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Liquid Hydrogen & Noble Gases Scintillators

10 min talk

10 Nov 2000

$\nu$_ cool Instrumentation Workshop

Table 1
Properties of noble liquids

| | | LAr | LKr | LXe |
|---|---|---|---|---|
| Density | g/cm$^3$ | 1.39 | 2.45 | 3.06 |
| d$E$/d$x$ ⟨mip⟩ | MeV/cm | 2.11 | 3.45 | 3.89 |
| Radiation length | cm | 14.3 | 4.76 | 2.77 |
| Molière radius [a] | cm | 7.3 | 4.7 | 4.1 |
| Photons/MeV [16] | k | | 19 | 26 |
| % light in fast component | | 8 | 1 | 77 |
| Decay const. | | | | |
| fast | ns | 6.5 | 2 | 2 |
| slow | ns | 1100 | 85 | 30 |
| $\lambda$ peak | nm | 130 | 150 | 175 |
| Refractive index @ 170 nm | | – | 1.41 | 1.60 |
| Drift vel. (10 kV/cm) | cm/$\mu$s | 0.5 | 0.5 | 0.3 |
| Fano factor | | 0.11 | 0.06 | 0.05 |
| Dielectric constant | | 1.51 | 1.66 | 1.95 |
| Triple point | | | | |
| Temperature | K | 84 | 116 | 161 |
| Pressure | bar | 0.67 | 0.72 | 0.80 |

[a] PDG definition.

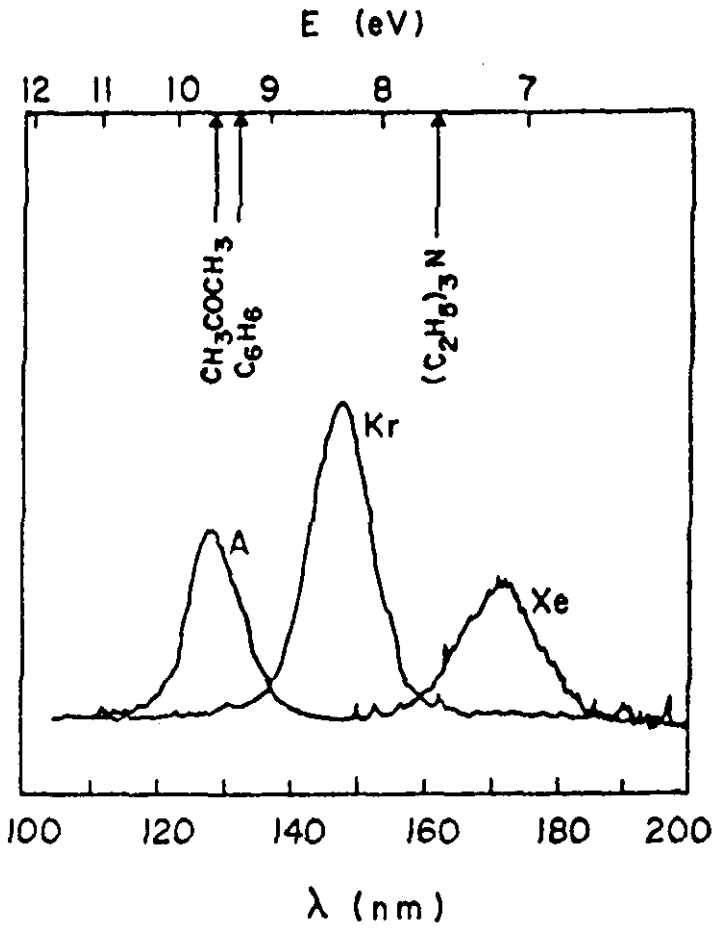
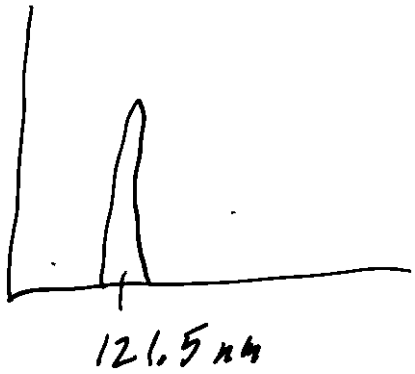
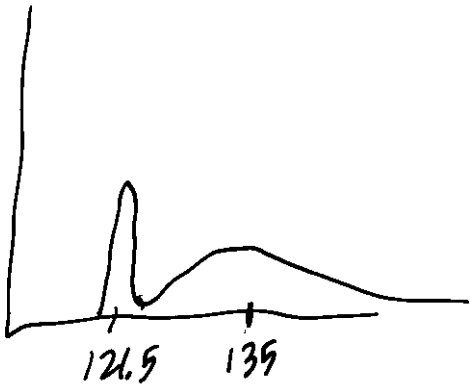



