Einstein Neutron Stars
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Version: GRMHD tabEoS eikonal LES
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Fields

Sfd_x, Sfd_y, Sfd_z, Bfu_x, Bfu_y, Bfu_z, Df, DYf, $tauf$, $phif$, gtd_xx, gtd_xy, gtd_xz, gtd_yy, gtd_yz, gtd_zz, Atd_xx, Atd_xy, Atd_xz, Atd_yy, Atd_yz, Atd_zz, $Gamh\_x$, $Gamh\_y$, $Gamh\_z$, $Betau\_x$, $Betau\_y$, $Betau\_z$, $Alpha$, chi, trK, $theta$

Spatial Coordinates

x, y, z

Time Coordinate

t

Parameters

Parameter	Type	Default value
do_leakage	INT	Not set
threshold_leakage_vacuum	REAL	Not set
eos_type	INT	Not set
Betau_x_0	REAL	Not set
Betau_y_0	REAL	Not set
Betau_z_0	REAL	Not set
calculate_les_terms	INT	Not set
externalCon2Prim	INT	Not set
threshold_sqBmax	REAL	1
initialYe	REAL	Not set
initialTemperature	REAL	Not set
minTableTemperature	REAL	Not set
minTableEnergy	REAL	Not set
energyShift	REAL	Not set
vacuum_ye_beta	REAL	Not set
vacuum_ye	REAL	Not set
vacuum_rho_reset	REAL	Not set
vacuum_P_reset	REAL	Not set
vacuum_ye_reset	REAL	Not set
vacuum_temp_reset	REAL	Not set
vacuum_tau	REAL	Not set
vacuum_tau_reset	REAL	Not set
ye_maximum	REAL	Not set
ρ_0	REAL	Not set
ρ_1	REAL	Not set
ρ_2	REAL	Not set
gamma_0	REAL	Not set
gamma_1	REAL	Not set
gamma_2	REAL	Not set
gamma_3	REAL	2 Not set
a_0	REAL	Not set
a_1	REAL	Not set
a_2	REAL	Not set
a_3	REAL	Not set
K_0	REAL	Not set

Auxiliary Fields

ρf, Yef, vfd_x, vfd_y, vfd_z, pf, $epsf$, Tf, $sqcs$, qnu, rnu, $optdepthe$, $optdeptha$, $optdepthx$, $chie$, $chia$, $chix$, $t\_optdepthe$, $t\_optdeptha$, $t\_optdepthx$, t_chie, t_chia, t_chix, Efu_x, Efu_y, Efu_z, $TauN\_x$, $TauN\_y$, $TauN\_z$, $TauNe\_x$, $TauNe\_y$, $TauNe\_z$, $TauM\_xy$, $TauM\_xz$, $TauM\_yz$, $TauT\_xx$, $TauT\_xy$, $TauT\_xz$, $TauT\_yy$, $TauT\_yz$, $TauT\_zz$, $dpfdeps$, $dpfdrho$, $dpfdye$, qnu_a, qnu_e, qnu_x

Auxiliary Variables

Bvf, $optdepth eh$, $optdepthah$, $optdepthxh$, $optdepthev$, $optdepthav$, $optdepthxv$, $optdepthed$, $optdepthad$, $optdepthxd$, $chieh$, $chiah$, $chixh$, $chiev$, $chiav$, $chixv$, $chied$, $chiad$, $chixd$, sqa, $sqca$, $sqbc$, h, D, tau, Sd_x, Sd_y, Sd_z, Su_x, Su_y, Su_z, Bd_x, Bd_y, Bd_z, Bu_x, Bu_y, Bu_z, W, $faceta$, $kappa\_cc$, $kappa\_z1$, $kappa\_z2$, $feta$, chi_max, inv_chi, $detgtd$, $idetgtd$, gtu_xx, gtu_xy, gtu_xz, gtu_yy, gtu_yz, gtu_zz, $sdetg$, Bfd_x, Bfd_y, Bfd_z, Sfu_x, Sfu_y, Sfu_z, Efd_x, Efd_y, Efd_z, $Thetaf$, $sqvf$, $sqvf$, $Bfvf$, $sqBf$, $sqEf$, sqW, $invsqW$, $Sfuu\_xx$, $Sfuu\_xy$, $Sfuu\_xz$, $Sfuu\_yy$, $Sfuu\_yz$, $Sfuu\_zz$, $Tf4u\_tt$, $Tf4u\_tx$, $Tf4u\_ty$, $Tf4u\_tz$, $Tf4u\_xx$, $Tf4u\_xy$, $Tf4u\_xz$, $Tf4u\_yy$, $Tf4u\_yz$, $Tf4u\_zz$, Tu_tt, Tu_tx, Tu_ty, Tu_tz, Tu_xx, Tu_xy, Tu_xz, Tu_yy, Tu_yz, Tu_zz, rho_ADM, Jtd_ADM_x, Jtd_ADM_y, Jtd_ADM_z, $Betatd\_x$, $Betatd\_y$, $Betatd\_z$, $pTtd\_ADM\_xx$, $pTtd\_ADM\_xy$, $pTtd\_ADM\_xz$, $pTtd\_ADM\_yy$, $pTtd\_ADM\_yz$, $pTtd\_ADM\_zz$, tr_pT, $Atud\_xx$, $Atud\_xy$, $Atud\_xz$, $Atud\_yx$, $Atud\_yy$, $Atud\_yz$, $Atud\_zx$, $Atud\_zy$, $Atud\_zz$, $trAt$, Atu_xx, Atu_xy, Atu_xz, Atu_yy, Atu_yz, Atu_zz, Ctd_xxx, Ctd_xxy, Ctd_xxz, Ctd_xyy, Ctd_xyz, Ctd_xzz, Ctd_yxx, Ctd_yxy, Ctd_yxz, Ctd_yyy, Ctd_yyz, Ctd_yzz, Ctd_zxx, Ctd_zxy, Ctd_zxz, Ctd_zyy, Ctd_zyz, Ctd_zzz, Ct_xxx, Ct_xxy, Ct_xxz, Ct_xyy, Ct_xyz, Ct_xzz, Ct_yxx, Ct_yxy, Ct_yxz, Ct_yyy, Ct_yyz, Ct_yzz, Ct_zxx, Ct_zxy, Ct_zxz, Ct_zyy, Ct_zyz, Ct_zzz, div_Beta, $d\_div\_Beta\_x$, $d\_div\_Beta\_y$, $d\_div\_Beta\_z$, $Gamt\_x$, $Gamt\_y$, $Gamt\_z$, Zu_x, Zu_y, Zu_z, Rpd_xx, Rpd_xy, Rpd_xz, Rpd_yy, Rpd_yz, Rpd_zz, Rtd_xx, Rtd_xy, Rtd_xz, Rtd_yy, Rtd_yz, Rtd_zz, $Rscalar$, $Psi1\_xx$, $Psi1\_xy$, $Psi1\_xz$, $Psi1\_yy$, $Psi1\_yz$, $Psi1\_zz$, $trPsi1$, $Psi1TF\_xx$, $Psi1TF\_xy$, $Psi1TF\_xz$, $Psi1TF\_yy$, $Psi1TF\_yz$, $Psi1TF\_zz$, $Sfud\_xx$, $Sfud\_xy$, $Sfud\_xz$, $Sfud\_yx$, $Sfud\_yy$, $Sfud\_yz$, $Sfud\_zx$, $Sfud\_zy$, $Sfud\_zz$, $trSf$, $kappa\_f$, $decay\_factor$, vfu_x, vfu_y, vfu_z, Epf, $CovdinvsqW\_x$, $CovdinvsqW\_y$, $CovdinvsqW\_z$, $CovdDf\_x$, $CovdDf\_y$, $CovdDf\_z$, $CovdDYf\_x$, $CovdDYf\_y$, $CovdDYf\_z$, $CovdBvf\_x$, $CovdBvf\_y$, $CovdBvf\_z$, $Covdrhof\_x$, $Covdrhof\_y$, $Covdrhof\_z$, $Covdpf\_x$, $Covdpf\_y$, $Covdpf\_z$, $Covdepsf\_x$, $Covdepsf\_y$, $Covdepsf\_z$, $Covdhf\_x$, $Covdhf\_y$, $Covdhf\_z$, $CovdEpf\_x$, $CovdEpf\_y$, $CovdEpf\_z$, $CovdThetaf\_x$, $CovdThetaf\_y$, $CovdThetaf\_z$, $Covddpfdeps\_x$, $Covddpfdeps\_y$, $Covddpfdeps\_z$, $Covddpfdrho\_x$, $Covddpfdrho\_y$, $Covddpfdrho\_z$, $Covddpfdye\_x$, $Covddpfdye\_y$, $Covddpfdye\_z$, $CovdYef\_x$, $CovdYef\_y$, $CovdYef\_z$, $CovuYef\_x$, $CovuYef\_y$, $CovuYef\_z$, $CovuinvsqW\_x$, $CovuinvsqW\_y$, $CovuinvsqW\_z$, $CovuBvf\_x$, $CovuBvf\_y$, $CovuBvf\_z$, $Covurhof\_x$, $Covurhof\_y$, $Covurhof\_z$, $Covuepsf\_x$, $Covuepsf\_y$, $Covuepsf\_z$, $Covuhf\_x$, $Covuhf\_y$, $Covuhf\_z$, $CovuThetaf\_x$, $CovuThetaf\_y$, $CovuThetaf\_z$, $Covdvfu\_xx$, $Covdvfu\_xy$, $Covdvfu\_xz$, $Covdvfu\_yx$, $Covdvfu\_yy$, $Covdvfu\_yz$, $Covdvfu\_zx$, $Covdvfu\_zy$, $Covdvfu\_zz$, $Covdvfd\_xx$, $Covdvfd\_xy$, $Covdvfd\_xz$, $Covdvfd\_yx$, $Covdvfd\_yy$, $Covdvfd\_yz$, $Covdvfd\_zx$, $Covdvfd\_zy$, $Covdvfd\_zz$, $Covuvfu\_xx$, $Covuvfu\_xy$, $Covuvfu\_xz$, $Covuvfu\_yx$, $Covuvfu\_yy$, $Covuvfu\_yz$, $Covuvfu\_zx$, $Covuvfu\_zy$, $Covuvfu\_zz$, $CovdBfu\_xx$, $CovdBfu\_xy$, $CovdBfu\_xz$, $CovdBfu\_yx$, $CovdBfu\_yy$, $CovdBfu\_yz$, $CovdBfu\_zx$, $CovdBfu\_zy$, $CovdBfu\_zz$, $CovdBfd\_xx$, $CovdBfd\_xy$, $CovdBfd\_xz$, $CovdBfd\_yx$, $CovdBfd\_yy$, $CovdBfd\_yz$, $CovdBfd\_zx$, $CovdBfd\_zy$, $CovdBfd\_zz$, $CovuBfu\_xx$, $CovuBfu\_xy$, $CovuBfu\_xz$, $CovuBfu\_yx$, $CovuBfu\_yy$, $CovuBfu\_yz$, $CovuBfu\_zx$, $CovuBfu\_zy$, $CovuBfu\_zz$, $CovdEfu\_xx$, $CovdEfu\_xy$, $CovdEfu\_xz$, $CovdEfu\_yx$, $CovdEfu\_yy$, $CovdEfu\_yz$, $CovdEfu\_zx$, $CovdEfu\_zy$, $CovdEfu\_zz$, $CovdEfd\_xx$, $CovdEfd\_xy$, $CovdEfd\_xz$, $CovdEfd\_yx$, $CovdEfd\_yy$, $CovdEfd\_yz$, $CovdEfd\_zx$,

$CovdEfd\_zy$, $CovdEfd\_zz$, $CovuEfu\_xx$, $CovuEfu\_xy$, $CovuEfu\_xz$, $CovuEfu\_yx$, $CovuEfu\_yy$, $CovuEfu\_yz$, $CovuEfu\_zx$, $CovuEfu\_zy$, $CovuEfu\_zz$, $Phivh\_x$, $Phivh\_y$, $Phivh\_z$, $PhiMh\_xx$, $PhiMh\_xy$, $PhiMh\_xz$, $PhiMh\_xy$, $PhiMh\_yy$, $PhiMh\_yz$, $PhiMh\_xz$, $PhiMh\_yz$, $PhiMh\_zz$, $PhiThetah$, $PhiAh$, $HPres$, $HTheta$, Hv_x, Hv_y, Hv_z, HM_xy, HM_xz, HM_yz, HE_x, HE_y, HE_z, HN_x, HN_y, HN_z, HNe_x, HNe_y, HNe_z, HT_xx, HT_xy, HT_xz, HT_yy, HT_yz, HT_zz, $Sfud\_xx$, $Sfud\_xy$, $Sfud\_xz$, $Sfud\_yx$, $Sfud\_yy$, $Sfud\_yz$, $Sfud\_zx$, $Sfud\_zy$, $Sfud\_zz$, $trSf$

Analysis Fields

$Rscalar$, $HamCon$, $MomCon\_x$, $MomCon\_y$, $MomCon\_z$, trA, $detgtm1$, M_ADM_surf, Jz_ADM_surf, M_Komar, Jz_Komar, $psi4R$, $psi4I$, Z_x, Z_y, Z_z, $flux\_mass$

Auxiliary Analysis Variables

r_pos, Ju_x, Ju_y, Ju_z, hf, $kappa\_cc$, $kappa\_z1$, $kappa\_z2$, $feta$, inv_chi, $detgtd$, $idetgtd$, gtu_xx, gtu_xy, gtu_xz, gtu_yy, gtu_yz, gtu_zz, $g4d\_tt$, $g4d\_tx$, $g4d\_ty$, $g4d\_tz$, $g4d\_xx$, $g4d\_xy$, $g4d\_xz$, $g4d\_yy$, $g4d\_yz$, $g4d\_zz$, $g4u\_tt$, $g4u\_tx$, $g4u\_ty$, $g4u\_tz$, $g4u\_xx$, $g4u\_xy$, $g4u\_xz$, $g4u\_yy$, $g4u\_yz$, $g4u\_zz$, $sdetg$, vfu_x, vfu_y, vfu_z, Bfd_x, Bfd_y, Bfd_z, Sfu_x, Sfu_y, Sfu_z, $sqvf$, $sqBf$, $Bfvf$, sqW, $Sfuu\_xx$, $Sfuu\_xy$, $Sfuu\_xz$, $Sfuu\_yy$, $Sfuu\_yz$, $Sfuu\_zz$, $Tf4u\_tt$, $Tf4u\_tx$, $Tf4u\_ty$, $Tf4u\_tz$, $Tf4u\_xx$, $Tf4u\_xy$, $Tf4u\_xz$, $Tf4u\_yy$, $Tf4u\_yz$, $Tf4u\_zz$, Tu_tt, Tu_tx, Tu_ty, Tu_tz, Tu_xx, Tu_xy, Tu_xz, Tu_yy, Tu_yz, Tu_zz, rho_ADM, Jtd_ADM_x, Jtd_ADM_y, Jtd_ADM_z, $Atud\_xx$, $Atud\_xy$, $Atud\_xz$, $Atud\_yx$, $Atud\_yy$, $Atud\_yz$, $Atud\_zx$, $Atud\_zy$, $Atud\_zz$, Atu_xx, Atu_xy, Atu_xz, Atu_yy, Atu_yz, Atu_zz, Ctd_xxx, Ctd_xxy, Ctd_xxz, Ctd_xyy, Ctd_xyz, Ctd_xzz, Ctd_yxx, Ctd_yxy, Ctd_yxz, Ctd_yyy, Ctd_yyz, Ctd_yzz, Ctd_zxx, Ctd_zxy, Ctd_zxz, Ctd_zyy, Ctd_zyz, Ctd_zzz, Ct_xxx, Ct_xxy, Ct_xxz, Ct_xyy, Ct_xyz, Ct_xzz, Ct_yxx, Ct_yxy, Ct_yxz, Ct_yyy, Ct_yyz, Ct_yzz, Ct_zxx, Ct_zxy, Ct_zxz, Ct_zyy, Ct_zyz, Ct_zzz, $Gamt\_x$, $Gamt\_y$, $Gamt\_z$, Zu_x, Zu_y, Zu_z, Rpd_xx, Rpd_xy, Rpd_xz, Rpd_yy, Rpd_yz, Rpd_zz, Rtd_xx, Rtd_xy, Rtd_xz, Rtd_yy, Rtd_yz, Rtd_zz, uph_x, uph_y, uph_z, ur_x, ur_y, ur_z, $uthd\_x$, $uthd\_y$, $uthd\_z$, uth_x, uth_y, uth_z, $wphph$, vph_x, vph_y, vph_z, $wrph$, wrr, vr_x, vr_y, vr_z, $wthph$, $wthr$, $wthth$, vth_x, vth_y, vth_z, $dSigma\_x$, $dSigma\_y$, $dSigma\_z$, Td_tt, Td_tx, Td_ty, Td_tz, Td_xx, Td_xy, Td_xz, Td_yy, Td_yz, Td_zz, TT, $EWeyl\_xx$, $EWeyl\_xy$, $EWeyl\_xz$, $EWeyl\_yy$, $EWeyl\_yz$, $EWeyl\_zz$, Del_Kd_xxx, Del_Kd_xxy, Del_Kd_xxz, Del_Kd_yxx, Del_Kd_yxy, Del_Kd_yxz, Del_Kd_zxx, Del_Kd_zxy, Del_Kd_zxz, Del_Kd_xyy, Del_Kd_xyz, Del_Kd_yyy, Del_Kd_yyz, Del_Kd_zyy, Del_Kd_zyz, Del_Kd_xzz, Del_Kd_yzz, Del_Kd_zzz, $BWeyl\_xx$, $BWeyl\_xy$, $BWeyl\_xz$, $BWeyl\_yx$, $BWeyl\_yy$, $BWeyl\_yz$, $BWeyl\_zx$, $BWeyl\_zy$, $BWeyl\_zz$, mmR_xx, mmR_xy, mmR_xz, mmR_yy, mmR_yz, mmR_zz, mmI_xx, mmI_xy, mmI_xz, mmI_yy, mmI_yz, mmI_zz

Imported Models

Einstein + MHD

Region

main
Interior models
Einstein + MHD

Spatial Domain

Coordinate	Min	Max
x	-4	4
y	-4	4
z	-4	4

Initial Conditions

The condition is:

$$optdepthe = 0 \tag{1}$$

$$optdeptha = 0 \tag{2}$$

$$optdepthx = 0 \tag{3}$$

$$chie = 0 \tag{4}$$

$$chia = 0 \tag{5}$$

$$chix = 0 \tag{6}$$

Segment interactions

Interaction 1
Target segments: x-Lower, x-Upper, y-Lower, y-Upper, z-Lower, z-Upper

interaction

Analysis Field Equations

Analysis field equation

$$Rscalar = Op(x, y, z, t) \tag{7}$$

$$Op(x,y,z,t) = +(chi\ Rtd\_xx + Rpd\_xx)\ gtu\_xx + 2\ (chi\ Rtd\_xy + Rpd\_xy)\ gtu\_xy + 2\ (chi\ Rtd\_xz + Rpd\_xz)\ gtu\_xz + (chi\ Rtd\_yy + Rpd\_yy)\ gtu\_yy + 2\ (chi\ Rtd\_yz + Rpd\_yz)\ gtu\_yz + (chi\ Rtd\_zz + Rpd\_zz)\ gtu\_zz \tag{8}$$

Analysis field equation

$$HamCon = Op(x,y,z,t) \tag{9}$$

$$\begin{aligned} Op(x,y,z,t) = {} & +(-16\ \pi\ rho\_ADM) + (chi\ Rtd\_xx + Rpd\_xx)\ gtu\_xx \\ & +2\ (chi\ Rtd\_xy + Rpd\_xy)\ gtu\_xy + 2\ (chi\ Rtd\_xz + Rpd\_xz)\ gtu\_xz \\ & + (chi\ Rtd\_yy + Rpd\_yy)\ gtu\_yy + 2\ (chi\ Rtd\_yz + Rpd\_yz)\ gtu\_yz \\ & + (chi\ Rtd\_zz + Rpd\_zz)\ gtu\_zz + (-Atd\_xx\ Atu\_xx) \\ & + (-2\ Atd\_xy\ Atu\_xy) + (-2\ Atd\_xz\ Atu\_xz) \\ & + (-Atd\_yy\ Atu\_yy) + (-2\ Atd\_yz\ Atu\_yz) \\ & + (-Atd\_zz\ Atu\_zz) + 0.6666666666666667\ trK^2 \end{aligned} \tag{10}$$

