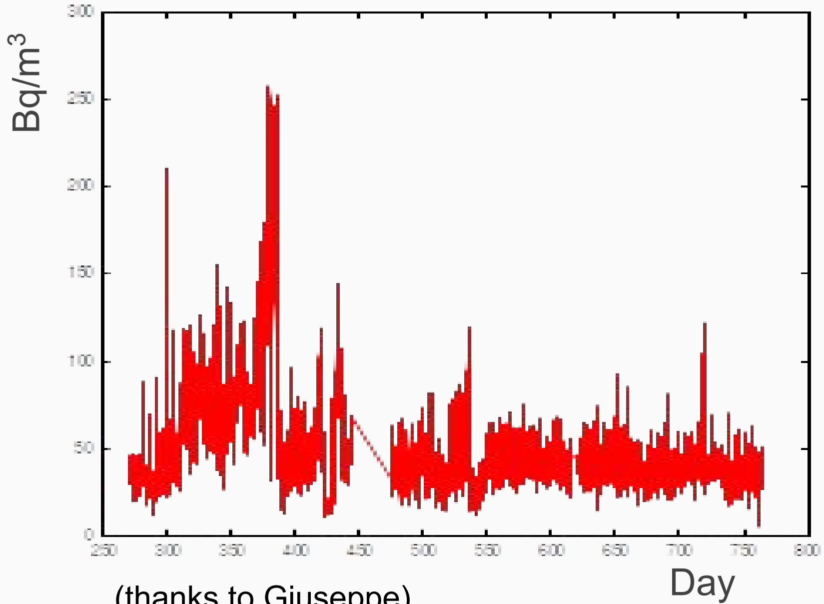
Simulation of background from ^{222}Rn inside the CIS tube and Radon box

Giulia D'Imperio, Paolo Montini
Università La Sapienza and INFN Roma 1

Measurements of ^{222}Rn in Hall B at LNGS

- Radon concentration measured hourly in Hall B, since Oct-1-2014 to Feb-4-2016. Values in Bq/m^3 versus days (starting from 1/1/2014)

