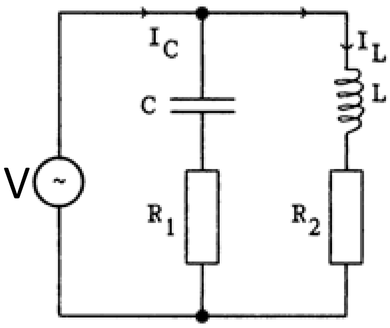
# RLC Parallel Resonance




- Assume the applied voltage has the form $V = V_o \sin \omega t$.

- Assume $R_1$ and $R_2$ are low resistances, as compared with the capacitive reactance ($X_C = \frac{1}{\omega C}$) and the inductive reactance ($X_L = \omega L$).

- The two branches, ($C+R_1$) and ($L+R_2$), are joined in parallel, so the voltages across them must be the same at any time.

- As $V_C \approx V_L \approx V$ (effect of the two resistors is neglected), so the two currents, $I_C$ and $I_L$ are respectively

$$I_C \approx \frac{V_o}{X_C}\sin(\omega t + \frac{\pi}{2}) \qquad \text{(In C, I leads V by } \pi/2\text{)}$$

$$I_L \approx \frac{V_o}{X_L}\sin(\omega t - \frac{\pi}{2}) \qquad \text{(In L, V leads I by } \pi/2\text{)}$$

  Hence, $I_C$ and $I_L$ are nearly $\pi$ out of phase.

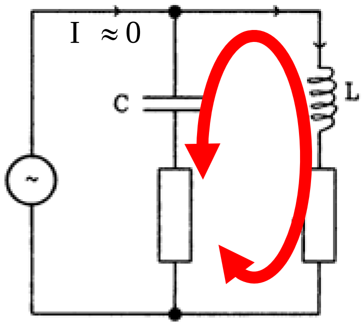
- The current from the source $I = I_C + I_L$.
  (i) At low frequencies, $X_C >> X_L$, so the peak currents $I_o \approx I_{Lo} >> I_{Co}$
  (ii) At high frequencies, $X_C << X_L$, so the peak currents $I_o \approx I_{Co} >> I_{Lo}$

- Parallel resonance occurs when $X_L = X_C$ or frequency

  $f_o = \frac{1}{2\pi\sqrt{LC}}$.

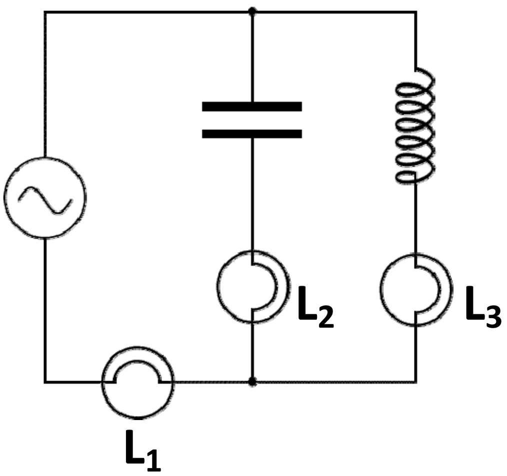
  (i) Since $X_L = X_C$, the magnitudes of the currents passing through L and C are the same. Besides, they are nearly $\pi$ out of phase. In other words, when parallel resonance occurs,

## A large current circulate to and fro within the L-C loop.




(ii) The overall supply current $I = I_L + I_C \approx 0$.

## A demonstration of Parallel Resonance




To turn on a light bulb, the current passing through it must be considerably large.

| | $f << f_o$ | $f = f_o$ | $f >> f_o$ |
|---|---|---|---|
| $L_1$ | | | |
| $L_2$ | | | |
| $L_3$ | | | |

(where $f_o = \dfrac{1}{2\pi\sqrt{LC}}$)

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1. Go to http://ngsir.netfirms.com/englishhtm/Parallel_Resonance.htm and play the applet. See how the brightness of each light bulb changes with the frequency.

2. Complete the above table and make a brief explanation.