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FISICA DELLA PASTA, DELL' ARROSTO, ETC.

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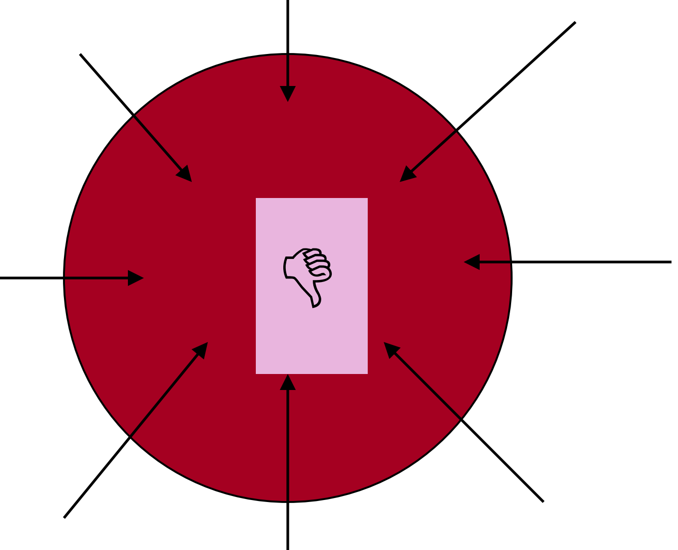
Formula generale per il tempo di cottura

$\frac{1}{t} \neq b$

Flusso di calore



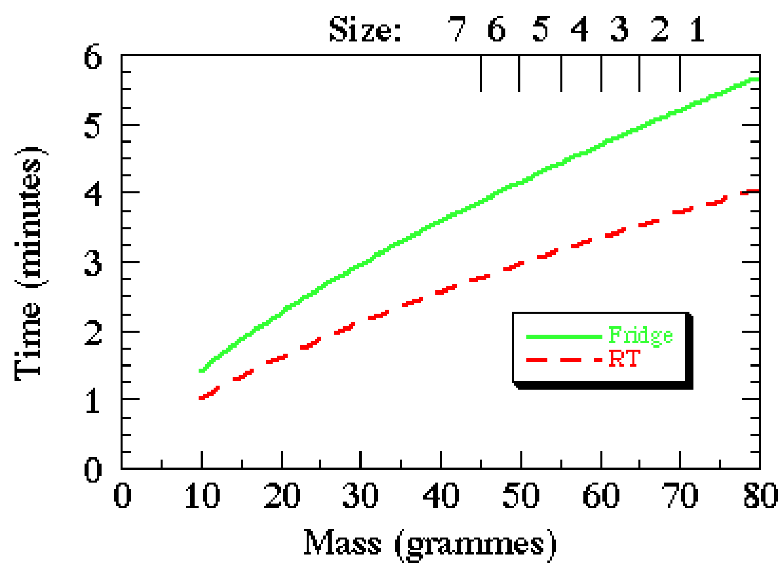
$$\frac{\partial T}{\partial \tau} = -\kappa \frac{\partial^2 T}{\partial \rho^2}$$

