Connecting to Sentaurus

EE232 Discussion

2/2/2015

Connection Options

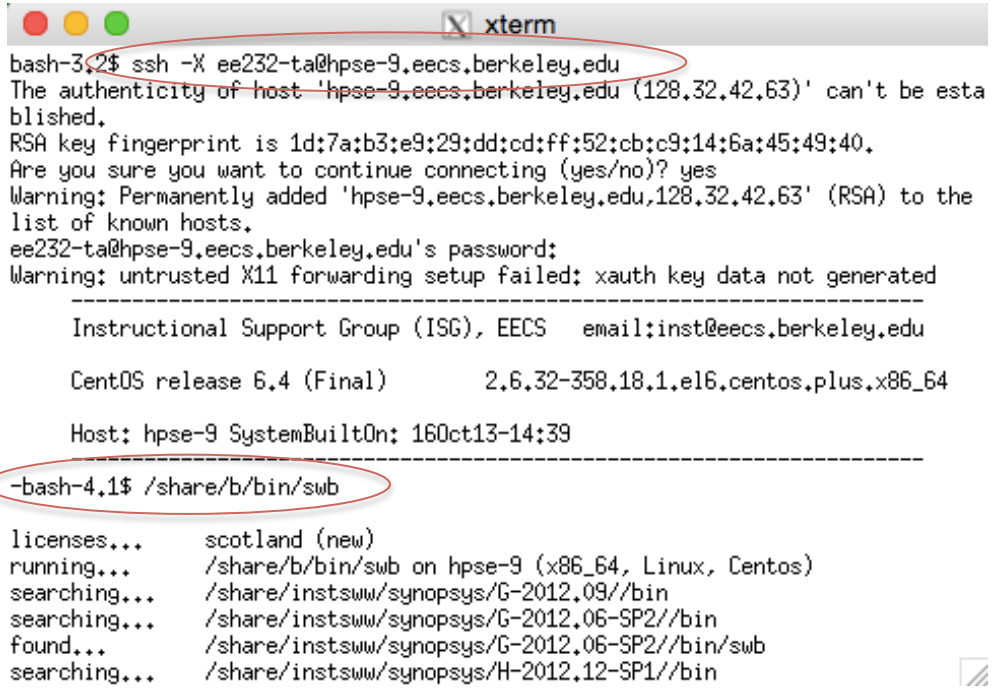
- Class Account (a bit slow):
  - hpse-9.eecs, hpse-10.eecs, hpse-11.eecs, … , hpse-15.eecs
- Device group members have access to their own servers. Ask a member of your group.
- Install on your workstation at your desk (must have linux installed).

EECS Instructional Connection

- Connection via X11 (graphical SSH)
- Install the following software on your computer first:
  - Windows: MobaXterm http://mobaxterm.mobatek.net/download.html
  - Mac: Xquartz http://xquartz.macosforge.org/landing/

Connect to server

- ssh -X *username*@hpse-9.eecs.berkeley.edu
- Launch Sentaurus workbench:
  - Type '/share/b/bin/swb'



Some Notes about connecting

- Each time swb is run, you must select the folder where your sentaurus projects reside (STDB). This can be your home directory or a folder your create.
- Sentaurus will only run while you stay connected. If you lose your connects the program (and you simulations) will stop.
- If your connection is spotty, consider remote desktop to a windows server on campus and doing your remote X11 session from that computer.
- For more details, see inst website (http://inst.eecs.berkeley.edu/cgi-bin/pub.cgi?file=synopsys.help)

Getting Started

- Copy ‘EEL-1D’ example to your directory
- Edit device structure with sde
- Edit device simulation with sdevice
- Add a parameter to your device simulation
- Edit your data analysis in svisual
- Save and pre-process
- Run your simulation
- View your device structure with svisual
- View your simulation results with svisual

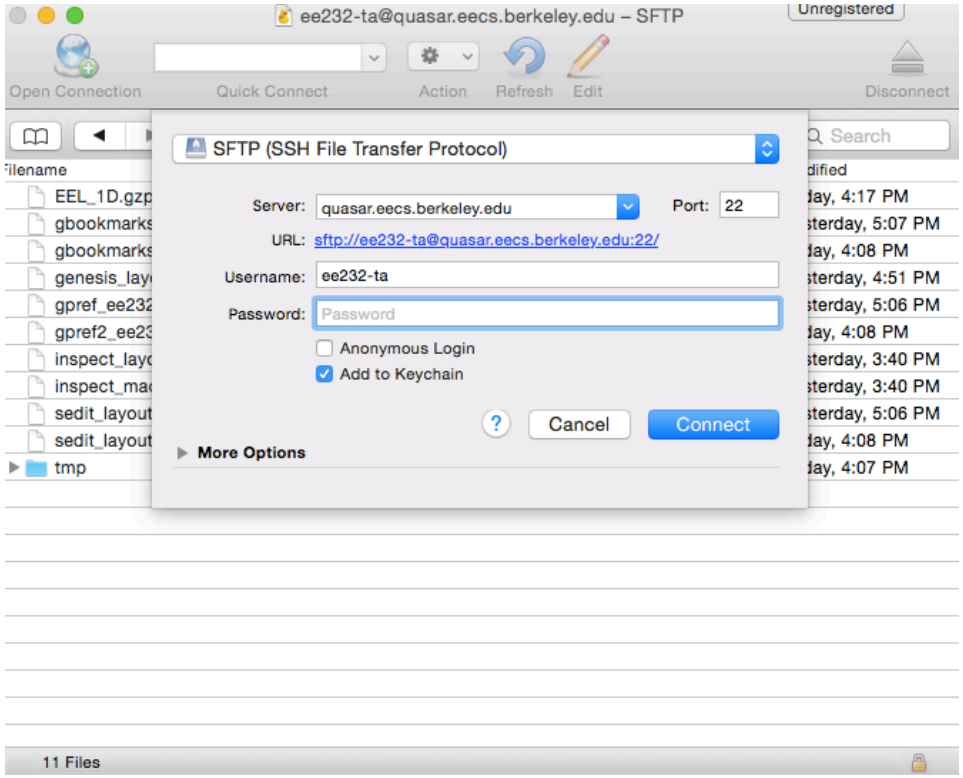
Copy Example to your directory

Using SFTP copy the example (EEL_1D.gzp) to your project directory.

Mac: cyberduck (https://cyberduck.io/?l=en)

Window: WinSCP (http://winscp.net/eng/index.php)

