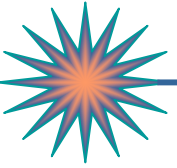
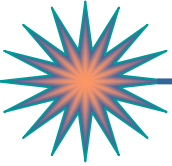


Virtual Wafer Fab (VWF) Framework from Silvaco

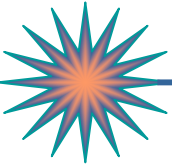


What is VWF?



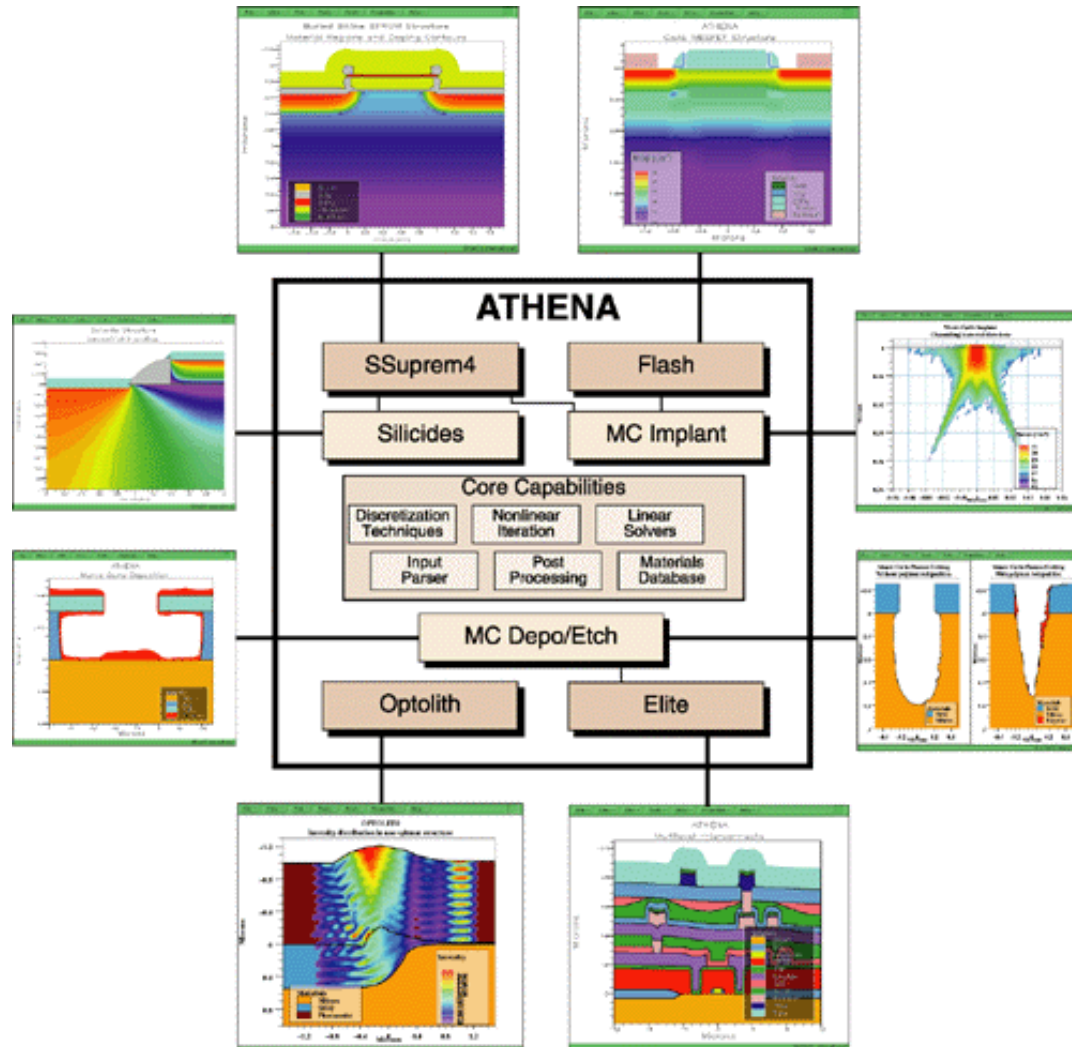
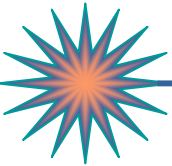
- A set of computer tools to simulate semiconductor structures in different stages of making including:
 - ◆ Fabrication process => Athena
 - ◆ Device performance => Atlas
 - ◆ Circuit performance => SmartSpice

