Purity and purification of argon in terms of ^{222}Rn

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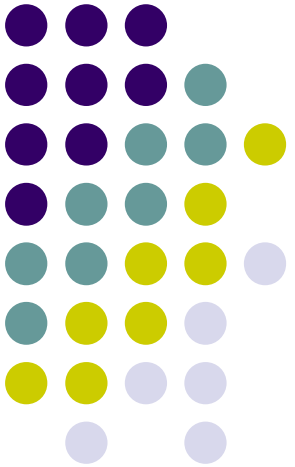
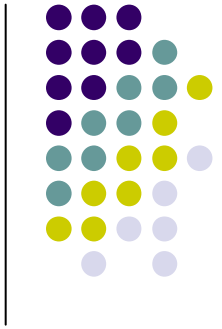


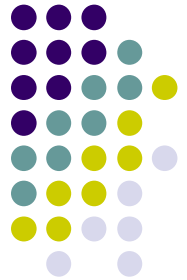
Introduction



- 3 subprojects:
  - Measurement of ^{222}Rn in commercially available Ar
  - Search for clean storage tanks
  - Design of a dedicated ^{222}Rn purification column
- GSTR-07-006 available on webpage
  - Summarizing results until April 07

- In the talk (as usual): All gas volumes at Standard Temperature and Pressure (STP)

Status after Ringberg meeting: ^{222}Rn in commercial Ar



Initial activties at time of LAr delivery:

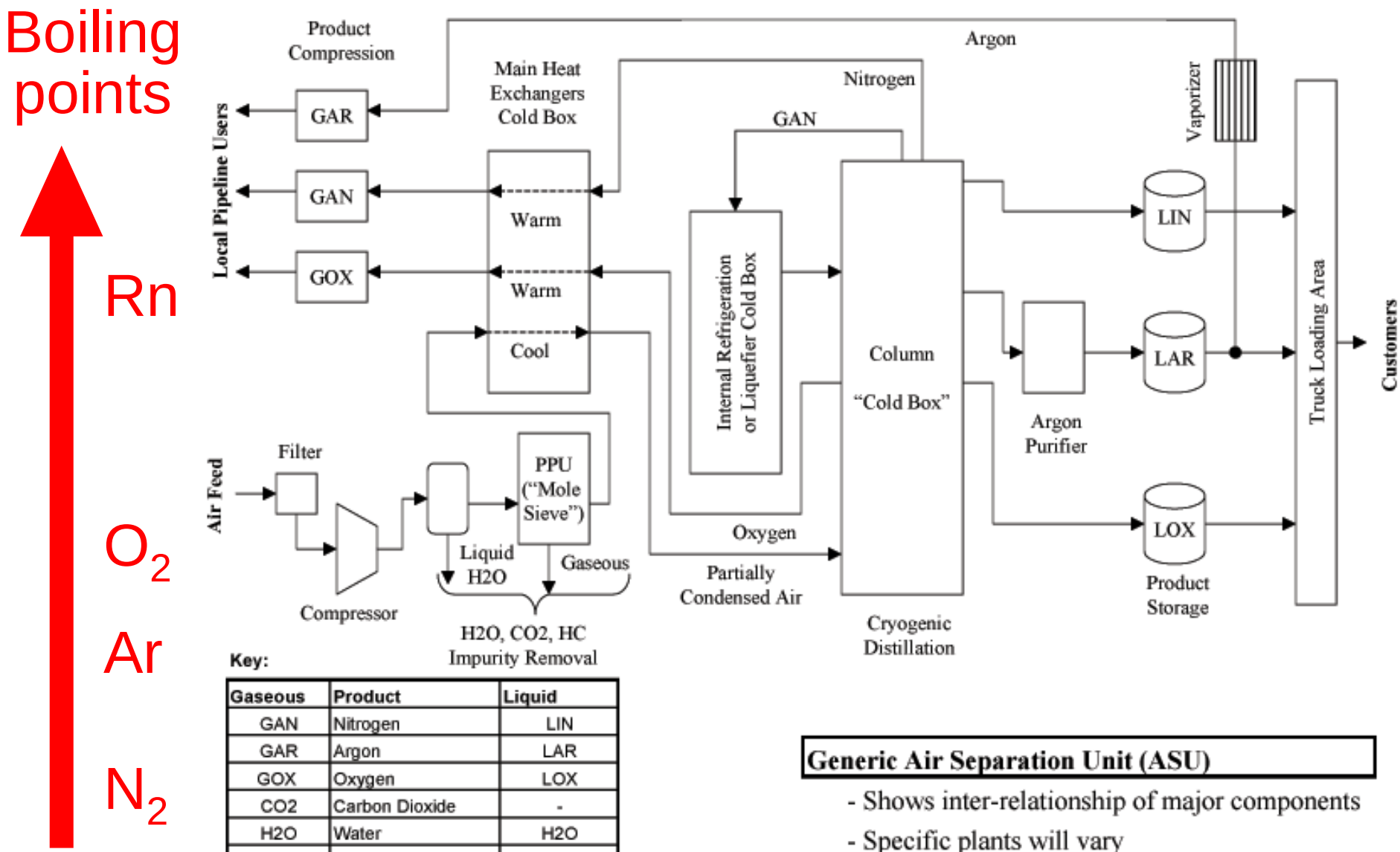
- Argon 5.0 (Westfalen AG): 8.4 mBq/m^3
- Argon 6.0 (Westfalen AG): 0.4 mBq/m^3

$\Rightarrow$ Concentration depends on quality

$\Rightarrow$ ~2 orders of magnitude worse than N_2

Can it be understood?

Air separation plant



Key:

Gaseous	Product	Liquid
GAN	Nitrogen	LIN
GAR	Argon	LAR
GOX	Oxygen	LOX
CO2	Carbon Dioxide	-
H2O	Water	H2O
HC	Hydrocarbons	-

Generic Air Separation Unit (ASU)

- Shows inter-relationship of major components
- Specific plants will vary

New results on initial Ar purity

- Argon 5.0 (LINDE) [Gran Sasso]:

  0.4 mBq/m^3

- Argon 4.8 (Air Liquide) [MPIK]:

  0.3 mBq/m^3

- Argon 4.6 (Westfalen AG) [MPIK]:

