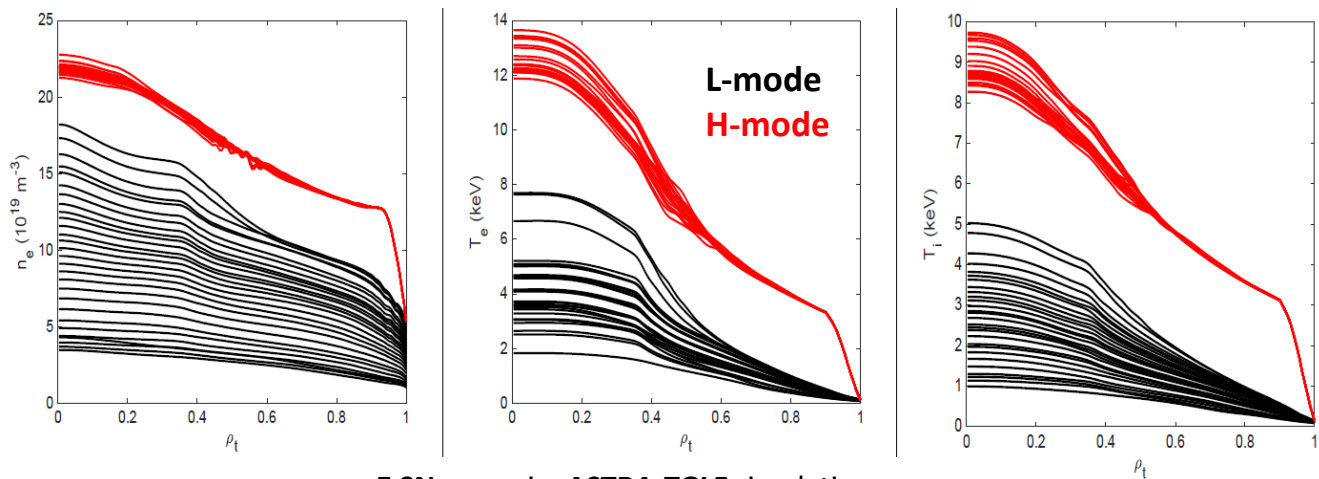
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- 10 MW **Neutral Beam Injector** -> Physics of **Fast Ions**
- **Additional systems** to explore **turbulence** dynamics



E SN scenario, ASTRA-TGLF simulations

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PHASE-2 Equipment

Magnetic Measurements
Toroidal Alfvén Eigenmodes diagnostic heads
Scattering techniques and Spectroscopic Measurements
Thermal He Beam
Polarimetric Thomson Scattering
Tangential GEM SXR Imaging
Interferometric and Microwave Techniques
Phase Contrast Imaging
Correlation & Imaging ECE
Plasma Position Reflectometry
Neutron, γ , REs, Fast particle Measurements
Neutron Gamma Camera
Time of Flight Neutron Spectrometer
HXR Spectrometers
Fast Ion D- α
Fast Ion Loss Detector
Neutral Particle Analyser
Cherenkov Probe

Innovative diagnostic techniques

Innovative **Diagnostic development:**

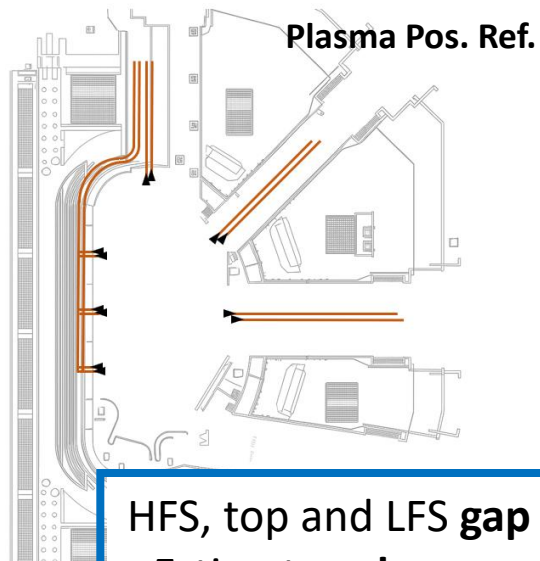


Innovative diagnostic techniques



Innovative Diagnostic development:

- Plasma Position Reflectometry



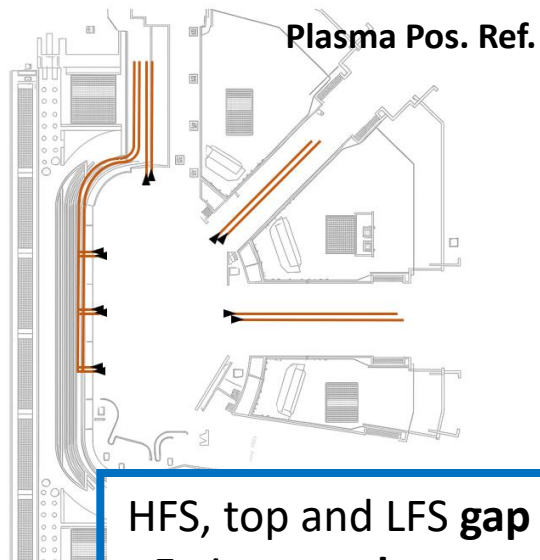
see [[F. Ruffini et al JINST 20 C05030 \(2025\)](#)]

[[F. da Silva et al 2025 JINST 20 C09004 \(2025\)](#)]

Innovative diagnostic techniques

Innovative Diagnostic development:

- Plasma Position Reflectometry
- Polarimetric Thomson



HFS, top and LFS gap measurements:

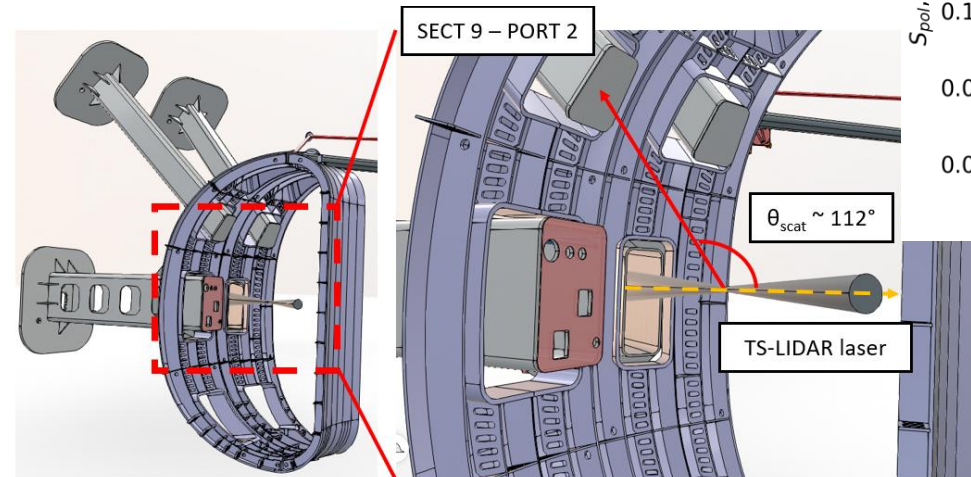
- Estimates **plasma position** and **shape**
- Intrinsically **resistant to neutrons**

see [F. Ruffini *et al* JINST 20 C05030 (2025)]
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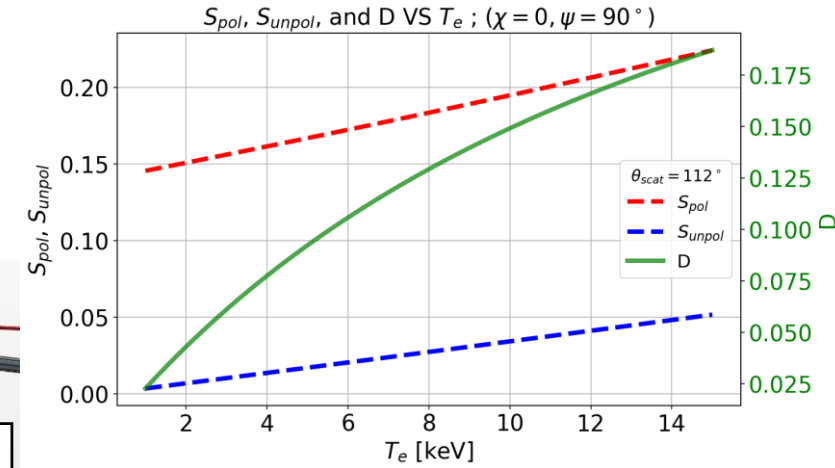
Preliminary design for DTT

see [F. Bagnato *et al* JINST 20 C10012 (2025)] for more details

Polarimetric TS



➤ Supports ECE-TS high- T_e experiments



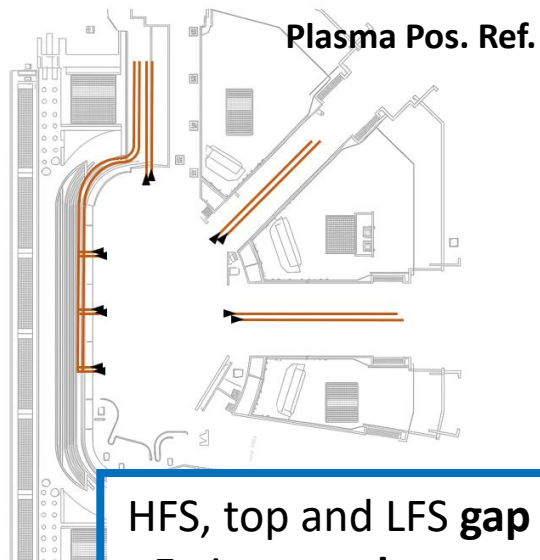
Probes **high T_e** by measuring Thomson **scattered light polarisation** characteristics

(see presentations by F. P. Oristo and L. Senni at this conference)

Innovative diagnostic techniques

Innovative Diagnostic development:

- Plasma Position Reflectometry
- Polarimetric Thomson
- Cherenkov Probe
- ...



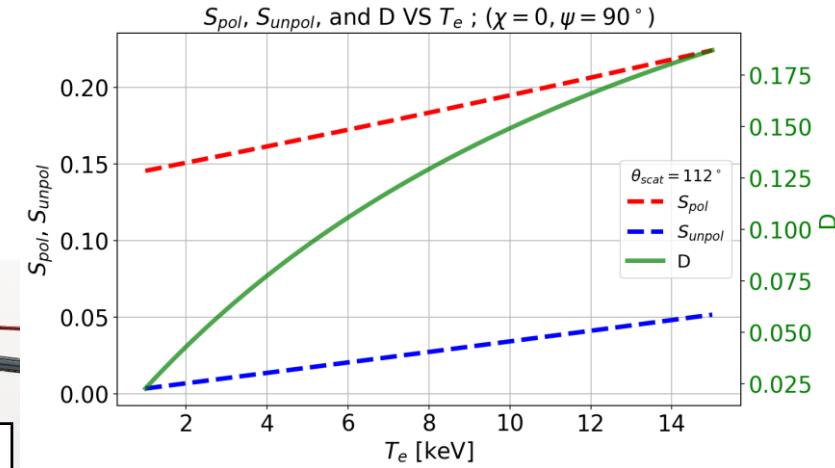
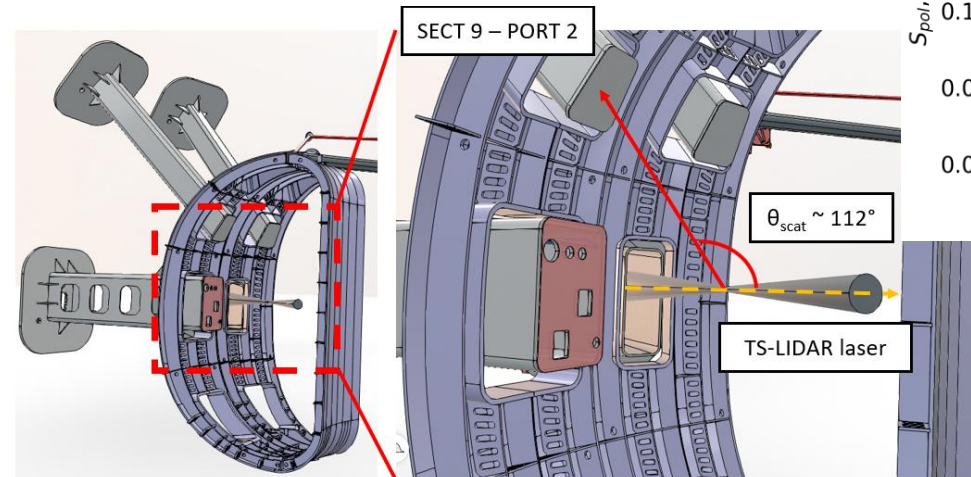
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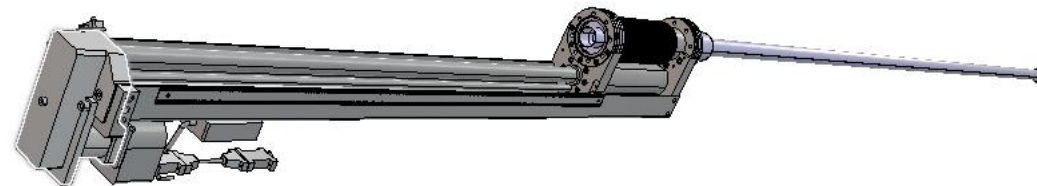


