

Radiant 1.4 – Manual

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Chapter 1

Introduction

This software calculates density distributions of meteor radiants. The disk-read procedures interpret meteor co-ordinate data in the PosDat and FIDAC formats. The user should have some basic knowledge of creating dBase files. The density distributions are gnomonically projected, thus simplifying the calculating procedures. For most radiant searches the investigated area is small enough ($< 20^\circ$ across) that the scale change over this “gnomonic chart” can be neglected. Radiant knows three methods of radiant determinations: backward tracings, intersection counts and probability distributions.

Radiant is a product which developed by its users. I would like to specially thank Malcolm J. Currie for his numerous suggestions, André Knöfel for testing the current version and setting up the FIDAC file structure, Ralf Koschack for mathematical ideas and the analysis of plotting and velocity errors, Luis R. Bellot for modifying the angular speed formula, Detlef Koschny for setting up the PosDat file structure and many more. I would also like to thank my computer system (386-40) and a late hard disk for patiently compiling the software thousands of times.

Hardware Requirements Operating System

- PC AT, hard disk recommended with at least 600K free disk space
- MS-DOS or PC-DOS version 3 or higher, DR-DOS 5.0 or higher
- at least 350K free memory
- VGA graphics board (640 × 480 pixel, 16 colours)
- at least analog black-and-white monitor (VGA-Monitor)
- a numeric processor is required which is included in all 486DX and Pentium processors

The following files should be on the Radiant 1.41 diskette:

RAD14.EXE:	main programme of the Radiant software
RAD14.OVR:	overlay file for Radiant
RAD14.HLP:	help file for context help
RAD14.IDX:	help index
RAD14.CFG:	standard configuration file
RAD14.ICO:	icon for Windows 3.x*
RAD14.PRJ:	example project file
PRJ14.EXE:	Project Editor
EGAVGA.BGI:	graphics driver
PDHEAD-S.DBF:	example header file (in PosDat format)*
PDDATA-S.DBF:	example data file*
FIDAC-S.DBF:	example FIDAC file*
VMDBSITE.DBF:	site code file of IMO (use it if you do not have programmes of the Visual Meteor DataBase, otherwise it can be erased)

Additionally, Radiant may create the following files during runtime:

- ~RADLIST.TMP: When started Radiant creates this file to swap large numbers of meteors to disk. If you find this file after unregularly exiting the programme you can erase it. Otherwise it will be overwritten at the next start of Radiant.
- ~RADTELE.TMP: Temporary file to swap telescopic fields to disk when running a DOS shell.

*) Files can be deleted if not needed.

You can run Radiant with different configuration files. Give the name behind the programme name:

RAD14 *cfgname*

where *cfgname* is the filename of the configuration file. The standard *cfgname* is RAD14.CFG.

Chapter 2

How to Use Radiant

2.1 The creation of PosDat databases

Either of the database packages dBase (version II or higher) or Fox software (FoxBase, FoxPlus, FoxPro) should be installed in your computer. The maintenance of PosDat files needs some dBase commands which will be shortly described here. First, we should talk about the understanding of PosDat, then tackle the details.

dBase files are sequential, each record is followed by another. In a database containing meteors, this would mean one record for each meteor. A part of the information belonging to a meteor is redundant for many meteors in an observing session, like the date, the field of view or the observing method, which may no doubt be interesting for future analyses. PosDat tries to keep these repetitions less frequent by the introduction of two files: The *header file*, in which general information about an observing session is stored, and the *data file*, in which the actual meteors are stored. Whenever we refer to PosDat data, we refer to two parallel files that should never be separated.

Both files are connected by an ID field containing three characters. For example, a one-hour observing session containing 15 meteors leads to one record in the header file with a certain ID, say AAA, and 15 records in the data file with the same ID, AAA. The IDs should be subsequently increased like AAA, AAB, ..., AAZ, ABA, ABB, ..., ABZ, ..., ZZZ, giving 17576 combinations.

The software Radiant is delivered with two PosDat example files, PDHEAD-S.DBF and PDDATA-S.DBF, the header and data files resp. It is recommended to maintain separate sets of files for each year. If you wish to create files for 1997, enter your database software and type

```
use pdhead-s
```

and

```
copy structure to pdhead97
```

The same applies for the data file:

```
use pddata-s
```

```
copy structure to pddata97
```

If you want to add a record to the header file, type

```
use pdhead97
```

to open the database and

```
append blank
```

to add a blank new record which can be filled with the header data of the observing session. Then for the meteors:

```
use pddata97
```

```
append blank
```


You can write your own software for the input of meteors in PosDat, either in dBase language or in another language for which the following command may be useful. You should create ASCII files with one row for each record; the fields must follow each other without delimiter, with the same field lengths as given in the table below. In the database software, type

```
use pdhead97
```

```
append from pdhead97.txt type sdf
```

depending on what filename you used for the ASCII file. The structure descriptions of both the header and data file follow.

Fields of PDHEAD yy .DBF:

ID	3-character identification field to connect one header records with the data records in PDDATA yy .DBF. Following strings should be used: AAA, AAB, ..., ZZZ; 000, 001, ..., 999.
YEAR	Although the filename specifies the year already, it is safer to have this value also in the database itself. Moreover, one might compile several PosDat files to one for some global analysis. It is an 4-digit field.
MONTH	2-digit field for the month of the observation. An observation on 31 July/01 Aug gives MONTH=7.
DAY	5-character field for the night of observation. Generally, 05/06 for the night July 05-06. (By definition, the first day gives that day, meteors between 12–24h UT refer to; the second gives the day, meteors between 0–12h UT refer to.) The night Jul 31/Aug 01 gives DAY=31/01 (MONTH=7). The night 1991 Dec 31/1992 Jan 01 is stored as YEAR=1991, MONTH=12, DAY=31/01. The complete observation belongs to PDHEAD91.DBF und PDDATA91.DBF.
OBSCODE	5-character IMO-code. If new codes are introduced, the names and countries should be mentioned in a separate file of any structure or on a paper.
SITECODE	5-digit IMO-code. If new codes are introduced, the names, countries and co-ordinates of these sites should be mentioned in a separate file or on a paper.
METHOD	11-character field for the observing method. Visual observers simply give P for plotting, R for reporting. Telescopic observers give TmmXaaatfff, where mm magnification, aaa diameter of aperture in millimeter, t type (B – binoculars, N – Newtonian, M – bin. Newtonian, R – refracting telescope, S – Schmidt-Newtonian), fff field of view in tenth of a degree (5° is 050). T10X080B035 – telescopic observation with 10x80 binoculars with 3.5° field of view.
MAP	5-character field for the charts used. BR – Atlas Brno, T... – user defined telescopic charts, FE – FEMA charts, SL – Slovak gnomonic atlas, AG – gnomonic maps of Roland Egger.
LM	4,1-digit field for the limiting magnitude.
RACEN	3-digit field for the right ascension of the centre of the view field. If no centre is reported this field is 999.
DECEN	3-digit field for the declination of the centre of the view field. If no centre is reported this field is 999.

Fields of PDDATA yy .DBF:

REF_NO 4-digit field for individual reference numbers. This field is optional.
 HOUR 2-digit field for the time in UT (hours).
 MIN 2-digit field (minutes).
 SEC 2-digit field (seconds).
 MAG 4,1-digit field for the magnitude of the meteor.
 VEL 2-character field. It should contain numbers in degrees per second (0...40 /s). Arbitrary speed scales should be given as characters (A...E).
 TYPE 2-character field for telescopic observations only. 00 – meteor started and ended within the field of view, 10 – started within, ended outside the field, 01 – started outside, ended within the field, 11 – start and end lie outside the field of view.
 RABEG 6,2-digit field for the right ascension of the meteor's start point with two decimals.
 DECBEG 6,2-digit field for the declination.
 RAEND 6,2-digit field for the right ascension of the meteor's end point with two decimals.
 DECEND 6,2-digit field for the declination.
 ACC 1-digit field for the subjective plotting accuracy. 1 – accurate plot, 2 – not the best plot, 3 – inaccurate plot.
 ID 3-character field which connects this file (PDDATA yy .DBF) with the header file (PDHEAD yy .DBF) of the same year. (Remember that yy is replaced by the year of the observations.) See description of ID in PDHEAD yy .DBF for details.
 REM Optional 4-character field for some references to remarks. You may also use this field to give the observer's shower association for the meteor.

