

# **2006 Workshop on Compact Modeling**

## **“A Unified Parameter Extraction Procedure for Scalable Bipolar Transistor Model Mextram”**

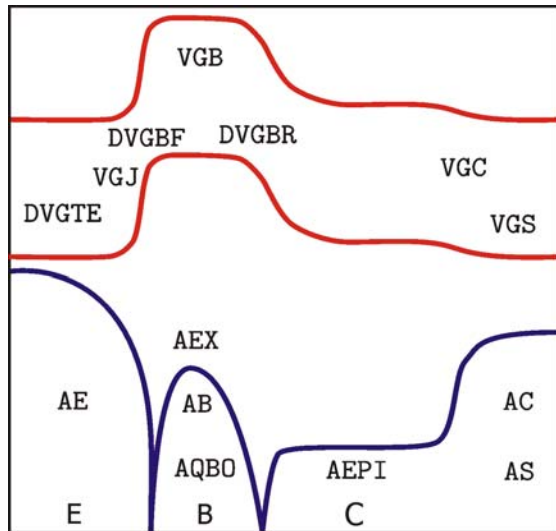
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# Introduction

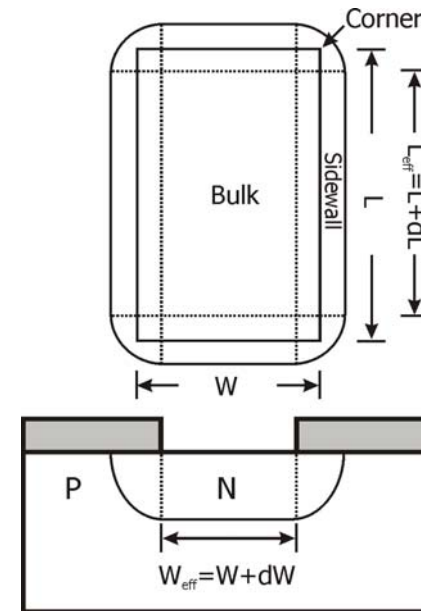
- **In this paper, a unified parameters extraction procedure for temperature and geometry scalable bipolar transistor model Mextram has been demonstrated using an example of high speed SiGe HBT technology.**
- **The essential feature of the proposed methodology is a direct extraction of the temperature and geometry parameters from the measured electrical characteristics. Moreover, the model parameters are extracted only once for a reference temperature and geometry.**

# Physics of Temperature and Geometry Scalable Mextram Model



$$t_N = \frac{T}{T_R}$$

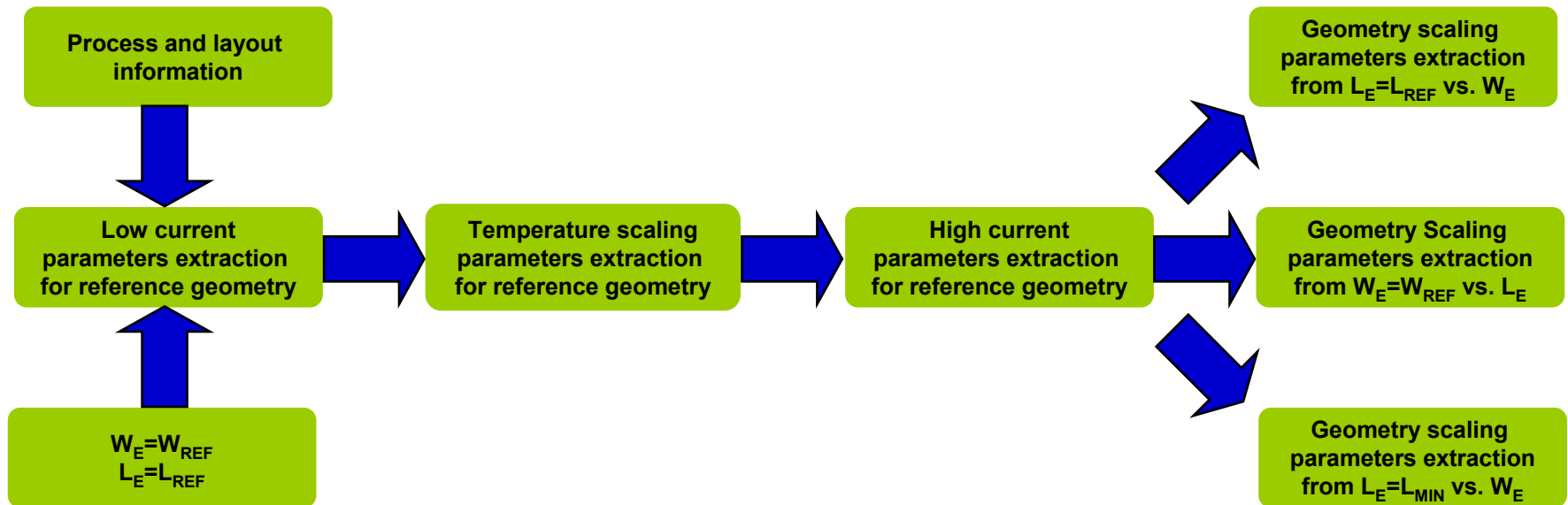
$$\frac{P}{P_{REF}} = \begin{cases} 1 & T = T_R \\ f(P_T, t_N) & T \neq T_R \end{cases}$$