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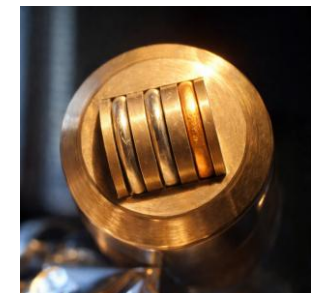
(see presentations by F. P. Oristo and L. Senni at this conference)

Cherenkov probe



Diamond detectors with metal coating to probe REs at **low energy** (58-359 keV in FTU)

see [F Bagnato *et al* 2018 *Plasma Phys. Control. Fusion* **60** 115010]



Outlook and conclusions

DTT is designed to **approach** fusion **reactor relevant** bulk and edge **plasma conditions** in a **scaled** and **flexible** facility and **without** the use of **Tritium**, all in a **W environment**



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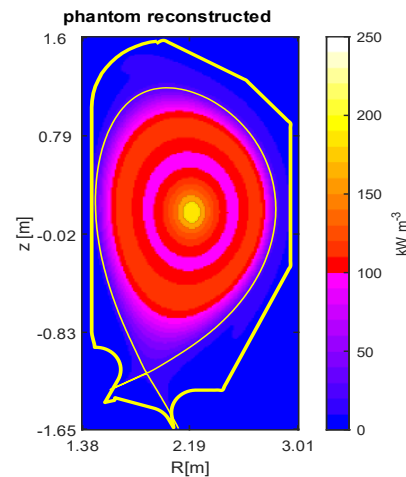


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BOLO tomography



Outlook and conclusions



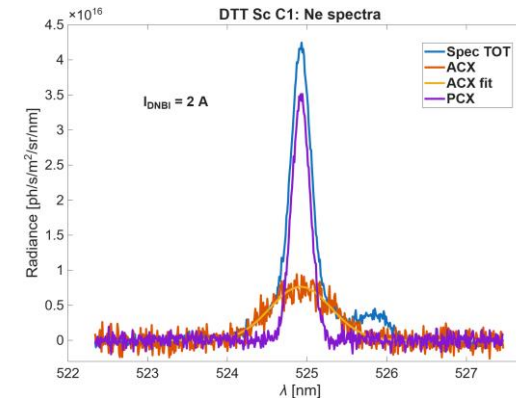
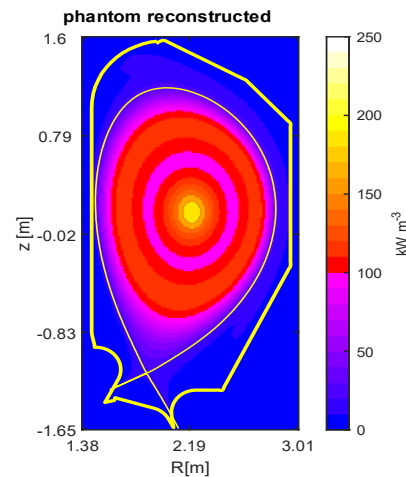
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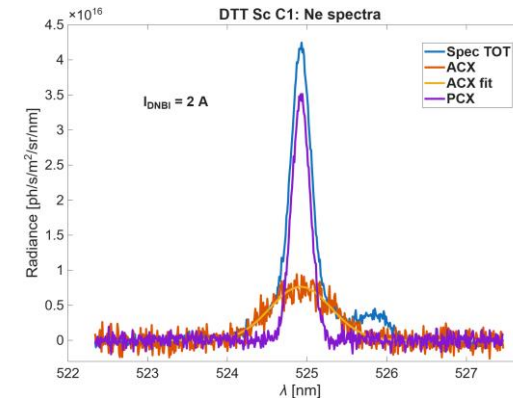
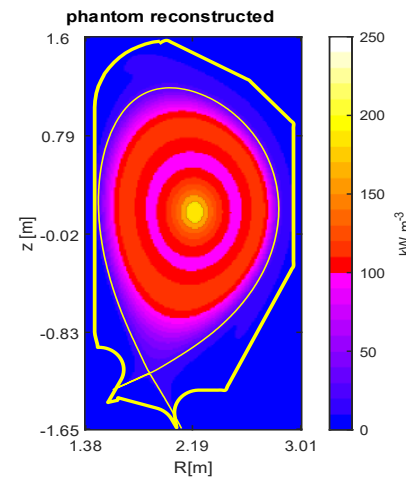
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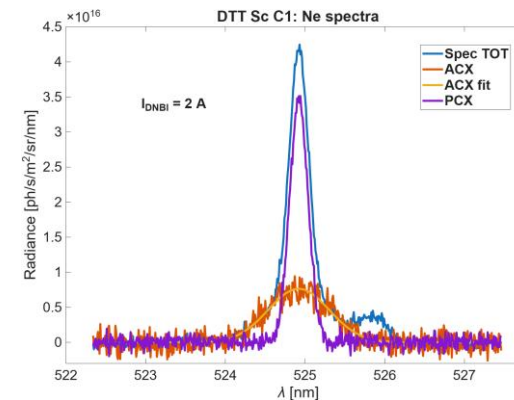
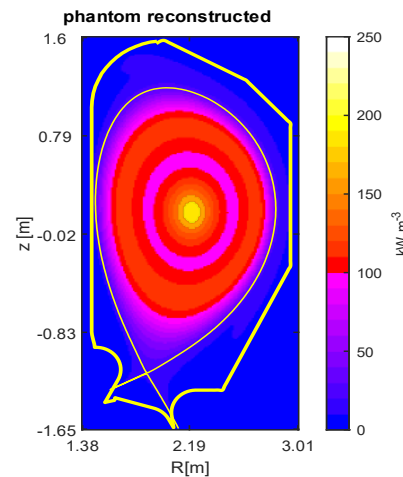
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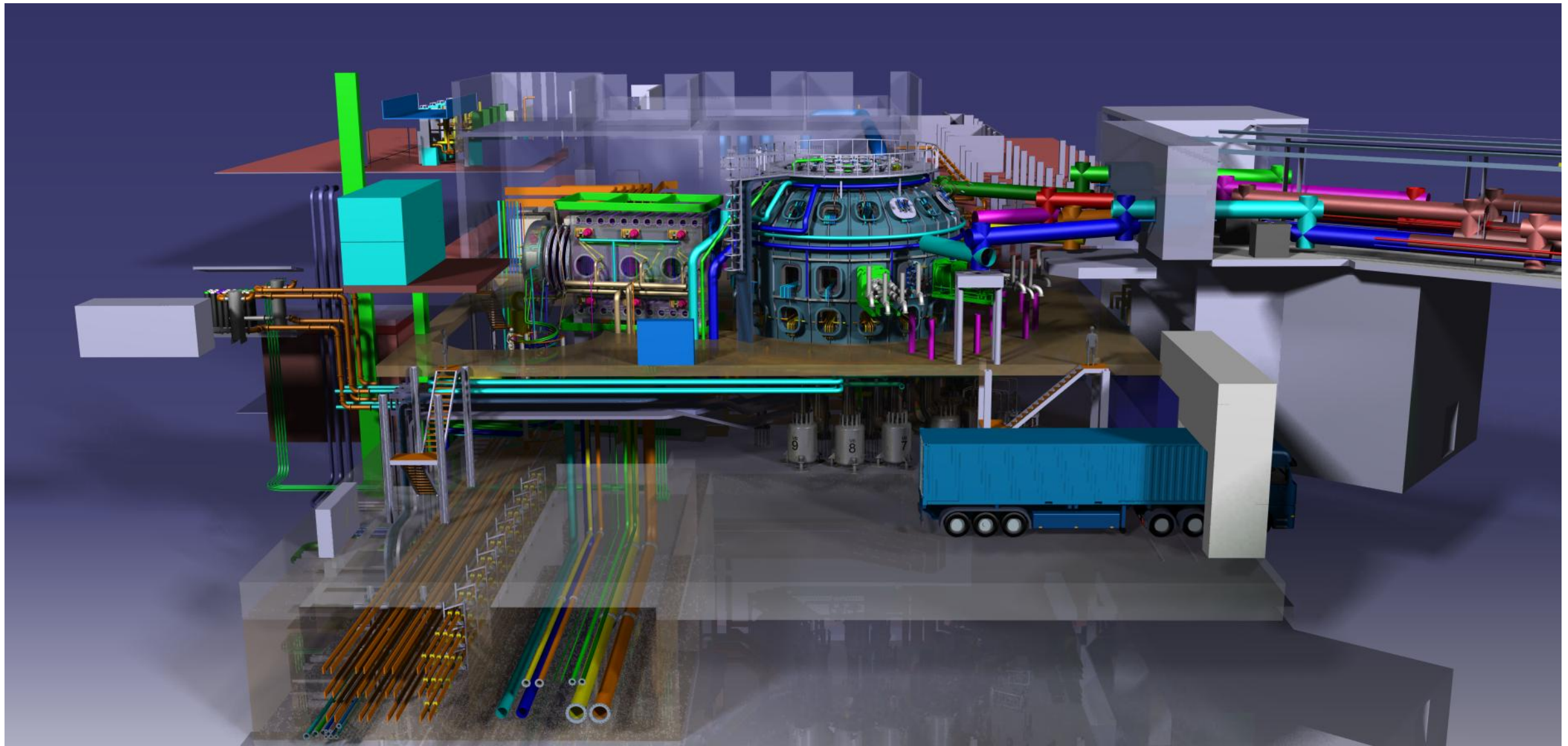


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DTT diagnostics are being **developed** by **ENEA** under a **collaboration** agreement with the **DTT Consortium**, in synergy with **Italian research institutions, industries** and **EUROfusion** collaborators.

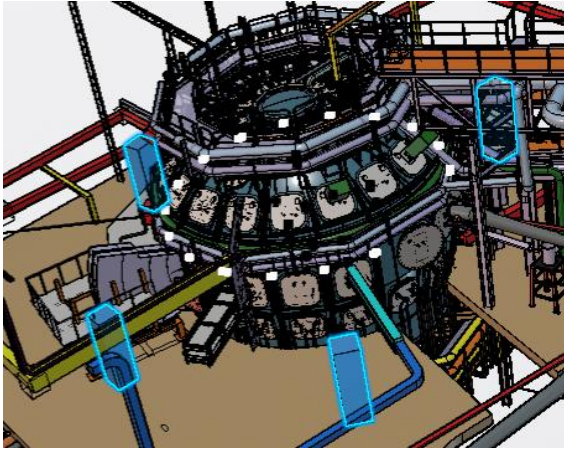


Ex-Cryostat Diagnostics

*see [D. Marocco et al, FED 202 114308 (2024)] & D. Marocco et al. 'Neutron and runaway electron diagnostics for first plasma DTT operation', this conference

DTT Ex-Cryostat systems comprise **diagnostics** and **sensors** installed **outside** the **cryostat** and **not connected** to it:

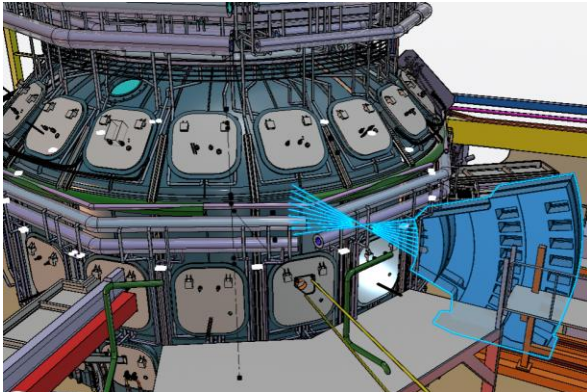
Neutron, γ and Hard X-ray monitors



4 locations around the torus for homogeneous coverage

- **Total neutron yield rate** $\rightarrow$ 16 ^{235}U fission chambers + 6 BF_3 detectors.
- **Triton burn-up yield rate** $\rightarrow$ EJ301 scintillator + 2 single Crystal Diamond (sCD) matrix
- **Runaway-induced hard x-rays** $\rightarrow$ NE213 + 4 BC-509 (C_6F_6) scintillators

