Lawrence Livermore National Laboratory

ALE3D Users' Meeting

4.10 release

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LLNL-PRES-412763

Approved for unlimited distribution

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LLNL-PRES-412763

ALE3D is now for Official-Use-Only, as well as Export Controlled

Do NOT distribute ALE3D or put on a machine

Contact ale3d-help@llnl.gov

<u>Export Control</u>

Will observe all applicable US and foreign laws and regulations concerning the transfer of

- **the ALE3D code,**
- **documentation, or**
- **related technical data**

<u>Official Use Only</u>

By DOE Order 471.3. OUO may be exempt from public release under the Freedom of Information Act (5 U.S.C 552), Exemption 2, Circumvention of Statute. Access is on a need-to-know basis and individuals with access must treat it as such.

LLNL and collaborators are

- **Checking need-to-know before providing access to ALE3D**
- **Maintaining list of those having access to ALE3D**

Access by users and developers

US Citizen

- **Must have national security application and need-to-know**
- **Need WCI approval**

DOE National Lab Legal Permanent Resident (LPR) Foreign Nationals (FN)

- **Permission <u>should</u> be obtained from the sponsoring DOE program**

  The Visitor Tracking System (VTS) processing is usually sufficient with "approval" by DOE of the VTS Statement of work (SOW) and Sensitive Subject Review (SSR) form

  Specify what LPR FN is working on and that he or she is using the executable and/or has access to the source code ALE3D which is an OUO and export controlled code. This will result in notification of DOE

  Since the VTS does not have a DOE signature process, to confirm DOE's acceptance, we recommend that a call be made or e-mail sent to the DOE program manager for verbal or e-mail confirmation

- **<u>Must</u> have WCI approval – contact ale3d-help@llnl.gov**

Responsibilities of Users and Developers

Users/developers must never give source/executable access to anyone

Executable access

- **Download is restricted**
- **If on your local machine (desktop, laptop, server)**
  - **Control access**
  - **Maintain list of users – WCI pre-approval required – e-mail ale3d-help.llnl.gov**

Source code access

- **Justification required – e.g., code development, debugging, building on a unique architecture**
- **If download to local machine/server, responsible for**
  - **controlling access to executable**
  - **maintaining list of users of executable and applications**
  - **obtaining pre-approval from WCI**

User manual

- **Do not distribute – treat as you would executable access**

External packages

- **Each have their own distribution restrictions – work with WCI for both ALE3D and external packages**

Two training classes are planned for this year

ALE3D Introductory Class

Proposed Date:	**Fall of 2009**
Location:	**LLNL?**

ALE3D Advanced Advection Class

Proposed Date:	**Fall of 2009**
Location:	**LLNL**

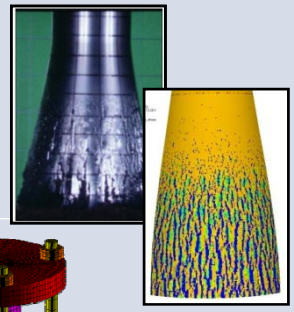
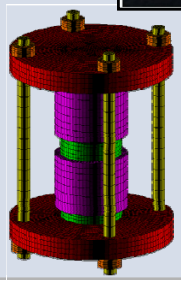
Others Possible Classes

ALE3D with CHEETAH	**TBD**
DSD Workshop	**TBD**
Mesh Generation	**TBD**

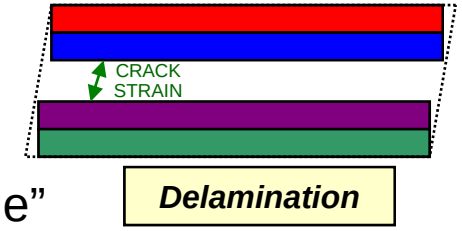
ALE3D V4.10.0 to be released this week

- Many new features
- Draft PDFs of the manual now available on LC
  - /usr/gapps/ale3d/doc
  - /usr/apps/ale3d/doc

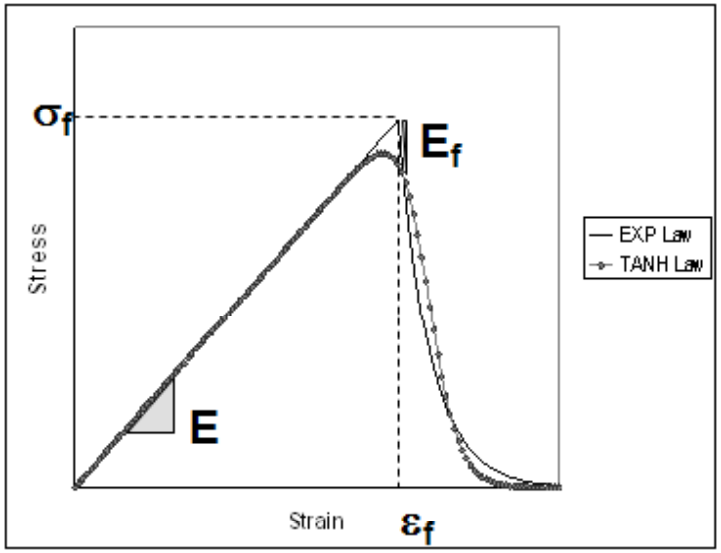
New and updated material models enable new applications

Material Model	Application
▪ Progressive damage composite model • Added Klepeis-Bales and multi-phase shear modulus models • Tabular EOS available with Haselman form ▪ Cagnoux-Glenn glass EOS with bulking • TEPLA updated to 3/2008 version • Mossfrac model updated to spring '08 version • Fisher parameter model added for high temperature fracture • Modified Johnson-Cook models for high triaxiality • Temperature dependent, tabular shear modulus and bilinear hardening model • Eng model 64 has option for recoverable elastic foam • Tabular thermal expansion model similar to traditional engineering models	▪ Composite armor ▪ Transparent armor ▪ Fracture fragmentation  ▪ IM/Cookoff 