Connect to quasar.eecs.berkeley.edu for SFTP

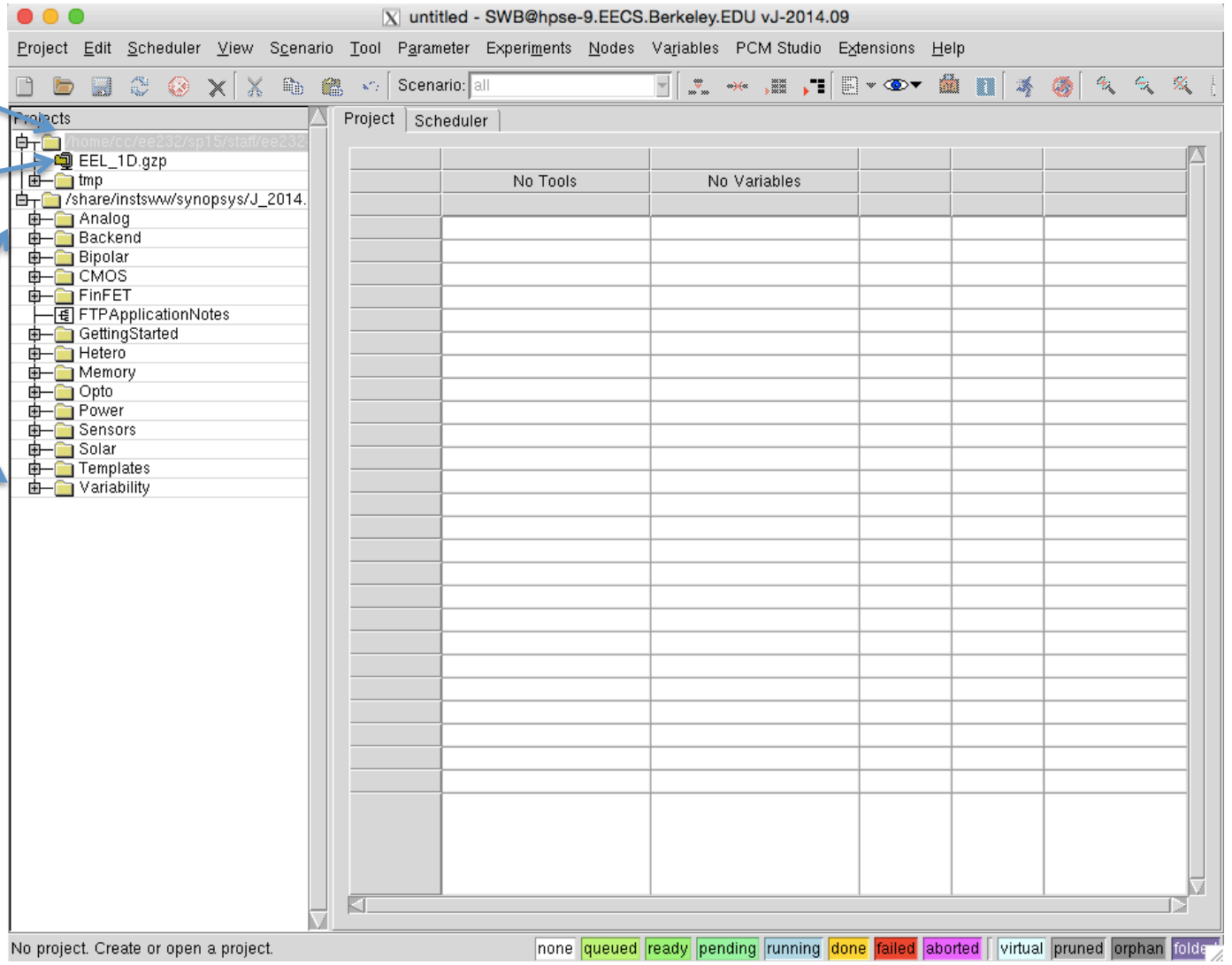


Open Sentaurus

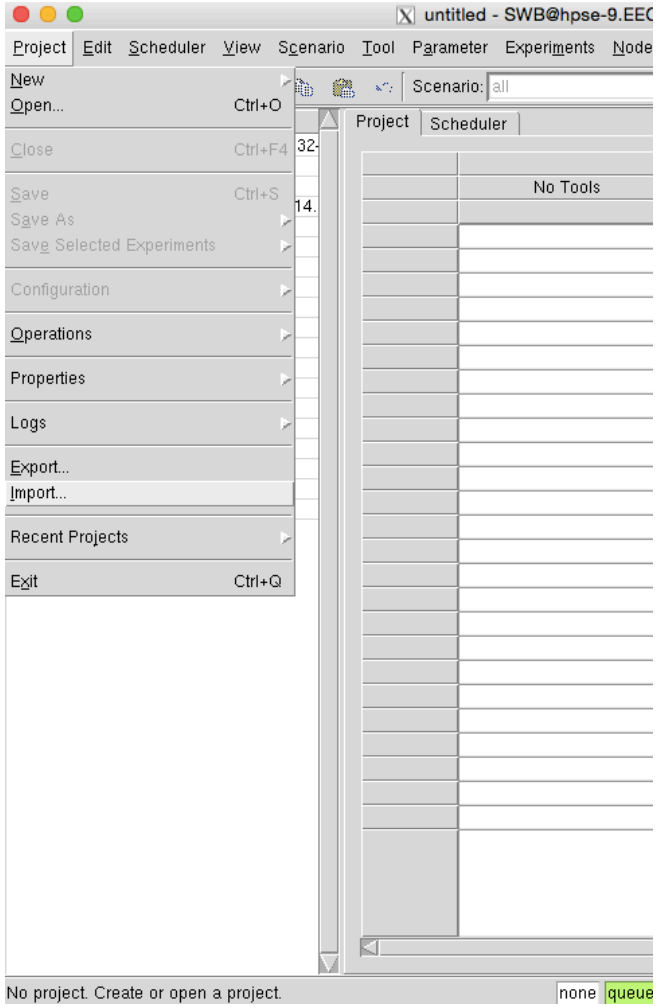
Your project directory

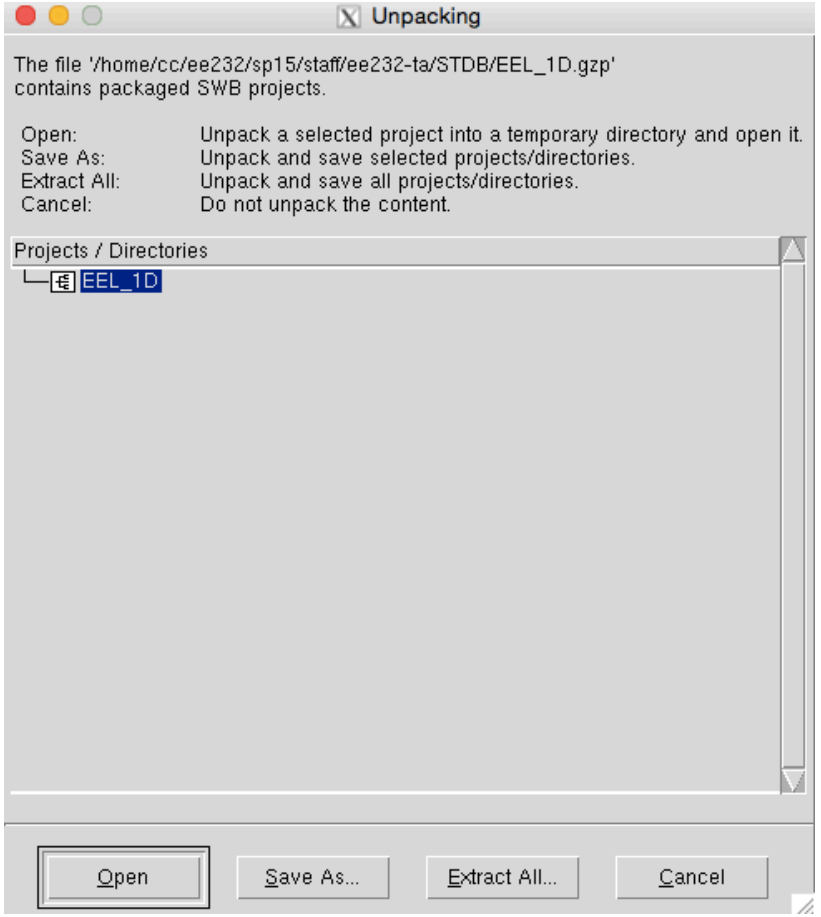
Example project

Other Examples:
Can copy these
to your project
directory.



