

*Ciemat*

# PDS BG validation

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Low Energy Meeting

17/04/24

# Generation problems

*dunesw v09\_85\_00d00*

- > 50% of jobs are now failing on CERN clusters with the mysterious error message:

```
terminate called after throwing an instance of 'boost::filesystem::filesystem_error'  
  what(): boost::filesystem::copy_file: No such file or directory [system:2]: "./TFileService-a915-  
51de-c471-f196.root", "prodradiological_hist.root"
```

- No one (including CERN support) seems to know what's going on, but it seems to be related to how the "temp files are stored).
- An additional ~10% of jobs fail silently and output empty trees. Still figuring out this part, for now my solution is to just purge the empty trees at the end.
- FlashMatcher in VD is broken and runs out of memory. You have to turn it off by hand.

Extra comment: We should really be consistent with channel naming! (i.e. CavernwallGammasAtLAr vs CavernwallGammasAtLAr1x8x14)

# Backgrounds - VD (before)

Average hit rate at the cathode vs. wall X-ARAPUCAS.  
Rate in **Hz/ARAPUCA (two channels per ARAPUCA)**.  
**Three main backgrounds are  $^{39}\text{Ar}$ ,  $^{232}\text{Th}$  and  $^{85}\text{Kr}$ .**

Please see:  
<https://indico.fnal.gov/event/62250/contributions/279953/attachments/173121/234216/backgrounds%20nov23.pdf> for details on the BG sources.

All ARAPUCAS.  
50\*20 BG events.  
VD 1x8x14  
*dunesw v09\_82\_02d01*

	Total	Cathode	Wall
$^{39}\text{Ar}$ in LAr	3934	3635	4400
$^{232}\text{Th}$ chain in cathode	997	1582	87
$^{85}\text{Kr}$ in LAr	450	410	513
$^{238}\text{U}$ chain in cathode	297	472	25
$^{222}\text{Rn}$ chain from $^{214}\text{Bi}$ in cathode mesh	243	383	26
Foam gammas at LAr	236	61	507
$^{222}\text{Rn}$ chain from $^{210}\text{Bi}$ in cathode mesh	205	324	18
$^{222}\text{Rn}$ chain $^{218}\text{Po}$ in LAr	166	173	154
$^{222}\text{Rn}$ chain $^{222}\text{Rn}$ in LAr	154	158	148

# Backgrounds - VD (before)

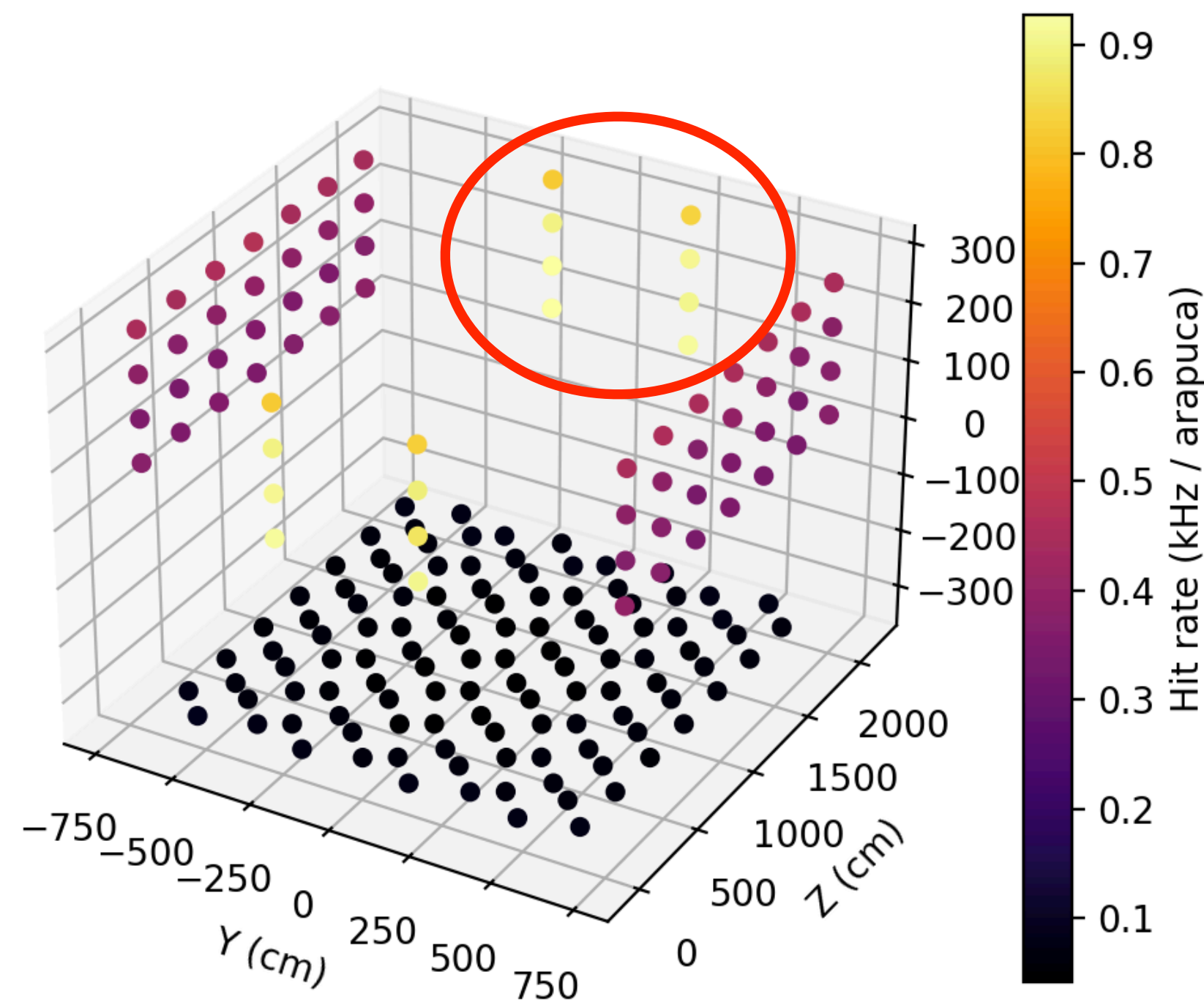
All ARAPUCAS.