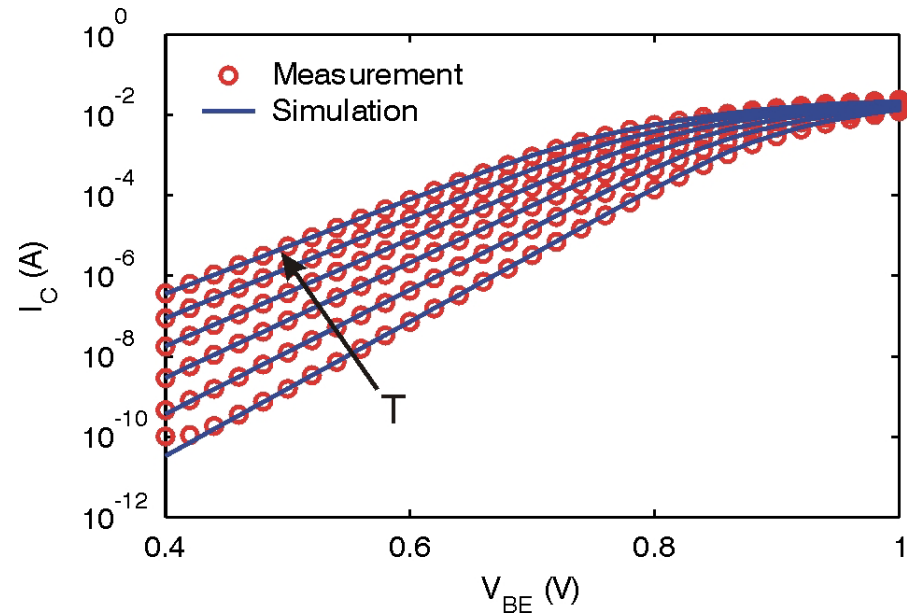
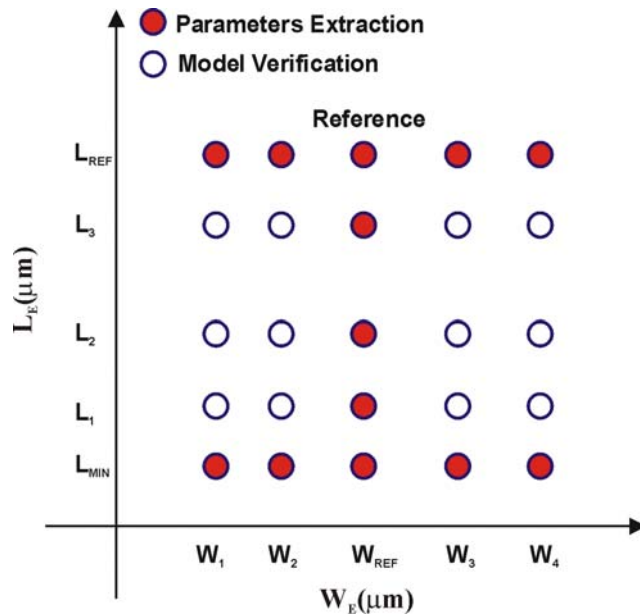
$$P = \underbrace{P_A(W + dW)(L + dL)}_{Bulk} + \underbrace{P_W(W + dW) + P_L(L + dL)}_{Sidewall} + \underbrace{P_C}_{Corner}$$