Import zipped example



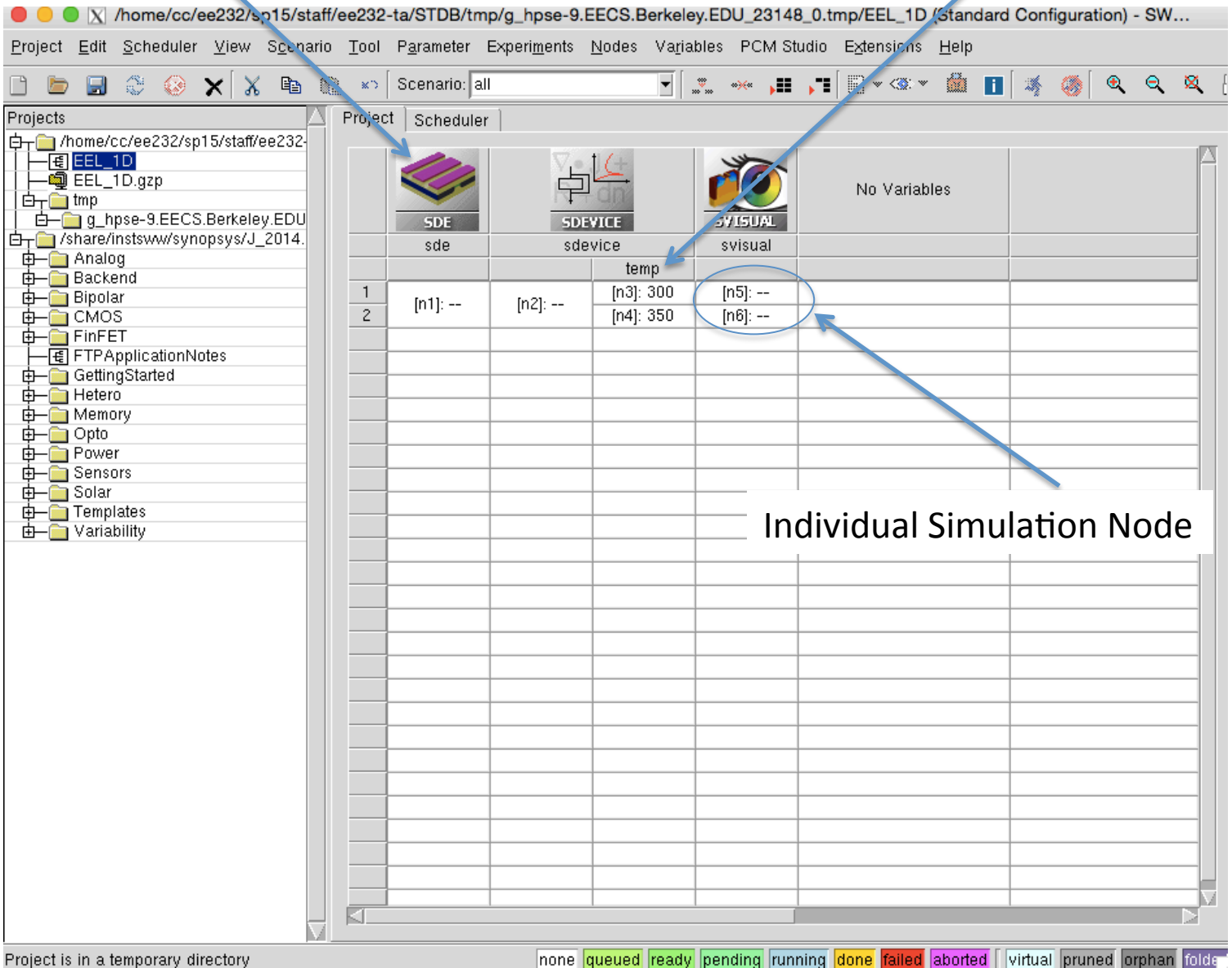


- Go to ‘Project -> Import…’
- Select the EEL-1D project and click ‘Save As…’ or ‘Extract All..’ to save to your project directory.

