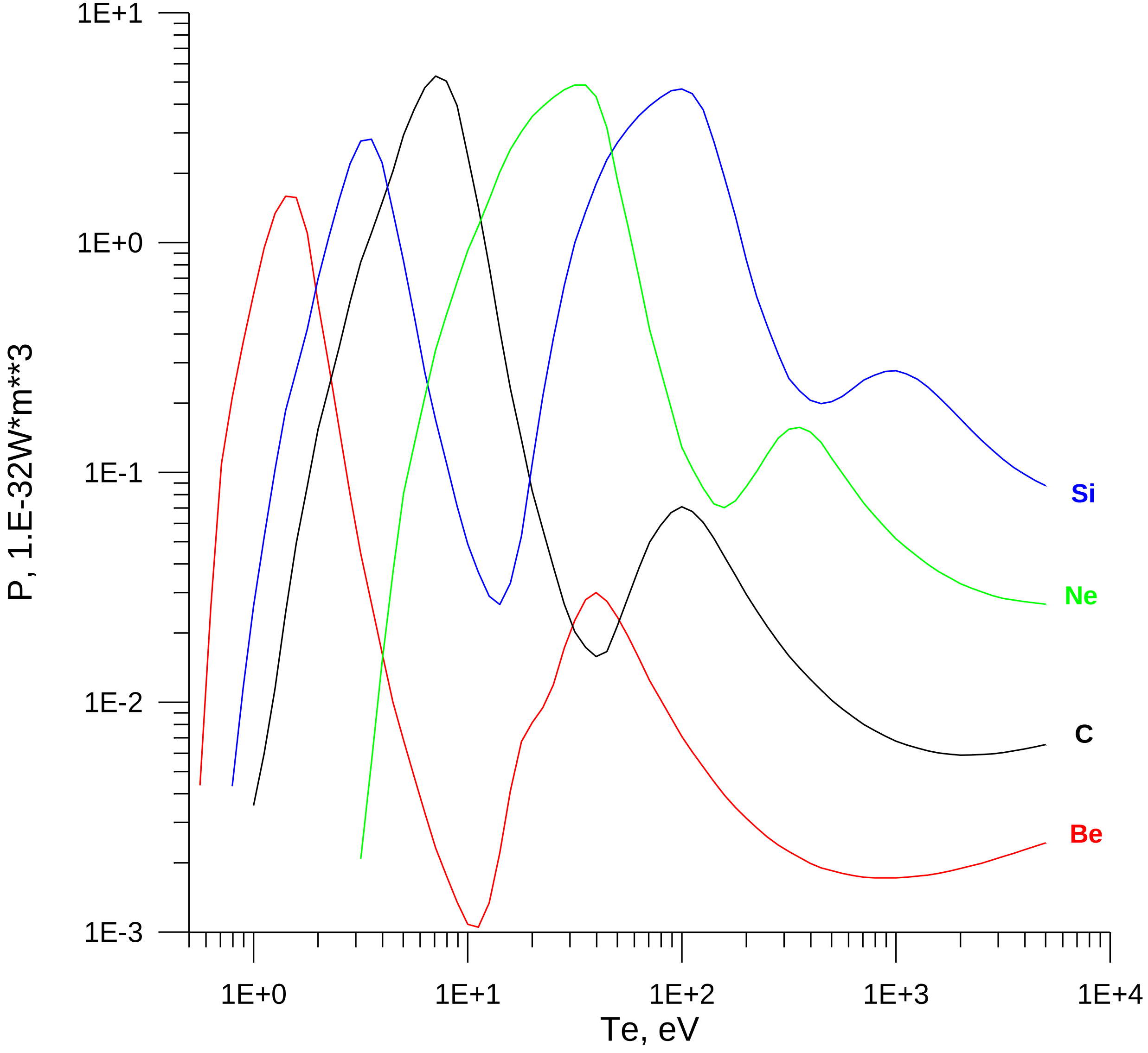