  0.7 mBq/m^3

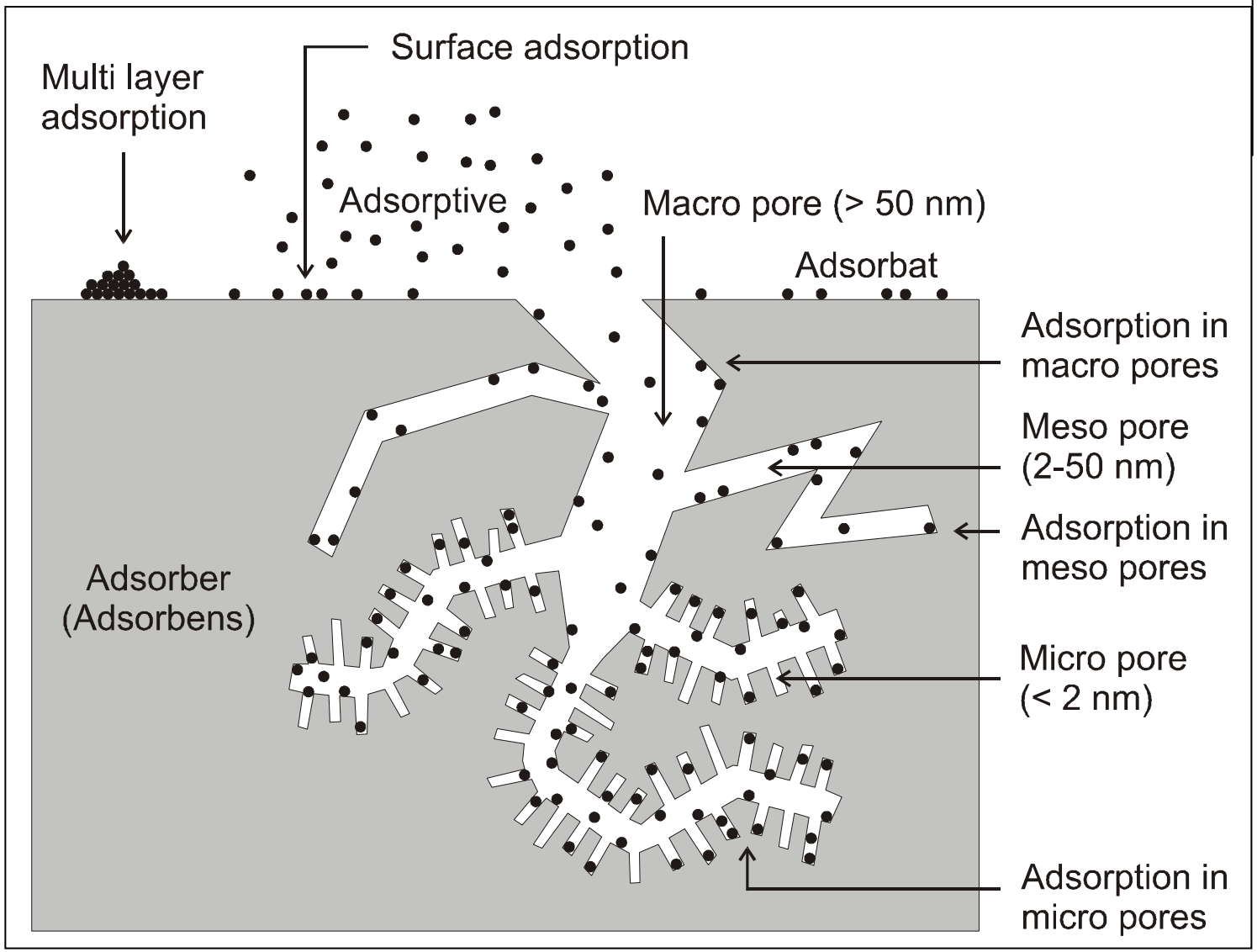
- Better than expected (but still worse than N_2)

$\Rightarrow$ Storage time between production and delivery must be taken into account.

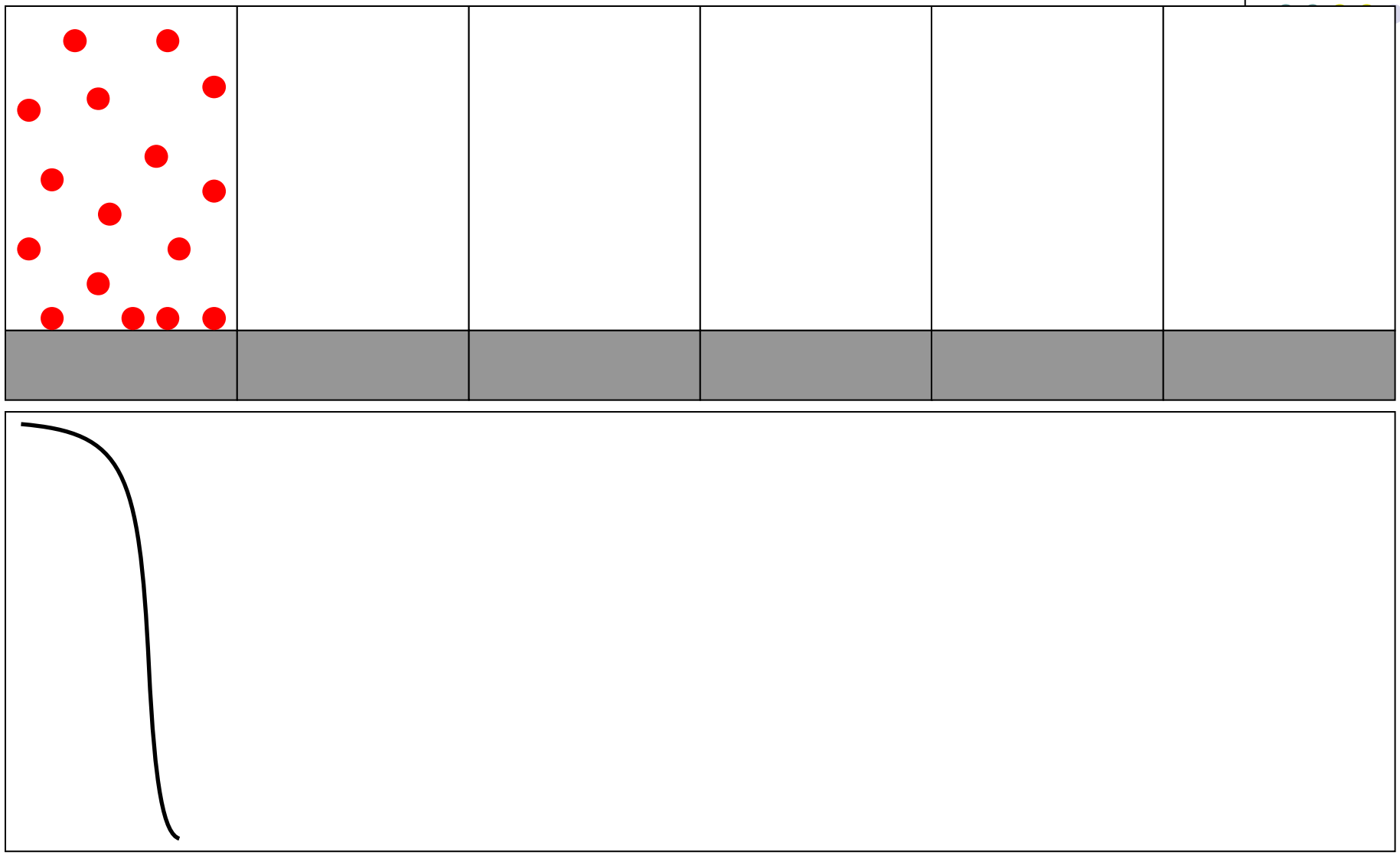
^{222}Rn emanation of storage tanks for cryogenic liquids

Tank from	Quality of stored gas	Vol. [m^3]	^{222}Rn activity in saturation [mBq]	specific ^{222}Rn act. [mBq/m^3]
Westfalen AG	technical	3	177 +- 6	59 +- 2
Westfalen AG	6.0	0.67	42 +- 2	63 +- 3
SOL	6.0	16	65 +- 6	4.1 +- 0.4
LINDE	7.0	3	2.7 +- 0.3	0.9 +- 0.1
Air Liquide	technical	0.67	1.8 +- 0.4	2.7 +- 0.6
LINDE	technical	6.3	3.5 +- 0.2	0.56 +- 0.03

