Why do tubes sound so good? It's in the math!

When you look at simple models of a tube, a FET, and a BJT, the answer is clear.

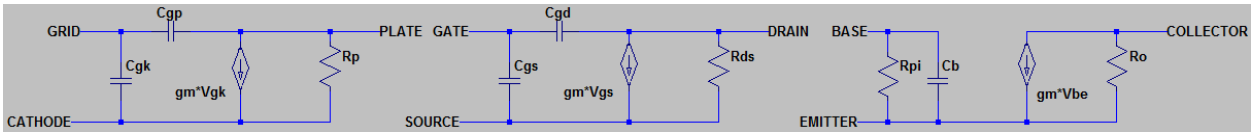

Figure 1: Simple models of a vacuum tube, a MOSFET, and a BJT (left to right).

Consider the transconductance, g_m ,of each model:

$g_m = \frac{3}{2}\sqrt[3]{K^2 I}$ (vacuum tube)

$g_m = \sqrt{2KI}$ (MOSFET)

$g_m = \frac{qI}{kT}$ (BJT)

For all of these devices, the transconductance is a function of current, I , through the device. If one considers only the effect of current on transconductance:

$g_m \propto \sqrt[3]{I}$ (vacuum tube)

$g_m \propto \sqrt{I}$ (MOSFET)

$g_m \propto I$ (BJT)

In a vacuum tube, the transconductance is a weak function (cube root) of current. The end result is that a vacuum tube has lower distortion (better linearity) than MOSFETs or BJTs over the same region of operation -that is why vacuum tubes sound so much better than other devices when reproducing recorded music.

Our engineer guy says 'proof is all in the math'. Personally, this 'math' is easier:

However you choose to do the math, tubes just sound better. ;o)