Database structure of PDHEAD yy .DBF as it is expressed in dBase:

1	ID	Character	3	
2	YEAR	Numeric	4	
3	MONTH	Numeric	2	
4	DAY	Character	5	
5	OBSCODE	Character	5	
6	SITECODE	Numeric	5	
7	METHOD	Character	11	
8	MAP	Character	5	
9	LM	Numeric	4	1
10	RACEN	Numeric	3	
11	DECCEN	Numeric	3	
**	Total	**	51	

Database structure of PDDATA yy .DBF as it is expressed in dBase:

1	REF_NO	Numeric	4	
2	HOUR	Numeric	2	
3	MIN	Numeric	2	
4	SEC	Numeric	2	
5	MAG	Numeric	4	1
6	VEL	Character	2	
7	TYPE	Character	2	
8	RABEG	Numeric	6	2
9	DECBEG	Numeric	6	2
10	RAEND	Numeric	6	2
11	DECEND	Numeric	6	2
12	ACC	Numeric	1	
13	ID	Character	3	
14	REM	Character	4	
**	Total	**	51	

2.2 The keyboard and the mouse

The **pull-down menu** can be activated by the TAB key or F10. You can also press the first letter of the item you want to open. Move the black bar up and down with ↑ and ↓. Change to another menu with ← and → or with the highlighted letter of the menu name. You may leave the pull-down menu with ESC without releasing any function or with ENTER to accept a certain item. Dots behind menu items indicate, that there is a further dialogue box for input. Some items in the pull-down menu are switches. If they are enabled they show a √. *Mouse* – Click with the left button on the item you want to open and drag down the selection bar to the desired item with the mouse button held down. Release the button to execute the item.

In **lists and directories** select the items with ↑, ↓, PGUP and PGDN. The highlighted bar moves up and down. Select a list item with ENTER. When you want to leave a menu press ESC. *Mouse* – Click on the required list item. Press the right mouse button to leave the list.

In **adjusting boxes** select the items with ↑ and ↓. Change the value of the highlighted item with ← and → or enter a number. Press ESC (“Cancel”) to cancel changes or ENTER (“OK”) to accept the adjustments. *Mouse* – Put the mouse pointer on the value to be changed and press the left and right button of the mouse to decrease and increase the value respectively. Press the button “OK” to accept the values and “Cancel” to abandon the changes.

In **input boxes** you have to use the letters and numbers on the keyboard. If something is already written in the input line simply replace it by entering the new text. Exception: BACKSPACE deletes the character before the cursor, ← and → move the cursor, HOME moves to the first letter, END, to the last character of the line. The right mouse button leaves the window. In alternative boxes select “YES” or “NO” with Y and N resp. Press the left mouse button on one of the buttons.

At almost every situation you get a **help window** with key F1. Generally, you will see the help index. The help text itself has four buttons. Press ENTER (“OK”) to return to the current action or F1 to see the “Index”. Press a letter to access a certain topic of the index faster. You can go through the latest help screens with ALT+F1 (“Back”) and CTRL+F1 (“Next”). Cross-references are implemented as buttons as well. In several cases (buttons “Find”, “Cros”, “Area” and menu items “Include”, “Exclude”) you have to **define parts** of the display. *Mouse* – With the mouse simply press the left button at the position of the upper left corner and drag the mouse pointer with pressed button to the lower right one. Keyboard users can move a small cross with the cursor keys. Press ENTER when you reach the upper left corner of the desired field. Move with the cursor keys to the lower right corner and press ENTER again.

2.3 Generating radiant distributions

2.3.1 First steps

The software Radiant is delivered with a set of sample PosDat files, PDHEAD-S.DBF and PDDATA-S.DBF. We will use these files for getting accustomed to how the programme works. If you have not changed the start-up configuration of Radiant yet, i.e. if you just put Radiant onto your harddisk, you can try the following items to quickly get a first result:

- Start Radiant with rad14 from the command line,
- press ENTER; you will see an input box asking for the database from which meteors are imported.
- The pre-defined input text just refers to the above mentioned example databases. Press ENTER to accept the header file and
- press ENTER again to accept the data file.
- Now, Radiant immediately starts to calculate a radiant distribution. Equatorial grid lines will be shown, and different coloured boxes represent the strength of the convergence points. The colour ranges from black (no radiant) via white (medium strength) to red (strong radiant).

- Use the cursor keys to move the little cross in the middle of the screen to the strongest radiant, i.e. to the red bin. The title line of the distribution window shows both the equatorial and ecliptical coordinates. It should read $\alpha = 127^{\circ}04$, $\delta = 17^{\circ}00$ now.
- Press s or the ‘Smth’ button on the screen now. An averaging procedure blurs the image reducing the aliasing effect of the discrete radiant bins a little.

After we have found a first radiant at $\alpha = 127^{\circ}$, $\delta = 17^{\circ}$, we should understand what we did. ENTER is the short-key of the menu item “DISPLAY: Calculate”. Try to activate it with the mouse too. When no meteors are loaded into Radiant, the calculation procedure asks for databases to be imported. This was the input box you have seen. After the filenames were entered or accepted, the calculation procedure starts its work and draws the final result on the screen. The pre-defined method for radiant searches is the simple backward prolongation of meteors. A part of the sky (the square on the screen, with the coordinate lines) is divided into little pices (pixels), and the value of each piece is increased when a backward prolongation of a meteor crosses it.

2.3.2 Adjustments prior to a radiant search

Now we have to think about which parameters have to be adjusted before our own radiant search. Most of the values can be set in the menu “OPTIONS”. If your PosDat database contains meteors of many nights of the year, you have to select the period in which the investigated shower is active. Do this by “OPTIONS: Selection”. A lot of selection criteria will show up; generally you will just give a beginning and end of the period of interest.

Now select “OPTIONS: Calculation” from the menu and adjust the geocentric velocity, which is a very essential parameter for radiant investigations. Since we have to look at the right part of the sky for our radiant, we have to choose “OPTIONS: Centre” to set the coordinates of the centre of the radiant distribution grid. Finally, some information on the daily motion of the shower should be given under “OPTIONS: Daily Motion”. Every radiant moves towards the east about parallel to the ecliptic for geometrical reasons. You will be asked for a daily-motion value in degrees which means the drift of a radiant parallel to the ecliptic per day. The standard value of $1^{\circ}0$ is reasonable for most radiant searches as long as the period from which the meteors are selected is not too large. The daily-motion value allows the usage of meteors from different dates, since each meteor is shifted along the ecliptic producing a sharp radiant, albeit the drift would smear out the structure. Naturally, we must give the reference date to which all meteors are shifted. This is asked for in the second line of the input box. You can either give a date in the form MM/DD.DD with decimal days or just a solar longitude in degrees.

We are ready for the calculation of a radiant distribution. Start it with “DISPLAY: Calculate”, and you will be asked for the database files in case you changed the selection of meteors from the database. After the calculation is ready, ou can save the result with “DISPLAY: Save”. The option “Save Meteor List” is recommended to be tagged when saving displays; this allows the exact reproduction of the calculation. The meteor lists are saved in Radiant’s internal format which saves a lot of disk space compared to the original PosDat files.