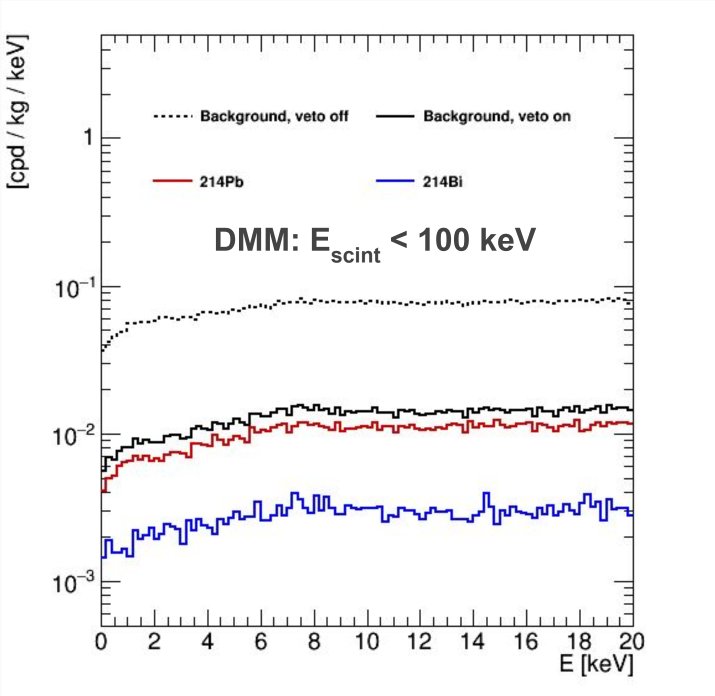


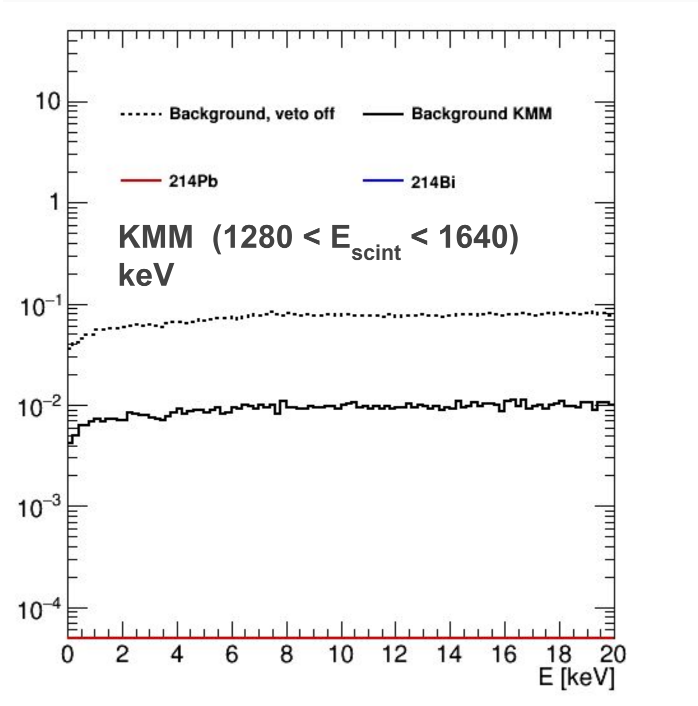
(thanks to Giuseppe)

- Level of Radon changes a lot from a baseline of ~30 Bq/m^3, with spikes up to 250 Bq/m^3

^{222}Rn Background in CIS

- Worst case: **No Purging** - Rn contamination in the entire volume of the CIS tube
- Rn activity assumed as 30 Bq/m^3 (baseline value of Hall B measurements)