Analysis field equation

$$MomCon\_x = Op(x,y,z,t) \tag{11}$$

$$\begin{aligned} Op(x,y,z,t) = {} & -Ct\_yxx\ Atud\_xy - Ct\_yxy\ Atud\_yy - Ct\_yxz\ Atud\_zy \\ & - Ct\_zxx\ Atud\_xz - Ct\_zxy\ Atud\_yz - Ct\_zxz\ Atud\_zz \\ & - Gamt\_x\ Atd\_xx - Gamt\_y\ Atd\_xy - Gamt\_z\ Atd\_xz \\ & + gtu\_xx\ \partial_x Atd\_xx + gtu\_xy\ \partial_x Atd\_xy + gtu\_xz\ \partial_x Atd\_xz \\ & + gtu\_xy\ \partial_y Atd\_xx + gtu\_yy\ \partial_y Atd\_xy + gtu\_yz\ \partial_y Atd\_xz \\ & + gtu\_xz\ \partial_z Atd\_xx + gtu\_yz\ \partial_z Atd\_xy + gtu\_zz\ \partial_z Atd\_xz \\ & - Ct\_xxx\ Atud\_xx - Ct\_xxy\ Atud\_yx - Ct\_xxz\ Atud\_zx \\ & - 1.500000000000000\ inv\_chi\ Atud\_zx\ \partial_z chi \\ & - 1.500000000000000\ inv\_chi\ Atud\_xx\ \partial_x chi \\ & - 1.500000000000000\ inv\_chi\ Atud\_yx\ \partial_y chi \\ & + (-8)\ \pi\ Jtd\_ADM\_x\ inv\_chi - 0.6666666666666667\ \partial_x trK \end{aligned} \tag{12}$$

Analysis field equation

$$MomCon\_y = Op(x, y, z, t) \tag{13}$$

$$\begin{aligned} Op(x, y, z, t) = &+ gtu\_xx\ \partial_x Atd\_xy + gtu\_xy\ \partial_x Atd\_yy + gtu\_xz\ \partial_x Atd\_yz \\ &+ gtu\_xy\ \partial_y Atd\_xy + gtu\_yy\ \partial_y Atd\_yy + gtu\_yz\ \partial_y Atd\_yz \\ &+ gtu\_xz\ \partial_z Atd\_xy + gtu\_yz\ \partial_z Atd\_yy + gtu\_zz\ \partial_z Atd\_yz \\ &- Ct\_xxy\ Atud\_xx - Ct\_xyy\ Atud\_yx - Ct\_xyz\ Atud\_zx \\ &- Ct\_yxy\ Atud\_xy - Ct\_yyy\ Atud\_yy - Ct\_yyz\ Atud\_zy \\ &- Ct\_zxy\ Atud\_xz - Ct\_zyy\ Atud\_yz - Ct\_zyz\ Atud\_zz \\ &- Gamt\_x\ Atd\_xy - Gamt\_y\ Atd\_yy - Gamt\_z\ Atd\_yz \\ &- 1.500000000000000\ inv\_chi\ Atud\_xy\ \partial_x chi \\ &- 1.500000000000000\ inv\_chi\ Atud\_yy\ \partial_y chi \\ &- 1.500000000000000\ inv\_chi\ Atud\_zy\ \partial_z chi \\ &+ (-8)\ \pi\ Jtd\_ADM\_y\ inv\_chi - 0.6666666666666667\ \partial_y trK \end{aligned} \tag{14}$$

Analysis field equation

$$MomCon\_z = Op(x, y, z, t) \tag{15}$$

$$\begin{aligned} Op(x, y, z, t) = &- 1.500000000000000\ inv\_chi\ Atud\_xz\ \partial_x chi \\ &- 1.500000000000000\ inv\_chi\ Atud\_yz\ \partial_y chi \\ &- 1.500000000000000\ inv\_chi\ Atud\_zz\ \partial_z chi \\ &+ (-8)\ \pi\ Jtd\_ADM\_z\ inv\_chi + gtu\_xx\ \partial_x Atd\_xz \\ &+ gtu\_xy\ \partial_x Atd\_yz + gtu\_xz\ \partial_x Atd\_zz + gtu\_xy\ \partial_y Atd\_xz \\ &+ gtu\_yy\ \partial_y Atd\_yz + gtu\_yz\ \partial_y Atd\_zz + gtu\_xz\ \partial_z Atd\_xz \\ &+ gtu\_yz\ \partial_z Atd\_yz + gtu\_zz\ \partial_z Atd\_zz - Ct\_xxz\ Atud\_xx \\ &- Ct\_xyz\ Atud\_yx - Ct\_xzz\ Atud\_zx - Ct\_yxz\ Atud\_xy \\ &- Ct\_yyz\ Atud\_yy - Ct\_yzz\ Atud\_zy - Ct\_zxz\ Atud\_xz \\ &- Ct\_zyz\ Atud\_yz - Ct\_zzz\ Atud\_zz - Gamt\_x\ Atd\_xz \\ &- Gamt\_y\ Atd\_yz - Gamt\_z\ Atd\_zz - 0.6666666666666667\ \partial_z trK \end{aligned} \tag{16}$$

Analysis field equation

$$trA = Op(x, y, z, t) \tag{17}$$

$$Op(x, y, z, t) = +Atud\_xx + Atud\_yy + Atud\_zz \tag{18}$$

Analysis field equation

$$detgtm1 = Op(x, y, z, t) \tag{19}$$

$$Op(x, y, z, t) = +detgtd + (-1.0) \tag{20}$$

Analysis field equation

$$M\_ADM\_surf = Op(x, y, z, t) \tag{21}$$

$$\begin{aligned} Op(x, y, z, t) = &+0.019894367886486 9\ chi\ Gamt\_x\ dSigma\_x \\ &+ 0.019894367886486 9\ chi\ Gamt\_y\ dSigma\_y \\ &+ 0.019894367886486 9\ chi\ Gamt\_z\ dSigma\_z \\ &+ 0.125\ \frac{gtu\_xx\ dSigma\_x}{\pi}\ \partial_x chi \\ &+ 0.125\ \frac{gtu\_xy\ dSigma\_x}{\pi}\ \partial_y chi + 0.125\ \frac{gtu\_xz\ dSigma\_x}{\pi}\ \partial_z chi \\ &+ 0.125\ \frac{gtu\_xy\ dSigma\_y}{\pi}\ \partial_x chi + 0.125\ \frac{gtu\_yy\ dSigma\_y}{\pi}\ \partial_y chi \\ &+ 0.125\ \frac{gtu\_yz\ dSigma\_y}{\pi}\ \partial_z chi + 0.125\ \frac{gtu\_xz\ dSigma\_z}{\pi}\ \partial_x chi \\ &+ 0.125\ \frac{gtu\_yz\ dSigma\_z}{\pi}\ \partial_y chi + 0.125\ \frac{gtu\_zz\ dSigma\_z}{\pi}\ \partial_z chi \end{aligned} \tag{22}$$

Analysis field equation

$$Jz\_ADM\_surf = Op(x, y, z, t) \tag{23}$$

$$Op(x,y,z,t) = +0.0397887357729738\ chi\ (uph\_x\ (0.3333333333333333\ trK\ gtu\_xx + Atu\_xx) + uph\_y\ (0.3333333333333333\ trK\ gtu\_xy + Atu\_xy) + uph\_z\ (0.3333333333333333\ trK\ gtu\_xz + Atu\_xz))\ dSigma\_x + 0.0397887357729738\ chi\ (uph\_x\ (0.3333333333333333\ trK\ gtu\_xy + Atu\_xy) + uph\_y\ (0.3333333333333333\ trK\ gtu\_yy + Atu\_yy) + uph\_z\ (0.3333333333333333\ trK\ gtu\_yz + Atu\_yz))\ dSigma\_y + 0.0397887357729738\ chi\ (uph\_x\ (0.3333333333333333\ trK\ gtu\_xz + Atu\_xz) + uph\_y\ (0.3333333333333333\ trK\ gtu\_yz + Atu\_yz) + uph\_z\ (0.3333333333333333\ trK\ gtu\_zz + Atu\_zz))\ dSigma\_z \tag{24}$$

Analysis field equation

$$M\_Komar = Op(x,y,z,t) \tag{25}$$

$$Op(x,y,z,t) = \tag{26}$$
$$+2\ \frac{\frac{(-0.5\ TT\ g4d\_tt)+Td\_tt}{Alpha} + \left(-\frac{((-0.5\ TT\ g4d\_tx)+Td\_tx)\ Betau\_x}{Alpha}\right) + \left(-\frac{((-0.5\ TT\ g4d\_ty)+Td\_ty)\ Betau\_y}{Alpha}\right) + \left(-\frac{((}{}\right.}{chi^{1.500000000000000}}$$

Analysis field equation

$$Jz\_Komar = Op(x,y,z,t) \tag{27}$$

$$Op(x,y,z,t) = \tag{28}$$
$$-\frac{\frac{((-0.5\ TT\ g4d\_tx)+Td\_tx)\ vph\_x}{Alpha} + \left(-\frac{((-0.5\ TT\ g4d\_xx)+Td\_xx)\ Betau\_x\ vph\_x}{Alpha}\right) + \left(-\frac{((-0.5\ TT\ g4d\_xy)+Td\_xy)\ Beta}{Alpha}\right.}{}$$

Analysis field equation

$$psi4R = Op(x,y,z,t) \tag{29}$$

$$Op(x,y,z,t) = +\max\{0.0000000001, \sqrt{x^2+y^2+z^2}\}\ ((-BWeyl\_xx\ mmI\_xx) + EWeyl\_xx\ mmR\_xx + (-BWeyl\_yx\ mmI\_xy) + 2\ EWeyl\_xy\ mmR\_xy + (-BWeyl\_zx\ mmI\_xz) + 2\ EWeyl\_xz\ mmR\_xz + (-BWeyl\_xy\ mmI\_xy) + (-BWeyl\_yy\ mmI\_yy) + EWeyl\_yy\ mmR\_yy + (-BWeyl\_zy\ mmI\_yz) + 2\ EWeyl\_yz\ mmR\_yz + (-BWeyl\_xz\ mmI\_xz) + (-BWeyl\_yz\ mmI\_yz) + (-BWeyl\_zz\ mmI\_zz) + EWeyl\_zz\ mmR\_zz) \tag{30}$$

Analysis field equation

$$psi4I = Op(x,y,z,t) \tag{31}$$

$$Op(x,y,z,t) = +\max\{0.0000000001, \sqrt{x^2+y^2+z^2}\}\ (BWeyl\_xx\ mmR\_xx + EWeyl\_xx\ mmI\_xx + BWeyl\_yx\ mmR\_xy + 2\ EWeyl\_xy\ mmI\_xy + BWeyl\_zx\ mmR\_xz + 2\ EWeyl\_xz\ mmI\_xz + BWeyl\_xy\ mmR\_xy + BWeyl\_yy\ mmR\_yy + EWeyl\_yy\ mmI\_yy + BWeyl\_zy\ mmR\_yz + 2\ EWeyl\_yz\ mmI\_yz + BWeyl\_xz\ mmR\_xz + BWeyl\_yz\ mmR\_yz + BWeyl\_zz\ mmR\_zz + EWeyl\_zz\ mmI\_zz) \tag{32}$$

Analysis field equation

$$Z\_x = Op(x,y,z,t) \tag{33}$$

$$Op(x,y,z,t) = +Zu\_x \tag{34}$$

Analysis field equation

$$Z\_y = Op(x,y,z,t) \tag{35}$$

$$Op(x,y,z,t) = +Zu\_y \tag{36}$$

Analysis field equation

$$Z\_z = Op(x, y, z, t) \tag{37}$$

$$Op(x, y, z, t) = +Zu\_z \tag{38}$$

Analysis field equation

$$flux\_mass = Op(x, y, z, t) \tag{39}$$

$$Op(x, y, z, t) = +\left(Ju\_x\ x + Ju\_y\ y + Ju\_z\ z\right)\ r\_pos\ \textbf{SIGN(}\max\{Alpha\ hf\ \sqrt{sqW} - 1, 0\}\textbf{)} \tag{40}$$

Auxiliary Analysis Equations

Auxiliary analysis variable equation

$$kappa\_cc = Op(x, y, z, t) \tag{41}$$

$$Op(x, y, z, t) = \tag{42}$$
$$+\min\{p\_kappa\_cc, p\_kappa\_cc\ \left(\frac{R\_0}{\max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}\right)^{eta\_damping\_exp}\}$$

Auxiliary analysis variable equation

$$kappa\_z1 = Op(x, y, z, t) \tag{43}$$

$$Op(x, y, z, t) = \tag{44}$$
$$+\min\{p\_kappa\_z1, p\_kappa\_z1\ \left(\frac{R\_0}{\max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}\right)^{eta\_damping\_exp}\}$$

Auxiliary analysis variable equation

$$kappa\_z2 = Op(x, y, z, t) \tag{45}$$

$$Op(x, y, z, t) = \tag{46}$$
$$+\min\{p\_kappa\_z2, p\_kappa\_z2 \left(\frac{R\_0}{\max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}\right)^{eta\_damping\_exp}\}$$

Auxiliary analysis variable equation

$$feta = Op(x, y, z, t) \tag{47}$$

$$Op(x, y, z, t)$$
$$= +\min\{p\_feta, p\_feta \left(\frac{R\_0}{\max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}\right)^{eta\_damping\_exp}\} \tag{48}$$

Auxiliary analysis variable equation

$$inv\_chi = Op(x, y, z, t) \tag{49}$$

$$Op(x, y, z, t) = +\frac{1}{|chi|} \tag{50}$$

Auxiliary analysis variable equation

$$detgtd = Op(x, y, z, t) \tag{51}$$

$$Op(x, y, z, t) = +gtd\_yy\ gtd\_zz\ gtd\_xx + (-gtd\_yy\ gtd\_xz^2) + (-gtd\_zz\ gtd\_xy^2) + (-gtd\_yz^2\ gtd\_xx) + 2\ gtd\_yz\ gtd\_xy\ gtd\_xz \tag{52}$$

Auxiliary analysis variable equation

$$idetgtd = Op(x, y, z, t) \tag{53}$$

$$Op(x, y, z, t) = +\frac{1}{detgtd} \tag{54}$$

Auxiliary analysis variable equation

$$gtu\_xx = Op(x, y, z, t) \tag{55}$$

$$Op(x, y, z, t) = +idetgtd\ \ (gtd\_yy\ gtd\_zz - gtd\_yz^2) \tag{56}$$

Auxiliary analysis variable equation

$$gtu\_xy = Op(x, y, z, t) \tag{57}$$

$$Op(x, y, z, t) = +idetgtd\ \ ((-gtd\_xy\ gtd\_zz) + gtd\_yz\ gtd\_xz) \tag{58}$$

Auxiliary analysis variable equation

$$gtu\_xz = Op(x, y, z, t) \tag{59}$$

$$Op(x, y, z, t) = +idetgtd\ \ (gtd\_xy\ gtd\_yz - gtd\_yy\ gtd\_xz) \tag{60}$$

Auxiliary analysis variable equation

$$gtu\_yy = Op(x, y, z, t) \tag{61}$$

$$Op(x, y, z, t) = +idetgtd\ \ (gtd\_xx\ gtd\_zz - gtd\_xz^2) \tag{62}$$

Auxiliary analysis variable equation

$$gtu\_yz = Op(x, y, z, t) \tag{63}$$

$$Op(x, y, z, t) = +idetgtd\ \ ((-gtd\_xx\ gtd\_yz) + gtd\_xy\ gtd\_xz) \tag{64}$$

Auxiliary analysis variable equation

$$gtu\_zz = Op(x, y, z, t) \tag{65}$$

$$Op(x, y, z, t) = +idetgtd\ \ (gtd\_xx\ gtd\_yy - gtd\_xy^2) \tag{66}$$

Auxiliary analysis variable equation

$$g4d\_tt = Op(x, y, z, t) \tag{67}$$

$$\begin{aligned} Op(x, y, z, t) = +(-Alpha^2) + inv\_chi\ \ (&gtd\_xx\ Betau\_x^2 \\ &+ 2\ gtd\_xy\ Betau\_y\ Betau\_x + 2\ gtd\_xz\ Betau\_z\ Betau\_x \\ &+ gtd\_yy\ Betau\_y^2 + 2\ gtd\_yz\ Betau\_z\ Betau\_y + gtd\_zz\ Betau\_z^2) \end{aligned} \tag{68}$$

Auxiliary analysis variable equation

$$g4d\_tx = Op(x, y, z, t) \tag{69}$$

$$Op(x, y, z, t) = +inv\_chi\ \ (gtd\_xx\ Betau\_x + gtd\_xy\ Betau\_y + gtd\_xz\ Betau\_z) \tag{70}$$

Auxiliary analysis variable equation

$$g4d\_ty = Op(x, y, z, t) \tag{71}$$

$$Op(x, y, z, t) = +inv\_chi\ \ (gtd\_xy\ Betau\_x + gtd\_yy\ Betau\_y + gtd\_yz\ Betau\_z) \tag{72}$$

Auxiliary analysis variable equation

$$g4d\_tz = Op(x, y, z, t) \tag{73}$$

$$Op(x, y, z, t) = +inv\_chi \ \ (gtd\_xz \ Betau\_x + gtd\_yz \ Betau\_y + gtd\_zz \ Betau\_z) \tag{74}$$

Auxiliary analysis variable equation

$$g4d\_xx = Op(x, y, z, t) \tag{75}$$

$$Op(x, y, z, t) = +inv\_chi \ gtd\_xx \tag{76}$$

Auxiliary analysis variable equation

$$g4d\_xy = Op(x, y, z, t) \tag{77}$$

$$Op(x, y, z, t) = +inv\_chi \ gtd\_xy \tag{78}$$

Auxiliary analysis variable equation

$$g4d\_xz = Op(x, y, z, t) \tag{79}$$

$$Op(x, y, z, t) = +inv\_chi \ gtd\_xz \tag{80}$$

Auxiliary analysis variable equation

$$g4d\_yy = Op(x, y, z, t) \tag{81}$$

$$Op(x, y, z, t) = +inv\_chi \ gtd\_yy \tag{82}$$

Auxiliary analysis variable equation

$$g4d\_yz = Op(x, y, z, t) \tag{83}$$

$$Op(x, y, z, t) = +inv\_chi\ gtd\_yz \tag{84}$$

Auxiliary analysis variable equation

$$g4d\_zz = Op(x, y, z, t) \tag{85}$$

$$Op(x, y, z, t) = +inv\_chi\ gtd\_zz \tag{86}$$

Auxiliary analysis variable equation

$$g4u\_tt = Op(x, y, z, t) \tag{87}$$

$$Op(x, y, z, t) = -\frac{1}{Alpha^2} \tag{88}$$

Auxiliary analysis variable equation

$$g4u\_tx = Op(x, y, z, t) \tag{89}$$

$$Op(x, y, z, t) = +\frac{Betau\_x}{Alpha^2} \tag{90}$$

Auxiliary analysis variable equation

$$g4u\_ty = Op(x, y, z, t) \tag{91}$$

$$Op(x, y, z, t) = +\frac{Betau\_y}{Alpha^2} \tag{92}$$

Auxiliary analysis variable equation

$$g4u\_tz = Op(x, y, z, t) \tag{93}$$

$$Op(x, y, z, t) = +\frac{Betau\_z}{Alpha^2} \tag{94}$$

Auxiliary analysis variable equation

$$g4u\_xx = Op(x, y, z, t) \tag{95}$$

$$Op(x, y, z, t) = +chi\ gtu\_xx + \left(-\frac{Betau\_x^2}{Alpha^2}\right) \tag{96}$$

Auxiliary analysis variable equation

$$g4u\_xy = Op(x, y, z, t) \tag{97}$$

$$Op(x, y, z, t) = +chi\ gtu\_xy + \left(-\frac{Betau\_x\ Betau\_y}{Alpha^2}\right) \tag{98}$$

Auxiliary analysis variable equation

$$g4u\_xz = Op(x, y, z, t) \tag{99}$$

$$Op(x, y, z, t) = +chi\ gtu\_xz + \left(-\frac{Betau\_x\ Betau\_z}{Alpha^2}\right) \tag{100}$$