2.3.3 Calculation methods

The backward prolongation of meteors of the simplest method of finding radiants. It can be improved by considering the angular velocity of meteors and their path length as it is done in Radiant, but we should allow for other methods as well. Radiant implements three methods which can be found in the menu “ENVIRONMENT”. The “Tracings” are tagged—below that you find “Intersections” and “Probabilities”. The intersection method calculates the intersection points of each pair of meteors possible and increases the grid bin on the display in which this intersection point falls. The probability-function method is the most expensive in calculation time. Because of plotting errors, it is not just a straight line behind a meteor which may include the true radiant, but a whole area of roughly elliptic shape. Therefore, a certain probability to be the radiant of the meteor is computed for each distribution bin behind the meteor. These probabilities result from typical errors in plotting and velocity estimates.

2.3.4 Analysing the result

One of the most often used function is the “Smth” button about which we talked in the “First steps”. This feature is less important when calculating radiant distributions from probability functions, since those are fairly smooth *per se*. Another helpful tool is the “Dist” button which shows the distribution of the actual meteors around the display. The investigated area is indicated by a dotted line. This line is bended because the meteor distribution is not shown on a gnomonic projection, which is inappropriate for large distances from the centre. Hence, you should be aware of that you cannot prolong the meteor streaks on the meteor distribution screen by straight lines. Nevertheless, it gives you an idea of how well the meteors are distributed around the area under study. It is in fact essential to have a homogeneous distribution of meteors, otherwise the result may be biased along the direction in which most of the meteors emanated.

We should also find out whether or not a certain region of our result is a significant radiant. This is the most tricky question and cannot be answered unambiguously. The most essential prerequisite to any radiant study is, that the meteors are not pre-selected. In order to determine the significance of a radiant we need the noise of the surrounding areas for comparison. If you use only meteors for your study which seem to come from the suspected radiant, you will naturally find the radiant as a prominent source. We define a certain value called the ‘prominence’ telling us how strongly the radiant exceeds the average level of spurious radiants. The values of all bins in the radiant display are averaged and the standard deviation is calculated. The prominence then means how many times the standard deviation our radiant stands out of the average.

The prominence can be determined by “BACKGRND: Get Noise”. A small window appears showing you the average bin value, the standard deviation and the prominence z . You move the small cross reporting the coordinates in the display and find out how the prominence changes in each bin. The red bins (white bins on b/w monitor) have highest prominence of course. The radiant mentioned in the “First steps” has prominence $z = 5.65$ after smoothing with the “Smth” button. Unfortunately, the prominence is not a universal value as it depends on many parameters like the screen resolution, the calculation method and whether or not the display was smoothed. It is recommended to use the prominence as a relative measure to compare the development of a radiant with time as long as the parameters mentioned are not changed. You can check whether the suspected radiant has a variation in prominence just like an activity graph, instead of a constant, low prominence indicating that you just found a number of spurious radiants right in your area of investigation which do not belong to a real shower.

There are other methods of checking the significance of a radiant too. They use the fact that a true meteor shower has certain characteristics, particularly geocentric velocity and radiant drift, which must be fulfilled. Hence, the radiant should be much less prominent when one of these parameters is mistuned. You can set the daily motion to 0° and check the prominence of the radiant. This, however, only works, if you have meteors from several dates, say of a whole week or longer. Otherwise, the daily-motion value has no effect of course. Changing the geocentric velocity is a very powerful tool. When you tune the velocity you should again get a kind of prominence curve with maximum at a certain speed. And if you are investigating an unknown shower, you automatically get an estimate of the geocentric velocity of the stream. This method shows, how important velocity estimates in degrees per second are.

Chapter 3

Menu reference

3.1 The Menu Item “PROGRAMME”

3.1.1 DOS

With this item it is possible to run DOS commands, e.g. copy, replace, rename files or make directories. Radiant switches to the normal DOS text screen. When you are done leave this screen with

```
exit
```

You get into Radiant again. Functions “Smth”, “Log”, “eXp”, “Grad” and the colour ranges are lost.

3.1.2 PROJECT

ALT+P

This item starts the external Project Editor PRJ14.EXE. It is a small editor for calculation projects, which make larger analyses easier. See page 37 for a detailed description of the Project Editor.

3.1.3 SAVE STATE

Radiant does not save the settings of the programme when you finish your work. You may now explicitly save the configuration with a chosen name of 8 characters. This way, you can make several configuration files which can be called while starting Radiant with

```
rad14 cfgname
```

where *cfgname* is the filename of the configuration including the extension .CFG. You may also retrieve configuration files with “PROGRAMME: Load State”. The following example shows all settings of the initialization file:

Mouse installed:	Mouse=0N
Mouse pointer speed:	MouseSpeed={1...63}
EMS manager installed:	EMS=0N
Standard directory for displays:	DspDirectory=C:\RAD14\DSP
The file with the sitecode definitions:	SiteFile=C:\RAD14\VMDBSITE.DBF
PosDat header file:	HeaderFile=C:\DBASE\POSDAT\PDHEAD-S.DBF
PosDat data file:	DataFile=C:\DBASE\POSDAT\PDDATA-S.DBF
FIDAC file:	FidacFile=C:\DBASE\FIDAC\FIDAC91.DBF
Project file	ProjectFile=C:\RAD14\RAD14.PRJ
If meteors are saved with the display	LoadSaveMeteors=0N
Calculation method	Method={ Tracing Intersection Probability }
Switches in ENVIRONMENT:	ScaleCorrection=0N
	VelocityConsideration=0N

(OFF means ReadPosDat)	SitecodeInquiry=OFF
	ReadFIDAC=OFF
	ProjectLogFile=OFF
RESOLUTION:	Res={ 100 50 25 }
Switches in ADDITIONALS:	Monitor={ Colour Mono }
	Paint=ON
	EquGrid=OFF
	TelescopicFields=OFF
	Stars40=OFF
	Stars55=OFF
	Radiants=OFF
	Ecliptic=OFF
Switches in ASCII:	ASCIIEnv=OFF
	ASCIIEspl=OFF
	ASCIIRaDec=ON
Delimiter (may contain any character):	ASCIIDel={ 32...127 }
Switches in PRINT:	PrinterType={ EPSON9 IBM24 HPDESKJET HPLASERJET HPLJMICROTONER }
	PrinterPort={ LPT1 LPT2 LPT3 }
	PrintCStrip=ON
	PrintEnv=OFF
	PrintFast=OFF
Centre of display:	GenRA=150.00
	GenDE=5.00
Settings of OPTIONS, Calculation:	PixelSize=1.00
	GeoVel=35.0
	MinSpeed=0
	MaxSpeed=25
	MaxDist=70
	Ratio=1.00
	SpeedScale=5.00
	MinAngle=20
Settings of OPTIONS, Daily Motion:	Motion=1.00
	SolLong=300.00
Settings of OPTIONS, Colours	ColGrid=4
(0-black, 1...4-grey, 6-pink, 7-yellow,	ColTele=6
8-orange, 9-lt. red, 10-dk. red,	ColStars=15
11-lt. blue, 12-dk. blue, 13-lt. green,	ColExclude=4
14-dk. green, 15-white)	ColRadiants=14
	ColEcliptic=7
Settings of OPTIONS, Std. Deviations:	S0 = 0.90
(velocity sigma)	S5 = 3.00
	S10= 3.70
	S15= 4.60
	S20= 5.80
	S25= 5.90
	S30= 6.00
(plotting sigma)	P0 = 0.50
	P5 = 1.40
	P15= 2.60
	P30= 3.80
	P50= 4.00
	P70= 4.50
Settings of OPTIONS, Image	SmoothRate=0.50

```
ExpBase=2.00  
LogBase=2.00  
GridWidthAlpha=10.0  
GridWidthDelta=10.0
```

Values in parentheses give a list of alternative choices. Use only one word or number from that list. Key words as well as settings are not case-sensitive, hence `Mouse=ON` is identical with `mouse=on` and `MOUSE=On`.

3.1.4 LOAD STATE

Retrieves configuration files `*.CFG`. These files must have been saved with “PROGRAMME: Save” State or edited with an ordinary ASCII editor before.