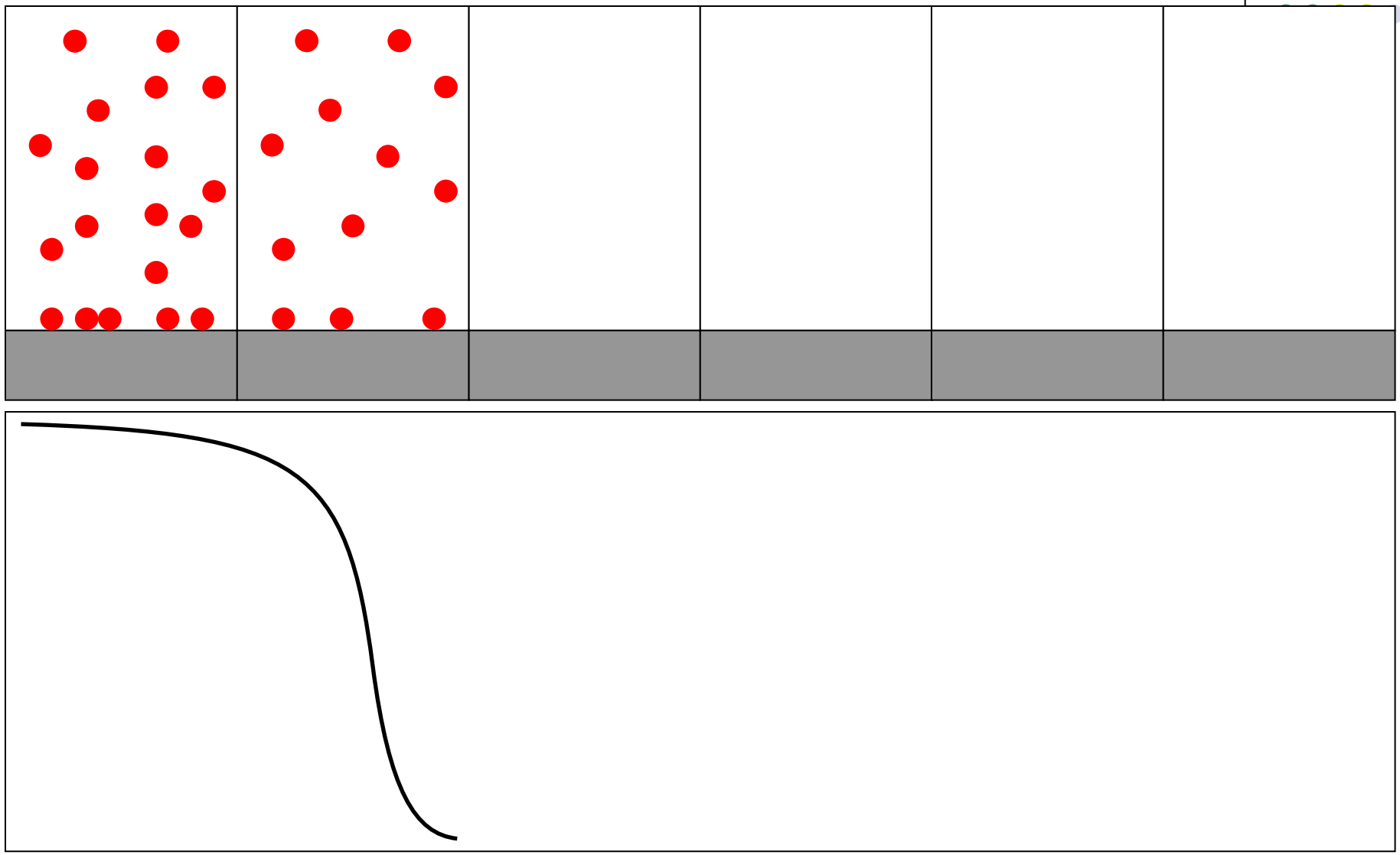
Adsorption in pores



Column purification



Column purification



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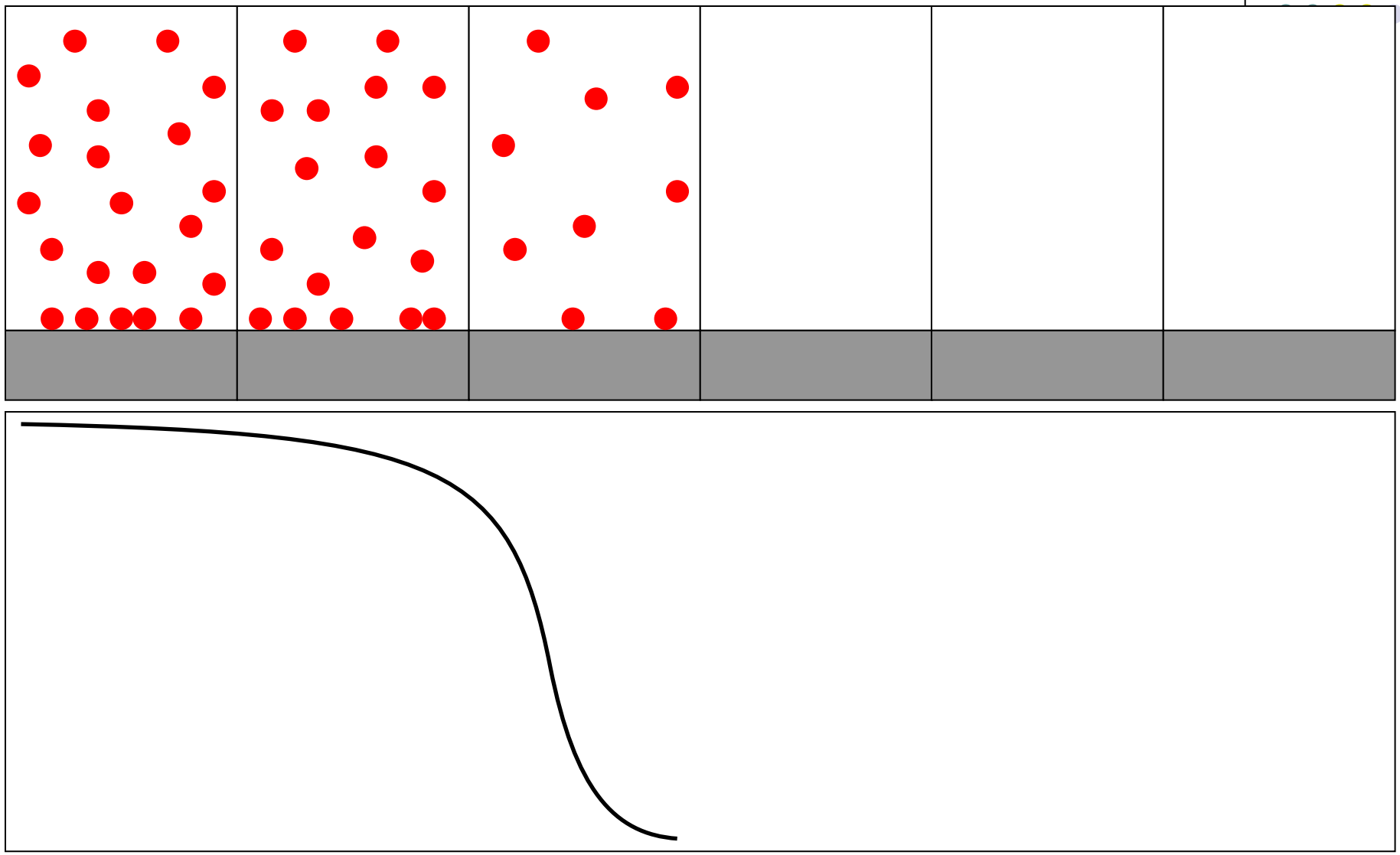
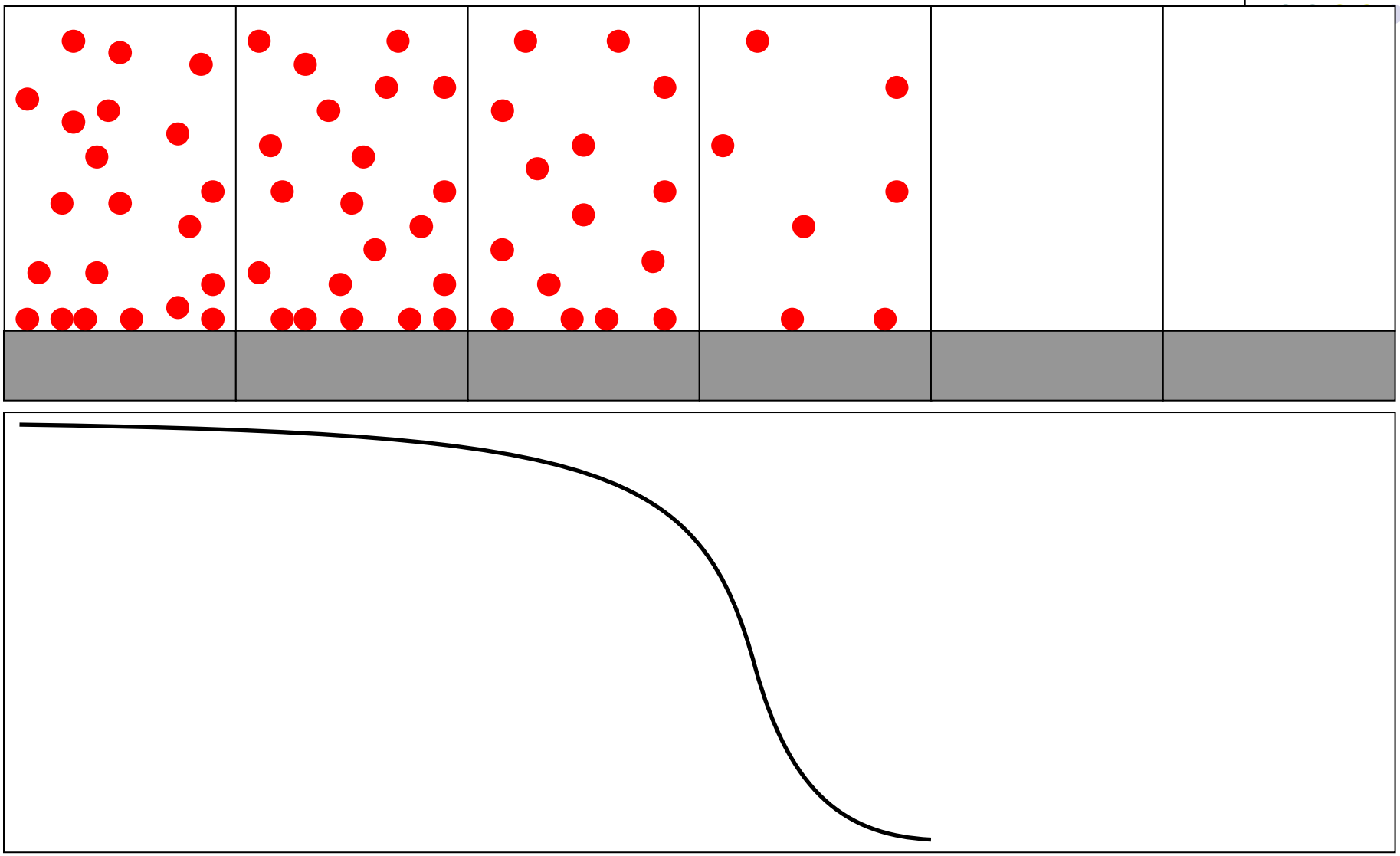