50\*20 BG windows.

VD 1x8x14

*dunesw v09\_82\_02d01*

We found some strange hit distribution in the cavern and foam gammas...



Foam gammas

```
X0: [ -420. , -420. , -420., -420. , 349.5 ] # in cm in world coordinates, low x-values of planes
X1: [ 350. , 350. , 350., 350. , 350.5 ] # in cm in world coordinates, high x-values of planes
Y0: [ -750. , -750. , -751., 750. , -750. ] # in cm in world coordinates, low y-values of planes
Y1: [ 750. , 750. , -750., 751. , 750. ] # in cm in world coordinates, high y-values of planes
[...]
dunevd10kt_1x8x14_gammas_from_cavernwall_atLAr.Z0: [ -78.5, 2173.5, -78., -78. , -78. ] # in cm in world coordinates, low z-values of planes for VD 1x8x14 -JReichenbacher (10/13/2023)
dunevd10kt_1x8x14_gammas_from_cavernwall_atLAr.Z1: [ -77.5, 2174.5, 2174., 2174. , 2174. ] # in cm in world coordinates, high z-values of planes for VD 1x8x14 -JReichenbacher (10/13/2023)
```

ARAPUCAS are at Z=-96.5 cm and Z=2191.6 cm

- **Short wall** gammas were being generated **in front of the ARAPUCAS**, while long wall gammas are being generated behind.
- Leading to a much higher hit rate in the short wall ARAPUCAS.

# Backgrounds - VD

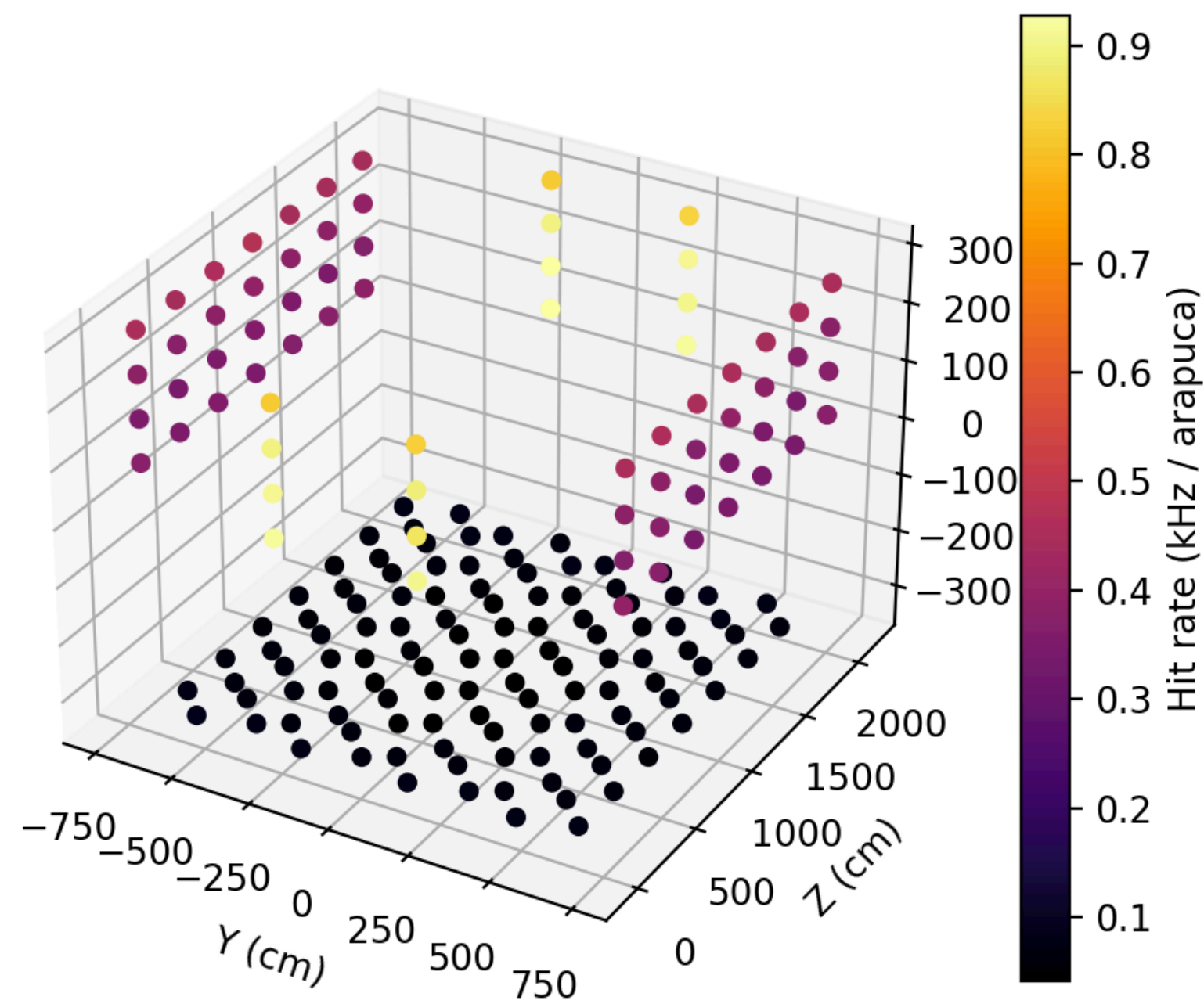
Comparison of new fhicls provided by Juergen moving the gamma generation plains vs. previous backgrounds.