3.1.5 SYSTEM INFO

Gives information about the following things:

- the release date which should be 23 December 1993 for Radiant 1.4 and 1.4a; 1 December 1996 for Radiant 1.41,
- whether calculations are done by the CPU or on the numeric processor.
- Free DOS RAM: Sum of all free conventional RAM blocks in kbytes.
- Largest free RAM block. If the difference between free DOS RAM and largest block becomes large, please use “PROGRAMME: DOS Shell” to reorganize the memory.
- Free EMS RAM: Free expanded memory in kbytes. If no EMM is installed this number is 0. Radiant uses 160 KB of EMS for fast overlay swapping.
- Frame: address of the page frame which is used by the EMM as interface to the programme.
- Free Disk Space: Complete free space in MB of the disk Radiant is working on.

3.1.6 QUIT

ALT+X

The Radiant session will be closed. The current state is not saved. This can be done with “Save State”.

3.2 The Menu Item “OPTIONS”

3.2.1 SELECTION Ctrl+s

A dialogue box opens showing several options to select appropriate observations from the header file of PosDat or from FIDAC files respectively. The meteors of these observations can be imported into a Radiant meteor list by “METEORS: Import”. Additionally, there is an automatism in the “DISPLAY: Calculate” function that every time when the selection was changed and the calculating procedure is called, Radiant asks for the import databases. If the selection was not changed this procedure does not ask for the names. The input window is closed with “OK”. The button “Clear” (F8) releases all criteria without clearing the meteors currently loaded. Every input line offers a help screen by pressing F1.

- Observer: Give the IMO abbreviations of the observers whose observations you want to be used. The observers have to be separated by commas. Examples: `renju,rogpa,wooje` or `RENJU,ROGPA,WOOJE`. The maximum number of selectable observers is 5.
- Site: Give the IMO abbreviation of the site from which the selected observations should be made. It is possible to enter only the first digits to select more than one site; e.g. "12" selects all observations made at sites in Australia.
- Atlas: Give an abbreviation of the used atlas or charts collection. This way you can choose the observing method. E.g. type `t` to use only telescopic observations or `br` to use those which were made visually on the Atlas Brno charts. Allowed abbreviations are:
- `br` Atlas Brno (magnification 160)
 - `fe` FEMA charts (magnification 75)
 - `sl` Slovak gnomonic atlas
 - `ag` Gnomonic Atlas by Roland Egger
 - `tXnnn` Telescopic Atlas. `X` is the atlas issue and `nnn`, the number of the chart
- Examples of input: `ta001, tb123, ta, t`
- Period: Surely you only want to use observations made in a certain period including the investigated (expected) shower. Then type the month and the day of begin and end of the period as numbers. The selection includes meteors after $0^{\text{h}}00^{\text{m}}$ UT of the begin date until $23^{\text{h}}59^{\text{m}}$ UT of the end date. A period from Aug 10 (08/10) to Aug 10 (08/10) selects meteors from 0^{h} to 24^{h} UT of this day. The button "S.L." (F9) switches to solar longitudes. These can be defined in degrees with two decimals. With the same button you get back to dates. The dates and solar longitudes are not converted into each other. The selection depends on what was given last.
- Limiting Magn.: The accuracy of meteor plottings diminishes with decreasing limiting magnitude because less reference stars for plotting can be seen. Only observations made under equal or better conditions will be considered. (The allowed values are from 3^{m} to 14^{m} .)
- Accuracy: This criterion uses the personal valuation of the plot. Meteors with equal or better plotting accuracy will be selected (only 1, 2 or 3 allowed). If no accuracy was stored in the database Radiant sets it to nought and rejects the meteors if a certain accuracy was specified.
- Year: Due to the idea of PosDat and FIDAC to have annual files this criterion is generally not necessary. Use it if yet several years are in one database file. If you selected a period from December 20 to January 10 and the year 1990, meteors are selected from the end and beginning of 1990 only (not end 1990 to beginning 1991).

3.2.2 CALCULATION

CTRL+A

A new menu will be opened which shows several adjustable items influencing the calculation of a radiant density distribution. These adjustments are used whenever you choose the procedure "DISPLAY, Calculate".

Consider the following remarks on the behaviour of the calculation routine: If you did not change the selection criteria in "OPTIONS: Selection", i.e. if you want to use the same meteors, "DISPLAY: Calculate" immediately starts to compute a new display without an inquiry whether or not to clear the display, since Radiant believes you are still looking for the best way to display the density distribution. The adjustment of the calculation parameters is finished with "OK". "Cancel" or "ESC" nullifies all changes in that window.

- Pixel Size: Give the resolution of the display in the centre of the gnomonic projection in degrees. Since the image scale changes with increasing distance from the centre, the size of one pixel is smaller in these outer regions. The smallest size permitted is 0.05 ($= 3'$). This gives an edge length of the display of 5° . The largest value depends on the type of display you have chosen. It can be up to 2° , 4° and 8° in high, medium and low resolution (cf. p. 28), respectively. **Note:** With changed pixel size the display will be cleared since you cannot superimpose density distributions with different pixel sizes.
- Geocentric Velocity: Give the pre-atmospheric velocity v_∞ in kilometers per second. This velocity is the vectorial addition of the motions of Earth and meteoroid (geocentric velocity v_g), increased by the acceleration due to the Earth's gravity. Hence, the allowed range is $11 \leq v_\infty \leq 72$ km/s. Note that the pre-atmospheric velocity (also called entry velocity) and geocentric velocity are not distinguished throughout this manual and the software itself, but their difference will be noted when necessary. The height of the meteor layer depends on the geocentric velocity. It is re-calculated with the approximate formula $H \approx 0.62 v_\infty + 76$ [km]. In the calculations the velocity is not considered if “ENVIRONMENT: Velocity Consid.” is off.
- Minimum Angular Speed: A telescopic observer looking at a certain point on the sky sees meteors from one shower with very similar velocities, due to the small field size compared to the distance from the radiant. Therefore, a certain shower can be filtered out of all meteors seen with Minimum and Maximum Angular Speed.
- Maximum Angular Speed: The plotting accuracy depends on the angular velocity of the meteor. Therefore, give an upper measure of the speed to exclude too fast meteors. The minimum angular velocity must be smaller or equal to the Maximum Angular Speed.
- Maximum Distance: Since visual observations are rather inaccurate it will be necessary to give a maximum distance of meteors from the centre of display thus sharpening the density distribution.
- Ratio Distance/Length: Since, generally, this is one of the criteria for shower association, it should also be considered while calculating the backward tracings. The backward prolongations must not start less distant than the path length multiplied by this ratio. Calculations in probability mode are not influenced by this value. For example, if the ratio is 2 the tracing does not start until the distance from the meteor's beginning point is further than twice the path length.
- Speed Scale Factor: Speed scales are expressed by characters in PosDat. The scale factor converts these letters into velocities. A factor of 5 gives $A \rightarrow 5^\circ/s$, $B \rightarrow 10^\circ/s$, ... A factor of 3 yields $A \rightarrow 3^\circ/s$, $B \rightarrow 6^\circ/s$, ... FIDAC files contain an extra field for arbitrary velocity scales. Speeds are expressed by numbers 1–5. Radiant's internal list stores A–E then.
- Min. Intersection Angle: Valid for the “ENVIRONMENT: Intersection” method (see p. 21). Defines the minimum angle between two meteors to cause an intersection. Low intersection angles produce very inaccurate results. This item is obsolete in Radiant 1.41. Intersections always get a weight $\sin^2 \alpha$ where α be the intersection angle.

3.2.3 CENTRE

CTRL+C

Enter the right ascension and declination in degrees of the region you want to investigate. The display is cleared immediately after the input indicating that you are now looking at another area on the sky and

everything now calculated has nothing in common with your former distribution.