Column purification



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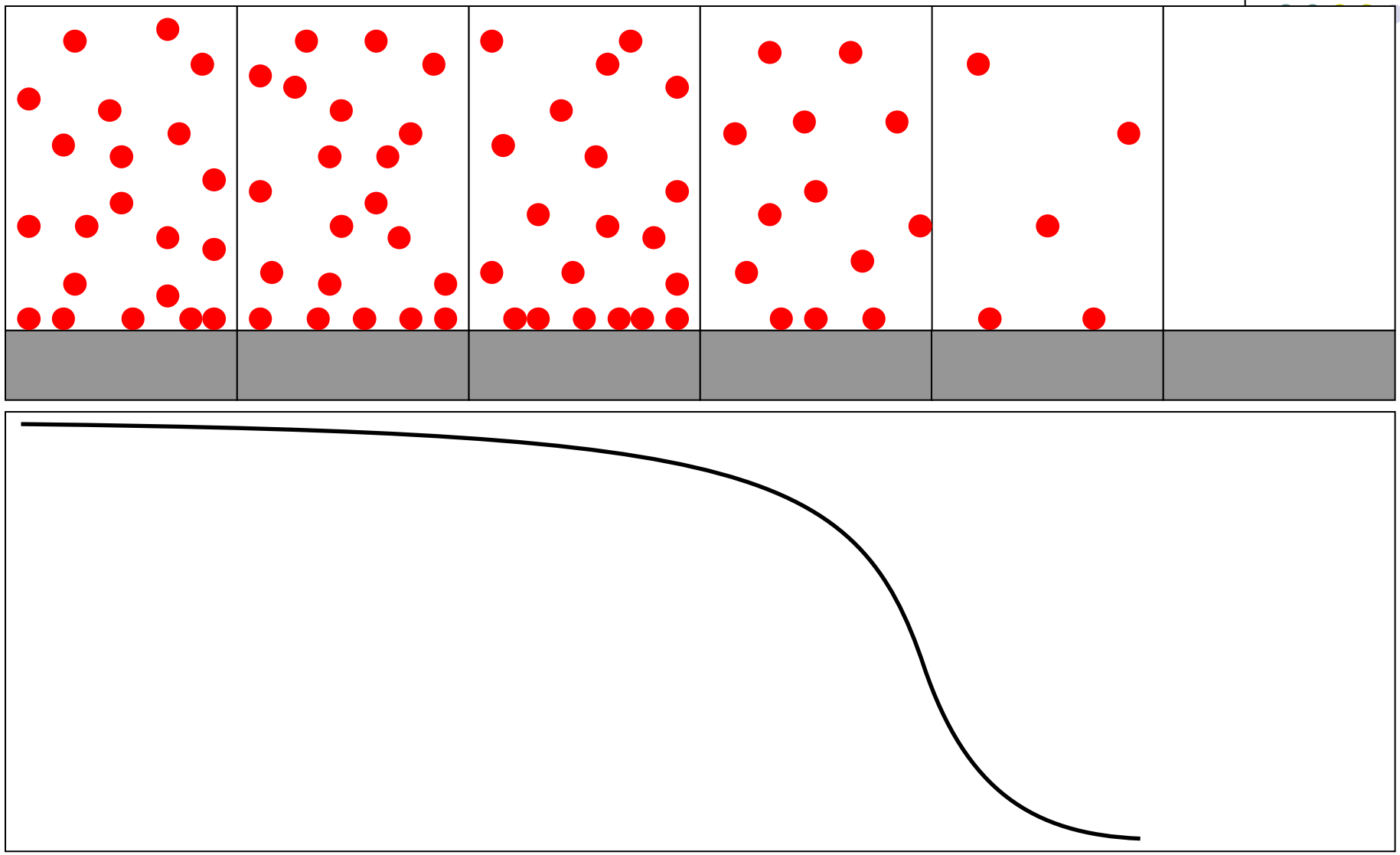