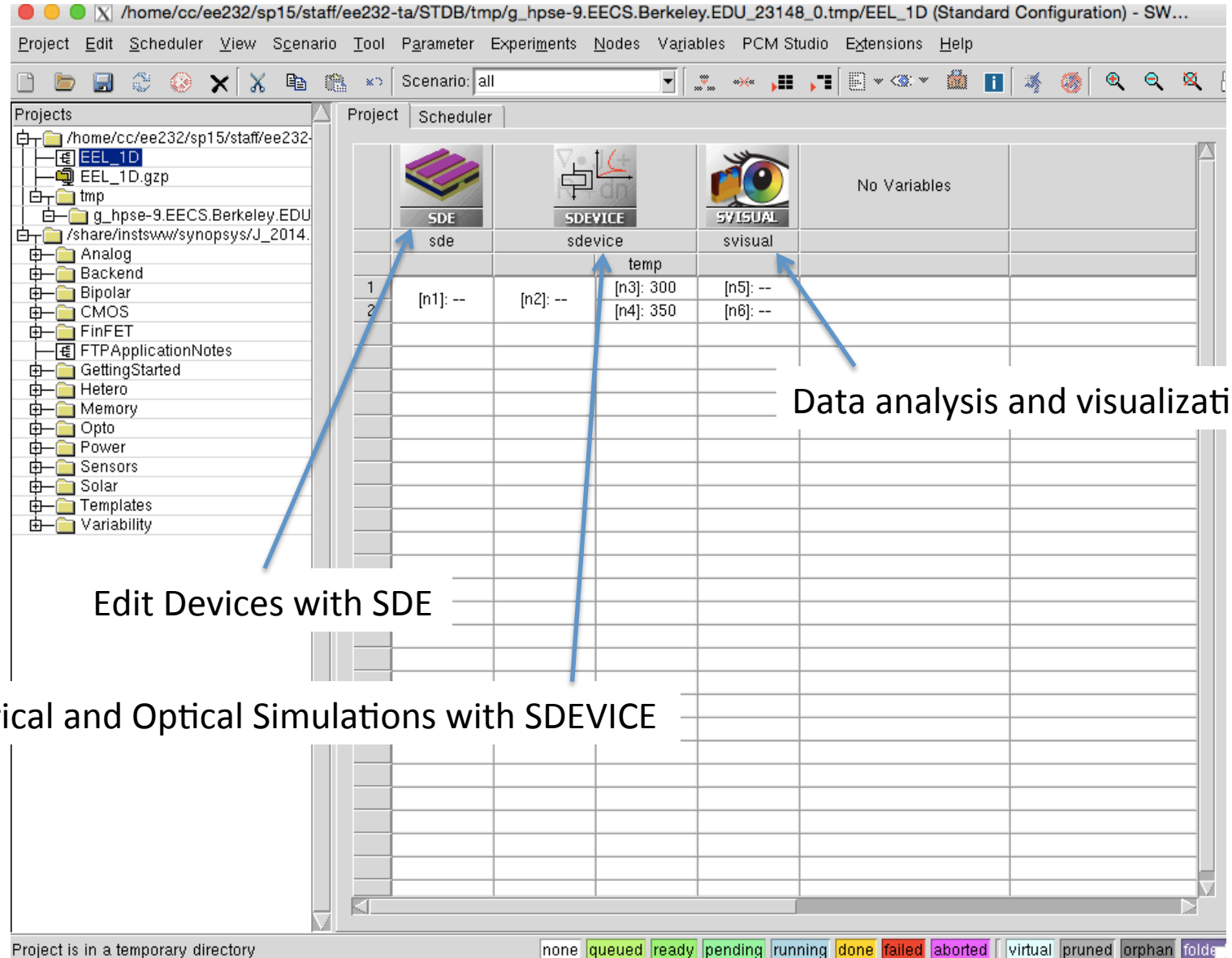
Layout of SWB

Simulation tool

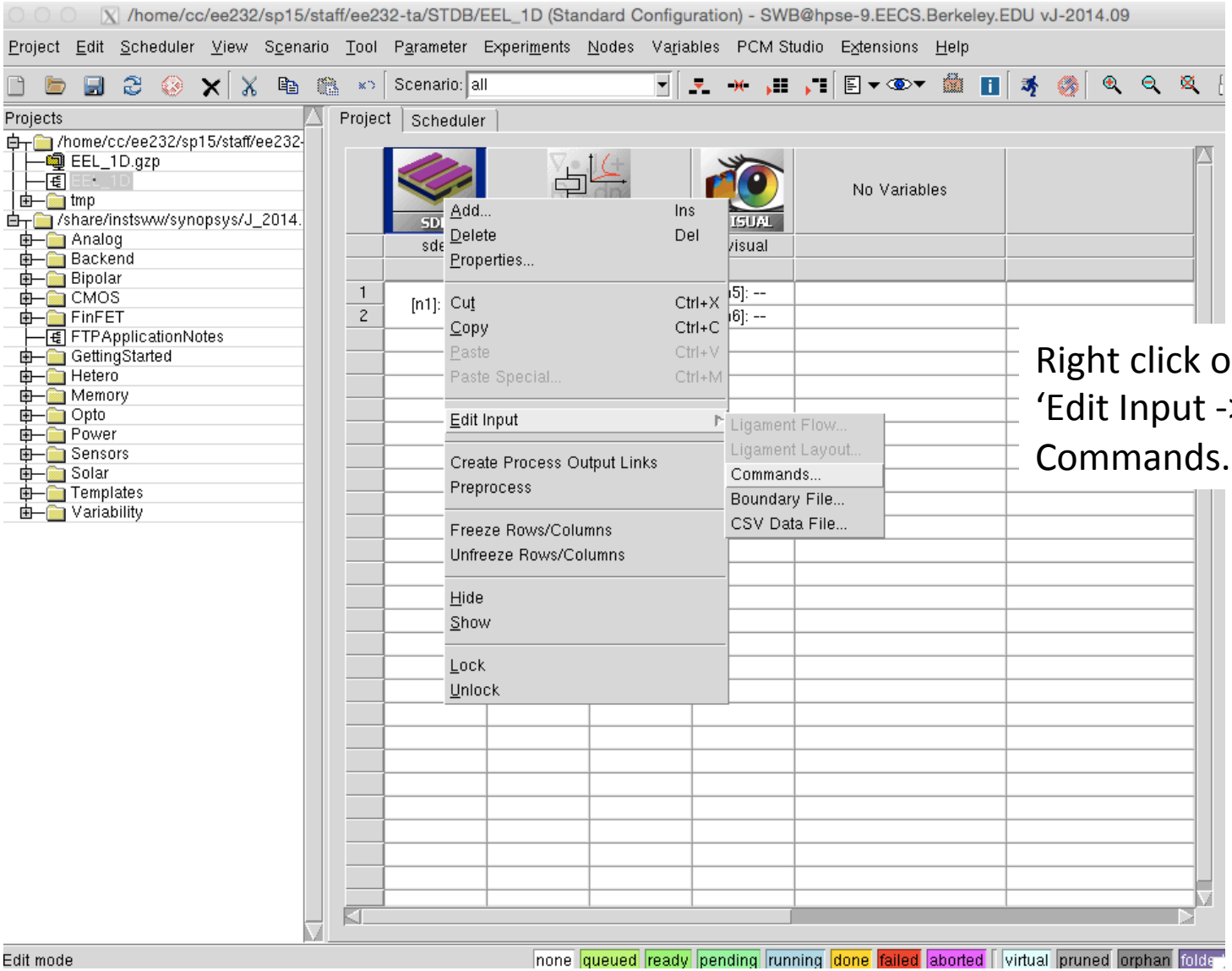
Parameter for simulation



Layout of SWB



Edit Structure with SDE



Right click on SDE tool, ‘Edit Input -> Commands…’

Edit Structure with SDE (2)

/home/cc/ee232/sp15/staff/ee232-ta/STDB/EEL_1D/sde_dvs.cmd - sedit

File Edit Format Settings Help

```
(sde:clear)
;; geometry layer depths

(define width 1)
(define dbulk 1.9); um
(define dsch 0.07 ) ; um
(define dactive 0.05) ; um

(define bulk_mat "AlGaAs");
(define sch_mat "AlGaAs") ;
(define active_mat "GaAs") ;

;; dopings

(define dopval_nbulk 5e17 )   ;[1/cm3]
(define dopval_pbulk 1e18 )   ;[1/cm3]
(define dopval_active 1e15 )  ;[1/cm3]

(define doptype_pbulk "BoronActiveConcentration")
(define doptype_nbulk "ArsenicActiveConcentration")
(define doptype_active "ArsenicActiveConcentration")

;; mole fraction values

(define molf_nbulk 0.4 )
```

- Everything defined with text file. Need to define materials, geometry, doping level, mole fraction, and contact placement.
- The simulation mesh is also defined here. Commands can be found in the SDE manual.

Edit Device Simulation with SDEVICE

/home/cc/ee232/sp15/staff/ee232-ta/STDB/EEL_1D/sdevice_des.cmd - sedit

File Edit Format Settings Help

```
#setdep @previous@

#define _Eqs_ Poisson Contact Circuit Hole Electron PhotonRate Temperature

Device diode {
Electrode {
    { Name="p_Contact" Voltage= 0.0 AreaFactor= 500}
    { Name="n_Contact" Voltage= 0.0 AreaFactor= 500 }
}

Thermode {
    { Name="p_Contact" AreaFactor= 500 Temperature=  @temp@ SurfaceResistance= 0
    { Name="n_Contact" AreaFactor= 500 Temperature=  @temp@ SurfaceResistance= 0
}

File {
        Grid=       "@tdr@"
        Parameter= "@parameter@"
        Current=    "@plot@"
        Plot=       "@tdrdat@"
        * ----- Specify base file name for saving modal gain spectrum
    Gain="n@node@"
}

Plot {
```

- Similarly right click on sdevice to edit the command file.
- Syntax is different here. Need to define input/output files, electrodes, thermodes (if doing thermal simulation), all physics models used, and the actual voltages, currents to sweep.

