User Guide Part 3: Configuring ZEUS-MP for Execution

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Like ZEUS-2D and the 1.0 release of ZEUS-MP, this version of ZEUS-MP uses an input file to configure the calculation and determine a host of run-time parameters. Called "zmp_inp", this file lives along with the executable (zeusmp.x) in the zeusmp2/exe90 directory. zmp_inp is a collection of namelists; users of the 1.0 version will note that the collection of namelists has been considerably expanded in this release. This is because nearly all of the CPP macros used to configure the code in the previous release have been abandoned in favor of integer and logical control parameters than can be set at execution time. The first five namelists in zmp_inp contain real, integer, and logical control parameters serving the configuration functions formerly performed by entries in the "zeusmp.def" macro file used by Version 1. This page itemizes the contents of the zmp_inp file and describes the function of each parameter. The parameters are tabulated by namelist; where appropriate, a "remarks" section follows the corresponding table.

Namelist GEOMCONF			
Parameter	**Data Type**	**Attribute**	**Valid Values**
LDIMEN	Integer	Problem Dimensionality	1 (Cartesian), 2 (Cylindrical), or 3 (Spherical)
LGEOM	Integer	Grid Geometry	1, 2, or 3

Namelist PHYSCONF				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
LRAD	Integer	radiation toggle	0 (no radiation) or 1 (FLD)	
LEOS	Integer	equation of state toggle	1 (user may add more)	See **PHYS_Remarks (1)**
NSPEC	Integer	total number of fluid species	1 or higher	
XHYDRO	Logical	spatial advection toggle	.TRUE. or .FALSE.	See **PHYS_Remarks (2)**
XFORCE	Logical	body force toggle	.TRUE. or .FALSE.	See **PHYS_Remarks (2)**

XMHD	Logical	MHD toggle	.TRUE. or .FALSE.	
XTOTNRG	Logical	Evolve total energy	.TRUE. or .FALSE.	See **PHYS_Remarks (3)**
XGRAV	Logical	Gravity toggle	.TRUE. or .FALSE.	See **PHYS_Remarks (4)**
XGRVFFT	Logical	Enable FFTW gravity solver	.TRUE. or .FALSE.	See **PHYS_Remarks (4)**
XSPHGRV	Logical	Assume GM/r potential	.TRUE. or .FALSE.	See **PHYS_Remarks (4)**
XPTMASS	Logical	Point-mass potential	.TRUE. or .FALSE.	See **PHYS_Remarks (4)**
XISO	Logical	Isothermal EOS	.TRUE. or .FALSE.	See **PHYS_Remarks (1)**
XSUBAV	Logical	Sub-cycle artificial viscosity	.TRUE. or .FALSE.	
XVGRID	Logical	moving grid toggle	.TRUE. or .FALSE.	See **PHYS_Remarks (5)**

PHYS_Remarks:

1. The LEOS equation of state toggle selects between gamma-law equations of state (LEOS = 1) and whatever a user may wish to implement as an alternative (LEOS > 1). The isothermal case (gamma = 1) requires that LEOS = 1 **and** XISO be set to .TRUE., as the isothermal case is treated as a special case in the code.

2. The existence of both the XHYDRO and XFORCE switches is primarily a debugging tool, but a useful one. Setting XHYDRO to .TRUE. and XFORCE to .FALSE. reduces the calculation to one of pure advection. The converse case is not physically meaningful. Setting both of these switches to .FALSE., however, allows calculations of radiation transport through static media to be performed with a minimum of CPU cost.

3. If XTOTNRG is set to .TRUE., then the ZEUS-MP field array, "e(i,j,k)" is used to store the total gas energy rather than the internal energy. **This option is not valid if radiation, gravity, or magnetic fields are present.**

4. The gravity switches are designed around the following logic:
   - XGRAV and XGRVFFT are "top-level" switches that decide whether gravity -- by any means other than a point-mass potential -- is computed at all. **XGRVFFT is reserved for 3D cartesian grids with triply-periodic problems.** For other general potential problems (2D or 3D), set XGRAV to .TRUE. and XGRVFFT to .FALSE.
   - A GM/r potential may be used in 1D or 2D by setting XGRAV and XSPHGRV to .TRUE.

- The point-mass potential is treated is as a special case. If a point-mass potential is desired, set XPTMASS to .TRUE. and XGRAV, XGRVFFT, and XSPHGRV to .FALSE.

5. The moving grid has only been fully implemented for **parallel execution** for the case of grid motion along the 1-axis.