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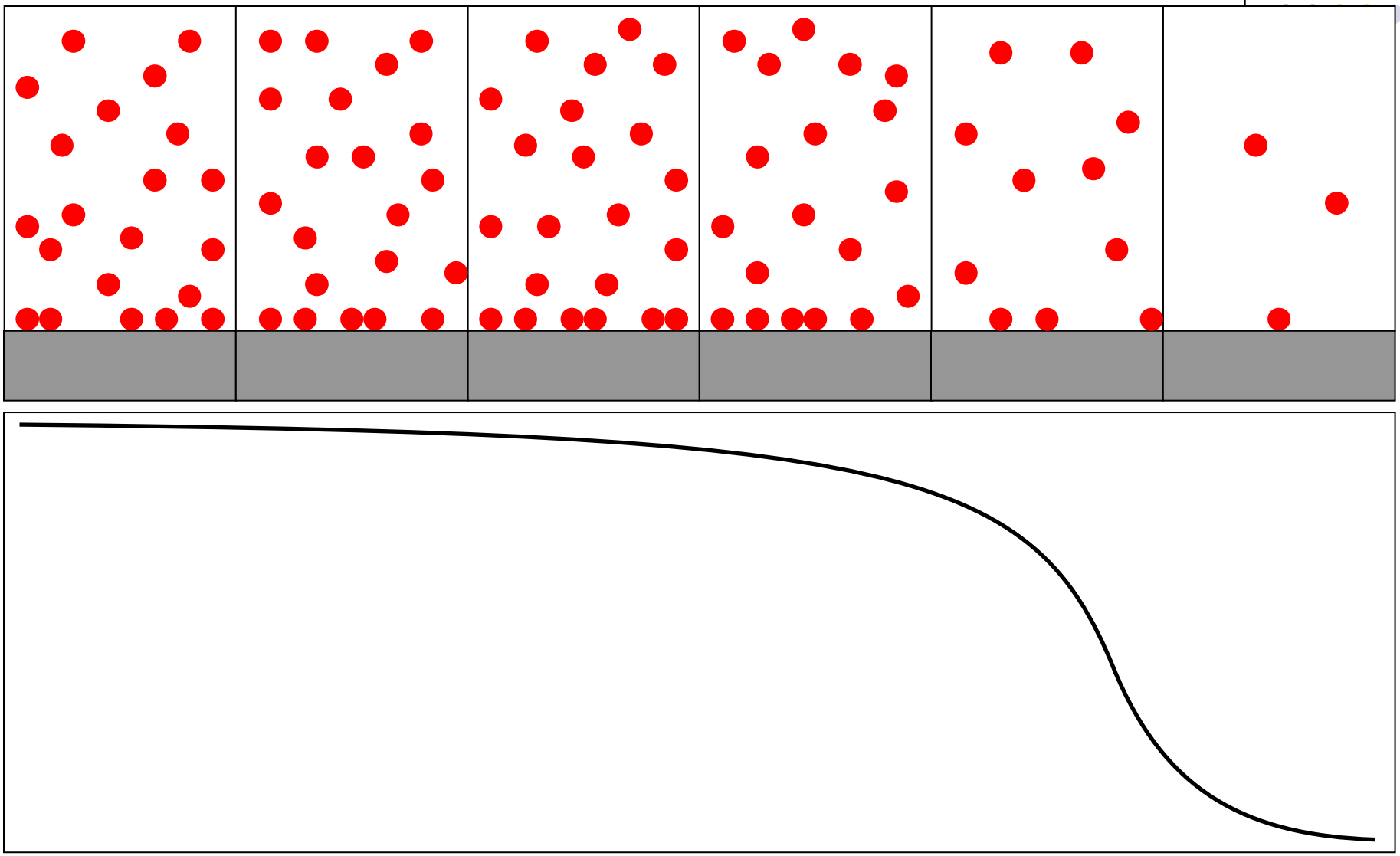
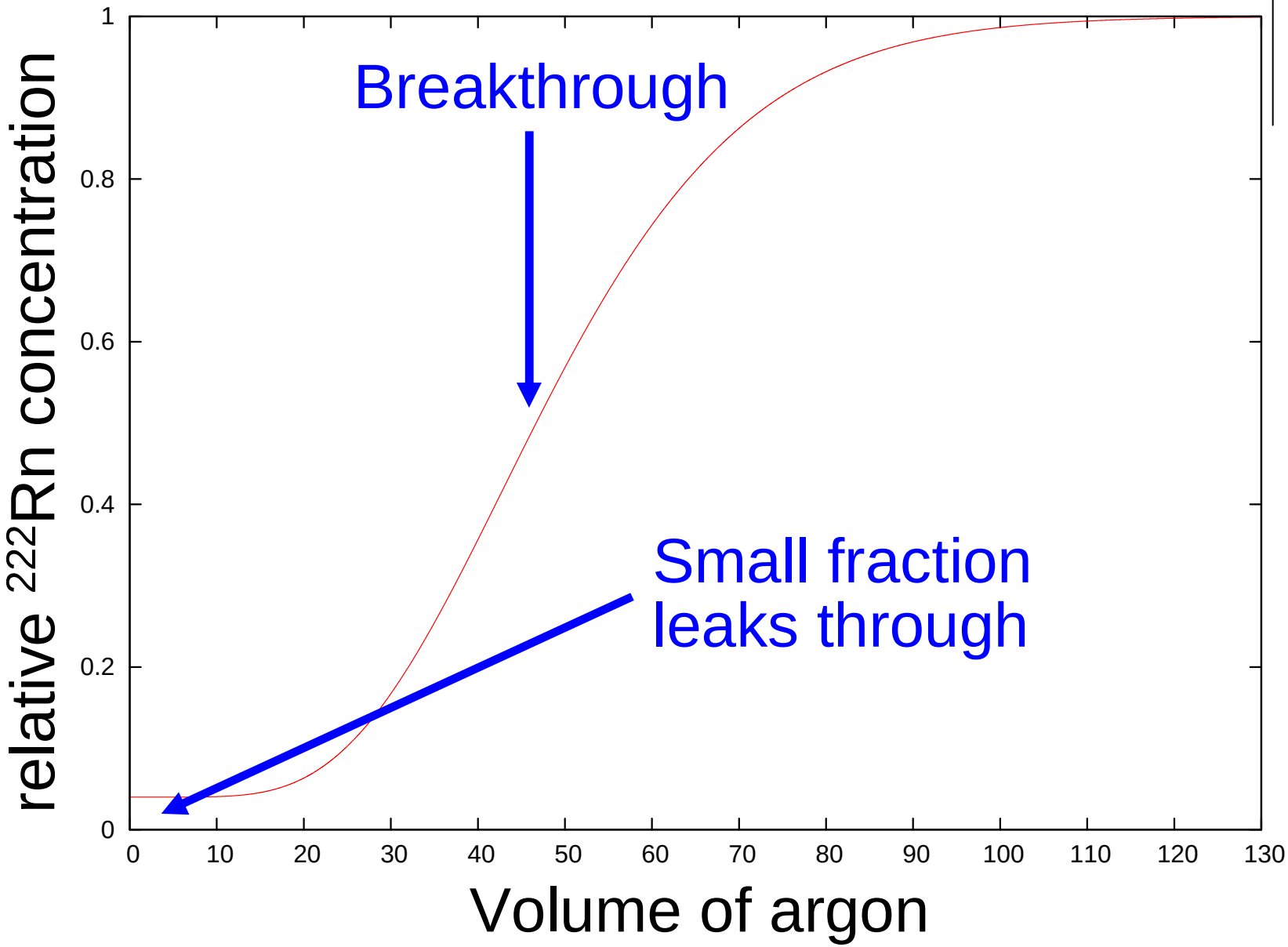
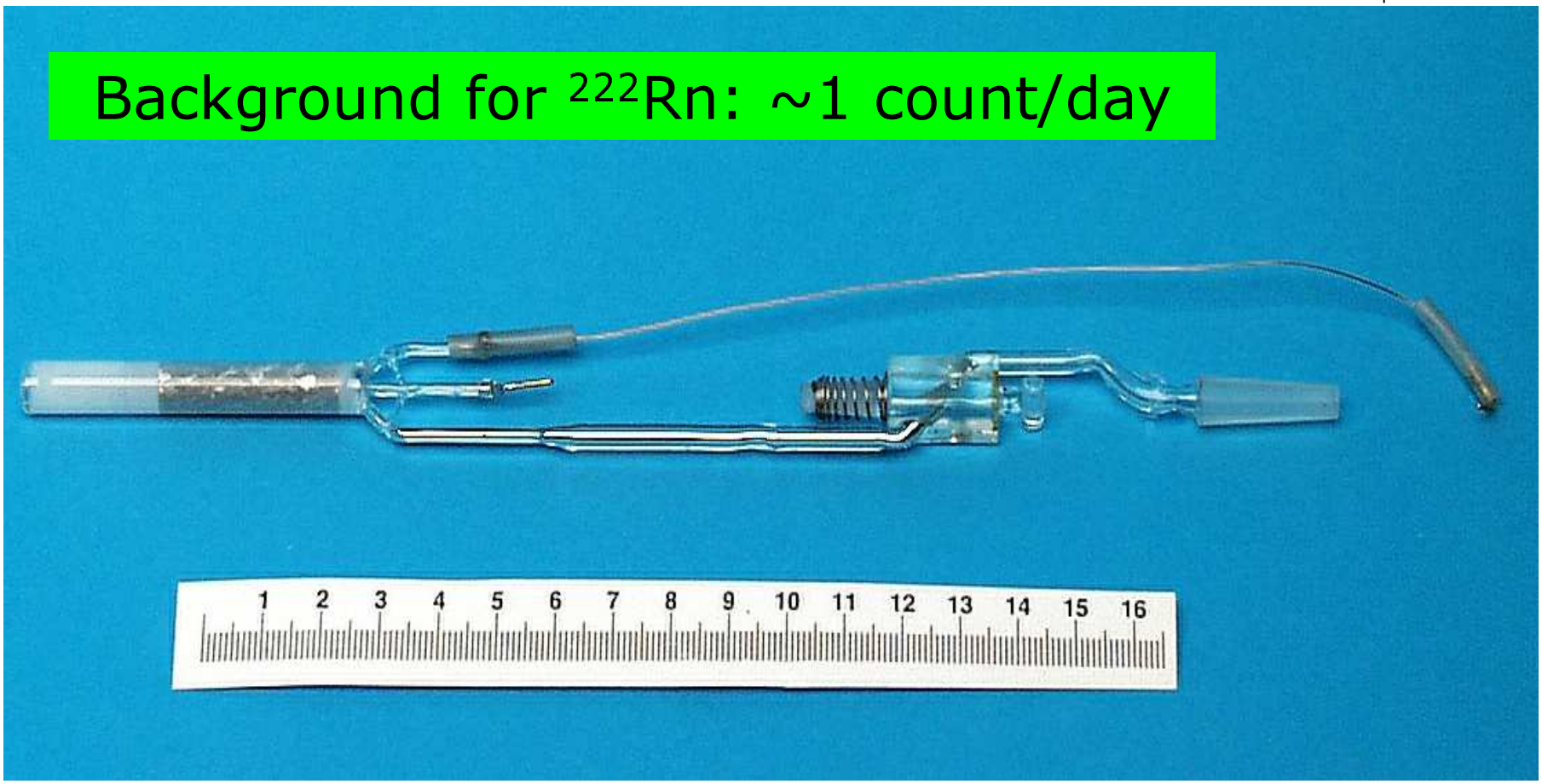


