

ATLAS

Release Notes

03/20/12

RELEASE NOTES

VERSION 5.18.3

ALTERATIONS AND ENHANCEMENTS

- Improve 3D GaN polarization model to prevent possible crash in structures with voids
- Improve QTUNNSC quantum tunneling model to prevent incorrect energy spacing values
- Remove spurious solver error messages from Mercury
- Improve optical beam intensity cutback to prevent potential crash
- Improve optical beam intensity cutback to prevent incorrect values after restarting from SOLVE INIT
- Improve temperature specification to prevent potential crash

VERSION 5.18.2

ALTERATIONS AND ENHANCEMENTS

- Improve 3D log file probe to prevent incorrect results when using BLOCK method
- Improve FDTD 3D photo-generation rate calculation to prevent potential crash

VERSION 5.18.1

NEW FEATURES

- Support for BICGST iterative linear solver in 2D

ALTERATIONS AND ENHANCEMENTS

- Improve interface trap model handling of S.X interfaces to prevent incorrect results
- Improve Geiger mode simulation to prevent spurious error message and empty file output
- Improve structure loading of insulator charge for materials which have been made into semiconductors
- Improve 3D ray trace handling of partially absorbed rays to increase accuracy

- Improve run-time output in extended-precision mode to prevent incorrect output

VERSION 5.18.0

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of 3D lattice temperature equation to prevent potential convergence problem in 80-bit extended-precision mode
- Improve structure file reload of degradation model to prevent incorrect results
- Improve FDTD sub-sampling to prevent potential crash
- Improve interface statement handling of S.X interfaces to prevent incorrect results

VERSION 5.17.47

NEW FEATURES

- 2-band stress-dependent zincblende k.p model
- Oxygen vacancy and interstitial velocity enhancement structure file output
- Multi-state trap occupation probabilities structure file output and reload
- Parallel ITAT.SC, MIMTUN, MIMTAT, SIS.EL, SIS.HO, SHJ.EL, SHJ.HO and BBT.NONLOCAL models
- Largest effective gain search option for Laser and Waveguide
- Spontaneous emission spectra and gain log file output for LED and Laser
- Multi-state trap recombination inclusion in channel continuity and generic ion transport equations parameter specification
- Reference electrode specification for parabolic Schottky model
- Oxygen transport velocity enhancement parameter specification
- Run-time material information for Pasveer mobility model
- Log file probe for QWELL bound energies
- DG and BQP intercompatibility specification

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of LI and ZB.KP bandgap model for $\text{InAs}(1-y)\text{P}(y)$ to prevent incorrect results
- Improve optical s-matrix model to allow yield reload, multiple dipole locations output and integrated yield and DOS output
- Improve MIXEDMODE .NET simulation to prevent potential crash
- New default values of INTDEFECTS density of states
- Improve handling of zero trap density specification in structure file output
- Remove spurious error message from 2D ray trace
- Allow Geiger mode simulation to output structure during mesh creation or after initial solution
- Improve small-signal optical beam simulation to prevent potential crash
- Improve accuracy of combined TAT.LOCAL and ITAT.SC models to prevent potential convergence problem
- Allow negative values of MAG.INDEX on MATERIAL statement
- Improve accuracy of conductor/semiconductor interface resistance model to prevent incorrect results
- Improve calculation of total current structure file output to prevent incorrect results
- New default values of SRH lifetime for SiC
- Improve handling of auxiliary Schrodinger-Poisson mesh specification in 3D to prevent incorrect results
- Simplify named materials interface specification
- Improve Laser model with REFLECT to prevent potential convergence issue
- Improve FDTD auto mesh to prevent incorrect results
- Improve accuracy of source photo-current post-processing calculation to prevent incorrect results
- Improve GaAs/semiconductor interface node definition to prevent incorrect results
- Support for MIN and MAX with log file probe of electric field magnitude
- Improve TMM model to prevent incorrect results with diffusive interfaces
- Improve accuracy of GaN polarization model to allow charge addition at adjacent interface points
- Improve degradation model interface charge calculation to prevent incorrect results
- Allow loading of structure files with more than 1000 interface traps per node

- Improve accuracy of spontaneous emission spectrum integration calculation for radiative recombination to prevent incorrect results
- Improve TMM calculation of source photo-current to prevent incorrect results
- PAM.MPI parallel iterative solver now uses number of processors specified by '-P' command-line argument instead of '-MPI'
- Support for exit side optical interfaces in 3D ray trace
- Remove spurious linear solver warning messages when using Laser or Waveguide
- Improve transient time step algorithm to prevent incorrect time step cutbacks when simulating lattice and electron temperature equations in 80-bit extended-precision mode
- Improve convergence of multi-state trap model during lattice temperature simulation

VERSION 5.17.46

NEW FEATURES

- Direction specification for parallel FDTD domain decomposition
- Multi-state interface trap model
- Multi-state interface trap model recombination and generation rate log file probe
- Coupled hydrogen transport and multi-state interface trap model
- NBTI multi-state trap models

ALTERATIONS AND ENHANCEMENTS

- Increase 3D FDTD simulation speed
- Improve accuracy of quantum well model calculation of structure file bound state energies and band edges near hetero-interfaces
- Improve quantum well capture-escape model with internal QWELL mesh to prevent potential crash
- Add power factors to maximum oxygen vacancy and interstitial densities model
- Improve oxygen renormalization method to remove discontinuities in oxygen vacancy and interstitial densities
- METHOD statement specification of oxygen renormalization method

- Improve transient convergence of oxygen transport equations
- Structure file reload of oxygen vacancies and interstitial densities
- Improve structure file output of electric field and current density in conductors to prevent incorrect results
- Improve interface resistance model to prevent incorrect results
- Improve INTTRAP model to prevent incorrect calculation of interface boundaries and density of states
- Remove spurious error message from structure file flowline output when trap tunnel model is enabled

VERSION 5.17.45

NEW FEATURES

- Scott-Malliaras boundary conditions for Schottky barrier contacts

ALTERATIONS AND ENHANCEMENTS

- Increase FDTD simulation speed
- Improve stability of TAT.LOCAL model to prevent potential convergence issues
- Improve accuracy of exciton diffusion coefficient calculation to prevent incorrect results
- Increase maximum number of regions to 1500
- Improve renormalization method for oxygen transport to prevent convergence issues