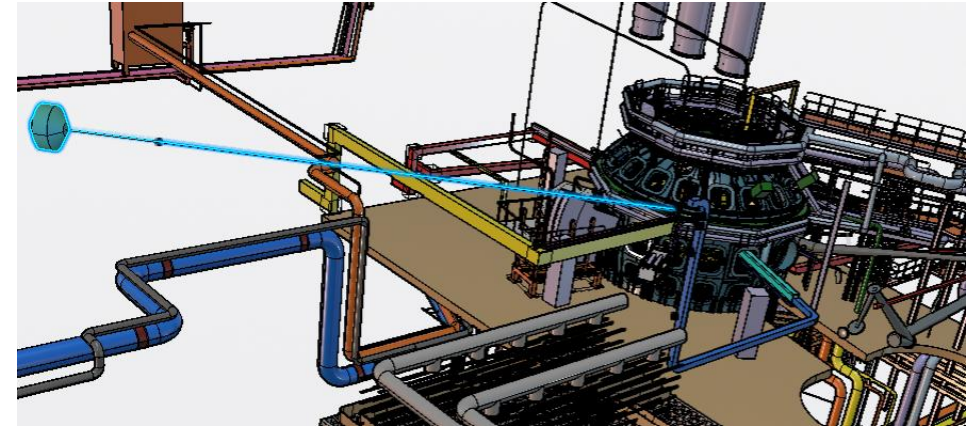
Neutron Gamma Camera



Support structure outside the machine, 9 collimated LOS:

- **Neutron emissivity, runaway-induced x-rays** $\rightarrow$ ^4He scintillator, EJ301 scintillator, sCD matrix
- **Gamma-rays from reactions between fast ions and impurities** $\rightarrow$ $\text{LaBr}_3:\text{Ce}$ scintillator + LiH neutron attenuator

Time of Flight neutron spectrometer



Delicate path: no obstacle between plasma and detector (except for a reduced layer of steel on the port flange)

- $\rightarrow$ dedicated **penetrations** on the walls
- $\rightarrow$ Appropriate **screening** for neutrons

Single collimated LOS for the measurement of:

- **2.5 MeV and 14 MeV neutrons spectrum** $\rightarrow$ *TOF with two layers of forward stop detectors*
- **Fast ions induced Gamma-rays** $\rightarrow$ $\text{LaBr}_3:\text{Ce}$ + LiH attenuator

In-Duct diagnostics

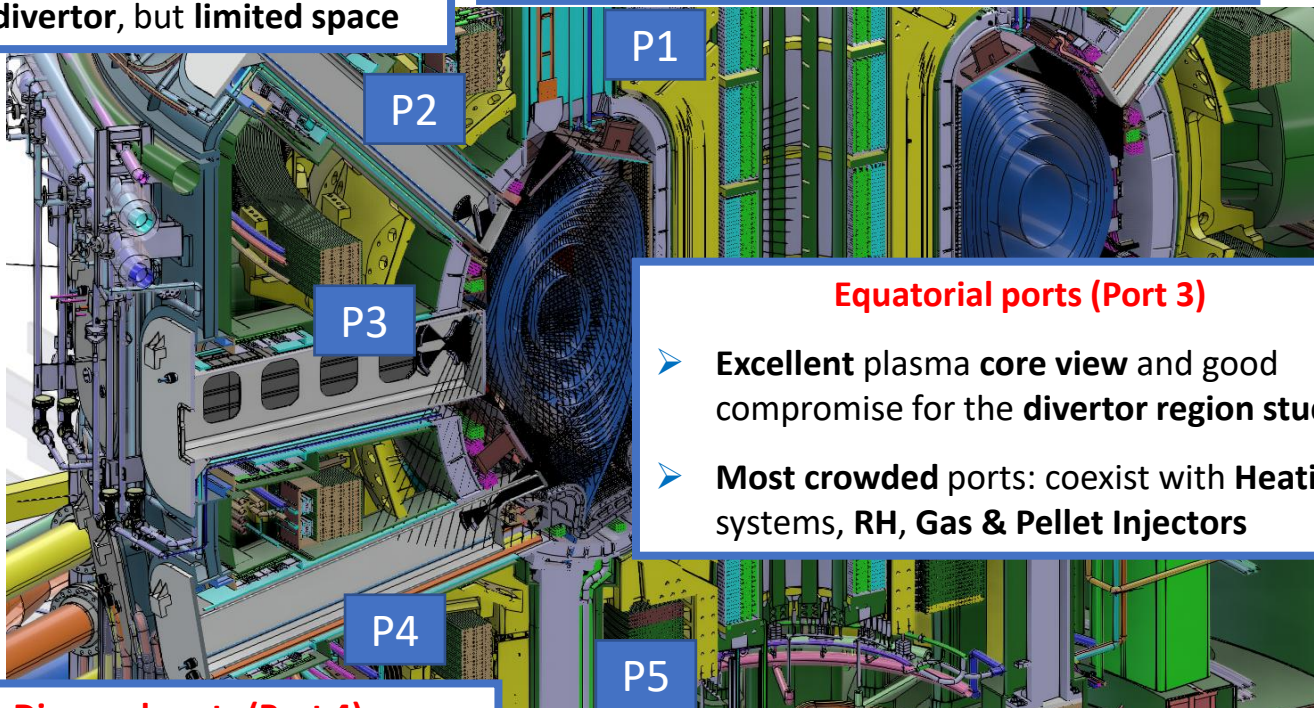
Five Vacuum Vessel (VV) port entrances, distributed over 18 sectors, are available in DTT

Upper Diagonal ports (Port 2)

- Good location to **observe** plasma core & divertor, but **limited space**

Upper Vertical ports (Port 1)

- Used by the FW Remote Handling system
-> **diagnostics must avoid any interferences**



Equatorial ports (Port 3)

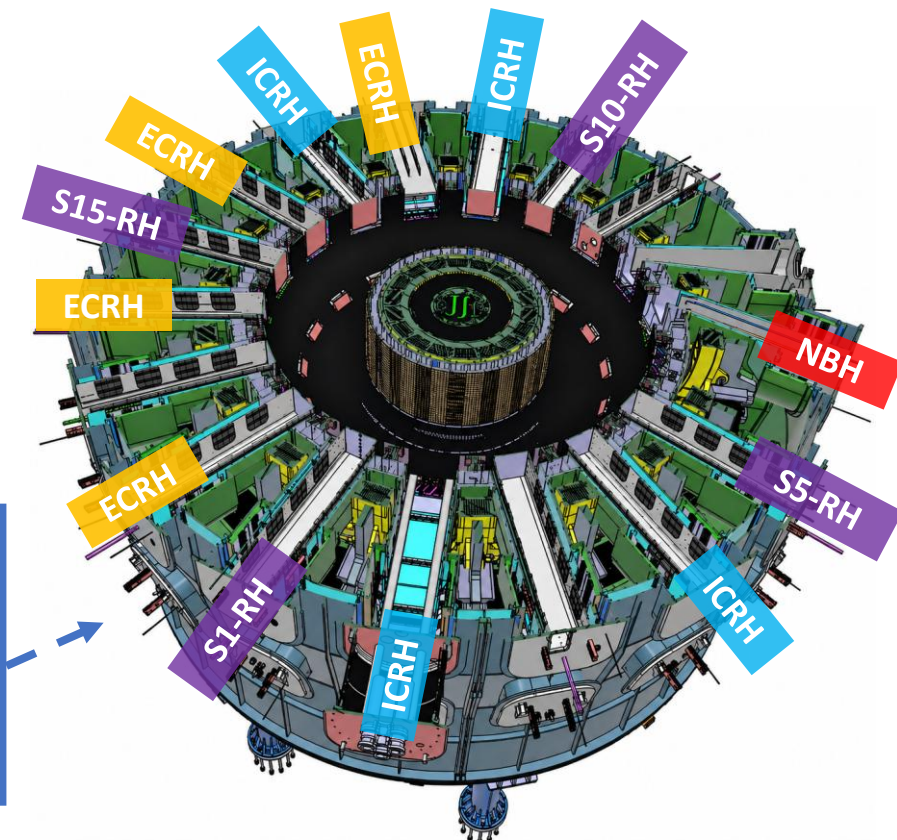
- **Excellent** plasma **core view** and good compromise for the **divertor region studies**
- **Most crowded** ports: coexist with Heating systems, RH, Gas & Pellet Injectors

Lower Diagonal ports (Port 4)

- **Limited space**, good for **divertor** systems

Lower Vertical ports (Port 5)

- Many occupied by VV supports
- **10 available** for **pumping** system, **limited opening** for **diagnostics**, **cables** and **boronisation** system



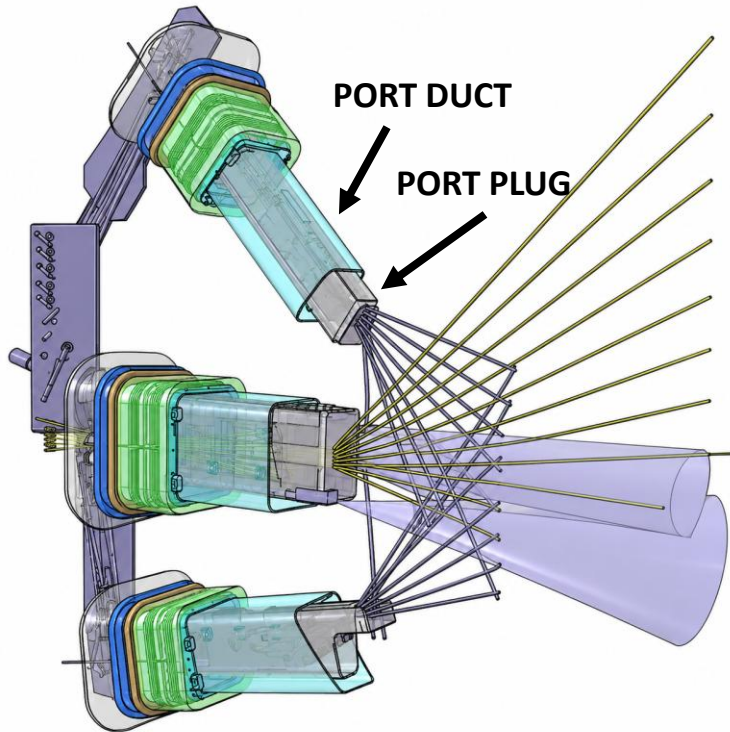
- **59/89** ports **available** for diagnostics
- **40** already **assigned**
- **19** equipped at **Day-0**

In-Duct diagnostics: Port Plugs

Critical aspects

1. Withstand high **thermal loads** during **plasma** (0.5 MW/m^2 to the FW) and **baking** operations (up to 200°C) → **active cooling system required**
2. Compliance with **vacuum** requirements → **appropriate material, double windows**
3. Withstand **stray radiation load** under **EC operations** (estimated max 0.5 MW/m^2)

CRYOSTAT FLANGE



see also A. Salvitti, SOFT 2026 poster

To provide proper **protection** for **diagnostics** and ease the **remote extraction** for maintenance activities, ports **P2**, **P3** and **P4** host **port plug** structures

- Help **reducing neutron flux** to TF coils
- **Extractable**
- Surrounded by **heating panels** to ensure **homogeneous heating**

Here, **diagnostics** have to **co-exist** with **cables**, **heating systems** and **cooling pipes**. A **protection panel** (called **plasma viewing walls**) will be **installed** at the **end** of the **port plug** to **screen** diagnostics from strong **heat fluxes**, with dedicated **apertures** for the diagnostic **lines of sight**

Neutron & Gamma production

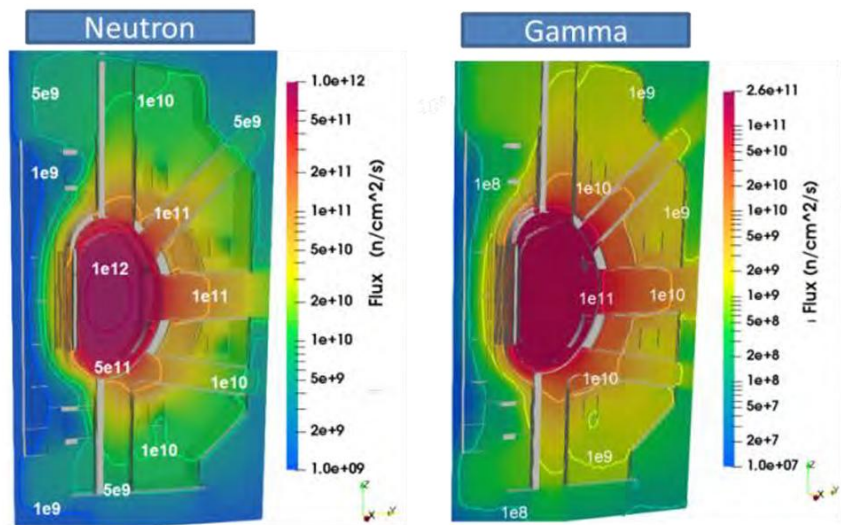


Figure XI.3: Maps of neutron (left) and gamma (right) fluxes inside cryostat in high performance phase.

