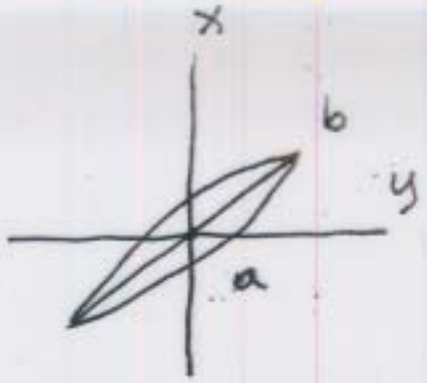


$$\psi = \frac{b}{a} = \pi K_{CM} B^2 p_a \frac{L}{\lambda} \cdot \operatorname{sen} 2\theta$$

Where K_{CM} is the Cotton-Mouton constant typical for each gas.

So that for fixed pressure one has a pattern like

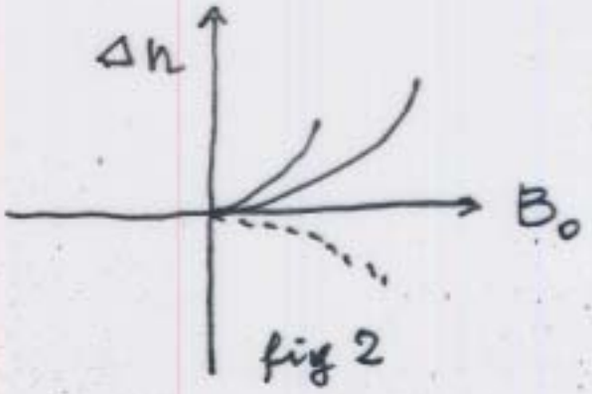


fig 2

same positive et some negative.

We have done an intense measurements to establish with precision the constant K_{CM} (gas) for many gasses (see pag 2).

In fig 4 is given the measurement's scheme

Notice the linearization expressed by the therm $2\psi_T(t)\eta(t)$: the $\eta(t)$ is the carrier signal. We use the heterodyne method to find $\psi(t)$. In ψ are included all strategic.

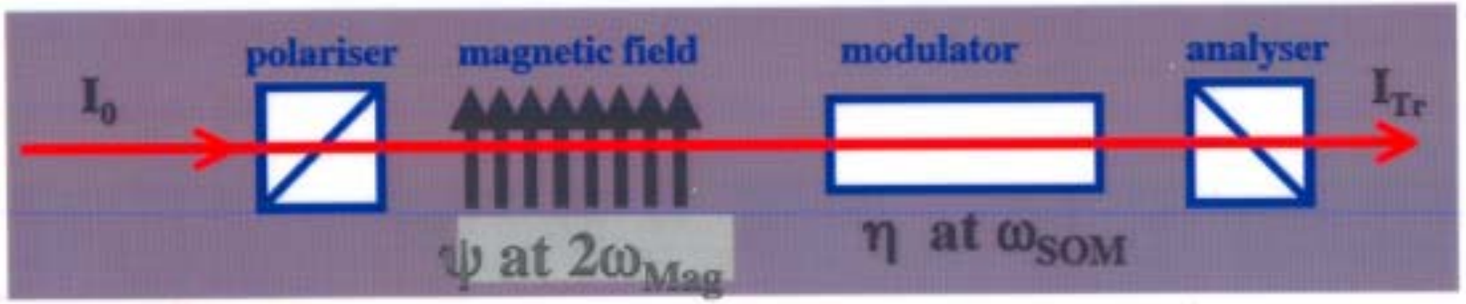
From the inverse measurements with
[illegible] we checked that all crosses
the negative at 196° as must.

At this point let-us inject a small
amount of He gas .....