Athena

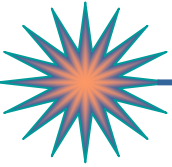


- A collection of tools to simulate different fabrication steps:
 - ◆ Oxide growth
 - ◆ Diffusion of impurities
 - ◆ Implantation
 - ◆ Deposition of different materials, i.e., poly-silicon, metal
 - ◆ Composite materials

Athena (cont.)

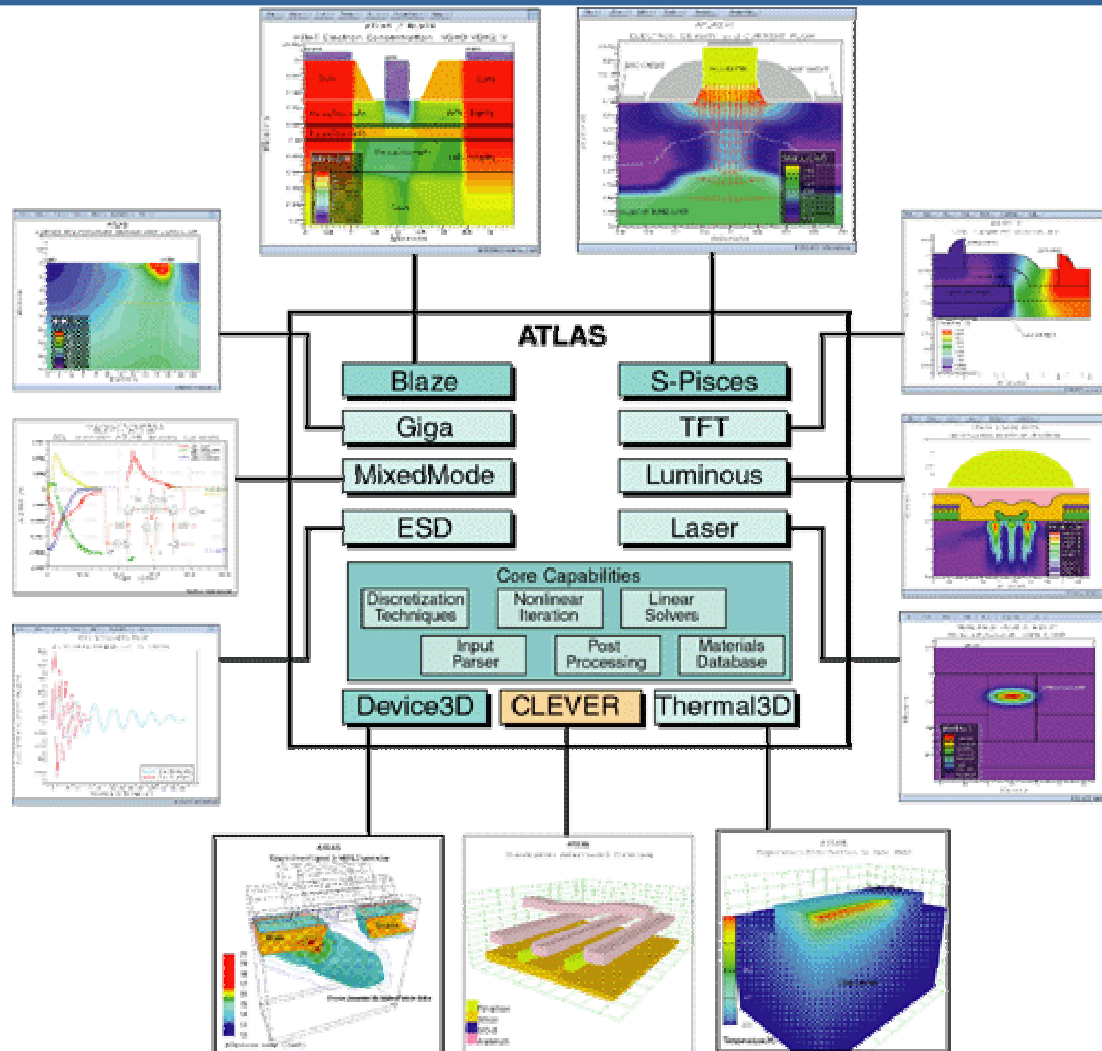
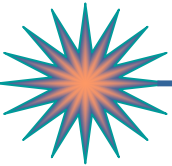