$$\frac{P}{P_{REF}} = 1 + P_A \left( \frac{WL}{W_{REF}L_{REF}} - 1 \right) + P_W \left( \frac{W}{W_{REF}} - 1 \right) + P_L \left( \frac{L}{L_{REF}} - 1 \right)$$

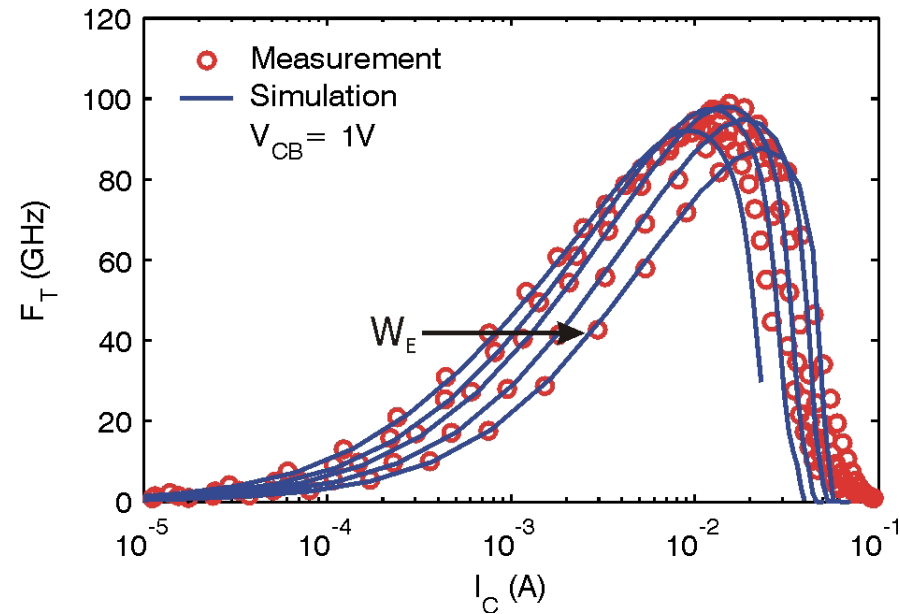
# Flow-Chart of A Unified Parameter Extraction