VERSION 5.17.44

NEW FEATURES

- ITAT model support for semiconductor IMO regions
- Localized trap state tunneling for ITAT model
- MIXEDMODE Verilog-A support
- 2D and 3D anisotropic FDTD with arbitrary index variation in any direction

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of Quantum-NEGF solver in cylindrical coordinates
- Improve accuracy of energy dependent probes output for Quantum-NEGF solver
- Improve accuracy of 1.5D effective index Helmholtz solver for REFLECT and HELM.GEOM=15DX
- Improve accuracy of 3D ray trace with angle specification on SOLVE statement
- Improve accuracy of 3D ray trace with lenses
- Improve accuracy of 3D FDTD with S.RIGHT specification on BEAM statement
- Improve handling of subcircuits in MIXEDMODE to prevent potential crash
- Improve incomplete ionization model to prevent incorrect values in extended-precision mode
- Increase initialization speed of FDTD with planar/linear sources

VERSION 5.17.43

NEW FEATURES

- Modal field pattern support in LASER modal spontaneous emission model
- 3D FDTD support for single Z-layer 2D simulations

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of 3D Langevin scattering model
- Improve accuracy of exciton-exciton/exciton-polaron terms in exciton continuity equations
- Polarization charge is now included only at the interfaces for Poisson's equation for POLARIZATION model
- Improve 3D ray trace to prevent spurious error condition when no OUTFILE is specified on BEAM statement
- Improve accuracy of FDTD absorption and source boundary calculation
- Improve accuracy of LASER stimulated emission modal spectrum output
- Improve lenslet display in FDTD file output
- Improve accuracy of ray trace with angle specification
- Improve 3D parallel FDTD to prevent potential crash

- Improve accuracy of 3D TFSF boundaries
- Improve accuracy of Coulombic trapping model

VERSION 5.17.42

NEW FEATURES

- Juska Langevin recombination model
- Nenashev Langevin recombination model
- Optional specification of weak convergence rule initial iteration number
- Device boundary oxygen partial pressure specification
- FDTD y-direction period boundary specification
- Semiconductor-specific oxygen transport equations

ALTERATIONS AND ENHANCEMENTS

- New default value of EFRENKEL.OX for IMO and CMO materials
- Improve accuracy of k.p model for InGaN
- Improve accuracy of GaN polarization model
- Improve accuracy of oxygen exchange model
- Improve structure file reload to prevent spurious error messages
- Improve Luminous output file naming
- Improve accuracy of 3D carrier velocity structure file output
- Add more information to FDTD run time output

VERSION 5.17.41

NEW FEATURES

- Temperature-dependent Pasveer mobility model
- Device boundary oxygen vacancy and interstitial activation energy specification

- Contact oxygen vacancy and interstitial activation energy specification
- Ionic oxygen band parameters structure file output
- Ionic oxygen valence band reference energy specification
- Ionic oxygen Frenkel energy specification
- Ionic oxygen exchange model
- Small-signal ionic oxygen transport simulation

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of BQP model intrinsic carrier concentration calculation with BQP.NEWTON
- Improve TMM model error conditions
- Improve optical index file conversion
- Improve accuracy of FDTD lens model

VERSION 5.17.40

NEW FEATURES

- Anisotropic FDTD PMLs
- Transient general species reaction rate model
- General species reaction rate model log file probe
- Activation energy specification for general species reaction rate model
- Structure file strain tensor dependent polarization model with triangle edge averaging
- Dual grid point averaging for polarization charge model
- 3D ray tracing for relative optical sources
- Beam characterization rescaling
- Optional electrode polarization charge specification
- Optional interface polarization charge specification
- Full newton coupling for BQP model

- Modify exponential limit for oxygen vacancy concentration during SOLVE INIT and at device boundaries

ALTERATIONS AND ENHANCEMENTS

- Improve general reaction capability algorithm for species composition number
- Improve TEN.PIEZO polarization model to include charge at electrode nodes
- Improve general species reaction rate model to prevent incorrect transient initialization
- Parameter to specify longitudinal mode energy spacing instead of using default Fabry-Perot resonator calculation
- Improve AC current calculation with generic ion transport model
- Improve accuracy of TEN.PIEZO model with compositional grading

VERSION 5.17.39

NEW FEATURES

- Random textured lenslet characterization
- Spontaneous emission between neighboring quantum wells for QWELL capture-escape model
- Generic ion transport model
- General reaction capability for generic ion transport model
- 3D FDTD twisted nematic liquid crystal model
- FDTD graded index anti-reflection layers
- FDTD graded anisotropic index
- Run-time material information for organic hopping mobility model

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of orientation dependent effective mass in 2D and cylindrical Schrodinger solver
- Modify Schrodinger-Poisson solver to give error message for incorrect values of NUM.DIR
- Improve accuracy of LED spontaneous emission spectra calculation
- Improve accuracy of generic ionic species model in AC simulations

- Improve accuracy of log file probe integration with generic ionic species model
- Improve accuracy of QWELL LED inter-well output spectrum calculation
- Improve anisotropic FDTD parameter specification
- Allow ODEFECTS statement to be used for non-organic materials
- Improve bound state energies and wave functions output for Schrodinger-Poisson when NUM.DIRECT=4
- Improve convergence run-time output to prevent possible crash
- Improve accuracy of angle scanning in 3D ray trace
- Improve 2D ray trace reflection and absorption log file output calculation so that averaged values are used for multiple beams

VERSION 5.17.38

NEW FEATURES

- Optional WKB approximation for SIS.EL and SIS.HO models transmission co-efficient calculation
- Parameter to specify ratio of singlet-to-triplet excitons formed during triplet-triplet exciton annihilation
- Orientation-dependent effective mass in Schrodinger-Poisson solver

ALTERATIONS AND ENHANCEMENTS

- Improve Pasveer mobility model to prevent possible convergence issues when using Langevin recombination model
- Increase speed of 1D optical scattering matrix method
- Improve 3D bias cutback to prevent incorrect results if solution does not converge within specified number of cutbacks
- Change minimum trap concentration to 0 from 1
- Parameter to specify potential X-norm for Schrodinger-Poisson model
- Improve FLUENCE model to prevent potential crash
- Improve accuracy of optical radiative recombination rate calculation

