

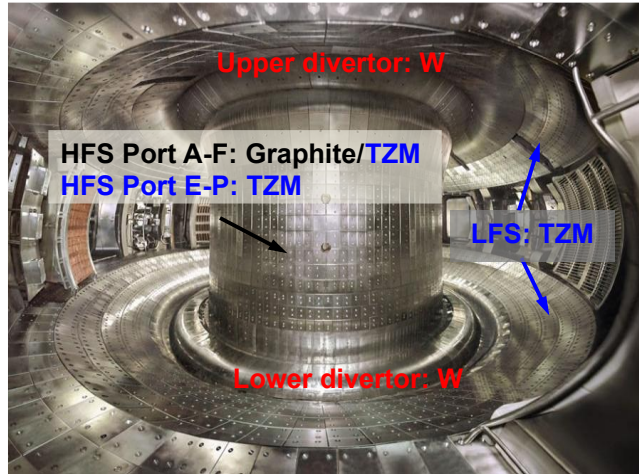
Study on the Evolution of Stray-Light Effects in the Visible Spectral Region in EAST

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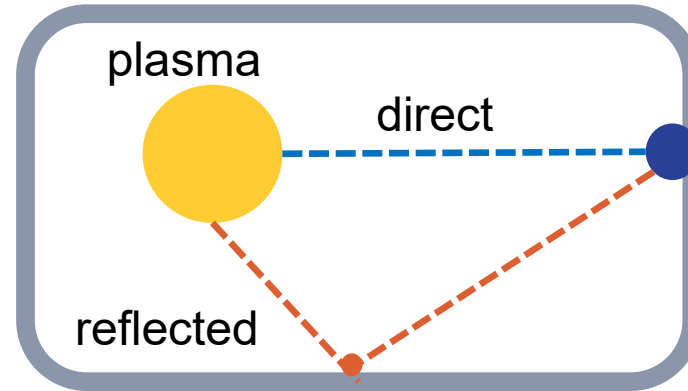