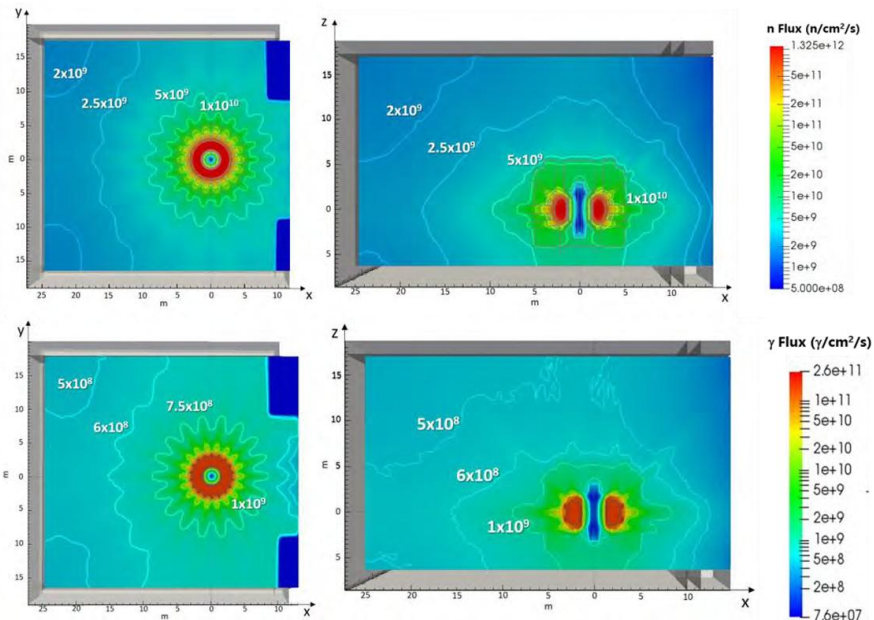
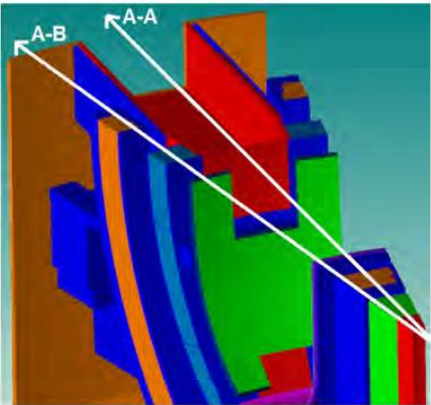
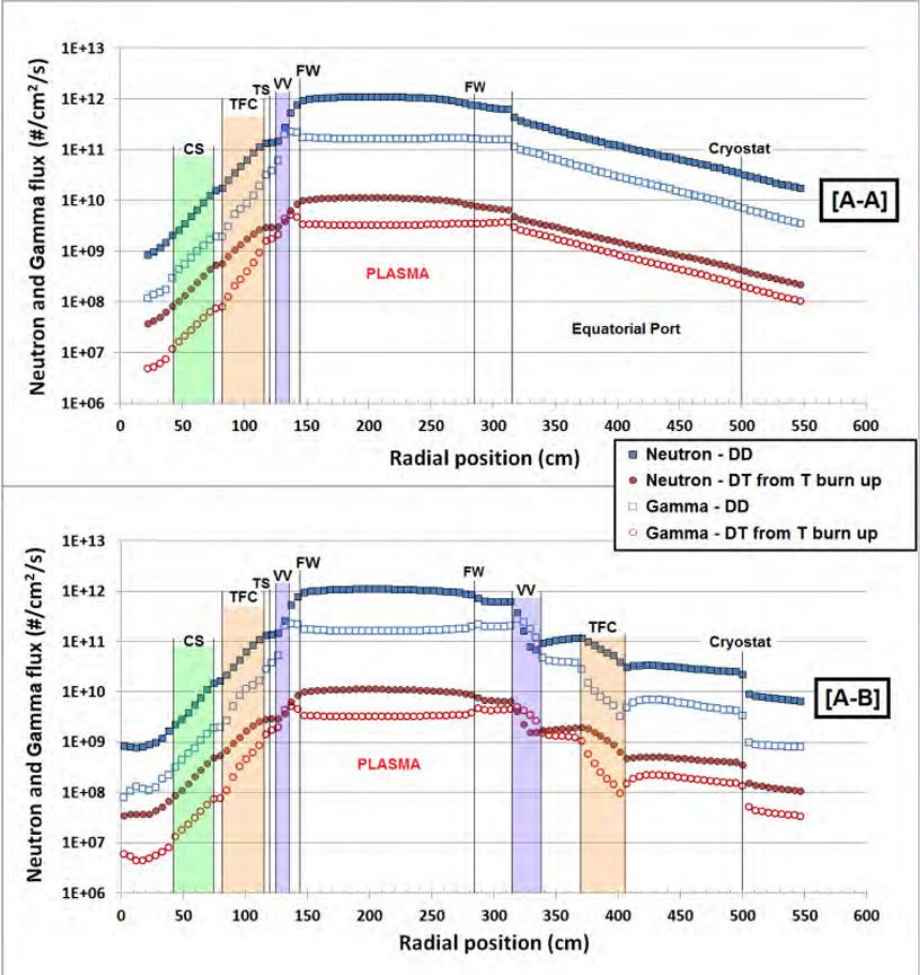


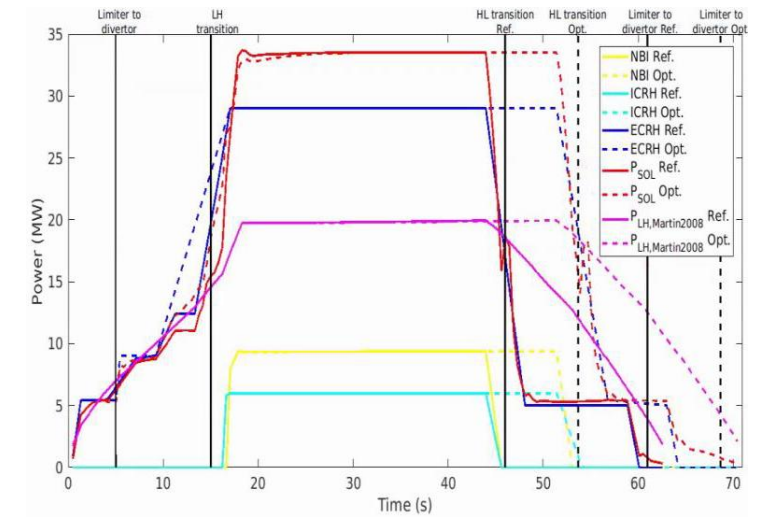
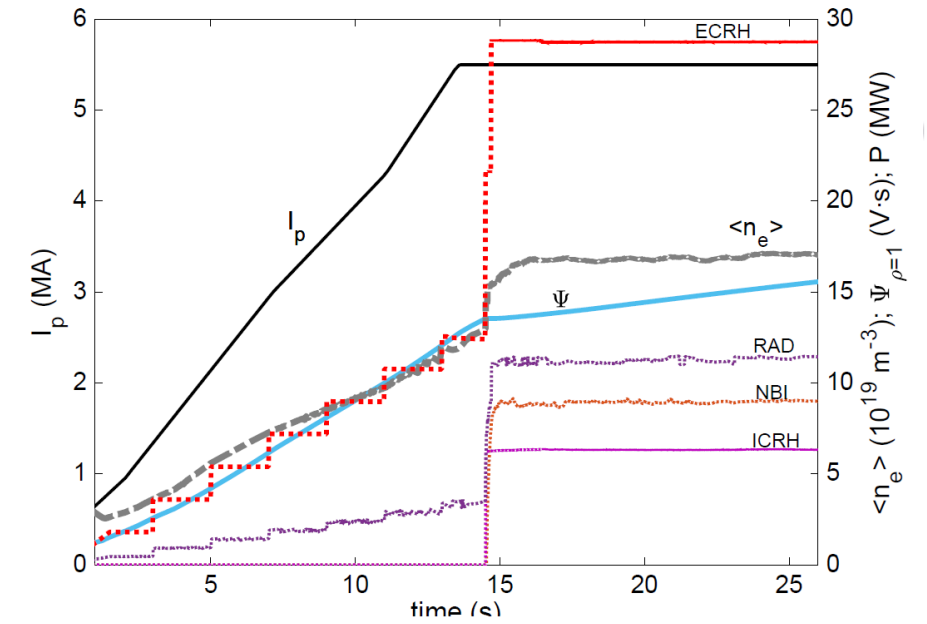
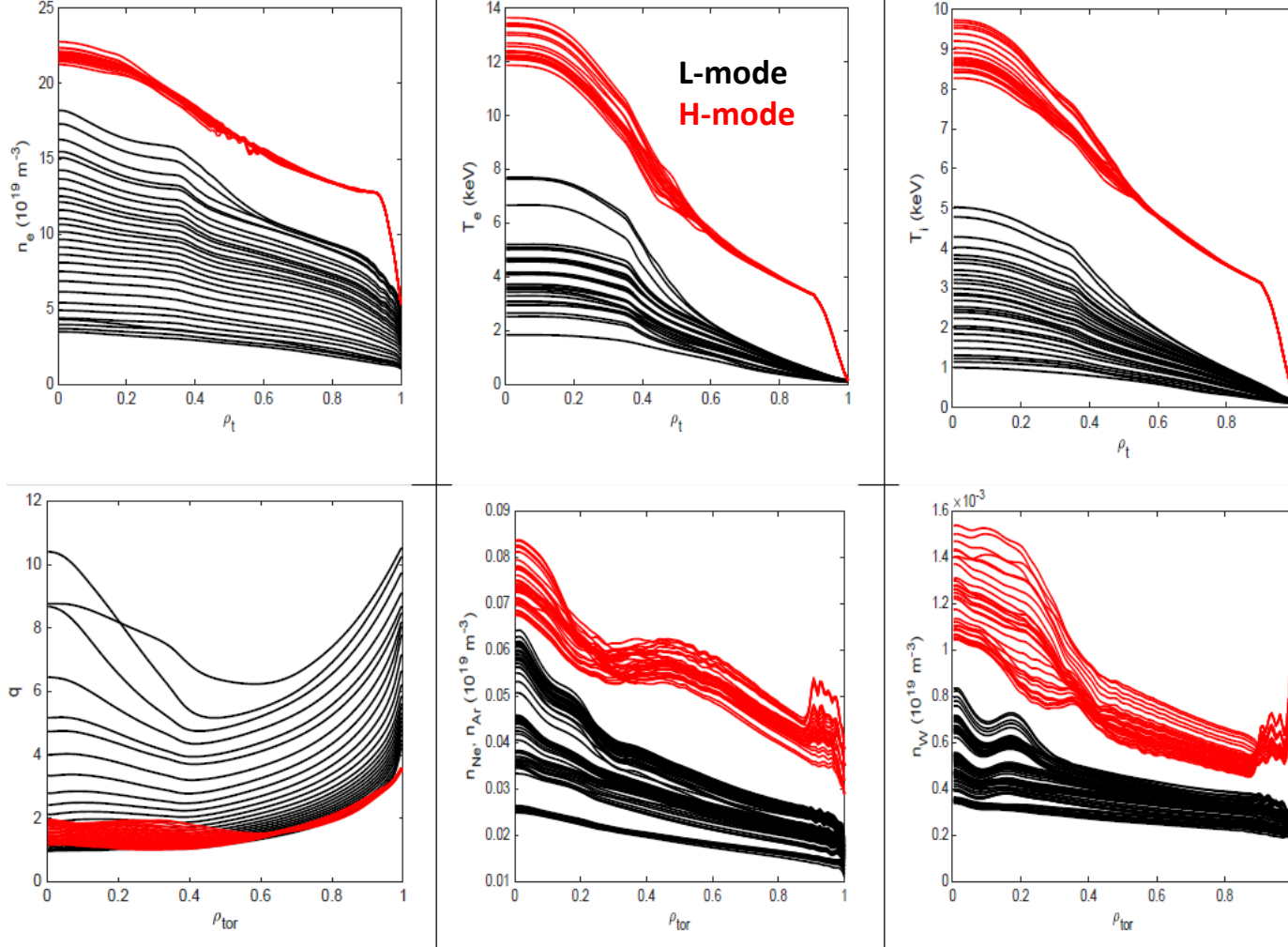
Figure XI.5: Maps of neutron (top) and gamma (bottom) fluxes inside the building during high performance phase.