New Capabilities of Composite Model with Progressive Damage

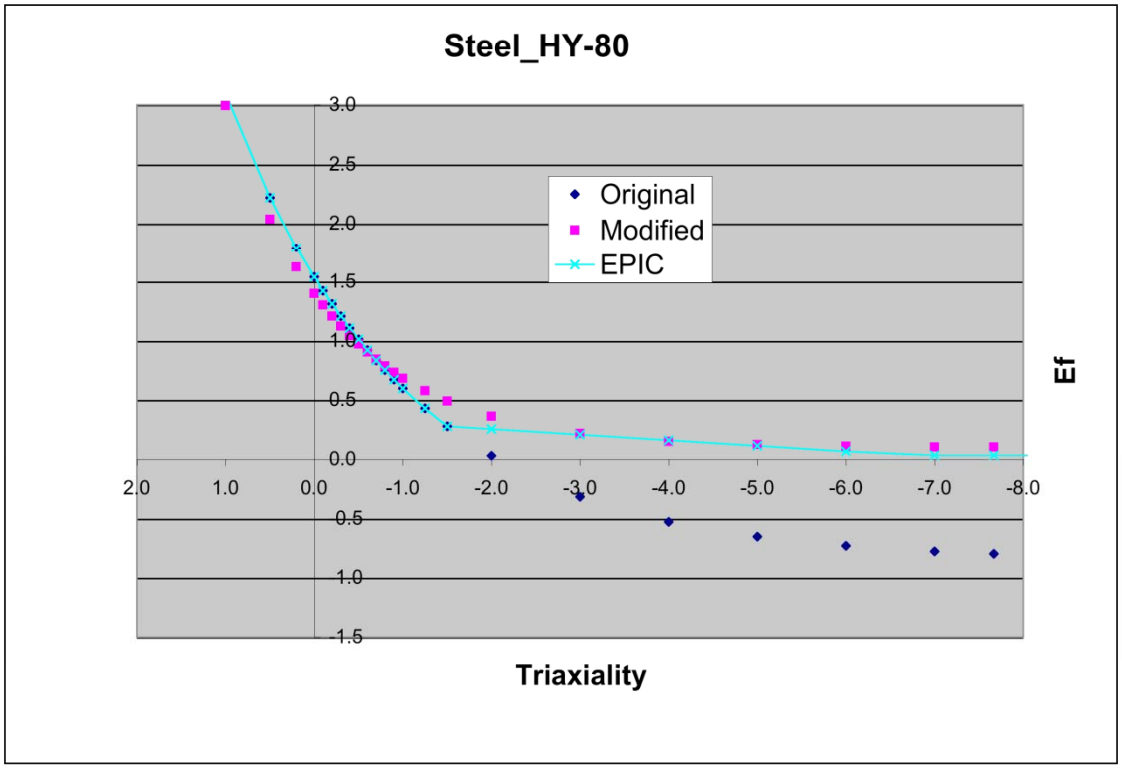


- Delamination through internal crack strain
- Lamina damage, delamination damage, or both
- Continuum damage mechanics based "Progressive Damage" (tracks damage to individual layers)
- Transfer of load as individual layers fail
- Can model pre-existing defects
- Three damage surfaces
  - Unidirectional
  - General orthotropic (0°/90°)
  - Homogenized multi-layer (many fiber orientations)
- Two strength decay laws
- Exponential (abrupt /brittle failure)
- Hyperbolic tangent (gradual failure)



Johnson-Cook models modified for high triaxiality

- In Johnson & Cook (1985), they included a transition region from ductile fracture to spall failure
- ALE3D MS and Eng JC models now include this modification
  - Not default – need to specify jc_fail_crit



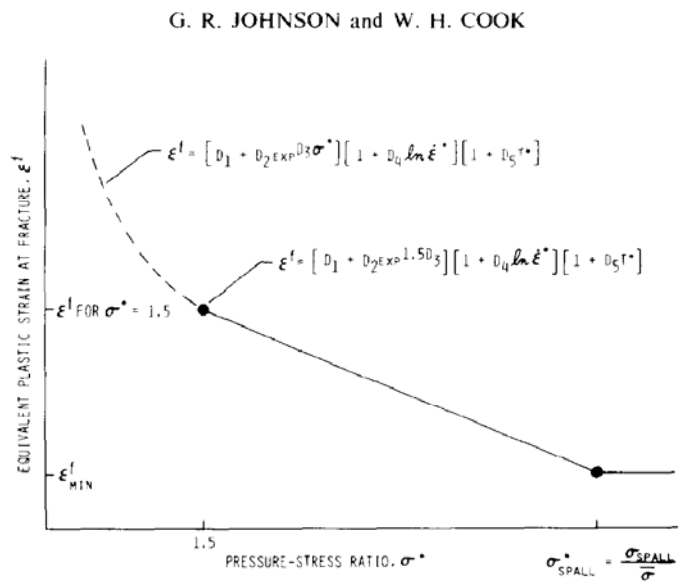


Fig. 15. Definition of fracture strains at large tensile pressure–stress ratios.