Fig. 2 Spectral distribution of the secondary light emission of pure noble gases, in moderate electric fields, together with the ionization potentials of some vapours (Ref. 13).

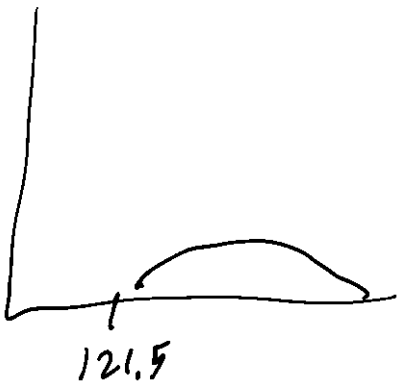
Atomic Gas




Atomic Gas at Pressure




Pure $LH_2$



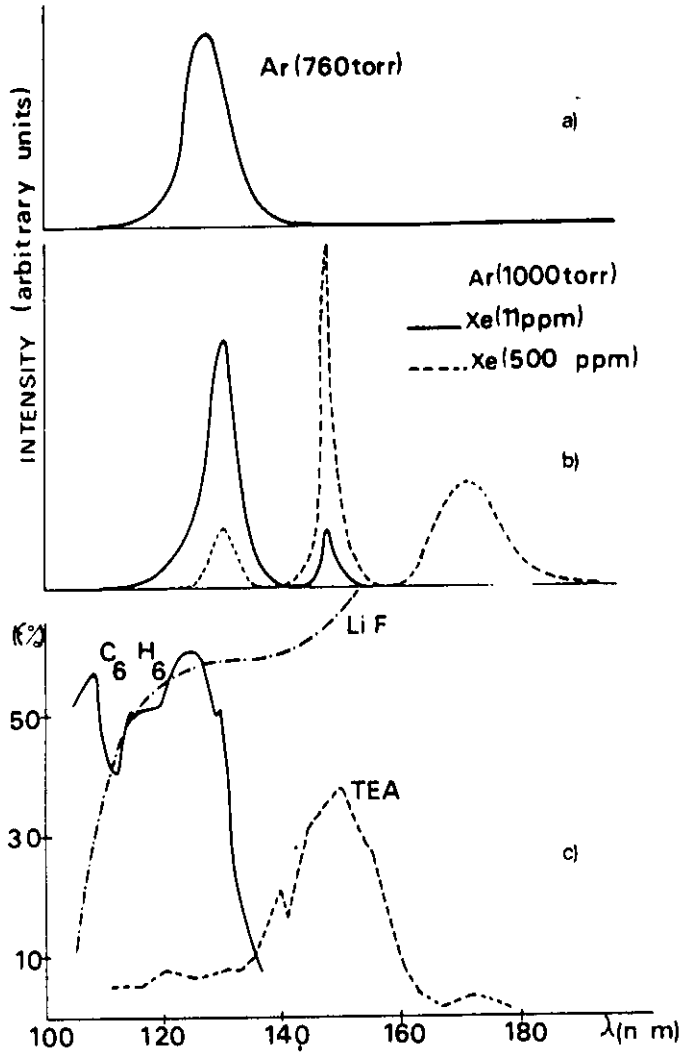



Fig. 1. (a) Emission spectrum of proport argon (at 760 Torr) (after ref. 6). (b) gaseous argon (1000 Torr) doped with concentrations (after ref. 10). (c) Qua benzene and triethylamine (TEA) and 5 mm thick LiF cystal as a function of (after refs. 4 and 13).

