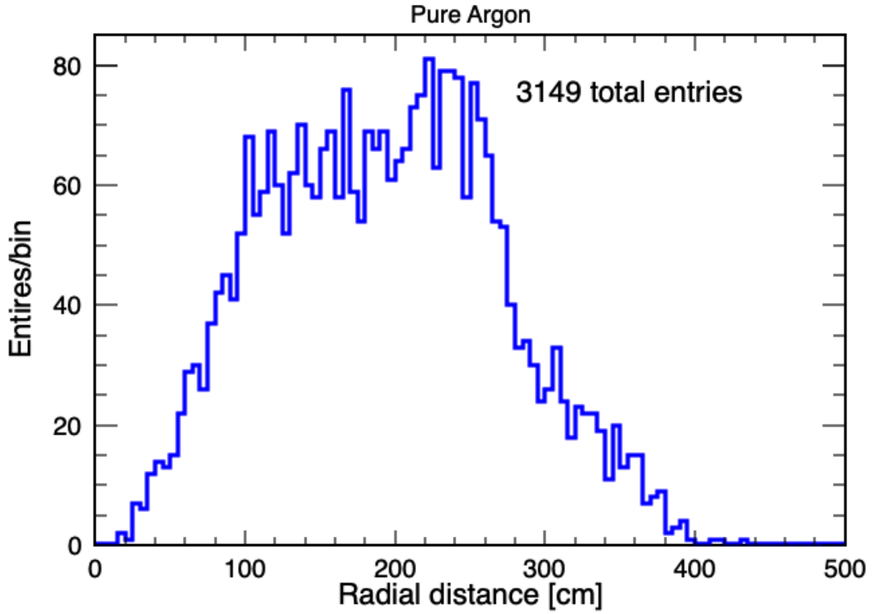
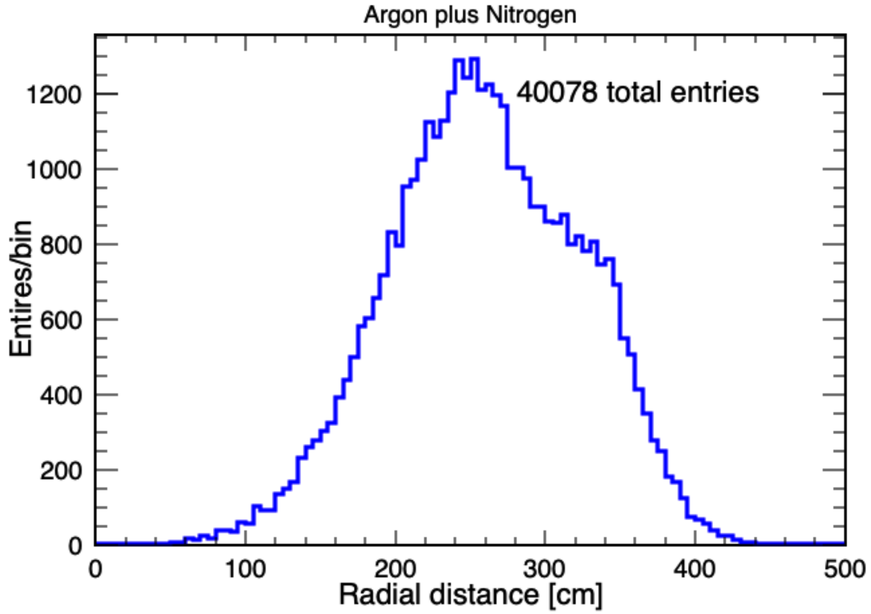
Nitrogen contamination

Dante Totani

Events distribution vs radial distance





Data are grouped for radial stance values and a fit of the main pack is used to get the mean value of the photon detected.

