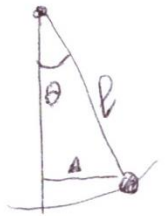
Note su di un possibile esperimento "casalingo" con un pendolino per la misura di g



@ $l = 100\ cm$

$\Delta = 1\ cm \rightarrow \theta \sim 0{,}57^\circ\ (0.01\ rad) \rightarrow \left|\frac{\theta - \sin\theta}{\sin\theta}\right| \sim 1.7 \times 10^{-5}$

$\Delta = 10\ cm \rightarrow \theta \sim 5{,}7^\circ\ (0{,}10\ rad) \rightarrow \left|\frac{\theta - \sin\theta}{\sin\theta}\right| \sim 1.7 \times 10^{-3}$

@ $l = (100{,}5 \pm 0{,}5)\ cm$

$16 \times T = \begin{vmatrix} 32\ s \\ 33\ s \\ 32\ s \end{vmatrix} \Rightarrow \Delta t = 1\ s$

$T_{max} = \frac{16 \times T_{max}}{16} = \frac{33}{16} = 2.0625\ s$

$T_{min} = \frac{16 \times T_{min}}{16} = \frac{32}{16} = 2{,}0000\ s$

$T_{intermedio} = \frac{T_{max} + T_{min}}{2} = 2{,}02083\ s$

$\Delta T = \frac{T_{max} - T_{min}}{2} = 0{,}031\ s$

$T_{exp} \pm \Delta T = (2{,}021 \pm 0{,}031)\ s$

$T_{atteso} = 2\pi\sqrt{\frac{l}{g}} = 2\pi\sqrt{\frac{1{,}005}{9{,}81}} = 2{,}011\ s$

$\frac{T_{exp} - T_{atteso}}{T_{atteso}} = \frac{2{,}021 - 2{,}011}{2{,}011} = 0{,}0050$

@ $l = (52{,}0 \pm 0{,}5)\ cm$

$42 \times T = 61\ s$ (con $\Delta t = 1\ s$)

$T_{exp} = 1{,}45238\ s$

$T_{atteso} = 2\pi\sqrt{\frac{0{,}52}{9{,}81}} = 1{,}4466\ s$

$\frac{T_{exp} - T_{atteso}}{T_{atteso}} = \frac{1{,}45238 - 1{,}4466}{1{,}4466} = 0{,}0040$

@ $l = (26{,}5 \pm 0{,}5)\ cm$

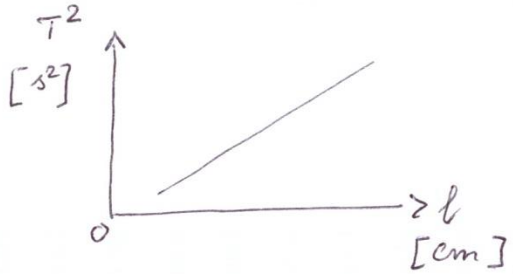
$30 \times T = 30\ s$ (con $\Delta t = 1\ s$)

$T_{exp} = 1{,}00000\ s$

$T_{atteso} = 2\pi\sqrt{\frac{0{,}265}{9{,}81}} = 1{,}032686\ s$

$\frac{T_{exp} - T_{atteso}}{T_{atteso}} = -0{,}032$

l [cm]	T [s]	T^2 [s^2]
100,5	2,02083	4,08375
52,0	1,45238	2,10941
26,5	1,00000	1,00000



$T^2 = a + bl$

$a = -(0{,}081 \pm 0{,}047)\ s^2$

$b = (0{,}04155 \pm 0{,}00071)\ s^2/cm$

$\chi^2_{fit} = \dfrac{0{,}00141234848}{3-2} = 0{,}038\ s^2$

$T^2 = (2\pi)^2 \dfrac{l}{g}$ $\quad b = \dfrac{(2\pi)^2}{g}$ $\rightarrow$ $g = \dfrac{(2\pi)^2}{b} = 950{,}14242\ cm/s^2$

