

# Package ‘snapshot’

February 20, 2015

**Type** Package

**Title** Gadget N-body cosmological simulation code snapshot I/O utilities

**Version** 0.1.2

**Date** 2013-10-04

**Author** Aaron Robotham

**Maintainer** Aaron Robotham <aaron.robotham@uwa.edu.au>

**Description** Functions for reading and writing Gadget N-body snapshots. The Gadget code is popular in astronomy for running N-body / hydrodynamical cosmological and merger simulations. To find out more about Gadget see the main distribution page at [www.mpa-garching.mpg.de/gadget/](http://www.mpa-garching.mpg.de/gadget/)

**License** GPL-2

**Depends** R (>= 2.13)

**NeedsCompilation** no

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snapshot-package      *Gadget N-body cosmological simulation code snapshot I/O utilities ~~  
package title ~~*

---

### Description

Functions for reading and writing Gadget N-body snapshots. The Gadget code is popular in astronomy for running N-body / hydrodynamical cosmological and merger simulations. To find out more about Gadget see the main distribution page at [www.mpa-garching.mpg.de/gadget/](http://www.mpa-garching.mpg.de/gadget/)

### Details

Package: snapshot  
 Type: Package  
 Version: 0.1.2  
 Date: 2013-10-04  
 License: GPL-2

### Author(s)

Aaron Robotham

Maintainer: Aaron Robotham <aaron.robotham@uwa.edu.au>

### Examples

```
## Not run:
temp=snapread('snapshot_XXX')
temp$part[, 'x']=temp$part[, 'x']+10
snapwrite(temp$part, temp$head, 'snapshot_XXX_mod')

## End(Not run)
```

---

addhead      *Add header information to particle data*

---

### Description

Function to add required header information to a Gadget read particle dataframe. This has sensible defaults for a small galaxy merger style simulation

**Usage**

```
addhead(part, Npart = 2, Massarr = 0, Time = 0, z = 0, FlagSfr = 0,
FlagFeedback = 0, FlagCooling = 0, BoxSize = 0, OmegaM = 0, OmegaL = 0,
h = 1, FlagAge = 0, FlagMetals = 0, NallHW = 0, flag_entr_ics = 0)
```

**Arguments**

**part** Strictly speaking 'part' is passed through the function, but to make this a useful object 'part' should be a data.frame containing the main particle level information. Columns required are:

ID	particle ID
x	x position in units of Mpc
y	y position in units of Mpc
z	z position in units of Mpc
vx	x velocity in units of km/s
vy	y velocity in units of km/s
vz	z velocity in units of km/s
Mass	particle mass in units of Msun

<b>Npart</b>	The index on the Npart vector that should contain the particle number, where: gas [1] / collisionless particles [2:6]. The actual value is calculated based on the part data.frame provided with 'part', Nall is also calculated based on this number and not given as an option since the same index as Npart must be used
<b>Massarr</b>	The mass of the particles in the particle index provided to Npart
<b>Time</b>	Time of snapshot in units of km/s and kpc so 1 unit is ~10 Gyrs
<b>z</b>	Redshift of snapshot
<b>FlagSfr</b>	Star formation turned on/off
<b>FlagFeedback</b>	Feedback turned on/off
<b>FlagCooling</b>	Cooling turned on/off
<b>BoxSize</b>	Size of simulation box edge length in units of kpc
<b>OmegaM</b>	Omega matter of the simulation
<b>OmegaL</b>	Omega lambda of the simulation
<b>h</b>	Hubble constant divided by 100 used in the simulation
<b>FlagAge</b>	Stellar ages on/off
<b>FlagMetals</b>	Stellar metallicities on/off
<b>NallHW</b>	Tell Gadget to use large integers in the particle index provided to Npart- not usually necessary
<b>flag_entr_ics</b>	Entropy for gas on/off

**Details**

Nall is calculated based on Npart, and therefore it cannot be specified via an input argument. This increases the likelihood that a legal Gadget header will be produced.