01 | Metallic first wall



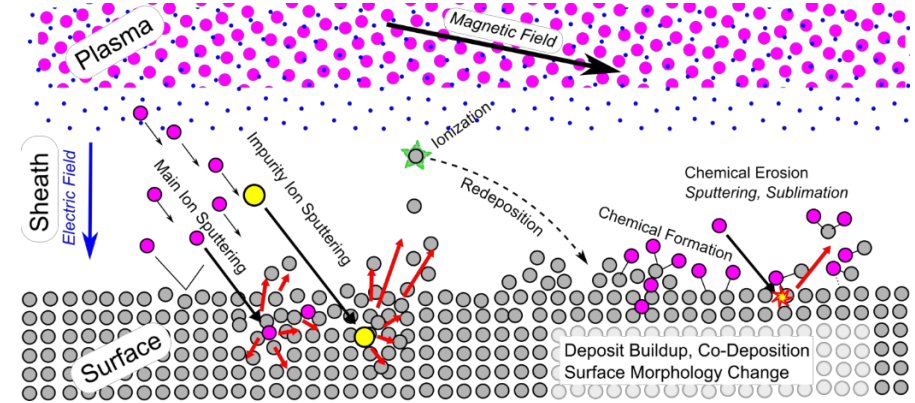
Reflective wall surfaces in EAST

02 | Diagnostic impact



Direct + reflected light

03 | PWI-driven evolution



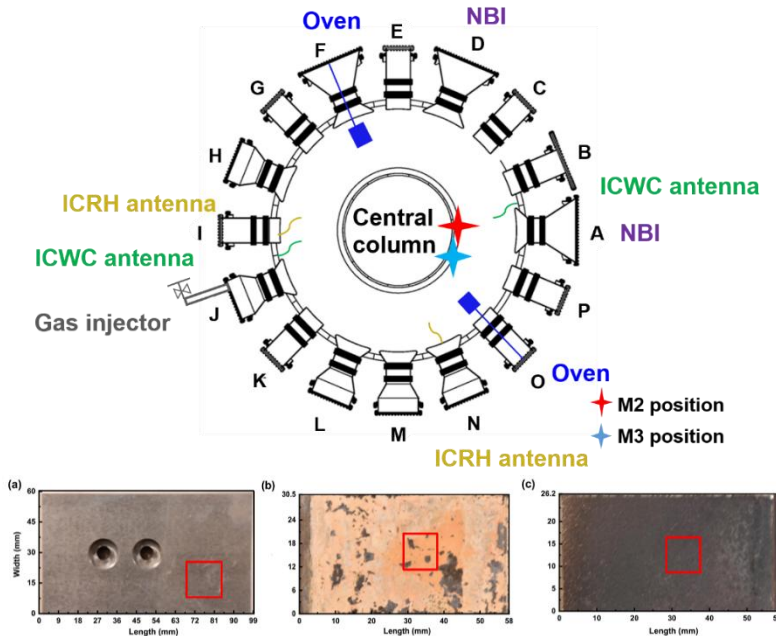
Erosion/deposition changes BRDF

Research question

How does plasma-induced BRDF evolution affect the received visible signal in EAST?