VERSION 5.17.37

NEW FEATURES

- 3D FDTD anisotropic index model
- Reference activation energy calculation for oxygen vacancy and interstitial transport equations

ALTERATIONS AND ENHANCEMENTS

- TEN.PIEZO model run-time charge output
- Modify POLARIZATION model to use nodal area in charge density calculation
- Modify POLARIZATION model to give an error message if no substrate material is specified when calculating polarization charges
- Include polarization along insulator interfaces in TEN.PIEZO model
- Improve transient simulation stability of oxygen transport model
- Modify structure file output so that polarization charge will be saved by default
- Include polarization along electrode interfaces in TEN.PIEZO model
- Remove spurious error message about intersection of optical source and device domain from 2D ray trace
- PIEZO.SCALE now scales only strain dependent piezoelectric polarization
- POLAR.SCALE now scales both spontaneous and piezoelectric polarization
- Improve structure file output to prevent incorrect labeling of stress
- Improve 3D ray trace structure file output to correctly account for lenses
- Improve lattice temperature equation convergence
- Improve structure file output to prevent incorrect doping values when using traps
- Improve accuracy of illumination windowing in 2D ray trace

VERSION 5.17.36

NEW FEATURES

- MIXEDMODE support for HEIMAN and SR.HEIMAN interface trap hysteresis
- 3D UST model
- Structure file strain tensor dependent polarization model
- Run-time material information for oxygen transport model

ALTERATIONS AND ENHANCEMENTS

- Improve handling of 3D OUTFILE and RAYTRACE parameters of BEAM statement to ensure correct functionality
- Improve accuracy of Geiger mode model log file probe quantities
- Improve MIXEDMODE transient log file output to prevent incorrect values in extended-precision mode
- Independent specification of PSP.SCALE and PIEZO.SCALE polarization model parameters
- Improve TEN.PIEZO model to prevent incorrect scaling of epitaxial strain
- Improve 3D LED license to prevent incorrect license request when saving spectrum files
- Improve user-defined ray specification to ensure correct functionality
- Improve oxygen transport model to ensure correct equilibrium oxygen vacancy and interstitial densities

VERSION 5.17.35

NEW FEATURES

- Error check for multiple embedded lens BEAM statement definition
- 1D optical scattering matrix method for LED emission

ALTERATIONS AND ENHANCEMENTS

- Improve anti-reflective material specification on INTERFACE statement
- Improve accuracy of 2D SEU photo-generation model
- Improve accuracy of time step algorithm for oxygen transport model
- QWELL capture-escape model is now compatible with BQP model
- Improve RTAT.SC model to prevent NaNs

VERSION 5.17.34

NEW FEATURES

- Current dependent sign of trap charge for kinetic degradation model
- Oxygen vacancy and interstitial transport equations

ALTERATIONS AND ENHANCEMENTS

- Parameter to specify that negative Y-direction rays are reflected, and positive Y-direction rays are transmitted
- Improve ITAT convergence for MISM and MSISM type structure
- Improve 3D FDTD structure file output
- Improve accuracy of TMM angled source photo-current calculation
- Improve accuracy of 2D UST model

VERSION 5.17.33

NEW FEATURES

- Schur complement (block-type) solver for laser and quantum well capture-escape model
- Default parameters for selenium
- Anti-reflective material specification for LENS statement
- Kinetic degradation model
- Default material group specification on REGION statement
- Magnitude complex index dependent auto-meshing for FDTD

ALTERATIONS AND ENHANCEMENTS

- Improve DEFECTS model to increase stability with ITAT models
- Remove spurious error message from structure file output when using conductor model
- Improve MIXEDMODE to prevent potential crash when using ferro-electric model

VERSION 5.17.32

NEW FEATURES

- User-specifiable scaling of BBT.HURKX model statistical factor
- Current dependent BBT.HURKX model statistical factor
- Gradient of electric field and quasi-Fermi level dependent BBT.HURKX model statistical factor
- Structure file output of BBT.HURKX model statistical factor
- Option to use Schenk BBT model statistical factor in BBT.HURKX model
- ITAT models with Gaussian defect energy distributions

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of MIM.ITAT transient tunnel current calculation
- Improve FDTD structures file output to prevent incorrect cropping
- Improve ITAT models to prevent possible convergence issue
- Improve accuracy of LED FDTD far field patterns
- Improve Geiger mode model to prevent possible crash
- Improve structure file output to prevent possible crash when saving LED optical intensity

VERSION 5.17.31

NEW FEATURES

- Carrier species specification for MIMTUN
- Support for Metal-Insulator-Metal structures in ITAT model
- Oxygen mass action and Frenkel coefficient parameters
- Index files are now automatically sorted by wavelength
- TEMPERATURE parameter on the MODELS statement can now be varied during simulation
- Support for voids in 3D MESH CYLINDRICAL structures

- Self-consistent solution of Poisson's equation and MIM.ITAT model

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of 3D LED FDTD dipole scanning
- Improve TRAP.JTAT model to increase stability
- Improve parsing of TRAP.HURKX parameter to ensure correct usage
- Improve accuracy of trap dependent quantities in structure file output calculated by MIM.ITAT/RTAT models
- Improve ITAT models convergence at high bias
- Improve accuracy of structure file lenses defined in 3D ray trace
- Improve 3D polarization model to prevent possible crash in structures with voids
- Improve ITAT model to increase stability

VERSION 5.17.30

NEW FEATURES

- FDTD automatic meshing to FDTD
- Local electric field based TAT model
- FDTD analysis specification on LED statement
- V.HELM/S.HELM LASER small signal AC response
- Parameter to specify that Hurkx TAT enhancement factor only applies to recombination/generation part of continuous DEFECTS model

ALTERATIONS AND ENHANCEMENTS

- Improve 2D random constant angle "GIZA" pyramids in ray trace to prevent incorrect pyramid generation
- Improve 3D ray trace to prevent potential crash
- Improve structure file loading to prevent potential crash
- Prevent potential crash when loading ray trace data
- Improve accuracy of Pasveer mobility model to prevent incorrect electric field dependence

