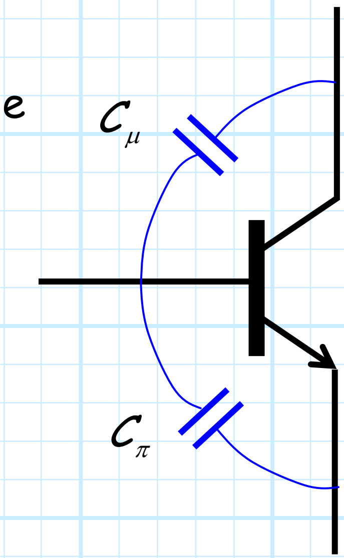
BJT Internal Capacitances



There are **very small capacitances** in a BJT between the collector and the base, and the base and the emitter.

Since the capacitor values are very small, their impedance at **low** and moderate frequencies is large. I.E.:

$$Z_C = \frac{1}{j\omega C} \quad \text{is large if } \omega C \ll 1$$

In other words, at low and moderate frequencies, these capacitor impedances are approximately **open** circuits, and thus they can be **ignored**.

However, at **high** frequencies, the capacitor impedance can drop to **moderate** values (e.g., $K\Omega s$).

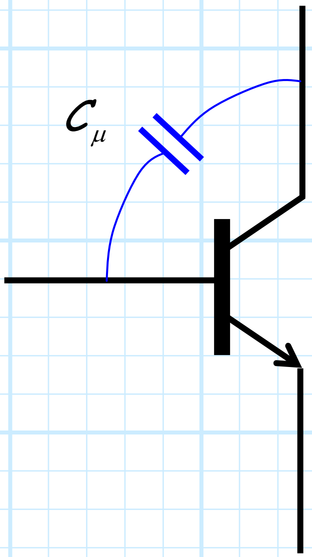
In this case, we can **no longer** ignore these capacitances, but instead must incorporate them into our **small-signal model**!

The capacitance between base and collector

Q: *What are C_μ and C_π?*

A: See below!

C_μ



C_μ is a parasitic capacitance between the **collector** and the **base**.

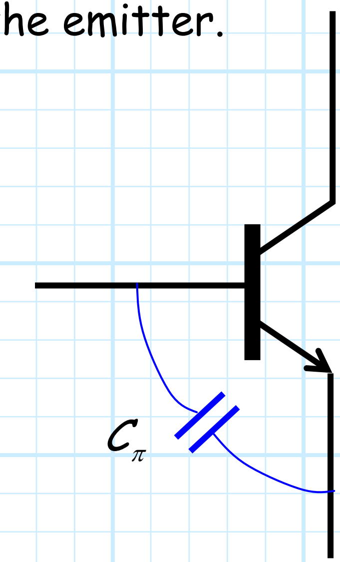
This capacitance is due to the *pn* **junction** (between collector and base).

Typical values of C_μ are a few picofarads or **less**.

The capacitance between base and emitter

C_π

C_π is a parasitic (i.e., small) capacitance between the base and the emitter.



This capacitance actually consists of **two** parts:

$$C_\pi = C_{je} + C_{de}$$

where:

$$\left.\begin{aligned} C_{de} &= \text{diffusion capacitance} \\ C_{je} &= \text{junction capacitance} \end{aligned}\right\} \textit{pn} \text{ junction capacitance}$$

Typically, C_π is a **few picofarads**.