VLBA ACQUISITION MEMO #233

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To: VLBA Data Acquisition Group

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Subject: Dynamic forces on the tape edge

Roughness on the tape edge will result in transverse acceleration of the tape in response to the roughness. If the roughness is characterized by

$$y = a \cos(kx)$$

where a = magnitude of roughness (2 μm)
k = $2\pi/\lambda$
λ = scale size of edge contact area or roughness (whichever is larger) (1000 μm)
x = distance along tape
= $v\,t$
v = velocity (8 m/s)

then acceleration is

$$\ddot{y} = -a\,v^2\,k^2 \cos(k\,v\,t)$$

and the force magnitude needed to produce this acceleration is

$$f = a\,v^2\,k^2\,\rho\,d\,w\,L$$

where ρ = density (2000 kg/m^3)
d = thickness (16 μm)
L = length of tape which has to move in response to the edge noise (10 cm)
w = tape width (2.54 cm)

and f = 0.5 N using values given in ().

If the contact area is 1000 x 16 μm^2 this force results in a pressure of 5000 psi which is approaching the elastic limit for PET. The motivation for this calculation is the concern that tapes with rough edges could become damaged by extended running at high speeds. Given the potential problem we plan to study this further. If necessary, we could increase the contact area in the edge guiding region by reducing the tape angle (see Acquisition Memos 124 and 142).