**Value**

part	Strictly speaking 'part' is passed through the function, but to make this a useful object 'part' should be a data.frame containing the main particle level information. Assuming 'part' has been given a sensible input, columns provided are:																
	<table> <tr> <td>ID</td> <td>particle ID</td> </tr> <tr> <td>x</td> <td>x position in units of Mpc</td> </tr> <tr> <td>y</td> <td>y position in units of Mpc</td> </tr> <tr> <td>z</td> <td>z position in units of Mpc</td> </tr> <tr> <td>vx</td> <td>x velocity in units of km/s</td> </tr> <tr> <td>vy</td> <td>y velocity in units of km/s</td> </tr> <tr> <td>vz</td> <td>z velocity in units of km/s</td> </tr> <tr> <td>Mass</td> <td>particle mass in units of Msun</td> </tr> </table>	ID	particle ID	x	x position in units of Mpc	y	y position in units of Mpc	z	z position in units of Mpc	vx	x velocity in units of km/s	vy	y velocity in units of km/s	vz	z velocity in units of km/s	Mass	particle mass in units of Msun
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z	z position in units of Mpc																
vx	x velocity in units of km/s																
vy	y velocity in units of km/s																
vz	z velocity in units of km/s																
Mass	particle mass in units of Msun																
head	A list containing various header information as list elements. These are:																
Npart	Vector of length 6 containing the number of particles in this snapshot file, where: gas [1] / collisionless particles [2:6]																
Massarr	Vector of length 6 containing the particle masses for the respective particle types in Npart																
Time	Time of snapshot in units of km/s and kpc so 1 unit is ~10 Gyrs																
z	Redshift of snapshot																
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FlagFeedback	Feedback turned on/off																
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**Author(s)**

Aaron Robotham

**See Also**

[snapwrite](#), [snapread](#), [genparam](#)

**Examples**

```
## Not run:
tempadd=addhead(temp$part)

## End(Not run)
```

---

genparam	<i>Generates a Gadget paramter file</i>
----------	---

---

**Description**

Function to generator a legal Gadget paramter setup file. This has a sensible selection of defaults chosen for fairly small (non Cosmological) simulations.

**Usage**

```
genparam(ParamFile = "galaxy.param", ParamBase = "./HernTest/",
InitCondFile = "./HernStart.gdt", OutputDir = "./HernTest/", EnergyFile = "energy.txt",
InfoFile = "info.txt", TimingsFile = "timings.txt", CpuFile = "cpu.txt",
RestartFile = "restart", SnapshotFileBase = "snapshot",
OutputListFilename = "parameterfiles/output_list.txt", TimeLimitCPU = 36000,
ResubmitOn = 0, ResubmitCommand = "my-scriptfile", ICFormat = 1, SnapFormat = 1,
ComovingIntegrationOn = 0, TypeOfTimestepCriterion = 0, OutputListOn = 0,
PeriodicBoundariesOn = 0, TimeBegin = 0, TimeMax = 0.001, Omega0 = 0, OmegaLambda = 0,
OmegaBaryon = 0, HubbleParam = 1, BoxSize = 0, TimeBetSnapshot = 1e-05,
TimeOffFirstSnapshot = 0, CpuTimeBetRestartFile = 36000, TimeBetStatistics = 0.05,
NumFilesPerSnapshot = 1, NumFilesWrittenInParallel = 1, ErrTolIntAccuracy = 0.025,
CourantFac = 0.3, MaxSizeTimestep = 0.1, MinSizeTimestep = 0, ErrTolTheta = 0.5,
TypeOfOpeningCriterion = 1, ErrTolForceAcc = 0.005, TreeDomainUpdateFrequency = 0.1,
DesNumNgb = 32, MaxNumNgbDeviation = 8, ArtBulkViscConst = 1, InitGasTemp = 0,
MinGasTemp = 100, PartAllocFactor = 3.0, TreeAllocFactor = 4.8, BufferSize = 25,
UnitLength_in_cm = 3.085678e+21, UnitMass_in_g = 1.989e+43,
UnitVelocity_in_cm_per_s = 1e+05, GravityConstantInternal = 0,
MinGasHsm1Fractional = 0.25, SofteningGas = 1e-04, SofteningHalo = 1e-04,
SofteningDisk = 0.4, SofteningBulge = 0.8, SofteningStars = 0, SofteningBndry = 0.1,
SofteningGasMaxPhys = 1e-04, SofteningHaloMaxPhys = 1e-04, SofteningDiskMaxPhys = 0.4,
SofteningBulgeMaxPhys = 0.8, SofteningStarsMaxPhys = 0, SofteningBndryMaxPhys = 0.1,
MaxRMSDisplacementFac = 0.2, NFWConcentration = 10, VirialMass = 200, FlatRadius = 1e-05,
DeltaVir = 200, addNFW = FALSE)
```

**Arguments**

ParamFile	Name for the paramter file
ParamBase	Base file path for the paramter file
InitCondFile	Full path of file containing initial conditions