- Pure Argon: 10 groups for Rc=75+i*20 cm (i=0,1,2…9) each group: Rc-20 < r < Rc+20
- Ar + N2: 20 groups for Rc=155+i*10 cm (i=0,1,2…19) each group: Rc-5 < r < Rc+5

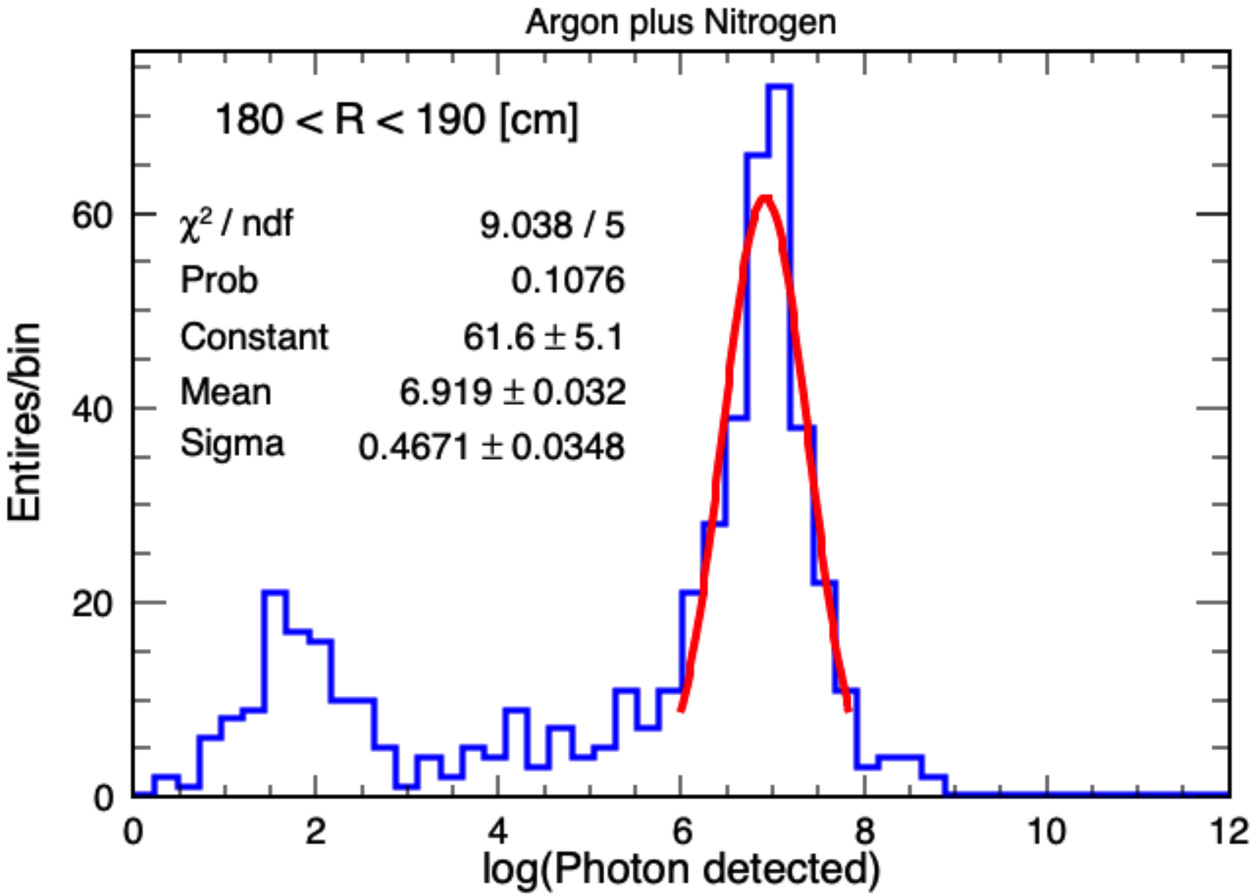
Fit example

Events for a radial distance [180, 190] cm are grouped. The logarithm of the number of photons detected is used to fit the histogram.

Gaussian fit of the main peak is used to get the value for the photon detected for the given radial distance interval.

The radial distance value of the interval is obtained averaging the R for events lying between $\pm 3\sigma$.

The Nph logarithm can be reproduced accurately using a Gaussian, since the linear Nph follow a Landau distribution.



