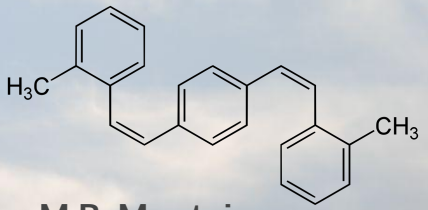
Performance of bis-MSB wavelength shifters in He-40%CF_4



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CYGNO Experiment

Topics:

- Experimental setup
- Charge readout
- Optical readout

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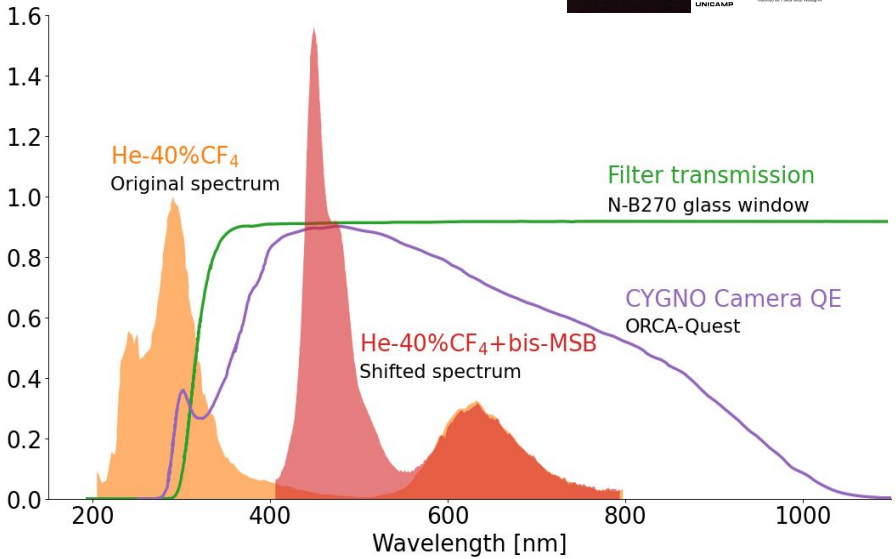
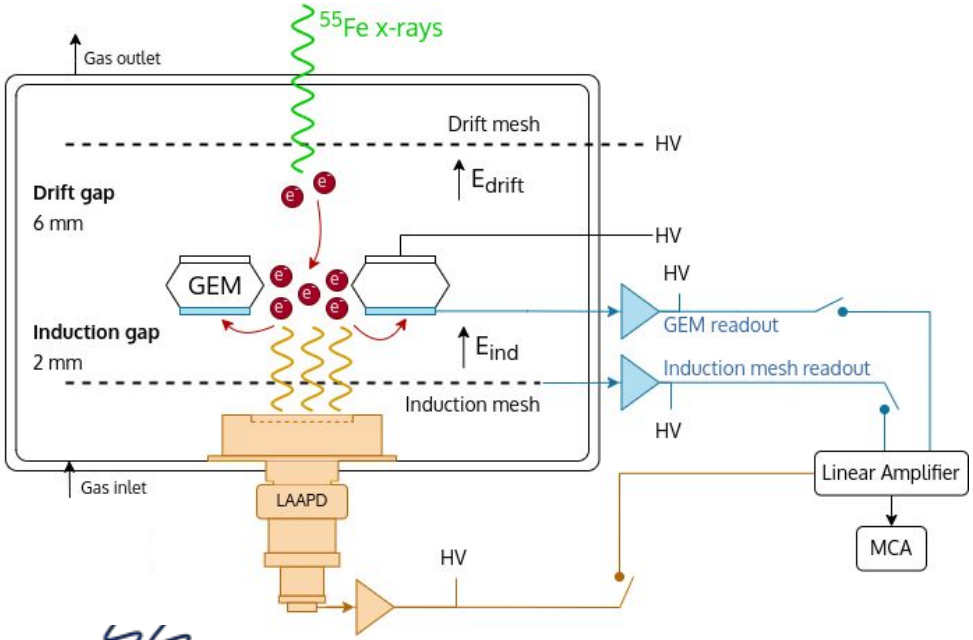
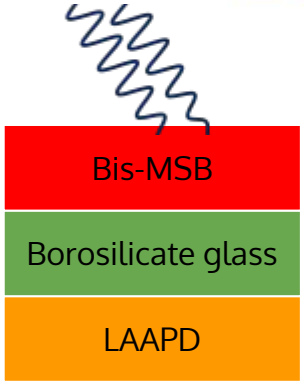
Experimental setup

Bis-MSB is able to convert the UV photons emitted by He-40%CF_4 to the visible range.