$$\left[\frac{1}{t}\right] = \frac{[\kappa]}{[r^2]}$$

t cook = aD2 +b

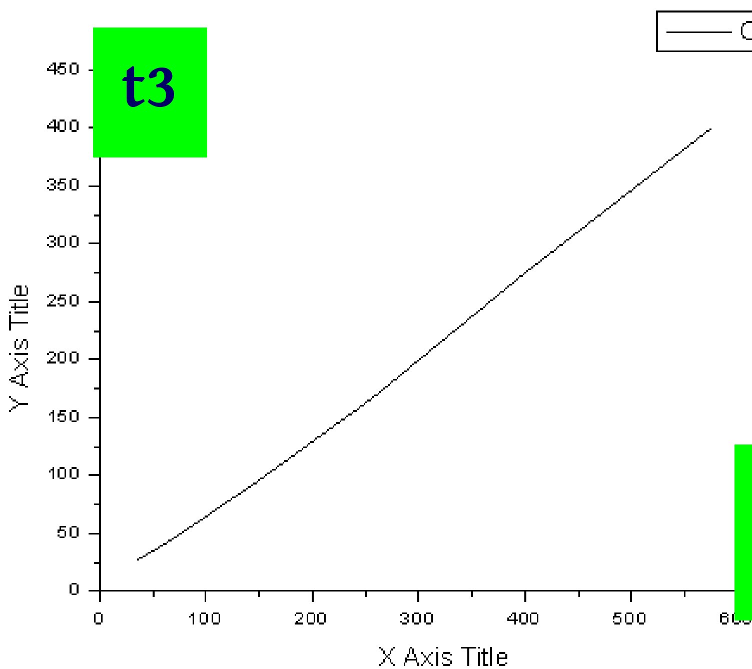
1. Egg alla "coque"

$$T_{cook} \sim M^{2/3}\log_e[0.76(T_{egg}-T_{water})/(T_{yolk}-T_{water})]$$



2. Il segreto del tacchino di Natale

t cook = aM2/3 + b



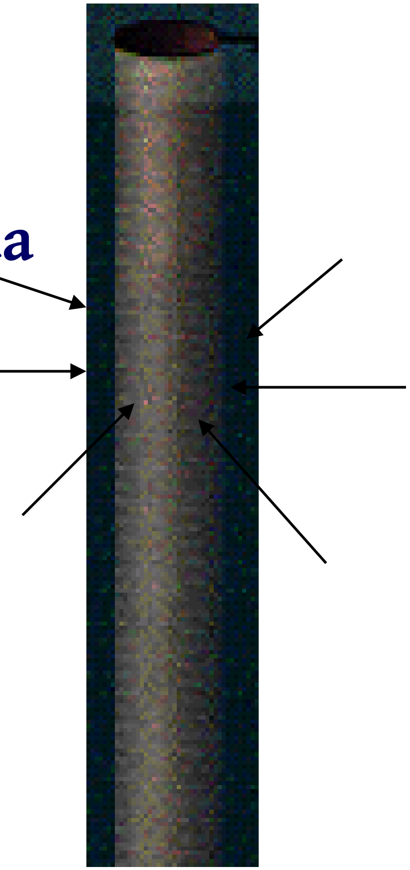
t3

M2

Massa (libbre)	Tempo di cottura (ore)
6	3
8	3.5
12	4.5
16	5.5
20	6.5
24	7.35

3. La fisica della pasta

Flusso di calore e diffusione dell'acqua



Trasferimento di calore:

$$\frac{\partial T}{\partial \tau} = -\kappa \frac{\partial^2 T}{\partial \rho^2}$$

Diffusione dell' acqua:

$$\frac{\partial n}{\partial t} = -k \frac{\partial^2 n}{\partial r^2}$$

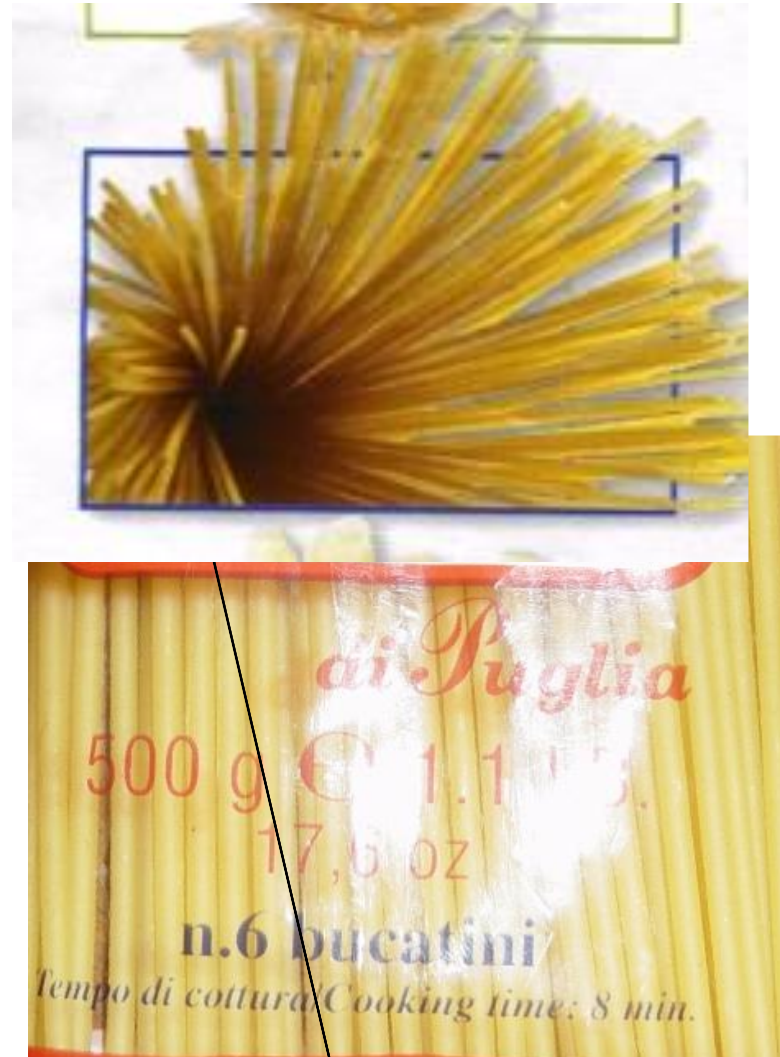
Tempo di cottura: t=aD2 +b

Tabella dei tempi di cottura per diversi tipi di spaghetti

Tipo di pasta	Diametro est. D	Diametro int. d	Tempo di cottura sper.	Tempo di cottura teor.
Capellini n.1	1.15 mm	--	3 min	2 min
Spaghettini n. 3	1.45 mm	--	5 min	5.0 min
Spaghetti n. 5	1.75 mm	--	8 min	8.2 min
Vermicelli n. 7	1.90 mm	--	11 min	10.7 min
Vermicelli n. 8	2.05 mm	--	13 min	13.0 min
Bucatini	2.70 mm	1mm	8 min	25 min ?!

$a = 3.8$ min / mm^2 **$t = aD^2 + b$** $b = -3$ min

Il caso dei bucatini vuole un trattamento particolare:
La formula corretta e':
$t=a(D-d)2 +b$