SGEOS database updated to 1996 version

- The materials in the left column have new rate-dependent parameters (steinberg-lund model). Expect answers to change if you're using "`use ko <num>`" to get material defaults.
- To get old behavior, either specify old parameters in MATERIAL block (see your old .rin files), or use "`sgeosfile /usr/gapps/ale3d/data/sgeos.xml`" in the `CONTROL` block to get old behavior
- See Appendix A in the 4.10 manual for more detail

Materials with rate-dependent parameters changed:

- Beryllium (23)
- Fansteel (147)
- Molybdenum (114)
- Niobium (76)
- Stainless Steel 304 annealed (28)
- Tantalum (77)
- Tungsten (78)
- Vanadium (113)

- New Materials:
  - Cadmium (148)
  - Gold – 5% Cu (32)
  - Halfnium (154)
  - Nylon Type 6/6 (149)
  - Platinum – 20% Ir (85)
  - Polyethylene (CH_2) (46)
  - Silver (99)
  - Steel 4340 RC 38 (150)
  - Tungsten (98.52%) in plastic binder (151)
  - Zinc (152)
  - Zirconium (153)

Greatly simplified UMAT process

Old Procedure

- Make sure UMAT compiles
- Create/clone wrapper function
- Add call to wrapper function
- Add post-advection mapping function
- Add call to map function
- Define model number and numbers of parameters
- Add case statement to allocate for defined parameters
- Declare material parameter names
- Write read and copy functions
- Declare state variables
- Register state variables
- Extract state variables
- Add UMAT filename to Makefile
- Compile and relink

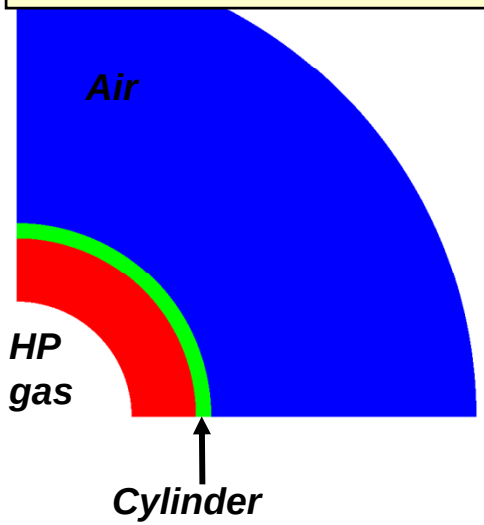
New Procedure

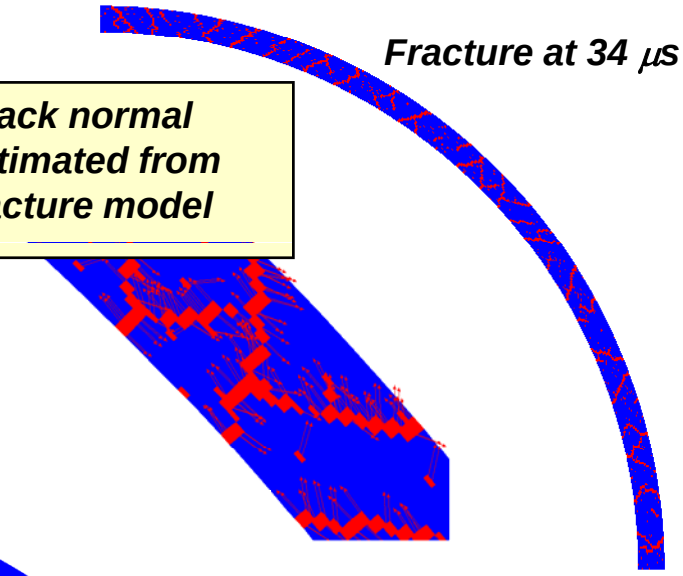
- **Make sure UMAT compiles**
- **Replace existing src/ms/umat.f**
- **Compile and relink**

```
MATERIAL umat
 matinput  rho 2.7 e0 0.0 v0 1.0 t0 293.  cvav 2.e-5
 msinput
    ysmodel 180
    num_constants 8   num_depvars 5   umat_number 3
    shear_mod 0.25    bulk_mod   0.8
    constants
      0.7    0.3  0.01   20   0.95 0.00821 0.002 0.185
  elasmodel   99
  hardmodel 299
  eosmodel  399
  failmodel   499
END
```

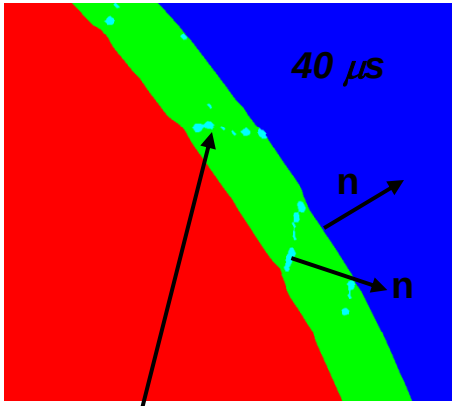
ALE3D simulation of cylinder fracture and gas blow through

Void seeding and stress relaxation during fragmentation



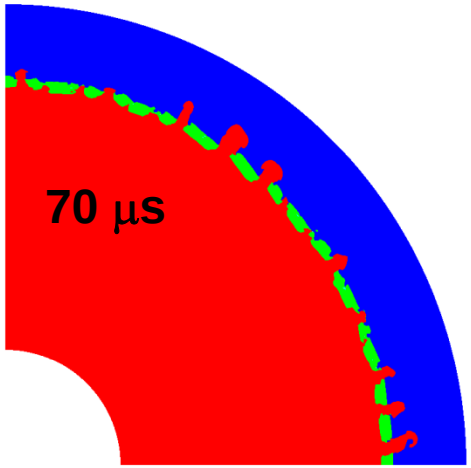


Crack normal estimated from fracture model



Void material seeded in cracks
Normal determined by interface reconstruction

Gas blowing by fragments



Early development – use with caution!