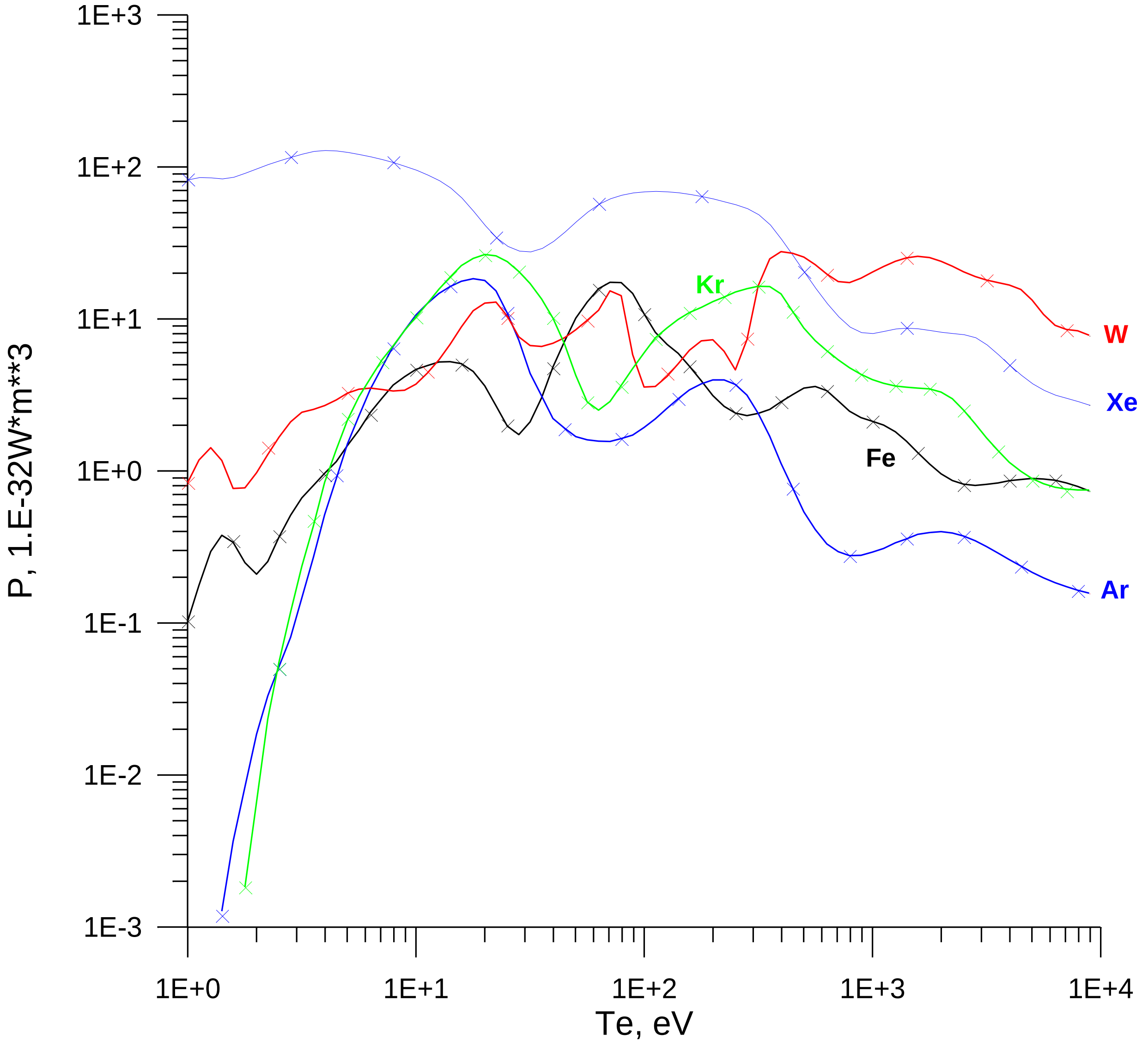
Be or W