The two 3 µm thick bis-MSB samples (A & C) were deposited on a quartz window and provided by LADEP.





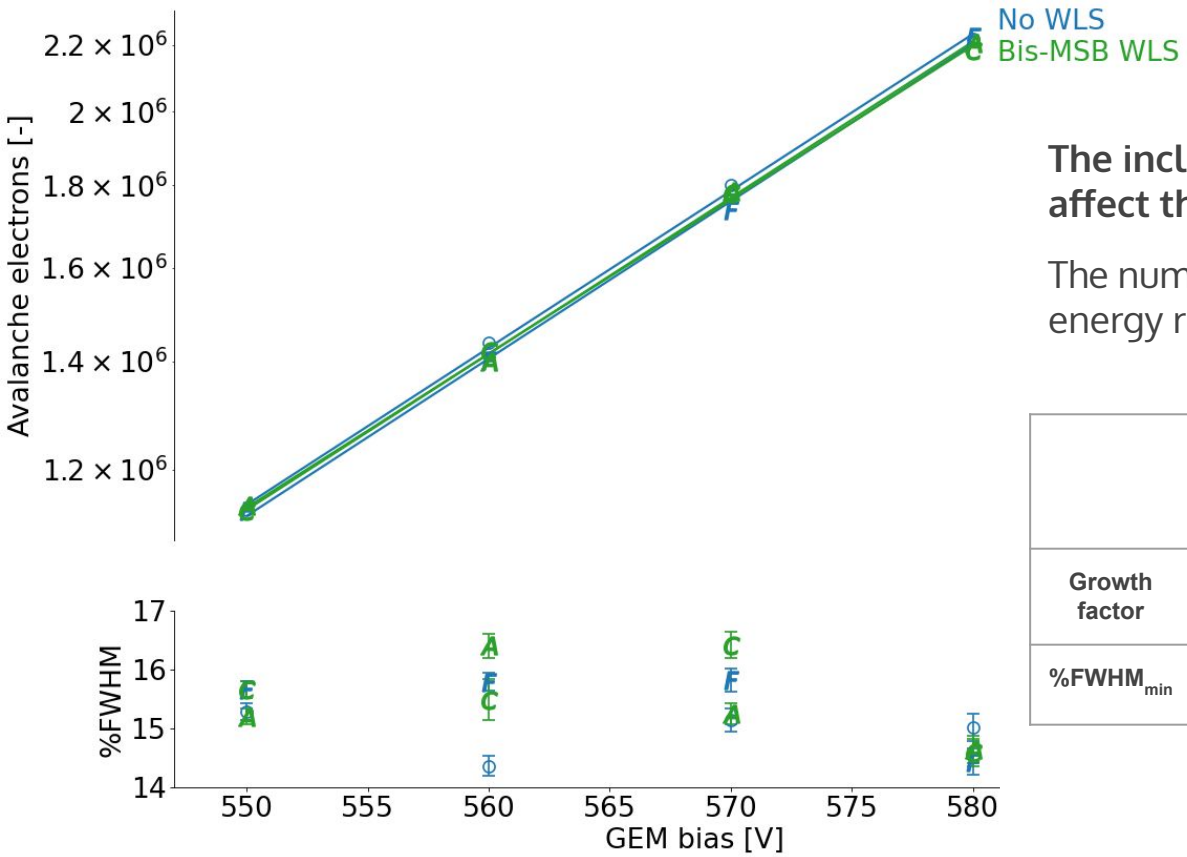


WLS: UV emission → visible (423 nm).

Filtering: removes photons <300 nm.

Detection: quantification of photons.