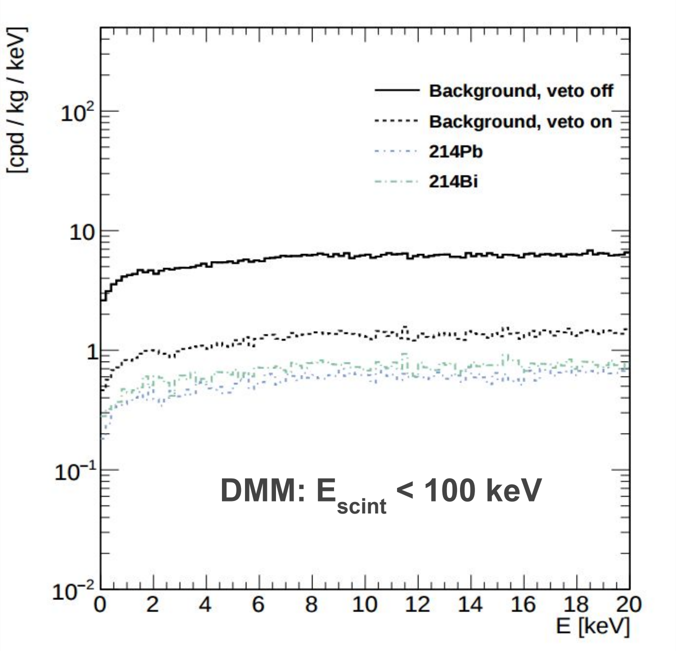


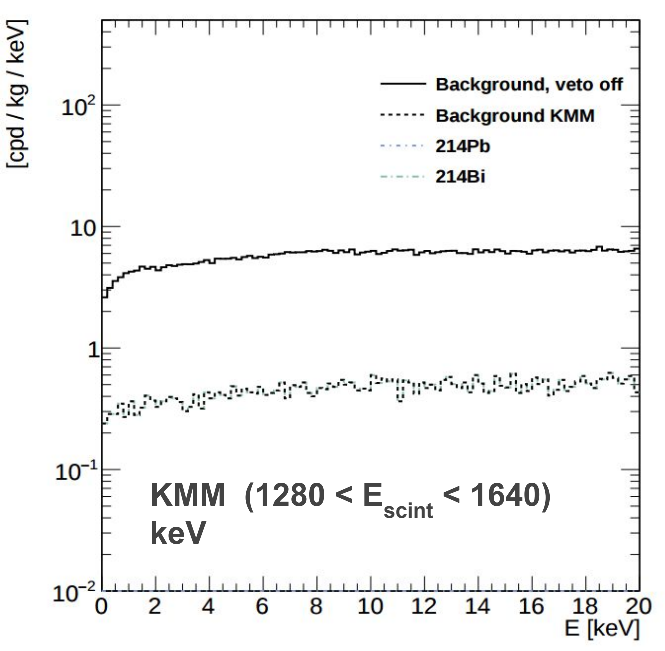
Isotope	Bkg No veto [cpd/kg] 2-6 keV	Bkg DMM [cpd/kg] 2-6 keV	Bkg KMM [cpd/kg] 2-4 keV
214Pb	0.09733 +/- 0.00068	0.03563 -/+ 0.00041	0 +/- 0
214Bi	0.1764 +/- 0.0011	0.01035 -/+ 0.0002	0.01727 +/- 0.00035
Tot	**0.2737 +/- 0.0013**	**0.04597 -/+ 0.00049**	**0.01727 +/- 0.00035**

^{222}Rn Background in Radon box

Radon box is defined as the volume between the inner walls of the PE shield and the vessel.

- ★ Worst case: **No Purging** - Rn contamination in the entire volume of the Radon box
- ★ Rn activity assumed as 30 Bq/m^3 (baseline value of Hall B measurements)





Isotope	Bkg No veto [cpd/kg] 2-6 keV	Bkg DMM [cpd/kg] 2-6 keV	Bkg KMM [cpd/kg] 2-4 keV
214Pb	5.069 +/- 0.073	1.99 -/+ 0.046	0 +/- 0
214Bi	16.67 +/- 0.13	2.54 -/+ 0.051	0.8026 +/- 0.029
Tot	**21.74 +/- 0.15**	**2.54 -/+ 0.051**	**0.8026 +/- 0.029**

^{222}Rn Background - summary

Assuming radon-contaminated air at the level of 30 Bq/m^3 (baseline value of Hall B measurements),
background from Radon is significant for both DMM and KMM

- **NO N_2 FLUSHING inside the CIS** tube:
  - O(10^{-1}) of the intrinsic crystal background
  - Same order of the other backgrounds (in total)

- **NO N_2 FLUSHING inside the airbox:**
  - O(10) of the intrinsic crystal background
  - O(10^2) of other backgrounds (in total)

However, with **N_2 FLUSHING** applied and assuming a radon content in nitrogen at the level of ~1 mBq/m^3 (evaporation from commercial liquid nitrogen), the background contribution for DMM and KMM will be reduced to an acceptable level:

- ~10^{-5} cpd/kg/keV from **CIS**
- ~10^{-3} cpd/kg/keV from the **Radon box**

Nitrogen sample	^{222}Rn activity (μBq/m^3)
Gas phase of storage tank, Heidelberg	63 ± 10; 43 ± 6; 54 ± 7
Liquid phase of storage tank, Heidelberg	144 ± 16
Purified by LTA, Heidelberg	≤ 25; ≤ 5
Liquid phase of storage tanks, Gran Sasso	51 ± 8; 27 ± 4; 78 ± 12
Purified by LTA, Gran Sasso	0.3 ± 0.3; 0.5 ± 0.3; 0.7 ± 0.1; 0.3 ± 0.1

^{222}Rn detection at the μBq/m^3 range in nitrogen gas and a new Rn purification technique for liquid nitrogen

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