Add Parameter to simulation

/home/cc/ee232/sp15/staff/ee232-ta/STDB/EEL_1D/sdevice_des.cmd - sedit

File Edit Format Settings Help

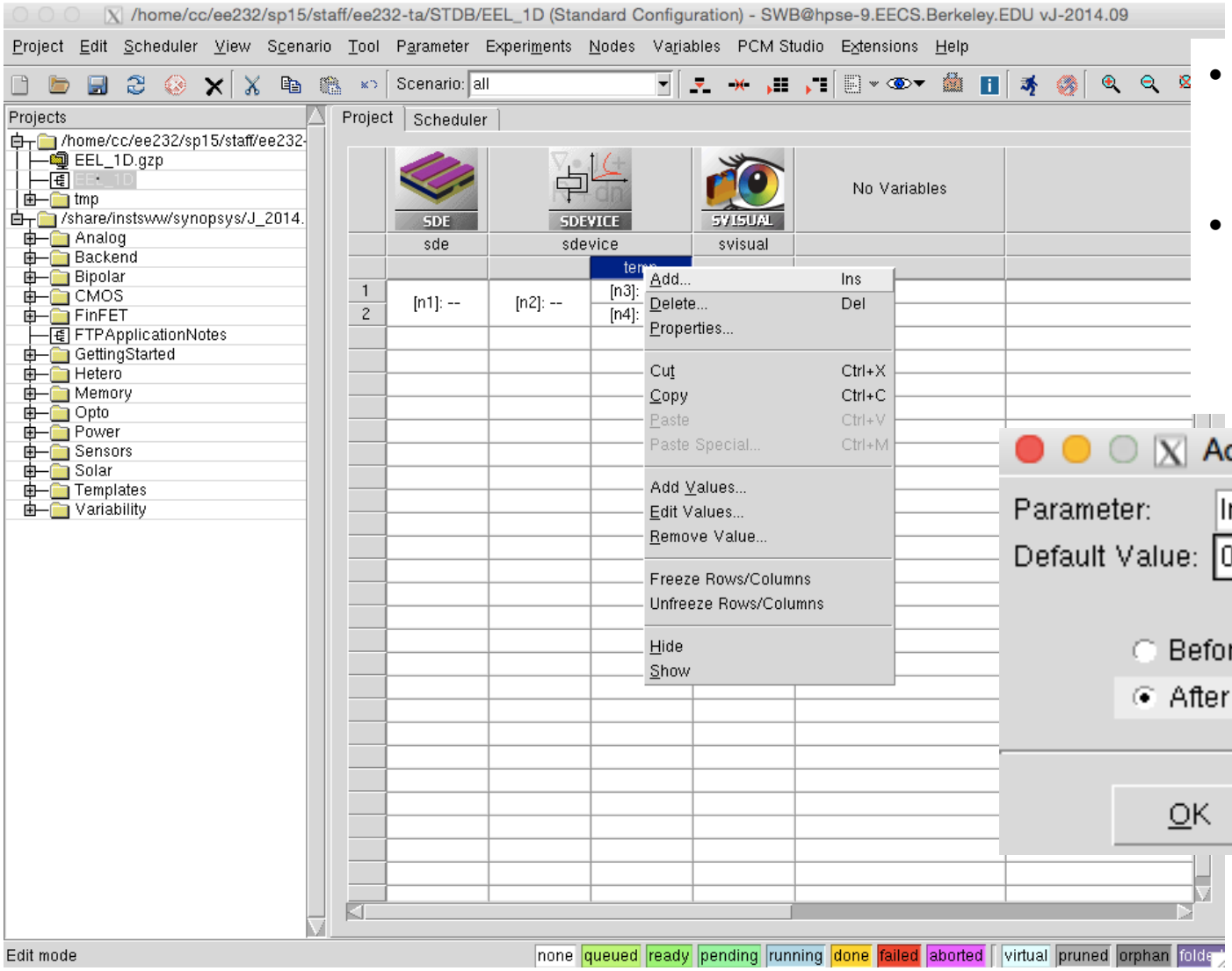
```
}

Physics {
    Laser (
       Optics(
           FEScalar(EquationType= Waveguide
                    Symmetry= Periodic
                    Polarization= TE
           )
       )
       FreeCarr
       RefractiveIndex(TemperatureDep)
       Longitudinalmodes
       ModeNumber= 1
       CavityLength= 500
       OpticalLoss= 2
       lFacetReflectivity= @lreflect@
       rFacetReflectivity= 0.9

       Broadening (Type= Coshyper Gamma= 0.02)
    )
    Thermionic
    HeteroInterfaces
    Mobility ( DopingDependence )
    Recombination ( SRH Auger)
```

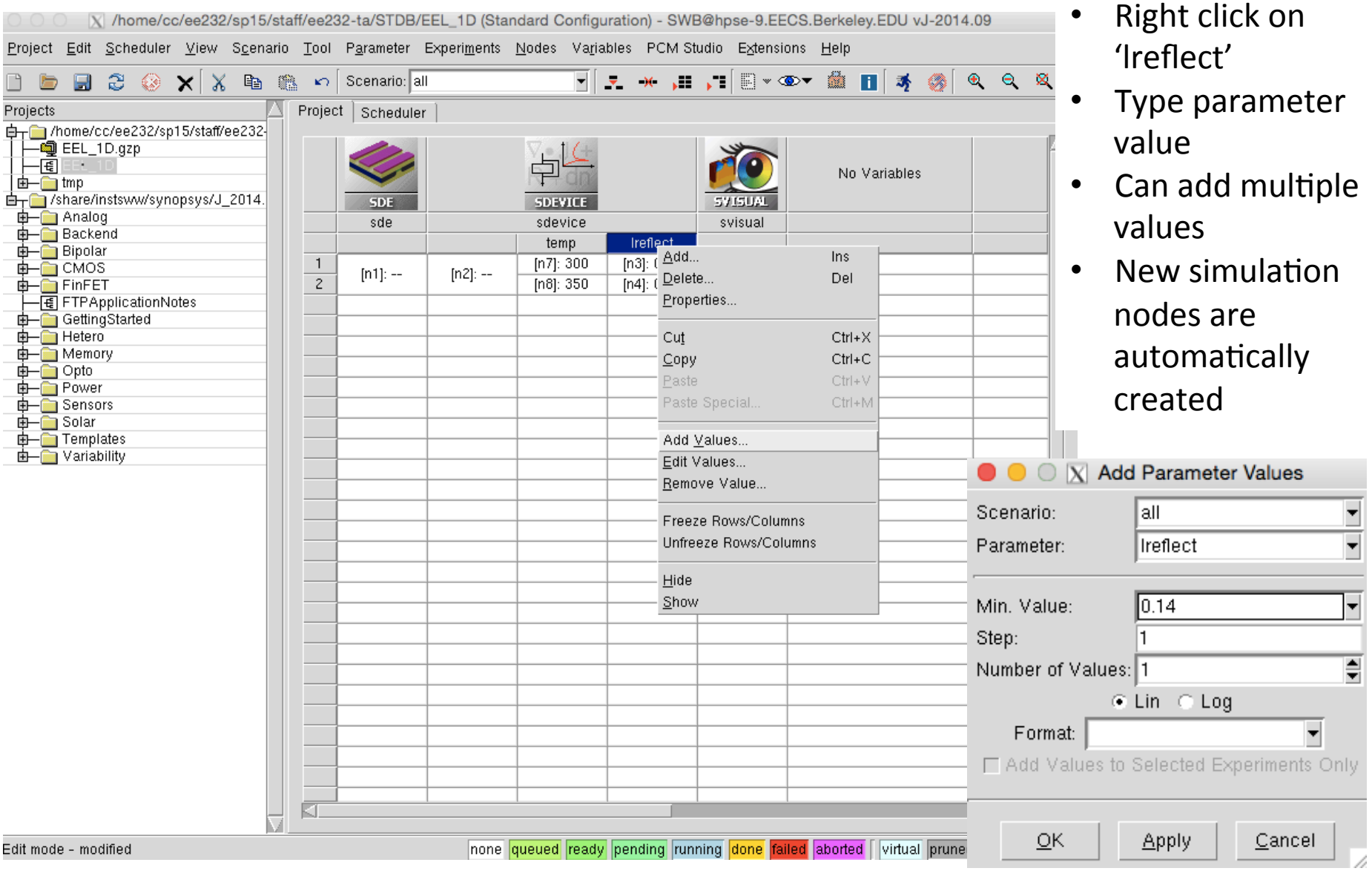
- We can make one of the mirror reflectivities in the laser a parameter in the workbench.
- In the sdevice command file, change the lFacetReflectivity from 0.07 to @lreflect@
- The @..@ indicates a paramter and any name can be used.