Strain rates of materials in mixed zones are adjusted to drive toward traction equilibrium

$$n \cdot \sigma_a = n \cdot \sigma_b$$

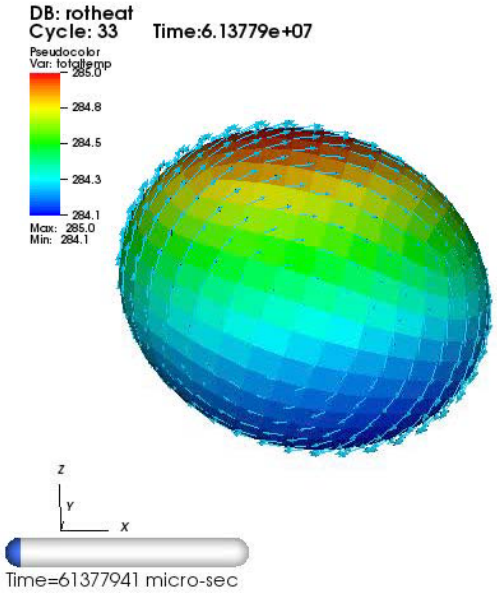
Chemistry improvements and CHEETAH coupling provide expanded applications

- **New Reactions**
  - Higher order CT_reactiveflow (iform 15) model available
  - Added convective burn model
  - Added Fragmentation Form Factor deflagration model
  - Shear ignition reaction model added
  - HVRB reactive flow EOS model added
- **CHEETAH**
  - Use of the cheetah eos and conductivity models from within the meta material model
  - Cheetah as a thermal conductivity model

- **Time step control**
  - Code now controlled by effective volume fraction change as well as mass fraction change

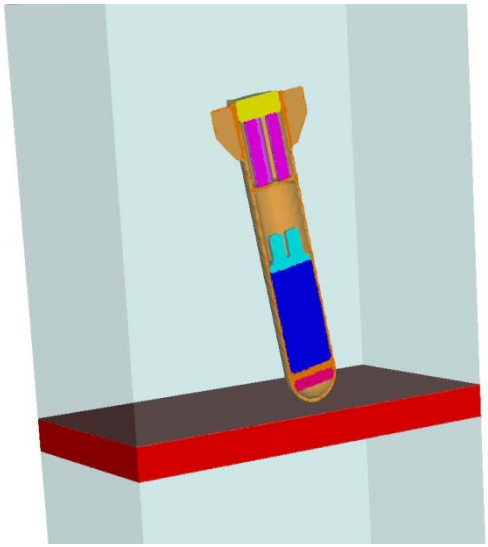
Implicit Mechanics improvements strengthen ability to model cook-offs

- **Keyword implicithydro now a flag (0 or 1)**
  - Quasi-static or dynamic with imp_time_integ
- **Convergence control**
  - Can scale back implicit displacement corrections in iteration cycle
  - Material numerical derivatives for implicit mechanics calculations available
- **Slide surfaces**
  - Tied slides available for implicit calculations
- **Boundary conditions**
  - Can now specify a center of mass boundary condition that will properly constrain and move a free object in implicit mechanics



Mesh Generation improvements

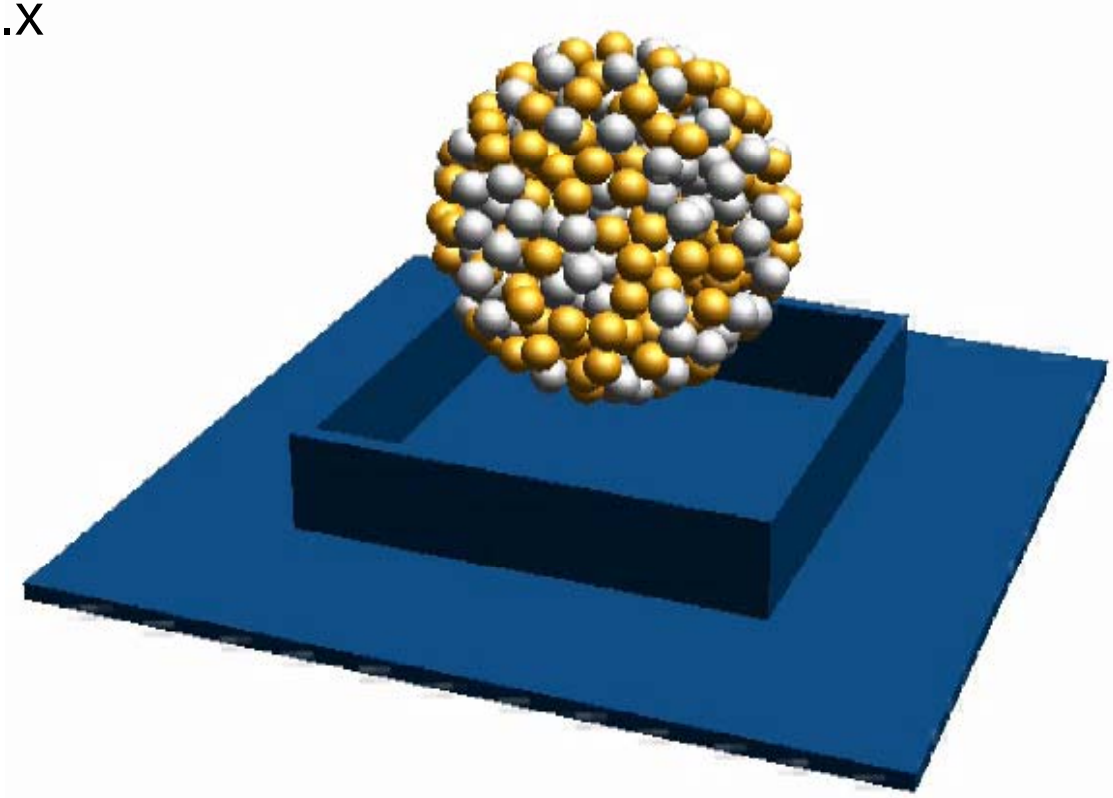
- Ability to specify the mesh file in MESH block (e.g. sami, tg, cubit)
- Specify ratio zoning with a meshtable
- ABAQUS mesh translation utility
- Read CUBIT Genesis files natively from gen3d
  - Hex meshes with nodesets for slides and BC's
  - Tet meshes for shaping into background internal mesh