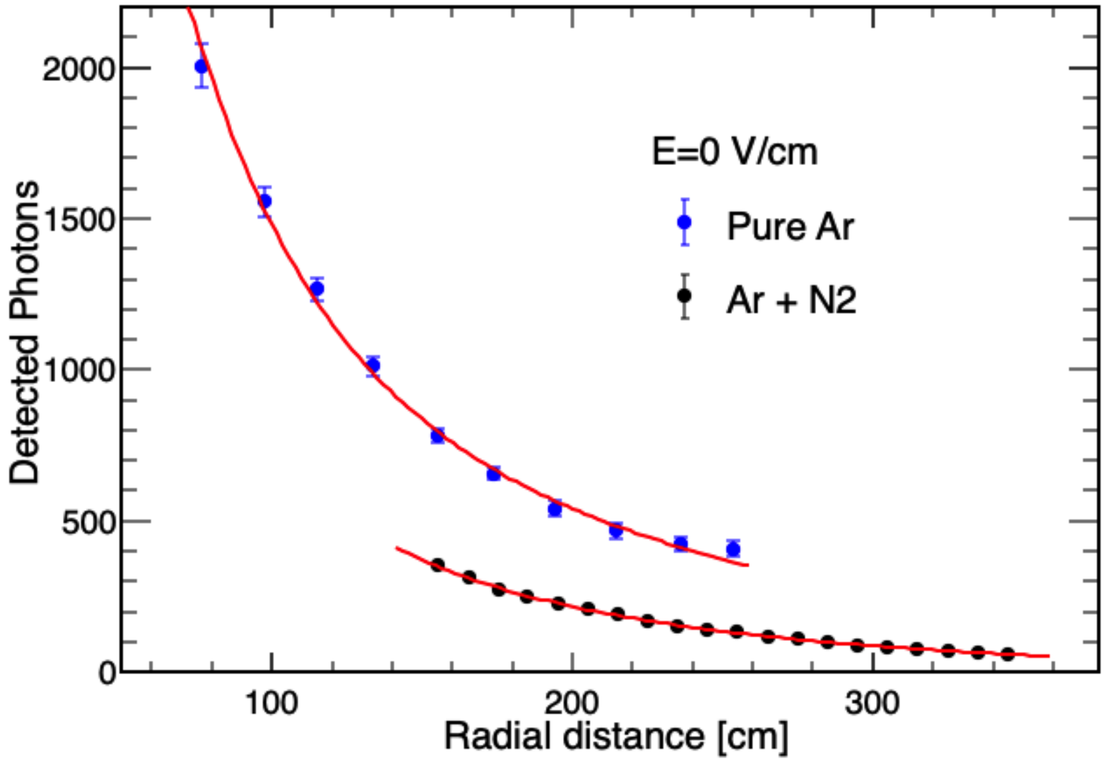
Photons vs radial distance

$$f_1(r) = A \cdot exp(-r/B) + C \cdot exp(-r/D)$$

$$f_2(r) = f_1(r) \cdot Q \cdot exp(-r/\Lambda)$$

Simultaneous fit:
"Pure Ar" in [40, 260] cm range, using f_1
"Ar+N2" in [140, 360] cm range, using f_2

Minimizer is Minuit2 / Migrad			
Chi2 = 37.7869		NDf	= 24
Edm = 4.24885e-06		NCalls	= 1313
A	= 1780.52	+/-	213.239
B	= 156.872	+/-	14.1282
C	= 6846.19	+/-	1601.89
D	= 39.3462	+/-	3.9354
Q	= 0.607084	+/-	0.0609271
Λ	= 481.331	+/-	125.075



The main parameters we are interested are:

Q = 0.61 +/- 0.06 (N2 quenching)
Λ = 4.8 +/- 1.2 m (N2 absorption)

They refer only to the N2 amount entered during the contamination accident.