Add Parameter to workbench



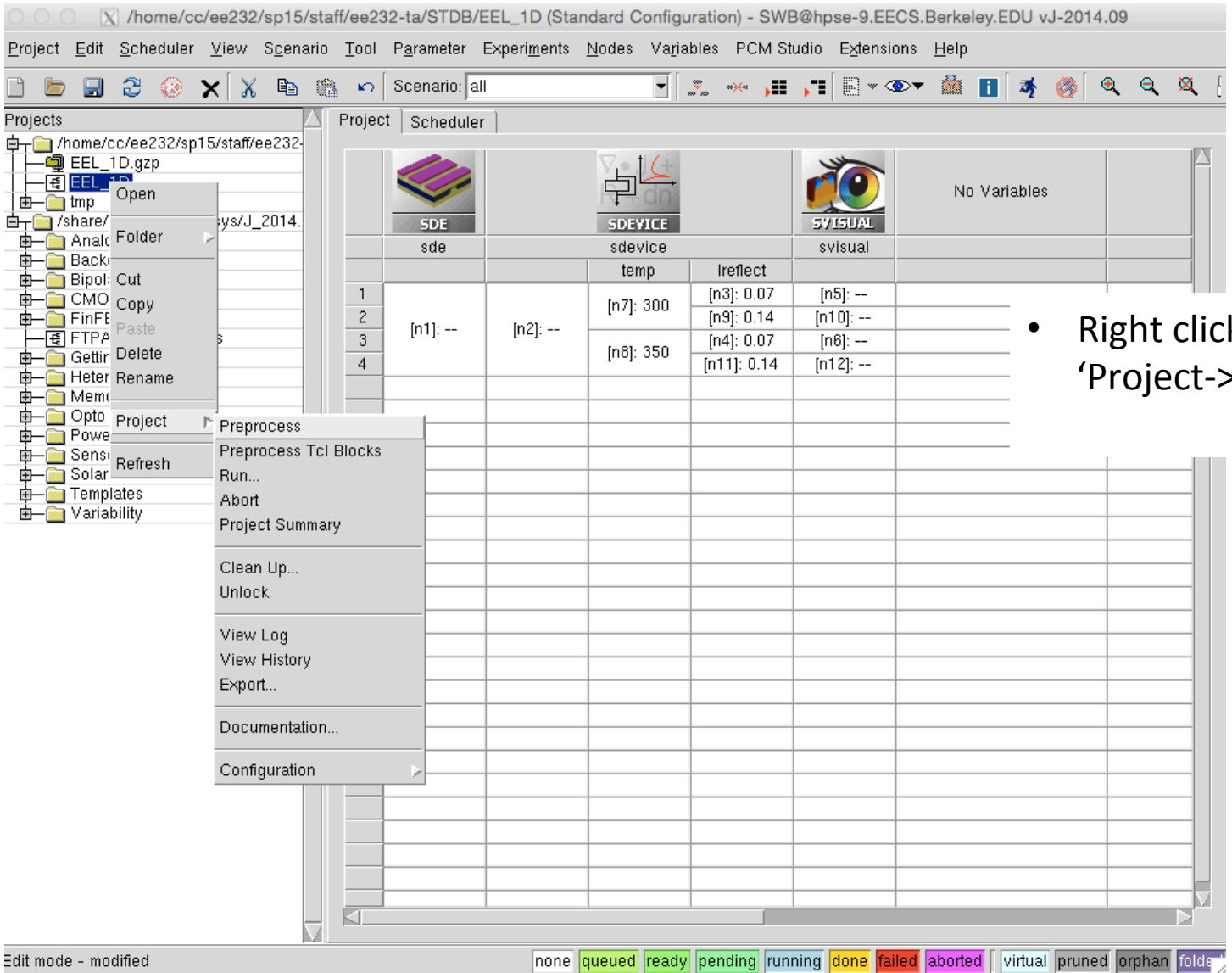
- Right click under sdevice and select Add…
- Type parameter name and default value

Add more values



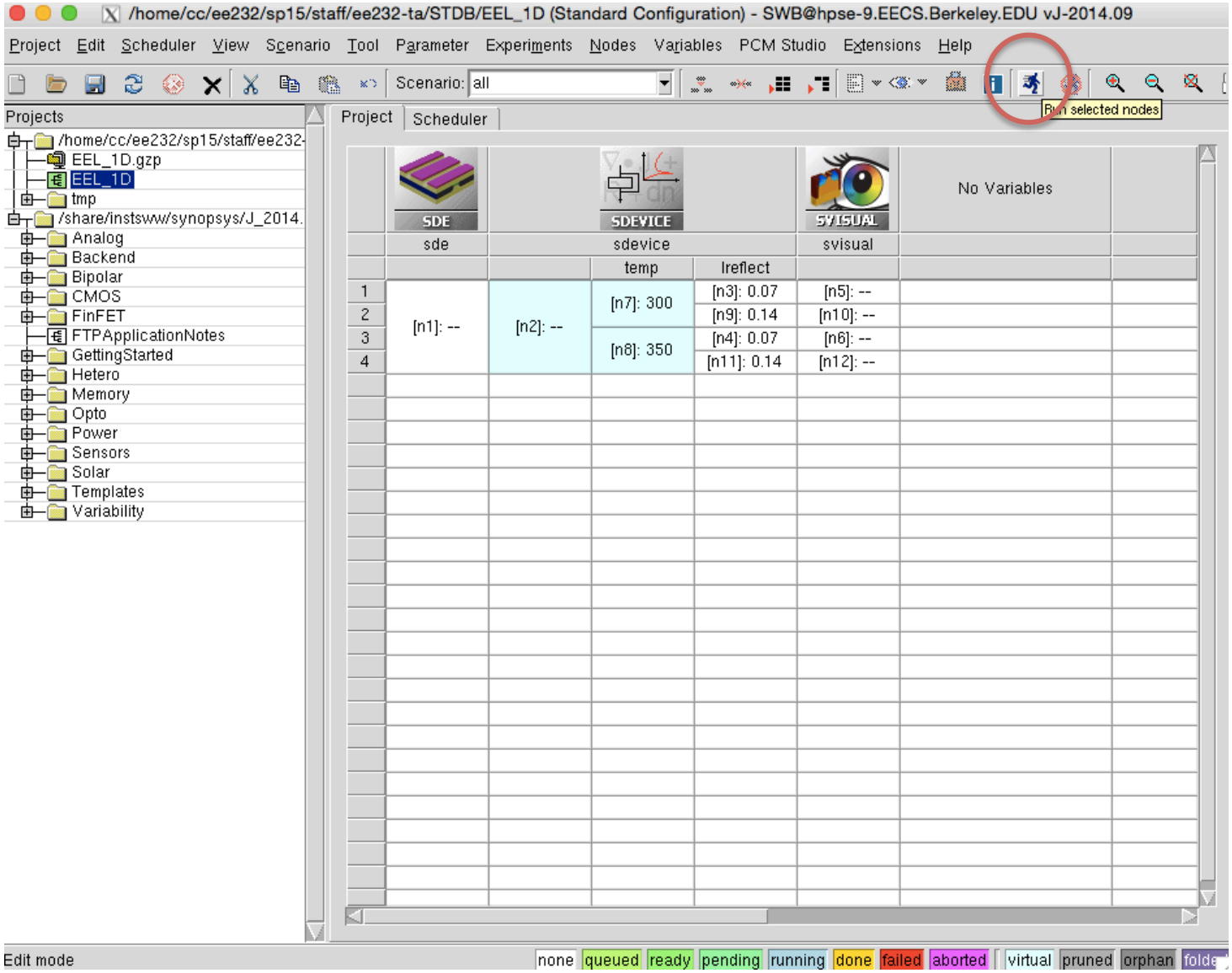
- Right click on ‘Ireflect’
- Type parameter value
- Can add multiple values
- New simulation nodes are automatically created