Measurement principle

4

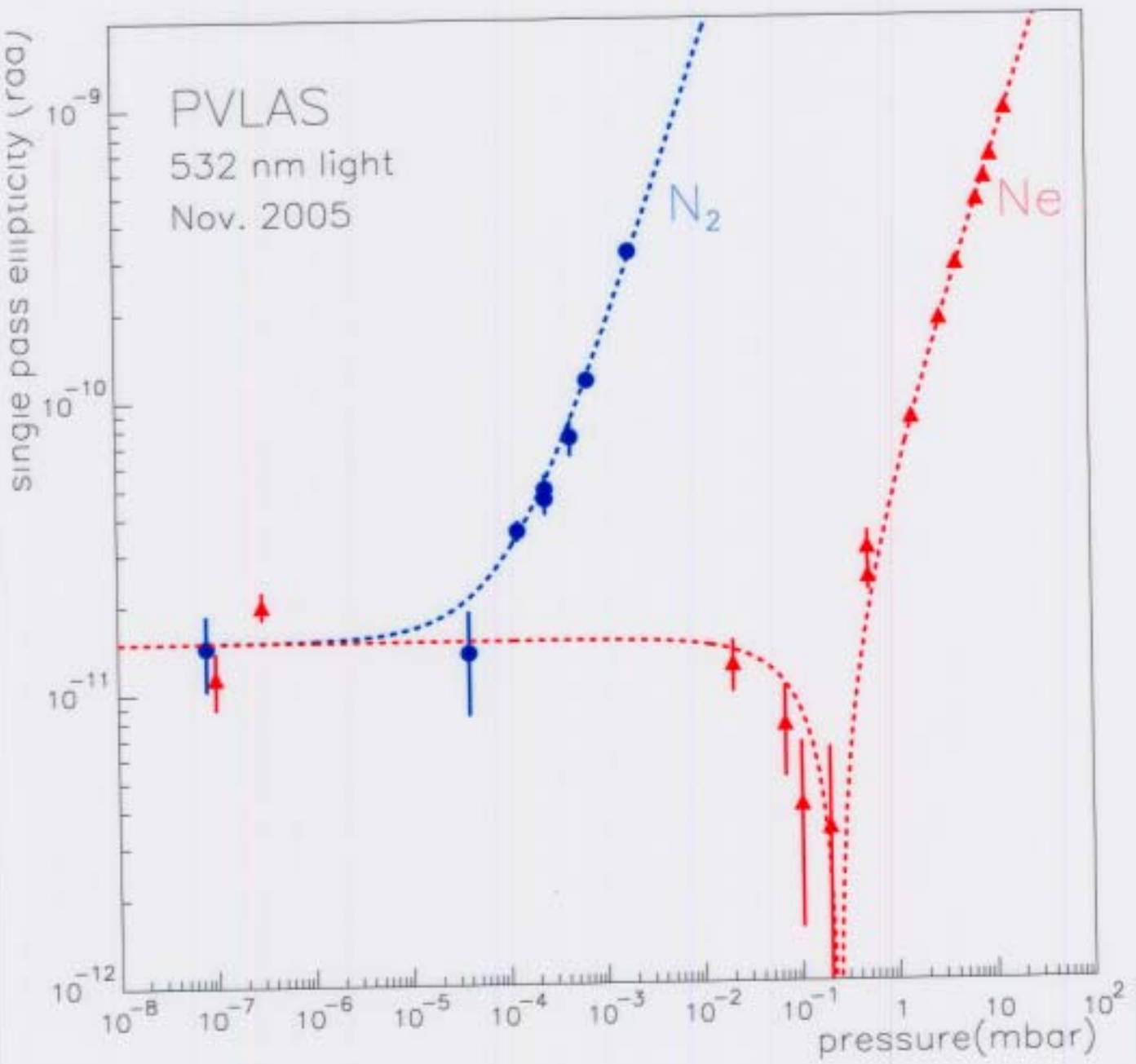
- Static measurement is excluded. But more $\Psi(t) = \sum \psi_i(t)$ $i = I, V$ I: in i = helium V = vacuum
- Modulate the field and add a carrier signal at ω_{SOM}
- Rotating the field at Ω produces an ellipticity at 2Ω