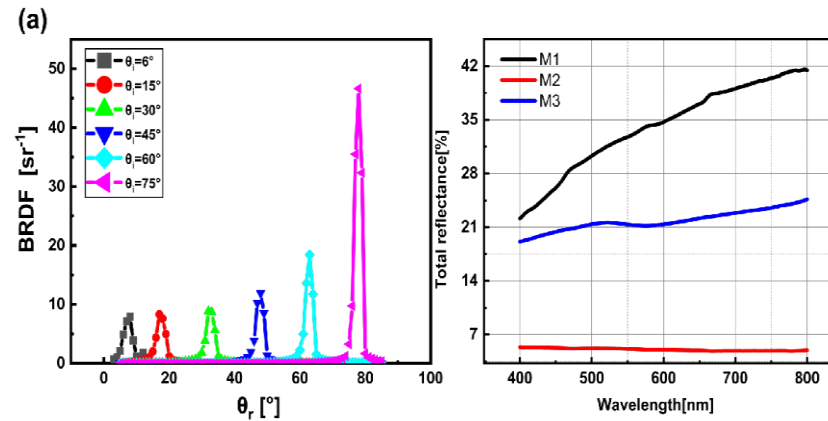
Overall methodology

01 | EAST wall samples



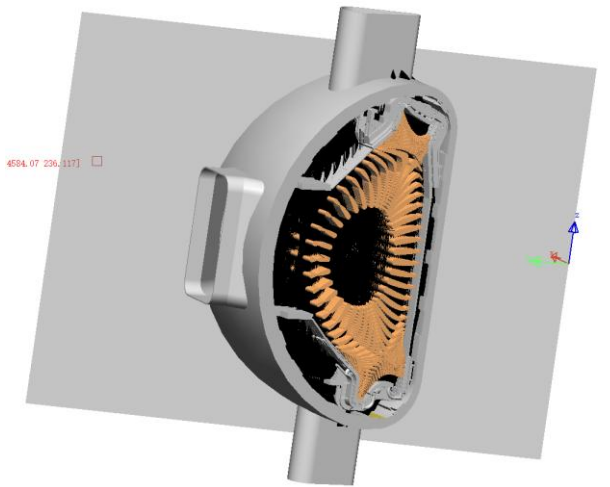
M1: Unexposed
M2/M3: Plasma-exposed

02 | Optical characterization



Spectral reflectance
Measured BRDF at 656 nm

03 | LightTools simulation



Apply measured BRDFs
Calculate received signal

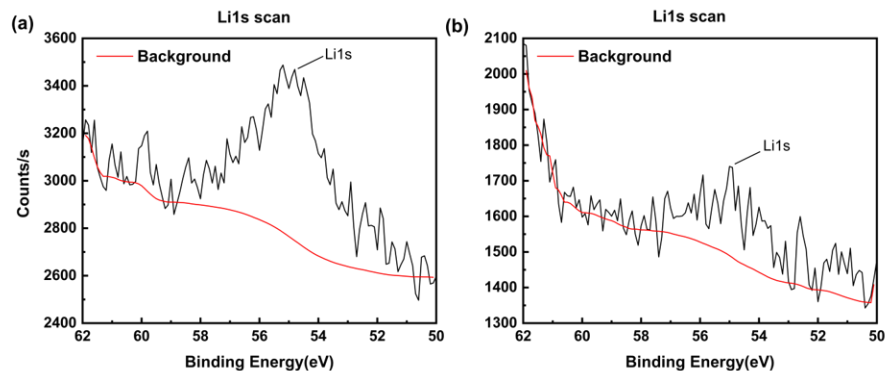
Measured BRDFs → LightTools model → Received visible signal

Surface evolution after plasma exposure

Selected EDS composition (wt%)

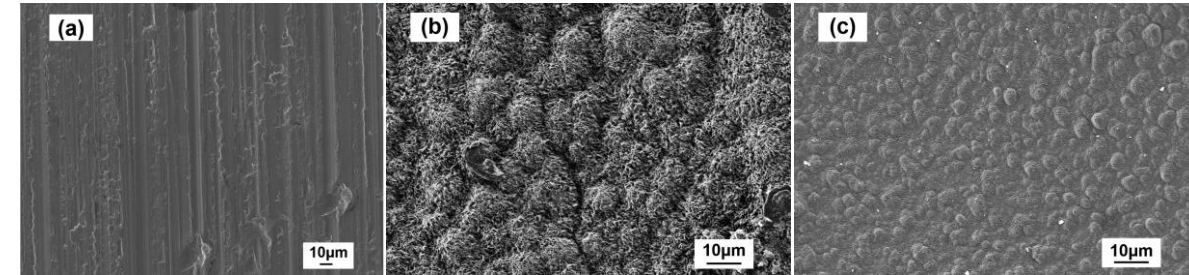
Samples	B	C	O	Mo
M1	-	-	7.1	92.4
M2	-	7.98	57.15	34.67
M3	4.11	4.29	36.7	24.47

XPS characterization



Li detected by XPS

Surface morphology (SEM)