VERSION 5.17.29

NEW FEATURES

- Carrier species specification for QWELL model
- Optional use of ITAT model current calculation is SIS.TAT model
- TAT.TRAP and ITAT/RTAT model structure file output
- Optional suppression of PMLs in output structure files
- Piezoelectric and spontaneous polarization model for non-homogenous layer strain
- REGION MODIFY now modifies donor and acceptor doping

ALTERATIONS AND ENHANCEMENTS

- Remove spurious error message from 3D LED
- Improve spatial stepping in LED reverse ray trace and FDTD
- Increase speed of 3D FDTD
- Improve accuracy of FDTD for non-90 degree illumination
- Improve ITAT/RTAT models to prevent non-linear potential profile in gate insulator
- Support X rotational beam coordinates in FDTD
- Reduce FDTD memory usage
- Rename parameter TAT.NSLICES to TAT.SLICEPTS
- Sign of imaginary refractive index LASER and WAVEGUIDE is now consistent with ray trace
- Improve Pasveer mobility with Langevin recombination to prevent possible NaNs
- Improve BICGST iterative solver to return best solution if solver diverges

VERSION 5.17.28

NEW FEATURES

- Default parameters for CMO and IMO materials

- ITAT/RTAT models now work with insulator materials which have been made into semiconductors

ALTERATIONS AND ENHANCEMENTS

- Improve Adachi index model to correctly account for energies greater than bandgap

VERSION 5.17.27

NEW FEATURES

- Steady state and transient inelastic TAT and recombination TAT models
- Self-consistent solution of Poisson's equation and inelastic TAT/recombination TAT models
- Transverse imaginary index for PMLs
- Parameter to specify re-use of last calculated quantum potentials when BQP model is disabled
- Run-time material information for mobility enhancement model
- Region specific TRAP and TAT.TRAP specification on DOPING statement
- Optional FETIS compatible material defaults for GaN, AlN, InN, AlGaIn, InGaIn and sapphire

ALTERATIONS AND ENHANCEMENTS

- Improve 2D and 3D mobility enhancement models to prevent incorrect results
- Improve 3D structure file output to include flowlines
- Improve BQP model to prevent NaNs in extended-precision mode
- Improve structure file loading so that user-defined materials are treated as built-in materials where possible
- ATLAS will now wait until the required BLAZE license becomes available instead of exiting
- Improve selection of bundle licenses to allow more flexibility
- Parameter to specify whether polarization charge is to be added to insulators which are changed into semiconductors
- Improve 3D LED model to prevent crash if void is present in the structure
- Improve accuracy of k.p model InGaIn affinity calculation

VERSION 5.17.26

NEW FEATURES

- ILK iterative linear solver precondition
- FDTD based LED simulation
- 2D mobility enhancement model
- New output file parameters for multiple log files, structure files, near field patterns, and far field patterns

ALTERATIONS AND ENHANCEMENTS

- Automatic modification of FDTD TD.SRATE and PROP.LENG by maximum index of refraction to increase stability
- Improve power dissipation calculation in FDTD 2D and 3D to increase accuracy
- Improve QTNLSC.EL and QTNLSC.HO models to prevent potential crash in transient simulations
- Improve QTNLSC.EL and QTNLSC.HO models prevent possible overestimation of tunneling current
- Improve convergence behavior of QTUNNSC models
- Improve QTUNNSC models to prevent potential crash in parallel simulations
- Modify QTNLSC.BBT model statistical factor so that it is consistent with BBT.NONLOCAL model
- Improve structure file output to prevent incorrect values of interface charge at semiconductor/insulator interfaces
- Change TM/TE definition in FDTD to match TMM and ray trace
- Improve transient pulse specification to prevent incorrect results when FREQUENCY and PIULSE.WIDTH are both specified
- Electron and hole Schottky tunneling models can now be specified individually

VERSION 5.17.25

NEW FEATURES

- Run-time material information for SCHENK.BBT model
- Wavelength run-time output for 3D ray trace
- Parameter to add stimulated recombination into lattice temperature equation heat source
- LED FDTD coupled surface definition
- Modal spectra file output for V.HELM and S.HELM LASER models
- Generalized Einstein coefficient coupled with Pasveer mobility model
- FDTD output file decimal precision specification

ALTERATIONS AND ENHANCEMENTS

- Improve ray trace file loading to prevent potential crash
- Improve degradation model to prevent incorrect results during transient cutbacks
- LASER and LED are now compatible with lattice temperature model
- Improve conductor model to prevent possible convergence problem during SOLVE INIT
- Improve bias cutbacks to prevent unlimited number of cutbacks
- Improve 3D ray trace to prevent possible NaNs in available photo-currents output
- Include extra information in verbose run-time output for 3D ray trace
- Improve convergence behavior of the QTNLSC.EL and QTNLSC.HO models with QTNL.DERIVS enabled
- Improve convergence behavior of the QTNLSC.BBT model with QTNL.DERIVS enabled
- Improve optical index file input to prevent incorrect values in extended-precision mode
- Improve accuracy of VCSEL resonance finding
- Re-introduced recombination rates into lattice temperature heat source
- Improve accuracy of Pasveer current calculation
- Improve 2D parallel ray trace to prevent spurious results
- Improve interface defects in 3D to prevent potential crash
- Improve bulk and interface defects statement parsing in 3D to make sure they are always correctly applied
- NaN detection for FDTD structure file output

- Improve absorption loss calculations in 2D FDTD
- Default complex index of refraction tables for GaN
- Parameter to select iterative solver used in 3D SOLVE INIT

VERSION 5.17.24

NEW FEATURES

- Minimum time step, maximum time step and constant time step parameters for MIXEDMODE transient simulation
- Carbon NanoTube (CNT) material default parameters
- Independent direction periodic boundaries specification for ray trace
- FDTD far field pattern
- RHS norm convergence parameter for BLOCK method
- Complex 2D Helmholtz (non-cylindrical) solver for LASER and WAVEGUIDE
- Optional single file parameter for MIXEDMODE .DC, .AC and .NET output log files