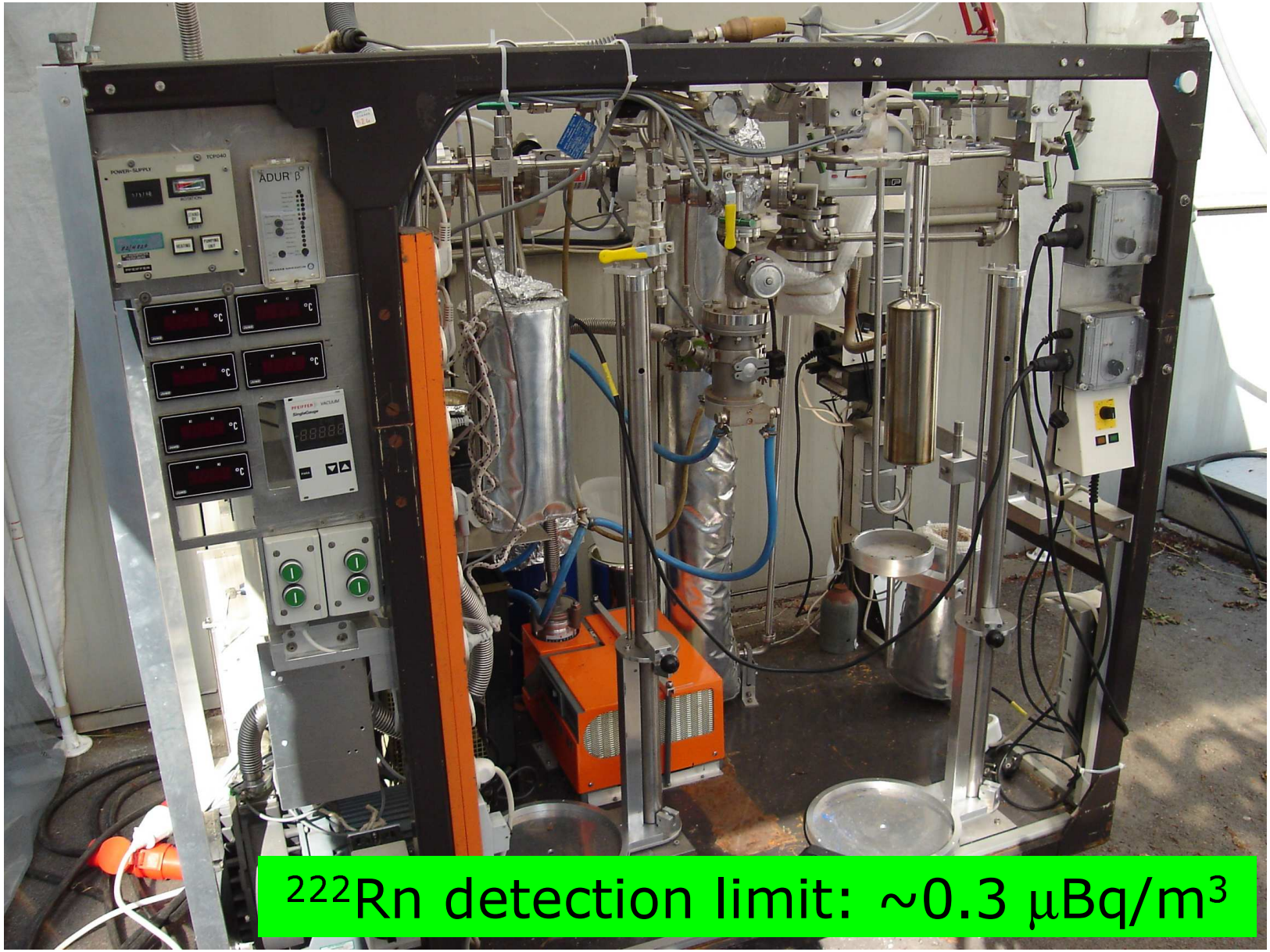
Expected breakthrough curve



Low-level proportional counter



Mobile Radon Extraction Unit



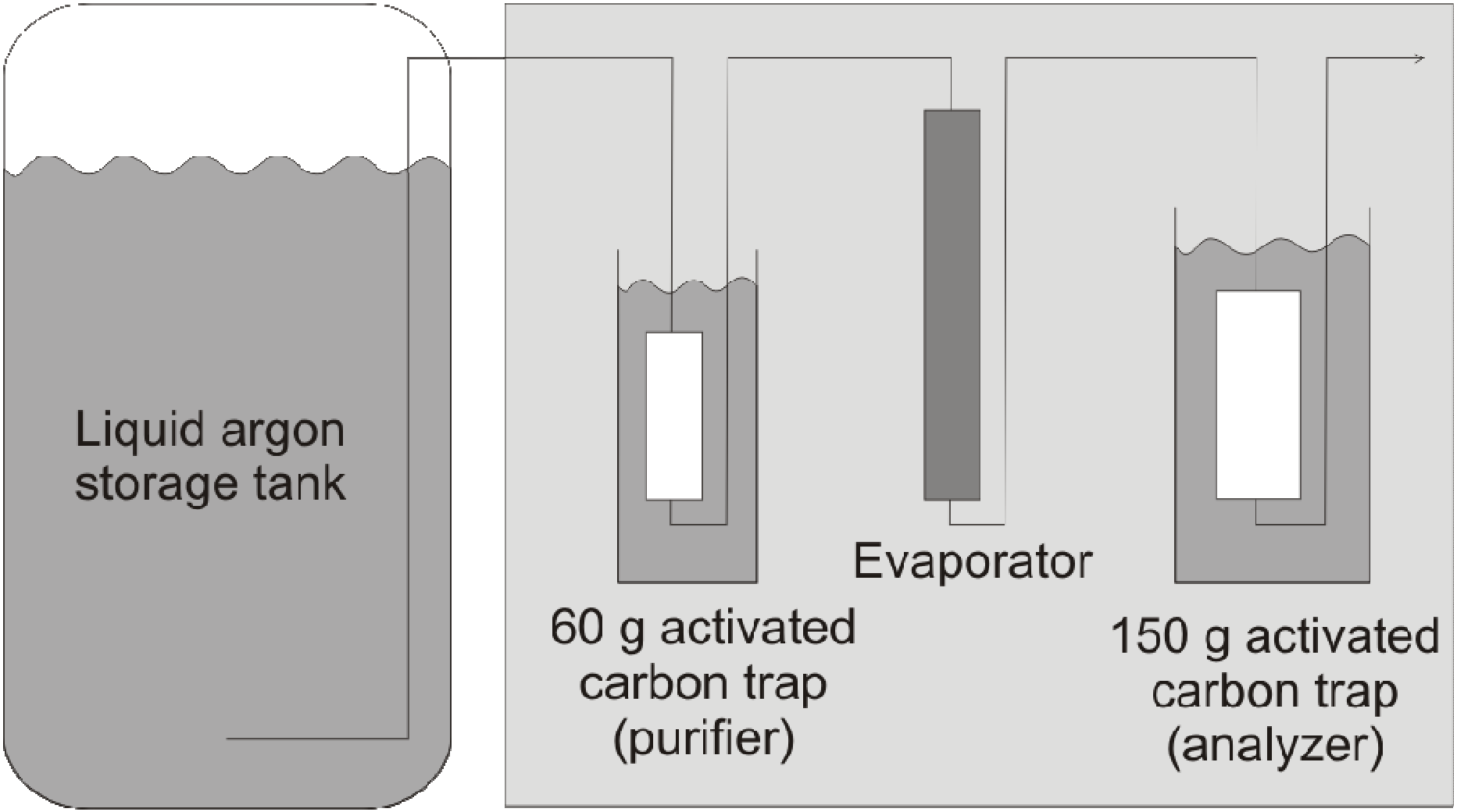
^{222}Rn detection limit: ~0.3 µBq/m^3

Results for gas phase adsorption (150 g carbon trap)

Date	Volume [m^3]	Initial conc. [mBq/m^3]	Final conc. [$\mu Bq/m^3$]	Reduction factor [1/kg]
4.11.04	141	0.20	<0.5	>2700
12.4.07	80	0.27	0.7	2600

^{222}Rn removal in gas phase is very efficient

