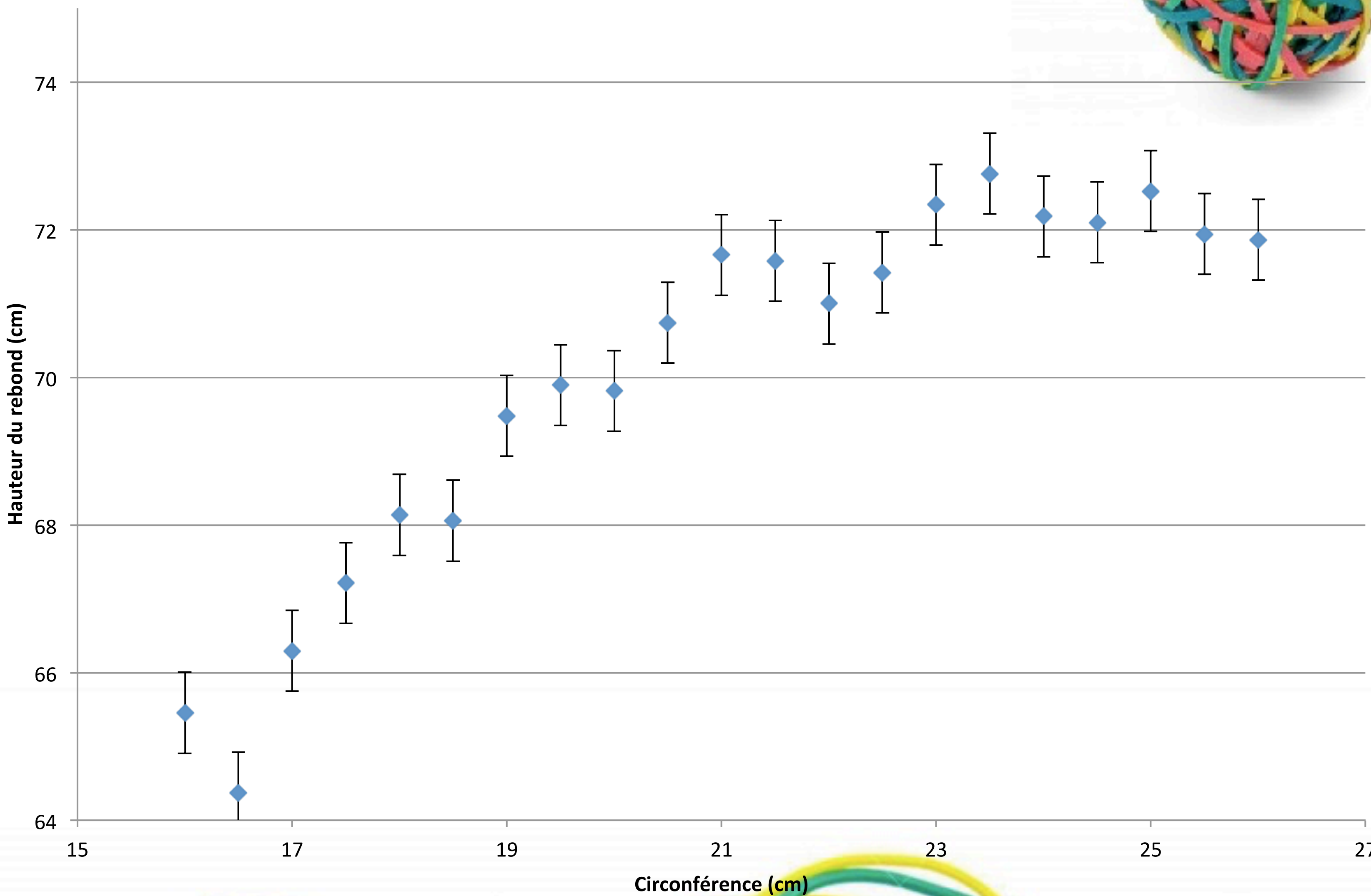
# Rubber band ball

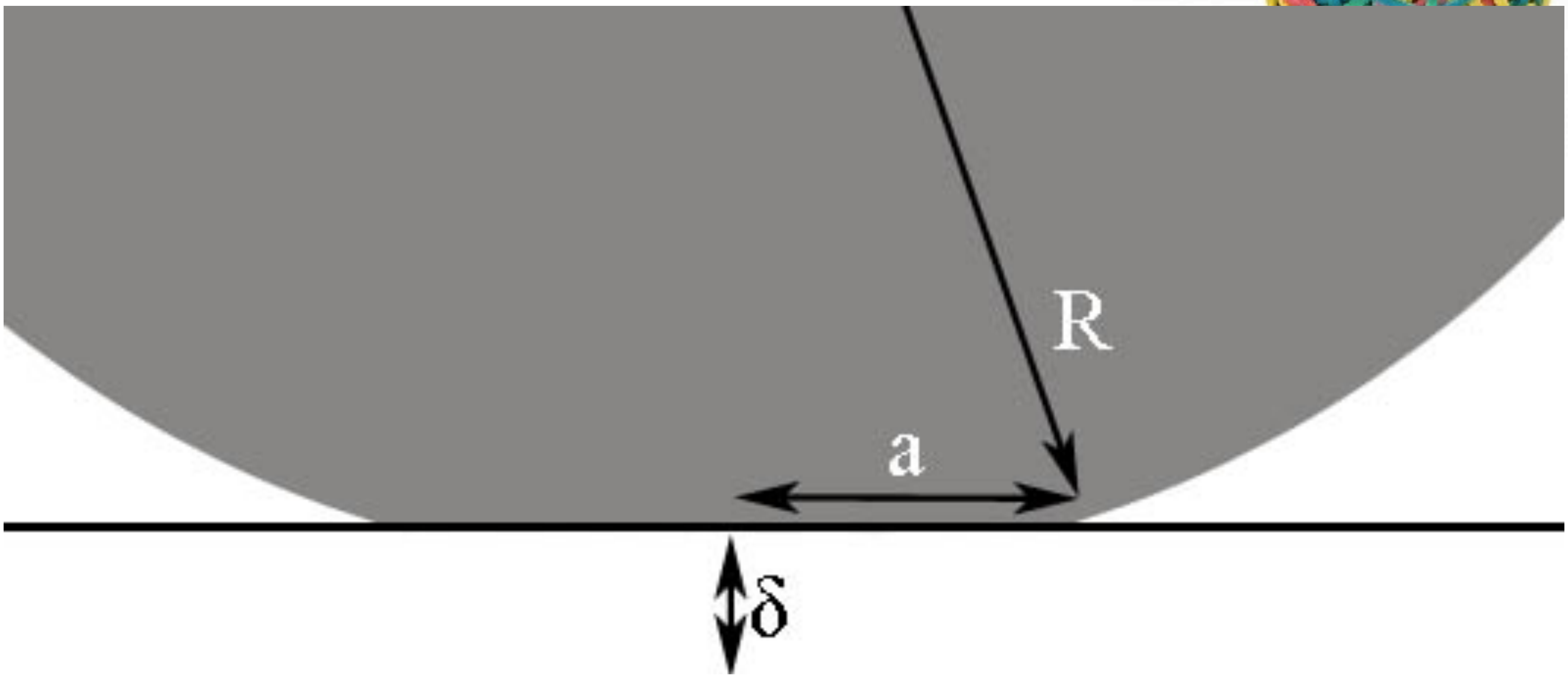
# 1 m


Hauteur du rebond (cm)
74
72
70
68
66
64
15
17
19
21
23
25
27
Circonférence (cm)

# 3 sources for the loss of energy :

- Deformation of the ball (and the support) -> heat
- Wave in the ball
- The core

