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# **Main differences from the original source files**

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# par\_ini.d

```

1 #####
2 ## parameters for COSMOS code #####
3 ## ver1.00 by Chulmoon Yoo #####
4 #####
5 999999 # maximum step of the main loop
6 400. # maximum time to evolve
7 3 # tab number of the bufer grids
8 10. # amp
9 -60 # minimum grid number of x = -nmax-1
10 60 # maximum grid number of x = imax/2-1
11 0 # minimum grid number of y
12 60 # maximum grid number of y
13 0 # minimum grid number of z
14 60 # maximum grid number of z
15 -1. # minimum coordinate of x
16 1. # maximum coordinate of x
17 0. # minimum coordinate of y
18 1. # maximum coordinate of y
19 0. # minimum coordinate of z
20 1. # maximum coordinate of z

```

```

1 #####
2 ## parameters for COSMOS code #####
3 ## ver1.00 by Chulmoon Yoo #####
4 #####
5 999999 # maximum step of the main loop
6 1. # maximum time to evolve
7 3 # tab number of the bufer grids
8 0. # amp
9 -40 # minimum grid number of x = -nmax-1
10 40 # maximum grid number of x = imax/2-1
11 0 # minimum grid number of y
12 40 # maximum grid number of y
13 0 # minimum grid number of z
14 40 # maximum grid number of z
15 -1. # minimum coordinate of x
16 1. # maximum coordinate of x
17 0. # minimum coordinate of y
18 1. # maximum coordinate of y
19 0. # minimum coordinate of z
20 1. # maximum coordinate of z

```

scale-up coordinate  
is not used 10. → 0.

number of grids 60 → 40

# par\_ini.d

```

33 #####
34 ### initial data parameter
35 #####
36 0.→ .....# 0:no continue 1:continue
37 ini_all.dat→...# continue file
38 0.50→ .....# amplitude
39 10.→.....# wave number
40 10.→.....# xi2 nonsphericity parameter 1
41 0.→ .....# xi3 nonsphericity parameter 2
42 0.→ .....# w3 alignment angle
43 0.→ .....# amplitude for the scalar field
44 10.→.....# wave number for the scalar field
45 15.→.....# xi2s
46 0.→ .....# xi3s
47 50.0→ .....# Hubble

```

```

33 #####
34 ### initial data parameter
35 #####
36 0.→ .....# 0:no continue 1:continue
37 ini_all.dat→...# continue file
38 0.01→ .....# amplitude
39 10.→.....# wave number
40 10.→.....# xi2 nonsphericity parameter 1
41 0.→ .....# xi3 nonsphericity parameter 2
42 0.→ .....# w3 alignment angle
43 0.→ .....# amplitude for the scalar field
44 10.→.....# wave number for the scalar field
45 15.→.....# xi2s
46 0.→ .....# xi3s
47 2.0→ .....# Hubble

```

initial amplitude  
for the perturbation

not used in sample\_pert

initial Hubble parameter =  $2/L$

```

57 #####
58 ### parameters for output
59 #####
60 0.5→ .....#1st part print interval boundary time
61 0.5→ .....#2nd part
62 100.→ .....#changing time for print interval

```

```

57 #####
58 ### parameters for output
59 #####
60 0.25→ .....#1st part print interval boundary time
61 0.5→ .....#2nd part
62 100.→ .....#changing time for print interval

```

output interval setting



# cosmos.cpp

```

267 + //setting for bools start
268 + fld=true; + + + + + // fluid evolution -> true/false
269 + scl=true; + + + + + // scalar evolution -> true/false
270 + cuev=true; + + + + + // curvature evaluation -> true/false

```

```

381 + else
382 + {
383 +     cout << "no continue" << endl;
384 +
385 +     //initial data setting start
386 +     //fmv->set_initial_scalar(mus,kks,xi2s,xi3s);
387 +     //pragma omp barrier
388 +     fmv->initial_nonsph(mu,kk,xi2,xi3,xi2s,xi3s,w3);
389 +     // fmv->initial(mu);
390 +     #pragma omp barrier
391 +     printpack(fmv0,ln,pk,pl,filex,filey,filez,filex0z,filexy0);
392 +     //initial data setting end
393 +
394 +     //printpack(fmv0,ln,pk,pl,filex,filey,filez,filex0z,filexy0);
395 + }
396 + //reading continue or setting initial date end

```

```

267 + //setting for bools start
268 + fld=true; + + + + + // fluid evolution -> true/false
269 + scl=false; + + + + + // scalar evolution -> true/false
270 + cuev=false; + + + + + // curvature evaluation -> true/false