All ARAPUCAS.

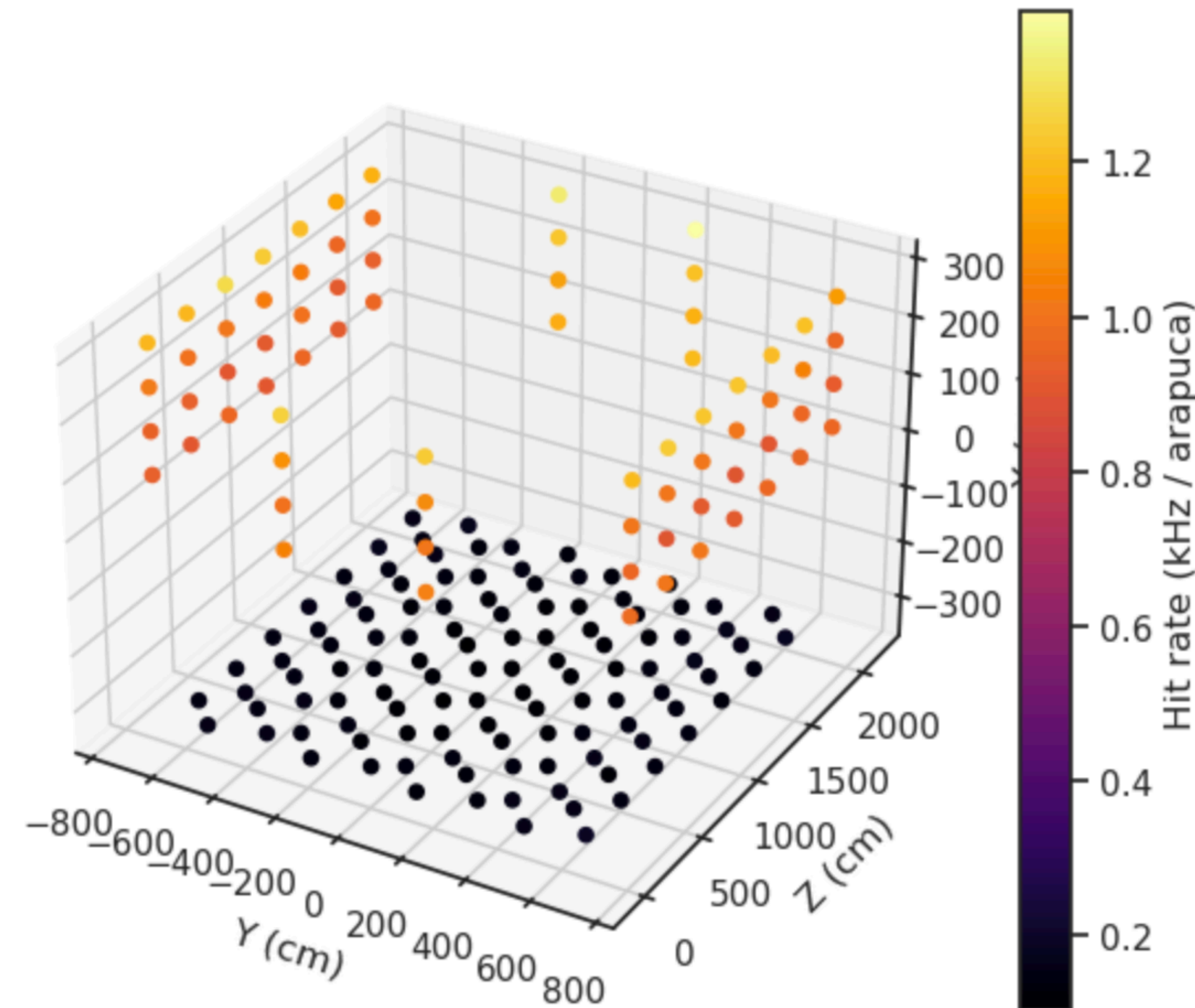
15\*20 BG windows.