# The Hertz contact




$$\delta \ll R, a \ll R \Rightarrow a^2 = 2R\delta$$

$$\delta \ll a \ll R$$

# The Hertz contact

$$\frac{F}{a^2} \sim E\frac{\delta}{a} \Rightarrow F \sim E\sqrt{R}\,\delta^{\frac{3}{2}}$$

$$Energy = mgh \sim E\sqrt{R}\,\delta_m^{\frac{5}{2}}$$

# Wave in the ball

$$amplitude : 10\,\%\, of\, \delta_m$$

$$since\; U \propto \delta_m^{\frac{5}{2}},\; U_{wave} \sim 10^{-3} U_{ball} \Rightarrow \boldsymbol{negligible}!$$

Rod Cross, « The bounce of a ball », Am. J. Phys 67 (March 1999)

# The core

$$E : 1\, mm \text{ for } 10\, N \Rightarrow E = 1\, MPa$$

$$R = 3\, cm, R_c = 2\, cm$$

$$\delta_m \sim 5\, mm \text{ and } a \sim 1\, cm$$

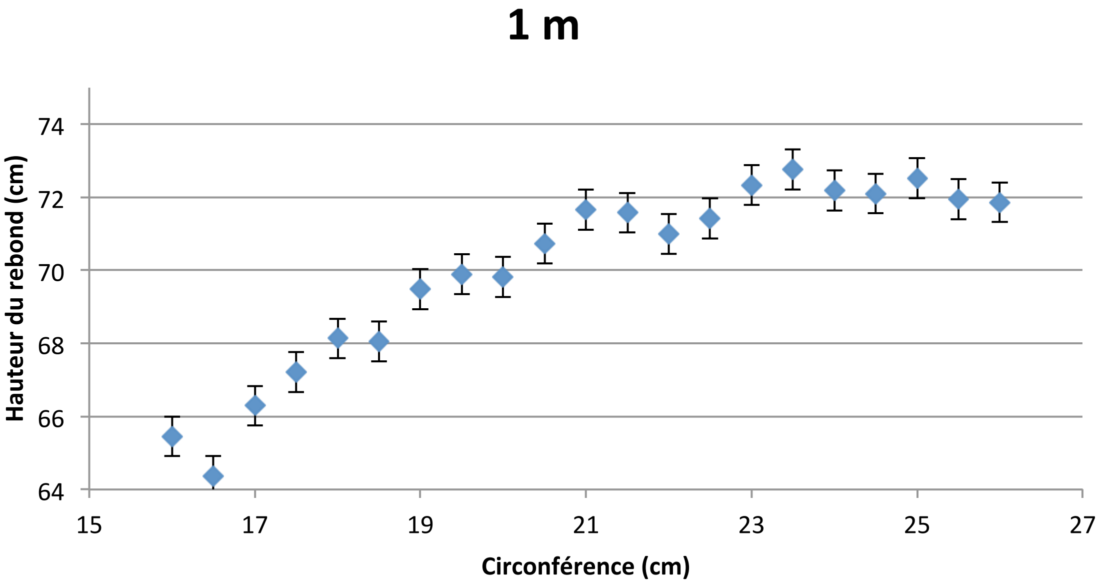
$$condition : a \leq R - R_c = 1\, cm\, !$$