see [R. Villari et al, FED **155**, 111551 (2020)] and [A. Colangeli et al, FED **171**, 112690 (2021)] for more details

Temperature & Density profiles

E SN scenario, ASTRA-TGLF simulations

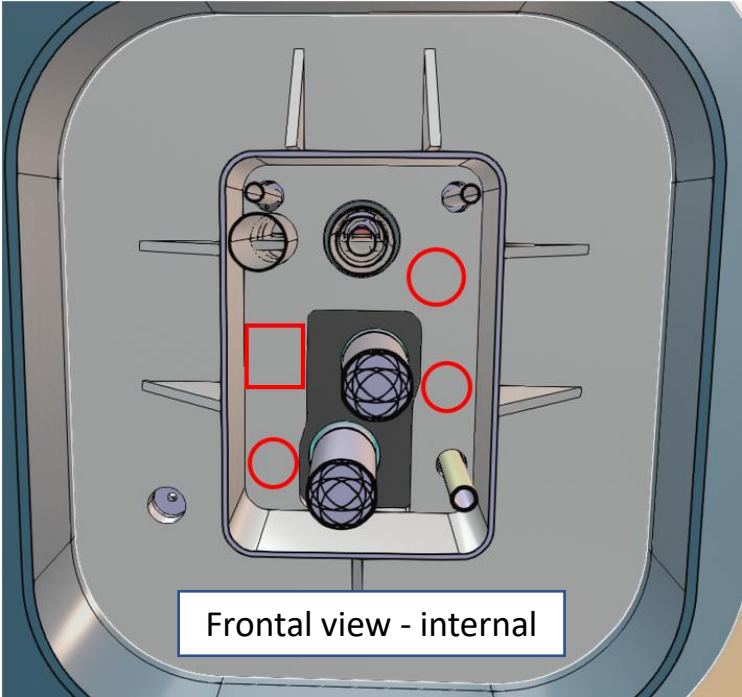
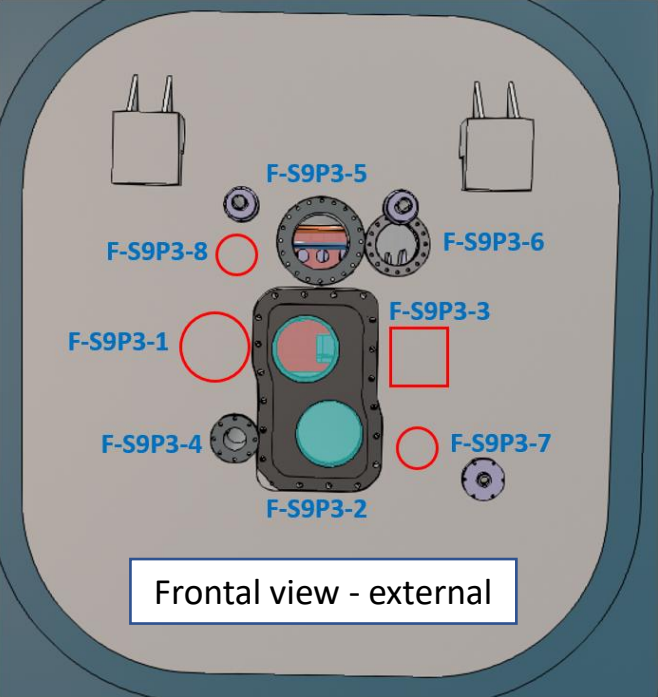


More on **chapter 2 Plasma scenarios of the RP!**

Port Plug integration: an example

- Port Plugs accommodate baking actuators
- All diagnostics can be removed from the PP
- Standardised disassembly procedure – RH approved
- Shielding structure for radiative heat load

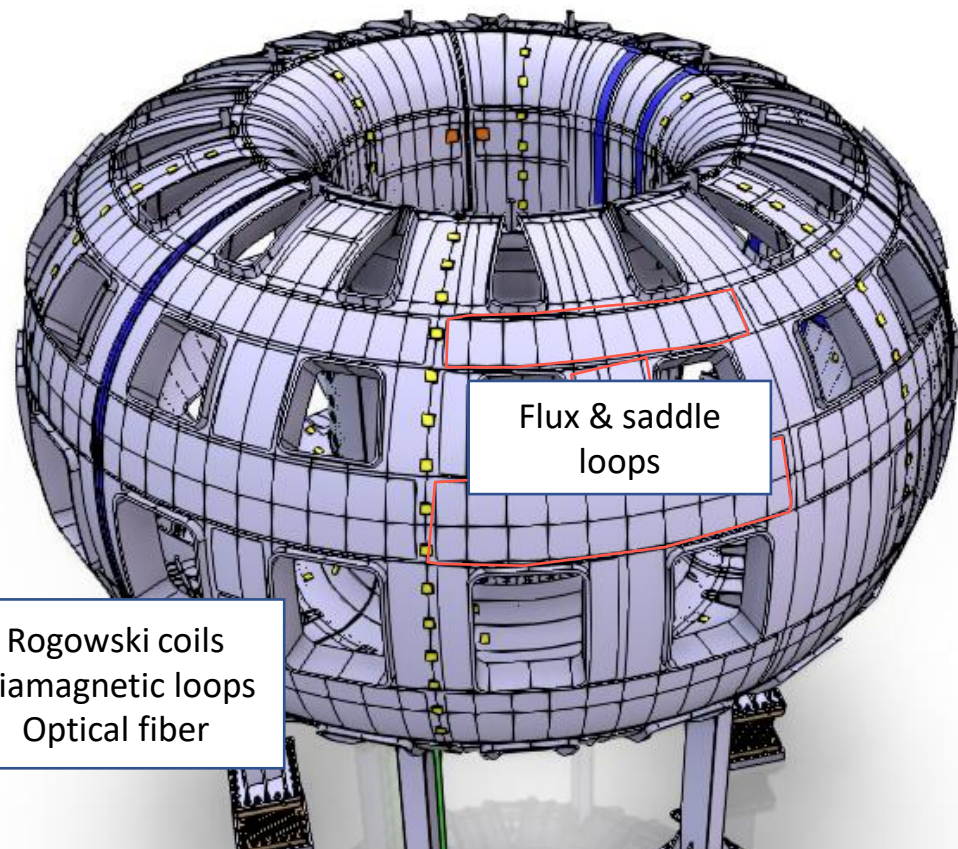
S9-P3



System	ID SUB-FLANGE
Massive Gas Injection (MGI)	F-S9P3-7
Interferometer Tangential	F-S9P3-1
Cameras IR and Visible WIDE ANGLE	F-S9P3-2
Electron Cyclotron Emission Turbulence Coherent	F-S9P3-3
Cherenkov Probe	F-S9P3-4
Runaway Electron Imaging Spectrometer (REIS)	F-S9P3-5
Shattered Pellet Injection	F-S9P3-8
Neutral Gas Analyzer (NGA) & Optical Gas Spectroscopy	F-S9P3-6

- System allocated
- Space allocated – dimensions not yet finalised

Inside & Outside VV magnetic sensors



Flux & saddle loops

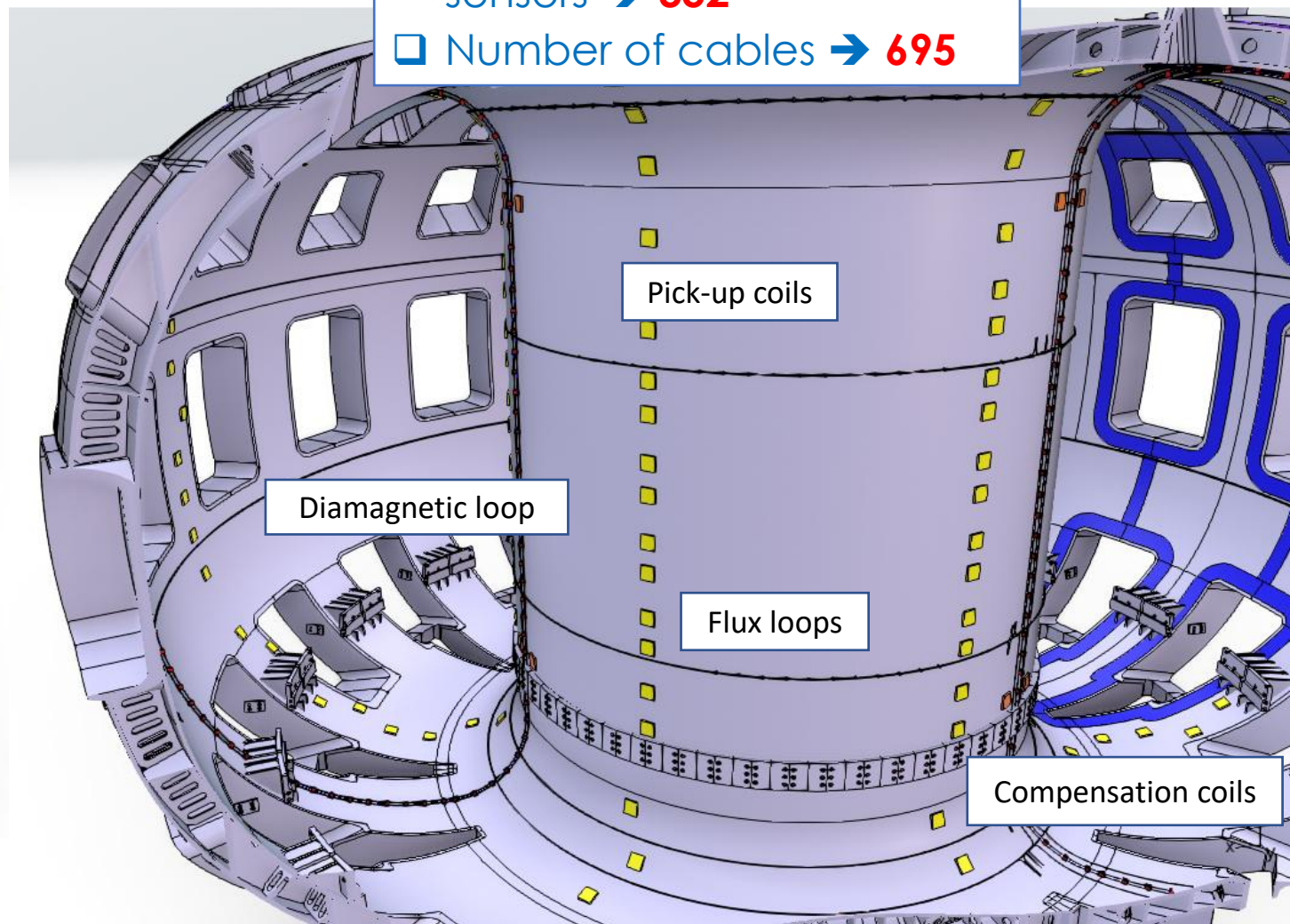
Rogowski coils
Diamagnetic loops
Optical fiber