VD 1x8x14

*dunesw v09\_85\_00d00*



Foam gammas at LAr (Old)



Foam gammas at LAr (New)

- New hit distribution of foam gammas after plane relocation check's out... except rates at the top of the short walls. Why are they now higher?
- **Rate for foam gammas** is ~2x than before, and is ~x3/x6 times higher per cm<sup>2</sup> than HD foam gammas (for the new fhicls).

Before (Hz/ARAPUCA)	Before (Hz/cm <sup>2</sup> )	Now (Hz/ARAPUCA)	Now (Hz/cm <sup>2</sup> )
236	0.677	479	0.138

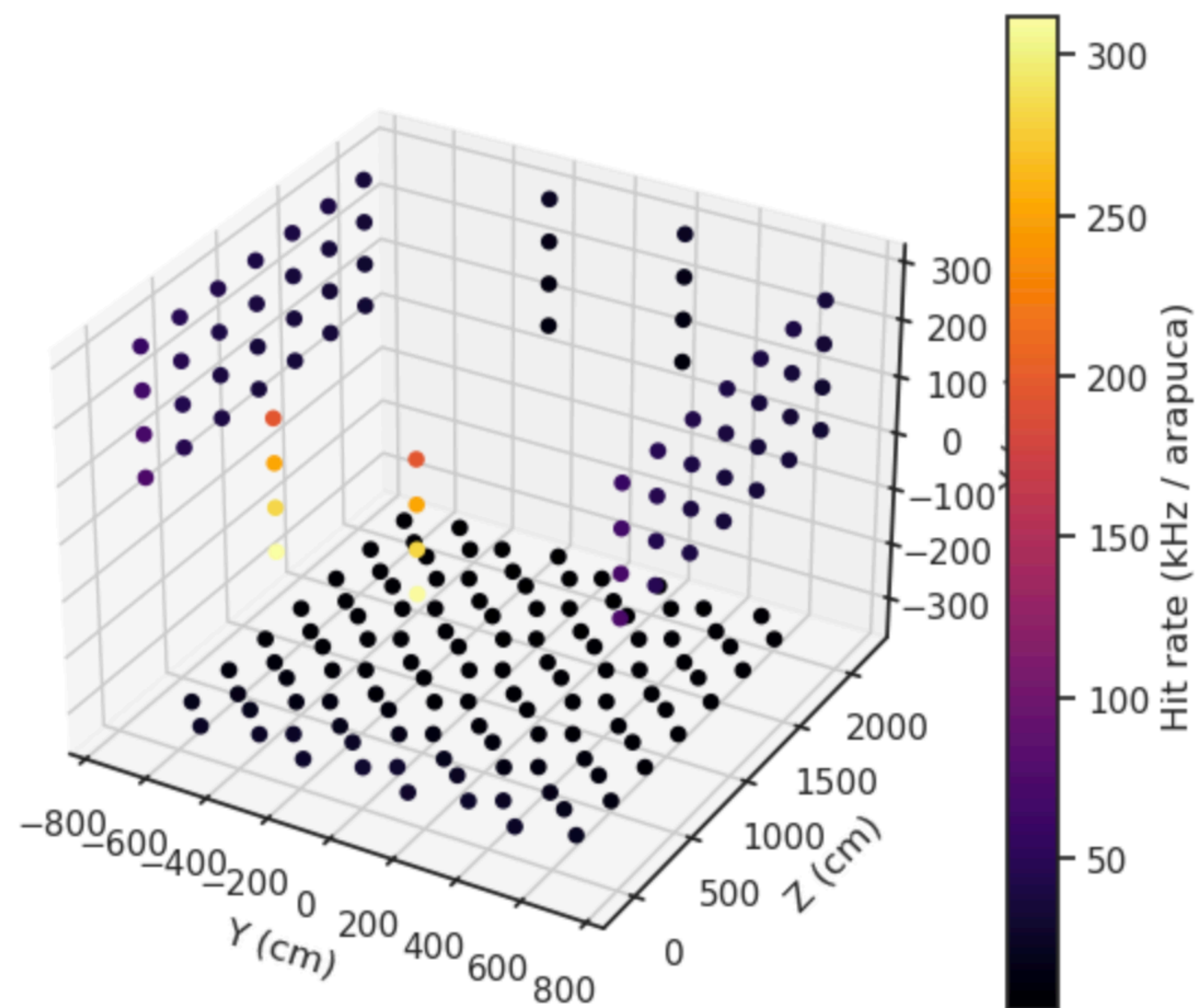
# Backgrounds - VD

All ARAPUCAS.