Namelist IOCONF				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
XASCII	Logical	ASCII dump file toggle	.TRUE. or .FALSE.	See **IOCONF_Remarks (1)**
XHDF4	Logical	HDF4 dump file toggle	.TRUE. or .FALSE.	See **IOCONF_Remarks (2)**
XRESTART	Logical	Restart dump file toggle	.TRUE. or .FALSE.	See **IOCONF_Remarks (3)**
XHDF5	Logical	HDF5 dump file toggle	.TRUE. or .FALSE.	HDF5 Dumps Not implemented
XTSL	Logical	"Time Slice" dump file toggle	.TRUE. or .FALSE.	Not implemented

IOCONF_Remarks

1. If XASCII = .TRUE., then subroutine TEXTDMP will write output files in ASCII format. Additional controls on the frequency of file dumps is input via namelist IOCON.

2. If XHDF4 = .TRUE., then subroutine HDFALL will write output files in HDF4 format. Additional controls on the frequency of file dumps is input via namelist IOCON.

3. If XRESTART = .TRUE., then subroutine MSAVE will write output files in binary format. Additional controls on the frequency of file dumps is input via namelist IOCON.

Namelist PRECONF				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
SMALL_NO	Real/Double	Smallest positive real	A REALLY small	See

SMALL_NO	Real/Double	number	number	remarks
LARGE_NO	Real/Double	Largest positive real number	A REALLY large number	See remarks

PRECONF_Remarks

SMALL_NO and LARGE_NO are used to initialize real arrays in ZEUS-MP such that underflow and overflow conditions will be avoided.

Namelist ARRAYCONF				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
IZONES	Integer	# of 1-coordinate zones per processor	5 or more	
JZONES	Integer	# of 2-coordinate zones per processor	8 or more	
KZONES	Integer	# of 3-coordinate zones per processor	5 or more	
MAXIJK	Integer	MAX(izones,jzones,kzones)	MAX(izones,jzones,kzones)	

Namelist MPITOP				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
ntiles(1)	Integer	# MPI processes spanning the 1-coordinate	> 0	
ntiles(2)	Integer	# MPI processes spanning the 2-coordinate	> 0	
ntiles(3)	Integer	# MPI processes spanning the 3-coordinate	> 0	
periodic	Logical Array(3)	Periodic B.C. Switch	.TRUE. or .FALSE.	See MPITOP_Remarks

MPITOP_Remarks

The MPITOP (Message-Passing Interface TOPology) namelist tells ZEUS-MP how many processors are used for the calculation and how many processors span each coordinate axis of the problem domain. Together with the array limits set forth in ARRAYCONF, the NTILES integers provide a complete description of how the problem data is subdivided and distributed over an array of parallel processors. The PERIODIC logical array is required by MPI as an identifier of coordinate axes along which periodic boundary conditions are used. The values of PERIODIC must be consisent with ZEUS-MP's BC flags specified in the BC namelists IIB, OIB, IJB, OJB, IKB, and OKB.

Namelist RESCON				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
IRESTART	Integer	Signifies that a run is beginning from a restart dump	0 (do not use a restart file) or 1 (use a restart file)	
RESFILE	Character	The name of the root process's restart file	"resaa000000.XXX", where XXX is the restart dump number	

Namelist PCON				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
NLIM	Integer	Number of timesteps to execute	> 0	
TLIM	Real	Problem evolution time limit	> 0.0	
CPULIM	Real	Wall Clock CPU time limit	>> 0.0	
MBATCH	Integer	Interactive status query toggle	0 or 1	0 is dangerous on IBM

Namelist HYCON				
	Data			

Parameter	Data Type	Attribute	Valid Values	Notes
QCON	Real	Neumann-Richtmeyer Artificial Viscosity Coefficient	0 or higher	
QLIN	Real	Linear Artificial Viscosity Coefficient	0 or higher	
COURNO	Real	Courant Number	0.5 recommended	

Namelist IIB

Parameter	Data Type	Attribute	Valid Values	Notes
NIIS(1)	Integer	Specifies Hydro BC at inner 1-boundary	1, 2, 3, 4	See comments in setup.F and bndyflgs.F
NIIS(2)	Integer	Specifies Radiation BC at inner 1-boundary	1, 2, 3, 4	See comments in setup.F
NIIS(3)	Integer	Specifies Gravity BC at inner 1-boundary	1, 2, 3, 4	See comments in setup.F
FIIS(1)	Real	Imposed inner boundary density when NIIS(1) = 3	Problem-specific	See comments in setup.F
FIIS(2)	Real	Imposed inner boundary gas energy when NIIS(1) = 3	Problem-specific	See comments in setup.F
FIIS(3)	Real	Imposed inner boundary value for V1 when NIIS(1) = 3	Problem-specific	See comments in setup.F
FIIS(4)	Real	Imposed inner boundary value for V2 when NIIS(1) = 3	Problem-specific	See comments in setup.F
FIIS(5)	Real	Imposed inner boundary value for V3 when NIIS(1) = 3	Problem-specific	See comments in setup.F
FIIS(6,7,8)	Real	Imposed inner boundary values for B(1,2,3) when NIIS(1) = 3	Problem-specific	See comments in setup.F, bndyflgs.F
FIIS(9,10,11)	Real	Imposed inner boundary values for EMF(1,2,3) when NIIS(1) = 3	Problem-specific	See comments in setup.F, bndyflgs.F
		Imposed inner boundary value for ER	Problem-	See comments in