ALTERATIONS AND ENHANCEMENTS

- Improve DYNASONOS model to prevent potential crash
- Support for zero orbital number in 2D cylindrical Helmholtz solver
- Improve lattice temperature simulation with conductors model and LTFULL to prevent possible incorrect values
- Run-time output now prints only calculated currents in terminal current summary
- Capability to switch between DG and BQP models during simulation
- Improve ray trace with thermionic interfaces to prevent zero reflection coefficient
- BLOCK method lattice temperature X and RHS norms calculations are now consistent with Newton method
- Remove non heat-generating recombination rates from lattice temperature equations
- Remove spurious error message from FILE.PHOTOGEN parameter on BEAM statement
- Improve flowlines algorithm to prevent possible memory problem

VERSION 5.17.23

NEW FEATURES

- 2D vector Helmholtz solver for cylindrical coordinates
- Optional Eigen vector output for LASER and WAVEGUIDE
- Perfect Electric Conductor (PEC) and Perfect Magnetic Conductor (PMC) boundary conditions for vector Helmholtz solver
- Optional ELECTRODE statement parameter to remove region from Helmholtz equation discretization domain
- Maximum time step parameter for MIXEDMODE
- DC bias sweep during MIXEDMODE noise simulation
- Increase maximum number of touching elements at a single point to 60

ALTERATIONS AND ENHANCEMENTS

- Resolve issue with QTREGION and STAY parameter to prevent incorrect behavior
- Improve trap file output to prevent constant zero bump state probability of occupation
- Improve trap file output to prevent use of incorrect band reference energy
- Change sign of gain dependence in real part of refractive index model
- Improve combined LASER and lattice temperature simulation to prevent potential crash
- FFT noise floor filter function
- Improve run-time output for cases where no residuals are needed
- Improve calculation of singlet binding energy to increase accuracy
- Density gradient model can now use BQP model parameters
- Improve contact potential calculation to better handle electrodes which simultaneously contact a semiconductor, insulator and another electrode region
- Improve user-defined material run-time output to prevent incorrect output when an unknown material is specified
- Improve MIXEDMODE AC simulation to increase accuracy of frequencies sweeps

- Improve log file output to prevent incorrectly numbering of unnamed electrodes
- Improve structure file output to prevent incorrectly naming of electrodes with white spaces

VERSION 5.17.22

NEW FEATURES

- Structure file save and reload electromagnetic field state
- Save and reload FDTD meshes from memory

ALTERATIONS AND ENHANCEMENTS

- Improve 3D BICGST iterative solve to prevent NaNs when solving structures created by VictoryCell
- LASER is now compatible with BQP model
- Improve 2D CONDUCTORS model to prevent possible crash
- Improve structure file output to prevent incorrect values of current density in 80-bit extended-precision mode
- Improve log file probe to prevent incorrect values of electron and hole drift and diffusion current
- Remove spurious error messages from complex index of refraction file loading
- Improve Geiger mode model to prevent possible crash
- Improve ray trace so that maximum total internal reflection angle can be specified
- Improve combined AC simulation prevent incorrect run-time output of currents when using BLOCK method
- Improve reflection calculation when INTERFACE statement is specified without OPTICAL parameter to prevent incorrect results
- Improve current boundary conditions bias sweep to ensure that whole range of requested values is used
- Improve accuracy of facet writing in FDTD
- Increase available and source photo-current log file precision
- Increase speed and accuracy of the PAM.MPI iterative solver
- Improve ferro-electric model to prevent possible convergence issue during SOLVE INIT

VERSION 5.17.21

NEW FEATURES

- Parallel MPI-based iterative solver for 64-bit 3D
- Thermionic insulator/insulator interfaces with MATERIAL SEMICONDUCTOR
- Mobility field characteristics structure file output
- Insulator interface polarization charge selection parameter
- Degradation power-law model
- Additional electron and hole impact ionization rate tabular data
- GaN velocity overshoot model from paper by Chen et al
- ZnO velocity overshoot model from paper by Ozgur et al
- Continuous trap energy specification for log file probe
- Bank-Rose, line search and explicit minimum damping methods for Newton non-linear solver
- Ionized trap density and probability of occupation file output

ALTERATIONS AND ENHANCEMENTS

- Add extra tunneling paths between silicon nitride, channel and gate to DYNASONOS model
- SONOS and DYNASONOS models now use thermionic interfaces for silicon nitride and surrounding gate stack materials
- Remove spurious error from potential initialization for GaN-based devices
- Improve performance of potential initialization for thermionic interfaces
- Improve thermionic interfaces and QTREGION model to prevent potential crash
- Improve MIXEDMODE to prevent incorrect parsing of voltage controlled switch model
- Improve noise model to prevent potential crash
- TE and TM modes can now be correctly selected
- Improve AC simulation prevent incorrect run-time output in extended-precision mode

- Improve combined AC/transient simulation to prevent possible incorrect values of conductance and capacitance
- Improve combined AC/transient simulation to prevent incorrect run-time output of currents
- Improve angled sources in ray trace to prevent possible incorrect results with high absorption coefficient materials
- Improve calculation of modal imaginary effective refractive index and effective absorption in LASER
- Optional radiative and stimulated recombination damping parameters to increase stability
- Improve accuracy of FDTD to prevent possible incorrect results

VERSION 5.17.20

NEW FEATURES

- Temperature dependence of trap capture and emission rate in HEIMAN model
- MIXEDMODE voltage controlled switch element
- Optional regularization parameter to improve stability of QTNLSC and QTUNN models with density gradient model
- Gaussian distribution for polarization charge
- Initial MIXEDMODE output log file start time parameter
- Impact ionization rate exponent limit parameter
- Electron and hole impact ionization rate tabular data
- Structure file output of field dependent impact ionization rates

ALTERATIONS AND ENHANCEMENTS

- Improve 3D to prevent potential incorrect results with conductor model
- Improve BOUND.TRAP model to prevent potential incorrect results with wide bandgap devices
- Improve TRAP.COULOMBIC model to prevent potential incorrect results with wide bandgap devices
- Resolve MIXEDMODE transient convergence issue with BSIM4 model

- MATERIAL INSULATOR now changes point membership along interfaces between insulator and semiconductors regions

VERSION 5.17.19

NEW FEATURES

- Default values of bandgap, affinity, permittivity, densities of states, and mobilities for IGZO
- Hydrogen density log output file probe
- Pasveer model for carrier concentration and electric field dependent organic/polymer mobility
- Optional trap activation energy level specification
- Structure file output of approximate ground state energy