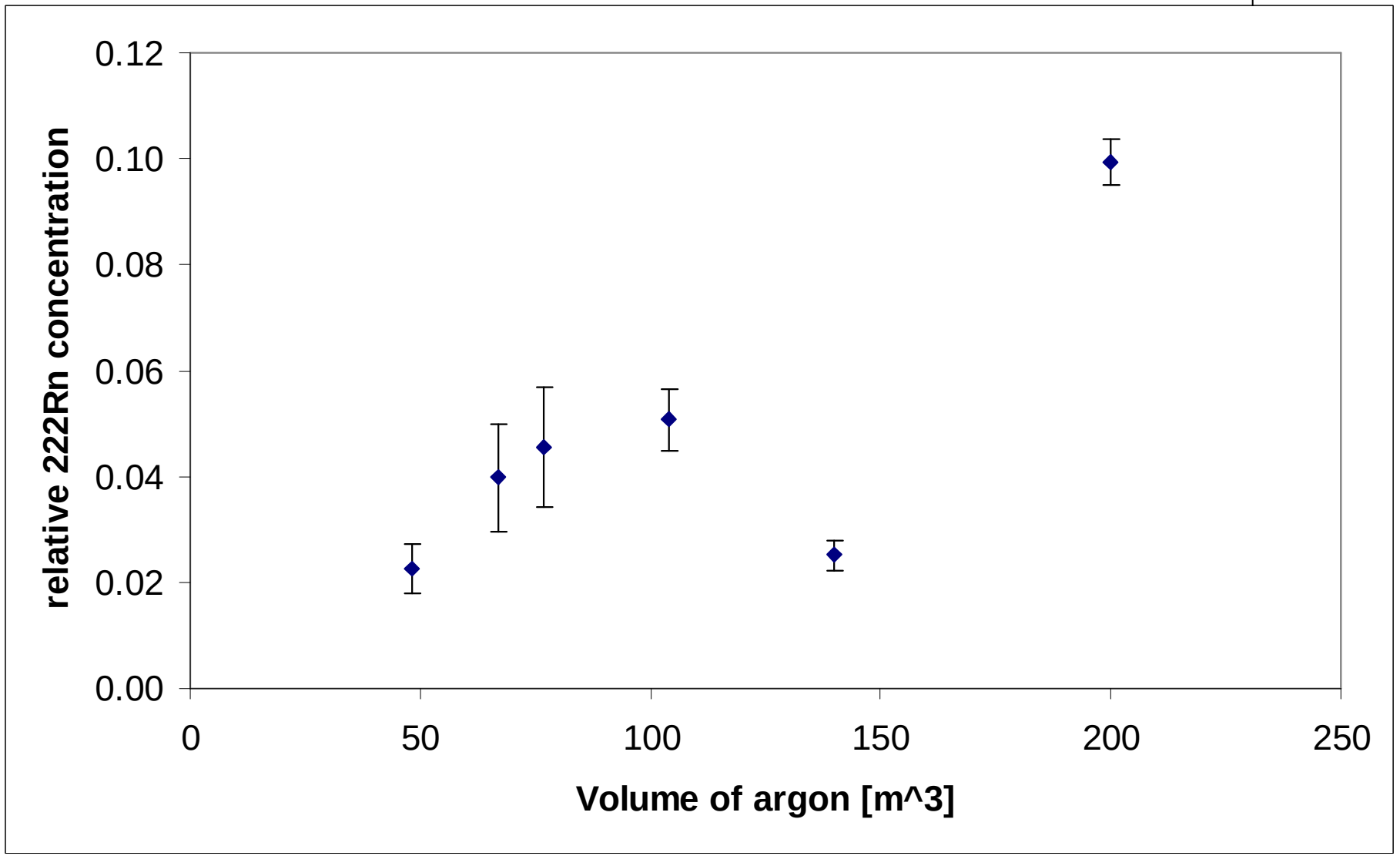
Experimental setup for liquid phase adsorption tests



Results for liquid phase adsorption (60 g carbon trap)

Date	Volume [m^3]	Initial conc. [mBq/m^3]	Final conc. [µBq/m^3]	Reduction factor [1/kg]
24.4.07	48	0.15	3.3	740
4.6.07	67	0.05	2.1	420
6.6.07	77	0.06	2.7	370
13.6.05	104	0.11	5.6	330
19.4.07	140	0.21	5.2	660
8.6.05	200	6.0	600	170

Results for liquid phase adsorption (60 g carbon trap)