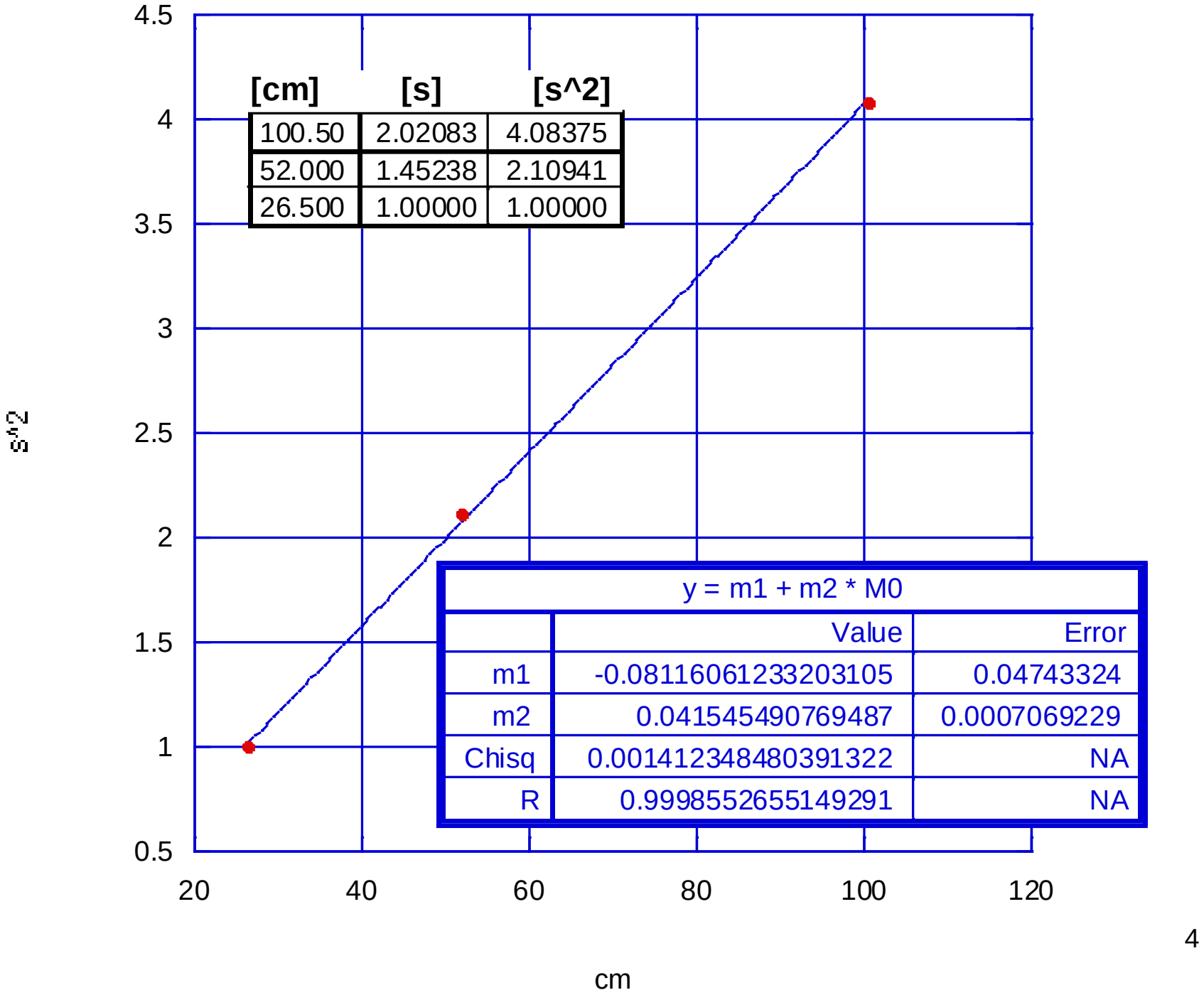
$\sigma^2(g) = \sigma^2\left(\dfrac{4\pi^2}{b}\right) = \left(-\dfrac{4\pi^2}{b^2}\right)^2 \sigma^2(b)$

$\sigma(g) = \dfrac{4\pi^2}{b^2}\sigma(b) = 16{,}24\ cm/s^2$

$g_{exp} \pm \sigma(g) = (950 \pm 16)\ cm/s^2 = (9{,}50 \pm 0{,}16)\ m/s^2$ $\quad \pm 1{,}7\%$

g_{atteso} @ $\lambda = 41°53'30''N$, $h = 52\ m$: $9{,}803223\ m/s^2$

@ G.U. 7/6/1999: $9{,}80352\ m/s^2$


[cm] [s] [s^2]
100.50 2.02083 4.08375
52.000 1.45238 2.10941
26.500 1.00000 1.00000
y = m1 + m2 * M0
Value Error
m1 -0.08116061233203105 0.04743324
m2 0.041545490769487 0.0007069229
Chisq 0.0014123484803913 22 NA
R 0.9998552655149291 NA
s^2
cm
4.5
4
3.5
3
2.5
2
1.5
1
0.5
20
40
60
80
100
120

$$\frac{g_{atteso} - g_{exp}}{\sigma_g} = \frac{9,803 - 9,50}{0,16} = 1,89 \Rightarrow P(|t| \geq 1,89) = 2 \times 0,029 = 0,058$$

$$\frac{g_{atteso} - g_{exp}}{g_{atteso}} = \frac{9,803 - 9,50}{9,803} = 3,1\,\%$$

$$T = 2\pi\sqrt{\frac{l}{g}} \rightarrow \ln T = \ln(2\pi) + \frac{1}{2}\ln l - \frac{1}{2}\ln g \longrightarrow \Delta g/g = \Delta L/L + 2\Delta T/T$$

$3,1\% \times 100,5\,cm = 3,1\,cm$

$3,1\% \times 26,5\,cm = 0,8\,cm$

2 x 3,1% x 2,021s = 0,126s

2 x 3,1% x 1,000s = 0,062s

La sistematica è imputabile principalmente alla misura manuale del periodo, meno credibile l'ipotesi di sistematica dovuta alla misura di lunghezza del pendolo.