Recap TB 2020-07 HOTNES

05/02/2021 – uRANIA
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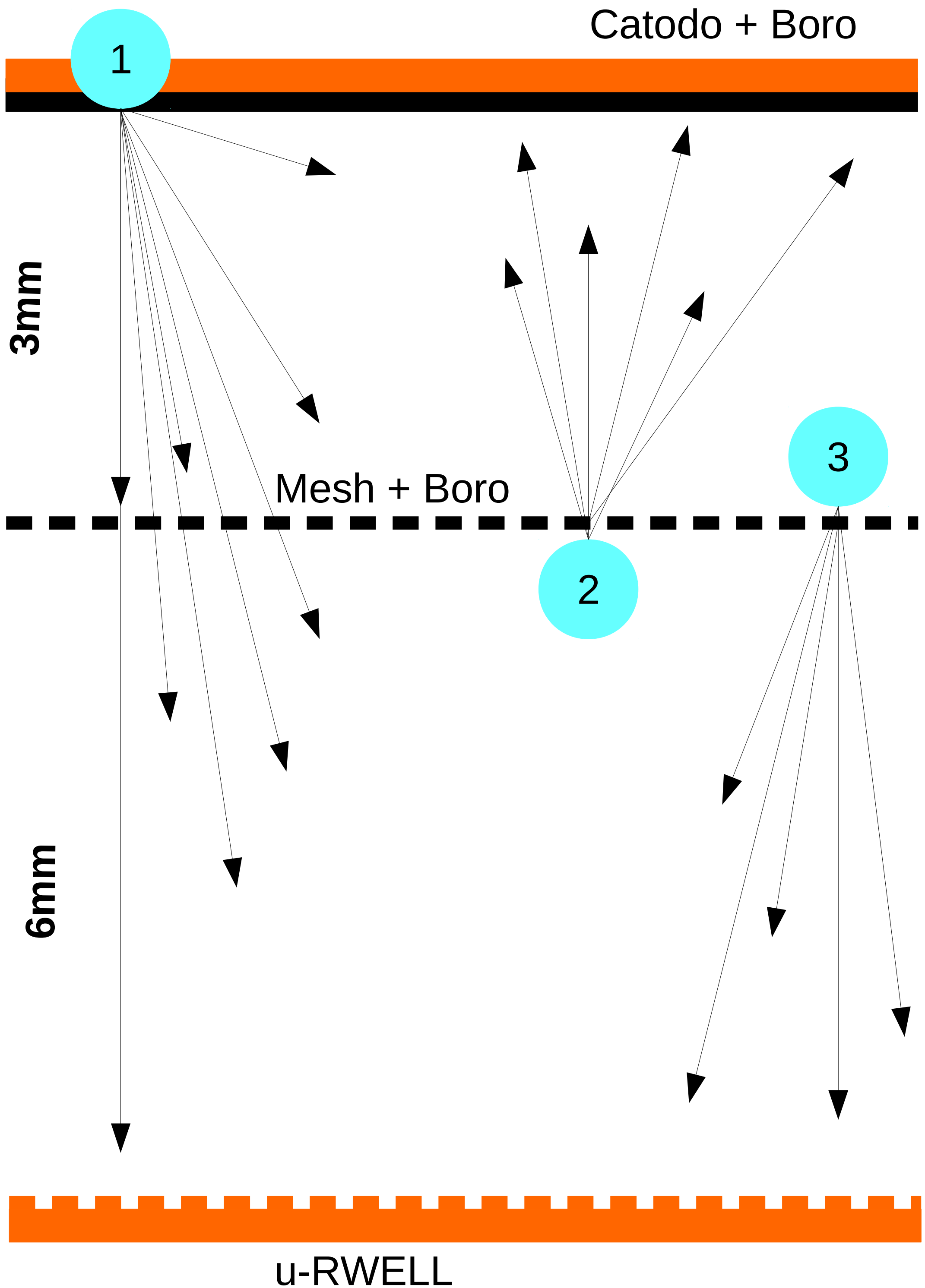