- Single Cubit .gen file
  - Projectile geometry from ACIS file
  - Tet mesh to shape in projectile (6 materials)
  - Hex mesh for background and target plate also from CUBIT

Initial autocontact capability is available

- 3D only
- Work progressing on intersecting surfaces (corners) in 4.11.x



Making advection more robust

- More robust for impact simulations
  - New flags to control "fixup" of tiny volume fractions driving the calculation bad (see advection chapter of manual)
  - Adjusted eps after epsfail is reached to prevent healing by advection for KO materials
  - The region "clean" command now works with AT/ATCYCLE commands
- More user control for advection/relaxation
  - Improved user control of integer history advection (advectint)
  - Extended program relax gridvsmx to two gradient directions
  - New command "rlxholdvar" allows constraining of relaxation on any variable with user-specified threshold
  - rlxweightvar will now work with a derivedvar (zone centered) as the controlling variable
  - Added back the ability to just iterate the relaxer (rlxitercnt)
  - Added time table and spacetable options for inflow/outflow

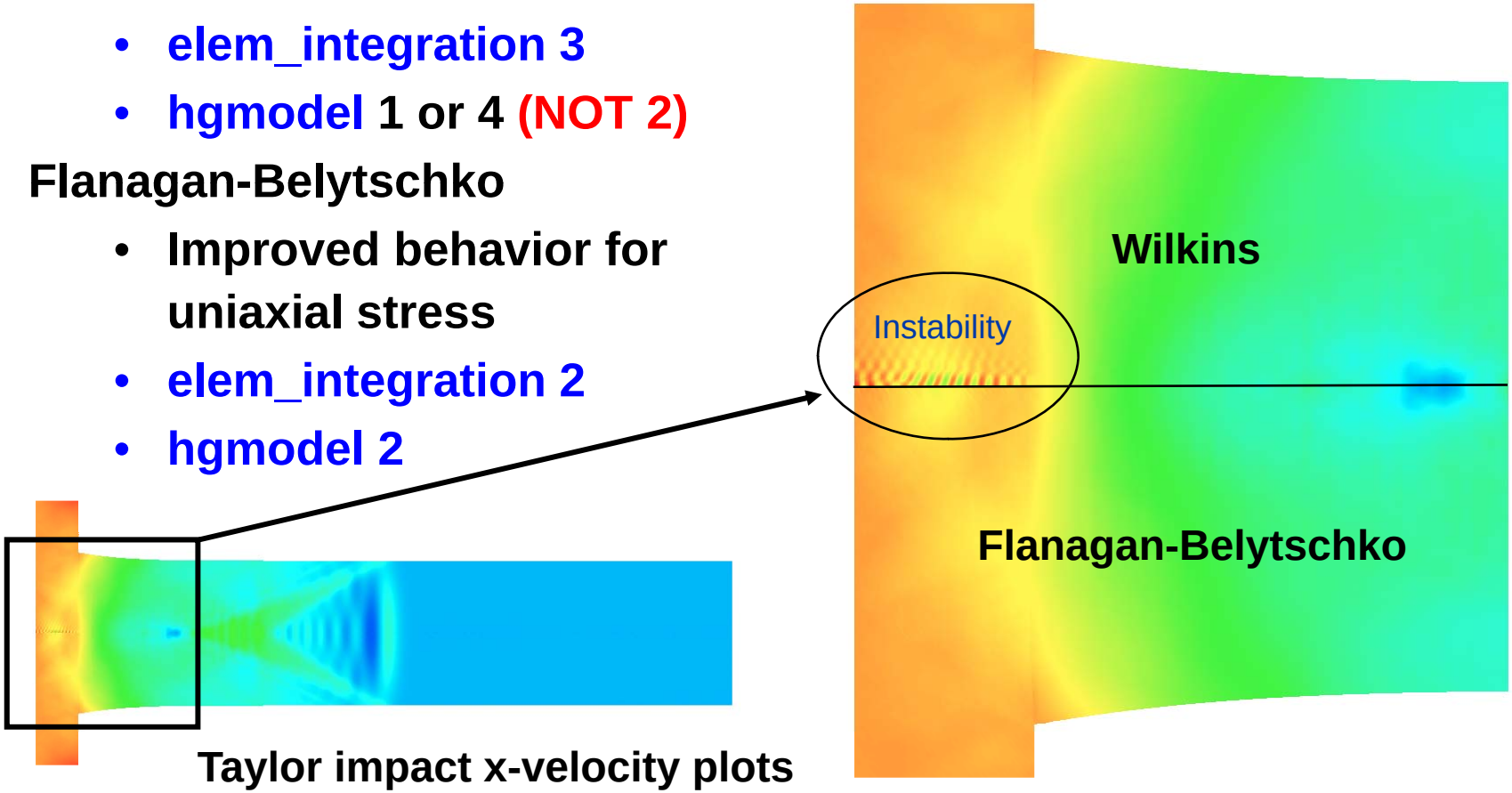
Important note on hourglass control with 2D axisymmetry

Wilkins method

- **default**
- **elem_integration 3**
- **hgmodel 1 or 4 (NOT 2)**

Flanagan-Belytschko

- **Improved behavior for uniaxial stress**
- **elem_integration 2**
- **hgmodel 2**



