5.8 BJT Internal Capacitances

Reading **Assignment**: 485-490

BJT's exhibit **capacitance** between each of its terminals (i.e., base, emitter, collector). These capacitances ultimately limit amplifier **bandwidth**.

Q: *Yikes! Who put these capacitors in the BJT? Why did they put them there? Why don't we just **remove** them?*

A: These capacitances are **parasitic** capacitances. Since the terminals are made of conducting materials (e.g., metal), there will **always** be some capacitance associated with any two terminals.

BJT designers and manufacturers work hard to **minimize** these capacitances—and indeed they are **very small**—but we **cannot** eliminate them entirely.

If the **signal frequency** gets **high** enough, these capacitances can affect amplifier performance.

HO: BJT Internal Capacitances

Now that we are aware of these internal capacitances, we must **modify** our small-signal circuit **models**.

HO: The High-Frequency Hybrid Pi Model

The significance of the internal capacitances are typically specified in terms of a frequency-dependent BJT parameter called $h_{fe}(\omega)$. This parameter is often referred to as the "**short-circuit current gain**" of the BJT.

From this function $h_{fe}(\omega)$ we can extract a BJT parameter called the **unity-gain bandwidth**—a result very analogous to **op-amps**!

HO: The Short-Circuit Current Gain