Save and Preprocess

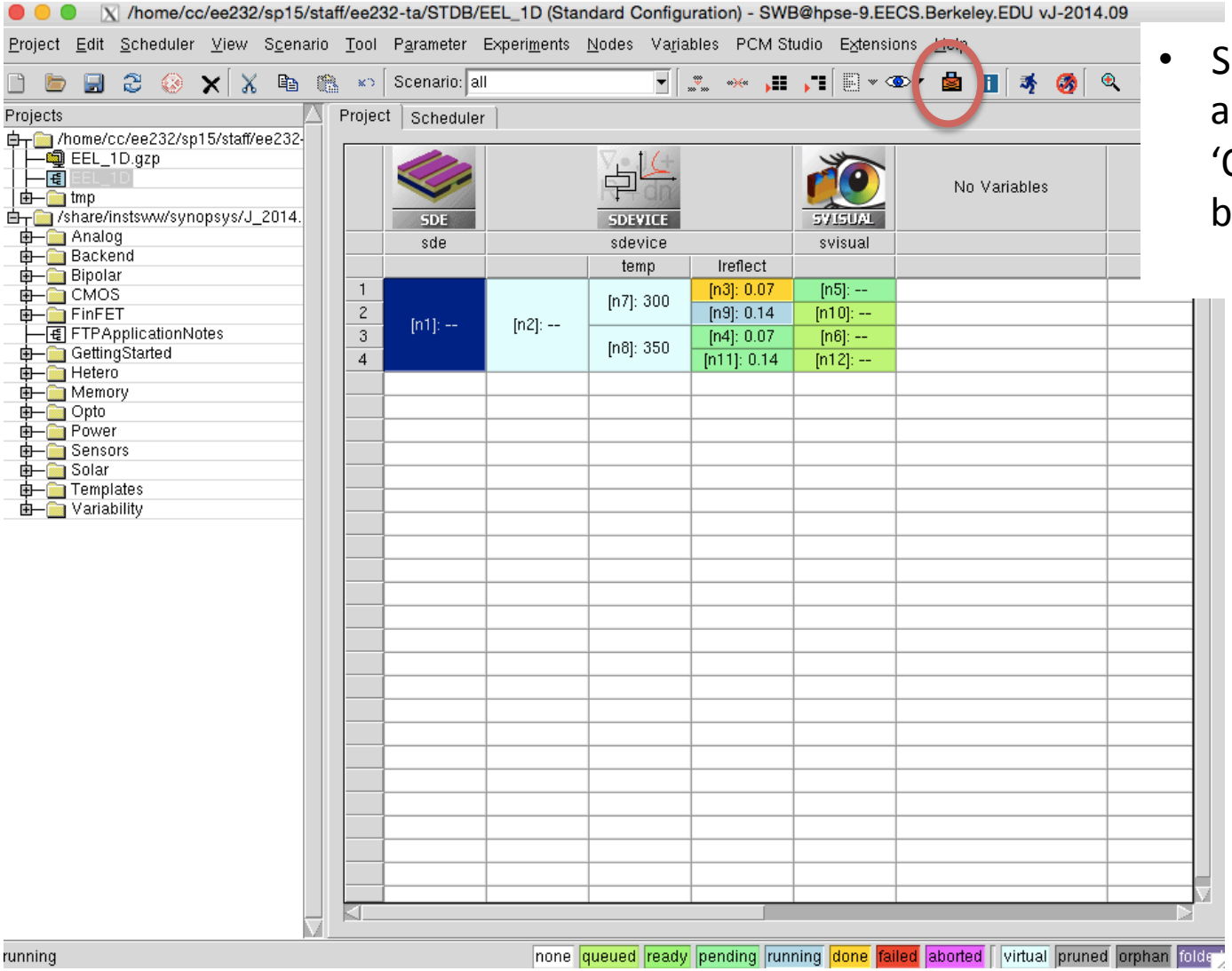


- Right click on project, ‘Project->Preprocess’