Magnetic Sensors – Out-vessel

- Number of magnetic sensors → **444**
- Number of cables → **681**

Magnetic Sensors – In-vessel

- Number of magnetic sensors → **352**
- Number of cables → **695**



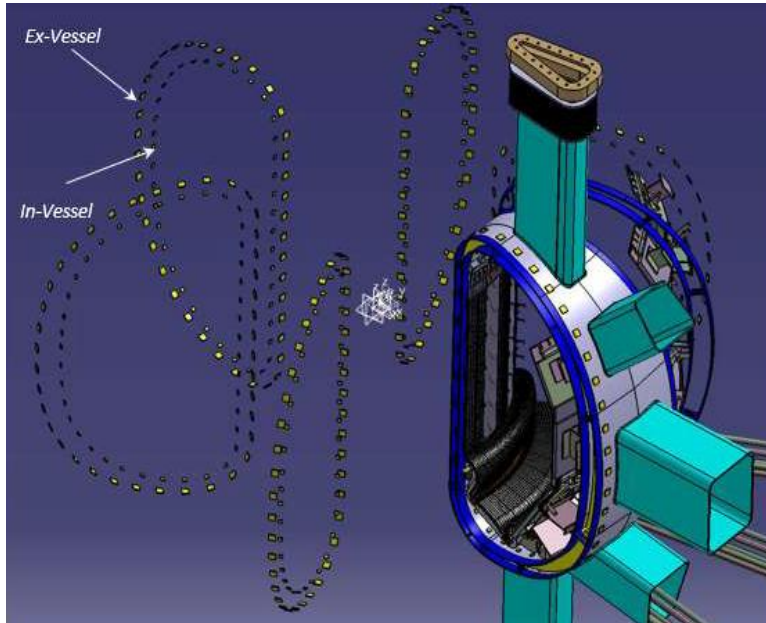
Pick-up coils

Diamagnetic loop

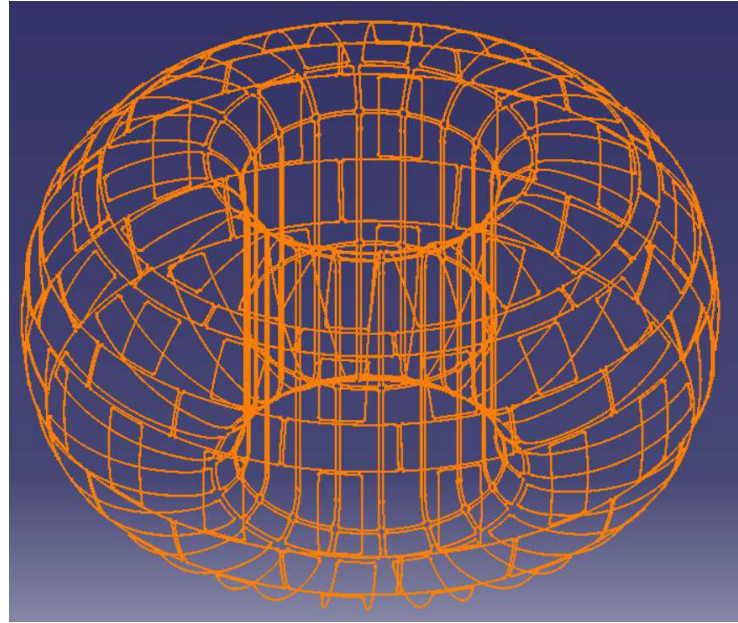
Flux loops

Compensation coils

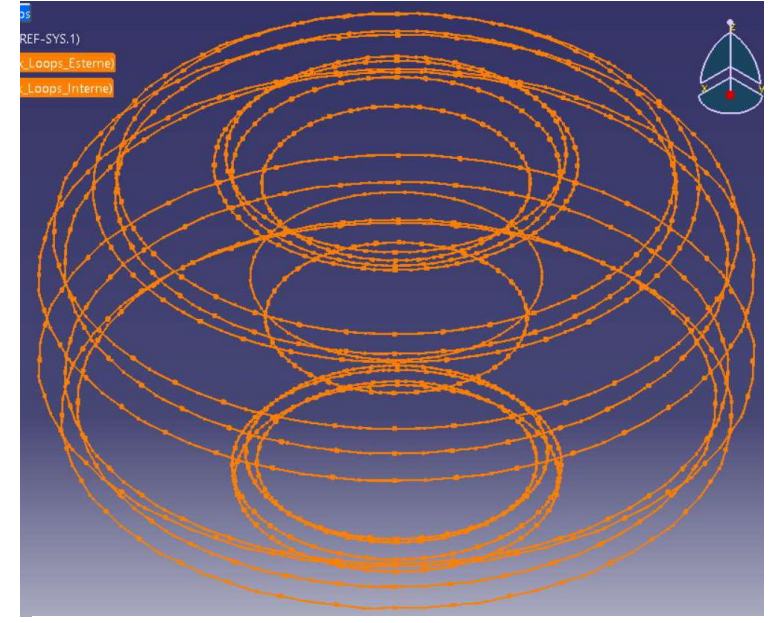
Magnetic diagnostic overview



Internal & External Pick-Up Coils



External Saddle Loops



Internal & External Flux Loops

Critical aspects:

- tight space available
- in-vessel obstacles
- urgent: -> impact on early assembly phase

In-Vessel signal cable choice:

- ☐ Neutron irradiation and heating could induce noise
- ☐ Baking compatible
- ☐ Suitable EC stray protection

Phase-2 diagnostics: a few examples

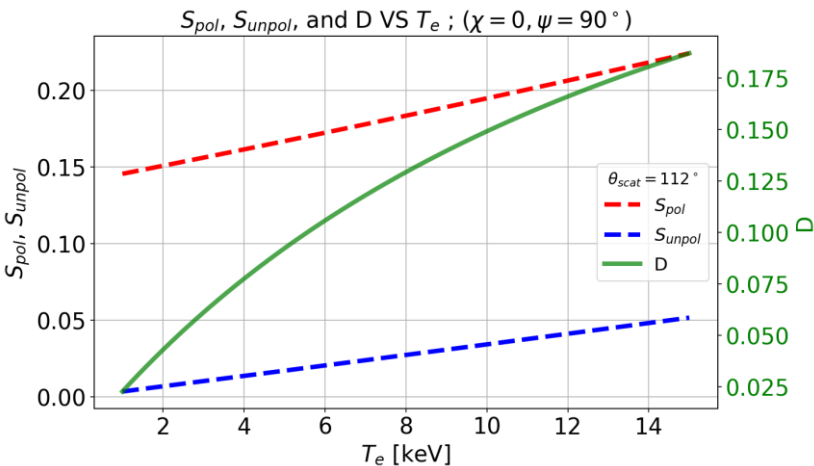
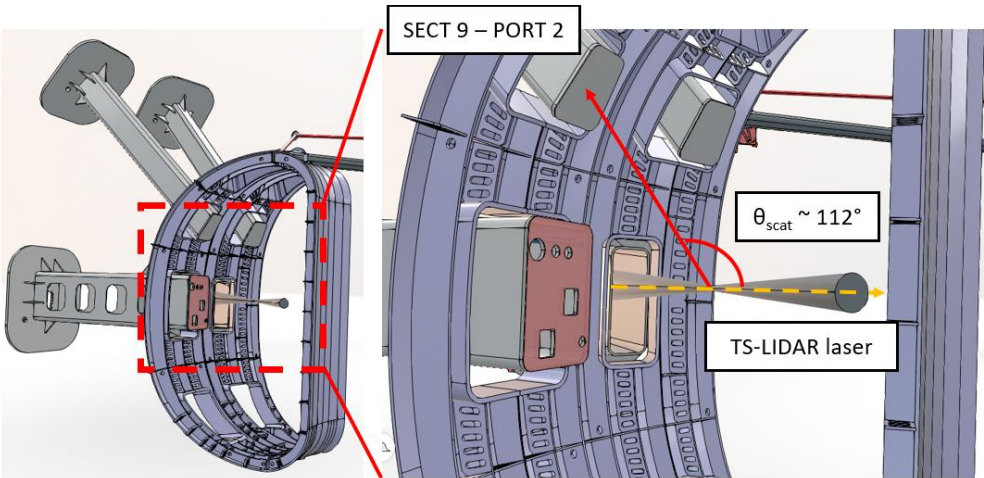


DTT scientific programme will evolve concomitantly with machine upgrades

Phase-2 diagnostics to probe advanced scenarios will be progressively installed

Phase-2 equipment (partial)

- Plasma-wall interaction
- Laser Induced Breakdown Spectroscopy (LIBS)
- Transport studies
- Beam Emission Spectroscopy (BES)
- Motional Stark Effect Polarimeter (MSE)
- Turbulence studies
- Phase Contrast Imaging (PSI)
- Gas Puffing Imaging
- Correlation Electron Cyclotron Emission (CECE)
- Fast Ions
- Fast Ion D-alpha (FIDA)
- Fast Ion Loss Detector (FILD)
- High temperature measurements
- Polarimetric Thomson Scattering (PTS)



Polarisation dependencies

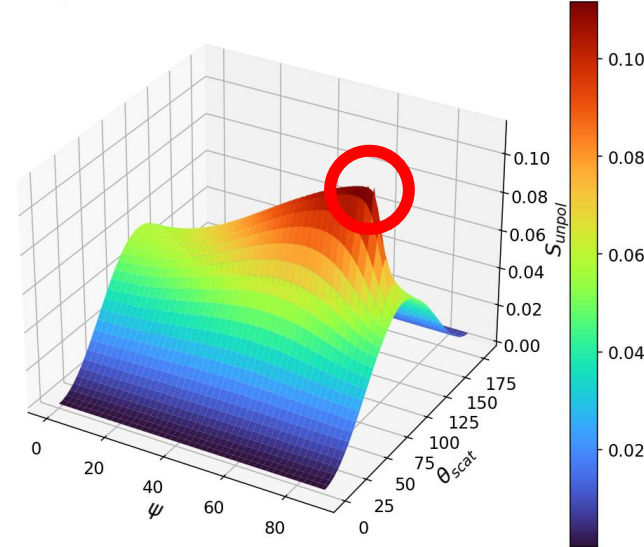
The **evolution** of the degree of **depolarisation** with T_e is often explored to **assess PTS performance**

This, however, **might be misleading**: both the **polarised** and **unpolarised components** S_{pol} and S_{unpol} should be **evaluated**, as these are the **measured quantities**

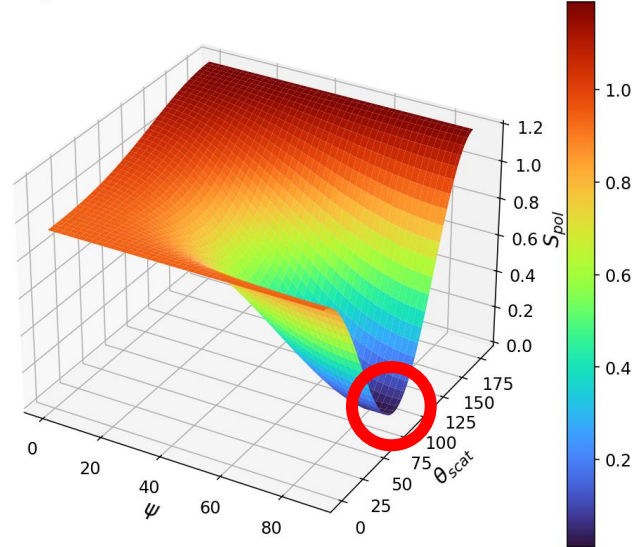
For instance, the most **favourable condition** with a **linearly polarised input laser** (ordinary TS setup) is obtained with $\theta_{scat} = 87^\circ$ and $\psi = 79^\circ$. Here, S_{unpol} is **max**, but $S_{pol} = 0$, making a practical **implementation** of the system **unfeasible**

$\theta_{scat} = 100^\circ$, instead, **grants** a relatively **high** value of S_{unpol} , concomitantly with a **non-null** value of S_{pol}

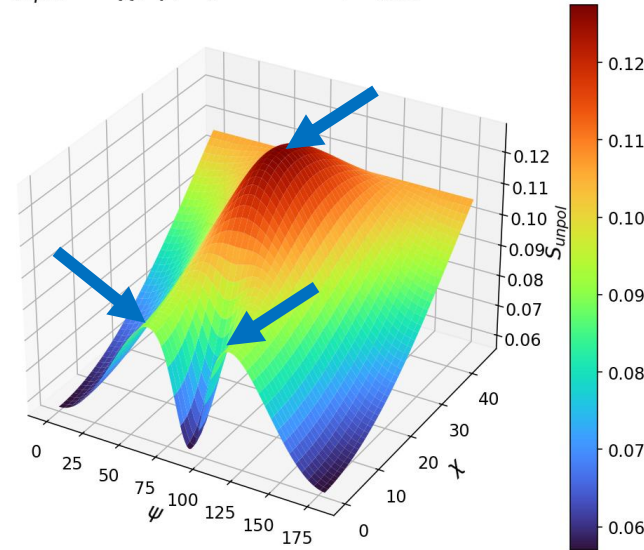
S_{unpol} VS ψ , θ_{scat} ; $\chi = 0$; $T_e = 15$ keV