ALTERATIONS AND ENHANCEMENTS

- Improve log file output of available and source photo-currents to prevent incorrect values with multiple beams
- Improve C-interpreter global parameter accessor functions to prevent potential crash
- DEVDEG.A parameter now causes traps created by electron current to be negatively charged, and those created by hole current to be positively charged
- Improve accuracy of QTNLSC model when used with BQP or density gradient model
- Improve TIF file loading to correct doping at semiconductor/insulator and semiconductor/metal interfaces
- Angle range specification for LASER far field calculation
- Improve 3D conductors to prevent possible stability issues
- Improve FDTD timing run-time output
- Optional specification of TM, TE or both during LED save

VERSION 5.17.18

NEW FEATURES

- 100,000 node version of 2D
- Optional MIXEDMODE minimum transient conductance value

VERSION 5.17.17

NEW FEATURES

- 250,000 node version of 2D
- Optional log file output of total interface charge from degradation model

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of hydrogen diffusion model at electrodes
- Improve AC simulation to prevent potential crash
- Improve structure file output to ensure total current density is zero in insulator nodes at semiconductor interfaces

VERSION 5.17.16

NEW FEATURES

- Support for hole inversion effect on forward reaction rate in degradation model
- Support of iterative solver FILL.RATIO parameter in 3D MIXEDMODE .NUMERIC statement

ALTERATIONS AND ENHANCEMENTS

- Remove spurious photonic crystals lens definition error message
- Improve 2D ray trace to prevent possible accuracy issue with lens definition
- Change default value of RD.COUPLED on DEGRADATION statement from false to true
- Temperature-dependent universal bandgap model now uses Hatakeyama parameters for SiC-4H

VERSION 5.17.15

NEW FEATURES

- SHJ.EL, SIS.EL, SHJ.HO and SIS.HO model recombination rate structure file output
- Thermionic transport model for insulators regions treated as semiconductors
- Wide bandgap semiconductor trap statement for degradation model
- Optional block impact ionization numerical solution method to stabilize convergence

ALTERATIONS AND ENHANCEMENTS

- Resolve parser conflict with BEAM statement REFLECT parameter
- User-defined wave-function overlap model for QWELL gain and spontaneous emission
- Improve universal BGN model to prevent possible incorrect values
- Improve selection of 64-bit precision SPEEDS, ZIP.BICGST and GMRES linear solvers to prevent selection of incorrect precision
- Improve accuracy of single heterojunction direct tunneling model
- Improve 160-bit extended-precision mode to prevent incorrect specification of workfunction
- Support for U.TRAP on OUTPUT statement in 3D

VERSION 5.17.14

NEW FEATURES

- Default parameter values for CdO, MgO, CdZnO, MgZnO, MgCdO, MgCdZnO materials
- Electron, hole and total drift and diffusion current log file probe
- Electron and hole thermal velocity log file probe
- Beam-specific source photo-current, available photo-current and wavelength log file output
- Default Sapphire effective masses
- 80-bit and 160-bit extended-precision modes
- Photonic crystals simulation
- Cylindrical lens

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of trap recombination in AC log file probe to correct incorrect values
- Modify wavelength ramp capability so that WSTEP and WFINAL apply to all beams if none are specified
- Rename molibdenum to molybdenum
- Optional net charge dependent depassivated charge for degradation model
- Correct effective mass value used in BQP model to improve accuracy
- Improve AC simulation to prevent potential crash
- Improve structure file loading to correct doping at semiconductor/semiconductor interfaces

VERSION 5.17.13

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of thermionic field emission tunneling current calculation
- Improve Auger recombination calculation which could cause zero recombination rate

VERSION 5.17.12

NEW FEATURES

- MOSFET degradation model based on depasivation of silicon/oxide interface dangling bonds
- Pseudo-Random Bit Sequence (PRBS) generator
- 3D LED simulation capability

ALTERATIONS AND ENHANCEMENTS

- Optional parameter to ensure zero imaginary complex index for energies less than bandgap
- Improve Helmholtz solver initial guess to prevent potential convergence issue in LASER
- Prevent Schottky barrier lowering model from giving NaNs when BARRIER is specified on CONTACT statement
- Allow more comprehensive parser parameter name matches
- Improve probe of 3D BQP recombination rate to prevent incorrect values

- BBT.NONLOCAL model to will now automatically cut back bias when needed
- Improve accuracy of photo-generation rate calculation
- Improve handling of unavailable licenses to prevent potential crash
- Improve accuracy of absorption coefficient verses wavelength output to prevent incorrect values
- Improve 3D CON.RES model to prevent possible convergence issues during SOLVE INIT
- MODIFY parameter on REGION statement is now supported in 3D
- Improve accuracy of 3D QWELL model to prevent zero spectrum with 1DZ confinement
- Improve convergence behavior of DEVDEG.RD model for structures with non-planar electrodes
- Improve accuracy of PWL time point specification to prevent possible incorrect final time point value
- FDTD structure file output support for devices with negative y coordinates
- Improve 256-bit extended-precision mode direct solver to prevent possible convergence issues during SOLVE INIT
- Default value of RD.COUPLED is now false
- Improve handling of X.COMP and Y.COMP on the REGION statement in 3D to prevent potential crash
- Improve accuracy of ferro-electric model
- Parallel AC direct solution method
- Increase speed of AC SOR solution method
- Support for structure file reload of LED devices
- Warning message for conflicting optical recombination models
- Support for LED bulk and quantum well region spectra and IV log file output
- Improve accuracy of ZB.KP effective mass calculation
- Improve convergence behavior ferro-electric model
- Extend laser multi-band gain model to handle bulk regions
- New transient local truncation error calculation to reduce numerical noise
- Magnetic field log file probe

- Support for electron and hole currents in AC IV log file output
- Resolve issues with terminal currents in log file output during combined transient/AC simulation
- Improve handling of NI.MIN for wide bandgap semiconductors to prevent possible convergence issue

VERSION 5.17.11

NEW FEATURES

- Optional absorption and refractive index coefficients for free-carrier absorption model
- Fermi's golden rule bulk material absorption model for LASER and WAVEGUIDE