Charge readout

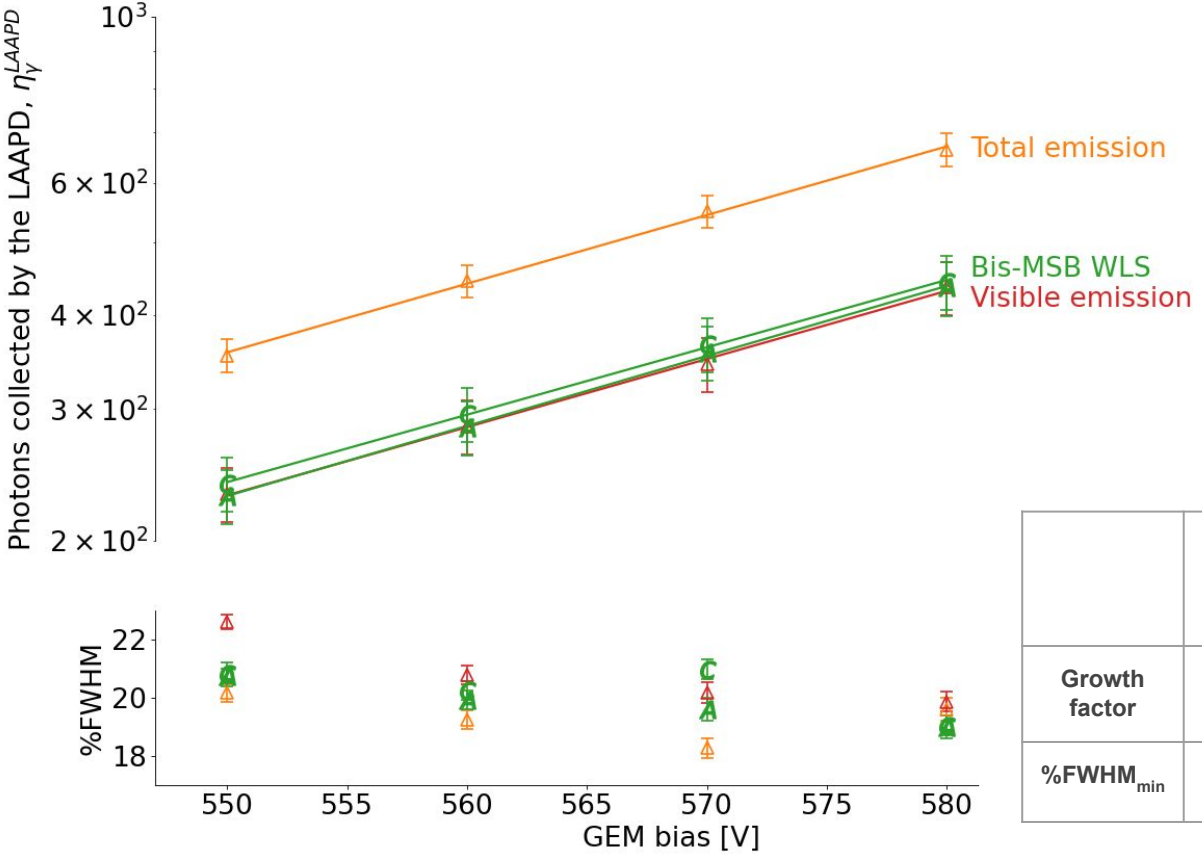


The inclusion of the bis-MSB does not affect the charge readout:

The number of avalanche electrons and the energy resolution stay the same.

	Total emission (o)	Visible emission (F)	bis-MSB Sample A	bis-MSB Sample C
Growth factor	0.0224(22)	0.0224(23)	0.0223(22)	0.0220(22)
$\%FWHM_{min}$	14.36(17)	14.43(22)	14.64(23)	14.59(23)

Optical readout



Amplitude of the scintillation peak

Energy of the ^{55}Fe x-rays

$$\eta_\gamma^{LAAPD} = \frac{A_s}{A_X} \times \frac{E}{w(Si) \times \mu_{QE}}$$

Amplitude of the direct x-ray peak

w-value of silicon

Average response of the LAAPD to the incoming photons

The bis-MSB does not affect the optical readout:

The amount of photons being collected by the LAAPD is similar with and without the bis-MSB.

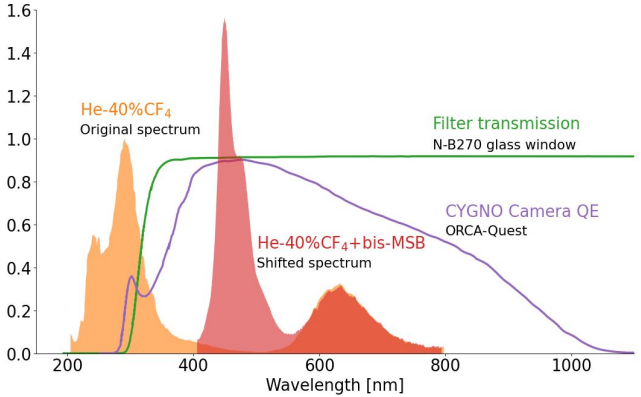
	Total emission (Δ)	Visible emission (Δ)	bis-MSB Sample A	bis-MSB Sample C
Growth factor	0.0211(22)	0.021(4)	0.022(4)	0.021(4)
%FWHM$_{min}$	18.26(34)	19.85(34)	19.0(4)	19.04(35)

Optical readout

The bis-MSB does not affect the optical readout:

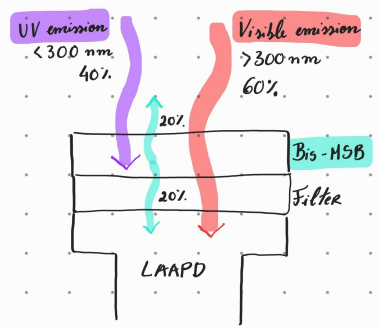
The amount of photons being collected by the LAAPD is similar with and without the bis-MSB.