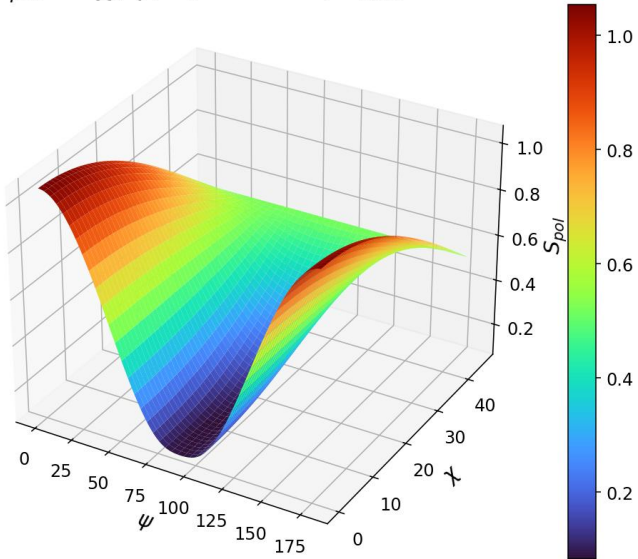
S_{pol} VS ψ , θ_{scat} ; $\chi = 0$; $T_e = 15$ keV



S_{unpol} VS χ , ψ ; $T_e = 15$ keV; $\theta_{scat} = 100^\circ$



S_{pol} VS χ , ψ ; $T_e = 15$ keV; $\theta_{scat} = 100^\circ$

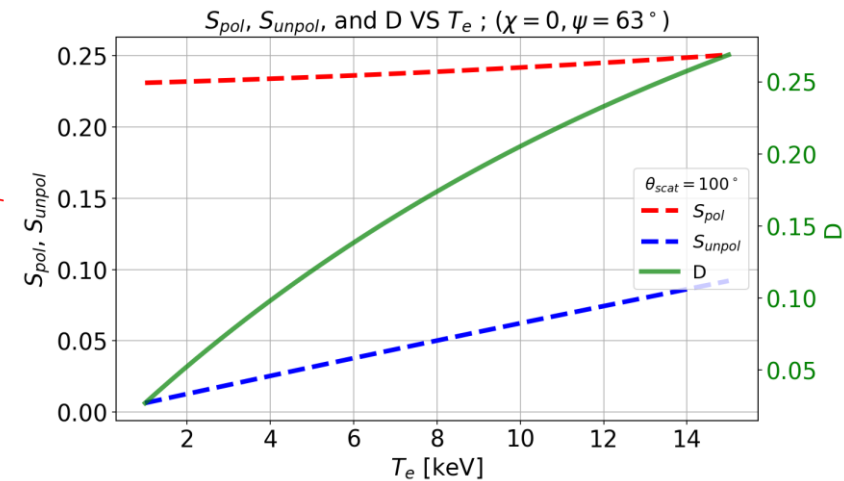
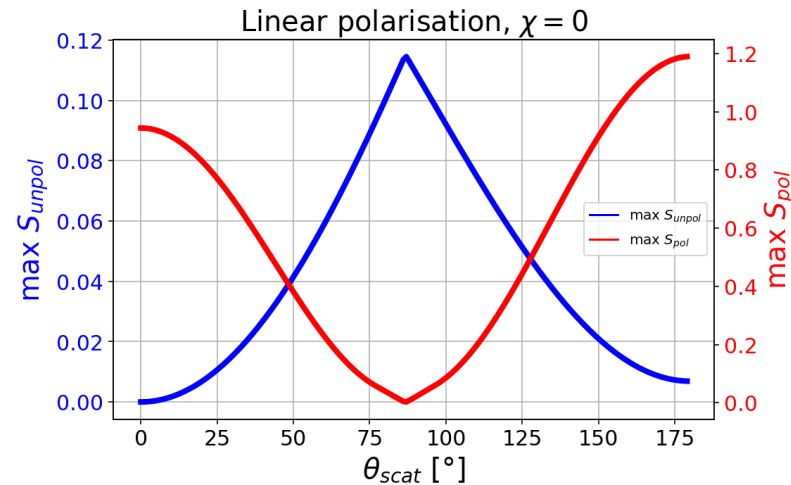
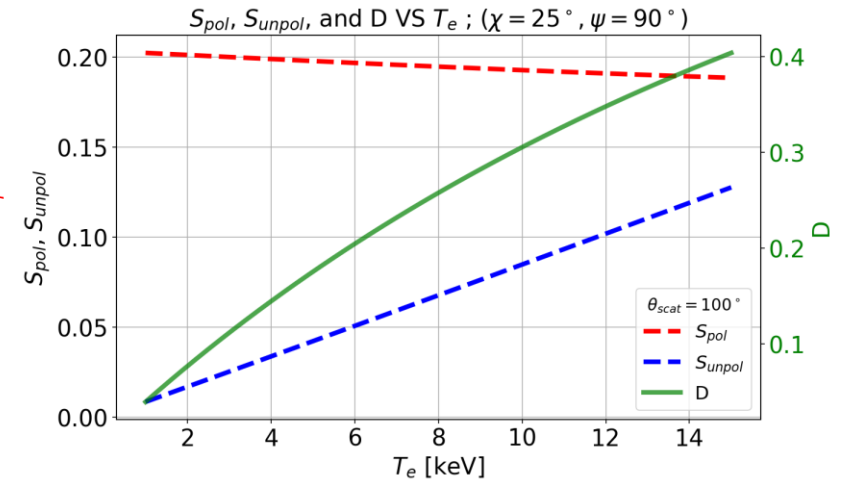
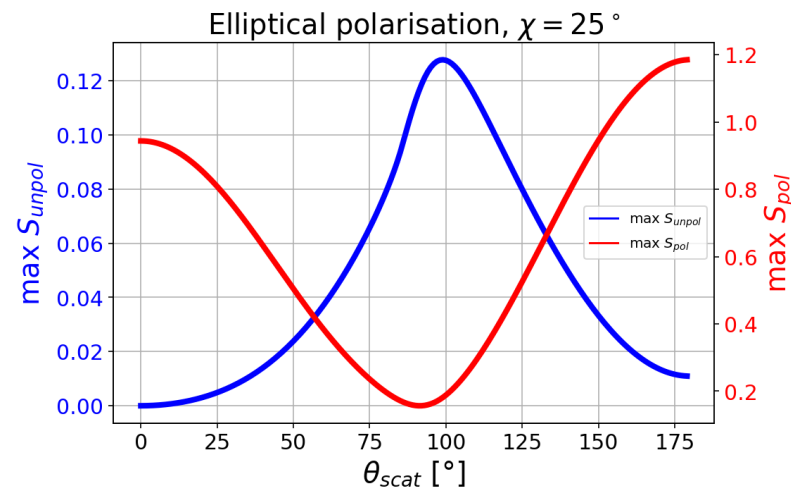


Elliptical polarisation

Based on the previous surface plots, the **strongest** degree of **depolarisation** is obtained with an **elliptically polarised** input laser at $(\chi, \psi) = (25^\circ, 90^\circ)$

Compared to linear polarisation, it **does not correspond** to a significantly **stronger** S_{unpol}

Therefore, there is **no practical advantage** in using an **elliptically polarised laser**, at least at the scattering **angles** conventionally **employed by TS systems**



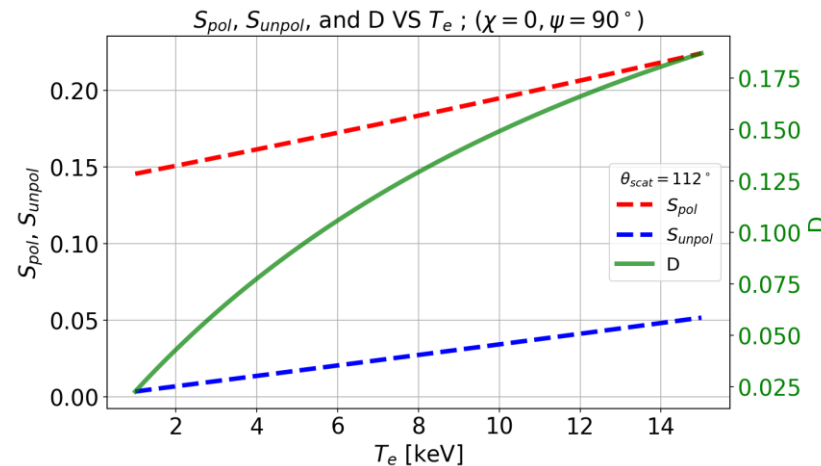
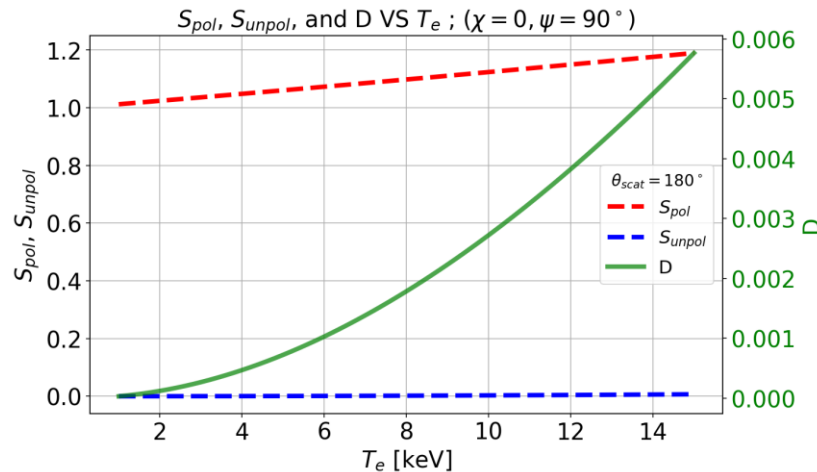
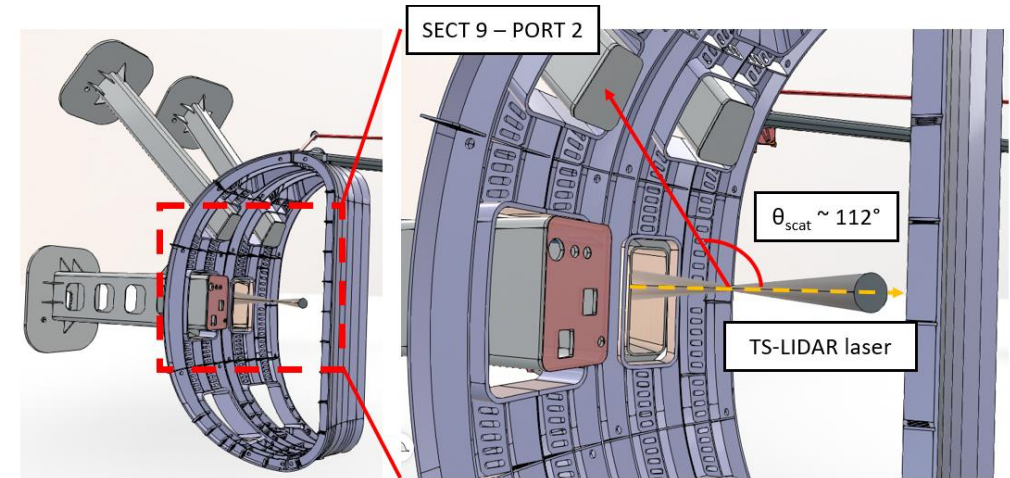
A **strong variation** of the degree of **depolarisation** with T_e is **observed** in the region $\theta_{\text{scat}} = 70^\circ - 120^\circ$. Within these conditions, a **linearly polarised** laser **provides** a sufficiently **strong signal**. Therefore, a **conventional setup** allows for a **combination** of a **spectral** and **polarimetric measurement**