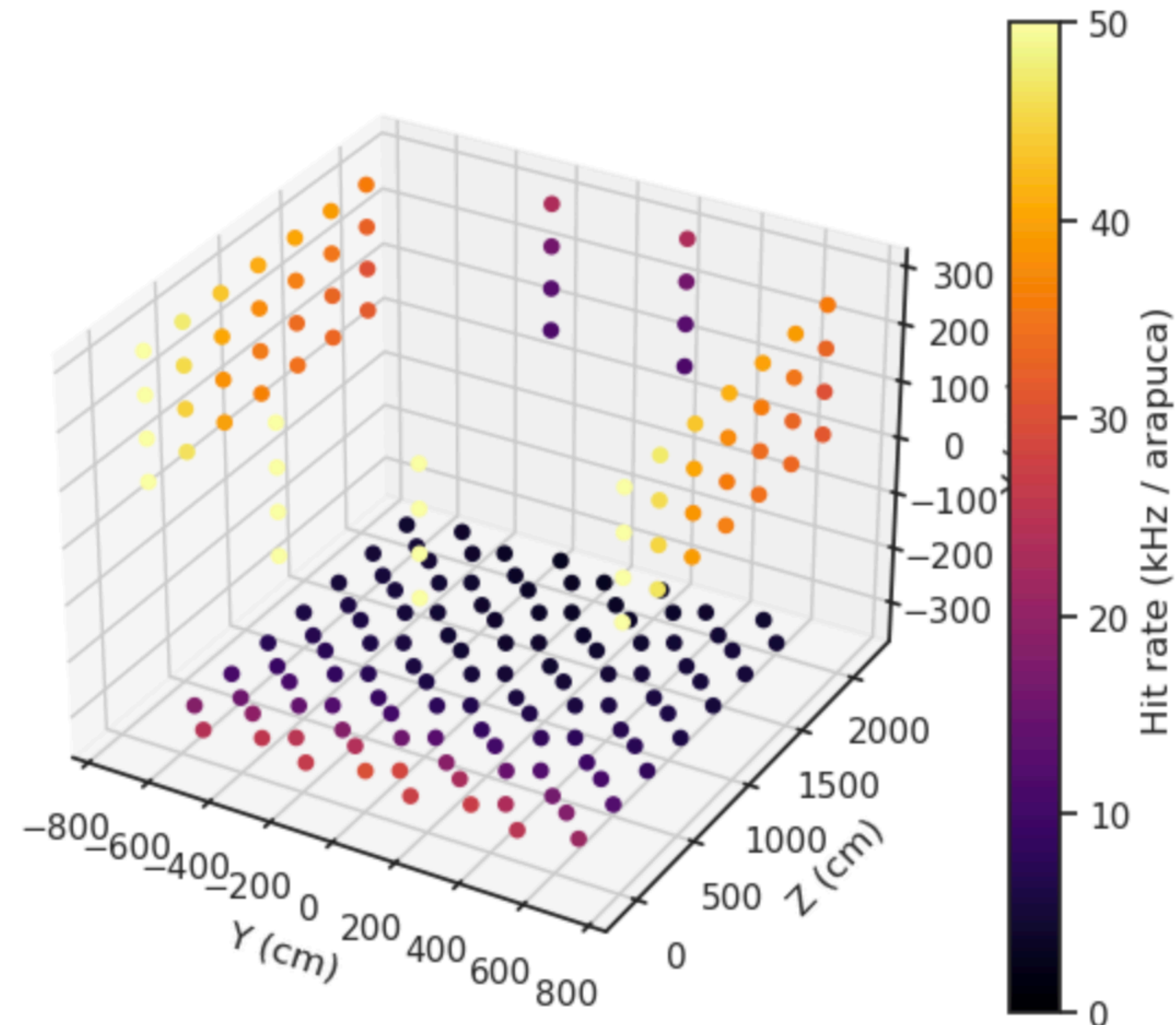
15\*20 BG windows.

VD 1x8x14

*dunesw v09\_85\_00d00*



Cavern wall gammas (New)



Cavern wall gammas (New)  
(capped at 50 kHz)

- No rate comparison is available vs. previous VD cavern wall gammas as I found an unexpectedly low rate ( $> 10$  Hz).
- **Rate for cavern wall gammas** is very high, especially in one of the short walls.

BqPercc: [ 4.65254, 0.147498, 1.05104, 1.05104, 1.05104 ]

Now (Hz/ARAPUCA)	Now (Hz/cm <sup>2</sup> )
30420	8.45

The relative hit rates make sense compared to the activities in the fhicl.

# Backgrounds - HD (before)

We found unexpectedly high gamma rates.

All ARAPUCAS.