Why?



Loss of converted photons?

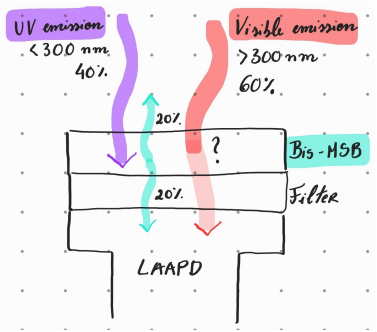
Due to the isotropic emission by the bis-MSB, half of the converted UV photons are emitted away from the LAAPD.



Absorption of the visible component?

The bis-MSB layer is clearly semi-opaque, meaning that it also absorbs part of the visible radiation. If this attenuation is high enough, it could compensate for the optical gain obtained by the conversion of the UV photons.

Would a thinner layer of bis-MSB help?



Grazie per l'attenzione
Any questions or suggestions?

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Backup slides – calculation of η_{γ}^{LAAPD}

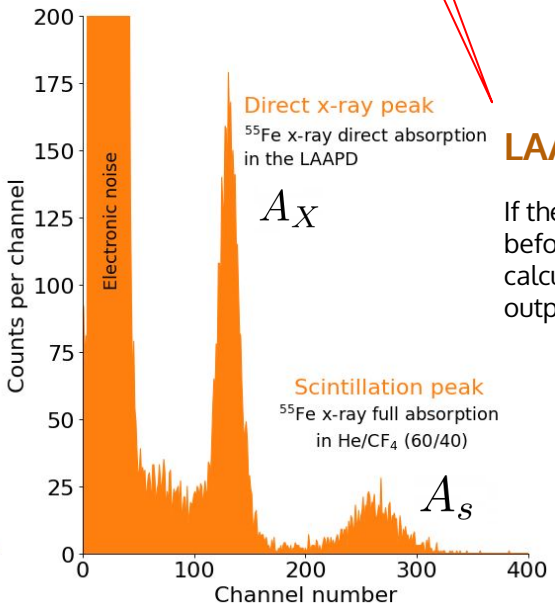
$$\mu_{QE} = \frac{\sum_{i=0}^{n}(QE_i \times S_i)}{\sum_{i=0}^{n} S_i}$$

$$\eta_{\gamma}^{LAAPD} = \frac{A_s}{A_X} \times \frac{E}{w(Si) \times \mu_{QE}}$$

- A_s: Amplitude of the scintillation peak
- A_X: Amplitude of the direct x-ray peak
- E: Energy of the ^{55}Fe x-rays: 5.9 keV
- $w(Si)$: w-value of silicon: 3.62 eV
- μ_{QE}: Average response of the LAAPD to the incoming photons

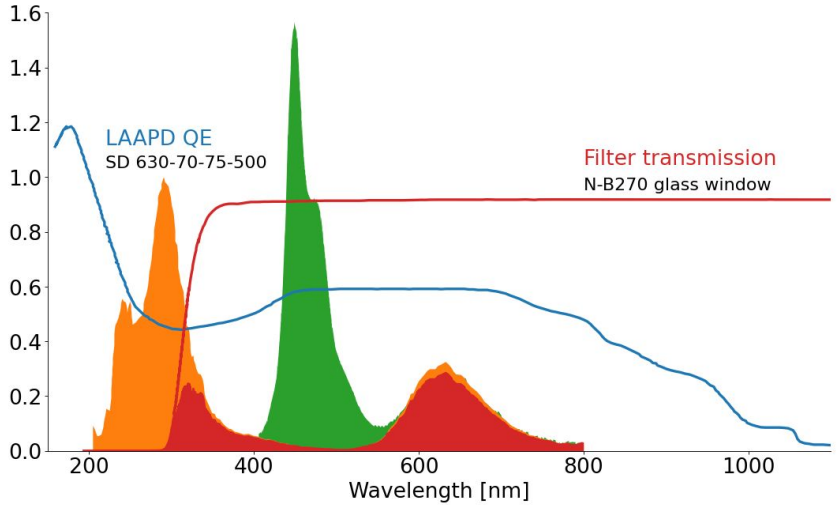
S_i – Emission spectra of the incoming photons

QE_i – LAAPD Quantum efficiency curve



LAAPD spectra

If the setup absorbs the ^{55}Fe x-rays before reaching the LAAPD, we can calculate this parameter using the output current of the LAAPD.



Total emission	Visible emission	Converted spectrum
54.0(27)%	50.6(25)%	57.9(29)%