3.2.4 DAILY MOTION

CTRL+D

With time, every radiant moves across the sky nearly parallel to the ecliptic, and it is necessary to shift the meteors from different dates to a certain reference solar longitude (Fig.1 and p. 20). Otherwise the display would be smeared over a certain ecliptical longitude.

- Daily Motion: Give the expected radiant drift in degrees of ecliptical longitude per day.
- Refer. Date/Slong.: Give the reference date or the solar longitude in the following formats:
- Date: MM/DD.D as numerals (Day can contain one decimal). The possibility to give a date serves the purpose of simplifying the input of reference longitudes. Radiant calculates an approximate solar longitude and writes it in the last line of the ADJUSTMENTS box (“Used Solar Long.”) when a display calculation is started. The meteors are correctly shifted to that longitude. Thus the result is completely exact.
 - S.long: Solar longitude in degrees (may contain decimals). When Radiant calculates a display this value should be identical with the “Used Solar Long.”
 - AUTO: Type “auto” if you do not know a certain longitude. Then the calculating procedure takes the first meteor in the list to determine a reference solar longitude which is written in the last line of the ADJUSTMENTS box.
- Examples:
- 280.51 The reference solar longitude is 280°51.
 - 09/08.5 The solar longitude is computed from (1994) Aug 8, 12^h00^m giving $\lambda_{\odot} = 135^{\circ}80$.
 - auto The date and time of the first meteor represent the reference solar longitude.

3.2.5 STANDARD DEVIATIONS

The standard deviation of the angular velocity estimates depends on the velocity itself. Likewise the plotting error at the radiant depends on the distance of the meteor from the radiant. When you calculate backward prolongations or intersections, only the velocity errors are needed to define the most reasonable section of the backward prolongation begin added to the radiant distribution. When you calculate probability areas, both the speed and the plotting error are needed.

The σ for the angular velocity are valid for the middle of the given interval. Twice the standard deviation is used to define the start and end point of the backward tracing. The σ for the plotting error concern the error of the backward tracing at the radiant. The closer an element of the distribution array to the backward tracing the higher is its probability to be radiant according to a Gaussian distribution (see Fig. 2 on p. XX). Therefore, the plotting error includes both the orientation and the shifting of the path, the last becoming considerable with meteors near the radiant. Therefore, the plotting error even of a stationary meteor is not zero. The values for different speeds and distances are linearly interpolated which is a sufficient approximation. The following table shows the default errors for visual observations.

Angular velocity ω	Error σ_{ω}	Distance D	Plotting error σ_p
2.5°/s	1.5°/s	0°	0°8
7.5°/s	3.1°/s	5°	1°2
12.5°/s	3.7°/s	15°	2°8
17.5°/s	4.5°/s	30°	4°5
22.5°/s	5.8°/s	50°	6°0
27.5°/s	5.9°/s	70°	6°6
35°/s	6.0°/s		

3.2.6 IMAGE

CTRL+I

Smooth Rate per Pixel	This value defines the strength of the anti-aliasing with the button “Smth”. (0.0–1.0)
Base for Logarithms	The base for taking the logarithms of the distribution values. (1.0–5.0)
Base for Raising	The base which is raised to the power of the distribution elements. (1.0–5.0)
Width of Equ. Grid α	The step width of the equatorial grid shown with “ADDIT, Equ. Grid” can be adjusted from 2° to 20°.
Width of Equ. Grid δ	see before.

3.2.7 RADIANTS

CTRL+R

A window shows the contents of the radiant list RAD14.DBF.

Abb	abbreviation used by IMO for shower identification. RAD14.DBF is sorted by this field.
Beg, End	dates of beginind and end dates of the activity period
Max	date of acitivity maximum
SL	solar longitude for which the radiant position is valid
α , δ	radiant position
v	pre-atmospheric velocity in km/s
$\Delta\alpha$, $\Delta\delta$	radiant drift in degrees; if the radiant motion is explicitly listed this value is 99.9
ϕ	diameter of the radiant or main axes for elliptical radiants

The small dots behind the radiant names indicate that these showers are selected for the additional drawing option “ADDIT: Radiants”. Generally, all radiants are selected. If you wish to see only a few of them, press on the “Untag All” button (ALT+U) and switch the desired showers with “Toggle” (SPACEBAR) on. “Tag All” (ALT+T) switches all showers on. As the records in RAD14.DBF are sorted you can easier access a radiant by typing the first letter of its abbreviation. Press ESC or the right mouse button to quit the radiant list. If you wish to apply the parameters of a shower to calculations, press on “Use for Options” (CTRL+ENTER) to change the display centre, geocentric velocity and daily motion. The dBase file RAD14.DBF is located in the programme directory. You can modify the file or add records. Please note that the file is not sorted by Radiant. The programme does not require a sorted file but you should insert new showers at the right position for your own convenience.

Structure of RAD14.DBF

RADIANT	C 20	name of the shower
SHOWTYP	C 3	abbreviation (sorting criterion)
ACTIVSTART	C 5	begin of activity (format DD/MM)
ACTIVEND	C 5	end of activity (format DD/MM)
MAXIMUM	C 5	activity maximum (format DD/MM)
SOLARLONG	N 6,2	solar longitude for which the position is valid
POSITIONRA	N 5,1	position α in degrees
POSITIONDE	N 5,1	position δ in degrees
VELOCITY	N 4,1	geocentric velocity in km/s
RADRIFT	N 5,2	radiant drift in α in degrees, is 99.99 for drift tables
DECDRIFT	N 5,2	radiant drift in δ in degrees, is 99.99 for drift tables
DIAMETER	C 5	diameter in degrees or elliptical axes (“5” or “15x10”)

Radiants with known drift tables have multiple records sorted by the solar longitude to which each of the radiant position refers. In this case the fields RADRIFT and DECDRIFT store 99.99. These records must be sorted by the solar longitude, otherwise Radiant cannot determine the correct position for the display function “ADDIT: Radiants”. Showers straddling March 21 ($\lambda_{\odot} \approx 0^\circ$) are sorted correctly (e.g. record order: 340°, 350°, 0°, 10°).

3.2.8 COLOURS

The drawing colours of equatorial grid, telescopic fields, stars, radiants, ecliptic and excluded areas can be changed. Save the configuration file to make changes permanent.

3.3 The Menu Item “DISPLAY”

3.3.1 CALCULATE

ENTER

This item is the heart of Radiant where the density distributions are produced. The meteors are also imported here. Its behaviour depends on the current status of selection and calculation.

- i) If you selected meteors (“Selection: CHANGED” in the status box): A new window opens prompting for the files of PosDat or FIDAC you want to use for the calculation. Give the names of these files (.DBF is not required). If the files are not in the same directory as Radiant give the full paths of these files. If something is already displayed, you get a question whether or not to clear the former density distribution. Choose your answer with Y and N. Otherwise, the calculation starts immediately.
- ii) If no selections were changed between two calculations: You are not asked to give the database names again, since the meteors are already selected. However, if you want to use other files in spite of that, use the item “METEORS: Clear” before or read other records with “METEORS: Import”.

How Does the Calculating Procedure Work?

Radiant knows three methods to determine radiant distributions. The first one simply traces the meteors backward, the second gives an intersection distribution of each meteor with each other and the last method calculates probability distributions for every meteor. At first the given reference solar longitude is checked. If it is AUTO the first meteor in the temporary list in memory is applied to determine a reference solar longitude written in the last line of the ADJUSTMENTS box. Otherwise, the value given in “OPTIONS: Daily Motion” is used.

Secondly, Radiant checks whether the meteor is not too far from the centre of the projection, not too fast or too slow considering the maximum and minimum angular speed (“OPTIONS: Calculation”) and not marked as deleted in “METEORS: List”. If not, the solar longitude of the appearance date and time of the meteor is calculated. The equatorial co-ordinates are shifted in ecliptical longitude l by the product

$$\Delta l = 1.01456 m_d (\lambda_{\text{ref}} - \lambda_{\text{met}})$$

of the daily motion m_d given under “OPTIONS: Daily Motion” and the difference of the reference solar longitude λ_{ref} and the meteor’s solar longitude λ_{met} . Hence, the resulting radiant position will be valid for the reference date. The function “METEORS: Mean Sol.Long.” calculates the mean solar longitude of the meteors on the display and gives the difference to the reference longitude.