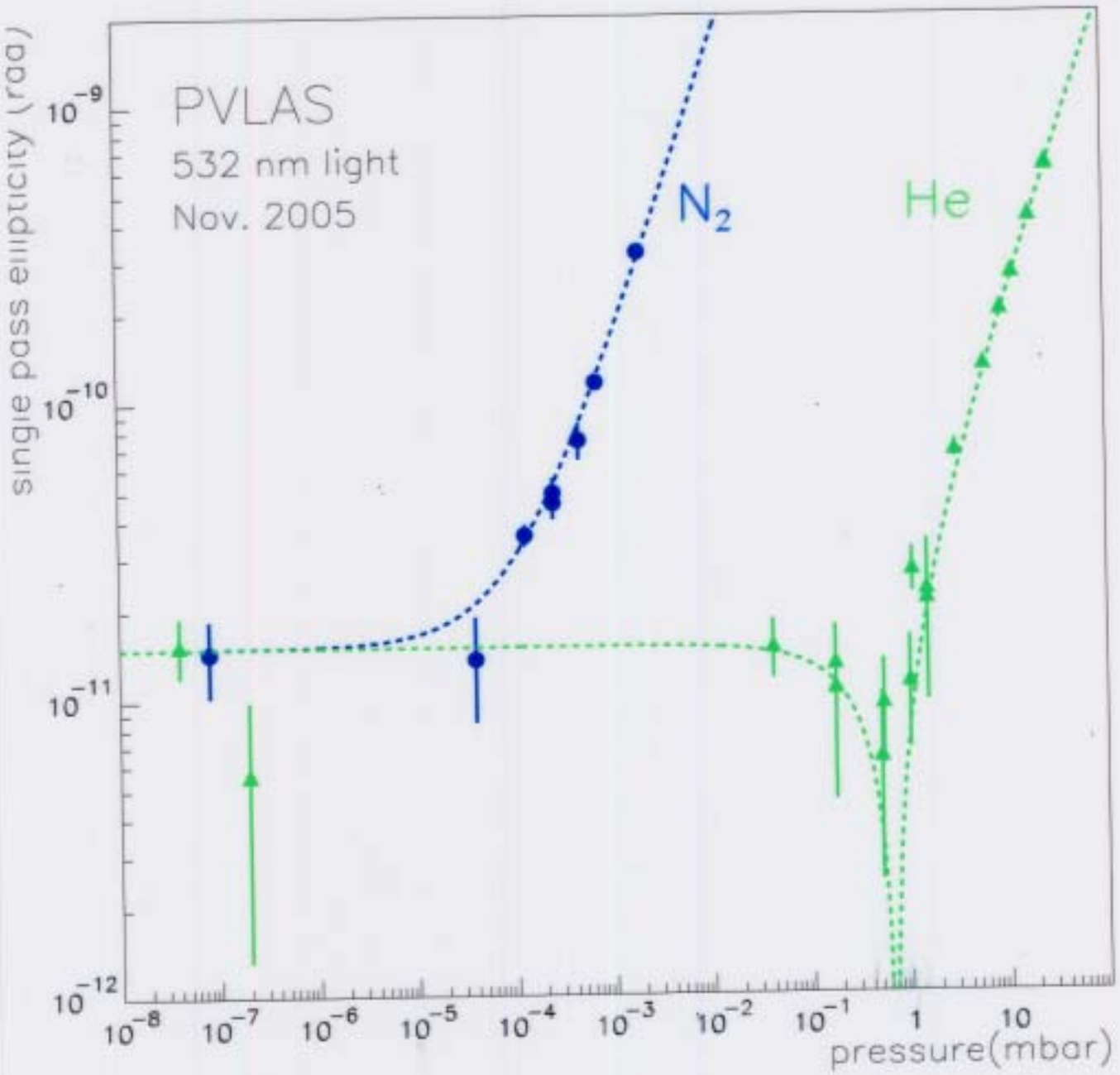
Ideally,

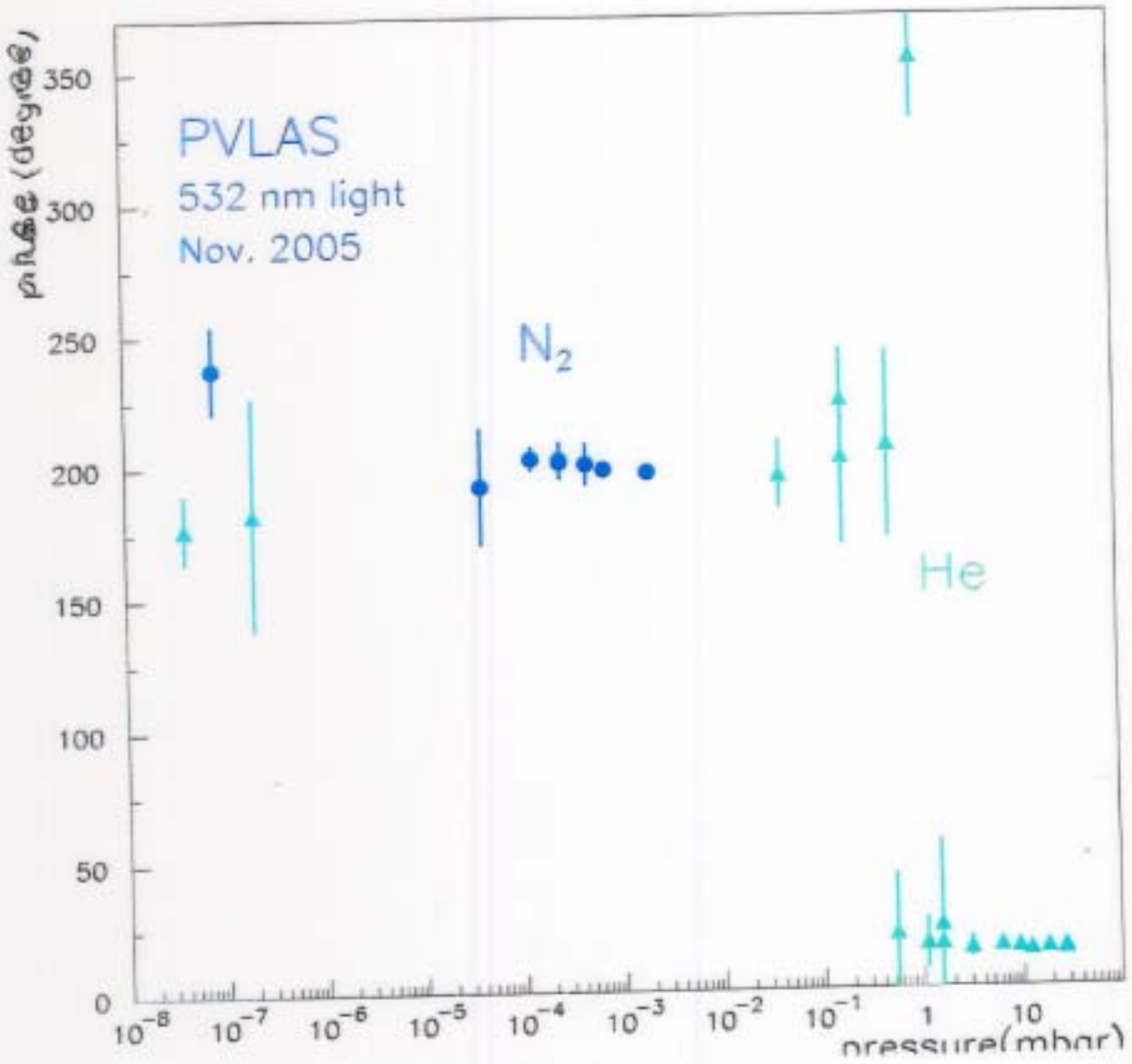
$$I_{Tr} = I_0\left[\sigma^2 + (\Psi(t) + \eta(t))^2\right] = I_0\left[\sigma^2 + \left(\Psi(t)^2 + \eta(t)^2 + 2\Psi(t)\eta(t)\right)\right]$$

Main frequency components at $\omega_{SOM} \pm 2\,\Omega_{Mag}$ and $2\omega_{SOM}$


PVLAS
532 nm light
Nov. 2005
N_2
Ne
single pass ellipticity (rad)
10^{-9}
10^{-10}
10^{-11}
10^{-12}
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
10^{2}
pressure(mbar)