Auxiliary analysis variable equation

$$g4u\_yy = Op(x, y, z, t) \tag{101}$$

$$Op(x, y, z, t) = +chi\ gtu\_yy + \left(-\frac{Betau\_y^2}{Alpha^2}\right) \tag{102}$$

Auxiliary analysis variable equation

$$g4u\_yz = Op(x, y, z, t) \tag{103}$$

$$Op(x, y, z, t) = +chi\ gtu\_yz + \left(-\frac{Betau\_y\ Betau\_z}{Alpha^2}\right) \tag{104}$$

Auxiliary analysis variable equation

$$g4u\_zz = Op(x, y, z, t) \tag{105}$$

$$Op(x, y, z, t) = +chi\ gtu\_zz + \left(-\frac{Betau\_z^2}{Alpha^2}\right) \tag{106}$$

Auxiliary analysis variable equation

$$sdetg = Op(x, y, z, t) \tag{107}$$

$$Op(x, y, z, t) = +chi^{(-1.500000000000000)} \tag{108}$$

Auxiliary analysis variable equation

$$r\_pos = Op(x, y, z, t) \tag{109}$$

$$Op(x, y, z, t) = +\max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\} \tag{110}$$

Auxiliary analysis variable equation

$$Ju\_x = Op(x, y, z, t) \tag{111}$$

$$Op(x, y, z, t) = +Df\ \ (Alpha\ vfu\_x - Betau\_x) \tag{112}$$

Auxiliary analysis variable equation

$$Ju\_y = Op(x, y, z, t) \tag{113}$$

$$Op(x, y, z, t) = +Df \ \ (Alpha \ vfu\_y - Betau\_y) \tag{114}$$

Auxiliary analysis variable equation

$$Ju\_z = Op(x, y, z, t) \tag{115}$$

$$Op(x, y, z, t) = +Df \ \ (Alpha \ vfu\_z - Betau\_z) \tag{116}$$

Auxiliary analysis variable equation

$$hf = Op(x, y, z, t) \tag{117}$$

$$Op(x, y, z, t) = +\rho f \ \ (1.0 + epsf) + pf \tag{118}$$

Auxiliary analysis variable equation

$$vfu\_x = Op(x, y, z, t) \tag{119}$$

$$Op(x, y, z, t) = +chi \ gtu\_xx \ vfd\_x + chi \ gtu\_xy \ vfd\_y + chi \ gtu\_xz \ vfd\_z \tag{120}$$

Auxiliary analysis variable equation

$$vfu\_y = Op(x, y, z, t) \tag{121}$$

$$Op(x, y, z, t) = +chi \ gtu\_xy \ vfd\_x + chi \ gtu\_yy \ vfd\_y + chi \ gtu\_yz \ vfd\_z \tag{122}$$

Auxiliary analysis variable equation

$$vfu\_z = Op(x, y, z, t) \tag{123}$$

$$Op(x, y, z, t) = +chi\ gtu\_xz\ vfd\_x + chi\ gtu\_yz\ vfd\_y + chi\ gtu\_zz\ vfd\_z \tag{124}$$

Auxiliary analysis variable equation

$$Bfd\_x = Op(x, y, z, t) \tag{125}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +inv\_chi\ gtd\_xx\ Bfu\_x + inv\_chi\ gtd\_xy\ Bfu\_y \\ & + inv\_chi\ gtd\_xz\ Bfu\_z \end{aligned} \tag{126}$$

Auxiliary analysis variable equation

$$Bfd\_y = Op(x, y, z, t) \tag{127}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +inv\_chi\ gtd\_xy\ Bfu\_x + inv\_chi\ gtd\_yy\ Bfu\_y \\ & + inv\_chi\ gtd\_yz\ Bfu\_z \end{aligned} \tag{128}$$

Auxiliary analysis variable equation

$$Bfd\_z = Op(x, y, z, t) \tag{129}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +inv\_chi\ gtd\_xz\ Bfu\_x + inv\_chi\ gtd\_yz\ Bfu\_y \\ & + inv\_chi\ gtd\_zz\ Bfu\_z \end{aligned} \tag{130}$$

Auxiliary analysis variable equation

$$Sfu\_x = Op(x, y, z, t) \tag{131}$$

$$Op(x, y, z, t) = +chi\ gtu\_xx\ Sfd\_x + chi\ gtu\_xy\ Sfd\_y + chi\ gtu\_xz\ Sfd\_z \tag{132}$$

Auxiliary analysis variable equation

$$Sfu\_y = Op(x, y, z, t) \tag{133}$$

$$Op(x, y, z, t) = +chi\ gtu\_xy\ Sfd\_x + chi\ gtu\_yy\ Sfd\_y + chi\ gtu\_yz\ Sfd\_z \tag{134}$$

Auxiliary analysis variable equation

$$Sfu\_z = Op(x, y, z, t) \tag{135}$$

$$Op(x, y, z, t) = +chi\ gtu\_xz\ Sfd\_x + chi\ gtu\_yz\ Sfd\_y + chi\ gtu\_zz\ Sfd\_z \tag{136}$$

Auxiliary analysis variable equation

$$sqvf = Op(x, y, z, t) \tag{137}$$

$$Op(x, y, z, t) = +vfu\_x\ vfd\_x + vfu\_y\ vfd\_y + vfu\_z\ vfd\_z \tag{138}$$

Auxiliary analysis variable equation

$$sqBf = Op(x, y, z, t) \tag{139}$$

$$Op(x, y, z, t) = +Bfu\_x\ Bfd\_x + Bfu\_y\ Bfd\_y + Bfu\_z\ Bfd\_z \tag{140}$$

Auxiliary analysis variable equation

$$Bfvf = Op(x, y, z, t) \tag{141}$$

$$Op(x, y, z, t) = +Bfu\_x\ vfd\_x + Bfu\_y\ vfd\_y + Bfu\_z\ vfd\_z \tag{142}$$

Auxiliary analysis variable equation

$$sqW = Op(x, y, z, t) \tag{143}$$

$$Op(x, y, z, t) = +\frac{1}{1.0 - sqvf} \tag{144}$$

Auxiliary analysis variable equation

$$Sfuu\_xx = Op(x, y, z, t) \tag{145}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +1.0\ Sfu\_x\ vfu\_x + chi\ gtu\_xx\ sdetg\ pf \\ & + \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_xx) + Bfu\_x^2}{sdetg\ sqW} \right) \\ & + \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_xx) + 2\ Bfu\_x\ vfu\_x)}{sdetg} \right) \end{aligned} \tag{146}$$

Auxiliary analysis variable equation

$$Sfuu\_xy = Op(x, y, z, t) \tag{147}$$

$$\begin{aligned} & Op(x, y, z, t) \\ & \quad = +0.5\ Sfu\_x\ vfu\_y + 0.5\ Sfu\_y\ vfu\_x + chi\ gtu\_xy\ sdetg\ pf \\ & \qquad + \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_xy) + Bfu\_x\ Bfu\_y}{sdetg\ sqW} \right) \\ & \qquad + \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_xy) + Bfu\_x\ vfu\_y + Bfu\_y\ vfu\_x)}{sdetg} \right) \end{aligned} \tag{148}$$

Auxiliary analysis variable equation

$$Sfuu\_xz = Op(x, y, z, t) \tag{149}$$

$$
\begin{aligned}
&Op(x,y,z,t)\\
&\quad = +0.5\ Sfu\_x\ vfu\_z + 0.5\ Sfu\_z\ vfu\_x + chi\ gtu\_xz\ sdetg\ pf\\
&\qquad + \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_xz) + Bfu\_x\ Bfu\_z}{sdetg\ sqW} \right)\\
&\qquad + \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_xz) + Bfu\_x\ vfu\_z + Bfu\_z\ vfu\_x)}{sdetg} \right)
\end{aligned}
\tag{150}
$$

Auxiliary analysis variable equation

$$Sfuu\_yy = Op(x,y,z,t) \tag{151}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+1.0\ Sfu\_y\ vfu\_y + chi\ gtu\_yy\ sdetg\ pf\\
&+ \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_yy) + Bfu\_y^2}{sdetg\ sqW} \right)\\
&+ \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_yy) + 2\ Bfu\_y\ vfu\_y)}{sdetg} \right)
\end{aligned}
\tag{152}
$$

Auxiliary analysis variable equation

$$Sfuu\_yz = Op(x,y,z,t) \tag{153}$$

$$
\begin{aligned}
&Op(x,y,z,t)\\
&\quad = +0.5\ Sfu\_y\ vfu\_z + 0.5\ Sfu\_z\ vfu\_y + chi\ gtu\_yz\ sdetg\ pf\\
&\qquad + \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_yz) + Bfu\_y\ Bfu\_z}{sdetg\ sqW} \right)\\
&\qquad + \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_yz) + Bfu\_y\ vfu\_z + Bfu\_z\ vfu\_y)}{sdetg} \right)
\end{aligned}
\tag{154}
$$

Auxiliary analysis variable equation

$$Sfuu\_zz = Op(x,y,z,t) \tag{155}$$

$$Op(x,y,z,t) = +1.0\ Sfu\_z\ vfu\_z + chi\ gtu\_zz\ sdetg\ pf + \left(-\frac{(-0.5\ chi\ sqBf\ gtu\_zz) + Bfu\_z^2}{sdetg\ sqW}\right) + \left(-0.5\ \frac{Bfvf\ \ ((-Bfvf\ chi\ gtu\_zz) + 2\ Bfu\_z\ vfu\_z)}{sdetg}\right) \tag{156}$$

Auxiliary analysis variable equation

$$Tf4u\_tt = Op(x,y,z,t) \tag{157}$$

$$Op(x,y,z,t) = +\frac{Df + tauf}{sdetg\ Alpha^2} \tag{158}$$

Auxiliary analysis variable equation

$$Tf4u\_tx = Op(x,y,z,t) \tag{159}$$

$$Op(x,y,z,t) = +\frac{Sfu\_x}{sdetg\ Alpha} + (-Betau\_x\ Tf4u\_tt) \tag{160}$$

Auxiliary analysis variable equation

$$Tf4u\_ty = Op(x,y,z,t) \tag{161}$$

$$Op(x,y,z,t) = +\frac{Sfu\_y}{sdetg\ Alpha} + (-Betau\_y\ Tf4u\_tt) \tag{162}$$

Auxiliary analysis variable equation

$$Tf4u\_tz = Op(x,y,z,t) \tag{163}$$

$$Op(x,y,z,t) = +\frac{Sfu\_z}{sdetg\ Alpha} + (-Betau\_z\ Tf4u\_tt) \tag{164}$$

Auxiliary analysis variable equation

$$Tf4u\_xx = Op(x, y, z, t) \tag{165}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_xx}{sdetg} + \left(-\frac{Sfu\_x\ Betau\_x}{sdetg\ Alpha}\right) + (-Betau\_x\ Tf4u\_tx) \tag{166}$$

Auxiliary analysis variable equation

$$Tf4u\_xy = Op(x, y, z, t) \tag{167}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_xy}{sdetg} + \left(-\frac{Sfu\_x\ Betau\_y}{sdetg\ Alpha}\right) + (-Betau\_x\ Tf4u\_ty) \tag{168}$$

Auxiliary analysis variable equation

$$Tf4u\_xz = Op(x, y, z, t) \tag{169}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_xz}{sdetg} + \left(-\frac{Sfu\_x\ Betau\_z}{sdetg\ Alpha}\right) + (-Betau\_x\ Tf4u\_tz) \tag{170}$$

Auxiliary analysis variable equation

$$Tf4u\_yy = Op(x, y, z, t) \tag{171}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_yy}{sdetg} + \left(-\frac{Sfu\_y\ Betau\_y}{sdetg\ Alpha}\right) + (-Betau\_y\ Tf4u\_ty) \tag{172}$$

Auxiliary analysis variable equation

$$Tf4u\_yz = Op(x, y, z, t) \tag{173}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_yz}{sdetg} + \left(-\frac{Sfu\_y\ Betau\_z}{sdetg\ Alpha}\right) + (-Betau\_y\ Tf4u\_tz) \tag{174}$$

Auxiliary analysis variable equation

$$Tf4u\_zz = Op(x, y, z, t) \tag{175}$$

$$Op(x, y, z, t) = +\frac{Sfuu\_zz}{sdetg} + \left(-\frac{Sfu\_z\ Betau\_z}{sdetg\ Alpha}\right) + (-Betau\_z\ Tf4u\_tz) \tag{176}$$

Auxiliary analysis variable equation

$$Tu\_tt = Op(x, y, z, t) \tag{177}$$

$$Op(x, y, z, t) = +Tf4u\_tt \tag{178}$$

Auxiliary analysis variable equation

$$Tu\_tx = Op(x, y, z, t) \tag{179}$$

$$Op(x, y, z, t) = +Tf4u\_tx \tag{180}$$

Auxiliary analysis variable equation

$$Tu\_ty = Op(x, y, z, t) \tag{181}$$

$$Op(x, y, z, t) = +Tf4u\_ty \tag{182}$$

Auxiliary analysis variable equation

$$Tu\_tz = Op(x, y, z, t) \tag{183}$$

$$Op(x, y, z, t) = +Tf4u\_tz \tag{184}$$

Auxiliary analysis variable equation

$$Tu\_xx = Op(x, y, z, t) \tag{185}$$

$$Op(x, y, z, t) = +Tf4u\_xx \tag{186}$$

Auxiliary analysis variable equation

$$Tu\_xy = Op(x, y, z, t) \tag{187}$$

$$Op(x, y, z, t) = +Tf4u\_xy \tag{188}$$

Auxiliary analysis variable equation

$$Tu\_xz = Op(x, y, z, t) \tag{189}$$

$$Op(x, y, z, t) = +Tf4u\_xz \tag{190}$$

Auxiliary analysis variable equation

$$Tu\_yy = Op(x, y, z, t) \tag{191}$$

$$Op(x, y, z, t) = +Tf4u\_yy \tag{192}$$

Auxiliary analysis variable equation

$$Tu\_yz = Op(x, y, z, t) \tag{193}$$

$$Op(x,y,z,t) = +Tf_4u\_yz \tag{194}$$

Auxiliary analysis variable equation

$$Tu\_zz = Op(x,y,z,t) \tag{195}$$

$$Op(x,y,z,t) = +Tf_4u\_zz \tag{196}$$

Auxiliary analysis variable equation

$$rho\_ADM = Op(x,y,z,t) \tag{197}$$

$$Op(x,y,z,t) = +Alpha^2\ Tu\_tt \tag{198}$$

Auxiliary analysis variable equation

$$Jtd\_ADM\_x = Op(x,y,z,t) \tag{199}$$

$$\begin{aligned} Op(x,y,z,t) = +Alpha\ \ ((Betau\_x\ Tu\_tt + Tu\_tx)\ \ gtd\_xx \\ + (Betau\_y\ Tu\_tt + Tu\_ty)\ \ gtd\_xy \\ + (Betau\_z\ Tu\_tt + Tu\_tz)\ \ gtd\_xz) \end{aligned} \tag{200}$$

Auxiliary analysis variable equation

$$Jtd\_ADM\_y = Op(x,y,z,t) \tag{201}$$

$$\begin{aligned} Op(x,y,z,t) = +Alpha\ \ ((Betau\_x\ Tu\_tt + Tu\_tx)\ \ gtd\_xy \\ +(Betau\_y\ Tu\_tt+Tu\_ty)\ \ gtd\_yy+(Betau\_z\ Tu\_tt+Tu\_tz)\ \ gtd\_yz) \end{aligned} \tag{202}$$

Auxiliary analysis variable equation

$$Jtd\_ADM\_z = Op(x, y, z, t) \tag{203}$$

$$\begin{aligned} Op(x, y, z, t) = +Alpha\ \ &((Betau\_x\ Tu\_tt + Tu\_tx)\ \ gtd\_xz \\ &+(Betau\_y\ Tu\_tt+Tu\_ty)\ \ gtd\_yz+(Betau\_z\ Tu\_tt+Tu\_tz)\ \ gtd\_zz) \end{aligned} \tag{204}$$

Auxiliary analysis variable equation

$$Atud\_xx = Op(x, y, z, t) \tag{205}$$

$$Op(x, y, z, t) = +gtu\_xx\ Atd\_xx + gtu\_xy\ Atd\_xy + gtu\_xz\ Atd\_xz \tag{206}$$

Auxiliary analysis variable equation

$$Atud\_xy = Op(x, y, z, t) \tag{207}$$

$$Op(x, y, z, t) = +gtu\_xx\ Atd\_xy + gtu\_xy\ Atd\_yy + gtu\_xz\ Atd\_yz \tag{208}$$

Auxiliary analysis variable equation

$$Atud\_xz = Op(x, y, z, t) \tag{209}$$

$$Op(x, y, z, t) = +gtu\_xx\ Atd\_xz + gtu\_xy\ Atd\_yz + gtu\_xz\ Atd\_zz \tag{210}$$

Auxiliary analysis variable equation

$$Atud\_yx = Op(x, y, z, t) \tag{211}$$

$$Op(x, y, z, t) = +gtu\_xy\ Atd\_xx + gtu\_yy\ Atd\_xy + gtu\_yz\ Atd\_xz \tag{212}$$

Auxiliary analysis variable equation

$$Atud\_yy = Op(x, y, z, t) \tag{213}$$

$$Op(x, y, z, t) = +gtu\_xy\ Atd\_xy + gtu\_yy\ Atd\_yy + gtu\_yz\ Atd\_yz \tag{214}$$

Auxiliary analysis variable equation

$$Atud\_yz = Op(x, y, z, t) \tag{215}$$

$$Op(x, y, z, t) = +gtu\_xy\ Atd\_xz + gtu\_yy\ Atd\_yz + gtu\_yz\ Atd\_zz \tag{216}$$

Auxiliary analysis variable equation

$$Atud\_zx = Op(x, y, z, t) \tag{217}$$

$$Op(x, y, z, t) = +gtu\_xz\ Atd\_xx + gtu\_yz\ Atd\_xy + gtu\_zz\ Atd\_xz \tag{218}$$

Auxiliary analysis variable equation

$$Atud\_zy = Op(x, y, z, t) \tag{219}$$

$$Op(x, y, z, t) = +gtu\_xz\ Atd\_xy + gtu\_yz\ Atd\_yy + gtu\_zz\ Atd\_yz \tag{220}$$

Auxiliary analysis variable equation

$$Atud\_zz = Op(x, y, z, t) \tag{221}$$

$$Op(x, y, z, t) = +gtu\_xz\ Atd\_xz + gtu\_yz\ Atd\_yz + gtu\_zz\ Atd\_zz \tag{222}$$

Auxiliary analysis variable equation

$$Atu\_xx = Op(x, y, z, t) \tag{223}$$

$$Op(x,y,z,t) = +Atud\_xx\ gtu\_xx + Atud\_xy\ gtu\_xy + Atud\_xz\ gtu\_xz \quad (224)$$

Auxiliary analysis variable equation

$$Atu\_xy = Op(x,y,z,t) \quad (225)$$

$$Op(x,y,z,t) = +Atud\_xx\ gtu\_xy + Atud\_xy\ gtu\_yy + Atud\_xz\ gtu\_yz \quad (226)$$

Auxiliary analysis variable equation

$$Atu\_xz = Op(x,y,z,t) \quad (227)$$

$$Op(x,y,z,t) = +Atud\_xx\ gtu\_xz + Atud\_xy\ gtu\_yz + Atud\_xz\ gtu\_zz \quad (228)$$

Auxiliary analysis variable equation

$$Atu\_yy = Op(x,y,z,t) \quad (229)$$

$$Op(x,y,z,t) = +Atud\_yx\ gtu\_xy + Atud\_yy\ gtu\_yy + Atud\_yz\ gtu\_yz \quad (230)$$

Auxiliary analysis variable equation

$$Atu\_yz = Op(x,y,z,t) \quad (231)$$

$$Op(x,y,z,t) = +Atud\_yx\ gtu\_xz + Atud\_yy\ gtu\_yz + Atud\_yz\ gtu\_zz \quad (232)$$

Auxiliary analysis variable equation

$$Atu\_zz = Op(x,y,z,t) \quad (233)$$

$$Op(x,y,z,t) = +Atud\_zx\ gtu\_xz + Atud\_zy\ gtu\_yz + Atud\_zz\ gtu\_zz \quad (234)$$