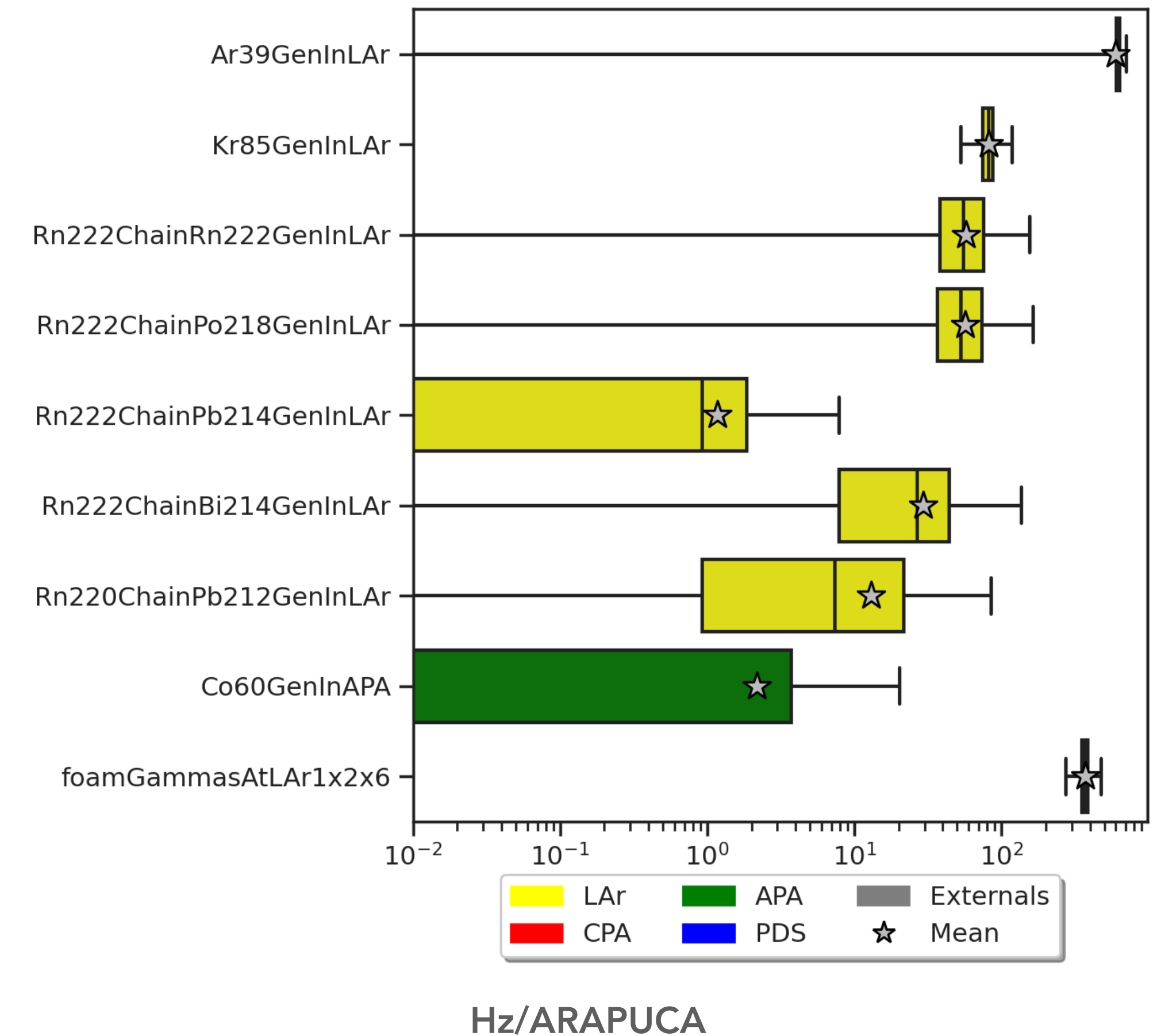
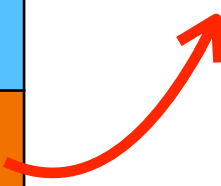
50\*20 BG windows.

HD 1x2x6

*dunesw v09\_82\_02d01*

	Total (Hz/ARAPUCA)	Total (Hz/cm <sup>2</sup> )
<b>Cavern wall gammas</b>	9223	18.6
<sup>39</sup> Ar in LAr	597	1.193
<b>Foam gammas</b>	371	0.742
<sup>85</sup> Kr in LAr	82	0.163
<sup>222</sup> Rn chain <sup>222</sup> Rn in LAr	58	0.115
<sup>222</sup> Rn chain <sup>218</sup> Po in LAr	57	0.113
<sup>222</sup> Rn chain <sup>214</sup> Bi in LAr	29	0.058
<sup>222</sup> Rn chain <sup>212</sup> Pb in LAr	13	0.026
<sup>60</sup> Co in APA	2.2	0.004

???