Nitrogen quenching

Three exponentials fit results:

Comp.	Sing. [ns]	Int. [ns]	Trip. [ns]
Pure Ar	12.72 ± 0.01	62.0 ± 0.5	1257 ± 1
Ar + N2	13.24 ± 0.05	77 ± 2	621 ± 1

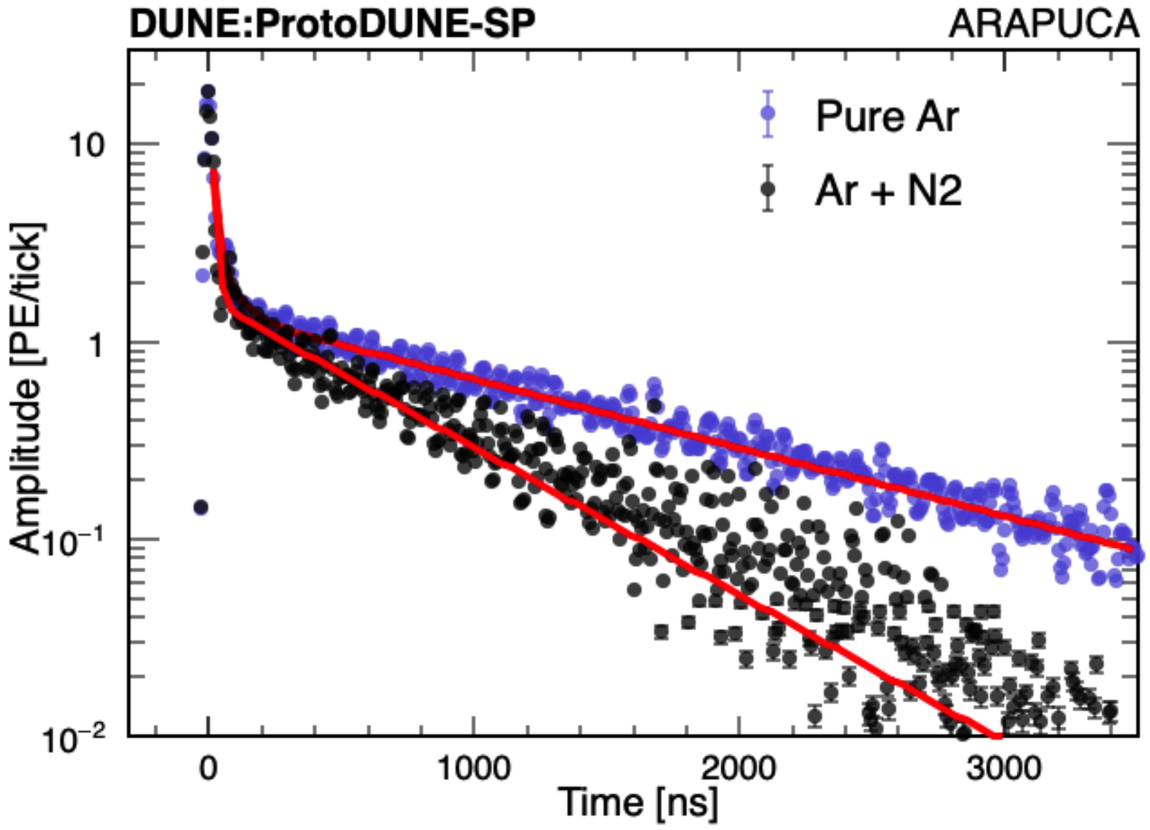
Two comp (*):
Singlet = 23% Triplet = 77%

Three comp (*):
Sing. = 18.8% Int = 7.4% Trip. = 73.8%

(*)**Effects of Nitrogen contamination in liquid Argon**
R Acciarri *et al* 2010 *JINST* **5** P06003

Both compatibles with the parameter from the simultaneous fit:

(N2 quenching) Q = 0.61 +/- 0.06

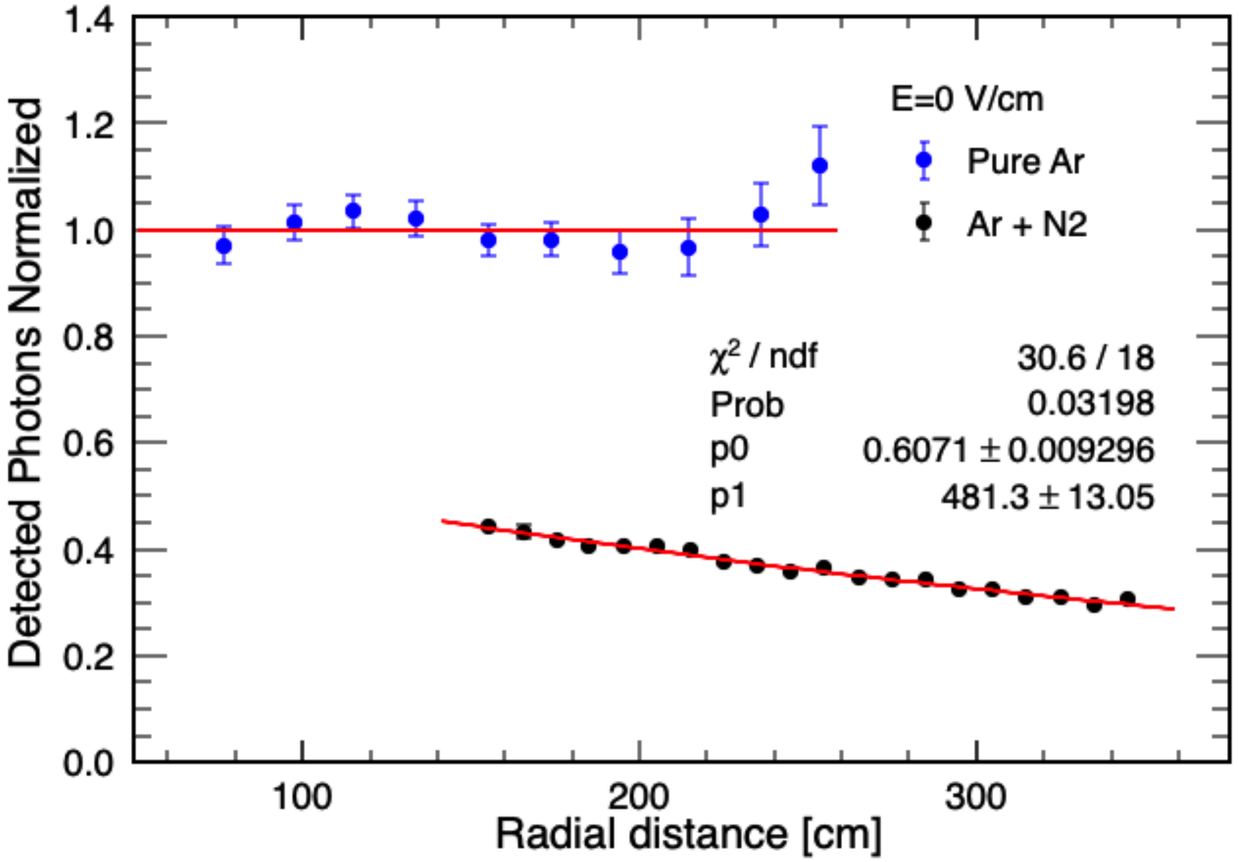


Assuming N2 quenching acts only on the Triplet, the expected reduction is:

$$R_{2c} = 0.23 + 0.77 \cdot \frac{621}{1257} \simeq 0.61$$

$$R_{3c} = 0.26 + 0.74 \cdot \frac{621}{1257} \simeq 0.62$$

Nitrogen absorption



The parameter Λ = 4.8 +/- 1.2 m obtained from the fit should be sensible to the absorption introduced only by the N2 injected (not to the full absorption)

$$\frac{1}{\Lambda} = \frac{1}{\Lambda_T} - \frac{1}{\Lambda_0}$$

Data normalized to the Pure Argon data fit function.

Fit function for Ar+N2 normalized data (black points):

$$f(r) = [p0] \cdot e^{-r/[p1]}$$

Pure Ar, Ar+N2 and Ar+N2+Xe