Ampiezza → ellitticità/pass

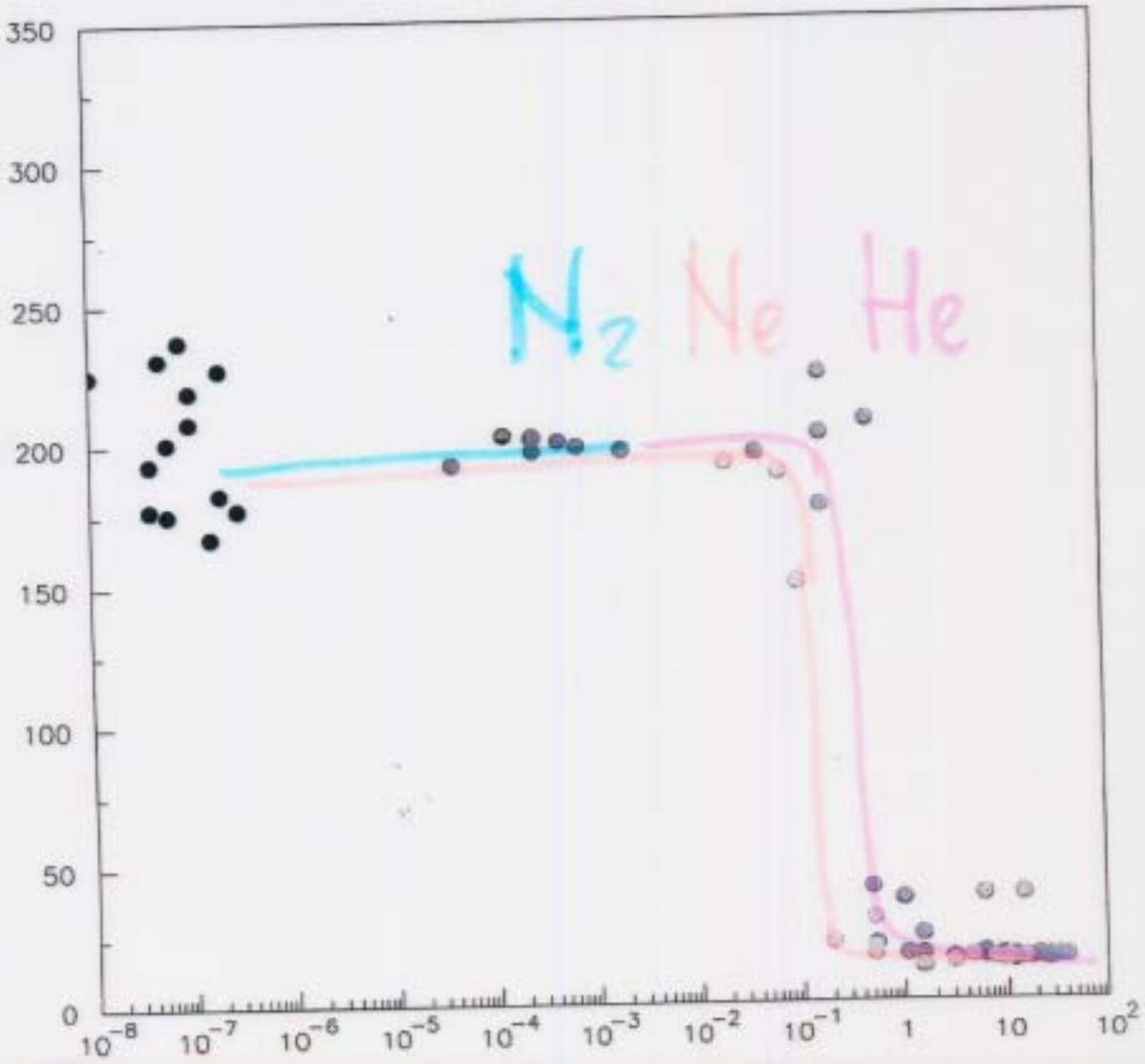



PVLAS
532 nm light
Nov. 2005
N_2
He
phase (degree)
350
300
250
200
150
100
50
0
10^{-8}
10^{-7}
10^{-6}
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
1
10
pressure(mbar)