OutputDir	Base directory in which to put the major Gadget outputs, including snapshots etc
EnergyFile	Name to give energy file
InfoFile	Name to give info file
TimingsFile	Name to give timings file
CpuFile	Name to give CPU file
RestartFile	Name to give restart file
SnapshotFileBase	Base name for snapshots, appended by snapshot number
OutputListFilename	Name of file containing output times / expansion factors
TimeLimitCPU	Max CPU time to use for Gadget run
ResubmitOn	Flag to tell super-computer there is a resubmit file
ResubmitCommand	Specific to super-computer resubmit command
ICFormat	Initial conditions format: PUT OPTIONS IN TABLE HERE
SnapFormat	Snapshot format: PUT OPTIONS IN TABLE HERE
ComovingIntegrationOn	Allow for expansion of Universe
TypeOfTimestepCriterion	Type of particle integrator- leave at 0
OutputListOn	Flag to tell it to use OutputListFilename as input
PeriodicBoundariesOn	Flag to turn on/off periodic box boundaries, only needed for large cosmological runs
TimeBegin	Time at the beginning of simulation
TimeMax	Max time to evolve particles to
Omega0	Total energy density
OmegaLambda	Cosmological constant energy density
OmegaBaryon	Baryonic energy density
HubbleParam	Value of H0/100 to be used
BoxSize	Length of box edge (important for cosmological runs only)
TimeBetSnapshot	Time between snapshots
TimeOfFirstSnapshot	Time at which to output first snapshot
CpuTimeBetRestartFile	How often to output full restart file
TimeBetStatistics	Time between energy.txt updates

NumFilesPerSnapshot	How many files to split snapshots over
NumFilesWrittenInParallel	How many files to split snapshots over (probably ignore)
ErrTolIntAccuracy	Orbital integration accuracy
CourantFac	Limit on time step compared to sound crossing time for hydro runs
MaxSizeTimestep	Maximum time step allowed
MinSizeTimestep	Minimum time step allowed
ErrTolTheta	Controls the accuracy of integration (smaller is closer to direct N-body)
TypeOfOpeningCriterion	Barnes-Hut or modified opening criteria (probably ignore)
ErrTolForceAcc	Only used for modified opening criterion (use default)
TreeDomainUpdateFrequency	How often should a tree be constructed
DesNumNgb	Number of neighbours to use for density estimation in SPH
MaxNumNgbDeviation	How much tolerance is allowed when finding neighbours
ArtBulkViscConst	Artificial viscosity term (use default)
InitGasTemp	Initial gas temperature
MinGasTemp	Minimum gas temperature allowed in the run
PartAllocFactor	Memory buffer per particle per processor
TreeAllocFactor	Memory buffer for tree calculation
BufferSize	Total memory buffer between processors
UnitLength_in_cm	Assumed IC distance units in cm (default assumes Kpc for input)
UnitMass_in_g	Assumed mass of provided IC mass units in grams (default assumes 1e10 Msun for input)
UnitVelocity_in_cm_per_s	Assumed velocity of provided units in cm/s (default assumes km/s)
GravityConstantInternal	Internal units for g
MinGasHsm1Fractional	Minimum multiplicative factor for smoothing length in hydro gas
SofteningGas	Softening to use for gas particles
SofteningHalo	Softening to use for halo particles
SofteningDisk	Softening to use for disk particles

SofteningBulge	Softening to use for bulge particles
SofteningStars	Softening to use for star particles
SofteningBndry	Softening to use for boundary particles
SofteningGasMaxPhys	Physical softening to use for gas particles (only relevant for Cosmo run)
SofteningHaloMaxPhys	Physical softening to use for halo particles (only relevant for Cosmo run)
SofteningDiskMaxPhys	Physical softening to use for disk particles (only relevant for Cosmo run)
SofteningBulgeMaxPhys	Physical softening to use for bulge particles (only relevant for Cosmo run)
SofteningStarsMaxPhys	Physical softening to use for star particles (only relevant for Cosmo run)
SofteningBndryMaxPhys	Physical softening to use for boundary particles (only relevant for Cosmo run)
MaxRMSDisplacementFac	Biggest distance that a particle can move in a time step
NFWConcentration	Concentration of analytic NFW profile, addNFW must be set to TRUE
VirialMass	Mass within virial radius of analytic NFW profile, addNFW must be set to TRUE
FlatRadius	Forces the NFW profile to be cored (not cusped), addNFW must be set to TRUE
DeltaVir	Virial overdensity of NFW profile, addNFW must be set to TRUE
addNFW	Logic determining whether the analytic NFW specific paramters be added to the setup file? See above

**Value**

No value returned, called for the side-effect of writing out a Gadget paramter setup file.