ALTERATIONS AND ENHANCEMENTS

- Improve MESH CIRCULAR (2D) and MESH CYLINDRICAL (3D) error checking
- Improve accuracy of DYNASONOS model to avoid potential error in erase configurations
- Improve accuracy of electric field calculation used in F.ETUNNEL and F.HTUNNEL C-Interpreter functions
- Improve 3D MIXEDMODE to prevent potential crash when calculating conductivity matrix
- Improve calculation of user-defined absorption in refractive index model
- Improve stability of Geiger mode model for low bias cases
- Improve stability of conductors in lattice temperature simulations
- Improve stability of conductor/semiconductor interfaces

VERSION 5.17.10

NEW FEATURES

- Optional 64-bit linear solvers selection when running in 128-bit extended-precision mode
- Optional iterative linear solver residual norm calculations output

ALTERATIONS AND ENHANCEMENTS

- Improve C-Interpreter to prevent potential crash in 128-bit extended-precision mode

- Improve calculation of luminescent power
- Improve calculation of anisotropic impact ionization model
- Improve accuracy of BICGST and BICGST.64 iterative solvers

VERSION 5.17.9

NEW FEATURES

- REGION statement QTREGION specification

ALTERATIONS AND ENHANCEMENTS

- Improve stability of QWELL model
- Improve stability of hot carrier current model for y-axis interfaces
- Improve stability of polarization charge model
- Improve k.p model calculation of valence band energy and bandgap with EG2300, EG1300 and EF12BOW parameters

VERSION 5.17.8

NEW FEATURES

- Single heterojunction direct tunneling model
- MIXEDMODE support for QTREGION statement
- K.p model support for EG1300, EG2300 and EG12BOW parameters
- New LASER and WAVEGUIDE free-carrier absorption model

ALTERATIONS AND ENHANCEMENTS

- Improve structure file output for polarization charge at thermionic hetero-interfaces
- Improve stability of non-local SIS.EL and SIS.HO models
- Improve stability of anisotropic impact ionization model
- Improve stability of QWELL model

- Improve QWELL model calculation of luminous intensity and radiative rate

VERSION 5.17.7

NEW FEATURES

- Default workfunction for TiN
- Small-signal AC analysis of optical sources using FDTD and TMM
- SIS.EL and SIS.HO models now support semiconductor barriers
- GaN polarization calculation for layers oriented normal to Z-axis
- High-k gate dielectric and semiconductor interface model
- Optional VictoryDevice style carrier concentration updates
- Optional VictoryDevice style carrier concentration update damping

ALTERATIONS AND ENHANCEMENTS

- Improve stability of 3D remote phonon scattering mobility model
- Improve handling of multiple optical sources for TMM and FDTD hybrid beams

VERSION 5.17.6

NEW FEATURES

- SIS.EL and SIS.HO model with QTREGION statement quantum region definition
- SIS.TAT model with QTREGION statement quantum region definition
- Default parameters for Ta2O5, TiO2, ZrO2 and La2O3 high-k dielectric materials
- High-k dielectric effective metal workfunction model
- High-k dielectric remote phonon scattering mobility model
- High-k dielectric remote Coulomb scattering mobility model
- Anisotropic impact ionization parameters run-time output
- Self-consistent QWELL charge model

ALTERATIONS AND ENHANCEMENTS

- Improve stability of gate tunneling model
- Improve structure file output to prevent incorrect values of positive and negative amphoteric trap densities
- Improve amphoteric trap probability of occupation calculation for p-type devices to reduce numerical noise
- Improve parallel ray trace to prevent potential crash
- Improve density gradient model to prevent potential memory issues
- Improve stability of parabolic Schottky model to prevent potential convergence issues
- Improve waveguide model handling of TRACE parameter
- Improve 3D BICGST iterative solver to prevent potential crash

VERSION 5.17.5

NEW FEATURES

- Electrode material modification via MODIFY on ELECTRODE statement
- Nonlinear spontaneous and piezoelectric polarization model for AlInGaN-based materials
- Gaussian, exponential and r-squared exponential distribution functions for geminate pair distance in exciton dissociation model
- 2D parallel ray trace
- Structure file electric field lines output for Geiger mode model
- Automatic flag to enable POLAR and CALC.STRAIN for all InAlGaN-based regions
- Potential specific bias projection method
- Structure file incorrect element definition error check
- Impact ionization support in 2D magnetic model
- Multi-band model parameters run-time output

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of QWELL model wavelength log file probe

- Improve loading of conductor regions from DevEdit structure files which conflict with REGION MODIFY
- Improve QWELL model to prevent potential crash in parallel version
- Improve accuracy of lattice temperature model to ensure 2D and 3D are equivalent
- Support for comma separators in Sopra optical database files
- Improve UST model for single carrier solutions to prevent potential crash
- Improve LASER multi-band gain model to prevent potential crash
- Improve log file output to prevent incorrect naming of DDMS.LOG files
- 3D QWELL spectrum files output
- Improve 3D GaN polarization model to prevent potential crash
- Improve TAT.NONLOCAL model to increase stability of forward bias junction simulations
- Geiger mode model now automatically disables impact ionization models
- Polarization charge sign now defaults to GaN FET sign
- Improve 3D licensing used in interface defects model
- Improve accuracy of MIXEDMODE sub-circuit parsing

VERSION 5.17.4

NEW FEATURES

- C-interpreter function for calculation of complex index of refraction as a function of bandgap
- Quantum well light absorption model
- Drude free-carrier absorption model
- BEAM and SOLVE statement selection of vector and scalar Helmholtz solver
- Probe local refractive index
- Uniform quasi-Fermi level super floating gate model
- Geiger mode model which calculates the probabilities that an electron, hole or electron-hole pair cause avalanche based on ionization integrals

ALTERATIONS AND ENHANCEMENTS

- Wurtzite k.p model compatibility with EG1300, EG2300 and EG12BOW parameters
- Improve generation of eye diagram to include full eye period
- Improve accuracy of transient square pulse generation
- Improve laser projection scheme to prevent possible convergence issues
- Improve transfer matrix method to account for non-isothermal complex index of refraction

VERSION 5.17.3

NEW FEATURES

- Transient HEIMAN interface trap hysteresis model
- Photon density bias projection method
- Position dependent magnetic field C-Interpreter function
- Doping and applied bias dependent complex optical refractive index change model, based on Burstein-Moss effect
- Parameter to specify the relationship of geminate distance to binding energy via a Coulombic model
- InGaP lattice match to GaAs parameter specification