Auxiliary analysis variable equation

$$Ctd\_xxx = Op(x, y, z, t) \tag{235}$$

$$Op(x, y, z, t) = +0.5\ \partial_x gtd\_xx \tag{236}$$

Auxiliary analysis variable equation

$$Ctd\_xxy = Op(x, y, z, t) \tag{237}$$

$$Op(x, y, z, t) = +0.5\ \partial_y gtd\_xx \tag{238}$$

Auxiliary analysis variable equation

$$Ctd\_xxz = Op(x, y, z, t) \tag{239}$$

$$Op(x, y, z, t) = +0.5\ \partial_z gtd\_xx \tag{240}$$

Auxiliary analysis variable equation

$$Ctd\_xyy = Op(x, y, z, t) \tag{241}$$

$$Op(x, y, z, t) = +1.0\ \partial_y gtd\_xy - 0.5\ \partial_x gtd\_yy \tag{242}$$

Auxiliary analysis variable equation

$$Ctd\_xyz = Op(x, y, z, t) \tag{243}$$

$$Op(x, y, z, t) = +0.5\ \partial_y gtd\_xz + 0.5\ \partial_z gtd\_xy - 0.5\ \partial_x gtd\_yz \tag{244}$$

Auxiliary analysis variable equation

$$Ctd\_xzz = Op(x, y, z, t) \tag{245}$$

$$Op(x,y,z,t) = +1.0\ \partial_z gtd\_xz - 0.5\ \partial_x gtd\_zz \tag{246}$$

Auxiliary analysis variable equation

$$Ctd\_yxx = Op(x,y,z,t) \tag{247}$$

$$Op(x,y,z,t) = +1.0\ \partial_x gtd\_xy - 0.5\ \partial_y gtd\_xx \tag{248}$$

Auxiliary analysis variable equation

$$Ctd\_yxy = Op(x,y,z,t) \tag{249}$$

$$Op(x,y,z,t) = +0.5\ \partial_x gtd\_yy \tag{250}$$

Auxiliary analysis variable equation

$$Ctd\_yxz = Op(x,y,z,t) \tag{251}$$

$$Op(x,y,z,t) = +0.5\ \partial_x gtd\_yz + 0.5\ \partial_z gtd\_xy - 0.5\ \partial_y gtd\_xz \tag{252}$$

Auxiliary analysis variable equation

$$Ctd\_yyy = Op(x,y,z,t) \tag{253}$$

$$Op(x,y,z,t) = +0.5\ \partial_y gtd\_yy \tag{254}$$

Auxiliary analysis variable equation

$$Ctd\_yyz = Op(x,y,z,t) \tag{255}$$

$$Op(x,y,z,t) = +0.5\ \partial_z gtd\_yy \tag{256}$$

Auxiliary analysis variable equation

$$Ctd\_yzz = Op(x, y, z, t) \tag{257}$$

$$Op(x, y, z, t) = +1.0\ \partial_z gtd\_yz - 0.5\ \partial_y gtd\_zz \tag{258}$$

Auxiliary analysis variable equation

$$Ctd\_zxx = Op(x, y, z, t) \tag{259}$$

$$Op(x, y, z, t) = +1.0\ \partial_x gtd\_xz - 0.5\ \partial_z gtd\_xx \tag{260}$$

Auxiliary analysis variable equation

$$Ctd\_zxy = Op(x, y, z, t) \tag{261}$$

$$Op(x, y, z, t) = +0.5\ \partial_x gtd\_yz + 0.5\ \partial_y gtd\_xz - 0.5\ \partial_z gtd\_xy \tag{262}$$

Auxiliary analysis variable equation

$$Ctd\_zxz = Op(x, y, z, t) \tag{263}$$

$$Op(x, y, z, t) = +0.5\ \partial_x gtd\_zz \tag{264}$$

Auxiliary analysis variable equation

$$Ctd\_zyy = Op(x, y, z, t) \tag{265}$$

$$Op(x, y, z, t) = +1.0\ \partial_y gtd\_yz - 0.5\ \partial_z gtd\_yy \tag{266}$$

Auxiliary analysis variable equation

$$Ctd\_zyz = Op(x, y, z, t) \tag{267}$$

$$Op(x,y,z,t) = +0.5\ \partial_y gtd\_zz \tag{268}$$

Auxiliary analysis variable equation

$$Ctd\_zzz = Op(x,y,z,t) \tag{269}$$

$$Op(x,y,z,t) = +0.5\ \partial_z gtd\_zz \tag{270}$$

Auxiliary analysis variable equation

$$Ct\_xxx = Op(x,y,z,t) \tag{271}$$

$$Op(x,y,z,t) = +gtu\_xx\ Ctd\_xxx + gtu\_xy\ Ctd\_yxx + gtu\_xz\ Ctd\_zxx \tag{272}$$

Auxiliary analysis variable equation

$$Ct\_xxy = Op(x,y,z,t) \tag{273}$$

$$Op(x,y,z,t) = +gtu\_xx\ Ctd\_xxy + gtu\_xy\ Ctd\_yxy + gtu\_xz\ Ctd\_zxy \tag{274}$$

Auxiliary analysis variable equation

$$Ct\_xxz = Op(x,y,z,t) \tag{275}$$

$$Op(x,y,z,t) = +gtu\_xx\ Ctd\_xxz + gtu\_xy\ Ctd\_yxz + gtu\_xz\ Ctd\_zxz \tag{276}$$

Auxiliary analysis variable equation

$$Ct\_xyy = Op(x,y,z,t) \tag{277}$$

$$Op(x,y,z,t) = +gtu\_xx\ Ctd\_xyy + gtu\_xy\ Ctd\_yyy + gtu\_xz\ Ctd\_zyy \tag{278}$$

Auxiliary analysis variable equation

$$Ct\_xyz = Op(x, y, z, t) \tag{279}$$

$$Op(x, y, z, t) = +gtu\_xx\ Ctd\_xyz + gtu\_xy\ Ctd\_yyz + gtu\_xz\ Ctd\_zyz \tag{280}$$

Auxiliary analysis variable equation

$$Ct\_xzz = Op(x, y, z, t) \tag{281}$$

$$Op(x, y, z, t) = +gtu\_xx\ Ctd\_xzz + gtu\_xy\ Ctd\_yzz + gtu\_xz\ Ctd\_zzz \tag{282}$$

Auxiliary analysis variable equation

$$Ct\_yxx = Op(x, y, z, t) \tag{283}$$

$$Op(x, y, z, t) = +gtu\_xy\ Ctd\_xxx + gtu\_yy\ Ctd\_yxx + gtu\_yz\ Ctd\_zxx \tag{284}$$

Auxiliary analysis variable equation

$$Ct\_yxy = Op(x, y, z, t) \tag{285}$$

$$Op(x, y, z, t) = +gtu\_xy\ Ctd\_xxy + gtu\_yy\ Ctd\_yxy + gtu\_yz\ Ctd\_zxy \tag{286}$$

Auxiliary analysis variable equation

$$Ct\_yxz = Op(x, y, z, t) \tag{287}$$

$$Op(x, y, z, t) = +gtu\_xy\ Ctd\_xxz + gtu\_yy\ Ctd\_yxz + gtu\_yz\ Ctd\_zxz \tag{288}$$

Auxiliary analysis variable equation

$$Ct\_yyy = Op(x, y, z, t) \tag{289}$$

$$Op(x,y,z,t) = +gtu\_xy\ Ctd\_xyy + gtu\_yy\ Ctd\_yyy + gtu\_yz\ Ctd\_zyy \quad (290)$$

Auxiliary analysis variable equation

$$Ct\_yyz = Op(x,y,z,t) \quad (291)$$

$$Op(x,y,z,t) = +gtu\_xy\ Ctd\_xyz + gtu\_yy\ Ctd\_yyz + gtu\_yz\ Ctd\_zyz \quad (292)$$

Auxiliary analysis variable equation

$$Ct\_yzz = Op(x,y,z,t) \quad (293)$$

$$Op(x,y,z,t) = +gtu\_xy\ Ctd\_xzz + gtu\_yy\ Ctd\_yzz + gtu\_yz\ Ctd\_zzz \quad (294)$$

Auxiliary analysis variable equation

$$Ct\_zxx = Op(x,y,z,t) \quad (295)$$

$$Op(x,y,z,t) = +gtu\_xz\ Ctd\_xxx + gtu\_yz\ Ctd\_yxx + gtu\_zz\ Ctd\_zxx \quad (296)$$

Auxiliary analysis variable equation

$$Ct\_zxy = Op(x,y,z,t) \quad (297)$$

$$Op(x,y,z,t) = +gtu\_xz\ Ctd\_xxy + gtu\_yz\ Ctd\_yxy + gtu\_zz\ Ctd\_zxy \quad (298)$$

Auxiliary analysis variable equation

$$Ct\_zxz = Op(x,y,z,t) \quad (299)$$

$$Op(x,y,z,t) = +gtu\_xz\ Ctd\_xxz + gtu\_yz\ Ctd\_yxz + gtu\_zz\ Ctd\_zxz \quad (300)$$

Auxiliary analysis variable equation

$$Ct\_zyy = Op(x, y, z, t) \tag{301}$$

$$Op(x, y, z, t) = +gtu\_xz\ Ctd\_xyy + gtu\_yz\ Ctd\_yyy + gtu\_zz\ Ctd\_zyy \tag{302}$$

Auxiliary analysis variable equation

$$Ct\_zyz = Op(x, y, z, t) \tag{303}$$

$$Op(x, y, z, t) = +gtu\_xz\ Ctd\_xyz + gtu\_yz\ Ctd\_yyz + gtu\_zz\ Ctd\_zyz \tag{304}$$

Auxiliary analysis variable equation

$$Ct\_zzz = Op(x, y, z, t) \tag{305}$$

$$Op(x, y, z, t) = +gtu\_xz\ Ctd\_xzz + gtu\_yz\ Ctd\_yzz + gtu\_zz\ Ctd\_zzz \tag{306}$$

Auxiliary analysis variable equation

$$Gamt\_x = Op(x, y, z, t) \tag{307}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +gtu\_xx\ Ct\_xxx + 2\ gtu\_xy\ Ct\_xxy + 2\ gtu\_xz\ Ct\_xxz \\ & + gtu\_yy\ Ct\_xyy + 2\ gtu\_yz\ Ct\_xyz + gtu\_zz\ Ct\_xzz \end{aligned} \tag{308}$$

Auxiliary analysis variable equation

$$Gamt\_y = Op(x, y, z, t) \tag{309}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +gtu\_xx\ Ct\_yxx + 2\ gtu\_xy\ Ct\_yxy + 2\ gtu\_xz\ Ct\_yxz \\ & + gtu\_yy\ Ct\_yyy + 2\ gtu\_yz\ Ct\_yyz + gtu\_zz\ Ct\_yzz \end{aligned} \tag{310}$$

Auxiliary analysis variable equation

$$Gamt\_z = Op(x, y, z, t) \tag{311}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +gtu\_xx\ Ct\_zxx + 2\ gtu\_xy\ Ct\_zxy + 2\ gtu\_xz\ Ct\_zxz \\ & + gtu\_yy\ Ct\_zyy + 2\ gtu\_yz\ Ct\_zyz + gtu\_zz\ Ct\_zzz \end{aligned} \tag{312}$$

Auxiliary analysis variable equation

$$Zu\_x = Op(x, y, z, t) \tag{313}$$

$$Op(x, y, z, t) = +0.5\ chi\ \ (Gamh\_x - Gamt\_x) \tag{314}$$

Auxiliary analysis variable equation

$$Zu\_y = Op(x, y, z, t) \tag{315}$$

$$Op(x, y, z, t) = +0.5\ chi\ \ (Gamh\_y - Gamt\_y) \tag{316}$$

Auxiliary analysis variable equation

$$Zu\_z = Op(x, y, z, t) \tag{317}$$

$$Op(x, y, z, t) = +0.5\ chi\ \ (Gamh\_z - Gamt\_z) \tag{318}$$

Auxiliary analysis variable equation

$$Rpd\_xx = Op(x, y, z, t) \tag{319}$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtd\_xx\ Gamh\_x\ \partial_x chi - 0.5\ gtd\_xx\ Gamh\_y\ \partial_y chi \\
&- 0.5\ gtd\_xx\ Gamh\_z\ \partial_z chi + 0.5\ gtd\_xx\ gtu\_xx\ \partial_x\partial_x chi \\
&+ 1.0\ gtd\_xx\ gtu\_xy\ \partial_y\partial_x chi + 1.0\ gtd\_xx\ gtu\_xz\ \partial_z\partial_x chi \\
&+ 0.5\ gtd\_xx\ gtu\_yy\ \partial_y\partial_y chi + 1.0\ gtd\_xx\ gtu\_yz\ \partial_z\partial_y chi \\
&+ 0.5\ gtd\_xx\ gtu\_zz\ \partial_z\partial_z chi - 0.5\ Ct\_yxx\ \partial_y chi \\
&- 0.5\ Ct\_zxx\ \partial_z chi - 0.25\ inv\_chi\ \partial_x chi\partial_x chi - 0.5\ Ct\_xxx\ \partial_x chi \\
&- 1.500000000000000\ gtd\_xx\ gtu\_xy\ inv\_chi\ \partial_y chi\partial_x chi \\
&- 1.500000000000000\ gtd\_xx\ gtu\_xz\ inv\_chi\ \partial_z chi\partial_x chi \\
&- 1.500000000000000\ gtd\_xx\ gtu\_yz\ inv\_chi\ \partial_z chi\partial_y chi \\
&+ 2\ inv\_chi\ Zu\_x\ gtd\_xx\ \partial_x chi \\
&+ 2\ inv\_chi\ Zu\_y\ gtd\_xy\ \partial_x chi + 2\ inv\_chi\ Zu\_z\ gtd\_xz\ \partial_x chi \\
&- 0.75\ gtd\_xx\ gtu\_xx\ inv\_chi\ \partial_x chi\partial_x chi \\
&- 0.75\ gtd\_xx\ gtu\_yy\ inv\_chi\ \partial_y chi\partial_y chi \\
&- 0.75\ gtd\_xx\ gtu\_zz\ inv\_chi\ \partial_z chi\partial_z chi + 0.5\ \partial_x\partial_x chi
\end{aligned}
\tag{320}
$$

Auxiliary analysis variable equation

$$
Rpd\_xy = Op(x,y,z,t) \tag{321}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ Ct\_xxy\ \partial_x chi - 0.5\ Ct\_yxy\ \partial_y chi - 0.5\ Ct\_zxy\ \partial_z chi \\
&- 0.5\ gtd\_xy\ Gamh\_x\ \partial_x chi - 0.5\ gtd\_xy\ Gamh\_y\ \partial_y chi \\
&- 0.5\ gtd\_xy\ Gamh\_z\ \partial_z chi + 0.5\ gtd\_xy\ gtu\_xx\ \partial_x\partial_x chi \\
&+ 1.0\ gtd\_xy\ gtu\_xy\ \partial_y\partial_x chi + 1.0\ gtd\_xy\ gtu\_xz\ \partial_z\partial_x chi \\
&+ 0.5\ gtd\_xy\ gtu\_yy\ \partial_y\partial_y chi + 1.0\ gtd\_xy\ gtu\_yz\ \partial_z\partial_y chi \\
&+ 0.5\ gtd\_xy\ gtu\_zz\ \partial_z\partial_z chi - 0.25\ inv\_chi\ \partial_x chi\partial_y chi \\
&- 1.500000000000000\ gtd\_xy\ gtu\_xy\ inv\_chi\ \partial_y chi\partial_x chi \\
&- 1.500000000000000\ gtd\_xy\ gtu\_xz\ inv\_chi\ \partial_z chi\partial_x chi \\
&- 1.500000000000000\ gtd\_xy\ gtu\_yz\ inv\_chi\ \partial_z chi\partial_y chi \\
&+ inv\_chi\ Zu\_x\ gtd\_xx\ \partial_y chi + inv\_chi\ Zu\_y\ gtd\_xy\ \partial_y chi \\
&+ inv\_chi\ Zu\_z\ gtd\_xz\ \partial_y chi + inv\_chi\ Zu\_x\ gtd\_xy\ \partial_x chi \\
&+ inv\_chi\ Zu\_y\ gtd\_yy\ \partial_x chi + inv\_chi\ Zu\_z\ gtd\_yz\ \partial_x chi \\
&- 0.75\ gtd\_xy\ gtu\_xx\ inv\_chi\ \partial_x chi\partial_x chi \\
&- 0.75\ gtd\_xy\ gtu\_yy\ inv\_chi\ \partial_y chi\partial_y chi \\
&- 0.75\ gtd\_xy\ gtu\_zz\ inv\_chi\ \partial_z chi\partial_z chi + 0.5\ \partial_y\partial_x chi
\end{aligned}
\tag{322}
$$

Auxiliary analysis variable equation

$$Rpd\_xz = Op(x, y, z, t) \tag{323}$$

$$\begin{aligned} Op(x, y, z, t) = & -0.5\ Ct\_xxz\ \partial_x chi - 0.5\ Ct\_yxz\ \partial_y chi - 0.5\ Ct\_zxz\ \partial_z chi \\ & - 0.5\ gtd\_xz\ Gamh\_x\ \partial_x chi - 0.5\ gtd\_xz\ Gamh\_y\ \partial_y chi \\ & - 0.5\ gtd\_xz\ Gamh\_z\ \partial_z chi + 0.5\ gtd\_xz\ gtu\_xx\ \partial_x \partial_x chi \\ & + 1.0\ gtd\_xz\ gtu\_xy\ \partial_y \partial_x chi + 1.0\ gtd\_xz\ gtu\_xz\ \partial_z \partial_x chi \\ & + 0.5\ gtd\_xz\ gtu\_yy\ \partial_y \partial_y chi + 1.0\ gtd\_xz\ gtu\_yz\ \partial_z \partial_y chi \\ & + 0.5\ gtd\_xz\ gtu\_zz\ \partial_z \partial_z chi - 0.25\ inv\_chi\ \partial_x chi \partial_z chi \\ & - 1.500000000000000\ gtd\_xz\ gtu\_xy\ inv\_chi\ \partial_y chi \partial_x chi \\ & - 1.500000000000000\ gtd\_xz\ gtu\_xz\ inv\_chi\ \partial_z chi \partial_x chi \\ & - 1.500000000000000\ gtd\_xz\ gtu\_yz\ inv\_chi\ \partial_z chi \partial_y chi \\ & + inv\_chi\ Zu\_x\ gtd\_xx\ \partial_z chi + inv\_chi\ Zu\_y\ gtd\_xy\ \partial_z chi \\ & + inv\_chi\ Zu\_z\ gtd\_xz\ \partial_z chi + inv\_chi\ Zu\_x\ gtd\_xz\ \partial_x chi \\ & + inv\_chi\ Zu\_y\ gtd\_yz\ \partial_x chi + inv\_chi\ Zu\_z\ gtd\_zz\ \partial_x chi \\ & - 0.75\ gtd\_xz\ gtu\_xx\ inv\_chi\ \partial_x chi \partial_x chi \\ & - 0.75\ gtd\_xz\ gtu\_yy\ inv\_chi\ \partial_y chi \partial_y chi \\ & - 0.75\ gtd\_xz\ gtu\_zz\ inv\_chi\ \partial_z chi \partial_z chi + 0.5\ \partial_z \partial_x chi \end{aligned} \tag{324}$$

