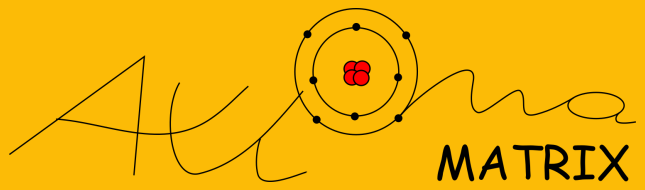


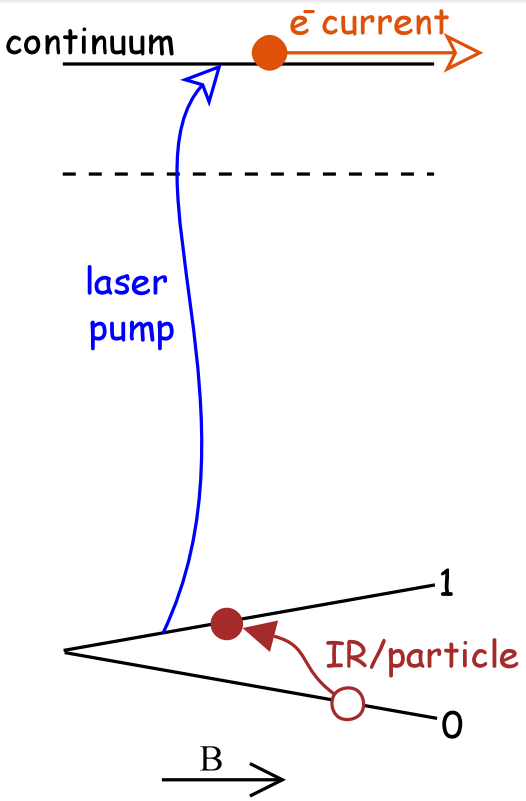
Electrons emission from crystals of inert gases