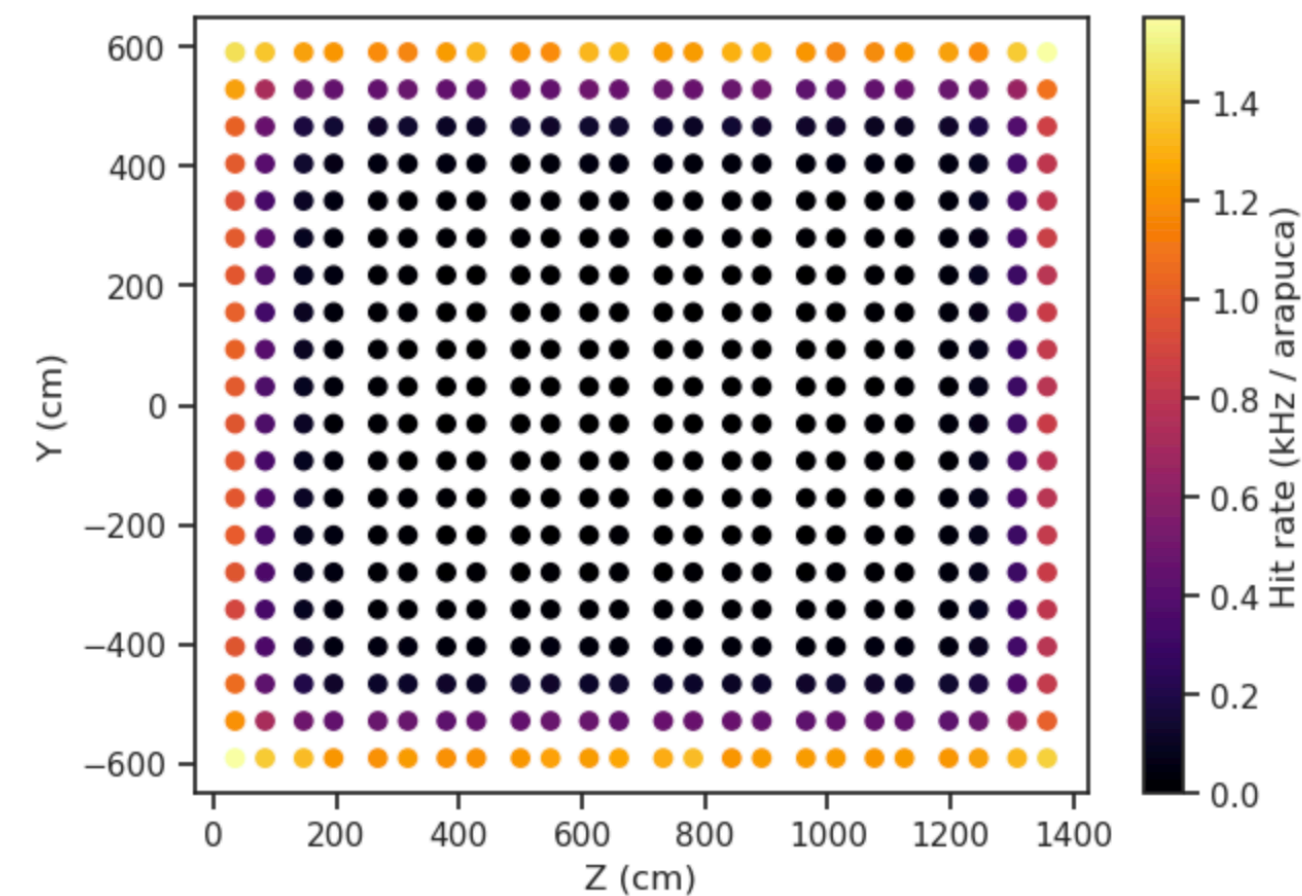
# Backgrounds - HD

Comparison of new fhicls provided by Juergen (with attenuated and reduced APA backgrounds) vs. previous backgrounds.