Auxiliary analysis variable equation

$$Rpd\_yy = Op(x, y, z, t) \tag{325}$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ Ct\_xyy\ \partial_x chi - 0.5\ Ct\_yyy\ \partial_y chi - 0.5\ Ct\_zyy\ \partial_z chi \\
&- 0.25\ inv\_chi\ \partial_y chi \partial_y chi + 0.5\ gtd\_yy\ gtu\_xx\ \partial_x \partial_x chi \\
&+ 1.0\ gtd\_yy\ gtu\_xy\ \partial_y \partial_x chi + 1.0\ gtd\_yy\ gtu\_xz\ \partial_z \partial_x chi \\
&+ 0.5\ gtd\_yy\ gtu\_yy\ \partial_y \partial_y chi + 1.0\ gtd\_yy\ gtu\_yz\ \partial_z \partial_y chi \\
&+ 0.5\ gtd\_yy\ gtu\_zz\ \partial_z \partial_z chi - 0.5\ gtd\_yy\ Gamh\_x\ \partial_x chi \\
&- 0.5\ gtd\_yy\ Gamh\_y\ \partial_y chi - 0.5\ gtd\_yy\ Gamh\_z\ \partial_z chi \\
&- 1.500000000000000\ gtd\_yy\ gtu\_xy\ inv\_chi\ \partial_y chi \partial_x chi \\
&- 1.500000000000000\ gtd\_yy\ gtu\_xz\ inv\_chi\ \partial_z chi \partial_x chi \\
&- 1.500000000000000\ gtd\_yy\ gtu\_yz\ inv\_chi\ \partial_z chi \partial_y chi \\
&+ 2\ inv\_chi\ Zu\_x\ gtd\_xy\ \partial_y chi \\
&+ 2\ inv\_chi\ Zu\_y\ gtd\_yy\ \partial_y chi + 2\ inv\_chi\ Zu\_z\ gtd\_yz\ \partial_y chi \\
&- 0.75\ gtd\_yy\ gtu\_xx\ inv\_chi\ \partial_x chi \partial_x chi \\
&- 0.75\ gtd\_yy\ gtu\_yy\ inv\_chi\ \partial_y chi \partial_y chi \\
&- 0.75\ gtd\_yy\ gtu\_zz\ inv\_chi\ \partial_z chi \partial_z chi + 0.5\ \partial_y \partial_y chi
\end{aligned}
\tag{326}
$$

Auxiliary analysis variable equation

$$
Rpd\_yz = Op(x,y,z,t) \tag{327}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtd\_yz\ Gamh\_x\ \partial_x chi - 0.5\ gtd\_yz\ Gamh\_y\ \partial_y chi \\
&- 0.5\ gtd\_yz\ Gamh\_z\ \partial_z chi + 0.5\ gtd\_yz\ gtu\_xx\ \partial_x \partial_x chi \\
&+ 1.0\ gtd\_yz\ gtu\_xy\ \partial_y \partial_x chi + 1.0\ gtd\_yz\ gtu\_xz\ \partial_z \partial_x chi \\
&+ 0.5\ gtd\_yz\ gtu\_yy\ \partial_y \partial_y chi + 1.0\ gtd\_yz\ gtu\_yz\ \partial_z \partial_y chi \\
&+ 0.5\ gtd\_yz\ gtu\_zz\ \partial_z \partial_z chi - 0.25\ inv\_chi\ \partial_y chi \partial_z chi \\
&- 0.5\ Ct\_xyz\ \partial_x chi - 0.5\ Ct\_yyz\ \partial_y chi - 0.5\ Ct\_zyz\ \partial_z chi \\
&- 1.500000000000000\ gtd\_yz\ gtu\_xy\ inv\_chi\ \partial_y chi \partial_x chi \\
&- 1.500000000000000\ gtd\_yz\ gtu\_xz\ inv\_chi\ \partial_z chi \partial_x chi \\
&- 1.500000000000000\ gtd\_yz\ gtu\_yz\ inv\_chi\ \partial_z chi \partial_y chi \\
&+ inv\_chi\ Zu\_x\ gtd\_xy\ \partial_z chi + inv\_chi\ Zu\_y\ gtd\_yy\ \partial_z chi \\
&+ inv\_chi\ Zu\_z\ gtd\_yz\ \partial_z chi + inv\_chi\ Zu\_x\ gtd\_xz\ \partial_y chi \\
&+ inv\_chi\ Zu\_y\ gtd\_yz\ \partial_y chi + inv\_chi\ Zu\_z\ gtd\_zz\ \partial_y chi \\
&- 0.75\ gtd\_yz\ gtu\_xx\ inv\_chi\ \partial_x chi \partial_x chi \\
&- 0.75\ gtd\_yz\ gtu\_yy\ inv\_chi\ \partial_y chi \partial_y chi \\
&- 0.75\ gtd\_yz\ gtu\_zz\ inv\_chi\ \partial_z chi \partial_z chi + 0.5\ \partial_z \partial_y chi
\end{aligned}
\tag{328}
$$

Auxiliary analysis variable equation

$$Rpd\_zz = Op(x, y, z, t) \tag{329}$$

$$\begin{aligned} Op(x, y, z, t) = & -0.5\ gtd\_zz\ Gamh\_x\ \partial_x chi - 0.5\ gtd\_zz\ Gamh\_y\ \partial_y chi \\ & - 0.5\ gtd\_zz\ Gamh\_z\ \partial_z chi + 0.5\ gtd\_zz\ gtu\_xx\ \partial_x \partial_x chi \\ & + 1.0\ gtd\_zz\ gtu\_xy\ \partial_y \partial_x chi + 1.0\ gtd\_zz\ gtu\_xz\ \partial_z \partial_x chi \\ & + 0.5\ gtd\_zz\ gtu\_yy\ \partial_y \partial_y chi + 1.0\ gtd\_zz\ gtu\_yz\ \partial_z \partial_y chi \\ & + 0.5\ gtd\_zz\ gtu\_zz\ \partial_z \partial_z chi - 0.5\ Ct\_xzz\ \partial_x chi \\ & - 0.5\ Ct\_yzz\ \partial_y chi - 0.5\ Ct\_zzz\ \partial_z chi - 0.25\ inv\_chi\ \partial_z chi \partial_z chi \\ & - 1.500000000000000\ gtd\_zz\ gtu\_xy\ inv\_chi\ \partial_y chi \partial_x chi \\ & - 1.500000000000000\ gtd\_zz\ gtu\_xz\ inv\_chi\ \partial_z chi \partial_x chi \\ & - 1.500000000000000\ gtd\_zz\ gtu\_yz\ inv\_chi\ \partial_z chi \partial_y chi \\ & + 2\ inv\_chi\ Zu\_x\ gtd\_xz\ \partial_z chi \\ & + 2\ inv\_chi\ Zu\_y\ gtd\_yz\ \partial_z chi + 2\ inv\_chi\ Zu\_z\ gtd\_zz\ \partial_z chi \\ & - 0.75\ gtd\_zz\ gtu\_xx\ inv\_chi\ \partial_x chi \partial_x chi \\ & - 0.75\ gtd\_zz\ gtu\_yy\ inv\_chi\ \partial_y chi \partial_y chi \\ & - 0.75\ gtd\_zz\ gtu\_zz\ inv\_chi\ \partial_z chi \partial_z chi + 0.5\ \partial_z \partial_z chi \end{aligned} \tag{330}$$

Auxiliary analysis variable equation

$$Rtd\_xx = Op(x, y, z, t) \tag{331}$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu\_xx\ \partial_x\partial_x gtd\_xx - 1.0\ gtu\_xy\ \partial_y\partial_x gtd\_xx \\
&- 1.0\ gtu\_xz\ \partial_z\partial_x gtd\_xx - 0.5\ gtu\_yy\ \partial_y\partial_y gtd\_xx \\
&- 1.0\ gtu\_yz\ \partial_z\partial_y gtd\_xx - 0.5\ gtu\_zz\ \partial_z\partial_z gtd\_xx \\
&+ 1.0\ gtd\_xx\ \partial_x Gamh\_x + 1.0\ gtd\_xy\ \partial_x Gamh\_y \\
&+ 1.0\ gtd\_xz\ \partial_x Gamh\_z + 1.0\ Gamh\_x\ Ctd\_xxx \\
&+ 1.0\ Gamh\_y\ Ctd\_xxy + 1.0\ Gamh\_z\ Ctd\_xxz \\
&+ gtu\_xx\ (3\ Ct\_xxx\ Ctd\_xxx + 2\ Ct\_yxx\ Ctd\_xxy \\
&\quad + Ct\_yxx\ Ctd\_yxx + 2\ Ct\_zxx\ Ctd\_xxz + Ct\_zxx\ Ctd\_zxx) \\
&+ gtu\_xy\ (3\ Ct\_xxy\ Ctd\_xxx + 2\ Ct\_yxy\ Ctd\_xxy \\
&\quad + Ct\_yxy\ Ctd\_yxx + 2\ Ct\_zxy\ Ctd\_xxz + Ct\_zxy\ Ctd\_zxx) \\
&+ gtu\_xz\ (3\ Ct\_xxz\ Ctd\_xxx + 2\ Ct\_yxz\ Ctd\_xxy \\
&\quad + Ct\_yxz\ Ctd\_yxx + 2\ Ct\_zxz\ Ctd\_xxz + Ct\_zxz\ Ctd\_zxx) \\
&+ gtu\_xy\ (3\ Ct\_xxx\ Ctd\_xxy + 2\ Ct\_yxx\ Ctd\_xyy \\
&\quad + Ct\_yxx\ Ctd\_yxy + 2\ Ct\_zxx\ Ctd\_xyz + Ct\_zxx\ Ctd\_zxy) \\
&+ gtu\_yy\ (3\ Ct\_xxy\ Ctd\_xxy + 2\ Ct\_yxy\ Ctd\_xyy \\
&\quad + Ct\_yxy\ Ctd\_yxy + 2\ Ct\_zxy\ Ctd\_xyz + Ct\_zxy\ Ctd\_zxy) \\
&+ gtu\_yz\ (3\ Ct\_xxz\ Ctd\_xxy + 2\ Ct\_yxz\ Ctd\_xyy \\
&\quad + Ct\_yxz\ Ctd\_yxy + 2\ Ct\_zxz\ Ctd\_xyz + Ct\_zxz\ Ctd\_zxy) \\
&+ gtu\_xz\ (3\ Ct\_xxx\ Ctd\_xxz + 2\ Ct\_yxx\ Ctd\_xyz \\
&\quad + Ct\_yxx\ Ctd\_yxz + 2\ Ct\_zxx\ Ctd\_xzz + Ct\_zxx\ Ctd\_zxz) \\
&+ gtu\_yz\ (3\ Ct\_xxy\ Ctd\_xxz + 2\ Ct\_yxy\ Ctd\_xyz \\
&\quad + Ct\_yxy\ Ctd\_yxz + 2\ Ct\_zxy\ Ctd\_xzz + Ct\_zxy\ Ctd\_zxz) \\
&+ gtu\_zz\ (3\ Ct\_xxz\ Ctd\_xxz + 2\ Ct\_yxz\ Ctd\_xyz + Ct\_yxz\ Ctd\_yxz \\
&\quad + 2\ Ct\_zxz\ Ctd\_xzz + Ct\_zxz\ Ctd\_zxz)
\end{aligned}
\tag{332}
$$

Auxiliary analysis variable equation

$$
Rtd\_xy = Op(x,y,z,t) \tag{333}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu\_xx\ \partial_x\partial_x gtd\_xy - 1.0\ gtu\_xy\ \partial_y\partial_x gtd\_xy \\
&- 1.0\ gtu\_xz\ \partial_z\partial_x gtd\_xy - 0.5\ gtu\_yy\ \partial_y\partial_y gtd\_xy \\
&- 1.0\ gtu\_yz\ \partial_z\partial_y gtd\_xy - 0.5\ gtu\_zz\ \partial_z\partial_z gtd\_xy \\
&+ 0.5\ gtd\_xx\ \partial_y Gamh\_x + 0.5\ gtd\_xy\ \partial_y Gamh\_y \\
&+ 0.5\ gtd\_xz\ \partial_y Gamh\_z + 0.5\ gtd\_xy\ \partial_x Gamh\_x \\
&+ 0.5\ gtd\_yy\ \partial_x Gamh\_y + 0.5\ gtd\_yz\ \partial_x Gamh\_z \\
&+ 0.5\ Gamh\_x\ (Ctd\_xxy + Ctd\_yxx) \\
&+ 0.5\ Gamh\_y\ (Ctd\_xyy + Ctd\_yxy) \\
&+ 0.5\ Gamh\_z\ (Ctd\_xyz + Ctd\_yxz) \\
&+ gtu\_xx\ (Ct\_xxx\ Ctd\_yxx + Ct\_xxx\ Ctd\_xxy + Ct\_xxy\ Ctd\_xxx \\
&\qquad + 2\ Ct\_yxx\ Ctd\_yxy + Ct\_yxy\ Ctd\_xxy + Ct\_zxx\ Ctd\_yxz \\
&\qquad + Ct\_zxx\ Ctd\_zxy + Ct\_zxy\ Ctd\_xxz) \\
&+ gtu\_xy\ (Ct\_xxy\ Ctd\_yxx + Ct\_xxy\ Ctd\_xxy + Ct\_xyy\ Ctd\_xxx \\
&\qquad + 2\ Ct\_yxy\ Ctd\_yxy + Ct\_yyy\ Ctd\_xxy + Ct\_zxy\ Ctd\_yxz \\
&\qquad + Ct\_zxy\ Ctd\_zxy + Ct\_zyy\ Ctd\_xxz) \\
&+ gtu\_xz\ (Ct\_xxz\ Ctd\_yxx + Ct\_xxz\ Ctd\_xxy + Ct\_xyz\ Ctd\_xxx \\
&\qquad + 2\ Ct\_yxz\ Ctd\_yxy + Ct\_yyz\ Ctd\_xxy + Ct\_zxz\ Ctd\_yxz \\
&\qquad + Ct\_zxz\ Ctd\_zxy + Ct\_zyz\ Ctd\_xxz) \\
&+ gtu\_xy\ (Ct\_xxx\ Ctd\_yxy + Ct\_xxx\ Ctd\_xyy + Ct\_xxy\ Ctd\_xxy \\
&\qquad + 2\ Ct\_yxx\ Ctd\_yyy + Ct\_yxy\ Ctd\_xyy + Ct\_zxx\ Ctd\_yyz \\
&\qquad + Ct\_zxx\ Ctd\_zyy + Ct\_zxy\ Ctd\_xyz) \\
&+ gtu\_yy\ (Ct\_xxy\ Ctd\_yxy + Ct\_xxy\ Ctd\_xyy + Ct\_xyy\ Ctd\_xxy \\
&\qquad + 2\ Ct\_yxy\ Ctd\_yyy + Ct\_yyy\ Ctd\_xyy + Ct\_zxy\ Ctd\_yyz \\
&\qquad + Ct\_zxy\ Ctd\_zyy + Ct\_zyy\ Ctd\_xyz) \\
&+ gtu\_yz\ (Ct\_xxz\ Ctd\_yxy + Ct\_xxz\ Ctd\_xyy + Ct\_xyz\ Ctd\_xxy \\
&\qquad + 2\ Ct\_yxz\ Ctd\_yyy + Ct\_yyz\ Ctd\_xyy + Ct\_zxz\ Ctd\_yyz \\
&\qquad + Ct\_zxz\ Ctd\_zyy + Ct\_zyz\ Ctd\_xyz) \\
&+ gtu\_xz\ (Ct\_xxx\ Ctd\_yxz + Ct\_xxx\ Ctd\_xyz + Ct\_xxy\ Ctd\_xxz \\
&\qquad + 2\ Ct\_yxx\ Ctd\_yyz + Ct\_yxy\ Ctd\_xyz + Ct\_zxx\ Ctd\_yzz \\
&\qquad + Ct\_zxx\ Ctd\_zyz + Ct\_zxy\ Ctd\_xzz) \\
&+ gtu\_yz\ (Ct\_xxy\ Ctd\_yxz + Ct\_xxy\ Ctd\_xyz + Ct\_xyy\ Ctd\_xxz \\
&\qquad + 2\ Ct\_yxy\ Ctd\_yyz + Ct\_yyy\ Ctd\_xyz + Ct\_zxy\ Ctd\_yzz \\
&\qquad + Ct\_zxy\ Ctd\_zyz + Ct\_zyy\ Ctd\_xzz) \\
&+ gtu\_zz\ (Ct\_xxz\ Ctd\_yxz + Ct\_xxz\ Ctd\_xyz + Ct\_xyz\ Ctd\_xxz \\
&\qquad + 2\ Ct\_yxz\ Ctd\_yyz + Ct\_yyz\ Ctd\_xyz + Ct\_zxz\ Ctd\_yzz \\
&\qquad + Ct\_zxz\ Ctd\_zyz + Ct\_zyz\ Ctd\_xzz)
\end{aligned}
\tag{334}
$$

Auxiliary analysis variable equation

$$Rtd\_xz = Op(x, y, z, t) \tag{335}$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu\_xx\ \partial_x\partial_x gtd\_xz - 1.0\ gtu\_xy\ \partial_y\partial_x gtd\_xz \\
&- 1.0\ gtu\_xz\ \partial_z\partial_x gtd\_xz - 0.5\ gtu\_yy\ \partial_y\partial_y gtd\_xz \\
&- 1.0\ gtu\_yz\ \partial_z\partial_y gtd\_xz - 0.5\ gtu\_zz\ \partial_z\partial_z gtd\_xz \\
&+ 0.5\ gtd\_xx\ \partial_z Gamh\_x + 0.5\ gtd\_xy\ \partial_z Gamh\_y \\
&+ 0.5\ gtd\_xz\ \partial_z Gamh\_z + 0.5\ gtd\_xz\ \partial_x Gamh\_x \\
&+ 0.5\ gtd\_yz\ \partial_x Gamh\_y + 0.5\ gtd\_zz\ \partial_x Gamh\_z \\
&+ 0.5\ Gamh\_x\ (Ctd\_xxz + Ctd\_zxx) \\
&+ 0.5\ Gamh\_y\ (Ctd\_xyz + Ctd\_zxy) \\
&+ 0.5\ Gamh\_z\ (Ctd\_xzz + Ctd\_zxz) \\
&+ gtu\_xx\ (Ct\_xxx\ Ctd\_zxx + Ct\_xxx\ Ctd\_xxz + Ct\_xxz\ Ctd\_xxx \\
&\qquad + Ct\_yxx\ Ctd\_zxy + Ct\_yxx\ Ctd\_yxz + Ct\_yxz\ Ctd\_xxy \\
&\qquad + 2\ Ct\_zxx\ Ctd\_zxz + Ct\_zxz\ Ctd\_xxz) \\
&+ gtu\_xy\ (Ct\_xxy\ Ctd\_zxx + Ct\_xxy\ Ctd\_xxz + Ct\_xyz\ Ctd\_xxx \\
&\qquad + Ct\_yxy\ Ctd\_zxy + Ct\_yxy\ Ctd\_yxz + Ct\_yyz\ Ctd\_xxy \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zxz + Ct\_zyz\ Ctd\_xxz) \\
&+ gtu\_xz\ (Ct\_xxz\ Ctd\_zxx + Ct\_xxz\ Ctd\_xxz + Ct\_xzz\ Ctd\_xxx \\
&\qquad + Ct\_yxz\ Ctd\_zxy + Ct\_yxz\ Ctd\_yxz + Ct\_yzz\ Ctd\_xxy \\
&\qquad + 2\ Ct\_zxz\ Ctd\_zxz + Ct\_zzz\ Ctd\_xxz) \\
&+ gtu\_xy\ (Ct\_xxx\ Ctd\_zxy + Ct\_xxx\ Ctd\_xyz + Ct\_xxz\ Ctd\_xxy \\
&\qquad + Ct\_yxx\ Ctd\_zyy + Ct\_yxx\ Ctd\_yyz + Ct\_yxz\ Ctd\_xyy \\
&\qquad + 2\ Ct\_zxx\ Ctd\_zyz + Ct\_zxz\ Ctd\_xyz) \\
&+ gtu\_yy\ (Ct\_xxy\ Ctd\_zxy + Ct\_xxy\ Ctd\_xyz + Ct\_xyz\ Ctd\_xxy \\
&\qquad + Ct\_yxy\ Ctd\_zyy + Ct\_yxy\ Ctd\_yyz + Ct\_yyz\ Ctd\_xyy \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zyz + Ct\_zyz\ Ctd\_xyz) \\
&+ gtu\_yz\ (Ct\_xxz\ Ctd\_zxy + Ct\_xxz\ Ctd\_xyz + Ct\_xzz\ Ctd\_xxy \\
&\qquad + Ct\_yxz\ Ctd\_zyy + Ct\_yxz\ Ctd\_yyz + Ct\_yzz\ Ctd\_xyy \\
&\qquad + 2\ Ct\_zxz\ Ctd\_zyz + Ct\_zzz\ Ctd\_xyz) \\
&+ gtu\_xz\ (Ct\_xxx\ Ctd\_zxz + Ct\_xxx\ Ctd\_xzz + Ct\_xxz\ Ctd\_xxz \\
&\qquad + Ct\_yxx\ Ctd\_zyz + Ct\_yxx\ Ctd\_yzz + Ct\_yxz\ Ctd\_xyz \\
&\qquad + 2\ Ct\_zxx\ Ctd\_zzz + Ct\_zxz\ Ctd\_xzz) \\
&+ gtu\_yz\ (Ct\_xxy\ Ctd\_zxz + Ct\_xxy\ Ctd\_xzz + Ct\_xyz\ Ctd\_xxz \\
&\qquad + Ct\_yxy\ Ctd\_zyz + Ct\_yxy\ Ctd\_yzz + Ct\_yyz\ Ctd\_xyz \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zzz + Ct\_zyz\ Ctd\_xzz) \\
&+ gtu\_zz\ (Ct\_xxz\ Ctd\_zxz + Ct\_xxz\ Ctd\_xzz + Ct\_xzz\ Ctd\_xxz \\
&\qquad + Ct\_yxz\ Ctd\_zyz + Ct\_yxz\ Ctd\_yzz + Ct\_yzz\ Ctd\_xyz \\
&\qquad + 2\ Ct\_zxz\ Ctd\_zzz + Ct\_zzz\ Ctd\_xzz)
\end{aligned}
\tag{336}
$$