Guarise Marco

AXIOMA Meeting Padova, 20 June 2017

UNIVERSITÀ DEGLI STUDI DI FERRARA
- EX LABORE FRUCTUS -

Scheme



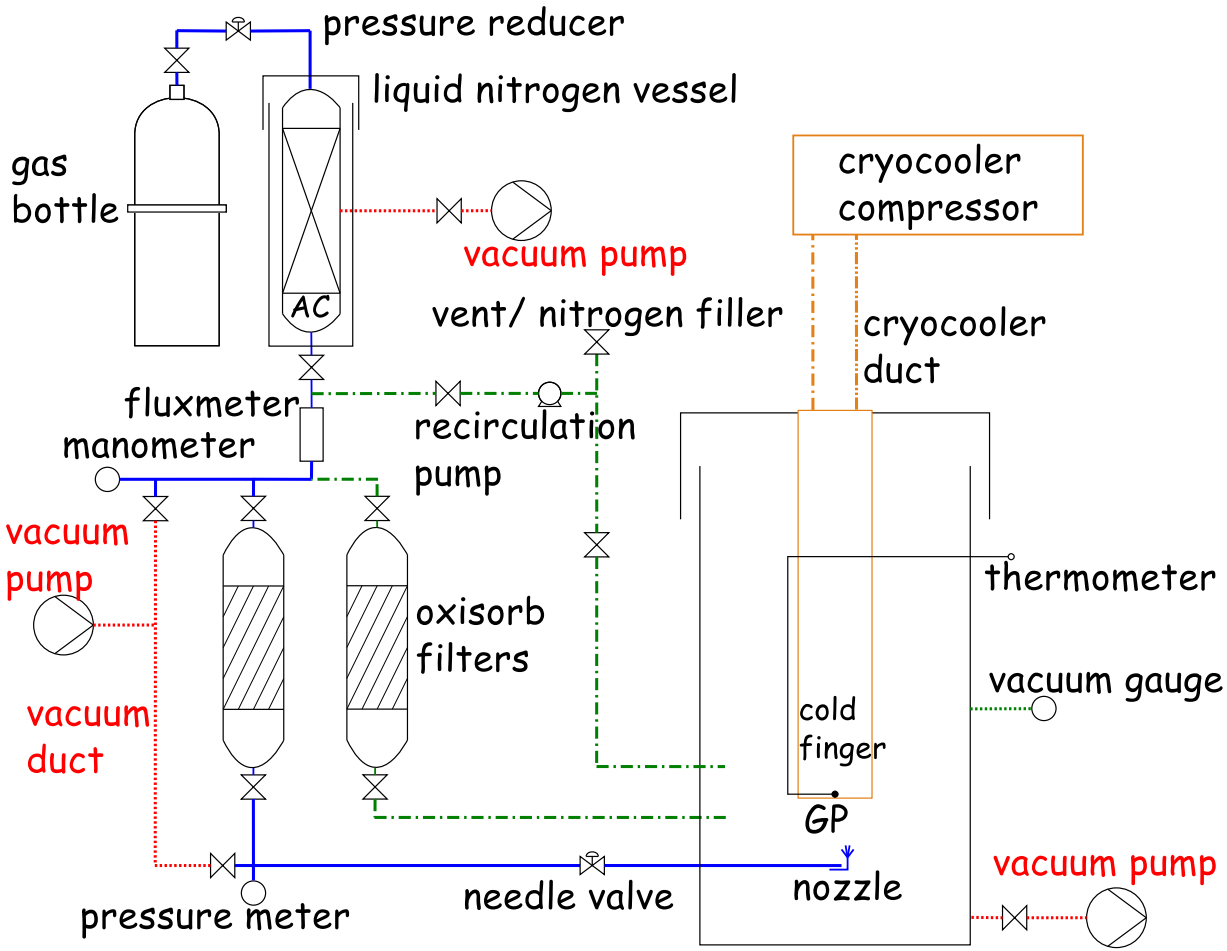
Features

- Matrix isolation technique [*J. Chem. Phys.* 22, 11 (1954)]
- matrix of inert gas (Ne, para-H_2, CH_4)
- Li, Na, K, Rb, Cs embedded in
- first ionization energy [3.89-5.39] eV
- $\sigma_{ionizzation} \sim 10^{-10} - 10^{-14}\,\mathrm{cm}^2$
- low interaction host-guest$\rightarrow$low linewidth broadening
- AXION mass: m_a tuned to the $0\rightarrow1$ transition (E_1-E_0)
- electron signal: high collection efficiency

Matrices parameters

matrix	**a (Å)**	$\mathbf{E}_{gap}$ **(eV)**	V_0	μ_e**(cm^2 V^{-1} s^{-1})**
Ne	~ 4.4	$\sim$13	+1.1	600
CH_4	~ 8	$\sim$24.5	-0.18	100
$para - H_2$	~ 3.7		+2	