Run Simulation

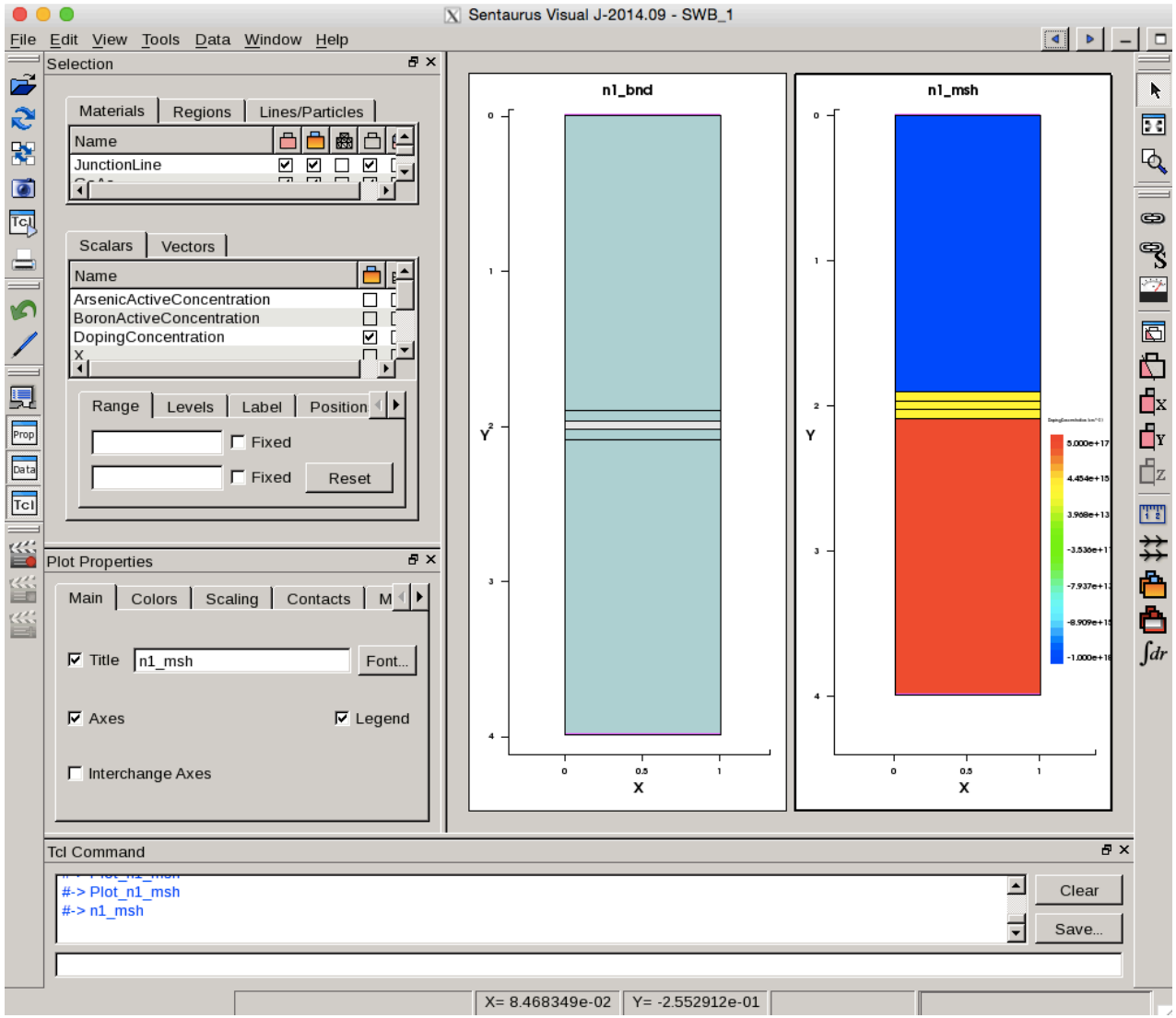


View Structure with Svisual



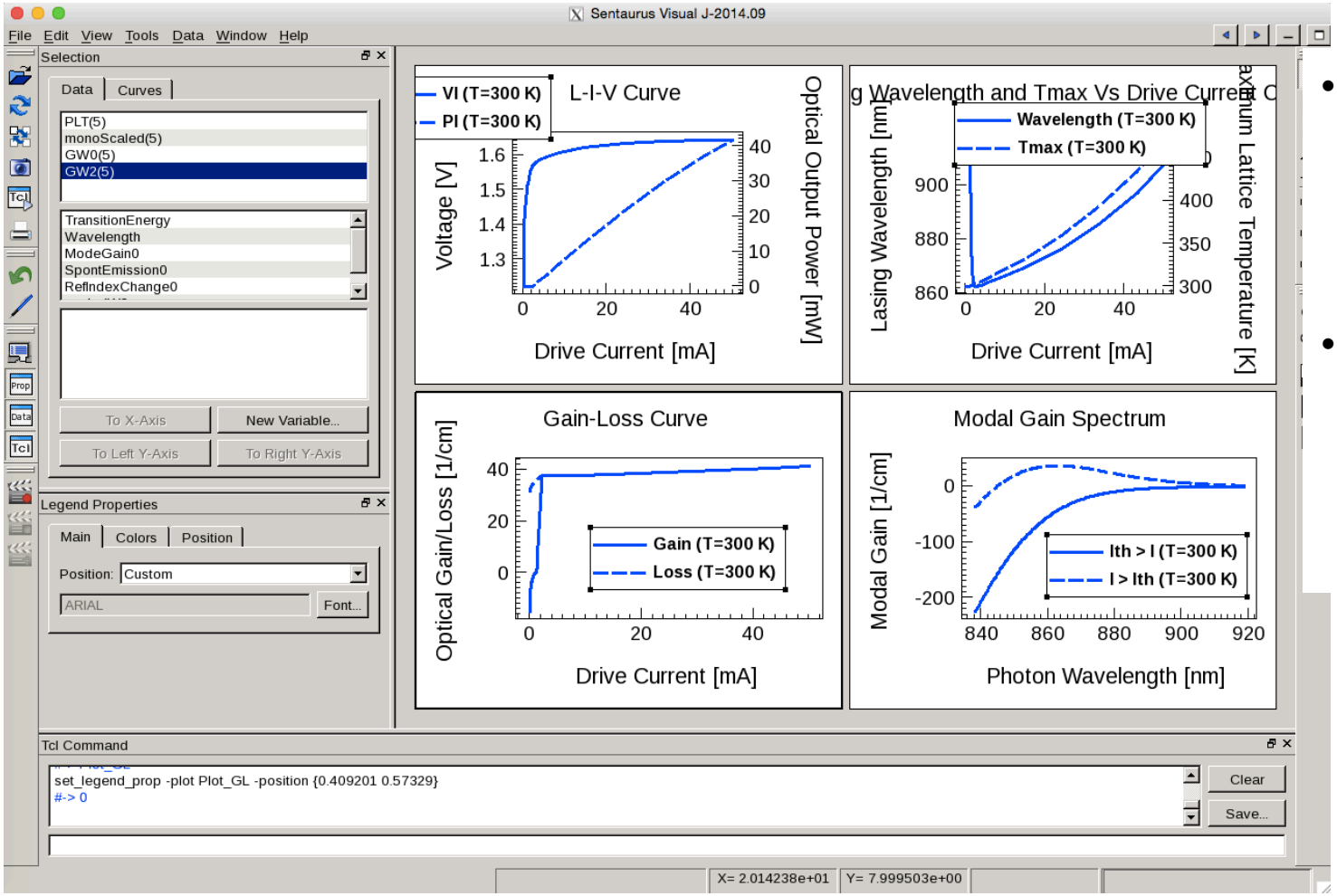
- Select SDE node and click the ‘Quick Visualize’ button

Structure in svisual



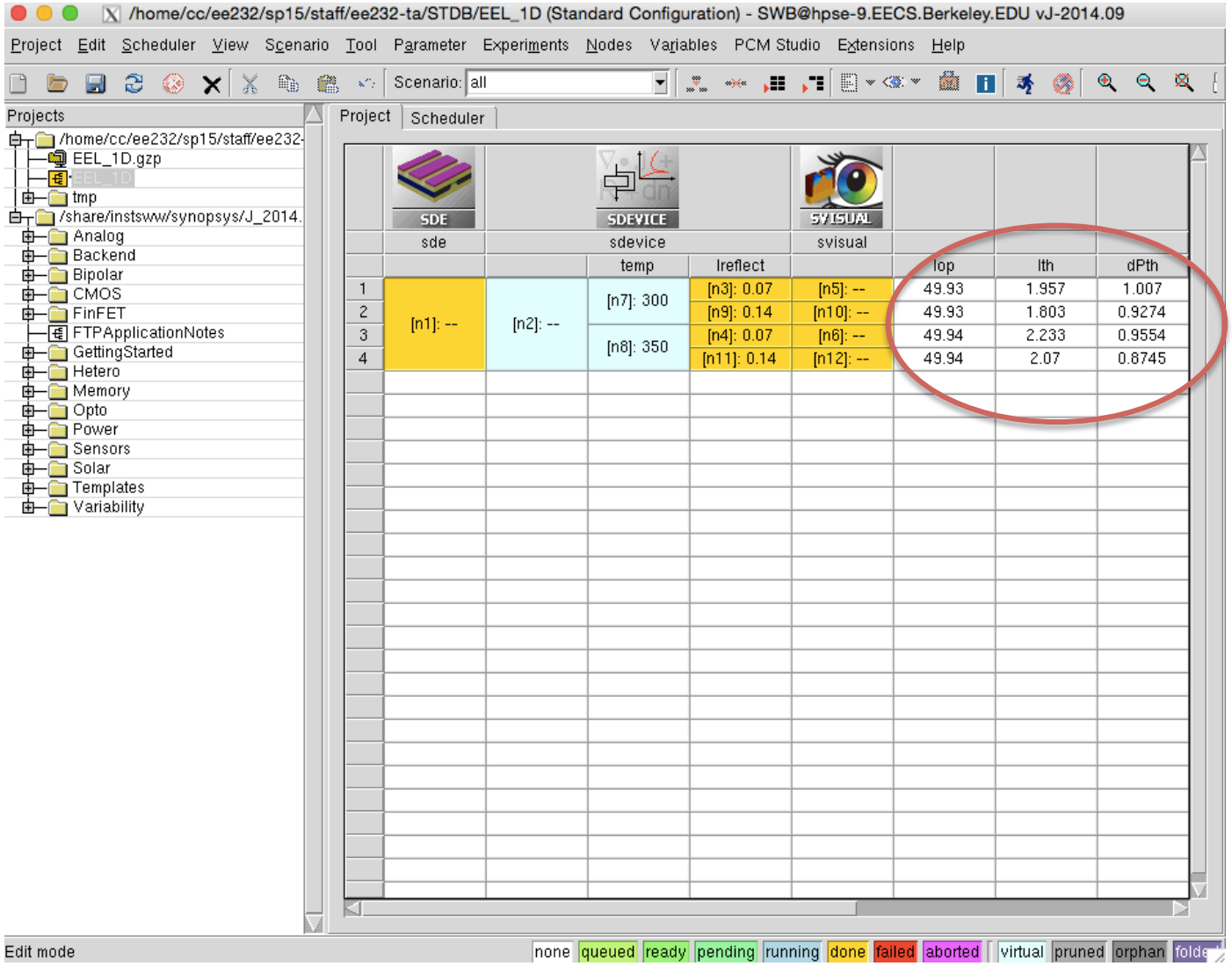
Can see many aspects of structure including dimensions, doping level, contacts, etc.

Data Analysis with svisual



- Click on svisual node and click run. Svisual script will analyze results and create graphs.
- You can edit the svisual command file to view script commands or add new analyses.

Svisual analysis will extract values visible in the workbench



This is useful for quick analysis or large parameter sweeps.

Sentaurus Manuals

- Manuals for the basic sentaurus tools are posted on piazza for the class.
- They can be found on the server here:
  /share/instsww/synopsys/J_2014.09/tcad/J-2014.09/manuals/PDFManual/data
- Don’t post or share the manuals publicly as part of the license agreement Berkeley has with synopsis.