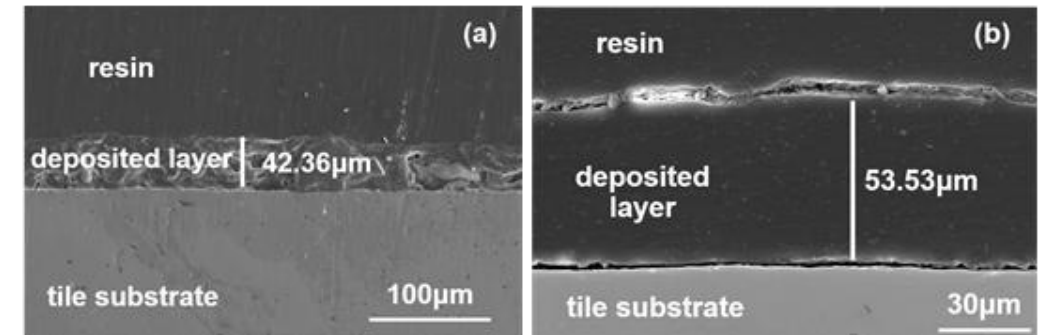


M1 — Unexposed

M2 — Exposed

M3 — Exposed

Cross-sectional SEM



Deposition layer thickness: M2~42 μm

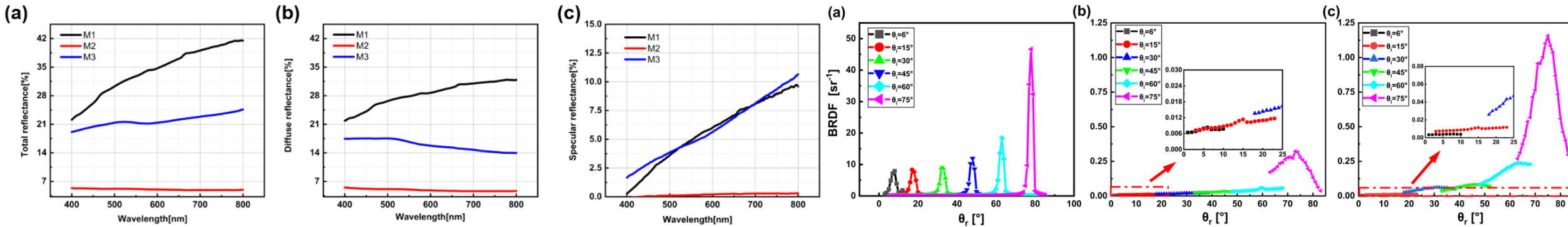
M3~54 μm

➤ Plasma exposure results in C/O enrichment and ~42–54 μm-thick deposition layers.

Evolution of optical properties after plasma exposure

Spectral reflectance

BRDF at 656 nm



Total reflectance ↓ markedly after plasma exposure

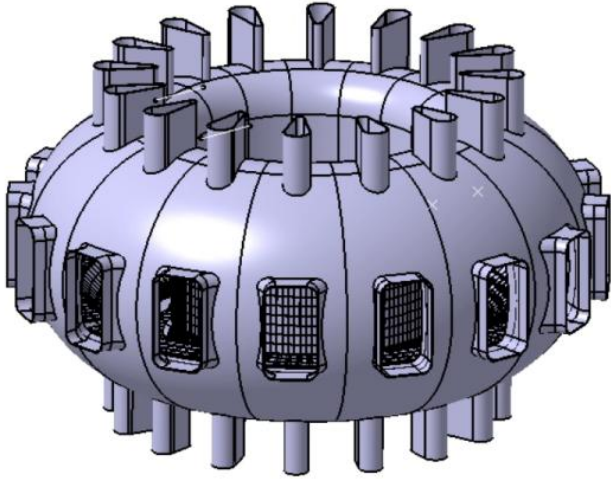
Peak BRDF ↓ by up to ~2 orders of magnitude

$\lambda = 656 \text{ nm}$ | beam diameter $\approx 10 \text{ mm}$ | $\varphi_i = 0^\circ$, $\varphi_r = 180^\circ$

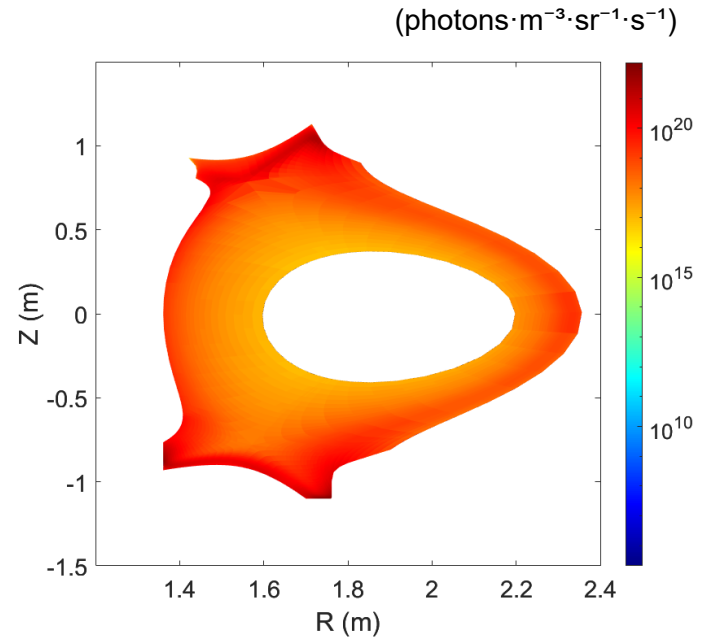
(a) M1 — Unexposed | (b) M2 — Plasma-exposed | (c) M3 — Plasma-exposed

Plasma exposure modifies both **the magnitude and angular distribution** of wall reflection.