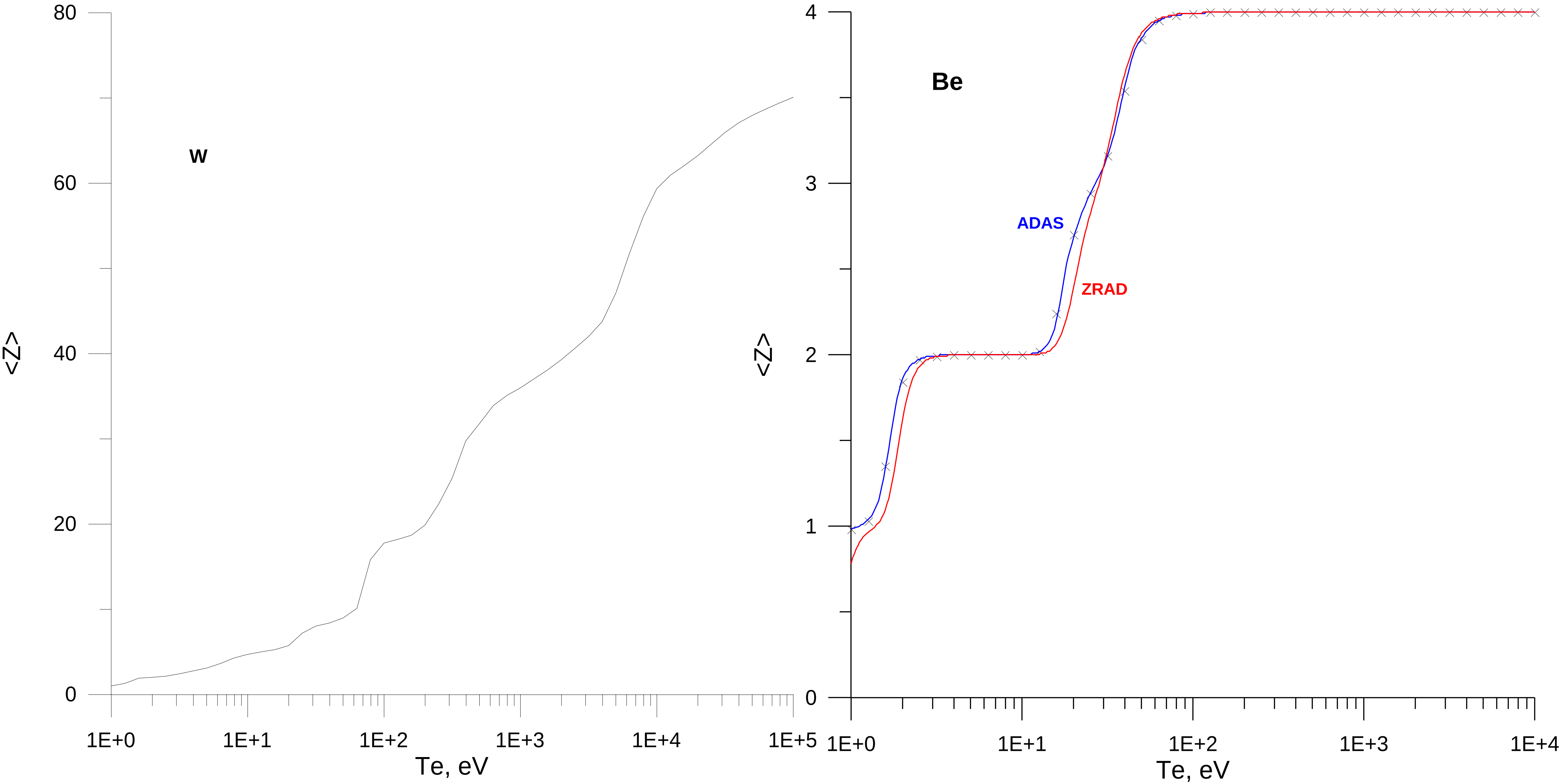
СОЧИ, 21.09.2023



P, 1.E-32W*m**3
1E+1
1E+0
1E-1
1E-2
1E-3
1E+0
1E+1
1E+2
1E+3
1E+4
Te, eV
Si
Ne
C
Be



P, 1.E-32W*m**3
1E+3
1E+2
1E+1
1E+0
1E-1
1E-2
1E-3
1E+0
1E+1
1E+2
1E+3
1E+4
Te, eV
Kr
W
Xe
Fe
Ar


W
Be
ADAS
ZRAD
<Z>
Te, eV
0
20
40
60
80
1
2
3
4
1E+0
1E+1
1E+2
1E+3
1E+4
1E+5

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Erosion, screening, and migration of tungsten in the JET divertor