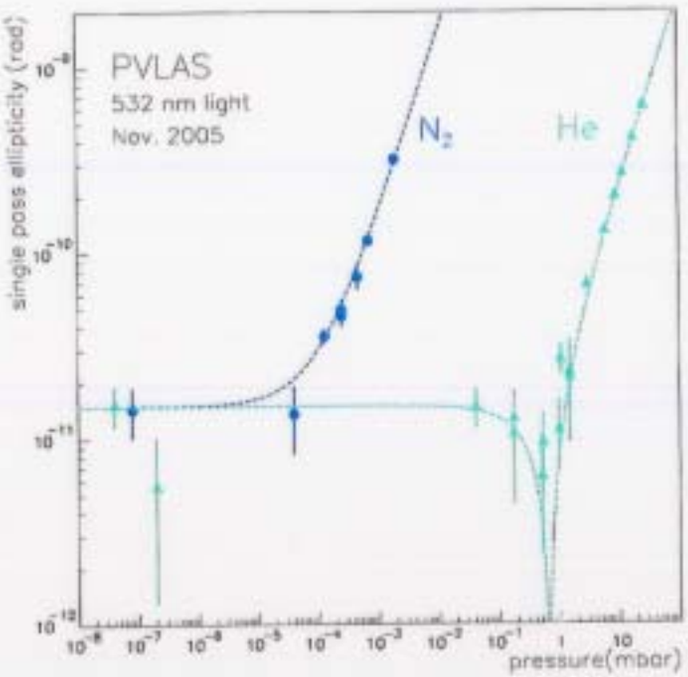
$2\omega_M$

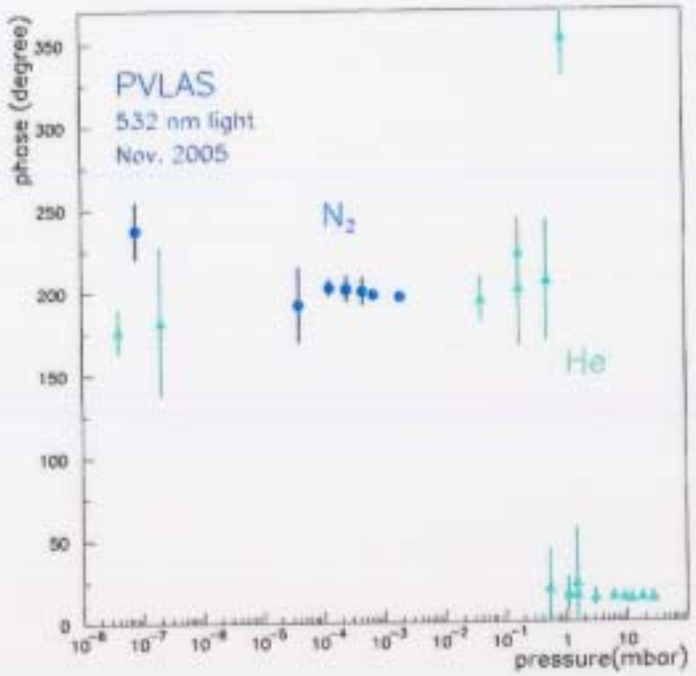
GREEN 2005

$\omega_{SOM} \pm 2\omega_M$ signal

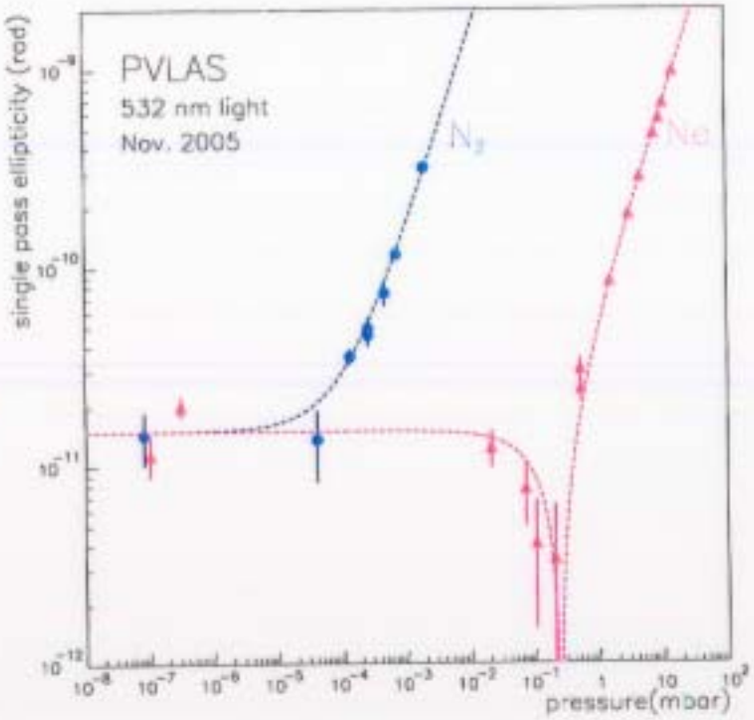


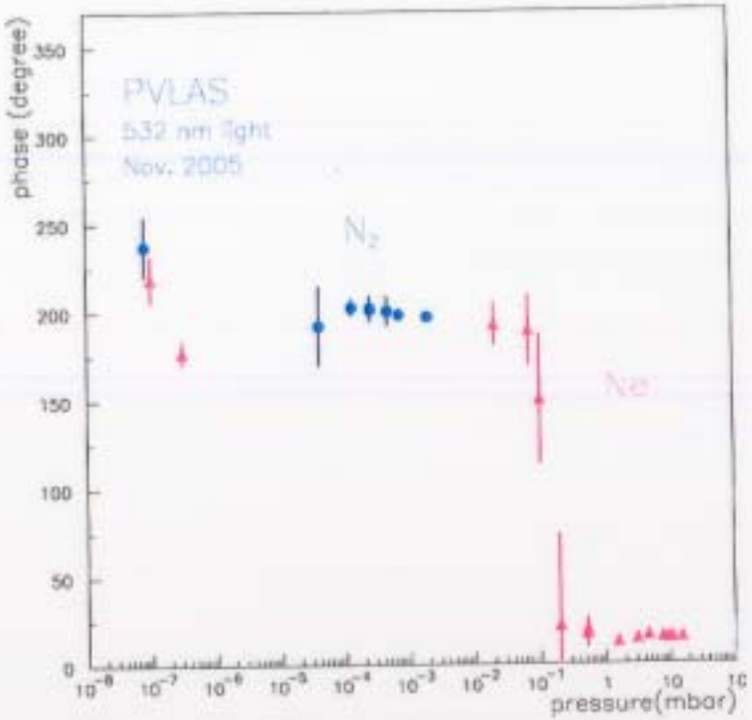
November 2005:
N_2+He + Vacuum

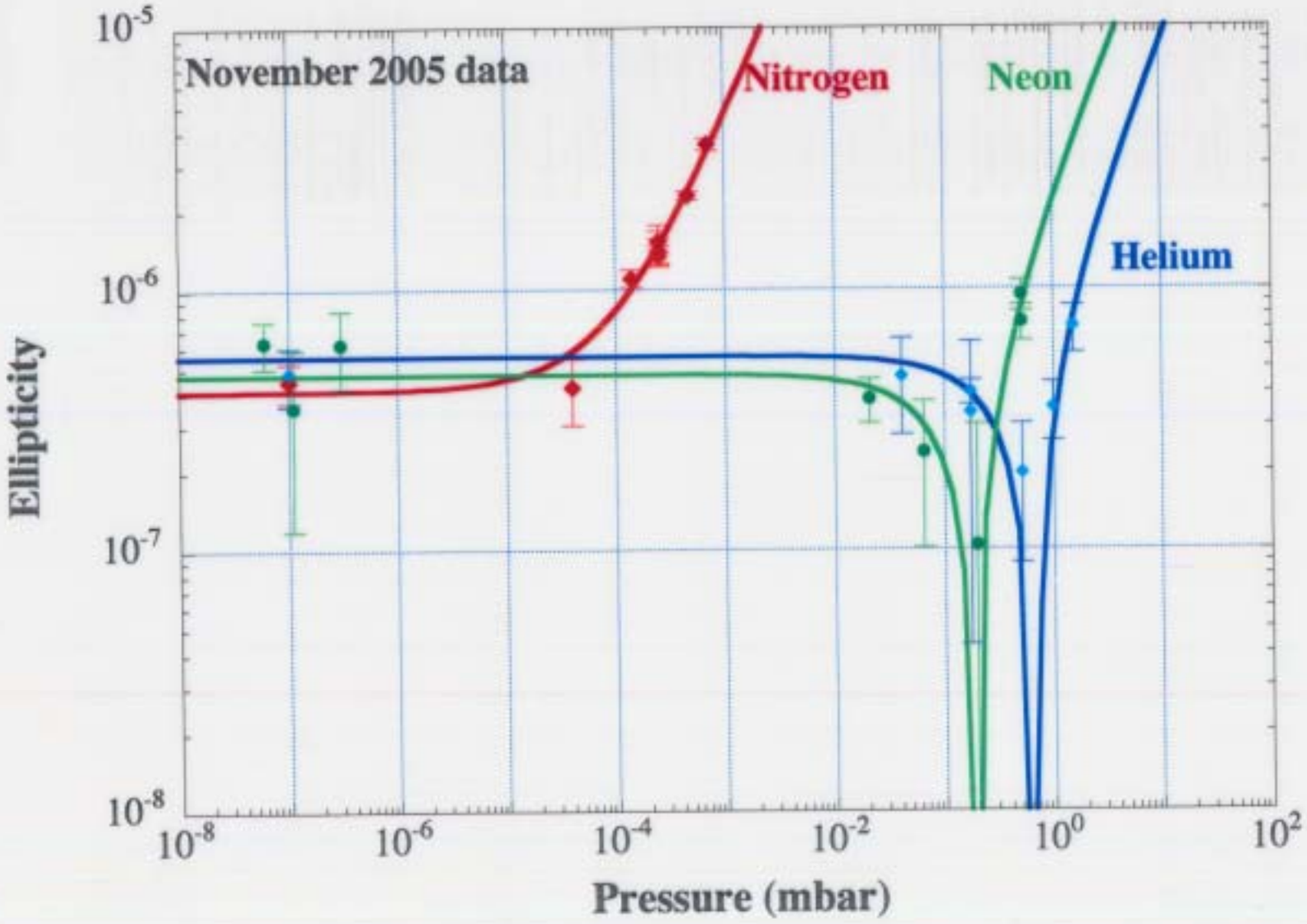


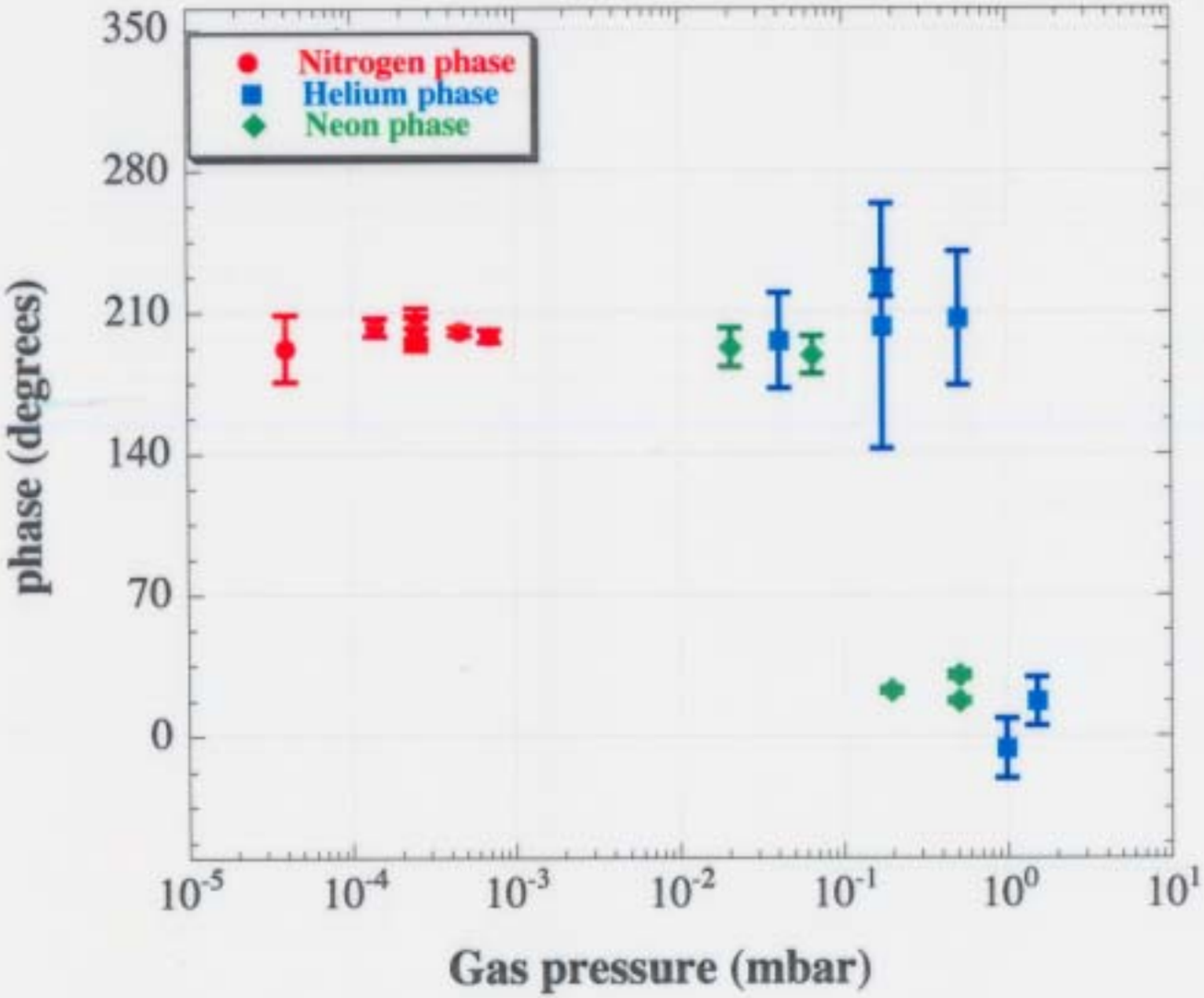


November 2005:
N_2+Ne + Vacuum






November 2005 data
Nitrogen
Neon
Helium
Ellipticity
Pressure (mbar)
10^-5
10^-6
10^-7
10^-8
10^-8
10^-6
10^-4
10^-2
10^0
10^2


Nitrogen phase