```

no scalar field and curvature calculation

```

381 + else
382 + {
383 +     cout << "no continue" << endl;
384 +
385 +     //initial data setting start
386 +     //fmv->set_initial_scalar(mus,kks,xi2s,xi3s);
387 +     //pragma omp barrier
388 +     //fmv->initial_nonsph(mu,kk,xi2,xi3,xi2s,xi3s,w3);
389 +     fmv->initial(mu);
390 +     #pragma omp barrier
391 +     printpack(fmv0,ln,pk,pl,filex,filey,filez,filex0z,filexy0);
392 +     //initial data setting end
393 +
394 +     //printpack(fmv0,ln,pk,pl,filex,filey,filez,filex0z,filexy0);
395 + }
396 + //reading continue or setting initial date end

```

initial data setting function changed

# cosmos\_initial\_pert.cpp

initial data setting function "void initial(double mu)"  
is defined in cosmos\_initial\_pert.cpp

# cosmos\_bssn.cpp

```

1602 //////////////////////////////////////////////////
1603 // Gauge
1604 //////////////////////////////////////////////////
1605
1606 //modified 1+log
1607 falpha=-etaa*(ek_p+2./(1.+fluidw)/tt)*alpha_p;
1608
1609 //synchronous
1610 //falpha=0.;
1611
1612 //modified harmonic
1613 //falpha=-(ek_p-get_bv(lui,kui,jui,20))*pow(al
1614
1615 //Gamma driver
1616 fbx=etabb*get_bv(1,k,j,4);
1617 fby=etabb*get_bv(1,k,j,5);
1618 fbz=etabb*get_bv(1,k,j,6);
1619
1620 //fbbx=fzgx -etab*get_bv(1,k,j,4);
1621 //fbby=fzgy -etab*get_bv(1,k,j,5);
1622 //fbbz=fzgz -etab*get_bv(1,k,j,6);
1623
1624 //for Lattice Uni
1625 fbbx=fzgx -2./(1.+fluidw)/tt*get_bv(1,k,j,4);
1626 fbby=fzgy -2./(1.+fluidw)/tt*get_bv(1,k,j,5);
1627 fbbz=fzgz -2./(1.+fluidw)/tt*get_bv(1,k,j,6);
1628
1629 //zero shift gauge
1630 fbx=0.;
1631 fby=0.;
1632 fbz=0.;
1633 fbbx=0.;
1634 fbby=0.;
1635 fbbz=0.;

```

gauge condition changed to the synchronous gauge

```

1602 //////////////////////////////////////////////////
1603 // Gauge
1604 //////////////////////////////////////////////////
1605
1606 //modified 1+log
1607 falpha=-etaa*(ek_p+2./(1.+fluidw)/tt)*alpha_p;
1608
1609 //synchronous
1610 falpha=0.;
1611
1612 //modified harmonic
1613 //falpha=-(ek_p-get_bv(lui,kui,jui,20))*pow(alpha
1614
1615 //Gamma driver
1616 fbx=etabb*get_bv(1,k,j,4);
1617 fby=etabb*get_bv(1,k,j,5);
1618 fbz=etabb*get_bv(1,k,j,6);
1619
1620 //fbbx=fzgx -etab*get_bv(1,k,j,4);
1621 //fbby=fzgy -etab*get_bv(1,k,j,5);
1622 //fbbz=fzgz -etab*get_bv(1,k,j,6);
1623
1624 //for Lattice Uni
1625 fbbx=fzgx -2./(1.+fluidw)/tt*get_bv(1,k,j,4);
1626 fbby=fzgy -2./(1.+fluidw)/tt*get_bv(1,k,j,5);
1627 fbbz=fzgz -2./(1.+fluidw)/tt*get_bv(1,k,j,6);
1628
1629 //zero shift gauge
1630 fbx=0.;
1631 fby=0.;
1632 fbz=0.;
1633 fbbx=0.;
1634 fbby=0.;
1635 fbbz=0.;

```

# makefile

```
33 # source file
34 SRC = $(PROG).cpp cosmos_bssn.cpp cosmos_initial.cpp cosmos_output.cpp cosmos_boundary.cpp cosmos_ahf.cpp cosmos_ipol.cpp
    cosmos_fluid.cpp cosmos_fmr.cpp
35 OBJS = $(SRC:%.$(LANG)=%.o)
```



```
36 # source file
37 SRC = $(PROG).cpp cosmos_bssn.cpp ../cosmos_initial.cpp cosmos_initial_pert.cpp ../cosmos_output.cpp ../cosmos_boundary.
    cpp ../cosmos_ahf.cpp ../cosmos_ipol.cpp ../cosmos_fluid.cpp ../cosmos_fmr.cpp
38 OBJS = $(SRC:%.$(LANG)=%.o)
```

- cosmos.cpp and cosmos\_bssn.cpp is used instead of the original ../cosmos.cpp and ../cosmos\_bssn.cpp
- cosmos\_initial\_pert.cpp is added to the list