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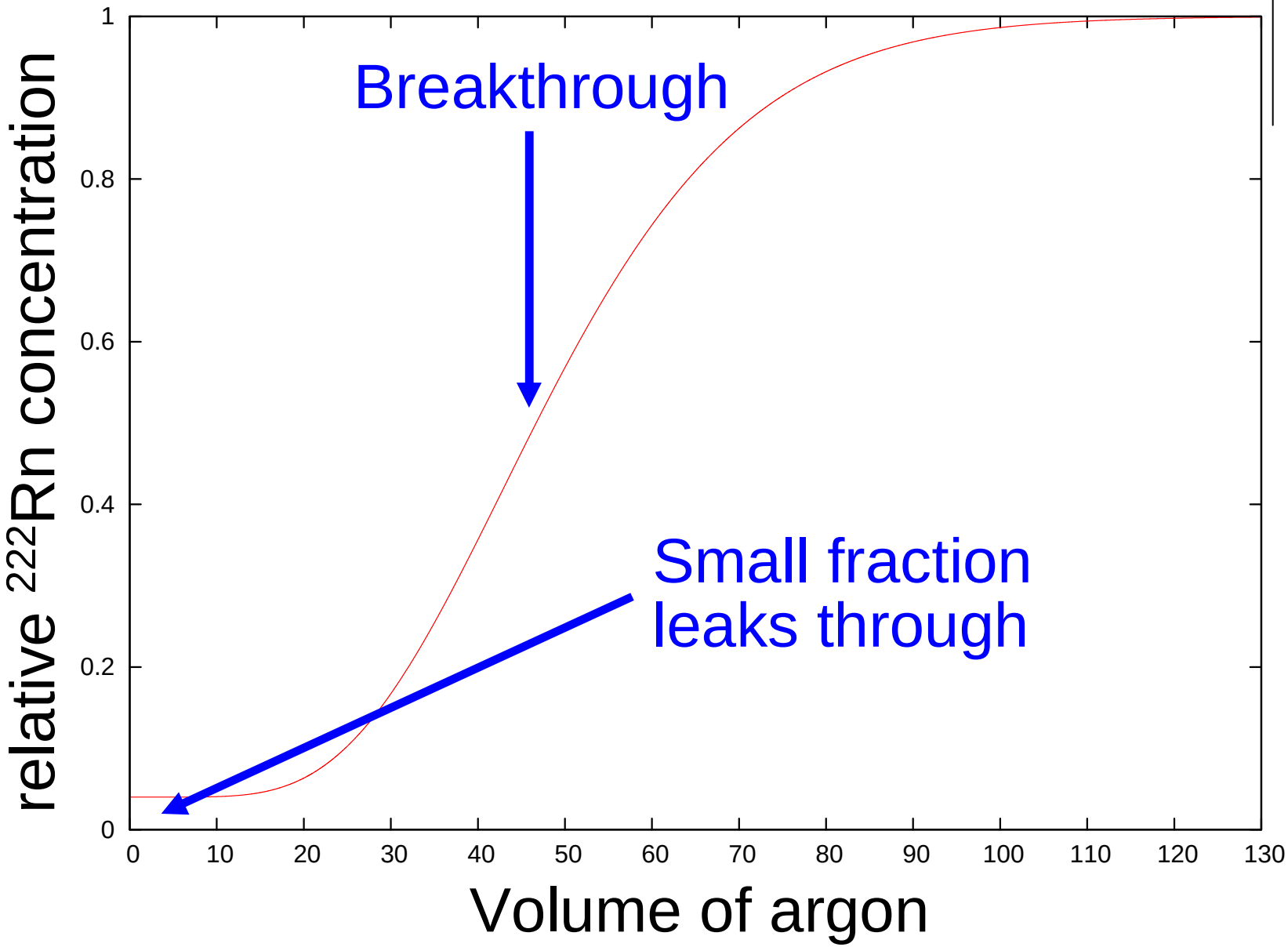

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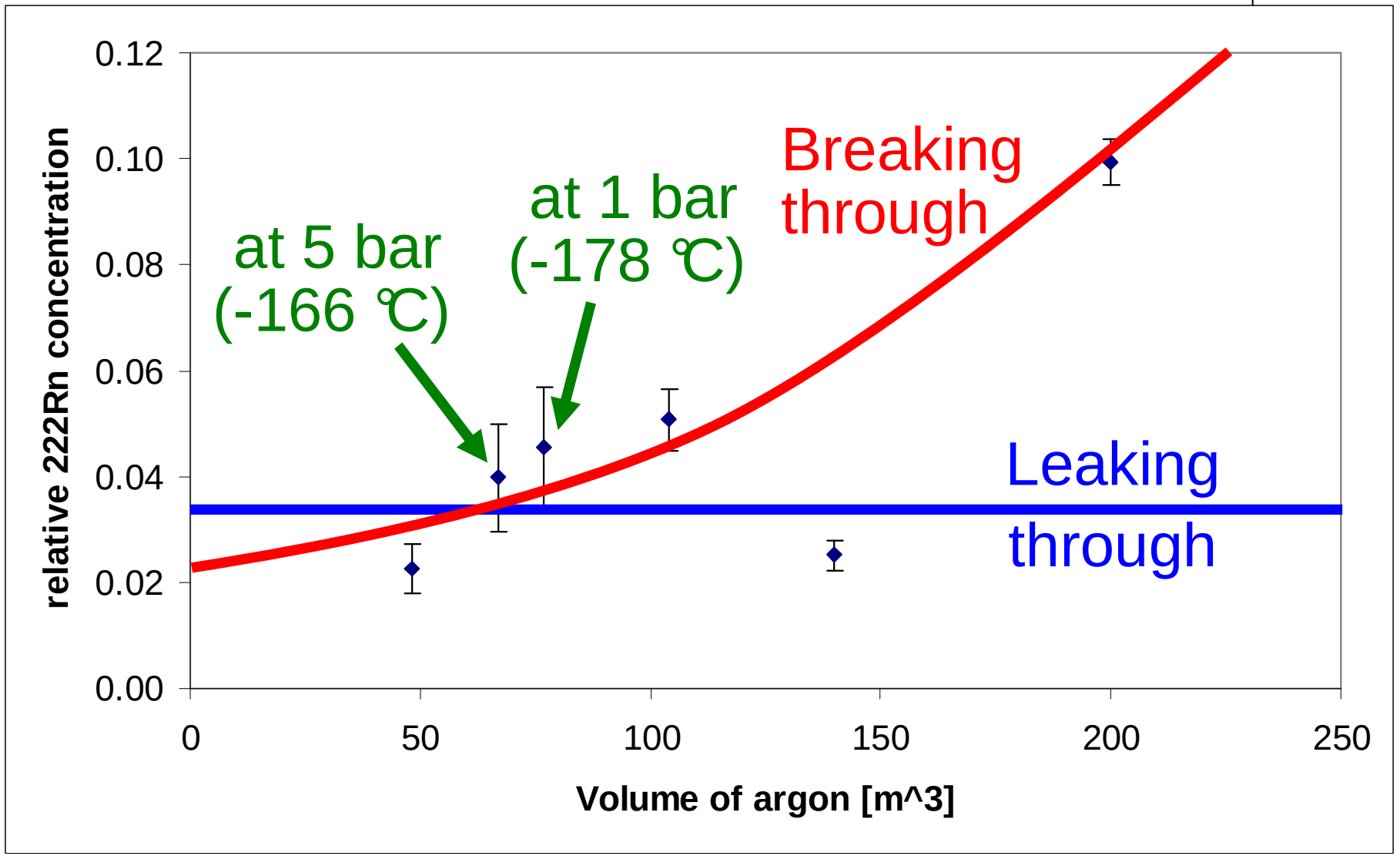

Conclusions

- Commercial Ar not as dirty as believed
  - still worse than N_2
- Very clean storage tank available at LNGS
- Purification still necessary
  - Contamination due to oxygen removal
- Next tests: Liquid phase adsorption with large adsorption column