Preliminary assessment for DTT PTS design



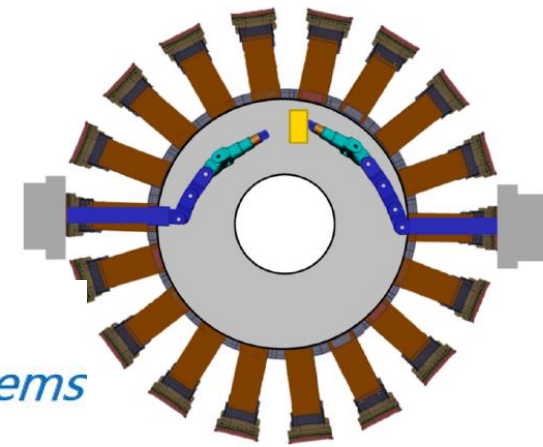
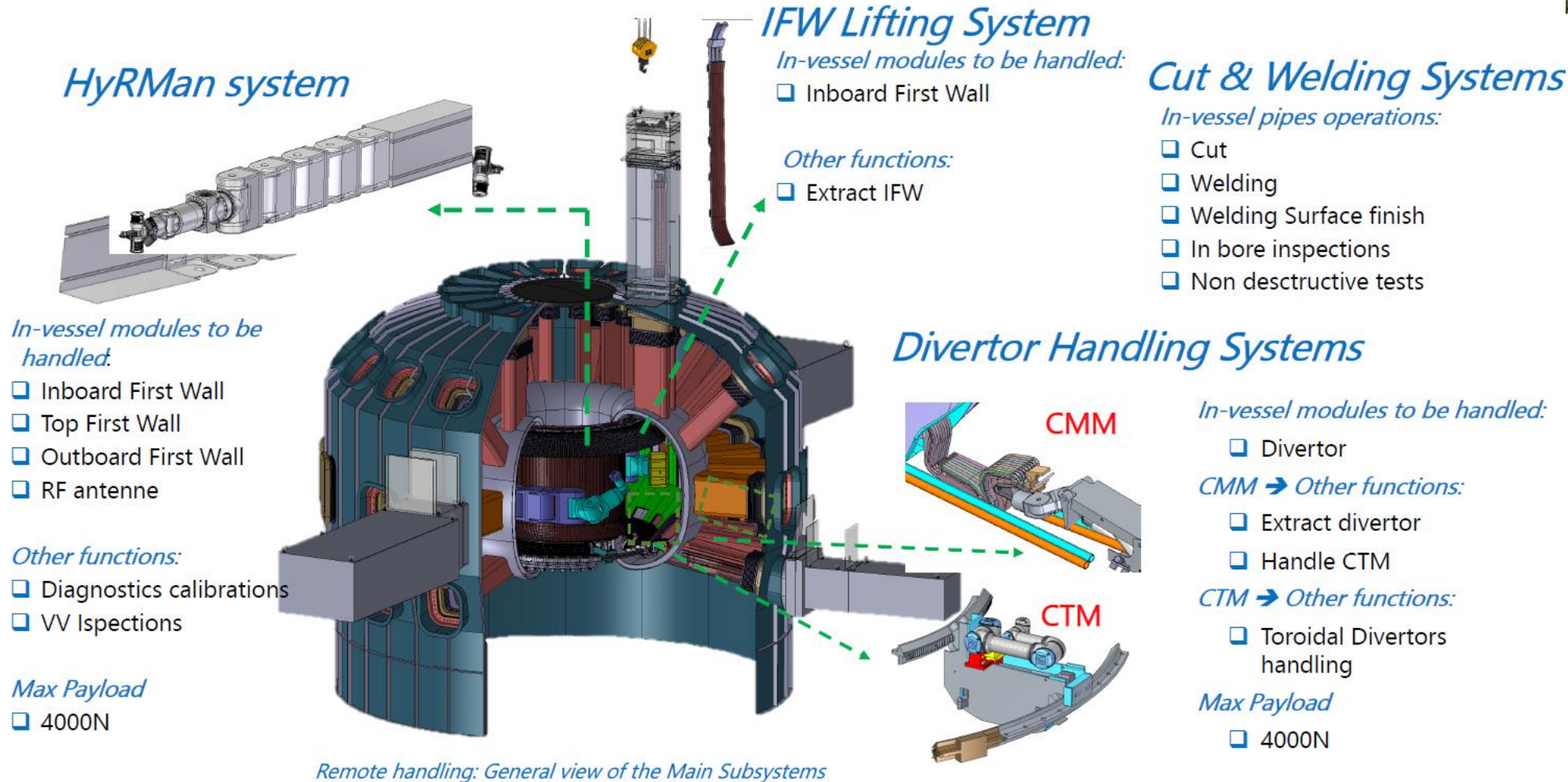
The **DTT** (Divertor Tokamak Test) facility is a **breakeven-class**, fully **superconducting compact size tokamak** ($R = 2.19$ m, $a = 0.70$ m) **under construction** in the ENEA research center in Frascati. It is **dedicated** to the study of **heat exhaust solutions** in **fusion-relevant** environments

DTT core TS, being a **LIDAR** system, **collects backscattered** light ($\theta_{\text{scat}} = 180^\circ$). At this angle, the **output signal** is **extremely low**. Therefore, an **alternative** viewing line from a diagonal port was **selected**, with $\theta_{\text{scat}} \approx 112^\circ$

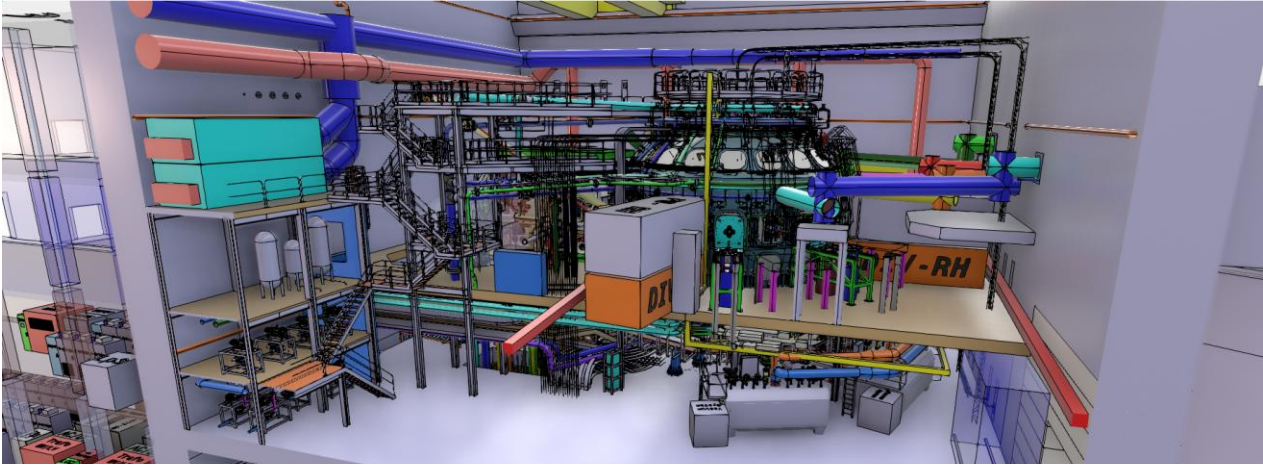


With such **independent view**, S_{unpol} **increases linearly** up to 5% at $T_e = 15$ keV, **concomitantly** with $S_{\text{pol}} \neq 0$

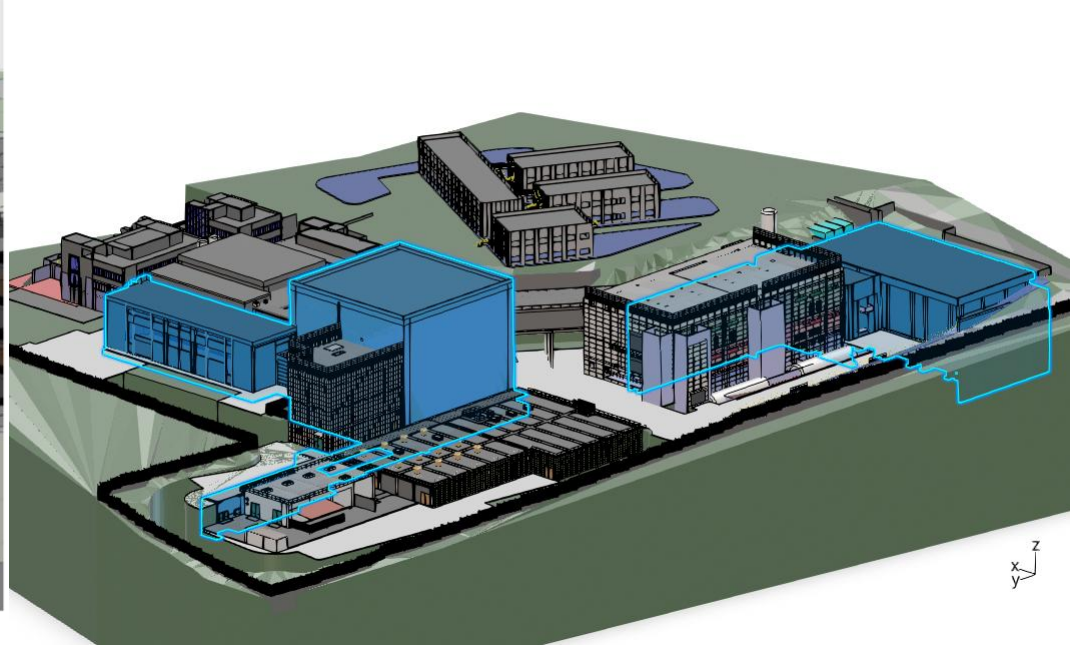
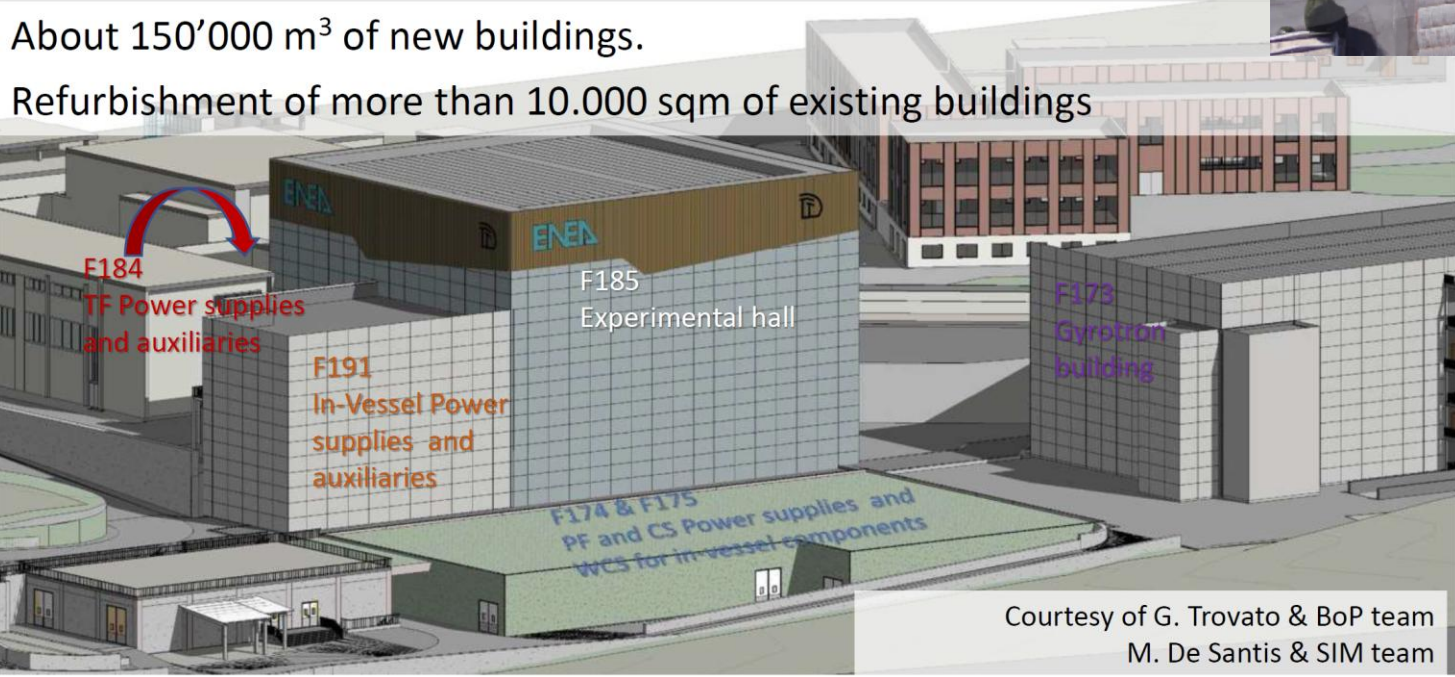
DTT – Remote Handling



DTT – main buildings



About 150'000 m³ of new buildings.
Refurbishment of more than 10.000 sqm of existing buildings



Courtesy of G. Trovato & BoP team
M. De Santis & SIM team