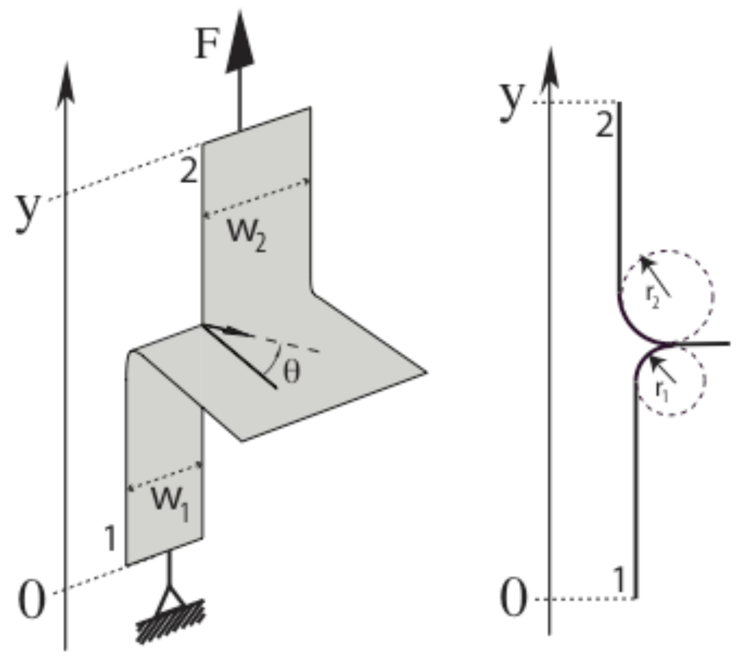
# SUPPLEMENTAL MATERIAL

**Energy Release Rate estimates for the trouser-test tearing geometry**

In our analysis, the energy release-rate $G$ in the trouser test (3) does not depend on the elastic properties of the sheet, because we have neglected the contribution of bending and stretching energies. We estimate here these contributions, and show that they are negligible. We consider a trouser test geometry, loaded in direction $\alpha = 0$ for simplicity.

***Stretching.*** As in the case of peeling [1], the flaps are in fact elastically strained in our experiment by $\varepsilon = F/Etw \sim 10^{-4}$ for a typical force $F \sim G_c t \sim 0.1$N ($E \sim 1$GPa is Young's modulus and $t$ the thickness of the sheets). The force required for crack propagation is modified by a factor $\varepsilon/2 \sim 0.005\%$. Following Kendall's argument [1], we therefore conclude that elastic stretching has a negligible contribution to the energy release rate.

***Bending.*** A scaling argument based on a simplified geometry gives an estimate of the effect of non-zero bending rigidity. We consider an off-centered tearing geometry where the folds have typical radii of curvature $r_1$, $r_2$ and width $w_1$ and $w_2$ (see figure below). A simple model is to assume that the strips are composed of a straight panel connected to a piece of cylinder with radius $r_1$, $r_2$ (see right part of figure), so that the total distance between the clamps is $y = S_1 - ar_1 + S_2 - ar_2$, where $S_1$, $S_2$ are the lengths of the strips, and $a = \pi/2 - 1$.




SUPPLEMENTAL FIGURE 1 : Off-centered tearing geometry (left), and corresponding idealized model (right)

We consider the case of an imposed distance between the clamps $y$, while the crack tip propagates by $ds$ in a direction $\theta$. Geometry therefore imposes that the effective width of the bent part of the strips are modified by $dw_2 = -dw_1 = \sin\theta\, ds$, and $(dr_1 + dr_2)\, a = \mathrm{d}S_1 + \mathrm{d}S_2 = 2\cos\theta\, \mathrm{d}s$.

The elastic energy stored in the system scales as $E = Bw_1/r_1 + Bw_2/r_2$, where $B \sim Et^3$ is the bending rigidity of the sheet [2].

We obtain

$$dE = - B(w_1 r_1^{-2}\, dr_1 + w_2 r_2^{-2}\, dr_2) \cos\theta \;- B(r_1^{-1} - r_2^{-1}) \sin\theta\, ds,$$

But if we note $F$ the force applied by the operator, force balance imposes that $F \sim Bw_1/r_1^2 \sim Bw_2/r_2^2$ and the energy release rate therefore takes the form

$$Gt = -dE/ds = \alpha \cos\theta + \beta \sin\theta$$

Where we recognize in the first term the expression used in equation (3) of the main article, because $\alpha = (2/a)\, F \sim 2F$. The second term $\beta = B(r_1^{-1} - r_2^{-1}) \sim F\,(B/F)^{1/2}(w_1^{-1/2} - w_2^{-1/2})$ was neglected and we can see that there are two reasons to consider that this additional contribution is negligible.

We first see that in the limit of vanishing thickness (*i.e.* zero bending rigidity) this second term vanishes. But we also note that this term is exactly zero if the crack is at the center ($w_1 = w_2$), as expected from symmetry argument. Even if the crack is off-centered by a distance $\delta w/w \sim 10\%$, a maximum value in experimental runs, we estimate the second term to be less than 1% of the first term because in our experiments $B/Fw \sim 5.10^{-3}$. It is therefore reasonable to neglect this term and use equation (3).

[1] Kendall, K. Thin film peeling – the elastic term. *J.Phys. D: Appl. Phys*, 8, 115 (1975)
[2] Timoshenko, S. The Theory of Plates and Shells, McGraw-Hill, 1964