1

Alpha/litio prodotti da neutroni convertiti sul catodo: vanno verso il basso. **Solo alcuni di loro riescono a ionizzare l'area oltre la mesh**, perché la mesh ha una trasparenza gemetrica e quindi alcuni alpha/litio sbattono sulla mesh e vengono fermati.
La ionizzazione prodotta prima della mesh va riscalata per la trasparenza elettronica, quella prodotta dopo no. **(Esistono quindi tracce che hanno la parte iniziale riscalata e quella finale no)**

2

Alpha/litio prodotti da neutroni convertiti sulla mesh, che vanno verso l'alto. La ionizzazione prodotta va riscalata per la trasparenza elettronica della mesh.

3

Alpha/litio prodotti da neutroni convertiti sulla mesh, che vanno verso il basso.

1 Cathode case

The case of the detector without mesh and with the boron cathode it's the easier between the two. Starting[1] from $i = eRG\tilde{N}$ we must expand the $\tilde{N}$ therm: $\tilde{N} = \epsilon_{\alpha}^{C} N_{\alpha} + \epsilon_{Li}^{C} N_{Li}$. The ϵ therms stands for the number of α and Li entering the gas (it's a fusion between the production term and their survival through the $^{10}B_4C$) and the N terms are their mean ionization in 3mm of gas.

The efficiency of the detector thus is $\epsilon = \epsilon_{\alpha}^{C} + \epsilon_{Li}^{C}$.

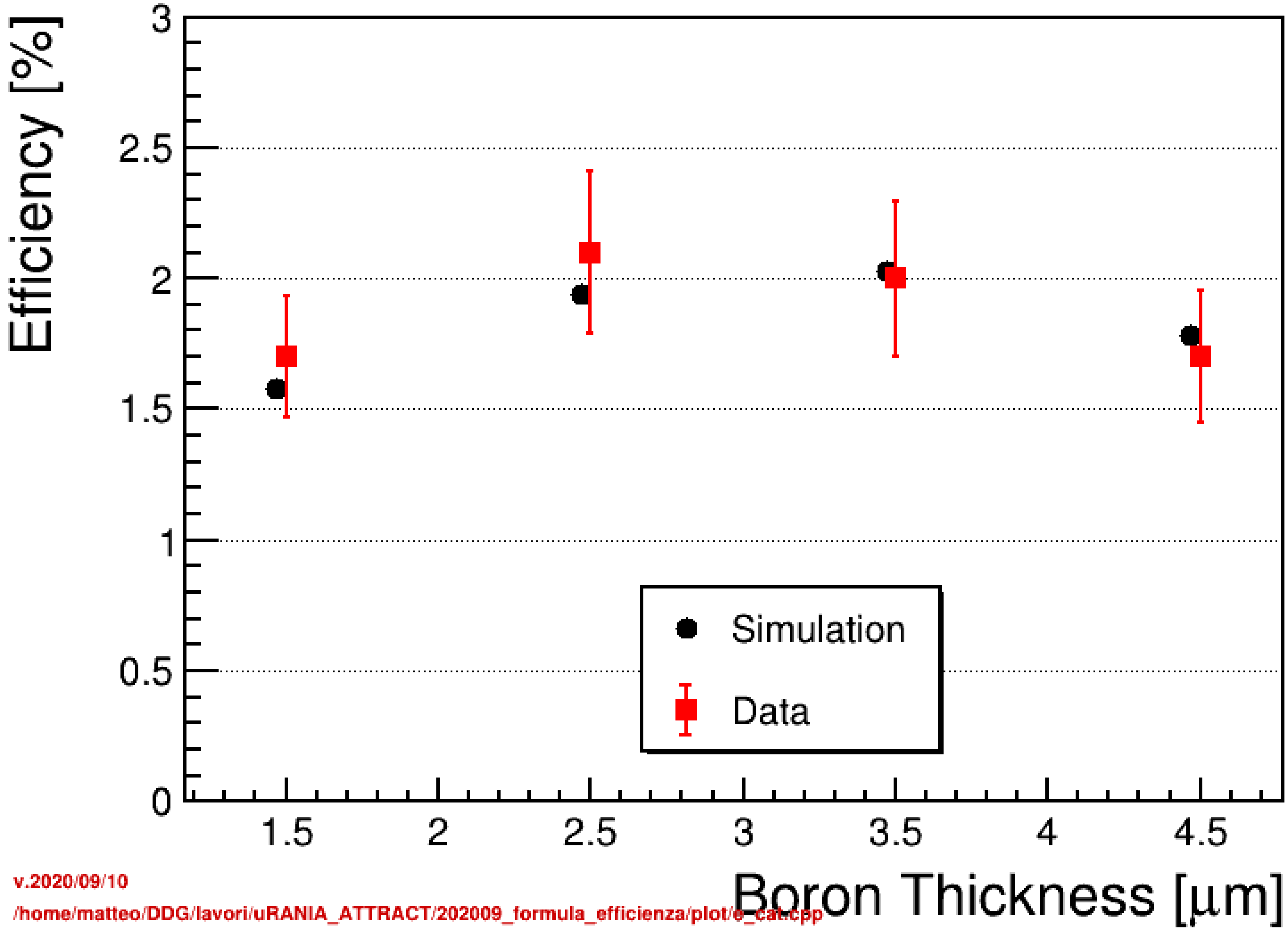
A possible strategy is to use the simulation to fix the ratio between α and Li entering the gas (defined K^C) and then extract only one ϵ therm from $\tilde{N}$.