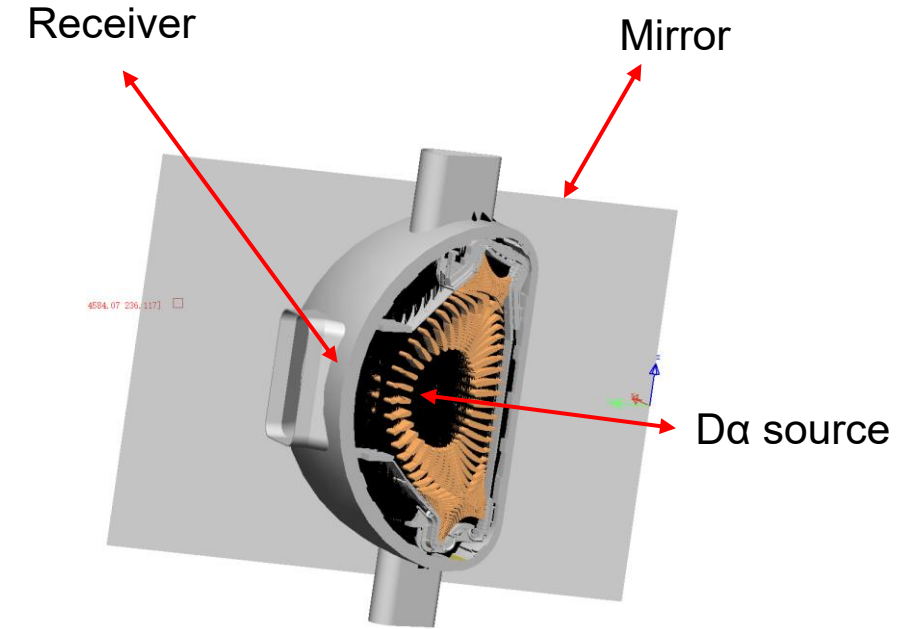
LightTools ray-tracing model



EAST first-wall geometry



SOLPS-derived D α emissivity



Visible-camera viewing geometry

Model setup

Source: D α emission (656.1 nm)

Geometry: 1/16 EAST sector

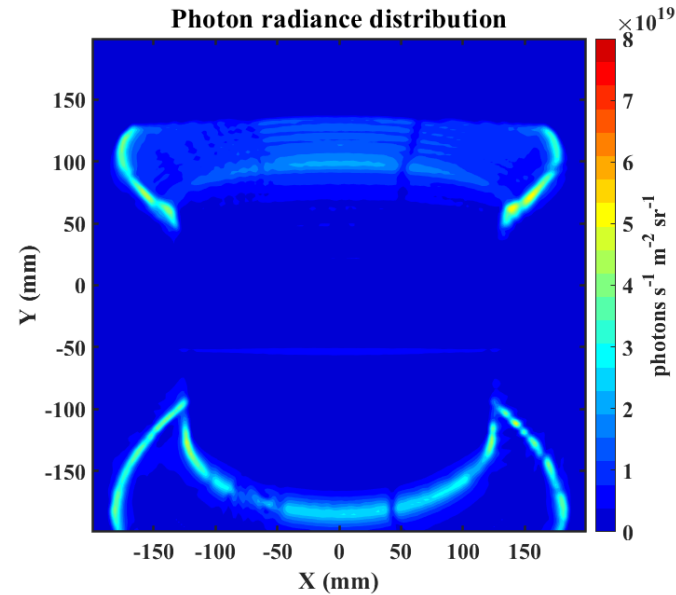
Receiver: Camera entrance aperture

Wall: Measured BRDFs (M1–M3)