Per i bucatini: **tb=8.2 min !**

Il fallimento della nostra teoria semplice per la pasta sottile

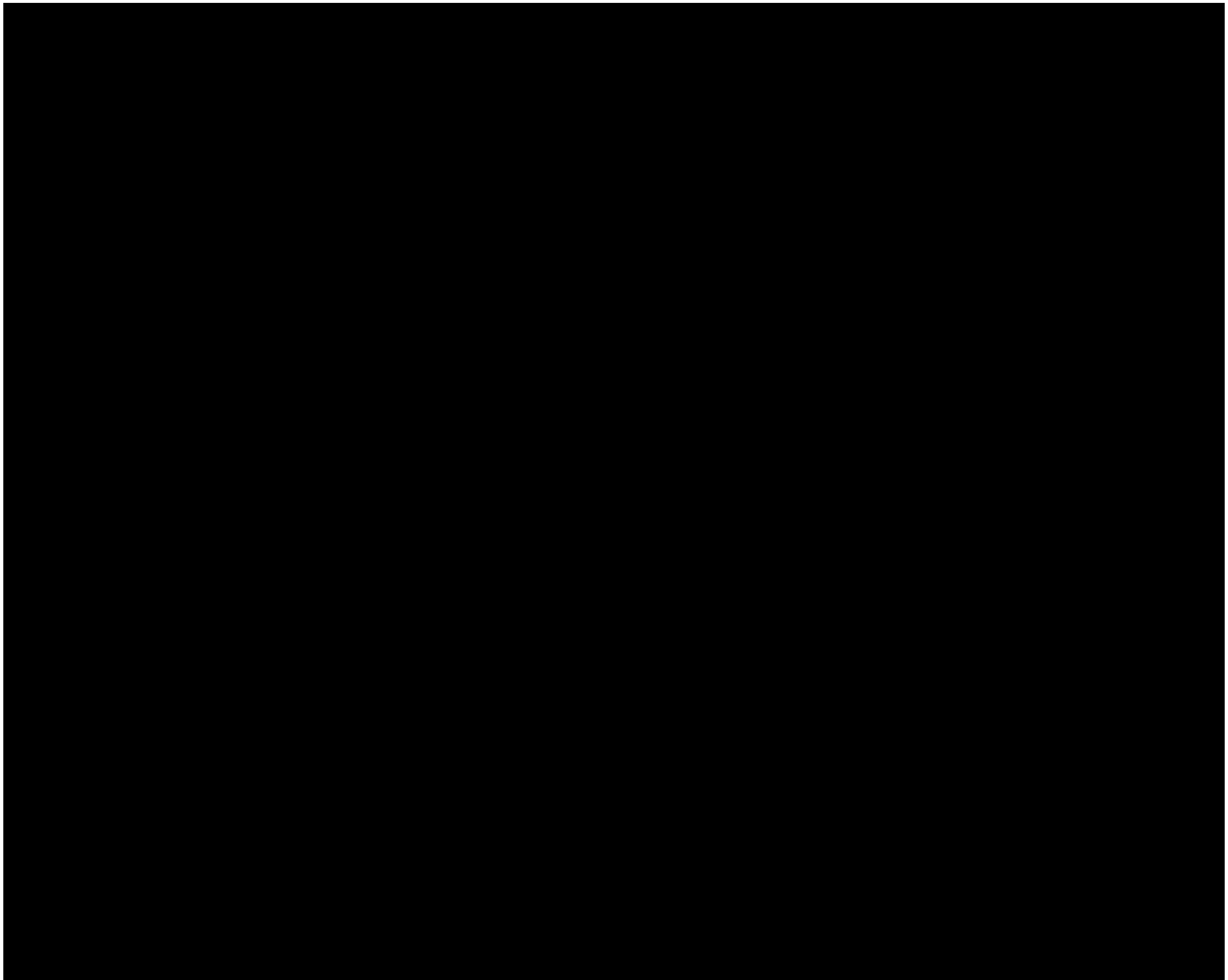
Capellini: $d = 1.15$ mm

$t_{cap} = 3.8\,[1.15]^2 - 3 \approx 2$ min

$aD^2 + b = 0$

$D_{cr} = \sqrt{|b|/a} \approx 0.85$ mm

Perche gli spaghetti non si rompono a meta' ?



Dinamica della rottura:
(B.Audoli, S.Neukirch, PRL, August 2005)

$$4u''''(\xi) + \xi^2 u''(\xi) + 3\xi u'(\xi) = 0.$$

$$\xi = (s/L)/\sqrt{t/T} = s/\sqrt{(\gamma t)}.$$

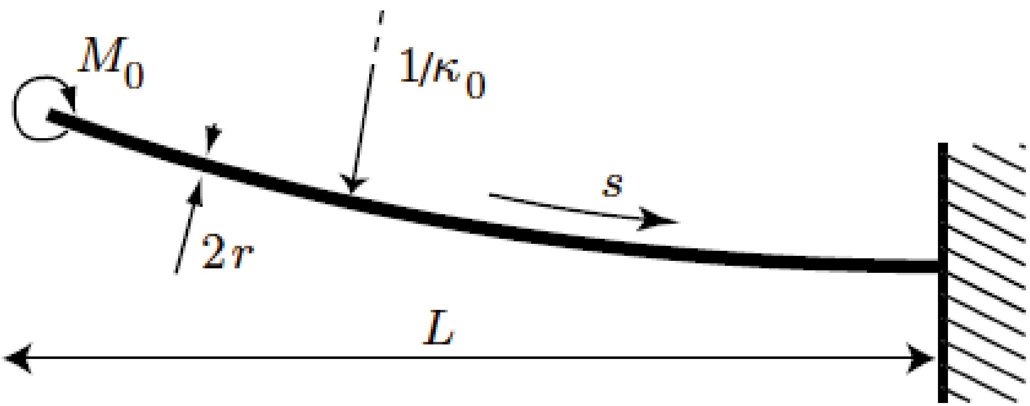


FIG. 1. The dynamics of a rod fragment following the initial breaking event in a brittle rod is modeled by releasing at time $t = 0$ a rod with fixed length L, initial curvature κ_0, and no initial velocity.