Helium phase
Neon phase
350
280
210
140
70
0
phase (degrees)
10^{-5}
10^{-4}
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
Gas pressure (mbar)

Cotton Mouton effect in gases

Birefringence

$$\Delta n = \Delta n_u \left(\frac{B[\mathrm{T}]}{1\mathrm{T}} \right)^2 \left(\frac{P}{P_{\mathrm{atm}}} \right)$$

Ellipticity Ψ due to birefringence

$$\Psi = \pi N \frac{L}{\lambda} \Delta n \sin(2\theta)$$

From literature

Gas	Δn_u (T ~ 293 K)
Nitrogen	- (2.47± 0.04) x 10^{-13}
Oxygen	- (2.52± 0.04) x 10^{-12}
Carbon Oxide	- (1.83± 0.05) x 10^{-13}

Measured by PVLAS

Gas	Δn_u (T ~ 290 K, λ=1064 nm)
Xenon	(2.44 ± 0.22)x10^{-15}
Kripton	(8.61 ± 0.35)x10^{-15}
Helium	(1.75 ± 0.07)x10^{-16}
Neon	(5.8 ± 0.1)x10^{-16}

Summary

Ellipticity per pass at 5 T field in vacuum

dato medio da	amplezza a 5 T (10^{-11} rad /pass)	fase / segno
misure con gas - infrarosso	0.42 ± 0.02	opposto al neon
record in vuoto - infrarosso	0.34 ± 0.03	161± 6
misure con gas - verde	1.45 ± 0.08	opposto al neon
record in vuoto - verde	0.60 ± 0.06	207 ± 6