Appendix F

BRUCE and KYLIE Command Files

F.1 Basic Syntax

The programs BRUCE and KYLIE, discussed in §7.2 and §7.3 respectively, are both controlled by user-supplied command files. These ASCII text files specify the stellar, pulsation and spectroscopic parameters to be used when the programs are run.

The syntax used in the files is the same for both BRUCE and KYLIE, and consists of one or more commands of the form

```
#<command> { <parswitch> <parswitch> ... }
```

where `<command>` is a token which specifies which particular aspect of the modelling is being controlled. Note that the spaces surrounding the braces *are* significant. The `<parswitch>` tokens, of which there can be one or more, have two forms; the first of these,

```
<parswitch> = <parname>:<parvalue>
```

specifies that the parameter `<parname>` should be assigned the numeric value `<parvalue>`. The second form,

```
<parswitch> = <switch>
```

specifies that some perturbation or modification specified by `<switch>` should be 'switched on'

The format of the files is case-insensitive, and carriage-returns are taken to be equivalent to whitespace. Comments may be included in the files by placing a % character anywhere on a line; all text following this character is discarded when the files are read. The ! character is used in a similar manner, but the comment text which it introduces is written to standard output rather than being completely discarded.

The following two sections describe the commands and parameters defined within this syntax for BRUCE and KYLIE.

F.2 BRUCE Commands

There are four basic commands used by BRUCE to define model characteristics, each with their own set of parameters. Some of these parameters are mutually exclusive, and others are mutually inclusive; they are summarized below. Parameters which must be specified are marked in boldface.

The `#stellar` Command

This command specifies the basic stellar parameters of the star, which are used to construct the equilibrium surface grid discussed in §7.2.2. Only one `#stellar` command may appear in the command file; the relevant parameters are as follows:

`polar_radius``:R` — Sets the polar radius to `R` $R_{\odot}$.

`polar_temperature``:T` — Sets the polar to `T` K.

`polar_log_gravity``:g` — Sets the polar logarithmic gravity to `g` cgs dex.

`stellar_mass``:M` — Sets the mass to `M` $M_{\odot}$.

`equatorial_velocity``:v` — Sets the equatorial rotation velocity to `V` km s^{-1}.

`polar_inclination``:i` — Sets the inclination of the polar axis to `i` degrees.

`zeipel_beta:b` — Sets the gravity-darkening coefficient to `b`. The default is 0.25.

Note: the `polar_log_gravity` and `stellar_mass` parameters are mutually exclusive; they provide alternative methods of specifying the polar gravity.

The `#fields` Command

This command specifies the overall characteristics of all perturbation fields defined in the models. Only one `#fields` command may appear in the command file; the relevant parameters are as follows:

`number_of_fields``:n` — Sets the number of separate time-points at which perturbation fields are calculated to `n`.

`dump_filestub``:<file>` — Sets the file-stub for all output files to `<file>`. All output files will have the filename `<file>nnn`, where `nnn` is a 3-digit number with leading zeros which indexes the files.

`matrix_dimension:N` — Sets the dimension of the matrices used in the ST technique to `N`. If this parameter is not specified, single spherical harmonics are used instead of the rotationally-modified basis states $|\lambda_{l_j,m}\rangle$.

`normal_fields` — If this switch is present, 'radial' velocity fields are directed along the local surface normal vector; otherwise, they are directed along the local radial vector.

`temperature_effects` — If this switch is present, temperature perturbations are included; otherwise, no such perturbations are applied.

`area_effects` — If this switch is present, surface area perturbations are included; otherwise, no such perturbations are applied.

`normal_effects` — If this switch is present, surface normal perturbations are included; otherwise, no such perturbations are applied.

`horizontal_velocity_fields` — If this switch is included, horizontal velocity perturbations are included; otherwise, no such perturbations are applied.

`physical_amplitudes` — If this switch is included, all a amplitude specifications in the `#mode` command are taken as physical amplitudes V_{max}; otherwise, they are taken as mathematical amplitudes V_0.

Note: whilst radial velocity fields are always included in calculations, horizontal velocity fields will only be incorporated if the `horizontal_velocity_fields` switch is present.

The `#mode` Command

This command specifies the properties a pulsation mode present in the model. One or more `#mode` commands may appear in the command file, up to a limit of 999; the relevant parameters are as follows:

`l_value``:l` — Sets the harmonic degree of the mode to `l`.

`m_value``:m` — Sets the azimuthal order of the mode to `m`.

`velocity_amplitude``:V` — Sets the velocity amplitude of the mode to `V` km s^{-1}. The meaning of this amplitude depends on whether the `physical_amplitudes` switch is present in the `#fields` command.

`corotating_period``:P` — Sets the pulsation period in the co-rotating frame to `P` hours.

`observers_period``:P` — Sets the pulsation period in the observer's frame to `P` hours.

`period_from_nu``:n` — Sets the pulsation period to have a value consistent with ν = `n`.

`initial_phase:`ϕ — Sets the initial phase of the mode to ϕ degrees `na_amplitude_shift`:ΔT — Sets the non-adiabatic temperature perturbation scaling factor to ΔT.

`na_phase_shift`:ψ — Sets the non-adiabatic temperature perturbation phase shift to ψ.

Note: The `corotating_period` , `observers_period` and `period_from_nu` parameters are mutually exclusive; they provide alternative methods of specifying the pulsation period.

The #timings Command

This command specifies the time interval over which calculations are to be performed. Only one `#timings` command may appear in the command file; the relevant parameters are as follows:

start_time:`t` — Sets the start time of the calculations to `t` hours.

finish_time:`t` — Sets the finish time of the calculations to `t` hours.

use_mode_parameter:`n` — Sets the start time of the calculations to 0 hours, and the finish time to the observer's period Π of the `n`th mode defined; there must therefore be at least `n` `#mode` commands in the command file.

Note: The third of these parameters is mutually exclusive with the first two; they provide alternative methods of specifying the modelling time interval.

F.3 KYLIE Commands

There are three basic commands used by BRUCE to define spectral synthesis characteristics, each with their own set of parameters; they are summarized below. Parameters which must be specified are marked in boldface.

The #fields Command

This command is equivalent to the BRUCE `#fields` command, and specifies which dump files produced by BRUCE to read in. Only one `#fields` command may appear in the command file; the relevant parameters are as follows:

number_of_fields:`n` — Sets the number of separate time-points at which spectra are calculated to `n`. This must be the same as the corresponding parameter used by BRUCE.

dump_filestub:`<file>` — Sets the file-stub for all input and output files to `<file>`; this must be the same as the corresponding parameter used by BRUCE. All output files will have the filename `<file>nnn.sdf`, where `nnn` is a 3-digit number with leading zeros which indexes the files.

`limb_u_override:u` — Specifies that the limb-darkening inherent to the intensity spectra is to be over-ridden by using a limb-darkening with a coefficient `u`.

The `#waveband` Command

This command specifies a wavelength region over which spectra are to be synthesized. As many `#waveband` commands as are needed may appear in the command file; the relevant parameters are as follows:

`start_wavelength:``l` — Sets the start wavelength of the region to `l` Å.

`finish_wavelength:``l` — Sets the finish wavelength of the region to `l` Å.

`wavelength_resolution:``r` — Sets the wavelength-spacing of points in the region to `r` Å.

The `#wavepoint` Command

This command specifies an isolated wavelength point at which spectra are to be calculated. As many `#wavepoint` commands as are needed may appear in the command file; the relevant parameter is as follows:

`wavelength:``l` — Sets the wavelength of the point to `l` Å.