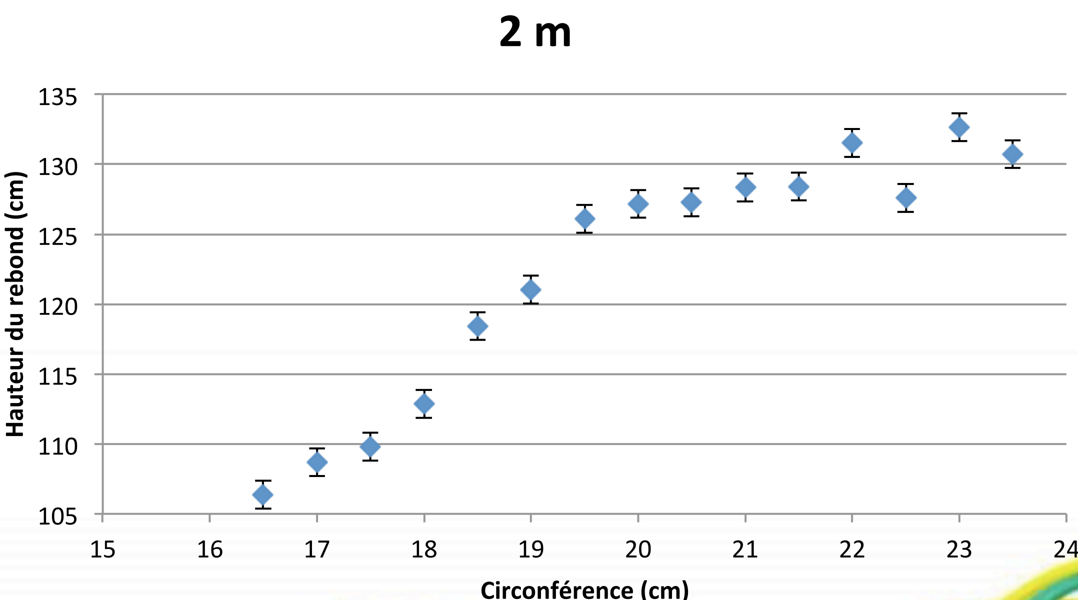
# The core

- Test of the model :

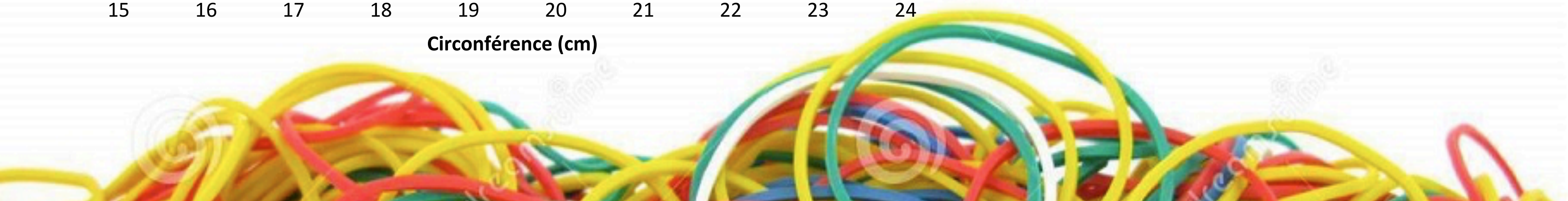
$$a \sim \sqrt{R\,\delta_m} \propto R(gh)^{\frac{1}{5}}$$

$$h' = 2h \Rightarrow \frac{a'}{a} = 2^{\frac{1}{5}}\frac{R'}{R} = 1.15\frac{R'}{R}$$




$$\frac{R'-R_c}{R-R_c}\,\frac{R}{R'} = 1.11\,!$$



# (partial) conclusion

- Need to verify $a \leq R - R_c$
- Then curve nearly flat => small variations of the heat deperdition.