All ARAPUCAS.  
 15\*20 BG windows.  
 HD 1x2x6  
*dunesw v09\_85\_00d00*

**New reduced**

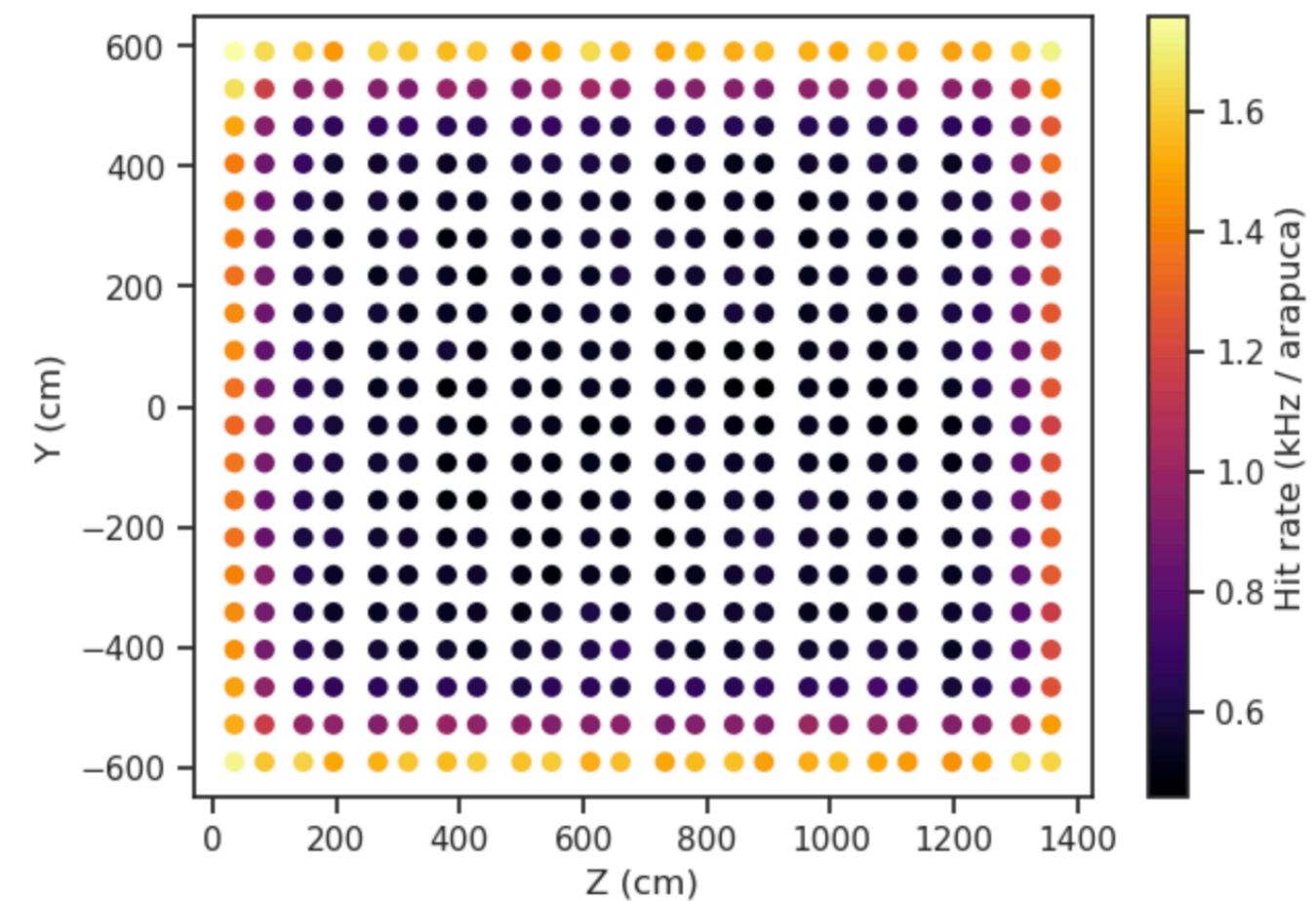
	Total (Hz/ ARAPUCA)	Total (Hz/cm <sup>2</sup> )
<b>Cavern wall gammas</b>	288	0.576
<b>Foam gammas</b>	11	0.022



Cavern wall gammas

**New attenuated**

	Total (Hz/ ARAPUCA)	Total (Hz/cm <sup>2</sup> )
<b>Cavern wall gammas</b>	780	1.560
<b>Foam gammas</b>	26	0.053

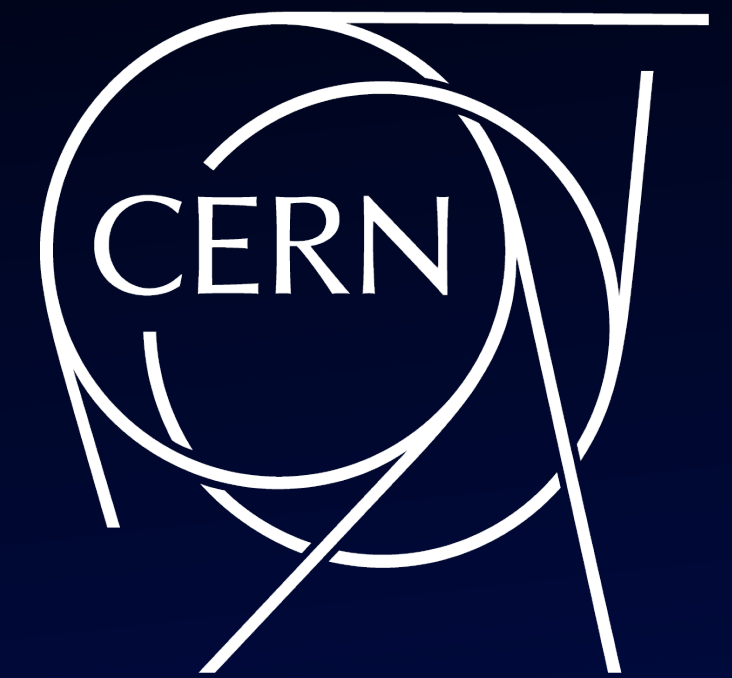


Cavern wall gammas



# Conclusions

- Validated background components of HD and VD except external gammas.
- **VD.** Gamma planes are now well placed. Need to resolve:
  - Why the overall rate is so much higher than before.
  - The effect of rising the activity in one of the short planes seems to be much stronger than intended (Clara, please comment).
- **HD.** Validated both configurations (reduced and attenuated APA backgrounds) for cavern gammas and foam gammas.



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