$$\begin{cases} \tilde{N} = \epsilon_{\alpha}^{C} N_{\alpha} + \epsilon_{Li}^{C} N_{Li} \quad \text{with } N_{\alpha} \text{ and } N_{Li} \text{ from the simulation,} \\ \epsilon_{\alpha}^{C} / \epsilon_{Li}^{C} = K^C \\ \epsilon_{Li}^{C} = \tilde{N} / (N_{Li} + K^C N_{\alpha}) \end{cases}$$

K from simulation

This allows us to find the total efficiency ϵ:

$$\epsilon = \epsilon_{\alpha}^{C} + \epsilon_{Li}^{C} = (1 + K^C)\epsilon_{Li}^{C} = (1+K^C)\tilde{N} / (N_{Li} + K^C N_{\alpha}),$$



ROSSO: efficienza dai dati secondo il procedimento precedente
NERO: somma delle efficienze per ogni ione, dalla simulazione

2 Cathode + Mesh case

Here the game became tricky due to the large number of parameters involved. Starting from $i = eRG\tilde{N}$ we must expand the $\tilde{N}$ therm:

$$\tilde{N} = \tau(\epsilon_{\alpha}^{C} N_{\alpha} + \epsilon_{Li}^{C} N_{Li}) + \tau(\epsilon_{\alpha}^{M} N_{\alpha} + \epsilon_{Li}^{M} N_{Li}) + \epsilon_{\alpha}^{M} N_{\alpha} + \epsilon_{Li}^{M} N_{Li},$$

with τ the simulated electronical transparency of the mesh, and the superscript C or M identifying cathode and mesh. We are using the following assumptions:

$\epsilon^{MB} \approx \epsilon^{MF} \doteq \epsilon^{M}$ the ions produced backward and frontward should have the same behaviour (quantity and energy spectrum). From the preliminary simulation in my possess it seems that there is a 10% disagreement between the producted ions backward and frontward and i don't know why. For the sake of this section I will assume this contributions the same but we must investigate.

$N^{C} \approx N^{M} \doteq N$ it could be possible that the different shape of the deposition between cathod and mesh could generate ions with different kinetic energy spectrum, with thus a slightly different mean ionization. At the moment I will assume this contributions the same.

The efficiency of the detector thus is $\epsilon = \epsilon_{\alpha}^{C} + \epsilon_{Li}^{C} + 2\epsilon_{\alpha}^{M} + 2\epsilon_{Li}^{M}$.