Atlas

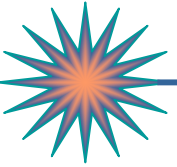


- A collection of tools to model different semiconductor devices including:
 - ◆ MOSFET
 - ◆ Bipolar junction transistor (BJT)
 - ◆ Silicon on insulator (SOI)
 - ◆ Charge coupled devices (CCD)
 - ◆ Photodiodes
 - ◆ TFT

Atlas (cont.)

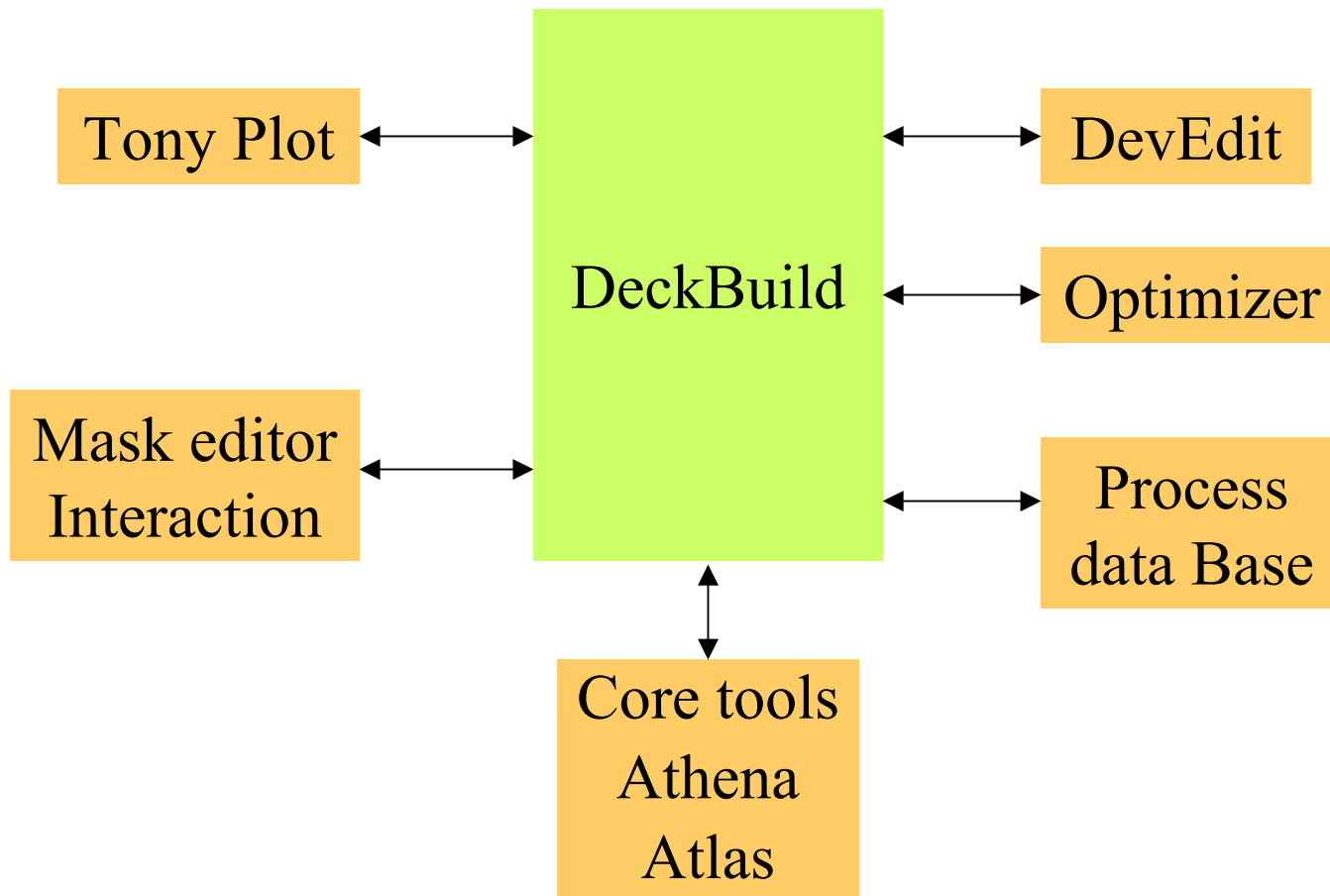
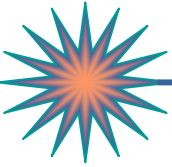