# The ball’s properties

# The issue of the volumic mass

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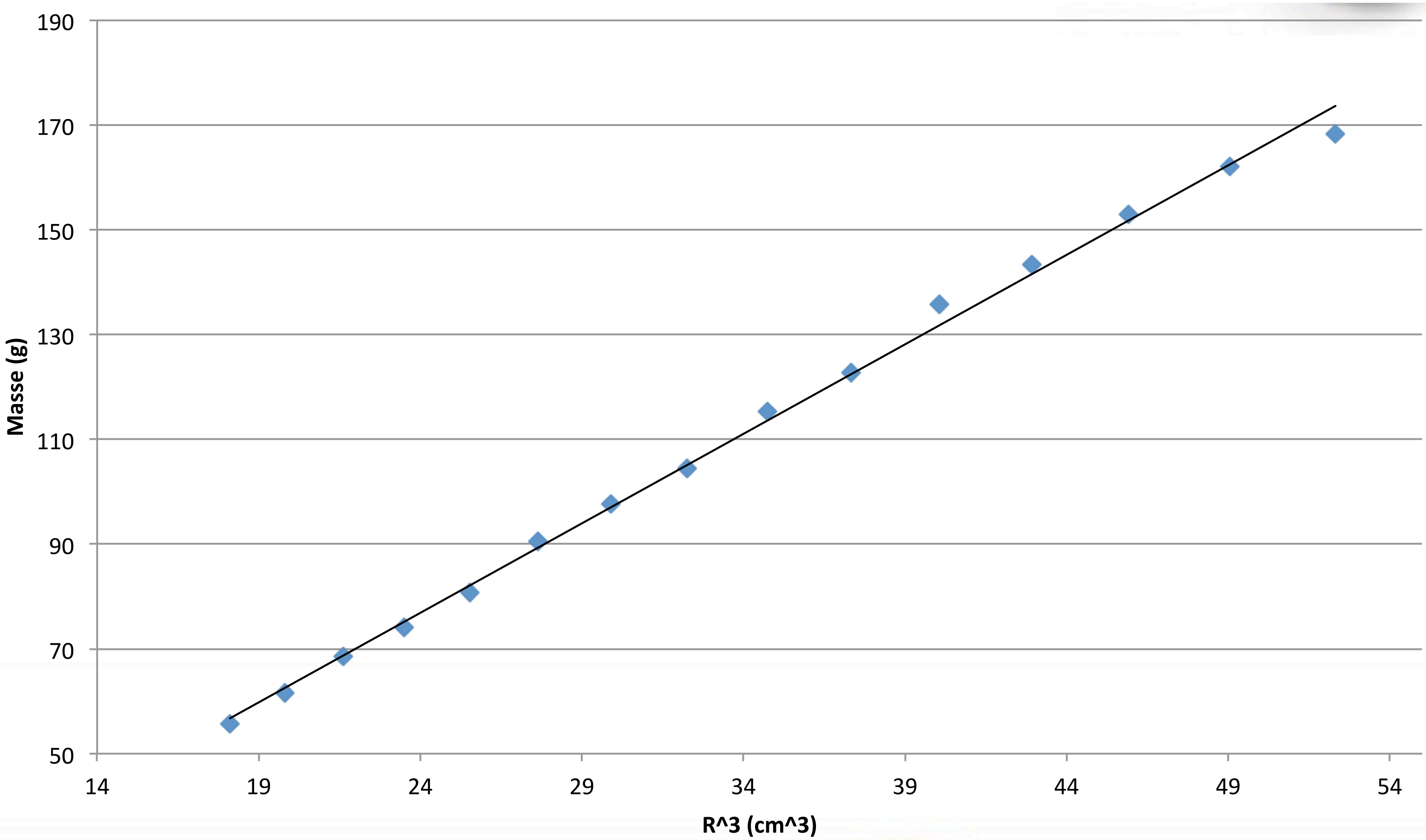
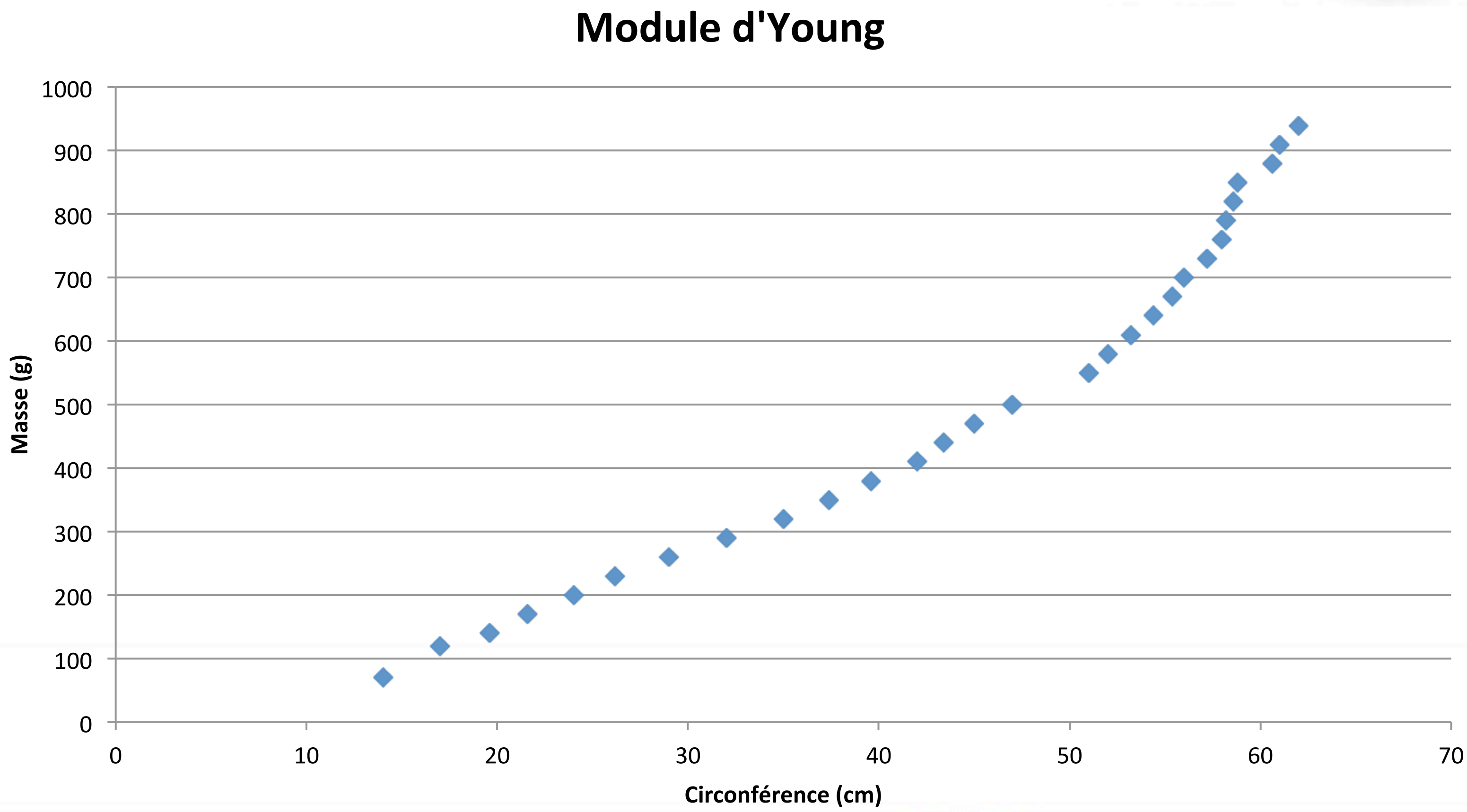


# The issue of the Young modulus


Vittel

# The issue of the Young modulus




# What we plan to do

- Measure E => law to fit the curve

# Thanks !

60 mm
351105
~ 1 kg
Bracelets caoutchouc étroits - Narrow rubber bands - Gomas elásticas estrechas - Pulseiras de borracha estreitas - Rubberen armbandjes smal - Elastici fettuccia gomma stretti - Enge Kautschuk-Armbänder - Úzké gumové náramky - Узкие каучуковые браслеты - Gumi karkötő, szoros - Gumki recepturki cienkie - Στενά λαστιχένια βραχιόλια - Úzke gumové náramky
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