Auxiliary analysis variable equation

$$Rtd\_yy = Op(x, y, z, t) \tag{337}$$

$$\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu_xx\ \partial_x\partial_x gtd_yy - 1.0\ gtu_xy\ \partial_y\partial_x gtd_yy \\
&- 1.0\ gtu_xz\ \partial_z\partial_x gtd_yy - 0.5\ gtu_yy\ \partial_y\partial_y gtd_yy \\
&- 1.0\ gtu_yz\ \partial_z\partial_y gtd_yy - 0.5\ gtu_zz\ \partial_z\partial_z gtd_yy \\
&+ 1.0\ gtd_xy\ \partial_y Gamh_x + 1.0\ gtd_yy\ \partial_y Gamh_y \\
&+ 1.0\ gtd_yz\ \partial_y Gamh_z + 1.0\ Gamh_x\ Ctd_yxy \\
&+ 1.0\ Gamh_y\ Ctd_yyy + 1.0\ Gamh_z\ Ctd_yyz \\
&+ gtu_xx\ (2\ Ct_xxy\ Ctd_yxx + Ct_xxy\ Ctd_xxy \\
&\qquad + 3\ Ct_yxy\ Ctd_yxy + 2\ Ct_zxy\ Ctd_yxz + Ct_zxy\ Ctd_zxy) \\
&+ gtu_xy\ (2\ Ct_xyy\ Ctd_yxx + Ct_xyy\ Ctd_xxy + 3\ Ct_yyy\ Ctd_yxy \\
&\qquad + 2\ Ct_zyy\ Ctd_yxz + Ct_zyy\ Ctd_zxy) \\
&+ gtu_xz\ (2\ Ct_xyz\ Ctd_yxx + Ct_xyz\ Ctd_xxy + 3\ Ct_yyz\ Ctd_yxy \\
&\qquad + 2\ Ct_zyz\ Ctd_yxz + Ct_zyz\ Ctd_zxy) \\
&+ gtu_xy\ (2\ Ct_xxy\ Ctd_yxy + Ct_xxy\ Ctd_xyy + 3\ Ct_yxy\ Ctd_yyy \\
&\qquad + 2\ Ct_zxy\ Ctd_yyz + Ct_zxy\ Ctd_zyy) \\
&+ gtu_yy\ (2\ Ct_xyy\ Ctd_yxy + Ct_xyy\ Ctd_xyy + 3\ Ct_yyy\ Ctd_yyy \\
&\qquad + 2\ Ct_zyy\ Ctd_yyz + Ct_zyy\ Ctd_zyy) \\
&+ gtu_yz\ (2\ Ct_xyz\ Ctd_yxy + Ct_xyz\ Ctd_xyy + 3\ Ct_yyz\ Ctd_yyy \\
&\qquad + 2\ Ct_zyz\ Ctd_yyz + Ct_zyz\ Ctd_zyy) \\
&+ gtu_xz\ (2\ Ct_xxy\ Ctd_yxz + Ct_xxy\ Ctd_xyz + 3\ Ct_yxy\ Ctd_yyz \\
&\qquad + 2\ Ct_zxy\ Ctd_yzz + Ct_zxy\ Ctd_zyz) \\
&+ gtu_yz\ (2\ Ct_xyy\ Ctd_yxz + Ct_xyy\ Ctd_xyz + 3\ Ct_yyy\ Ctd_yyz \\
&\qquad + 2\ Ct_zyy\ Ctd_yzz + Ct_zyy\ Ctd_zyz) \\
&+ gtu_zz\ (2\ Ct_xyz\ Ctd_yxz + Ct_xyz\ Ctd_xyz + 3\ Ct_yyz\ Ctd_yyz \\
&\qquad + 2\ Ct_zyz\ Ctd_yzz + Ct_zyz\ Ctd_zyz)
\end{aligned} \tag{338}$$

Auxiliary analysis variable equation

$$Rtd\_yz = Op(x, y, z, t) \tag{339}$$

$$
\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu\_xx\ \partial_x\partial_x gtd\_yz - 1.0\ gtu\_xy\ \partial_y\partial_x gtd\_yz \\
&- 1.0\ gtu\_xz\ \partial_z\partial_x gtd\_yz - 0.5\ gtu\_yy\ \partial_y\partial_y gtd\_yz \\
&- 1.0\ gtu\_yz\ \partial_z\partial_y gtd\_yz - 0.5\ gtu\_zz\ \partial_z\partial_z gtd\_yz \\
&+ 0.5\ gtd\_xy\ \partial_z Gamh\_x + 0.5\ gtd\_yy\ \partial_z Gamh\_y \\
&+ 0.5\ gtd\_yz\ \partial_z Gamh\_z + 0.5\ gtd\_xz\ \partial_y Gamh\_x \\
&+ 0.5\ gtd\_yz\ \partial_y Gamh\_y + 0.5\ gtd\_zz\ \partial_y Gamh\_z \\
&+ 0.5\ Gamh\_x\ (Ctd\_yxz + Ctd\_zxy) \\
&+ 0.5\ Gamh\_y\ (Ctd\_yyz + Ctd\_zyy) \\
&+ 0.5\ Gamh\_z\ (Ctd\_yzz + Ctd\_zyz) \\
&+ gtu\_xx\ (Ct\_xxy\ Ctd\_zxx + Ct\_xxy\ Ctd\_xxz + Ct\_xxz\ Ctd\_yxx \\
&\qquad + Ct\_yxy\ Ctd\_zxy + Ct\_yxy\ Ctd\_yxz + Ct\_yxz\ Ctd\_yxy \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zxz + Ct\_zxz\ Ctd\_yxz) \\
&+ gtu\_xy\ (Ct\_xyy\ Ctd\_zxx + Ct\_xyy\ Ctd\_xxz + Ct\_xyz\ Ctd\_yxx \\
&\qquad + Ct\_yyy\ Ctd\_zxy + Ct\_yyy\ Ctd\_yxz + Ct\_yyz\ Ctd\_yxy \\
&\qquad + 2\ Ct\_zyy\ Ctd\_zxz + Ct\_zyz\ Ctd\_yxz) \\
&+ gtu\_xz\ (Ct\_xyz\ Ctd\_zxx + Ct\_xyz\ Ctd\_xxz + Ct\_xzz\ Ctd\_yxx \\
&\qquad + Ct\_yyz\ Ctd\_zxy + Ct\_yyz\ Ctd\_yxz + Ct\_yzz\ Ctd\_yxy \\
&\qquad + 2\ Ct\_zyz\ Ctd\_zxz + Ct\_zzz\ Ctd\_yxz) \\
&+ gtu\_xy\ (Ct\_xxy\ Ctd\_zxy + Ct\_xxy\ Ctd\_xyz + Ct\_xxz\ Ctd\_yxy \\
&\qquad + Ct\_yxy\ Ctd\_zyy + Ct\_yxy\ Ctd\_yyz + Ct\_yxz\ Ctd\_yyy \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zyz + Ct\_zxz\ Ctd\_yyz) \\
&+ gtu\_yy\ (Ct\_xyy\ Ctd\_zxy + Ct\_xyy\ Ctd\_xyz + Ct\_xyz\ Ctd\_yxy \\
&\qquad + Ct\_yyy\ Ctd\_zyy + Ct\_yyy\ Ctd\_yyz + Ct\_yyz\ Ctd\_yyy \\
&\qquad + 2\ Ct\_zyy\ Ctd\_zyz + Ct\_zyz\ Ctd\_yyz) \\
&+ gtu\_yz\ (Ct\_xyz\ Ctd\_zxy + Ct\_xyz\ Ctd\_xyz + Ct\_xzz\ Ctd\_yxy \\
&\qquad + Ct\_yyz\ Ctd\_zyy + Ct\_yyz\ Ctd\_yyz + Ct\_yzz\ Ctd\_yyy \\
&\qquad + 2\ Ct\_zyz\ Ctd\_zyz + Ct\_zzz\ Ctd\_yyz) \\
&+ gtu\_xz\ (Ct\_xxy\ Ctd\_zxz + Ct\_xxy\ Ctd\_xzz + Ct\_xxz\ Ctd\_yxz \\
&\qquad + Ct\_yxy\ Ctd\_zyz + Ct\_yxy\ Ctd\_yzz + Ct\_yxz\ Ctd\_yyz \\
&\qquad + 2\ Ct\_zxy\ Ctd\_zzz + Ct\_zxz\ Ctd\_yzz) \\
&+ gtu\_yz\ (Ct\_xyy\ Ctd\_zxz + Ct\_xyy\ Ctd\_xzz + Ct\_xyz\ Ctd\_yxz \\
&\qquad + Ct\_yyy\ Ctd\_zyz + Ct\_yyy\ Ctd\_yzz + Ct\_yyz\ Ctd\_yyz \\
&\qquad + 2\ Ct\_zyy\ Ctd\_zzz + Ct\_zyz\ Ctd\_yzz) \\
&+ gtu\_zz\ (Ct\_xyz\ Ctd\_zxz + Ct\_xyz\ Ctd\_xzz + Ct\_xzz\ Ctd\_yxz \\
&\qquad + Ct\_yyz\ Ctd\_zyz + Ct\_yyz\ Ctd\_yzz + Ct\_yzz\ Ctd\_yyz \\
&\qquad + 2\ Ct\_zyz\ Ctd\_zzz + Ct\_zzz\ Ctd\_yzz)
\end{aligned}
\tag{340}
$$

Auxiliary analysis variable equation

$$Rtd\_zz = Op(x, y, z, t) \tag{341}$$

$$\begin{aligned}
Op(x,y,z,t) = &-0.5\ gtu_xx\ \partial_x\partial_x gtd_zz - 1.0\ gtu_xy\ \partial_y\partial_x gtd_zz \\
&- 1.0\ gtu_xz\ \partial_z\partial_x gtd_zz - 0.5\ gtu_yy\ \partial_y\partial_y gtd_zz \\
&- 1.0\ gtu_yz\ \partial_z\partial_y gtd_zz - 0.5\ gtu_zz\ \partial_z\partial_z gtd_zz \\
&+ 1.0\ gtd_xz\ \partial_z Gamh_x + 1.0\ gtd_yz\ \partial_z Gamh_y \\
&+ 1.0\ gtd_zz\ \partial_z Gamh_z + 1.0\ Gamh_x\ Ctd_zxz \\
&+ 1.0\ Gamh_y\ Ctd_zyz + 1.0\ Gamh_z\ Ctd_zzz \\
&+ gtu_xx\ (2\ Ct_xxz\ Ctd_zxx + Ct_xxz\ Ctd_xxz \\
&\qquad + 2\ Ct_yxz\ Ctd_zxy + Ct_yxz\ Ctd_yxz + 3\ Ct_zxz\ Ctd_zxz) \\
&+ gtu_xy\ (2\ Ct_xyz\ Ctd_zxx + Ct_xyz\ Ctd_xxz + 2\ Ct_yyz\ Ctd_zxy \\
&\qquad + Ct_yyz\ Ctd_yxz + 3\ Ct_zyz\ Ctd_zxz) \\
&+ gtu_xz\ (2\ Ct_xzz\ Ctd_zxx + Ct_xzz\ Ctd_xxz + 2\ Ct_yzz\ Ctd_zxy \\
&\qquad + Ct_yzz\ Ctd_yxz + 3\ Ct_zzz\ Ctd_zxz) \\
&+ gtu_xy\ (2\ Ct_xxz\ Ctd_zxy + Ct_xxz\ Ctd_xyz + 2\ Ct_yxz\ Ctd_zyy \\
&\qquad + Ct_yxz\ Ctd_yyz + 3\ Ct_zxz\ Ctd_zyz) \\
&+ gtu_yy\ (2\ Ct_xyz\ Ctd_zxy + Ct_xyz\ Ctd_xyz + 2\ Ct_yyz\ Ctd_zyy \\
&\qquad + Ct_yyz\ Ctd_yyz + 3\ Ct_zyz\ Ctd_zyz) \\
&+ gtu_yz\ (2\ Ct_xzz\ Ctd_zxy + Ct_xzz\ Ctd_xyz + 2\ Ct_yzz\ Ctd_zyy \\
&\qquad + Ct_yzz\ Ctd_yyz + 3\ Ct_zzz\ Ctd_zyz) \\
&+ gtu_xz\ (2\ Ct_xxz\ Ctd_zxz + Ct_xxz\ Ctd_xzz + 2\ Ct_yxz\ Ctd_zyz \\
&\qquad + Ct_yxz\ Ctd_yzz + 3\ Ct_zxz\ Ctd_zzz) \\
&+ gtu_yz\ (2\ Ct_xyz\ Ctd_zxz + Ct_xyz\ Ctd_xzz + 2\ Ct_yyz\ Ctd_zyz \\
&\qquad + Ct_yyz\ Ctd_yzz + 3\ Ct_zyz\ Ctd_zzz) \\
&+ gtu_zz\ (2\ Ct_xzz\ Ctd_zxz + Ct_xzz\ Ctd_xzz + 2\ Ct_yzz\ Ctd_zyz \\
&\qquad + Ct_yzz\ Ctd_yzz + 3\ Ct_zzz\ Ctd_zzz)
\end{aligned} \tag{342}$$

Auxiliary analysis variable equation

$$uph\_x = Op(x, y, z, t) \tag{343}$$

$$Op(x, y, z, t) = -y \tag{344}$$

Auxiliary analysis variable equation

$$uph\_y = Op(x, y, z, t) \tag{345}$$

$$Op(x, y, z, t) = +x \tag{346}$$

Auxiliary analysis variable equation

$$uph\_z = Op(x, y, z, t) \tag{347}$$

$$Op(x, y, z, t) = +\mathrm{o} \tag{348}$$

Auxiliary analysis variable equation

$$ur\_x = Op(x, y, z, t) \tag{349}$$

$$Op(x, y, z, t) = +x \tag{350}$$

Auxiliary analysis variable equation

$$ur\_y = Op(x, y, z, t) \tag{351}$$

$$Op(x, y, z, t) = +y \tag{352}$$

Auxiliary analysis variable equation

$$ur\_z = Op(x, y, z, t) \tag{353}$$

$$Op(x, y, z, t) = +z \tag{354}$$

Auxiliary analysis variable equation

$$uthd\_x = Op(x, y, z, t) \tag{355}$$

$$Op(x, y, z, t) = +x\ z \tag{356}$$

Auxiliary analysis variable equation

$$uthd\_y = Op(x, y, z, t) \tag{357}$$

$$Op(x, y, z, t) = +y\ z \tag{358}$$

Auxiliary analysis variable equation

$$uthd\_z = Op(x, y, z, t) \tag{359}$$

$$Op(x, y, z, t) = +(-x^2) + (-y^2) \tag{360}$$

Auxiliary analysis variable equation

$$uth\_x = Op(x, y, z, t) \tag{361}$$

$$Op(x, y, z, t) = +chi\ gtu\_xx\ uthd\_x + chi\ gtu\_xy\ uthd\_y + chi\ gtu\_xz\ uthd\_z \tag{362}$$

Auxiliary analysis variable equation

$$uth\_y = Op(x, y, z, t) \tag{363}$$

$$Op(x, y, z, t) = +chi\ gtu\_xy\ uthd\_x + chi\ gtu\_yy\ uthd\_y + chi\ gtu\_yz\ uthd\_z \tag{364}$$

Auxiliary analysis variable equation

$$uth\_z = Op(x, y, z, t) \tag{365}$$

$$Op(x, y, z, t) = +chi\ gtu\_xz\ uthd\_x + chi\ gtu\_yz\ uthd\_y + chi\ gtu\_zz\ uthd\_z \tag{366}$$

Auxiliary analysis variable equation

$$wphph = Op(x, y, z, t) \tag{367}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +inv\_chi\ gtd\_xx\ uph\_x^2 + 2\ inv\_chi\ gtd\_xy\ uph\_x\ uph\_y \\ & + 2\ inv\_chi\ gtd\_xz\ uph\_x\ uph\_z + inv\_chi\ gtd\_yy\ uph\_y^2 \\ & + 2\ inv\_chi\ gtd\_yz\ uph\_y\ uph\_z + inv\_chi\ gtd\_zz\ uph\_z^2 \end{aligned} \tag{368}$$

Auxiliary analysis variable equation

$$vph\_x = Op(x, y, z, t) \tag{369}$$

$$Op(x, y, z, t) = +\frac{uph\_x}{\max\{0.0001, \sqrt{wphph}\}} \tag{370}$$

Auxiliary analysis variable equation

$$vph\_y = Op(x, y, z, t) \tag{371}$$

$$Op(x, y, z, t) = +\frac{uph\_y}{\max\{0.0001, \sqrt{wphph}\}} \tag{372}$$

Auxiliary analysis variable equation

$$vph\_z = Op(x, y, z, t) \tag{373}$$

$$Op(x, y, z, t) = +\frac{uph\_z}{\max\{0.0001, \sqrt{wphph}\}} \tag{374}$$

Auxiliary analysis variable equation

$$wrph = Op(x, y, z, t) \tag{375}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ gtd\_xx\ ur\_x\ vph\_x + inv\_chi\ gtd\_xy\ ur\_x\ vph\_y \\ &+ inv\_chi\ gtd\_xz\ ur\_x\ vph\_z \\ &+ inv\_chi\ gtd\_xy\ ur\_y\ vph\_x + inv\_chi\ gtd\_yy\ ur\_y\ vph\_y \\ &+ inv\_chi\ gtd\_yz\ ur\_y\ vph\_z + inv\_chi\ gtd\_xz\ ur\_z\ vph\_x \\ &+ inv\_chi\ gtd\_yz\ ur\_z\ vph\_y + inv\_chi\ gtd\_zz\ ur\_z\ vph\_z \end{aligned} \tag{376}$$

Auxiliary analysis variable equation

$$wrr = Op(x,y,z,t) \tag{377}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ gtd\_xx\ ur\_x^2 + 2\ inv\_chi\ gtd\_xy\ ur\_x\ ur\_y \\ &+ 2\ inv\_chi\ gtd\_xz\ ur\_x\ ur\_z + inv\_chi\ gtd\_yy\ ur\_y^2 \\ &+ 2\ inv\_chi\ gtd\_yz\ ur\_y\ ur\_z + inv\_chi\ gtd\_zz\ ur\_z^2 \end{aligned} \tag{378}$$

Auxiliary analysis variable equation

$$vr\_x = Op(x,y,z,t) \tag{379}$$

$$Op(x,y,z,t) = +\frac{(-wrph\ vph\_x) + ur\_x}{\max\{0.0001, \sqrt{wrr}\}} \tag{380}$$

Auxiliary analysis variable equation

$$vr\_y = Op(x,y,z,t) \tag{381}$$

$$Op(x,y,z,t) = +\frac{(-wrph\ vph\_y) + ur\_y}{\max\{0.0001, \sqrt{wrr}\}} \tag{382}$$

Auxiliary analysis variable equation

$$vr\_z = Op(x,y,z,t) \tag{383}$$

$$Op(x,y,z,t) = +\frac{(-wrph\ vph\_z) + ur\_z}{\max\{0.0001, \sqrt{wrr}\}} \tag{384}$$