With the same strategy used before, the simulation fixes some ratios between α and Li entering the gas and then extract only one ϵ therm from $\tilde{N}$:

With the same strategy used before, the simulation fixes some ratios between α and Li entering the gas and then extract only one ϵ therm from $\tilde{N}$:

$$\begin{cases} \tilde{N} & = \tau(\epsilon^C_\alpha N_\alpha + \epsilon^C_{Li} N_{Li}) + \tau(\epsilon^M_\alpha N_\alpha + \epsilon^M_{Li} N_{Li}) + \epsilon^M_\alpha N_\alpha + \epsilon^M_{Li} N_{Li} \\ \epsilon^C_\alpha / \epsilon^C_{Li} & = K^C \\ \epsilon^M_\alpha / \epsilon^M_{Li} & = K^M \\ \epsilon^C_{Li} / \epsilon^M_{Li} & = K^{Li} \\ \epsilon^M_{Li} & = \tilde{N} / [\ [K^M + \tau(K^{Li} K^C + K^M)] N_\alpha + [1 + \tau(K^{Li} + 1)] N_{Li}\ ] \end{cases}$$

with N_α, N_{Li}, K^C, K^M and K^{li} from the simulation. This allows us to find the total efficiency ϵ:

$$\begin{aligned} \epsilon = & \quad \epsilon^C_\alpha + \epsilon^C_{Li} + 2\epsilon^M_\alpha + 2\epsilon^M_{Li} = (K^{Li} K^C + K^{Li} + 2K^M + 2)\epsilon^M_{Li} \\ = & \quad (\color{red}{K^{Li} K^C} + \color{red}{K^{Li}} + 2\color{red}{K^M} + 2)\tilde{N} / [\ [\color{red}{K^M} + \color{red}{\tau}(\color{red}{K^{Li} K^C} + \color{red}{K^M})]\color{red}{N_\alpha} + [1 + \color{red}{\tau}(\color{red}{K^{Li}} + 1)]\color{red}{N_{Li}}\ ] \end{aligned}$$

with parameters from the simulation in red.

Dati e analisi preliminare:

Una volta sviluppata l’algebra basta excel per fare I calcoli.

Al momento mancano alcuni valori per la trasparenza elettronica.

NEED!

e^- transp.	$\downarrow$: $\vec{E}$ fields
Al 33%	Up=0.00 DW=2.7
Al 33%	Up=0.10 DW=2.7
Al 33%	Up=0.10 DW=4.0
Cu 60%	Up=0.20 DW=2.7

flux	758	16	Na (>3mm)	28000
spot (cm^2)	100	2	NLi (>3mm)	14000
RATE	75800	2204		
Catod_absorb	0	0.01		
new RATE	75800	2204		
q(e)	1.60E-019			

													Alpha				Li					EXP-SIM	Eff (%)	
WELL	CAT B	MESH B	Type	Ed	Et	G	dG	modG	iRes (nA)	Ntilde	dN	trasp	eCat	eMB	eMF	Nt_a	eCat	eMB	eMF	Nt_li	Ntilde	in sigma	SIM	EXP
W3	2.5					700	105	1	4.1	482	75	1	0.0122			341	0.0053			75	415	0.9	1.8	2.0 ± 0.3
W9	2.5	NO	Cu 66	0.2	2.7	420	63	1	1.5	294	49	0.7	0.0122			239	0.0053			52	291	0.1	1.8	1.8 ± 0.3
W5	NO	2.5	Al 33	0.1	2.7	420	63	1	2.4	471	75	0.7		0.0099	0.0089	443		0.0046	0.004	101	544	-1.0	2.7	2.4 ± 0.4
W5_2	2.5	2.5	Al 33	0	2.7	420	63	1	1.4	274	46	0.7	0.0122	0.0099	0.0089	681	0.0053	0.0046	0.004	153	834	-12.1	4.5	1.5 ± 0.2
W9	2.5	3.5	Al 33	0.1	4	420	63	1	2.3	451	72	0.7	0.0122	0.0101	0.0084	672	0.0053	0.0045	0.0038	149	821	-5.2	4.4	2.4 ± 0.4
W1	2.5	1.5	Al 33	0.1	4	420	63	1	1.1	216	38	0.7	0.0122	0.0082	0.008	622	0.0053	0.0045	0.0043	157	779	-14.7	4.2	1.2 ± 0.2
												!!!!!!