FIIS(12)	Real	Imposed inner boundary value for ER when NIIS(2) = 3	Problem-specific	See comments in setup.F
FIIS(13)	Real	Imposed inner boundary value for GP when NIIS(3) = 3	Problem-specific	See comments in setup.F

Namelists OIB, IJB, OJB, IKB, OKB

The remaining boundary value namelists are defined analogously to the values in IIB. Read the comments in setup.F and bndyflgs.F for further details.

Namelists GGEN1, GGEN2, GGEN3

Parameter	Data Type	Attribute	Valid Values	Notes
NBL	Integer	Total number of physical zones along axis	>= per-processor minimum	See GGEN_Remarks
X(1,2,3)MIN	Real	Location of inner boundary face (cm)	User's choice	See GGEN_Remarks
X(1,2,3)MAX	Real	Location of outer boundary face (cm)	User's choice	See GGEN_Remarks
IGRID	Integer	Zoning Parameter	-1, 1, 0, -2, 2	See comments in GGEN.F
X(1,2,3)RAT	Real	Zoning Parameter	> 0.0	See comments in GGEN.F
DX(1,2,3)MIN	Real	Zoning Parameter	> 0.0	See comments in GGEN.F

GGEN_Remarks:

In the simplest case, the number designated by "NBL" in each GGEN namelist is simply the total number of zones in the global problem domain along the appropriate coordinate axis. In a parallel calculation, the following equalities would apply:

1. NBL(GGEN1) = NTILES(1) x I_ZONES
2. NBL(GGEN2) = NTILES(2) x J_ZONES
3. NBL(GGEN3) = NTILES(3) x K_ZONES

ZEUS-MP has the ability to adopt ratioed zoning according to parameters such as IGRID, X(1,2,3)RAT, and DX(1,2,3)MIN. A given zoning prescription (including uniforming zoning) can be applied to a subportion of the global axis, in which case NBL becomes the number of zones over which a given zoning prescription is employed. For example, if we wished to use uniform zoning along the inner half of the 1-axis and ratioed zoning along the outer half, our copy of ZMP_INP would contain two consecutive entries for GGEN1, in which the grid parameters for each block are chosen appropriately. Click here for an example ZMP_INP file which accomplishes this. Notice that in the first instance of GGEN1, the parameter LGRID is set to .FALSE., whereas in the second instance it is .TRUE. The value of .TRUE. tells ZEUS-MP that no further blocks of zones are to be read for this coordinate axis.

Namelist GRVCON				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
guniv	Real	Gravitional Constant	6.67e-8 (cgs)	See GRVCON_Remarks(1)
tgrav	Real	Time at which to enable gravity	User's Choice (sec)	See GRVCON_Remarks(2)
ptmass	Real	Mass of imposed point mass	User's Choice (gm)	See GRVCON_Remarks(3)
x1ptm	Real	1-coordinate of point mass	User's Choice (cm)	
x2ptm	Real	2-coordinate of point mass	User's Choice (cm)	
x3ptm	Real	3-coordinate of point mass	User's Choice (cm)	
XWEDGE	Logical	Compute M(r) assuming a 45 degree wedge	.TRUE. or .FALSE.	See GRVCON_Remarks(4)
GSUP	Integer	Cycle number at which to compute gravity	User's Choice (cm)	Obsolete; not used.

GRVCON_Remarks:

1. While ordinarily one would wish to set GUNIV to the usual CGS value; the pressureless-collapse test problem actually assumes that G = 1. GUNIV was therefore included in the input namelist for problem flexibility.
2. TGRAV allows the user to delay the calculation of gravity until some amount of evolution time has passed. Evidently there was some test or application where this was useful. Perhaps you'll find it useful.
3. If XPTMASS = .TRUE. in namelist PHYSCON, then PTMASS provides the mass in grams of the

point mass to be included. X(1,2,3)PTM provide the coordinates of the point mass in the computational domain.

4. If XSPHGRV = .TRUE. in namelist PHYSCON, then set XWEDGE = .TRUE. if the angular grid is an equatorial wedge spanning 45 degrees. This enables a correct computation of interior mass vs radius. If the angular mesh spans a full 180 degrees, set this flag to .FALSE. (default).