Auxiliary analysis variable equation

$$wthph = Op(x,y,z,t) \tag{385}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ gtd\_xx\ uth\_x\ vph\_x + inv\_chi\ gtd\_xy\ uth\_x\ vph\_y \\ &+ inv\_chi\ gtd\_xz\ uth\_x\ vph\_z \\ &+ inv\_chi\ gtd\_xy\ uth\_y\ vph\_x + inv\_chi\ gtd\_yy\ uth\_y\ vph\_y \\ &+ inv\_chi\ gtd\_yz\ uth\_y\ vph\_z + inv\_chi\ gtd\_xz\ uth\_z\ vph\_x \\ &+ inv\_chi\ gtd\_yz\ uth\_z\ vph\_y + inv\_chi\ gtd\_zz\ uth\_z\ vph\_z \end{aligned} \tag{386}$$

Auxiliary analysis variable equation

$$wthr = Op(x,y,z,t) \tag{387}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ gtd\_xx\ uth\_x\ vr\_x + inv\_chi\ gtd\_xy\ uth\_x\ vr\_y \\ &+ inv\_chi\ gtd\_xz\ uth\_x\ vr\_z \\ &+ inv\_chi\ gtd\_xy\ uth\_y\ vr\_x + inv\_chi\ gtd\_yy\ uth\_y\ vr\_y \\ &+ inv\_chi\ gtd\_yz\ uth\_y\ vr\_z + inv\_chi\ gtd\_xz\ uth\_z\ vr\_x \\ &+ inv\_chi\ gtd\_yz\ uth\_z\ vr\_y + inv\_chi\ gtd\_zz\ uth\_z\ vr\_z \end{aligned} \tag{388}$$

Auxiliary analysis variable equation

$$wthth = Op(x,y,z,t) \tag{389}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ gtd\_xx\ uth\_x^2 + 2\ inv\_chi\ gtd\_xy\ uth\_x\ uth\_y \\ &+ 2\ inv\_chi\ gtd\_xz\ uth\_x\ uth\_z + inv\_chi\ gtd\_yy\ uth\_y^2 \\ &+ 2\ inv\_chi\ gtd\_yz\ uth\_y\ uth\_z + inv\_chi\ gtd\_zz\ uth\_z^2 \end{aligned} \tag{390}$$

Auxiliary analysis variable equation

$$vth\_x = Op(x, y, z, t) \tag{391}$$

$$Op(x, y, z, t) = +\frac{(-wthph\ vph\_x) + (-wthr\ vr\_x) + uth\_x}{\max\{0.0001, \sqrt{wthth}\}} \tag{392}$$

Auxiliary analysis variable equation

$$vth\_y = Op(x, y, z, t) \tag{393}$$

$$Op(x, y, z, t) = +\frac{(-wthph\ vph\_y) + (-wthr\ vr\_y) + uth\_y}{\max\{0.0001, \sqrt{wthth}\}} \tag{394}$$

Auxiliary analysis variable equation

$$vth\_z = Op(x, y, z, t) \tag{395}$$

$$Op(x, y, z, t) = +\frac{(-wthph\ vph\_z) + (-wthr\ vr\_z) + uth\_z}{\max\{0.0001, \sqrt{wthth}\}} \tag{396}$$

Auxiliary analysis variable equation

$$dSigma\_x = Op(x, y, z, t) \tag{397}$$

$$Op(x, y, z, t) = +\frac{1\ ur\_x\ \max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}{chi^{1.500000000000000}} \tag{398}$$

Auxiliary analysis variable equation

$$dSigma\_y = Op(x, y, z, t) \tag{399}$$

$$Op(x, y, z, t) = +\frac{1\ ur\_y\ \max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}{chi^{1.500000000000000}} \tag{400}$$

Auxiliary analysis variable equation

$$dSigma\_z = Op(x, y, z, t) \tag{401}$$

$$Op(x, y, z, t) = +\frac{1\ ur\_z\ \max\{0.0000000001, \sqrt{x^2 + y^2 + z^2}\}}{chi^{1.5000000000000000}} \tag{402}$$

Auxiliary analysis variable equation

$$Td\_tt = Op(x, y, z, t) \tag{403}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +g4d\_tt^2\ Tu\_tt + 2\ g4d\_tx\ g4d\_tt\ Tu\_tx + 2\ g4d\_ty\ g4d\_tt\ Tu\_ty \\ & + 2\ g4d\_tz\ g4d\_tt\ Tu\_tz + g4d\_tx^2\ Tu\_xx \\ & + 2\ g4d\_ty\ g4d\_tx\ Tu\_xy + 2\ g4d\_tz\ g4d\_tx\ Tu\_xz \\ & + g4d\_ty^2\ Tu\_yy + 2\ g4d\_tz\ g4d\_ty\ Tu\_yz + g4d\_tz^2\ Tu\_zz \end{aligned} \tag{404}$$

Auxiliary analysis variable equation

$$Td\_tx = Op(x, y, z, t) \tag{405}$$

$$\begin{aligned} Op(x, y, z, t) = {} & +g4d\_tt\ g4d\_tx\ Tu\_tt + g4d\_tx^2\ Tu\_tx + g4d\_ty\ g4d\_tx\ Tu\_ty \\ & + g4d\_tz\ g4d\_tx\ Tu\_tz + g4d\_tt\ g4d\_xx\ Tu\_tx + g4d\_tx\ g4d\_xx\ Tu\_xx \\ & + g4d\_ty\ g4d\_xx\ Tu\_xy + g4d\_tz\ g4d\_xx\ Tu\_xz \\ & + g4d\_tt\ g4d\_xy\ Tu\_ty + g4d\_tx\ g4d\_xy\ Tu\_xy + g4d\_ty\ g4d\_xy\ Tu\_yy \\ & + g4d\_tz\ g4d\_xy\ Tu\_yz + g4d\_tt\ g4d\_xz\ Tu\_tz + g4d\_tx\ g4d\_xz\ Tu\_xz \\ & + g4d\_ty\ g4d\_xz\ Tu\_yz + g4d\_tz\ g4d\_xz\ Tu\_zz \end{aligned} \tag{406}$$

Auxiliary analysis variable equation

$$Td\_ty = Op(x, y, z, t) \tag{407}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_tt\ g4d\_ty\ Tu\_tt + g4d\_tx\ g4d\_ty\ Tu\_tx + g4d\_ty^2\ Tu\_ty \\
&+ g4d\_tz\ g4d\_ty\ Tu\_tz + g4d\_tt\ g4d\_xy\ Tu\_tx + g4d\_tx\ g4d\_xy\ Tu\_xx \\
&+ g4d\_ty\ g4d\_xy\ Tu\_xy + g4d\_tz\ g4d\_xy\ Tu\_xz \\
&+ g4d\_tt\ g4d\_yy\ Tu\_ty + g4d\_tx\ g4d\_yy\ Tu\_xy + g4d\_ty\ g4d\_yy\ Tu\_yy \\
&+ g4d\_tz\ g4d\_yy\ Tu\_yz + g4d\_tt\ g4d\_yz\ Tu\_tz + g4d\_tx\ g4d\_yz\ Tu\_xz \\
&+ g4d\_ty\ g4d\_yz\ Tu\_yz + g4d\_tz\ g4d\_yz\ Tu\_zz
\end{aligned}
\tag{408}
$$

Auxiliary analysis variable equation

$$Td\_tz = Op(x,y,z,t) \tag{409}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_tt\ g4d\_tz\ Tu\_tt + g4d\_tx\ g4d\_tz\ Tu\_tx + g4d\_ty\ g4d\_tz\ Tu\_ty \\
&+ g4d\_tz^2\ Tu\_tz + g4d\_tt\ g4d\_xz\ Tu\_tx + g4d\_tx\ g4d\_xz\ Tu\_xx \\
&+ g4d\_ty\ g4d\_xz\ Tu\_xy + g4d\_tz\ g4d\_xz\ Tu\_xz \\
&+ g4d\_tt\ g4d\_yz\ Tu\_ty + g4d\_tx\ g4d\_yz\ Tu\_xy + g4d\_ty\ g4d\_yz\ Tu\_yy \\
&+ g4d\_tz\ g4d\_yz\ Tu\_yz + g4d\_tt\ g4d\_zz\ Tu\_tz + g4d\_tx\ g4d\_zz\ Tu\_xz \\
&+ g4d\_ty\ g4d\_zz\ Tu\_yz + g4d\_tz\ g4d\_zz\ Tu\_zz
\end{aligned}
\tag{410}
$$

Auxiliary analysis variable equation

$$Td\_xx = Op(x,y,z,t) \tag{411}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_tx^2\ Tu\_tt + 2\ g4d\_xx\ g4d\_tx\ Tu\_tx + 2\ g4d\_xy\ g4d\_tx\ Tu\_ty \\
&+ 2\ g4d\_xz\ g4d\_tx\ Tu\_tz + g4d\_xx^2\ Tu\_xx \\
&+ 2\ g4d\_xy\ g4d\_xx\ Tu\_xy + 2\ g4d\_xz\ g4d\_xx\ Tu\_xz \\
&+ g4d\_xy^2\ Tu\_yy + 2\ g4d\_xz\ g4d\_xy\ Tu\_yz + g4d\_xz^2\ Tu\_zz
\end{aligned}
\tag{412}
$$

Auxiliary analysis variable equation

$$Td\_xy = Op(x,y,z,t) \tag{413}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_tx\ g4d\_ty\ Tu\_tt + g4d\_xx\ g4d\_ty\ Tu\_tx + g4d\_xy\ g4d\_ty\ Tu\_ty \\
&+ g4d\_xz\ g4d\_ty\ Tu\_tz + g4d\_tx\ g4d\_xy\ Tu\_tx \\
&+ g4d\_xx\ g4d\_xy\ Tu\_xx + g4d\_xy^2\ Tu\_xy + g4d\_xz\ g4d\_xy\ Tu\_xz \\
&+ g4d\_tx\ g4d\_yy\ Tu\_ty + g4d\_xx\ g4d\_yy\ Tu\_xy \\
&+ g4d\_xy\ g4d\_yy\ Tu\_yy + g4d\_xz\ g4d\_yy\ Tu\_yz \\
&+ g4d\_tx\ g4d\_yz\ Tu\_tz + g4d\_xx\ g4d\_yz\ Tu\_xz \\
&+ g4d\_xy\ g4d\_yz\ Tu\_yz + g4d\_xz\ g4d\_yz\ Tu\_zz
\end{aligned}
\tag{414}
$$

Auxiliary analysis variable equation

$$
Td\_xz = Op(x,y,z,t) \tag{415}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_tx\ g4d\_tz\ Tu\_tt + g4d\_xx\ g4d\_tz\ Tu\_tx + g4d\_xy\ g4d\_tz\ Tu\_ty \\
&+ g4d\_xz\ g4d\_tz\ Tu\_tz + g4d\_tx\ g4d\_xz\ Tu\_tx \\
&+ g4d\_xx\ g4d\_xz\ Tu\_xx + g4d\_xy\ g4d\_xz\ Tu\_xy \\
&+ g4d\_xz^2\ Tu\_xz + g4d\_tx\ g4d\_yz\ Tu\_ty + g4d\_xx\ g4d\_yz\ Tu\_xy \\
&+ g4d\_xy\ g4d\_yz\ Tu\_yy + g4d\_xz\ g4d\_yz\ Tu\_yz \\
&+ g4d\_tx\ g4d\_zz\ Tu\_tz + g4d\_xx\ g4d\_zz\ Tu\_xz \\
&+ g4d\_xy\ g4d\_zz\ Tu\_yz + g4d\_xz\ g4d\_zz\ Tu\_zz
\end{aligned}
\tag{416}
$$

Auxiliary analysis variable equation

$$
Td\_yy = Op(x,y,z,t) \tag{417}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+g4d\_ty^2\ Tu\_tt + 2\ g4d\_xy\ g4d\_ty\ Tu\_tx + 2\ g4d\_yy\ g4d\_ty\ Tu\_ty \\
&+ 2\ g4d\_yz\ g4d\_ty\ Tu\_tz + g4d\_xy^2\ Tu\_xx \\
&+ 2\ g4d\_yy\ g4d\_xy\ Tu\_xy + 2\ g4d\_yz\ g4d\_xy\ Tu\_xz \\
&+ g4d\_yy^2\ Tu\_yy + 2\ g4d\_yz\ g4d\_yy\ Tu\_yz + g4d\_yz^2\ Tu\_zz
\end{aligned}
\tag{418}
$$

Auxiliary analysis variable equation

$$
Td\_yz = Op(x,y,z,t) \tag{419}
$$

$$\begin{aligned} Op(x,y,z,t) = &+g4d\_ty\ g4d\_tz\ Tu\_tt + g4d\_xy\ g4d\_tz\ Tu\_tx + g4d\_yy\ g4d\_tz\ Tu\_ty \\ &+ g4d\_yz\ g4d\_tz\ Tu\_tz + g4d\_ty\ g4d\_xz\ Tu\_tx \\ &+ g4d\_xy\ g4d\_xz\ Tu\_xx + g4d\_yy\ g4d\_xz\ Tu\_xy \\ &+ g4d\_yz\ g4d\_xz\ Tu\_xz + g4d\_ty\ g4d\_yz\ Tu\_ty \\ &+ g4d\_xy\ g4d\_yz\ Tu\_xy + g4d\_yy\ g4d\_yz\ Tu\_yy \\ &+ g4d\_yz^2\ Tu\_yz + g4d\_ty\ g4d\_zz\ Tu\_tz + g4d\_xy\ g4d\_zz\ Tu\_xz \\ &+ g4d\_yy\ g4d\_zz\ Tu\_yz + g4d\_yz\ g4d\_zz\ Tu\_zz \end{aligned} \tag{420}$$

Auxiliary analysis variable equation

$$Td\_zz = Op(x,y,z,t) \tag{421}$$

$$\begin{aligned} Op(x,y,z,t) = &+g4d\_tz^2\ Tu\_tt + 2\ g4d\_xz\ g4d\_tz\ Tu\_tx + 2\ g4d\_yz\ g4d\_tz\ Tu\_ty \\ &+ 2\ g4d\_zz\ g4d\_tz\ Tu\_tz + g4d\_xz^2\ Tu\_xx \\ &+ 2\ g4d\_yz\ g4d\_xz\ Tu\_xy + 2\ g4d\_zz\ g4d\_xz\ Tu\_xz \\ &+ g4d\_yz^2\ Tu\_yy + 2\ g4d\_zz\ g4d\_yz\ Tu\_yz + g4d\_zz^2\ Tu\_zz \end{aligned} \tag{422}$$

Auxiliary analysis variable equation

$$TT = Op(x,y,z,t) \tag{423}$$

$$\begin{aligned} Op(x,y,z,t) = &+g4d\_tt\ Tu\_tt + 2\ g4d\_tx\ Tu\_tx + 2\ g4d\_ty\ Tu\_ty + 2\ g4d\_tz\ Tu\_tz \\ &+ g4d\_xx\ Tu\_xx + 2\ g4d\_xy\ Tu\_xy + 2\ g4d\_xz\ Tu\_xz \\ &+ g4d\_yy\ Tu\_yy + 2\ g4d\_yz\ Tu\_yz + g4d\_zz\ Tu\_zz \end{aligned} \tag{424}$$

Auxiliary analysis variable equation

$$EWeyl\_xx = Op(x,y,z,t) \tag{425}$$

$$\begin{aligned} Op(x,y,z,t) = &+ (-inv\_chi\ Rpd\_xx) + (-Rtd\_xx) \\ &+ inv\_chi\ \ (Atd\_xx\ Atud\_xx + Atd\_xy\ Atud\_yx + Atd\_xz\ Atud\_zx) \\ &+ (-0.333333333333333\ inv\_chi\ trK\ Atd\_xx) \\ &+ (-0.222222222222222\ inv\_chi\ gtd\_xx\ trK^2) \end{aligned} \tag{426}$$

Auxiliary analysis variable equation

$$EWeyl\_xy = Op(x,y,z,t) \tag{427}$$

$$\begin{aligned} Op(x,y,z,t) = &+ (-inv\_chi\ Rpd\_xy) + (-Rtd\_xy) \\ &+ inv\_chi\ \ (Atd\_xx\ Atud\_xy + Atd\_xy\ Atud\_yy + Atd\_xz\ Atud\_zy) \\ &+ (-0.333333333333333\ inv\_chi\ trK\ Atd\_xy) \\ &+ (-0.222222222222222\ inv\_chi\ gtd\_xy\ trK^2) \end{aligned} \tag{428}$$

Auxiliary analysis variable equation

$$EWeyl\_xz = Op(x,y,z,t) \tag{429}$$

$$\begin{aligned} Op(x,y,z,t) = &+ (-inv\_chi\ Rpd\_xz) + (-Rtd\_xz) \\ &+ inv\_chi\ \ (Atd\_xx\ Atud\_xz + Atd\_xy\ Atud\_yz + Atd\_xz\ Atud\_zz) \\ &+ (-0.333333333333333\ inv\_chi\ trK\ Atd\_xz) \\ &+ (-0.222222222222222\ inv\_chi\ gtd\_xz\ trK^2) \end{aligned} \tag{430}$$

Auxiliary analysis variable equation

$$EWeyl\_yy = Op(x,y,z,t) \tag{431}$$

$$\begin{aligned} Op(x,y,z,t) = &+ (-inv\_chi\ Rpd\_yy) + (-Rtd\_yy) \\ &+ inv\_chi\ \ (Atd\_xy\ Atud\_xy + Atd\_yy\ Atud\_yy + Atd\_yz\ Atud\_zy) \\ &+ (-0.333333333333333\ inv\_chi\ trK\ Atd\_yy) \\ &+ (-0.222222222222222\ inv\_chi\ gtd\_yy\ trK^2) \end{aligned} \tag{432}$$

Auxiliary analysis variable equation

$$EWeyl\_yz = Op(x, y, z, t) \tag{433}$$

$$\begin{aligned} Op(x, y, z, t) = &+ (-inv\_chi\ Rpd\_yz) + (-Rtd\_yz) \\ &+ inv\_chi\ \ (Atd\_xy\ Atud\_xz + Atd\_yy\ Atud\_yz + Atd\_yz\ Atud\_zz) \\ &+ (-0.3333333333333333\ inv\_chi\ trK\ Atd\_yz) \\ &+ (-0.2222222222222222\ inv\_chi\ gtd\_yz\ trK^2) \end{aligned} \tag{434}$$

Auxiliary analysis variable equation

$$EWeyl\_zz = Op(x, y, z, t) \tag{435}$$

$$\begin{aligned} Op(x, y, z, t) = &+ (-inv\_chi\ Rpd\_zz) + (-Rtd\_zz) \\ &+ inv\_chi\ \ (Atd\_xz\ Atud\_xz + Atd\_yz\ Atud\_yz + Atd\_zz\ Atud\_zz) \\ &+ (-0.3333333333333333\ inv\_chi\ trK\ Atd\_zz) \\ &+ (-0.2222222222222222\ inv\_chi\ gtd\_zz\ trK^2) \end{aligned} \tag{436}$$

Auxiliary analysis variable equation

$$Del\_Kd\_xxx = Op(x, y, z, t) \tag{437}$$

$$\begin{aligned} Op(x, y, z, t) = &+ inv\_chi\ \partial_x Atd\_xx \\ &- inv\_chi\ \ (2\ Atd\_xx\ Ct\_xxx + 2\ Atd\_xy\ Ct\_yxx + 2\ Atd\_xz\ Ct\_zxx) \\ &+ 0.3333333333333333\ inv\_chi\ gtd\_xx\ \partial_x trK \\ &+ 1.0\ inv\_chi^2\ Atd\_xx\ \partial_x chi - 1.0\ inv\_chi^2\ gtd\_xx\ Atud\_xx\ \partial_x chi \\ &- 1.0\ inv\_chi^2\ gtd\_xx\ Atud\_yx\ \partial_y chi \\ &- 1.0\ inv\_chi^2\ gtd\_xx\ Atud\_zx\ \partial_z chi \end{aligned} \tag{438}$$

