The toefl project

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Abstract

This is a program for 2d isothermal blob simulations.

1 Equations

Currently you can choose between 5 slightly different sets of equations

$$\frac{\partial n}{\partial t} + \nabla \cdot (n\mathbf{u}_E) = 0 \tag{1}$$

$$\frac{\partial \rho}{\partial t} + \nabla \cdot (\rho\mathbf{u}_E) + \nabla \cdot (n(\mathbf{u}_\psi + \mathbf{u}_d + \mathbf{u}_g)) = 0 \tag{2}$$

$$\rho = \nabla \cdot (n\nabla_\perp \phi/\Omega B) \tag{3}$$

...

2 Structure of input file

File format: json

Name	Type	Example	Default	Description
n	integer	3	-	# x-y-polynomials
Nx	integer	100	-	# grid points in x
Ny	integer	100	-	# grid points in y
dt	integer	3.0	-	time step in units of c_s/rho_s
n_out	integer	3	-	# x-y polynomials in output
Nx_out	integer	100	-	# grid points in x in output fields
Ny_out	integer	100	-	# grid points in y in output fields
itstp	integer	2	-	steps between outputs

maxout	integer	100	-	# outputs excluding first
eps_pol	float	1e-6	-	accuracy of polarisation solver
eps_gamma	float	1e-7	-	accuracy of Gamma
eps_time	float	1e-10	-	accuracy of implicit time-stepper
curvature	float	0.00015	-	magnetic curvature
tau	float	1	-	Ti/Te (only in gyrofluid models)
nu_perp	float	5e-3	-	pependicular viscosity
amplitude	float	1.0	-	amplitude of the blob
sigma	float	10	-	blob variance in units of rho_s
posX	float	0.3	-	blob x-position in units of lx
posY	float	0.5	-	blob y-position in units of ly
lx	float	200	-	lx in units of rho_s
ly	float	200	-	ly in units of rho_s
friction	float	0	0	friction coefficient in gravity model
bc_x	char	”DIR”	-	boundary condition in x (one of PER, DIR, NEU, DIR_NEU or NEU_DIR)
bc_y	char	”PER”	-	boundary condition in y (one of PER, DIR, NEU, DIR_NEU or NEU_DIR)
equations	char	”global”	”global”	local, global, gravity_local, gravity_global, drift_global
boussinesq	bool	false	false	boussinesq approximation in global models true or false

The default value is taken if the value name is not found in the input file. If there is no default and the value is not found, the program exits with an error message.

3 Structure of output file

File Format: netcdf-4 /hdf5

Name	Type	Dimension	Description
inputfile	text attribute	1	verbose input file as a string
energy_time	Dataset	1	timesteps at which 1d variables are written
time	Dataset	1	time at which fields are written
x	Dataset	1	x-coordinate
y	Dataset	1	y-coordinate
electrons	Dataset	3	electon density (time, y, x)

ions	Dataset	3	ion density (time, y, x)
potential	Dataset	3	electric potential (time, y, x)
vorticity	Dataset	3	Laplacian of potential (time, y, x)
dEdt	Dataset	1	change of energy per time (energy_time)
dissipation	Dataset	1	diffusion integrals (energy_time)
energy	Dataset	1	total energy integral (energy_time)
mass	Dataset	1	mass integral (energy_time)

References

[1] M. Wiesenberger, M. Held, R. Kube and O.E. Garcia, Phys. Plasmas 24, 064502 (2017)

[2] R. Kube, O.E. Garcia, and M. Wiesenberger, Phys. Plasmas 23, 122303 (2016)

[3] M. Wiesenberger, J. Madsen, and A. Kendl, "Radial convection of finite ion temperature, high amplitude plasma blobs", Phys. Plasmas 21, 092301 (2014) (https://doi.org/10.1063/1.4894220)