gas purification

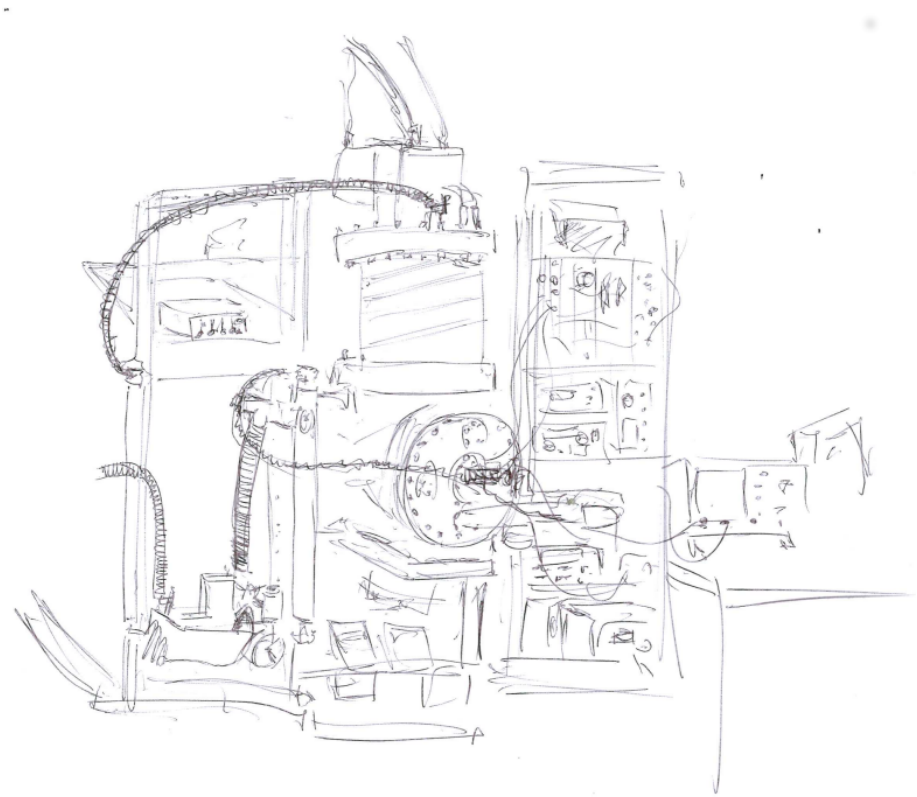


Features:

- activated charcoal filter
- Oxysorb filter

$\Longrightarrow$ O_2 impurities < 5ppb in Ne and CH_4

crystal growth



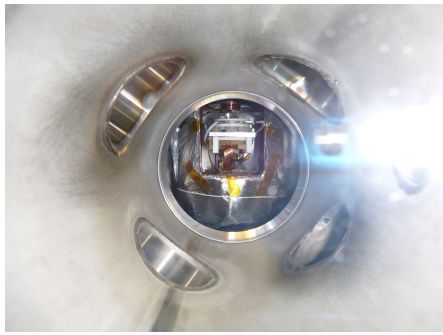
Characteristics

- 1 W pulse tube He cryocooler @ 4K
- fine tuning temperature control
- chamber cleaning & baking
- Oxysorb filter
- $P_{chamber} \sim 10^{-8}$ mbar

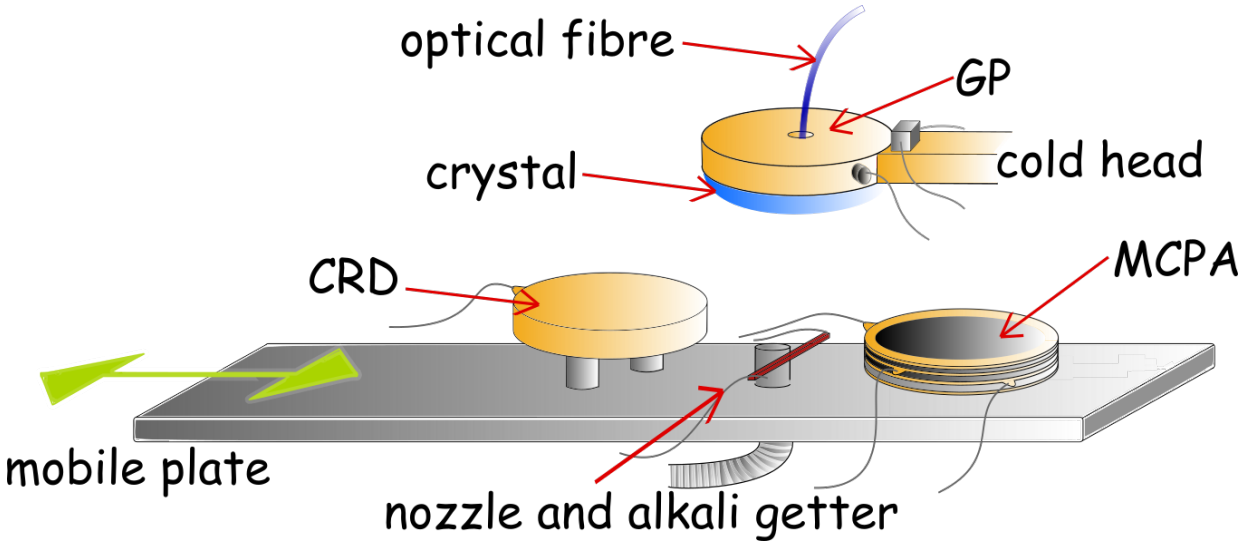
growing parameters:

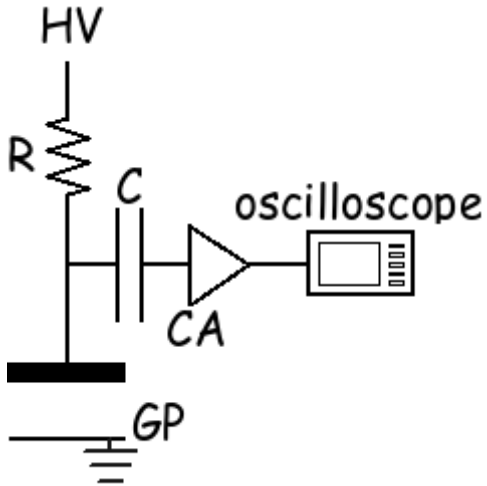
- $P_{growth} \sim 2 \cdot 10^{-5}$ mbar
- $t_{growth} \sim 2$ h
- $T_{growth} \sim 9$ K
- $t_{annealing} \sim 15$ min

$\Longrightarrow$ 25 mm diameter, 2 mm thickness crystals



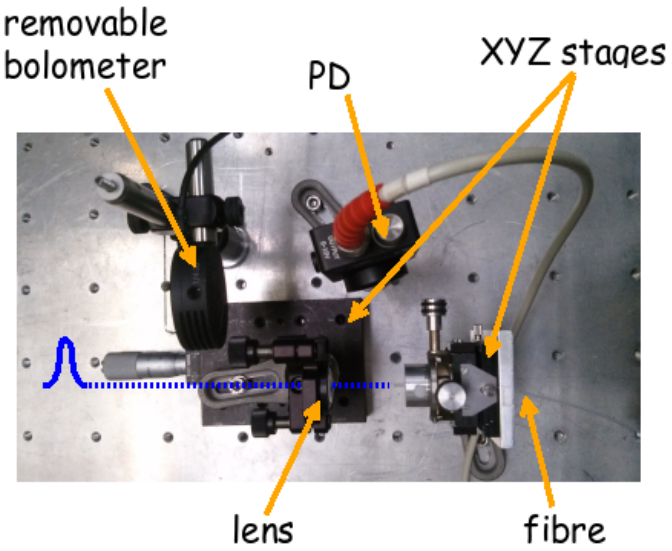
electrons injection & collection



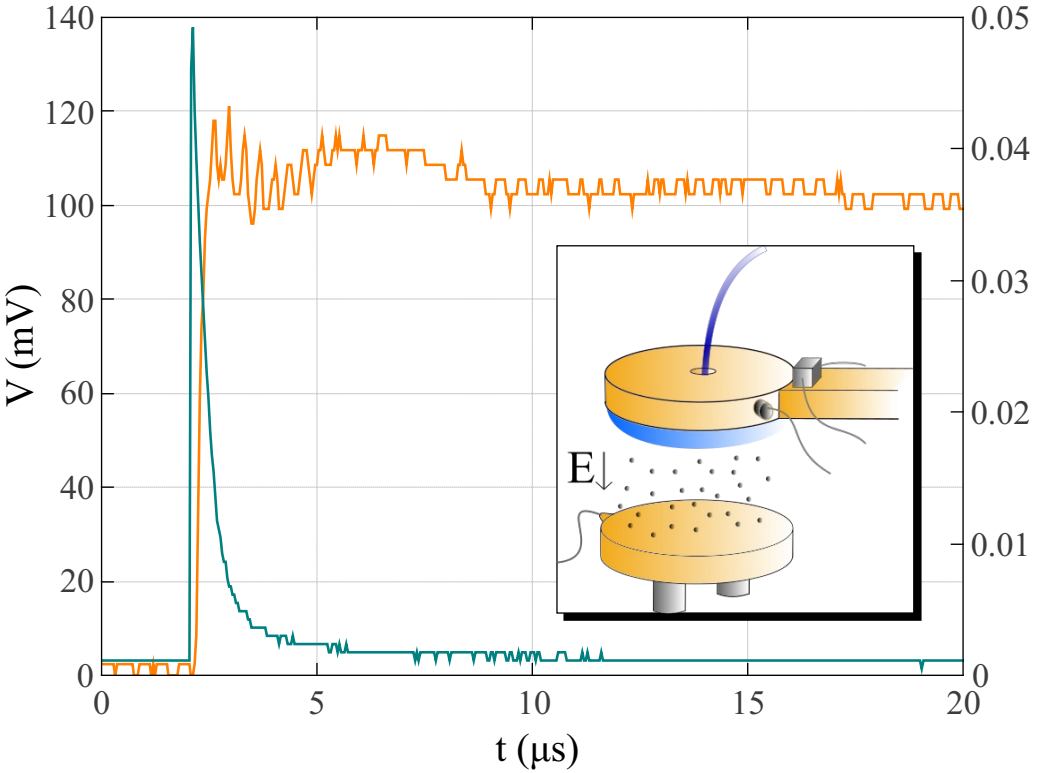


Characteristics

- Au photocathode in the cold head
- fused silica fibre
- 10 ns laser pulses @ 266 nm
- energy up to 1 mJ
- cherge receiver disk or microchannel plate assembly

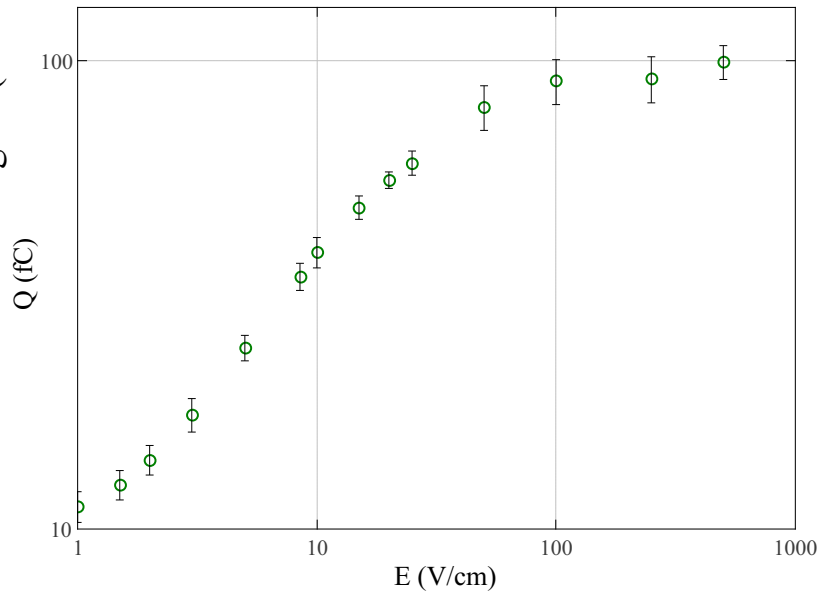


electrons extraction



Measurements

electrons injection and emission in s-Ne & s-CH_4 for different electric field applied



long time (hours) stability signal ⇒ no charge space effect! ⇒ no trapping sites! ⇒ high quality crystals!

conclusions

further steps

- cosmic rays detection in s-Ne & CH_4
- electrons focusing (test in progress)
- tests with silicon detector, channeltron and phospor scintillator (test in progress)
- alkali doping and spectroscopy

paper reference

ArXive 1703, 10880 (2017)

the end

Thanks for your attention

People

C. Braggio, R. Calabrese, G. Carugno, A. Dainelli, A. Khanbekyan, M. Guarise, E. Luppi, E.Mariotti, M. Poggi, L. Tomassetti