Auxiliary analysis variable equation

$$Del\_Kd\_xxy = Op(x, y, z, t) \tag{439}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_x Atd\_xy \\
&- inv\_chi\ (Atd\_xy\ Ct\_xxx + Atd\_xx\ Ct\_xxy + Atd\_yy\ Ct\_yxx \\
&\qquad + Atd\_xy\ Ct\_yxy + Atd\_yz\ Ct\_zxx + Atd\_xz\ Ct\_zxy) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_xy\ \partial_x trK \\
&+ 0.5\ inv\_chi^2\ Atd\_xy\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xx\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_xy\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_yy\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_zy\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_xx\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_yx\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{440}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_xxz = Op(x,y,z,t) \tag{441}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_x Atd\_xz \\
&- inv\_chi\ (Atd\_xz\ Ct\_xxx + Atd\_xx\ Ct\_xxz + Atd\_yz\ Ct\_yxx \\
&\qquad + Atd\_xy\ Ct\_yxz + Atd\_zz\ Ct\_zxx + Atd\_xz\ Ct\_zxz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_xz\ \partial_x trK \\
&+ 0.5\ inv\_chi^2\ Atd\_xz\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xx\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_xz\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_yz\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xx\ Atud\_zz\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_xx\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_yx\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{442}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_yxx = Op(x,y,z,t) \tag{443}
$$

$$
\begin{aligned}
Op(x,y,z,t) = {} & +inv\_chi\ \partial_y Atd\_xx \\
& - inv\_chi\ \left(2\ Atd\_xx\ Ct\_xxy + 2\ Atd\_xy\ Ct\_yxy + 2\ Atd\_xz\ Ct\_zxy\right) \\
& + 0.3333333333333333\ inv\_chi\ gtd\_xx\ \partial_y trK \\
& + 1.0\ inv\_chi^2\ Atd\_xy\ \partial_x chi - 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_xx\ \partial_x chi \\
& - 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_yx\ \partial_y chi \\
& - 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{444}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_yxy = Op(x,y,z,t) \tag{445}
$$

$$
\begin{aligned}
Op(x,y,z,t) = {} & +inv\_chi\ \partial_y Atd\_xy \\
& - inv\_chi\ \left(Atd\_xy\ Ct\_xxy + Atd\_xx\ Ct\_xyy + Atd\_yy\ Ct\_yxy \right. \\
& \qquad \left. + Atd\_xy\ Ct\_yyy + Atd\_yz\ Ct\_zxy + Atd\_xz\ Ct\_zyy\right) \\
& + 0.3333333333333333\ inv\_chi\ gtd\_xy\ \partial_y trK \\
& + 0.5\ inv\_chi^2\ Atd\_yy\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xy\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_xy\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_yy\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_zy\ \partial_z chi \\
& - 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_xx\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_yx\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{446}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_yxz = Op(x,y,z,t) \tag{447}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_y Atd\_xz - inv\_chi\ (Atd\_xz\ Ct\_xxy + Atd\_xx\ Ct\_xyz \\
&+ Atd\_yz\ Ct\_yxy + Atd\_xy\ Ct\_yyz + Atd\_zz\ Ct\_zxy + Atd\_xz\ Ct\_zyz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_xz\ \partial_y trK \\
&+ 0.5\ inv\_chi^2\ Atd\_yz\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xy\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_xz\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_yz\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_zz\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_xx\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_yx\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{448}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_zxx = Op(x,y,z,t) \tag{449}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_z Atd\_xx \\
&- inv\_chi\ (2\ Atd\_xx\ Ct\_xxz + 2\ Atd\_xy\ Ct\_yxz + 2\ Atd\_xz\ Ct\_zxz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_xx\ \partial_z trK \\
&+ 1.0\ inv\_chi^2\ Atd\_xz\ \partial_x chi - 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_xx\ \partial_x chi \\
&- 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_yx\ \partial_y chi \\
&- 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{450}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_zxy = Op(x,y,z,t) \tag{451}
$$

$$
\begin{aligned}
Op(x,y,z,t) = {} & +inv\_chi\ \partial_z Atd\_xy - inv\_chi\ (Atd\_xy\ Ct\_xxz + Atd\_xx\ Ct\_xyz \\
& + Atd\_yy\ Ct\_yxz + Atd\_xy\ Ct\_yyz + Atd\_yz\ Ct\_zxz + Atd\_xz\ Ct\_zyz) \\
& + 0.3333333333333333\ inv\_chi\ gtd\_xy\ \partial_z trK \\
& + 0.5\ inv\_chi^2\ Atd\_yz\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xz\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_xy\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_yy\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_zy\ \partial_z chi \\
& - 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_xx\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_yx\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{452}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_zxz = Op(x,y,z,t) \tag{453}
$$

$$
\begin{aligned}
Op(x,y,z,t) = {} & +inv\_chi\ \partial_z Atd\_xz - inv\_chi\ (Atd\_xz\ Ct\_xxz + Atd\_xx\ Ct\_xzz \\
& + Atd\_yz\ Ct\_yxz + Atd\_xy\ Ct\_yzz + Atd\_zz\ Ct\_zxz + Atd\_xz\ Ct\_zzz) \\
& + 0.3333333333333333\ inv\_chi\ gtd\_xz\ \partial_z trK \\
& + 0.5\ inv\_chi^2\ Atd\_zz\ \partial_x chi + 0.5\ inv\_chi^2\ Atd\_xz\ \partial_z chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_xz\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_yz\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_zz\ \partial_z chi \\
& - 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_xx\ \partial_x chi \\
& - 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_yx\ \partial_y chi \\
& - 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_zx\ \partial_z chi
\end{aligned}
\tag{454}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_xyy = Op(x,y,z,t) \tag{455}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_x Atd\_yy \\
&- inv\_chi\ \left(2\ Atd\_xy\ Ct\_xxy + 2\ Atd\_yy\ Ct\_yxy + 2\ Atd\_yz\ Ct\_zxy\right) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_yy\ \partial_x trK \\
&+ 1.0\ inv\_chi^2\ Atd\_xy\ \partial_y chi - 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_xy\ \partial_x chi \\
&- 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_yy\ \partial_y chi \\
&- 1.0\ inv\_chi^2\ gtd\_xy\ Atud\_zy\ \partial_z chi
\end{aligned}
\tag{456}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_xyz = Op(x,y,z,t) \tag{457}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_x Atd\_yz - inv\_chi\ \left(Atd\_xz\ Ct\_xxy + Atd\_xy\ Ct\_xxz\right. \\
&\left.+Atd\_yz\ Ct\_yxy + Atd\_yy\ Ct\_yxz + Atd\_zz\ Ct\_zxy + Atd\_yz\ Ct\_zxz\right) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_yz\ \partial_x trK \\
&+ 0.5\ inv\_chi^2\ Atd\_xz\ \partial_y chi + 0.5\ inv\_chi^2\ Atd\_xy\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_xz\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_yz\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xy\ Atud\_zz\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_xy\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_yy\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_xz\ Atud\_zy\ \partial_z chi
\end{aligned}
\tag{458}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_yyy = Op(x,y,z,t) \tag{459}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_y Atd\_yy \\
&- inv\_chi\ \left(2\ Atd\_xy\ Ct\_xyy + 2\ Atd\_yy\ Ct\_yyy + 2\ Atd\_yz\ Ct\_zyy\right) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_yy\ \partial_y trK \\
&+ 1.0\ inv\_chi^2\ Atd\_yy\ \partial_y chi - 1.0\ inv\_chi^2\ gtd\_yy\ Atud\_xy\ \partial_x chi \\
&- 1.0\ inv\_chi^2\ gtd\_yy\ Atud\_yy\ \partial_y chi \\
&- 1.0\ inv\_chi^2\ gtd\_yy\ Atud\_zy\ \partial_z chi
\end{aligned}
\tag{460}
$$

Auxiliary analysis variable equation

$$Del\_Kd\_yyz = Op(x, y, z, t) \tag{461}$$

$$\begin{aligned} Op(x, y, z, t) = &+inv\_chi\ \partial_y Atd\_yz - inv\_chi\ (Atd\_xz\ Ct\_xyy + Atd\_xy\ Ct\_xyz \\ &+ Atd\_yz\ Ct\_yyy + Atd\_yy\ Ct\_yyz + Atd\_zz\ Ct\_zyy + Atd\_yz\ Ct\_zyz) \\ &+ 0.3333333333333333\ inv\_chi\ gtd\_yz\ \partial_y trK \\ &+ 0.5\ inv\_chi^2\ Atd\_yz\ \partial_y chi + 0.5\ inv\_chi^2\ Atd\_yy\ \partial_z chi \\ &- 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_xz\ \partial_x chi \\ &- 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_yz\ \partial_y chi \\ &- 0.5\ inv\_chi^2\ gtd\_yy\ Atud\_zz\ \partial_z chi \\ &- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_xy\ \partial_x chi \\ &- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_yy\ \partial_y chi \\ &- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_zy\ \partial_z chi \end{aligned} \tag{462}$$

Auxiliary analysis variable equation

$$Del\_Kd\_zyy = Op(x, y, z, t) \tag{463}$$

$$\begin{aligned} Op(x, y, z, t) = &+inv\_chi\ \partial_z Atd\_yy \\ &- inv\_chi\ (2\ Atd\_xy\ Ct\_xyz + 2\ Atd\_yy\ Ct\_yyz + 2\ Atd\_yz\ Ct\_zyz) \\ &+ 0.3333333333333333\ inv\_chi\ gtd\_yy\ \partial_z trK \\ &+ 1.0\ inv\_chi^2\ Atd\_yz\ \partial_y chi - 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_xy\ \partial_x chi \\ &- 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_yy\ \partial_y chi \\ &- 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_zy\ \partial_z chi \end{aligned} \tag{464}$$

Auxiliary analysis variable equation

$$Del\_Kd\_zyz = Op(x, y, z, t) \tag{465}$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_z Atd\_yz - inv\_chi\ (Atd\_xz\ Ct\_xyz + Atd\_xy\ Ct\_xzz \\
&+ Atd\_yz\ Ct\_yyz + Atd\_yy\ Ct\_yzz + Atd\_zz\ Ct\_zyz + Atd\_yz\ Ct\_zzz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_yz\ \partial_z trK \\
&+ 0.5\ inv\_chi^2\ Atd\_zz\ \partial_y chi + 0.5\ inv\_chi^2\ Atd\_yz\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_xz\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_yz\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_yz\ Atud\_zz\ \partial_z chi \\
&- 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_xy\ \partial_x chi \\
&- 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_yy\ \partial_y chi \\
&- 0.5\ inv\_chi^2\ gtd\_zz\ Atud\_zy\ \partial_z chi
\end{aligned}
\tag{466}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_xzz = Op(x,y,z,t) \tag{467}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_x Atd\_zz \\
&- inv\_chi\ (2\ Atd\_xz\ Ct\_xxz + 2\ Atd\_yz\ Ct\_yxz + 2\ Atd\_zz\ Ct\_zxz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_zz\ \partial_x trK \\
&+ 1.0\ inv\_chi^2\ Atd\_xz\ \partial_z chi - 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_xz\ \partial_x chi \\
&- 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_yz\ \partial_y chi \\
&- 1.0\ inv\_chi^2\ gtd\_xz\ Atud\_zz\ \partial_z chi
\end{aligned}
\tag{468}
$$

Auxiliary analysis variable equation

$$
Del\_Kd\_yzz = Op(x,y,z,t) \tag{469}
$$

$$
\begin{aligned}
Op(x,y,z,t) = &+inv\_chi\ \partial_y Atd\_zz \\
&- inv\_chi\ (2\ Atd\_xz\ Ct\_xyz + 2\ Atd\_yz\ Ct\_yyz + 2\ Atd\_zz\ Ct\_zyz) \\
&+ 0.3333333333333333\ inv\_chi\ gtd\_zz\ \partial_y trK \\
&+ 1.0\ inv\_chi^2\ Atd\_yz\ \partial_z chi - 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_xz\ \partial_x chi \\
&- 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_yz\ \partial_y chi \\
&- 1.0\ inv\_chi^2\ gtd\_yz\ Atud\_zz\ \partial_z chi
\end{aligned}
\tag{470}
$$

Auxiliary analysis variable equation

$$Del\_Kd\_zzz = Op(x,y,z,t) \tag{471}$$

$$\begin{aligned} Op(x,y,z,t) = &+inv\_chi\ \partial_z Atd\_zz \\ &- inv\_chi\ \left(2\ Atd\_xz\ Ct\_xzz + 2\ Atd\_yz\ Ct\_yzz + 2\ Atd\_zz\ Ct\_zzz\right) \\ &+ 0.3333333333333333\ inv\_chi\ gtd\_zz\ \partial_z trK \\ &+ 1.0\ inv\_chi^2\ Atd\_zz\ \partial_z chi - 1.0\ inv\_chi^2\ gtd\_zz\ Atud\_xz\ \partial_x chi \\ &- 1.0\ inv\_chi^2\ gtd\_zz\ Atud\_yz\ \partial_y chi \\ &- 1.0\ inv\_chi^2\ gtd\_zz\ Atud\_zz\ \partial_z chi \end{aligned} \tag{472}$$

Auxiliary analysis variable equation

$$BWeyl\_xx = Op(x,y,z,t) \tag{473}$$

$$\begin{aligned} Op(x,y,z,t) = &+\left(-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yxx\right) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zxx \\ &+ gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_xxy + \left(-gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_zxy\right) \\ &+ \left(-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_xxz\right) + gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_yxz \end{aligned} \tag{474}$$

Auxiliary analysis variable equation

$$BWeyl\_xy = Op(x,y,z,t) \tag{475}$$

$$\begin{aligned} Op(x,y,z,t) = &+\left(-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yxy\right) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zxy \\ &+ gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_xyy + \left(-gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_zyy\right) \\ &+ \left(-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_xyz\right) + gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_yyz \end{aligned} \tag{476}$$

Auxiliary analysis variable equation

$$BWeyl\_xz = Op(x,y,z,t) \tag{477}$$

$$Op(x,y,z,t) = +(-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yxz) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zxz + gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_xyz + (-gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_zyz) + (-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_xzz) + gtd\_xx\ inv\_chi^{2.5}\ Del\_Kd\_yzz \tag{478}$$

Auxiliary analysis variable equation

$$BWeyl\_yx = Op(x,y,z,t) \tag{479}$$

$$Op(x,y,z,t) = +(-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_yxx) + gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_zxx + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xxy + (-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zxy) + (-gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_xxz) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_yxz \tag{480}$$

Auxiliary analysis variable equation

$$BWeyl\_yy = Op(x,y,z,t) \tag{481}$$

$$Op(x,y,z,t) = +(-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_yxy) + gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_zxy + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xyy + (-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zyy) + (-gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_xyz) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_yyz \tag{482}$$

Auxiliary analysis variable equation

$$BWeyl\_yz = Op(x,y,z,t) \tag{483}$$

$$Op(x,y,z,t) = +(-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_yxz) + gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_zxz + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xyz + (-gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_zyz) + (-gtd\_yy\ inv\_chi^{2.5}\ Del\_Kd\_xzz) + gtd\_xy\ inv\_chi^{2.5}\ Del\_Kd\_yzz \tag{484}$$

Auxiliary analysis variable equation

$$BWeyl\_zx = Op(x, y, z, t) \tag{485}$$

$$\begin{aligned} Op(x, y, z, t) = &+ (-gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_yxx) + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_zxx \\ &+ gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_xxy + (-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_zxy) \\ &+ (-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xxz) + gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yxz \end{aligned} \tag{486}$$

Auxiliary analysis variable equation

$$BWeyl\_zy = Op(x, y, z, t) \tag{487}$$

$$\begin{aligned} Op(x, y, z, t) = &+ (-gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_yxy) + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_zxy \\ &+ gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_xyy + (-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_zyy) \\ &+ (-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xyz) + gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yyz \end{aligned} \tag{488}$$

Auxiliary analysis variable equation

$$BWeyl\_zz = Op(x, y, z, t) \tag{489}$$

$$\begin{aligned} Op(x, y, z, t) = &+ (-gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_yxz) + gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_zxz \\ &+ gtd\_zz\ inv\_chi^{2.5}\ Del\_Kd\_xyz + (-gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_zyz) \\ &+ (-gtd\_yz\ inv\_chi^{2.5}\ Del\_Kd\_xzz) + gtd\_xz\ inv\_chi^{2.5}\ Del\_Kd\_yzz \end{aligned} \tag{490}$$

Auxiliary analysis variable equation

$$mmR\_xx = Op(x, y, z, t) \tag{491}$$

$$Op(x, y, z, t) = + (-0.5\ vph\_x^2) + 0.5\ vth\_x^2 \tag{492}$$

Auxiliary analysis variable equation

$$mmR\_xy = Op(x, y, z, t) \tag{493}$$

$$Op(x, y, z, t) = +(-0.5\ vph\_x\ vph\_y) + 0.5\ vth\_x\ vth\_y \tag{494}$$

Auxiliary analysis variable equation

$$mmR\_xz = Op(x, y, z, t) \tag{495}$$

$$Op(x, y, z, t) = +(-0.5\ vph\_x\ vph\_z) + 0.5\ vth\_x\ vth\_z \tag{496}$$

Auxiliary analysis variable equation

$$mmR\_yy = Op(x, y, z, t) \tag{497}$$

$$Op(x, y, z, t) = +(-0.5\ vph\_y^2) + 0.5\ vth\_y^2 \tag{498}$$

Auxiliary analysis variable equation

$$mmR\_yz = Op(x, y, z, t) \tag{499}$$

$$Op(x, y, z, t) = +(-0.5\ vph\_y\ vph\_z) + 0.5\ vth\_y\ vth\_z \tag{500}$$

Auxiliary analysis variable equation

$$mmR\_zz = Op(x, y, z, t) \tag{501}$$

$$Op(x, y, z, t) = +(-0.5\ vph\_z^2) + 0.5\ vth\_z^2 \tag{502}$$

Auxiliary analysis variable equation

$$mmI\_xx = Op(x, y, z, t) \tag{503}$$

$$Op(x,y,z,t) = +(-1.0)\ \ vph\_x\ vth\_x \tag{504}$$

Auxiliary analysis variable equation

$$mmI\_xy = Op(x,y,z,t) \tag{505}$$

$$Op(x,y,z,t) = +(-0.5\ vph\_x\ vth\_y) + (-0.5\ vph\_y\ vth\_x) \tag{506}$$

Auxiliary analysis variable equation

$$mmI\_xz = Op(x,y,z,t) \tag{507}$$

$$Op(x,y,z,t) = +(-0.5\ vph\_x\ vth\_z) + (-0.5\ vph\_z\ vth\_x) \tag{508}$$

Auxiliary analysis variable equation

$$mmI\_yy = Op(x,y,z,t) \tag{509}$$

$$Op(x,y,z,t) = +(-1.0)\ \ vph\_y\ vth\_y \tag{510}$$

Auxiliary analysis variable equation

$$mmI\_yz = Op(x,y,z,t) \tag{511}$$

$$Op(x,y,z,t) = +(-0.5\ vph\_y\ vth\_z) + (-0.5\ vph\_z\ vth\_y) \tag{512}$$

Auxiliary analysis variable equation

$$mmI\_zz = Op(x,y,z,t) \tag{513}$$

$$Op(x,y,z,t) = +(-1.0)\ \ vph\_z\ vth\_z \tag{514}$$

Boundary conditions

Segments: main

Type: extrapolation
Axis: All
Side: All

Fields: $theta$, trK, chi, $Alpha$, $Betau\_z$, $Betau\_y$, $Betau\_x$, $Gamh\_z$, $Gamh\_y$, $Gamh\_x$, Atd_zz, Atd_yz, Atd_yy, Atd_xz, Atd_xy, Atd_xx, gtd_zz, gtd_yz, gtd_yy, gtd_xz, gtd_xy, gtd_xx

Type: flat
Axis: All
Side: All

Fields: Sfd_x, Sfd_y, Sfd_z, Bfu_x, Bfu_y, Bfu_z, Df, DYf, $tauf$, $phif$, ρf, Yef, Tf, vfd_x, vfd_y, vfd_z, pf, $epsf$, $sqcs$, qnu, rnu, $optdepthe$, $optdeptha$, $optdepthx$, $chie$, $chia$, $chix$, $t\_optdepthe$, $t\_optdeptha$, $t\_optdepthx$, t_chie, t_chia, t_chix, Efu_x, Efu_y, Efu_z, $TauN\_x$, $TauN\_y$, $TauN\_z$, $TauNe\_x$, $TauNe\_y$, $TauNe\_z$, $TauM\_xy$, $TauM\_xz$, $TauM\_yz$, $TauT\_xx$, $TauT\_xy$, $TauT\_xz$, $TauT\_yy$, $TauT\_yz$, $TauT\_zz$, $dpfdeps$, $dpfdrho$, $dpfdye$

Boundary precedences

1. x-Lower
2. x-Upper
3. y-Lower
4. y-Upper
5. z-Lower
6. z-Upper

Finalization Conditions

The condition is:

$$t \geq tend \tag{515}$$