Taylor impact x-velocity plots

Changes to input/output in V4.10

- MATERIAL blocks no longer support region numbers in the header, **`timehist`** commands, or **`advinput`**. Use REGION blocks for those instead.
  - If your old input files won't work with 4.10, this is probably the reason why.
- **`matinit`** in MATERIAL block is no longer valid. Use **`reginit`** (in the REGION block) or **`histinit`**.
- Added spacetable derivedvar options
- New "const" derivedvar operator
- Derivedvars "diff", "sum", "product", and "divide" now recognize a constant scalar as one of the arguments
- Added VisIt expressions for visualization of vector and tensor history variables

New MHD features

- **Problem control**
  - `mhd_diffusion` option now only enables magnetic diffusion
    - MHD is now enabled by the existence of an MHD Block
  - New `mhd_dt_mult` input parameter allows specification of multiplier on MHD time constraint
  - Added `mhd_supercycle` input param to allow super cycling of the MHD diffusion solve based on a fixed number of time steps
- **Implicit Mechanics**
  - Implicit mechanics with MHD available for 3D problems
  - Maxwell stresses available with implicit MHD
- **Solvers**
  - The AMG/AMS solvers are now the default for MHD
  - `mhd_use_ams` and `mhd_use_amg` are gone – use standard `solverparams` interface for much better control

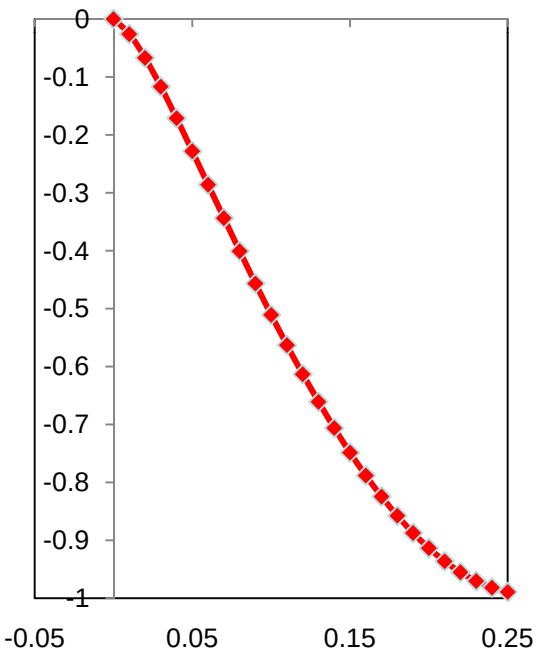
More new MHD features

- **Boundary Conditions**
  - Specification of background B field is now accomplished with a single parameter `mhd_backgroundb`
    - either constant or spatially varying fields (with spacetables)
    - `mhd_backgroundbx,y,z` are no longer valid
  - A new algorithm for coupling an external circuit to the MHD equations was implemented.
- **Electrical Conductivities**
  - Power law conductivity has been extended from 3 phase to 4 phase.
  - Added capability to specify electrical conductivity as a 2D table
    - function of temperature and density
  - New boundary condition which constrains the electrical conductivity of the elements associated a specified nodeset.

More more new MHD features

- **Notable Bug Fixes**
  - Fixed error in using mhd_backgroundb with both
    - mhd_smoothbtype==1
    - mhd_diffusion==0
  - J cross B forces in implicit MHD corrected
  - Corrected Joule heating in mixed zones
- **Output**
  - Added ability to get time histories of voltage, circuit current, total magnetic energy, total dissipated power and total JxB force

Current vs Time



Proposed future development

FY10	FY11	FY12	FY13	FY14
Improved interface tracking, 3D	Element Erosion	Discrete particles Spiral 0	Discrete particles Spiral 1	
Autocontact Spiral 1 (corners)	Autocontact Spiral 2	Autocontact with particles		Additional element formulations
	Embedded Grid Spiral 0	Embedded grid Spiral 1	Embedded grid Spiral 2 (shells)	
LLNL DSD, 2D Linking to LANL	DSD 2D, 3D boundary			
Material model parameter database, Spiral 0	Material model parameter database, LEOS, MSD	Material model parameter database, Thermal, Chemical		
Length and time scales to prevent abrupt release of energy	Improve robustness of advection with void seeding for mixed zone fracture	Fracture within embedded grid framework		
Implement existing corner theory yield surface model	Evaluate corner theory predictions compared to crystal plasticity results	Formulate yield surface vertex model based on crystal plasticity simulations	Implement and verify new continuum yield surface vertex models	Couple simple failure criterion to strain localization

Detailed list of changes in 4.10

These descriptions were automatically extracted from our internal issue/bug tracker. There is no order implied within a grouping (behavioral changes, new features, significant bug fixes). If you have a question about a particular item and don't know which ALE3D developer to ask about it, please use the *artfXXXXX* reference in an email to ale3d-help, and we'll have the person responsible get back to you to answer any questions.