Problem:

Very hard to get 121 nm light out!

Option 1

So we can dope with

1% Kr or Xe

Option 2

Wavelength shifter

Na - Salicylate is a great choice:

a.) can dissolve in $CH_2$ and

b.) efficient shifter at 120 nm into green-blue light.

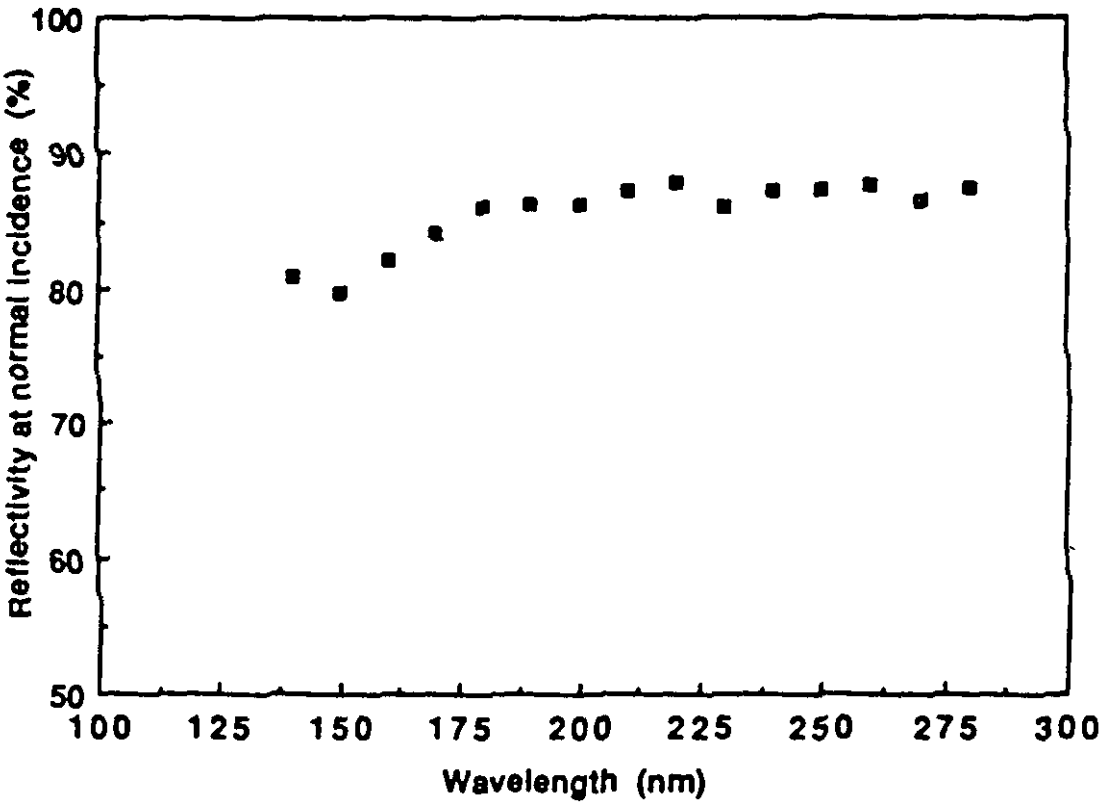



Fig. 3. The reflectivity of the aluminized cell walls versus wavelength for perpendicular incidence in vacuo.