If the switch “ENVIRONMENT: Zenithal Attraction” is enabled the meteor path will be shifted once more. The Earth’s gravity attracts the meteoroid to its centre. Hence, the radiant of the meteor appears higher above the horizon. The lower the geocentric velocity of a stream is the larger is the offset Δz :

$$\Delta z = 2 \arctan \left(\frac{v_g - v_\infty}{v_g + v_\infty} \tan \frac{z}{2} \right)$$

$$v_\infty = \sqrt{(11.2 \text{ km/s})^2 + v_g^2}$$

where v_g is the geocentric velocity of the stream, and v_∞ is the increased velocity due to the Earth’s gravity, z is the zenith distance, and 11.2 km/s is the velocity of escape from the Earth’s surface. Since meteors contributing to a radiant distribution may have been seen from different geographical

co-ordinates, the correction cannot be applied to the radiant after the calculation. Therefore, paths are shifted before used for the calculation of radiant distributions. Every meteor has a most probable radiant on its backward tracing (according to the angular and geocentric speed, and the height of the meteor). We can correct this supposed radiant by the zenithal attraction value. The path is shifted on the celestial sphere that it meets the corrected position of the most probable radiant of the meteor.

The following table gives an example of the zenith attraction of a meteoroid stream with a geocentric velocity of $v_g = 30$ km/s, and, therefore, a pre-atmospheric velocity of $v_\infty = 32$ km/s.

z	Δz	z	Δz	z	Δz
30	-1°0	70	-2°6	85	-3°4
60	-2°2	80	-3°1	89	-3°7

Backward Tracings

The start and end distances ξ_s and ξ_e of the backward tracing are calculated considering the given pre-atmospheric velocity v_∞ , the altitude of the start point h , the meteors’ layer in the atmosphere H (cf. p. 17), the length of the trail l and the observed angular velocity ω with the standard deviation σ from “OPTIONS: Std. Deviations”

$$\xi_s = \arcsin \frac{(\omega - 2\sigma)H}{v_\infty \sin h} - l, \quad \xi_e = \arcsin \frac{(\omega + 2\sigma)H}{v_\infty \sin h} - l$$

Figure 2 shows the distances used in the above formula. Sometimes it happens that the speed estimate plus twice the standard deviation, which determines the far end of the backward tracing, is too large for the geocentric velocity ($\arcsin(|x| > 1)$ is not defined). However, since it is acceptable with the lower measure (estimate minus twice the standard deviation), we put $\xi_e = \pi - \xi_s$. Even now the ratio of distance and path length has to be checked. If the quotient of ξ_s and length is smaller than the given ratio we set ξ_s to the product of the path length and the ratio. The meteor is now traced backward between the two distances $[\xi_s, \xi_e]$ from the meteor’s beginning point. Every square crossed by the tracing is increased by 1; if “OPTIONS: Scale Correction” is switched on it is increased by the scale correction c , given by the expression

$$c = 1 + x^2 + y^2$$

where x and y mean the dimensionless gnomonic co-ordinates with the radius of the projected sphere being 1. The procedure stops and reads the next meteor when Radiant notices that the tracing lies outside the visible display and moves away from it. The calculation procedure can be interrupted by pressing ESC.

Intersections

Every meteor is checked on intersection with each other meteor resulting in $n(n-1)/2$ intersections with n the number of meteors. Several conditions decrease this number. Equivalently to the backward tracings a subsection of the backward tracing is valid for the calculation considering the angular speed of the meteor and the ratio of the distance to the path length. Intersections have to occur within the interval $[\xi_s, \xi_e]$ of both meteors according to the previous paragraph. Furthermore, the intersection angle must exceed the value defined in “OPTIONS: Calculation, Minimum Intersection Angle” (Radiant versions 1.4 and 1.4a). Small angles produce very uncertain intersections as slight errors in the meteor paths cause considerable changes in the intersection position. In Radiant 1.41, every intersection point gets the weight $\sin^2 \alpha$ where α is the intersection angle between the backward prolongations. The menu item “OPTIONS: Calculation, Minimum Intersection Angle” is obsolete in this version. Stationary meteors are not used for intersection counts.

Probability Distribution Functions

Generally, every meteor represents two radiants, according to its direction and angular velocity, one on the first 90° of the prolongation and the complementary one to 180°. However, the estimates of speed

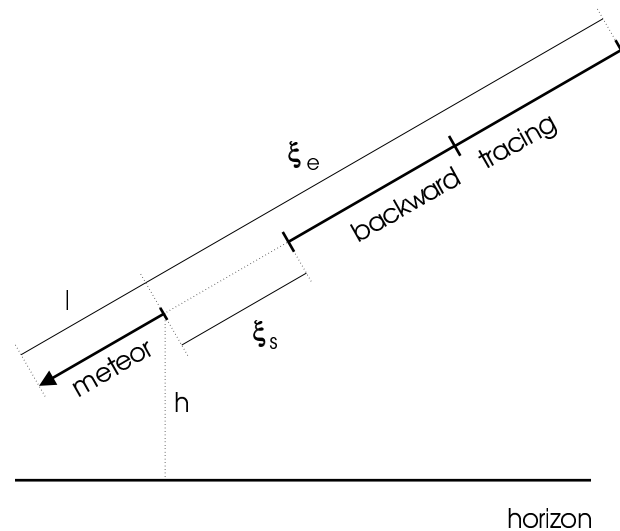


Figure 3.1: Distances considered in the backward tracing mode.

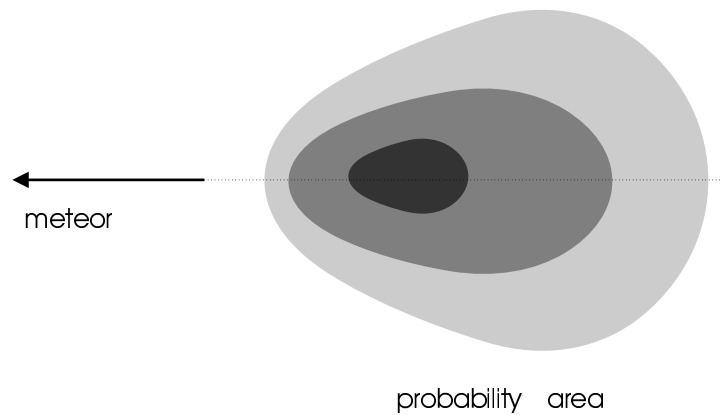


Figure 3.2: Probability distribution behind a meteor.

and position have natural errors mainly caused by the observer. We can give a radiant area with varying probabilities behind each meteor. Points near the exact radiant have high probability to be radiant, the further ones, low (see Figure 3).