SmartSpice

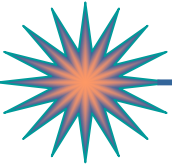


- Circuit simulation tools similar to Spice

VWF Interactive Tools

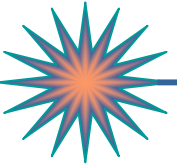


Example



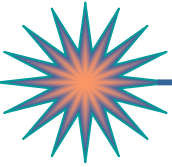
- Start by entering “ deckbuild &”
- Click on “Main Control” => “Examples”
- Select “MOS1” from section menu => “NMOS:Id/Vgs and Threshold Voltage”
- Click on “Load Example”
- By clicking on “Next”, you run the example one step at a time

Practice



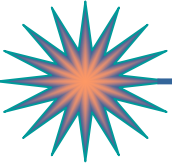
- Tailor the required parameters (substrate doping or thickness of gate oxide) to achieve a threshold voltage of 2.0V for the previous example

Assignment 1 (Diffusion)



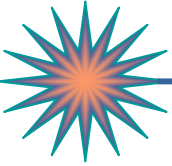
- The goal of this assignment is to familiarize you with “Deposit” and “Diffuse” commands
- Start with a <100> substrate with p-type background doping of ($N_{\text{back}}=10^{15}$)
- Pre-deposit a doped layer of phosphorous with surface density of ($N_s=10^{19}$)
- Assume a diffusion step for $t=1800\text{s}$ @temperature of 1000°C
- Find junction depth using “Extract” command
- Find the junction depth for diffusion temperature of 1200°C

Useful sites



- You can find user manuals from these sites:
 - ◆ http://www.ee.byu.edu/support/silvaco/pdfs/athena/at_toc.pdf
 - ◆ http://www.ee.byu.edu/support/silvaco/pdfs/toolsv1/t1_chapter2.pdf
 - ◆ <http://www.ece.ucsb.edu/comsup/silvaco/>

Assignment 2 (Implantation)



- The goal of this assignment is to familiarize you with “implant” and “Diffuse” commands
- Start with a <100> substrate with p-type background doping of ($N_{\text{back}}=10^{15}$)
- implant a doped layer of phosphorous using a dose of 10^{13} ions/cm² with energy of 30 keV
- Assume a diffusion step for $t=5\text{min}$ @ temperature of 900°C
- Find impurity profile and junction depth using “Extract” command
- Find the junction depth for similar case using <111> substrate