ALTERATIONS AND ENHANCEMENTS

- Increase maximum number 3D of interface nodes to 500,000
- LTE estimator for BDF1 transient method for improve accuracy
- Improve new LASER model to prevent potential convergence issues
- Improve doping filter to prevent potential crash with poly gate structures
- Improve accuracy of HEIMAN interface trap hysteresis model calculation of small signal admittances
- Improve bias projection method to prevent potential convergence issues
- Improve GMRES iterative solver to prevent potential convergence issues
- Remove spurious error message about ATHENA file doping from 3D structure file load

VERSION 5.17.2

NEW FEATURES

- WAVEGUIDE dispersion log file output for modal imaginary part of propagation constant, effective refractive index, and effective extinction coefficient
- Support for Nitride in ISE structure file load
- BDF1 method for discrete trap
- 2D and 3D Monte Carlo ray trace
- WAVEGUIDE and LASER gain confinement factor log file output
- WAVEGUIDE and LASER optical propagation constant (real and imaginary parts), effective refractive index, and extinction coefficient log file output
- User-defined scale parameters for gain and spontaneous emission models
- Command-line parameter to change selection criteria for material interfaces
- Output of Eigen energies and wave functions for planar NEGF model
- FDTD time duration specification parameter
- Support for Schottky contacts with lumped elements

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of waveguide dispersion calculation in 1D Helmholtz solver
- Improve MIXEDMODE sub-circuit parser to prevent incorrect expression evaluation
- Improve accuracy of transient trap TR-BDF2 discretization
- PARAM is now optional in MIXEDMODE .SUBCKT statement
- Improve memory handling in ZIP.BICGST iterative solver
- Include imaginary part of optical dielectric constant in LASER photon rate equations
- Rename LASER structure file outputs "Effective refractive index (Re) to "Refractive index (Re)" and "Effective refractive index (Im)" to "Refractive index (Im)"
- Improve ferro-electric model to prevent potential convergence problem
- Improve accuracy of saturated loop ferro-electric hysteresis calculation

- Remove spurious linear solver warning message from 3D MIXEDMODE
- Remove conflict between FDTD TD.SRATE parameter and C-interpreter
- MIXEDMODE log file now contains all elements by default

VERSION 5.17.1

NEW FEATURES

- BBT.NONLOCAL bias cutback
- Quantum well specification using REGION statement
- Automatic unit change for run-time simulation time output
- Sopra Al₂O₃.nk is now the default index file for Sapphire
- Additional aliases for YAN, LI and CHUAN models
- 3D parabolic Schottky model
- 1D scalar Helmholtz solver for LASER and WAVEGUIDE
- E.SIDE model for 3D impact ionization
- Minimum and maximum current component specification for E.SIDE impact ionization model
- Token bundle licensing for MERCURY
- Extra default electrode names on SOLVE statement
- New 3D MAGNETIC discretization method to improve convergence
- Magnetic dependence selection for individual carriers

ALTERATIONS AND ENHANCEMENTS

- Improve accuracy of ray trace
- Improve 3D optical model selection to prevent incorrect functionality of TR.MATRIX parameter
- Improve QWELL model to prevent incorrect functionality of SP.GEOMETRY parameter
- Increase number of digits for "Total time" run-time output
- Improve FDTD to prevent mismatch between user-defined optical mesh and device simulation domain

- Improve optical source definition with lenses
- Numerical integral controls for parabolic Schottky model
- Improve 3D QWELL internal quantum well mesh and interpolation models
- Improve accuracy of quantum well LED spectrum model for wells without bound states
- Improve organic dissociation model to prevent potential convergence issues
- AUTO.OHMIC on the CONTACT statement is now false by default
- Improve bias cutback method to prevent convergence issues in extended-precision mode
- Improve LASER simulations to prevent overwriting of TABLE files
- Improve MIXEDMODE input deck decrypting to prevent potential error
- Improve accuracy of spontaneous emission spectrum calculation for radiative recombination in QWELL LED model
- Improve accuracy of E.SIDE impact ionization model
- Improve bias stepping algorithm to prevent incorrect bias values when specifying current multiplication and number of steps
- Improve accuracy of transient time step algorithm to account for small final time values
- Improve CONDUCTOR model to prevent structure file error with GaN devices

VERSION 5.17.0

NEW FEATURES

- Add probe output for FDTD
- Filtering function to remove contiguous doping regions which are completely surrounded by opposite doping type
- Gaussian and error function doping roll-off
- Specification of MIXEDMODE circuit temperature in C
- Environment variable specification of number of CPUs for parallel simulation
- Support for Tungsten Silicide, Titanium Silicide, Nickel Silicide, Cobalt Silicide, Tantalum Silicide, Palladium Silicide, Platinum Silicide, Molybdenum Silicide, Zirconium Silicide and Aluminium Silicide materials in TIF file loading

ALTERATIONS AND ENHANCEMENTS

- Remove spontaneous luminous power from LASER and VCSEL output log files
- Spontaneous recombination and gain spectra now have the same units for 2D, 3D and cylindrical cases
- Improve accuracy of impact generation rate structure file output using OLD.AVG method
- Improve handling of insulator/conductor interfaces in BQP model to prevent convergence issues
- Improve internal mesh in QWELL model to prevent convergence issues
- Add valley number to "Bound State Energy" and "Wave Function" structure file names
- Improve QWELL gain model to prevent convergence issues with longitudinal mode simulations
- Improve 3D parallel ray trace to prevent potential crash
- Improve 3D ray trace to prevent potential crash when used with conductors
- Improve 3D ray trace to prevent potential generation rate calculation failure in near right triangles
- Improve INDEX.CHECK to prevent potential crash
- Improve VCSEL model to prevent incorrect light intensity calculation on LINUX systems
- Improve 2D magnetic simulation model to increase stability
- Improve HCTE and FERMI models to prevent potential crash in MIXEDMODE
- Improve gain and spontaneous spectra output in QWELL LED model to prevent energy shift in multiple quantum wells
- Improve accuracy of BQP model carrier recombination rate calculations