Since it is enormously difficult to find those pixels in advance, which have a significant probability, the display is simply scanned column by column. The procedure starts at the column and row behind the meteor. (Very steep and very gradual meteors are specially considered.) A column is finished if the probability falls below the first grey step again and the computation of one meteor is finished if a complete column becomes zero. The probability is the product of the value concerning the velocity and the value of the position. The probabilities follow from Gaussian distributions with the standard deviations of “OPTIONS: Std. Deviations”

$$p = \frac{1}{\sigma_\omega \sqrt{2\pi}} e^{-\frac{\Delta_\omega^2}{2\sigma_\omega^2}} \times \frac{1}{\sigma_p \sqrt{2\pi}} e^{-\frac{\Delta_p^2}{2\sigma_p^2}}$$

with Δ_ω the error of speed, Δ_p the positional error and σ_ω , σ_p the respective standard deviations. In

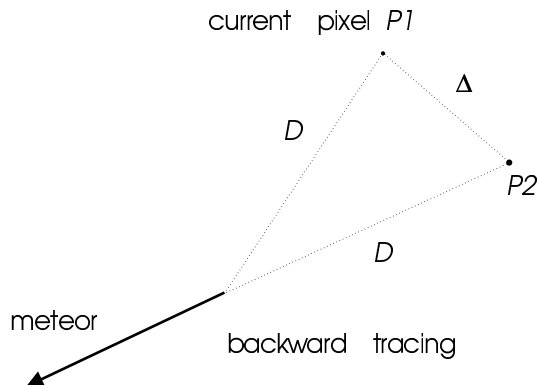


Figure 3.3: Distances considered in the probability function mode.

the case of the velocity the error is the difference

$$\Delta_{\omega} = \left| \omega - \arctan \frac{v_{\infty} \sin(D+l) \sin h}{H} \right|$$

of the estimated speed ω and the geometrical value, with D the distance from the start point of the meteor, l the length of the trail, h the altitude of the start point, v_{∞} the geocentric velocity and H the corresponding height of appearance (see p. 17). The positional error Δ_p is the distance of the current pixel from a point on the backward tracing of the meteor, which has the same distance from the start point of the meteor as the pixel (Figure 4). If “ENVIRONMENT: Velocity Consid.” is switched off, the probability functions cannot be used, since the function is one-dimensional then, although the distribution has two dimensions. The scale correction is also applied provided, the corresponding switch is on. Here, the scale correction preserves the total of weight of a meteor’s probability area which should be the same independent from the location of the area on the gnomonic chart. Preserving areas means

$$c = \frac{1}{1 + x^2 + y^2}.$$

However, we are not interested in total weights, but in the weight of a meteor per pixel, i.e. the radiant density. It is therefore recommended to switch the scale correction off during probability calculations.

The “STATUS of CALCULATION” Box

The first line shows the number of meteors currently loaded. It is always the current size of the temporary list in memory. The second line indicates the number of displayed meteors; it is the actual number of visible backward tracings. (If you diminish the resolution with “RES” the number of displayed meteors also changes to the correct value.) The third line indicates the number of ignored meteors. Meteors can be rejected if their angular velocity does not fit the values “OPTIONS: Calculation, Minimum Angular Speed” and “Maximum Angular Speed” or if they are more distant from the centre of the gnomonic projection than the “Maximum Distance”. Meteors which were excluded from the calculation in “METEORS: List” are also counted here. The fourth line counts the meteors being processed during the calculation. The sum of displayed and ignored meteors need not be equal to the number of selected meteors since there are often a number of tracings outside the visible distribution.

The “Calc.” line shows different words:

NOTHING	Status after start-up.
DOING	Radiant is calculating backward tracings or probability functions.
DONE	Calculation is ready.
INTERRUPTED	The calculations were interrupted by pressing “ESC”.

The “Selection” line indicates the status of selection from databases.

- CHANGED** The meteor selection for the database import was changed with “OPTIONS: Selection”. It indicates that the “Calculate” procedure will ask you for the databases again and clear the current list of meteors in memory.
- DONE** The selection was applied to the import of meteors.
- RELEASED** All kind of selective criteria are reset to their lowest level (all observers, all sites, period: Jan 01 to Dec 31, ...). “Calculate” will ask for databases.

Some Remarks on the Angular Velocity

Generally, the angular velocity of a meteor is stored in PosDat as a number representing the speed in degrees per seconds. The VEL field, however, can also contain letters from A to E. These characters are interpreted by the value of “OPTIONS: Calculation, Speed Scale Factor” (cf. p. 17). If the velocity is not reported Radiant stores 99. So you can delete these meteors in “METEORS: List”.

3.3.2 EXEC. PROJECT

Projects are files containing the information of several calculation tasks which are executed like a batch file. This item opens a directory window where you can select the project file to be executed. These files can be edited with the Project Editor PRJ14.EXE (see p. 37) or “PROGRAMME: Project”. The item “Exec. Project” executes the activated tasks of the selected file one after another. The results are automatically saved to disk under the filenames given in the editor. The execution of the calculation batch can be interrupted with ESC.

3.3.3 LOAD

F4

Loads a density distribution saved by Radiant. Give the name of the file and if necessary the directory of this file. Enter *name* to load *name*.DSP from disk, or press F5 to see the directory list (shows files with .DSP extension). The preview window opens by typing ALT+P. It shows a mini image of the density distribution and the number of displayed meteors. ALT+F5 switches to the mosaic mode where all density distributions stored in the current directory are displayed as mini images. Choose a file by clicking with the left mouse button on the corresponding image. You can faster search for a file by typing the first letter of its name. The option Load Meteor List (ALT+M) turns the automatic meteor loading on/off. Once a distribution is loaded the corresponding meteors are opened when found. Switch this option off if you work with files created by Radiant 1.2 and 1.3 which did not store meteor lists on disk.

3.3.4 ADD

CTRL+F4

Similarly to “Load” density distributions saved by Radiant can be opened. However, the elements of the distribution grid are added to the current display on the screen. If the projection centre, resolution or pixel size do not correspond to each other you get an error message. If the reference solar longitudes of both images are different a message warns you and asks for confirmation. You can decide whether this difference in solar longitude is negligible compared to the pixel resolution.

3.3.5 SAVE

F2

The current density distribution will be saved as well calculation-specific data. Enter a filename which can be up to eight characters long. You need not give an extension for the filename. The extension is always .DSP which should not interfere with other software. The current display is saved in a highly compressed format that can only be retrieved by Radiant itself. The option Save Meteor List (ALT+M) turns the automatic saving of the meteor list on/off. These files have the same name as the density distribution but with extension .M. Note that this switch is also valid for project calculations (see above under “Exec. Project”) and cannot be set in the Project Editor. Also saved: size of pixels, centre of

display, reference solar longitude, number of displayed meteors, numbers of meteors in lower resolutions (if possible), geocentric velocity, daily motion, method of calculation.

3.3.6 EXPORT BMP

Saves the current distribution screen in the uncompressed bitmap file format of Windows. The image size will be 400 by 400 pixels with a colour depth of 8 bit resulting in a file size of 157K. Enter the filename, the extension is always .BMP.

3.3.7 PICK DISPLAY

F7

This small list shows up to 16 of the recently loaded or saved density distributions.

3.3.8 MOS. PICK

ALT+F7

The mosaic pick list shows the mini images of up to 16 of the recently loaded or saved density distributions. Click with the left mouse button on the desired image to open it.

3.4 The Menu Item “METEORS”

3.4.1 OPEN

ALT+O

Opens a meteor list saved by Radiant. Enter the filename without extension (always .M) or press F5 to see the directory list. As fields of telescopic observations belong to the meteors they are loaded as well.

3.4.2 ADD

Opens a meteor list once saved by Radiant and appends the data to the currently used list. The on-screen status of the appended meteors is cleared.

3.4.3 SAVE

ALT+S

The currently opened meteor list is saved to disk in Radiant format. Meteors marked as deleted remain hidden but the status whether the meteor contributes to the density distribution is cleared. This status is only valid when you save the density distribution (“DISPLAY: Save”) coupled with the meteors. If telescopic fields were imported from PosDat they are appended to the meteor list.

3.4.4 IMPORT

ALT+M

Extracts meteor data from PosDat or FIDAC databases depending on the switches “ENVIRONMENT: Read PosDat” and “Read FIDAC”. Meteors are selected by the criteria defined in “OPTIONS: Selection” and converted into the internal format of Radiant. The upper line of the Status Box shows the number of selected meteors. (This import procedure is also called when you use “DISPLAY: Calculate” and no meteors have been read yet or when you changed the selective criteria.) Radiant automatically imports telescopic fields from PosDat if they are available. “ADDIT, Telescopic Fields” shows them on the screen.

3.4.5 INPUT METEORS

ALT+I

Enters the input mode of individual meteors. The meteors are appended to the current list in memory. If the site code is not found you are asked to put in the geographical co-ordinates.