- Darcy flow now based on gas pore pressure (artf10467)
- meshtables and their kin can now be defined in if clauses (artf10360)
- all volumes are tested against eosvmin and eosvmax and corrected before being sent to the material model (artf10344)
- Power law conductivity has been extended from 3 phase to 4 phase. Added two additional coefficients to define transition to plasma. (artf10123)
- The AMG/AMS solvers are now the default for MHD, to use different solvers requires a solverparams block, it is now possible to tune selected AMG/AMS solver parameters to optimize solver to the problem, significant reduction in MHD solver related input params (artf10006)
- Default value of ihslidemodel is now 2 (was: 1). (artf9954)
- ihslidemodel can be specified on per-slide basis (artf9953)
- histinit values for hierarchical materials are now properly propagated (artf9583)
- Adjusted eps after epsfail is reached to prevent healing by advection for KO materials (artf9549)
- correct defaults now for monotonic q (artf9062)
- improved q control (artf8850)
- a better implementation, with severe testing (artf8840)
- Allow setting Cheetah file location by environment variable (artf8705)

Behavioral changes

- Allow setting Cheetah file location by environment variable (artf8705)
- Mossfrac model updated to spring '08 version (artf8522)
- Added cell centered hydro scheme for multiphase problems (artf8382)
- A new algorithm for coupling an external circuit to the MHD equations was implemented. (artf8008)
- cfdavg option was removed from the code (artf7498)
- KO iforms 9' and '10' changed to '19' and '20' (artf7446)
- Advection flux limiter (van leer vs. superbee) now set via "rhobarlimiter" instead of an overloaded "rhobarorder" flag. (artf6646)
- Code will warn on matinit usage. Starting in 4.12 feature will go away!!! (artf10619)
- ssfric parameter is now just a switch for implicit mechanics (artf10611)
- MS Johnson-Cook fracture model modified for high triaxiality (artf10326)
- specification of background B field is now accomplished with a single param mhd_backgroundb which also allows for spatially varying fields (artf9277)
- mhd_diffusion option now only enables magnetic diffusion--MHD problems may now be run with this parameter set to 0 (artf9070)
- removed matplotfilter command which is more easily accomplished through VisIt thresholding (artf8900)
- Option added to prevent mid-step time increment reductions in implicit (artf8639)
- LEOS 'tcalc' option now selectable via 'tcalc_flag' parameter in leosinput (artf8580)
- MATERIAL blocks no longer support region numbers in the header, timehist commands, rlxweightvar commands, or advinput. Use REGION blocks for those instead. (artf8448)
- rusanov and hll options were removed from multiphase (artf8371)
- cleaned up pdf input syntax for cheetah (artf8318)

Behavioral changes (continued)

- Keywords mphase_drift and mphase_flux were removed from multiphase block. (artf10796)
- Symmetry bc was improved for multiphase problems (artf10787)
- change default thermalsharedopt = 1 (artf10753)
- Changed sanity checks from the "... so I'm doing it for you" style to the critical info (artf10725)
- changed spelling of "voidcrit principle" to "voidcrit principal" (artf10700)
- fixed error in econdmodel 2 which now requires 13 econdcoef values, the 13th being the conductivity lower bound (artf10650)
- Allow for sesame to defer emelt and soundspeed. (artf8267)
- implicithydro flag changed (artf7777)
- 'mixvarcut' in CONTROL block now called 'timehist_mixvarcut' in OUTPUT block (artf7515)
- default for ihsharedopt is now 1 (artf6566)
- Improved user control of integer history advection (artf6551)
- "allghost" flag has been deprecated (artf10886)
- "nodesetcleanup" flag has been deprecated (artf10793)
- lighting with concentric ring and rings without iteration (artf9580)
- Updated TEPLA with 3/2008 version from LANL (artf9506)
- Removed mhd_diffusion options 8 and 9 which can now be handled through the mhd_backgroundb syntax (artf9439)
- Code will now not allow cvfcutx to be set below 1e-20 as such values will likely result in errors (artf9090)
- When doing thermal and implicit mechanics solves, ALE3D now prints information to indicate what is not yet converged (artf8836)
- Normalized behavior of "implcithydro" flag (artf7045)

New Features in 4.10

- Windows now built against msmpi parallel (artf10714)
- Pressure offset available with LEOS and META leos models (artf10713)
- econdmodel 2 (LEOS Conductivity) now requires a lower bound (artf10538)
- histinit option added to region block (artf10536)
- pressure boundary condition added for darcy flow (artf10465)
- New multilayer composite model with damage (artf10461)
- HVRB now available in KO input (artf10455)
- Ability to query values of other fields at a min or max timehist reduction (artf10380)
- Users may specify reaction_zone to use with burndl<0 (artf10332)
- Higher order CT_reactiveflow/ iform 15 model available (artf10175)
- Added Klepeis-Bales and multi-phase shear modulus models to MS (artf10141)
- New boundary condition which constrains the electrical conductivity of the elements associated a specified nodeset. (artf10124)
- Extended program relax gridvsmx to two gradient directions (artf10115)
- Anisotropic (Transversely isotropic) conductivity constraint added, defined via nodeset, useful for arc models and stranded conductors (artf9988)
- Special Boundary Condition for Outflow Shear Layers - Experimental (artf9987)
- User may now specify a center of mass boundary condition that will properly constrain and move a free object in implicit mechanics (artf9959)
- ALE3D supported on LANL yellowrail/redtail machines (artf9950)
- added spacetable derivedvar options (artf9932)
- Temperature dependent, tabular shear modulus and bilinear hardening available in MS view (artf9919)
- Added capability to specify electrical conductivity as a 2D table--function of temperature and density (artf9912)
- added spacetable option for inflow/outflow (artf9724)

New Features in 4.10 (continued)

