Comment on "Variational Calculation of the Trapping Rate in Thermal Barriers" (UWFDM-490)

R. Carrera and J.D. Callen

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UWFDM-499

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In section 6 of Ref. 1 the analytic barrier trapping rate (J_t) results of Tables I and II are quoted as being taken from Ref. 2. However, those results are not the ones obtained in Ref. 2 (Figs. 6 and 7). Table I of this note gives in detail the correct results from Ref. 2. The model developed in Ref. 2 for the ion trapping rate in a thermal barrier is consistent with the variables considered to define the thermal barrier there, i.e. R_b, Φ_b, n_b, ν_{cx} and T_p. The total density of barrier particles (either ions or electrons) is physically the basic density that defines the collisional processes in the thermal barrier region and is experimentally measurable. The density n_b thus forms the basis of the analysis in Ref. 2 (where it is assumed to be known from quasineutrality). Therefore, when comparing the model of Ref. 2 with numerical studies one should consider thermal barriers of equal collisionality (same ν_s^b or n_b) and it is not consistent with that model to compare thermal barriers of equal ion barrier passing density n_{bp}, as suggested in Ref. 1. Also, in section 6 of Ref. 1 an argument is made about the sensitivity to using either of two expressions for j_t as a function of g when comparing with numerical results. That argument is not relevant to Ref. 2 since there the ion trapping rate is obtained directly from its definition $j_t \equiv \int d^3vC(f) = \nu_{cx}n_{bt}$ and the model gives $n_{bt} = n_b/[1 + (\lambda_{cx}^*/\lambda_{cx})^{1/2}]$, with these expressions depending only on the basic variables defining the thermal barrier model.

Table I

(a) $R_b = 20.$, $\Phi_b = 1.$ keV

Case*	n_b (10^{12} cm^{-3})	T_p (keV)	ν_s^b (10^3 sec^{-1})	ν_{cx} (10^3 sec^{-1})	$\lambda_{cx}^{*1/2}$	$\lambda_{cx}^{1/2}$	j_t^{**} (10^{15}/cm^3 sec)	$j_{t_3}^{*}$ (10^{15}/cm^3 sec)
1	4.24	1/3	0.705	2.	.208	.594	6.28	6.70
2	2.58	1/3	0.435	4.	.208	.330	6.34	6.76
3	1.89	1/3	0.321	8.	.208	.200	7.41	8.0
4	4.45	0.2	1.583	4.	.236	.629	12.94	14.2
5	2.26	0.4	0.291	4.	.199	.270	5.21	5.48
6	1.98	0.5	0.184	4.	.188	.214	4.22	4.36
7	8.33	1/3	1.361	4.	.208	.583	24.55	26.2
8	1.36	0.2	0.499	4.	.236	.353	3.26	3.66
9	6.74	0.4	0.844	4.	.199	.459	18.81	19.8
10	0.865	0.4	0.114	4.	.199	.169	1.59	1.68
11	5.52	0.5	0.498	4.	.188	.353	14.41	15.0

(b) $R_b = 2.$, $\Phi_b = 40.$ keV

Case*	n_b (10^{11} cm^{-3})	T_p (keV)	ν_s^b (sec^{-1})	ν_{cx} (sec^{-1})	$\lambda_{cx}^{*1/2}$	$\lambda_{cx}^{1/2}$	j_t^{**} (10^{11}/cm^3 sec)	$j_{t_3}^{*}$ (10^{11}/cm^3 sec)
1	3.8	15.	0.260	0.25	.639	1.020	0.59	0.675
2	2.54	15.	0.175	0.5	.639	0.592	0.61	0.720
3	1.98	15.	0.137	1.	.639	0.370	0.73	0.880
4	1.63	15.	0.114	2.	.639	0.239	0.88	1.06
5	1.28	15.	0.090	0.25	.639	0.600	0.16	0.183
6	3.98	10.	0.498	0.5	.707	0.998	1.16	1.44
7	2.71	10.	0.342	1.	.707	0.585	1.23	1.61
8	2.09	10.	0.266	2.	.707	0.365	1.43	1.98
9	2.01	10.	0.255	0.25	.707	1.010	0.30	0.365
10	5.39	10.	0.671	2.	.707	0.579	4.86	6.38
11	14.68	5.	5.011	0.25	.841	4.477	3.09	3.53

* Taken from: L. LoDestro, "Steady-State Ion Distributions in a Potential and Magnetic Well," Lawrence Livermore National Laboratory Report, UCAR-10060-80-2 (1980).

** Taken from Ref. 2.

References

1. X.Z. Li and G.A. Emmert, UWFDM-490 (1982).

2. R. Carrera and J.D. Callen, UWFDM-466 (1982); also Nuclear Fusion 23, 433 (1983).