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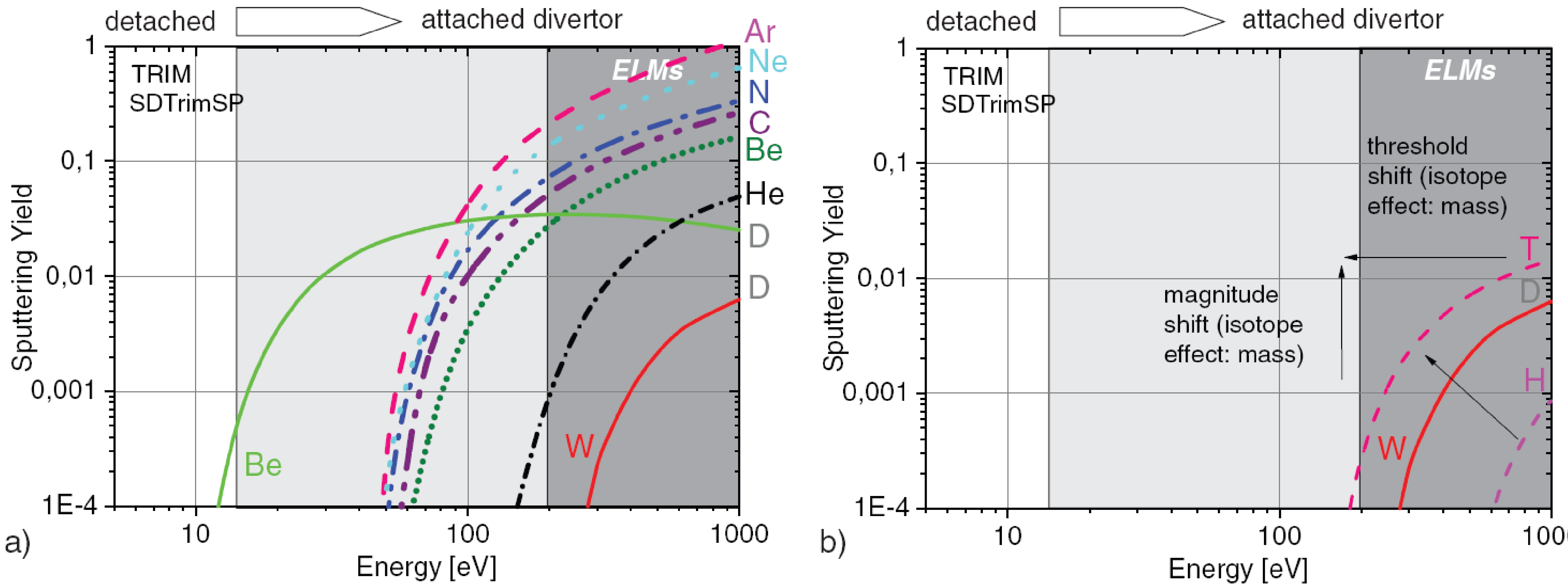

Figure 1. (*a*) The physical sputtering yield of W as function of impact energy for different fusion relevant monoenergetic projectiles. The impact is under normal incidence onto the target surface. (*b*) The corresponding physical sputtering yield of W as function of impact energy for the three hydrogen isotopes.

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PAPER

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Predictive 3D modelling of erosion and deposition in ITER with ERO2.0: from beryllium main wall, tungsten divertor to full-tungsten device

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Mitigation measures

1) SOL width from 15 to 45+ cm. What about permissible distance between In and Out separatrix? Predictions for the W erosion at the top of FW are not available yet