- New features for spacetable (artf9693)
- New detonation ring lighting feature (artf9582)
- Tabular thermal expansion model similar to traditional engineering models (artf9532)
- Tied slides available for implicit calculations (artf9061)
- Can now extract Exodus TETRA blocks and convert to ProE shape files (artf8708)
- User may scale back implicit displacement corrections in iteration cycle (artf8649)
- Code now controls on effective volume fraction change as well as mass fraction change (artf8539)
- Added glass model with bulking (artf8451)
- Added cheetah viscosity call (artf8351)
- User may now require material numerical derivatives for implicit mechanics calculations (artf8016)
- Added ability to get timehistories of voltage, circuit current, total magnetic energy, total dissipated power and total JxB force (artf8009)
- Added ability to read cubit exodusII files natively from gen3d (artf8003)
- New "const" derivedvar operator (artf7799)
- Added visit expressions for visualization of vector and tensor history variables (artf7785)
- New flags to control "fixup" of tiny volume fractions driving the calculation bad (artf7546)
- New command "rlxholdvar" allows constraining of relaxation on any variable with user-specified threshold (artf7435)
- Added Springs/Dashpots and point masses (artf6525)
- Added capability to specify range of shape id's (artf6433)
- Added back the ability to just iterate the relaxer (rlxitercnt) (artf6214)
- Better user control of matview (artf10723)
- New flag "timehist_header" allows for different levels of verbosity in timehist curve headers (artf10630)
- Can now rotate, magnify, translate proE formatted data (artf10608)
- meshtables can now be used to construct shapes (artf10358)
- rlxweightvar will now work with a derivedvar (zone centered) as the controlling variable (artf10169)

New Features in 4.10 (continued)

- Multitable LEOS tables (eosnums 100,000+) are now accessible in ALE3D (artf9708)
- allow spline data entry as yx data pairs (artf9514)
- Haselman EOS for now available (artf9479)
- optimize single-processor search for single-sided contact (artf9401)
- Added new derived var, epsdot, which will gather the history vars eps_dot and the equivalent for MS materials plast_edot into a domain length derived variable (artf9373)
- new mhd_dt_mult input parameter allows specification of multiplier on MHD time constraint (artf9276)
- Added mhd_supercycle input param to allow super cycling of the MHD diffusion solve based on a fixed number of time steps (artf9275)
- Maxwell stresses available with implicit MHD (artf8676)
- Temperature from either tcalc or tinverse now available for LEOS using MS models (artf8642)
- Users may now user the cheetah eos and conductivity models from within the meta material model (artf8598)
- Cheetah can now be used as a thermal model (artf8597)
- LEOS library updated to v 7.24.0 (artf8532)
- Eng model 64 has option for recoverable elastic foam (artf8521)
- Implicit MHD available for 3D problems (artf8094)
- Extended periodic bc to 2D configurations (artf7764)
- Stress relaxation in direction of interface normal is available (artf7495)
- Void seeding at finite volume fractions for fracture simulations (artf7494)
- Added new keyword "params_float_format" to OUTPUT block for controlling floating point precision in .params files (artf6556)

New Features in 4.10 (continued)

- New flag in output block "plot_midcycle" - writes a pre-advection plotfile at the same cycle as regular plotfiles (artf6504)
- User may now specify mesh file in input file (artf6461)
- Production (optimized) executables on Linux are now built with symbol table info, which allows basic debugging (artf6288)
- New "slab' geometry added (artf9561)
- tables and table2d (artf9541)
- Greatly simplified method for incorporating an Abaqus UMAT (artf9531)
- Preliminary version of autocontact working for surfaces without "corners" (artf9475)
- New leosinput options: tcalc_flag (avoid inverse calls) and extrap_flag (handle extrapolation in ALE3D vs. LEOS) (artf9155)
- Fisher parameter model added for high temperature fracture (artf8377)
- Users can now specify mesh ratioing with a meshtableop (artf8355)
- initial multiple bin particle sizes (artf8345)
- Tabular PDF available for initializing spatial distributions of history variables (artf7987)

Notable Bug Fixes in 4.10 (continued)

- Fixed potential floating point error in tanh law calculation of damage in model 143 (artf8967)
- Fixed bulk modulus/sound speed calculation in advecting composite materials (artf10819)
- MHD Advection fixed for small mesh sizes/time steps (artf10557)
- Econdmodel 1 and 2 now work correctly for mixed zones (artf10537)
- User warned if using incompatible augmented beta burn options (artf10359)
- Anglewall BCs now work correctly in implicit mechanics (artf10004)
- Inhomogeneous Neumann Boundary Conditions now work correctly on non-uniform meshes (artf9986)
- Bug fix for JWL+where 'alpha' should be defined as 0.5 instead of 0.05. (artf9612)
- User may now specify beta burn reference specific volume (artf9553)
- Fixed error in which mhd_backgroundb w/mhd_smoothbtype==1 and mhd_diffusion==0 results in incorrect results (artf9432)
- "finalplot 0" now has the intended effect (artf9392)
- Improved cheetah library reduces run time (artf9074)
- Fixed bug in MS LEOS tcalc initialization (artf9041)
- Fixed surface normal calculation to work in parallel (artf8409)
- The region "clean" command now works with AT/ATCYCLE commands (artf7530)
- Tolerance checked inside code (artf6434)
- Fixed computation of electrical conductivity for mixed zones in econdmodel 1 (artf10803)
- magnitude derived variable of mixed zone centered vector quantities now computes mixed part of magnitude (artf10736)
- Joule Heating and Lorentz Force now handles mixed zones correctly, and works for supercycling (artf10664)
- Code should reproduce identical answers for same decomposition run on different numbers of processors (artf10172)

Notable Bug Fixes in 4.10 (continued)

- Using the "sesame" tag in leosinput commands will now find the public default sesame database (artf10018)
- Fixed intermittent code crashes when using parwrite_subdir (artf9597)
- Fixed error in building femster with non-gnu make (artf9369)
- burnlin is not "broken" anymore (artf9284)
- J cross B forces in implicit MHD corrected (artf9036)
- Fixed mhd submenu on plot files (artf8449)
- Derivedvars "diff", "sum", "product", and "divide" now recognize a constant scalar as one of the arguments (artf6587)
- Underscores in problem kernel names will work with auto-pick restart if -prob is also used (artf6549)
- Fixed energy calculation for visco-elastic material model (ms elasmodel 47) (artf8894)