README FILE for "COMPT-Time-Lag-RMS" Software

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1 Introduction

Codes are written in FORTRAN90 programming language. There are three different codes: *timelag−seedphoton.f*90, *timelag–corona.f*90 and *tempratio–seedphoton.f*90. Each code performs a different specific task. We describe below in brief: *the tasks each code performs; the inputs one needs to execute a given code; the procedure to compile and run the code; the outputs one gets after successfully executing the code.*

2 Codes

2.1 timelag-seedphoton.f90

- This code calculates time-lags (in micro seconds) and $|\Delta n_\gamma/\Delta T_b|$ as a function of photon energy (in keV). These calculations have been performed for the scenario when there is variation of seed photon temperature. Note that $|\Delta n_\gamma|$ is the predicted r.m.s as a function of energy. Hence the output of the code can be multiplied by an energy independent factor corresponding to variation of seed temperature (ΔT_b) to compare with observations.

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- *input−timelag −seed.txt* is required input file. There are 12 variables which can be given values using this file. We list below the symbols used in the input file and their meaning along with possible default values of the varibles (in brackets).

  n, cn : number of points (4000, 4000)
  enmin, enmax : log of minimum and max energy in keV (-3, 2)
  eps : desired accuracy one needs for convergence (1.0d-5)
  tau : optical depth (2.4494)
  kte : k∗electron temperature in keV (15.0)
  ktb : k∗black body photon temperature in keV (0.3)
  af, Lf : af is the radius of the sphere producing the seed photons in cms. Lf if the size of the comptonzing region in cms. In this geometry the total radius of the system is af+Lf. (1.0d6, 5.0d5)
  freq : frequency of oscillation (850 Hz)
  Name of 2 output files is also assigned through this file.

- This code is compiled and run by following two commands(in order):
  $gfortran\ \ timelag-seedphoton.f90\ -o\ \ timelag-s.out$
  $./timelag-s.out$

- After successful execution of the code, the user gets two text files. The output file *delngama.dat* gives variation of $|\Delta n_\gamma/\Delta T_b|$ whereas $time-lag.dat$ gives variation of time-lags. Both variations are with respect to photon energy.

2.2 timelag-corona.f90

- This code calculates time-lags (in micro seconds) and $|\Delta n_\gamma/\Delta H_e|$ as a function of photon energy (in keV). These calculations have been performed for the scenario when there is variation in coronal heating rate. Note that $|\Delta n_\gamma|$ is the predicted r.m.s as a function of energy. Hence the output of the code can be multiplied by an energy independent factor corresponding to variation of seed temperature (ΔH_e) to compare with observations.

- Input file is $input-timelag-corona.txt$. There are 13 variables which can be given values using this file. We list below the symbols used in the input file and their meaning along with tentative values of the varibles (in brackets).

n, cn : number of points (4000, 4000)
enmin, enmax : log of minimum and max energy in keV (-3, 2)
eps : desired accuracy one needs for convergence (1.0d-5)
tau : optical depth (2.4494)
kte : k∗electron temperature in keV (15.0)
ktb : k∗black body photon temperature in keV (0.3)
af, Lf : af is the radius of the sphere producing the seed photons in cms. Lf if the size of the comptonzing region in cms. In this geometry the total radius of the system is af+Lf. (1.0d6, 5.0d5)
freq : frequency of oscillation (850 Hz)
eta : fraction of the Comptnized photon that impinge back onto to input photon source.
Name of 2 output files is also assigned through this file.

- This code is compiled and run by following two commands(in order):
  $gfortran\ \ timelag-corona.f90\ -o\ \ timelag-c.out$
  $./timelag-c.out$

- After successful execution of the code, the user gets two data files. The output file *delngama.dat* gives variation of $|\Delta n_\gamma/\Delta H_e|$ whereas $time-lag.dat$ gives variation of time-lags. Both variations are with respect to photon energy.

- For a given set of values of variables, this program calculates (and prints on the terminal) maximum possible value of *eta* also. Note that *eta* denote fraction of the Comptonized photons that impinge back onto the seed photon source.

2.3 tempratio-seedphoton.f90

- This code calculates $|\Delta T_e/|\Delta T_b|$ as well as $|\Delta N/\Delta T_b|$ as a function of frequency when there is variation of seed photon temperature.

- Input file is $input-tempratio-seed.txt$. There are 12 variables which can be given values using this file. We list below the symbols used in the input file and their meaning along with tentative values of the varibles (in brackets).
  n, cn : number of points (4000, 4000)
  enmin, enmax : log of minimum and max energy in keV (-3, 2)

eps : desired accuracy one needs for convergence (1.0d-5)
tau : optical depth (2.4494)
kte : k∗electron temperature in keV (15.0)
ktb : k∗black body photon temperature in keV (0.3)
af, **Lf** : af is the radius of the sphere producing the seed photons in cms. Lf if the size of the comptonzing region in cms. In this geometry the total radius of the system is af+Lf. (1.0d6, 5.0d5)
freq : start frequency (10 Hz)
Name of 2 output files is also assigned through this file.

- To compile and run the code following two commands is to be used(in order):
$gfortran\ \ tempratio-seedphoton.f90\ \ -o\ \ \ tempratio-s.out$
$./tempratio-s.out$

- After successfull executionof the code the user gets two data files. The output file $te.dat$ gives variation of $|\Delta T_e/|\Delta T_b|$ whereas $norm-gama.dat$ gives variation of $|\Delta N/\Delta T_b|$. Both variations are with respect to frequency. Note that here $\Delta N = \frac{\int \Delta n_\gamma n_\gamma dE}{\int n_\gamma dE}$ is normalized integrated photon density variation.

References

[1] Kumar, N. and Misra, R., 2014, MNRAS, 445, (2818-2824)