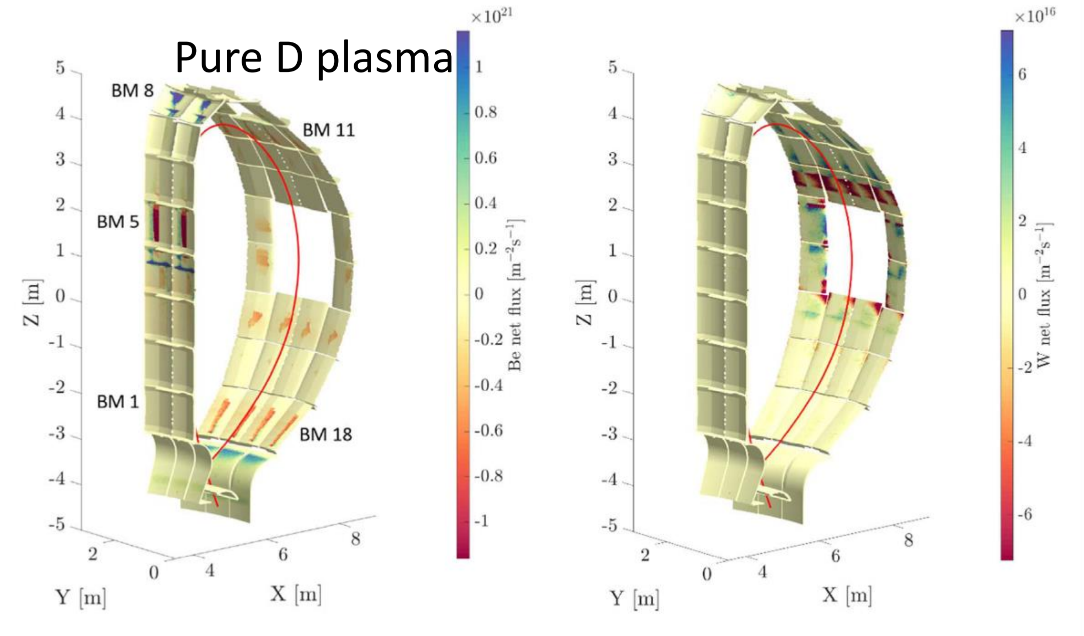

Figure 1. Modelled net deposition of beryllium for ITER with Be main wall (left) and tungsten for ITER with full-W main wall (right) in pure D plasma without seeding species.

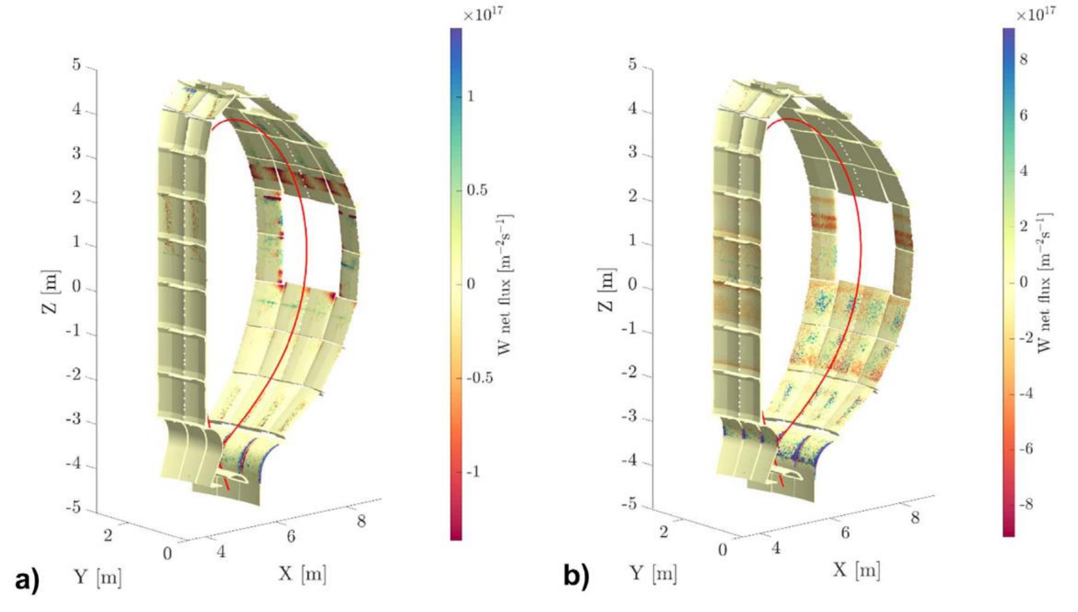

Figure 2. Modelled tungsten net deposition for full-W ITER including 0.2% Ne in the plasma: (a) magnetic configuration with wide Δr_{sep} and (b) modified magnetic configuration with narrow Δr_{sep}. Please note that the colour scale has been chosen to illustrate the main features at the outer wall. Therefore, areas of large net erosion at leading edges in the divertor and smaller net erosion/deposition fluxes e.g. at the top of the machine and the inner wall are not visible anymore.