# Temperature and Geometry Parameter Extraction



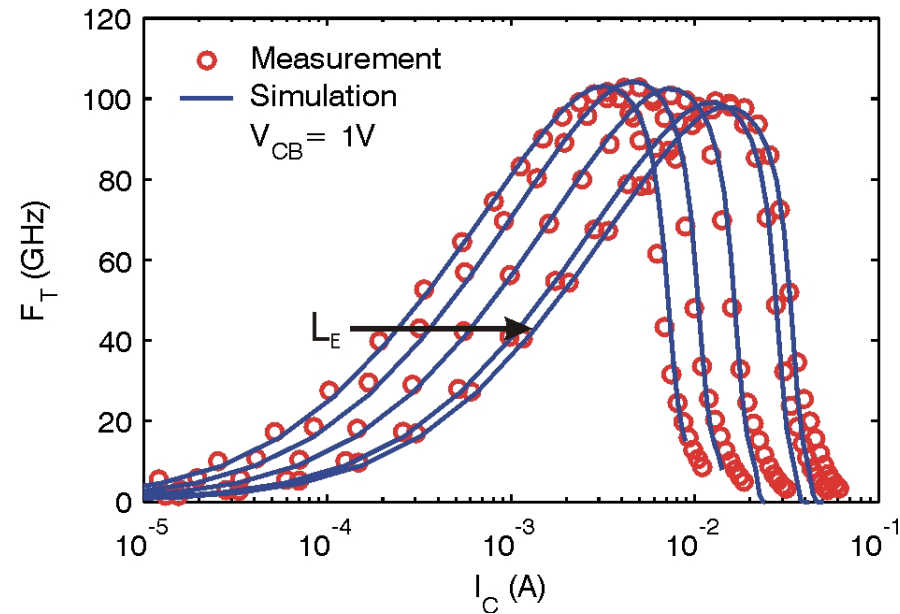
# Temperature and Geometry Parameter Extraction



$$L = L_{REF}$$

$$\frac{P}{P_{REF}} = 1 + (P_A + P_W) \left( \frac{W}{W_{REF}} - 1 \right)$$

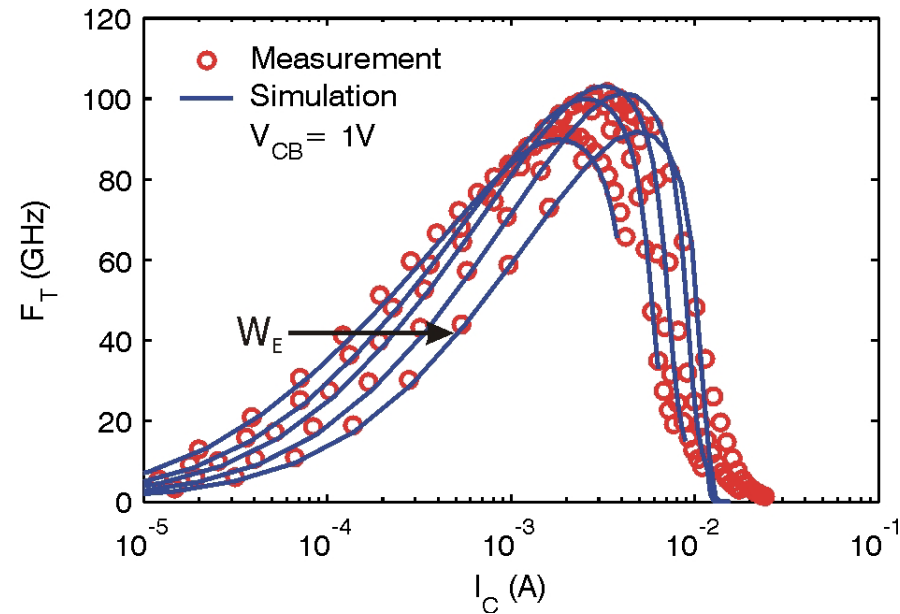
# Temperature and Geometry Parameter Extraction



$$W = W_{REF}$$

$$\frac{P}{P_{REF}} = 1 + (P_A + P_L) \left( \frac{L}{L_{REF}} - 1 \right)$$

# Temperature and Geometry Parameter Extraction



$$L = L_{MIN}$$

$$\frac{P}{P_{REF}} = 1 + \left( P_A \frac{L_{MIN}}{L_{REF}} + P_W \right) \frac{W}{W_{REF}} + P_L \left( \frac{L_{MIN}}{L_{REF}} - 1 \right) - P_A - P_W$$

# Conclusion

- **The proposed unified parameter extraction procedure for a scalable Mextram model is implemented on top of the single model parameter extraction procedure in the IC-CAP environment. There is no need for additional tool for temperature and geometry parameter extraction.**
- **As a result, the scalable model library generation is more efficient and the accuracy is increased with the new parameter extraction approach.**