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GalevNB: from simulations to observations

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Abstract. We present GalevNB (Galev for N-body simulations), an utility that converts fundamental stellar properties of N-body simulations into observational properties using the GALEV (GAlaxy EVolutionary synthesis models) package, and thus allowing direct comparisons between observations and N-body simulations. It converts the fundamental stellar properties of N-body simulations, i.e., stellar mass, temperature, stellar luminosity and metallicity, into observational magnitudes for a variety of filters of widely used instruments/telescopes (HST, ESO, SDSS, 2MASS), and into spectra that span from far-UV (90 Å) to near-IR (160 μm).

Keywords. N-body, magnitude, spectra

1. Introduction

The output parameters of NBODY6++ (Aarseth 1999) simulations are mostly theoretical values. To make a direct comparison between N-Body simulation data and observations, we combine GALEV (GALaxy EVolutionary synthesis models; Kotulla *et al.* 2009), a flexible algorithm to combine astrophysical colors in many filters and spectra of stars (Lejeune, Cuisinier & Buser 1997, 1998) or sets of stars, with NBODY6++ simulations. In this paper, we present the structure of this new code: GalevNB (Galev for N-Body simulations). Adapting subroutines from GALEV, GalevNB can produce spectra spans the range from far-UV at 90 Å to far IR at 160 μm, with a spectral resolution of 20 Å in the UV-optical and 50-100 Å in the near IR range. Given a list of requested filters in HST, ESO, SDSS, 2MASS etc., GalevNB convolves the spectra with the filter response functions and applies the chosen zero-points (Vegamag, ABmag, and STmag) to yield absolute magnitudes. GalevNB bridges theoretical parameters and their observed values, thus allows us to understand the color and spectra evolution of star clusters, and to determine the initial conditions and parameters of star cluster simulations with a direct comparison to observations.

2. GalevNB Structure and Usage

The main program of GalevNB is GalevNB.f90, which parses single snapshot files (stellar evolution only) generated by NBODY6++ / NBODY6. It uses seven subroutines (startomaginit, specint_initialize, reset_weights, startomag, add_star, spec2mag, spec_output) of GALEV package to convert effective temperature, stellar luminosity, metallicity, and mass into observational magnitudes and spectra. The GalevNB package contains four folders: 1) spectral_templates, in which locate all the spectral template files from the BaSeL library of model atmospheres (Lejeune, Cuisinier & Buser 1997, 1998); 2) standard_filters, contains a large set of filter response functions (FUV, NUV, U, B, V, R, I, J, H, K) that are used as standard reference filters;

Table 1. Column contents for the filter information file: `filterlist.dat`

Column	Content	ID of zero point
1	Filter name	
2	Corresponding path of the filter response function	
3	ID of selected zero point (default value is 1)	
4	Standard zero point in the Vega magnitude system	1
5	Standard zero point in the AB magnitude system	2
6	Standard zero point in the ST magnitude system	3
7	Optional user-defined zero point	4

3) `filter_response_curves`, includes filter response functions from magnitude systems of HST, ESO instruments, 2MASS, SDSS, Johnson, and Cousins in separate subfolders. We also provide a choice of user-specify filter response functions. Information about the entire set of available filters is included in the file `filterlist.dat`. Please aware that `filterlist.dat`, in which the user specify their own choice of magnitude system by uncommenting the line of chosen filter, MUST be presented in the same directory as the `NBODY6++` / `NBODY6` snapshot files. The content of the file, `filterlist.dat`, is presented in Table 1.

To compile `GalevNB`, the user should have C++ and fortran installed. The input file of `GalevNB` should be a sinlge snapshot output from `NBODY6++` / `NBODY6` simulations. In case of a file containing all snapshots (called `sev.83` in `NBODY6++` and `fort.83` in `NBODY6`), we provide the user with a shell script `generate_snapshots.sh` in the folder, `scripts`, for retrieving single snapshot data out of `sev.83` and `fort.83`. The user can select his/her preferred filters (maximum 20) by uncommenting the row of the corresponding filter in `filterlist.dat`, and choose his/her desired magnitude system (Table 1). Magnitudes of individual stars and the whole cluster, and spectra of the cluster or chosen stellar types are produced, respectively.

The code of `GalevNB` is published online†. Users can download it through internet.

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† `http://silkroad.bao.ac.cn/repos/galevnb`

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