The W-wall erosion mainly occurs at the outer wall with about 60% due to CX neutrals and 40% due to self-sputtering. About 99% of sputtered W is redeposited on the main wall and 1% flows to the divertor. There is only minor W sputtering in the divertor due to self-sputtering and thus only small tungsten deposition in the divertor. W erosion/deposition rates are a factor **of more than 10,000** those for Be

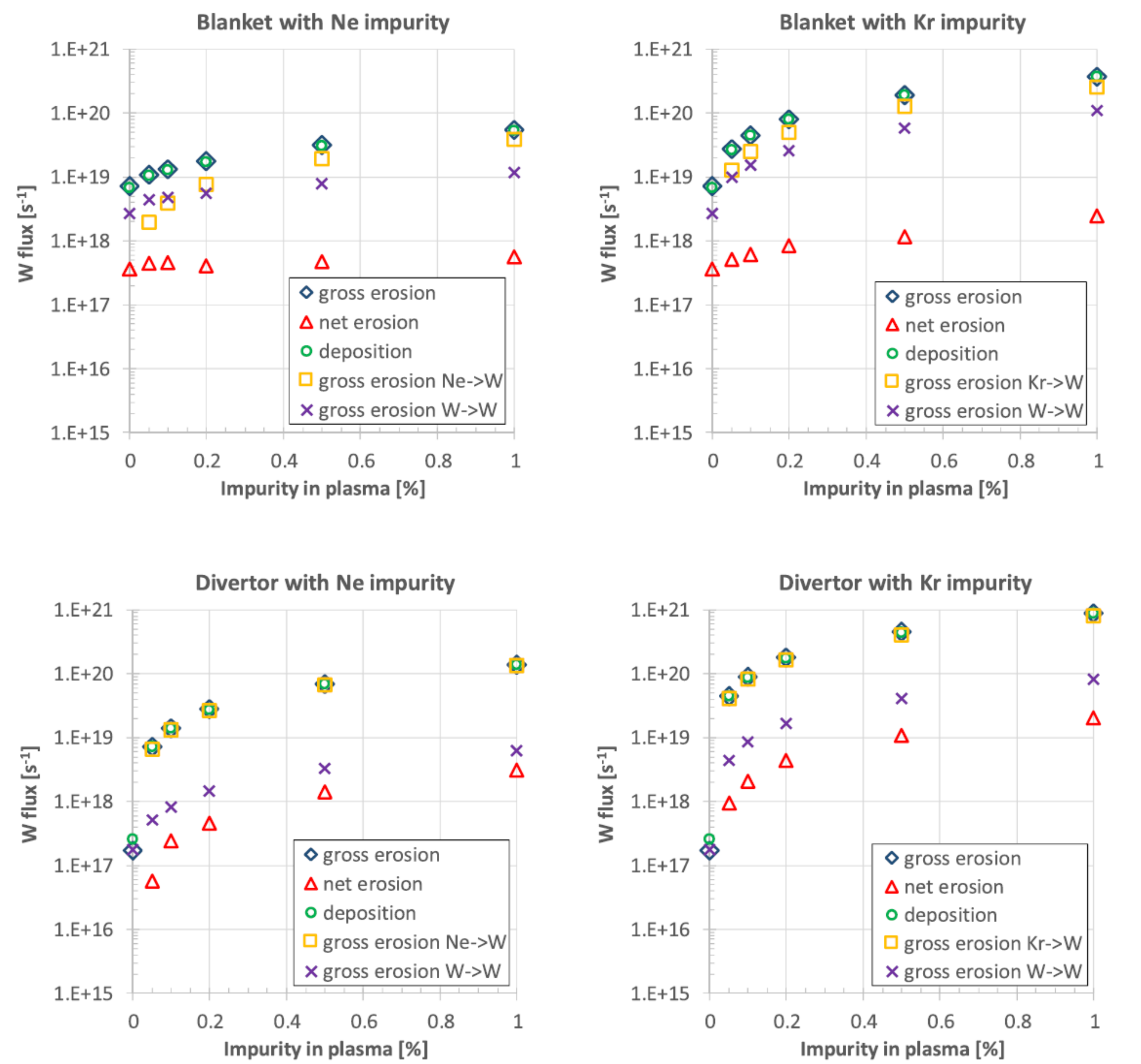

Figure 3. Surface-integrated rates of W gross and net erosion, W deposition and erosion due to the seeded species and self-sputtering. Left part for Ne seeding, right part for Kr seeding. Upper part for the blanket and lower part for the divertor. Please note that the rates of gross erosion and deposition are very close to each other.

- The gross erosion is dominated by the seeded impurities, especially in the divertor.
- The net erosion is between~1%and~5%of the gross erosion at the blanket and between ~0% and~2% in the divertor.
- The majority of not-redeposited W at the blanket panels is lost through the equatorial or through gaps between main wall panels and about1%is transported to the divertor.