Namelist RADCON				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
IFLD	Integer	Flux-Limiter selector	1 or 2	Used in DIFCO{1,2,3}.F
EPSME	Real	Newton-Raphson convergence tolerance	User's Choice	Used in GREY_FLD.F
CNVCRIT	Integer	N-R convergence check method	1 or 2	Used in GREY_FLD.F
ERNOM	Real	Nominal radiation energy density	application-specific	Used when CNVCRIT=2
ENNOM	Real	Nominal gas energy density	application-specific	Used when CNVCRIT=2
DEMAX	Real	N-R correction coefficient	Default=0.2	Used in GREY_FLD.F
DERMAX	Real	N-R correction coefficient	Default=0.2	Used in GREY_FLD.F
NMEITER	Integer	Maximum allowed number of N-R iterations	20 seems sufficient	Used in GREY_FLD.F
RADTH	Real	Time-centering parameter	0.0 - 1.0	Used in JACOB.F
EPSMAXD	Real	Radiation timestep limit parameter	Recommend 0.01 - 0.1	Used in RAD_IMP_DT.F
CGERRCRIT	Integer	Linear solver convergence checking	1 or 2	Used in CGSOLVE.F
IPCFLAG	Integer	Linear solver preconditioning flag	2	Used in routines called by CGSOLVE.F
XNU	Real	Density exponent in opacity power-law	application specific	Used in OPACITY.F, MATPROP.F
POWR	Real	Temperature exponent in opacity power-law	application specific	Used in OPACITY.F, MATPROP.F

rho0	Real	Density normalization in opacity power-law	application specific	Used in OPACITY.F, MATPROP.F
T_0	Real	Temperature normalization in opacity power-law	application specific	Used in OPACITY.F, MATPROP.F
RMFP0	Real	Coefficient in Rosseland mean-free path power-law	application specific	Used in OPACITY.F, MATPROP.F

Namelist EQOS

Parameter	Data Type	Attribute	Valid Values	Notes
GAMMA	Real	Adiabatic exponent	>1	For isothermal EOS, set XISO=.TRUE. in PHYSCON
MMW	Real	Mean molecular weight	>0 (duh!)	

Namelist PGEN

The contents of PGEN are entirely application-specific and defined according to the needs of the User. PGEN ("problem generation") is read by the problem-generating subroutine (or problem-restarting subroutine, as the case may be) written by the User. BLAST.F and RSHOCK.F are fine examples of problem-generating subroutines.

Namelist GCON

GCON contains parameters used to control grid motion. Grid motion is activated by setting XVGRID = .TRUE. in namelist PHYSCON. See the subroutines NEWGRID.F, NEWVG.F, NEWX1.F, NEWX2.F, and NEWX3.F to acquaint yourself with how grid motion is computed. The GCON namelist, containing all relevant parameters, is defined in SETUP.F.

Namelist IOCON (no, this isn't a repeat or a typo)				
Parameter	**Data Type**	**Attribute**	**Valid Values**	**Notes**
tusr	Integer	Evolution time for 1st ASCII dump	greater than time of previous dump, if restarting	See remarks
dtusr	Integer	Time increment for next ASCII dump	greater than zero	See remarks
thdf	Integer	Evolution time for 1st HDF4 dump	greater than time of previous dump, if restarting	See remarks
dthdf	Integer	Time increment for next HDF4 dump	greater than zero	See remarks
tdump	Integer	Evolution time for 1st restart dump	greater than time of previous dump, if restarting	See remarks
dtdump	Integer	Time increment for next restart dump	greater than zero	See remarks
t_out	Integer array	Preset times at which to dump data	greater than zero	Overrides dtusr and dthdf; see remarks

IOCON Remarks

The t*** and corresponding dt*** parameters specify the frequency with which each type of output file is written **provided that** the appropriate LOGICAL switch (XASCII, XHDF4, XRESTART) in namelist IOCONF has been set to ".TRUE.". For example, if XASCII is set to .TRUE., then an ASCII output file will be written once the evolution time (the **time** variable in ZEUS-MP) equals or exceeds the value of **tusr** specified in IOCON. Additional files will be written every **dtusr** seconds of **time** thereafter.

dthdf and dtusr may be overridden by specifying set times at which HDF and ASCI files are to be written. This is done by setting values of the array t_out(i), which can hold up to 32 entries (this is controlled by the value of the dimension parameter "nbuff". If entries for t_out(1), t_out(2), etc. are included in namelist IOCON, then the values of dtusr and dthdf will be ignored, **except** that dtusr and dthdf must be non-zero for files to be written at intermediate times! **Additional Note:** t_out does not overwrite the frequency, dtdump, at which restart files are written.

NOTE: Setting dtusr (for example) to zero will cause an ASCII file to be written only at the beginning and end of program execution.

WARNING FOR RESTARTING: If ZEUS-MP is initiated from a restart file, the values of tusr, thdf, and tdump MUST BE UPDATED to be greater than or equal to the time of the previous dump!! Failure to update the time counter may result in output files written at every timestep. Trust me; you don't want this.