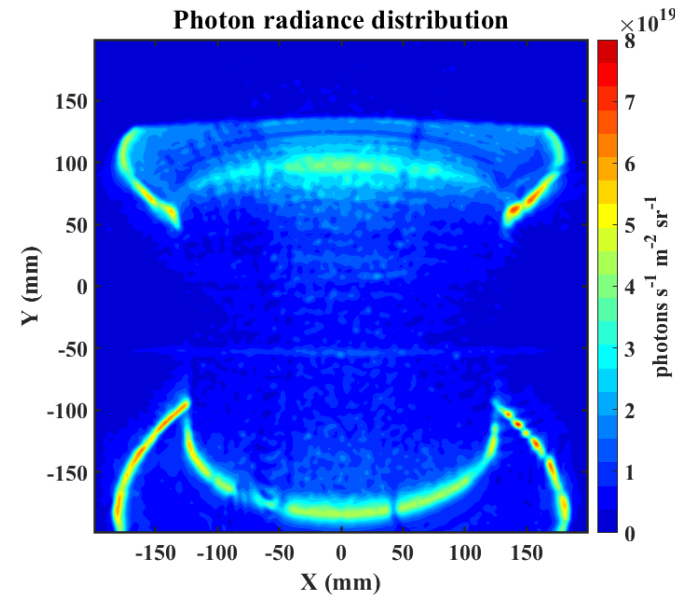
Method: Backward Ray tracing

Effect of wall reflection on the received signal

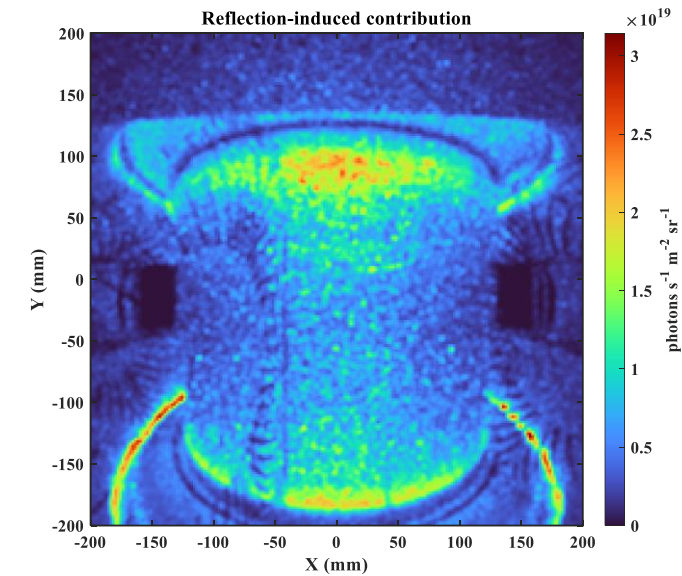
100% wall absorption



50% wall reflectivity



Reflection-induced contribution



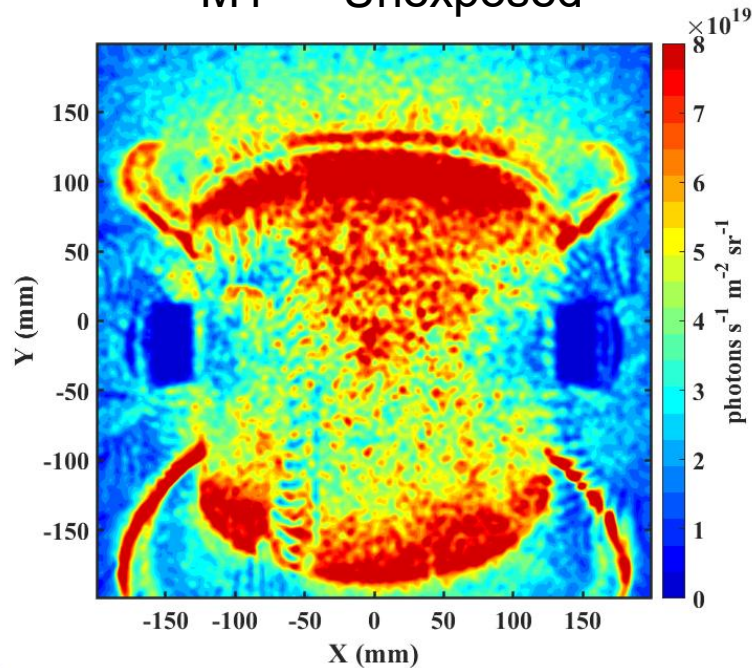
Reflective case: $R = 50\%$ (50%
diffuse / 50% specular)

Wall reflection introduces a substantial additional contribution and modifies the spatial distribution of the received signal.