La rimozione veloce del vincolo dell' estremita' di meta' - bacchetta risulta nella generazione dell' onda elastica:

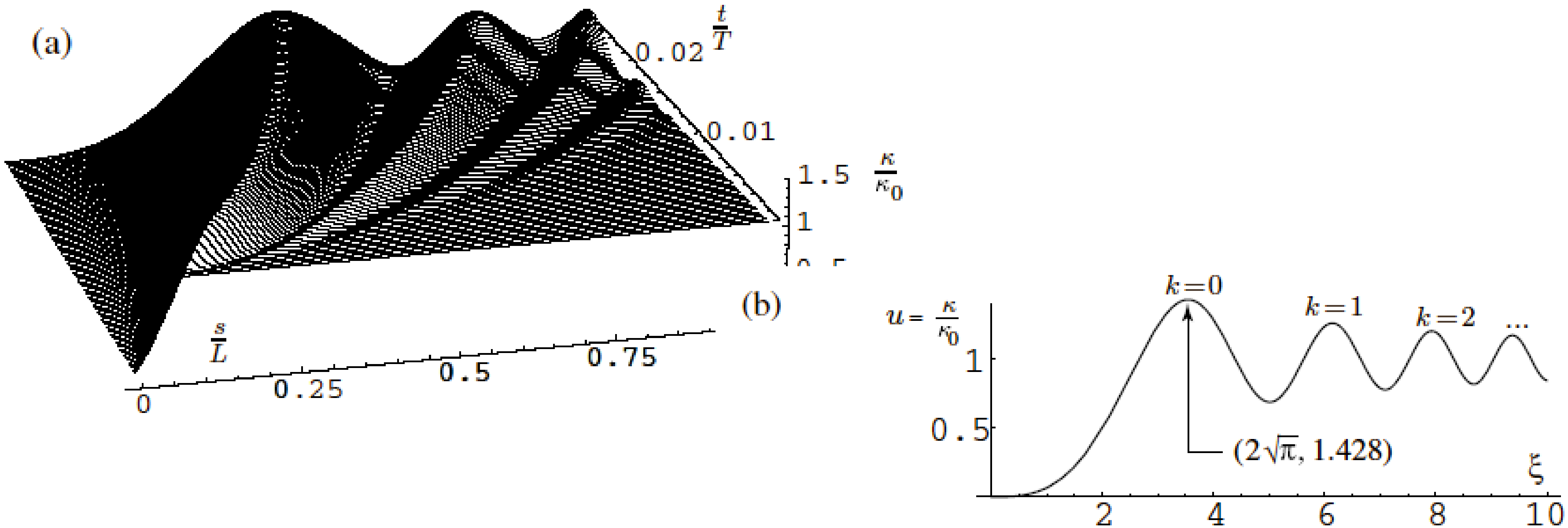


FIG. 2. (a) Numerical solution of the Kirchhoff Eq. (1) with clamped-free boundary conditions, for a uniform initial curvature κ_0. The curvature at the free end $\kappa(0, t)$ relaxes to zero within the first few time steps (quick relaxation of the incompatible curvature near free end) while it is given in the intermediate regime (2) by the universal self-similar solution (4), shown in (b) as a function of $\xi = s/\sqrt{\gamma t}$. At later times, for $t \sim T$, reflections are generated from the clamped end $s = L$.

[Simul.mov]()


EXPERIMENT
THEORY
NO ADJUSTABLE PARAMETER