**Author(s)**

Aaron Robotham

**See Also**

[snapwrite](#), [snapread](#), [addhead](#)

**Examples**

```
## Not run:
genparam('example.param', 'Demo/Example1/')

## End(Not run)
```



---

snapread	<i>Read in Gadget snapshots</i>
----------	---------------------------------

---

### Description

This function allows the user to read in the standard format Gadget binaries. It keeps the particle information and header information in separate components of a list.

### Usage

```
snapread(file)
```

### Arguments

file	The full path to the Gadget snapshot to be read in.
------	---

### Value

part	A data.frame containing the main particle level information. Columns included are:
------	--

ID	particle ID
x	x position in units of Mpc
y	y position in units of Mpc
z	z position in units of Mpc
vx	x velocity
vy	y velocity
vz	z velocity
Mass	particle mass in units of Msun

head	A list containing various header information as list elements. These are:
------	---

Npart	Vector of length 6 containing the number of particles in this snapshot file, where: gas [1] / collisionless particles [2:6]
Massarr	Vector of length 6 containing the particle masses for the respective particle types in Npart
Time	Time of snapshot in units of km/s and kpc so 1 unit is ~10 Gyrs
z	Redshift of snapshot
FlagSfr	Star formation turned on/off
Nall	Vector of length 6 containing the number of particles in all snapshot files, where: gas [1] / collisionless particles [2:6]
FlagFeedback	Feedback turned on/off
FlagCooling	Cooling turned on/off
NumFiles	Number of files per snapshot- usually 1
BoxSize	Size of simulation box edge length in units of kpc
OmegaM	Omega matter of the simulation

OmegaL	Omega lambda of the simulation
h	Hubble constant divided by 100 used in the simulation
FlagAge	Stellar ages on/off
FlagMetals	Stellar metallicities on/off
NallHW	Tell Gadget to use large integers for the respective particle types in Npart - not usually necessary
flag_entr_ics	Entropy for gas on/off

**Author(s)**

Aaron Robotham

**See Also**

[snapwrite](#), [addhead](#), [genparam](#)

**Examples**

```
## Not run:
temp=snapread('somepath/snapshot_XXX')

## End(Not run)
```

---

snapwrite

*Write in Gadget snapshots*

---

**Description**

This function allows the user to write standard format Gadget binaries. It can write the particle information and header information, which are provided as separate R objects.

**Usage**

```
snapwrite(part, head, file)
```

**Arguments**

`part` A data.frame containing the main particle level information. Columns required are:

ID	particle ID
x	x position in units of Mpc
y	y position in units of Mpc
z	z position in units of Mpc
vx	x velocity in units of km/s
vy	y velocity in units of km/s
vz	z velocity in units of km/s
Mass	particle mass in units of Msun

head	A list containing various header information as list elements. These are:
Npart	Vector of length 6 containing the number of particles in this snapshot file, where: gas [1] / collisionless particles [2:6]
Massarr	Vector of length 6 containing the particle masses for the respective particle types in Npart
Time	Time of snapshot in units of km/s and kpc so 1 unit is ~10 Gyrs
z	Redshift of snapshot
FlagSfr	Star formation turned on/off
Nall	Vector of length 6 containing the number of particles in all snapshot files, where: gas [1] / collisionless particles [2:6]
FlagFeedback	Feedback turned on/off
FlagCooling	Cooling turned on/off
NumFiles	Number of files per snapshot- usually 1
BoxSize	Size of simulation box edge length in units of kpc
OmegaM	Omega matter of the simulation
OmegaL	Omega lambda of the simulation
h	Hubble constant divided by 100 used in the simulation
FlagAge	Stellar ages on/off
FlagMetals	Stellar metallicities on/off
NallHW	Tell Gadget to use large integers for the respective particle types in Npart - not usually necessary
flag_entr_ics	Entropy for gas on/off
file	The full path to the Gadget snapshot to be created.

**Value**

No value returned, called for the side-effect of writing out a binary Gadget file.

**Author(s)**

Aaron Robotham

**See Also**

[snapread,addhead,genparam](#)

**Examples**

```
## Not run:
temp=snapwrite(snap$part,snap$head,'somepath/snapshot_XXX')

## End(Not run)
```

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