- With seeding, increased W erosion appears in the divertor resulting in integrated net erosion. Typically between 97% and 100% of particles eroded in the divertor are also deposited there. The small amount of eroded particles not deposited in the divertor is lost through poloidal gaps,
there is no significant W transport from the divertor to the main chamber.
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1) Эрозия в JET

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Comparison of JET inner wall erosion in the first three ITER-like wall campaigns

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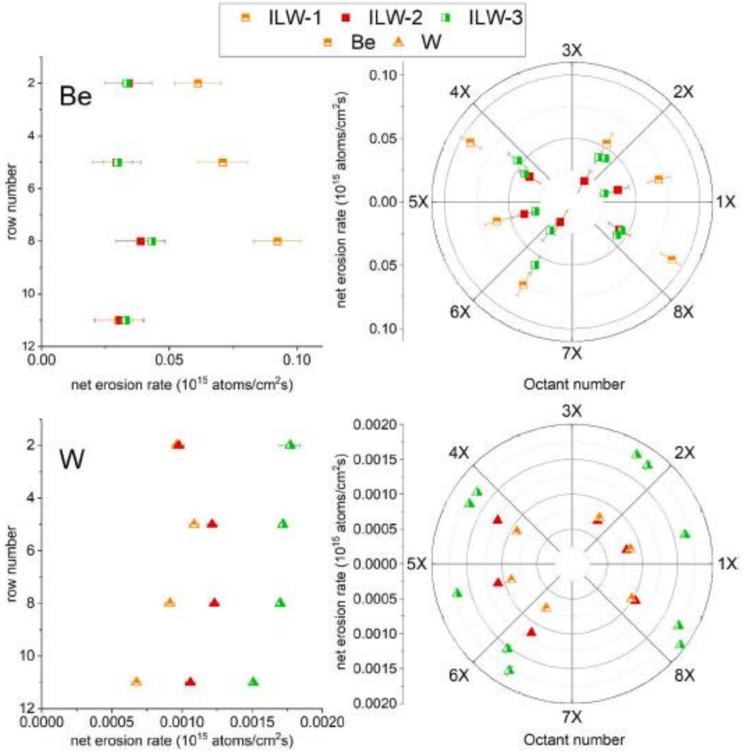

Fig. 2. Measured net erosion in poloidal (on the left, the tile row number is the vertical axis, erosion rate – horizontal axis) and toroidal direction (on the right, number of octant – angular axis, erosion rate – radial coordinate) distributions of Be (upper row, squares) and W (lower row, triangles) in the RAIW region of JET-ILW during ILW-1 (orange horizontally half-filled dots), ILW-2 (red filled dots) and ILW-3 (green, vertically half-filled dots). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Скорость распыления Be не более чем в 50 раз больше чем W

В JET концентрация Be ~ 1%

В ИТЭР фатальная концентрация W ~ 10^{-3}%

Если определяющим является источник со стенки, а переносы сходны, то получим ожидаемую концентрацию W в 20 раз больше фатальной