Effect of measured wall BRDF on the received signal

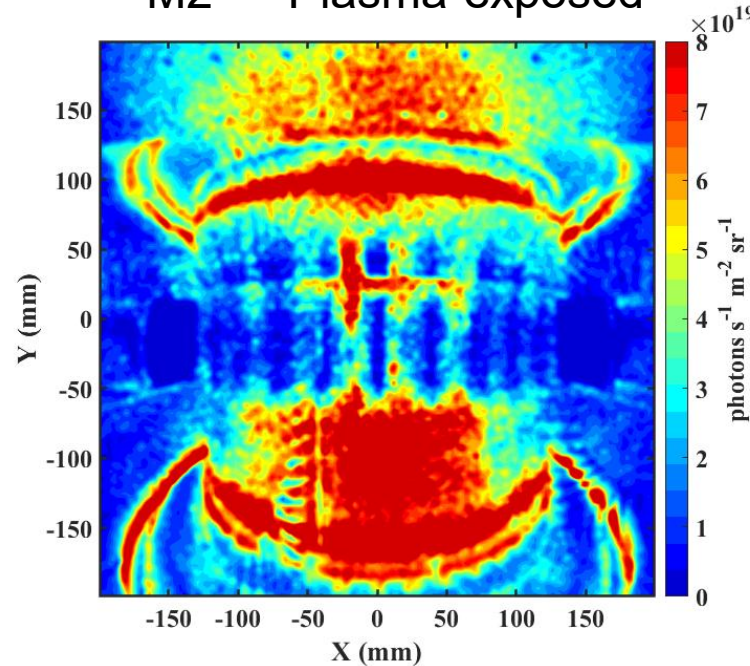
Measured BRDF applied to the wall surface

M1 — Unexposed



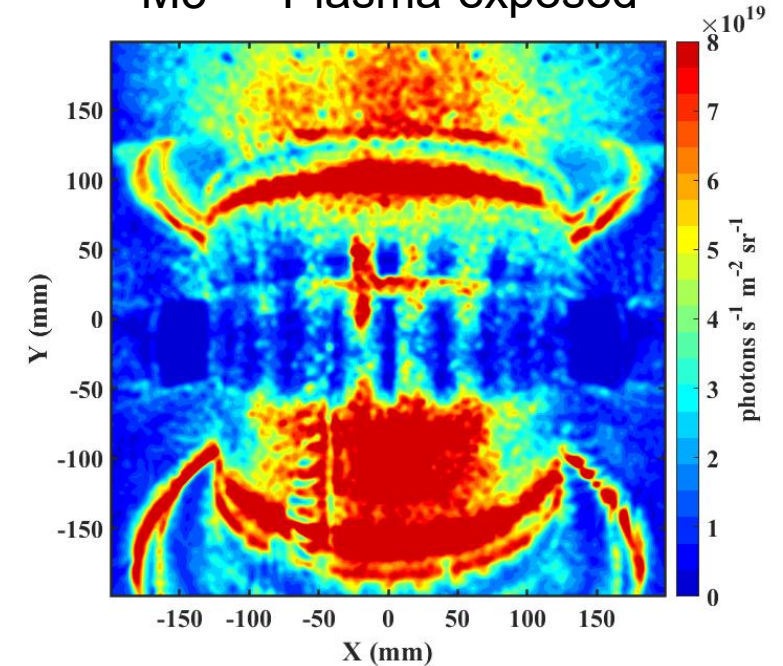
Normalized total signal = **1.000**

M2 — Plasma-exposed



Normalized total signal = **0.886**

M3 — Plasma-exposed



Normalized total signal = **0.885**

- Plasma-induced BRDF evolution reduces the total received signal by ~11% and significantly alters its spatial distribution.
- M2 and M3 show nearly identical total received signals.

01 | Surface evolution

42–54 μm

Impurity-rich deposition layers
after plasma exposure

02 | Optical evolution

~2 orders

Maximum reduction in peak BRDF

03 | Diagnostic impact

~11%

Reduction in total received signal, with spatial
redistribution

Outlook:

Further quantify wall-reflected stray light under different EAST plasma and wall conditions.