- Date: Give the date in the format YY/MM/DD, e.g. 91/09/25. Use always two-digit integers for the date. Consider that the date changes after midnight UT.
- Time: The time contains hours and minutes (UT). Examples: 21^h03^m→2103; 02^h35^m→0235 or 235; 00^h05^m→0005 or 5.
- Sitecode: Sitecode referring to VMDBSITE.DBF.
- Start α ... Equatorial co-ordinates in degrees.
- Velocity: Angular velocity in degrees per second. Arbitrary character scales do not work.

3.4.6 LIST

ALT+L

Sometimes it might be useful to have supervision above the selected meteors. Here you can check meteor by meteor and, if necessary, exclude it from calculation. A “ \diamond ” indicates that this meteor contributes to the current display. The table shows the date in YY/MM/DD format, the UT in HHMM format, the equatorial co-ordinates, the angular speed in degrees per second (A...E represent step scales) and the geographical co-ordinates from which the meteor was seen. ENTER changes the status of the highlighted meteor; deleted or not deleted. Meteors marked with “-” (symbolizing “not”) are ignored while calculating the density distribution. “ $\Delta\Delta$ ”, “ $\nabla\nabla$ ” or CTRL+PGUP, CTRL+PGDN: first/last page of the list.

3.4.7 CLEAR

F8

All meteors are removed from the temporary list in memory. When you next use “DISPLAY: Calculate” you are asked for the reference database again. The selective criteria are not affected.

3.4.8 MEAN SOL. LONG.

The mean solar longitude of the meteors in the temporary list as well as the meteors displayed is calculated. The first line gives the mean, followed by the standard deviation and the full range of longitudes. Offset means the difference of the mean from the reference solar longitude. The motion value gives the offset in ecliptical longitude, i.e. the product of the offset and the daily motion. If you shift the radiant found by this value (see next section) you get the radiant according to the centre of gravity of the meteors' dates. Press on “Radiant” (SPACEBAR) to show the shifted radiant in a small window.

Note: The motion value of all meteors is calculated with the setting “OPTIONS: Daily Motion”; the motion value of the displayed meteors uses the daily motion the currently visible display was calculated with. The middle button (press H) shows a diagram with the meteor distribution over the solar longitude.

3.4.9 DISPLACEMENT

The displacement value is identical with the motion value of the displayed meteors given under Mean Solar Longitude. However, if you run projects and do not save the meteor lists, you cannot determine the motion value from the meteors anymore. Therefore, switch the option “ENVIRONMENT: Logfile” on before executing the project. The motion value is then stored in RAD14.LOG. This value can be entered in “Displacement”. A small window shows the shifted radiant then.

3.5 The Menu Item “ENVIRONMENT”

3.5.1 TRACINGS, INTERSECTIONS, PROBABILITIES

SHIFT+T, I, P

These switches select the calculating method. Tracings are simple backward prolongations of the meteors, intersections are the points where the backward tracings meet and probability functions determine the probability of each distribution element behind the meteor to be its radiant. Note that the last item is inactive when the velocity consideration (see below) was switched off.

3.5.2 SCALE CORRECTION

Normally, every display is corrected with a scale correction considering the changing scale over a gnomonic projection. With pixel sizes smaller than 1° this correction is very slight. For large pixel sizes the display is strongly disfigured. In such cases you can switch the scale correction off and re-calculate the display.

3.5.3 VELOCITY CONSID.

If you expect meteors in the database that have no estimate for the angular velocity (esp. in older data), switch this item off. Then Radiant prolongs the meteors over the entire sky. Probability calculations are not possible without velocity consideration.

3.5.4 ZENITHAL ATTRACTION

Radiant positions suffer from the Earth's gravity. The calculating procedure corrects this attraction towards the zenith (see p. 20 for details).

3.5.5 SITE CODE INQUIRY

If Radiant finds meteors with unknown sitecodes these meteors are ignored and not loaded into the temporary list in memory. If the site code inquiry is on you are asked to enter the geographical co-ordinates of the unknown site as integers in degrees. This site stays in memory until the Radiant session is closed. The same prompt occurs when you try to enter a meteor via “METEORS: Input” seen from an unknown site independently of the switch.

3.5.6 READ POSDAT, READ FIDAC

These items switch between the import of PosDat and FIDAC files.

3.5.7 PROJECT LOGFILE

This item influences the execution of projects. When you use “DISPLAY: Exec. Project” the following things are stored in the ASCII file RAD14.LOG for each task besides the calculations:

- date and time when the task was started,
- number of selected meteors,
- date and time of begin and end of the calculation
- whether the calculation was interrupted
- number of displayed meteors
- number of ignored meteors
- the mean solar longitude of the displayed meteors, its standard deviation,
- the minimum and maximum solar longitude of the displayed meteors,
- the offset in solar longitude and the resulting motion value in ecliptical longitude,
- the time when the task was finished.

New entries into RAD14.LOG are always appended. If you don not need older logs anymore simply delete the file or delete the old parts with an ASCII editor.

3.6 The Menu Item “RES”

3.6.1 HIGH RESOLUTION 100 x 100 SHIFT+1

The display is divided into 100 by 100 elements, i.e. 10 000 real numbers. If you switch this item on from lower resolution the display will be cleared.

3.6.2 MEDIUM RESOLUTION 50 x 50 SHIFT+5

The display is divided into 50 by 50 elements, i.e. 2500 real numbers. If you switch this item on from high resolution the centre of the old display (elements [25,25]–[74,74]) stays available. Also the number of displayed meteors is adapted. If you switch this item on from low resolution the display will be cleared.

3.6.3 LOW RESOLUTION 25 x 25 SHIFT+2

The display is divided into 25 by 25 elements, i.e. 625 real numbers. If you switch this item on from high resolution the centre of the old display (elements [38,38]–[62,62]) stays available. From a display with 50 × 50 pixels you get the elements [13,13]–[37,37].

3.7 The Menu Item “ADDIT”

3.7.1 B/W MONITOR

The display of density distributions is changed from colour steps to only greys. All other characteristics stay the same.

3.7.2 PAINT WHILE CALC.

Normally, Radiant already gives you an impression of the density distribution at calculating time. This needs some additional time. If you switch this item on the programme switches to the text screen and shows only the numbers of the Status Box. The reduced information given speeds up the calculation. If you run Radiant under Windows 3.x or Windows95 with a 386 or higher processor you may now switch the background option on.

3.7.3 EQUATORIAL GRID SHIFT+G

This item switches an equatorial grid over the display on/off. The grid size is adjusted under “OPTIONS, Image”. It defaults to 10°.

3.7.4 TELESCOPIC FIELDS SHIFT+F

If this item is enabled the fields of view of telescopic observations are drawn as circles on the display. Telescopic fields are stored in PosDat, and they are imported automatically when you use PosDat meteors. This item helps detect artificial intersection areas due to the position of the fields. The field of view is stored in the fields RACEN and DECEN, the diameter, in METHOD in the header file of PosDat.

3.7.5 STARS <4.0 SHIFT+4

Shows the stars with a limiting magnitude of 4^m0.

3.7.6 STARS <5.5

SHIFT+S

Shows the stars with a limiting magnitude of 5^m5. The file RAD14.DAT stores the positions of the stars in a compressed format; therefore, editing the file is not possible.

3.7.7 RADIANTS

SHIFT+R

Shows the radiants stored in the RAD14.DBF dBase file considering the reference solar longitude with which the density distribution was calculated. A selection of radiants is drawn if you chose a few showers from the radiant browser “OPTIONS: Radiants” (see p. 19).

3.7.8 ECLIPTIC

SHIFT+E

Draws the ecliptic if it crosses the display window.

3.8 The Menu Item “ASCII”**3.8.1 ENVIRONMENT**

Additionally to the distribution values, the centre of the display, pixel size, reference solar longitude, daily motion, geocentric velocity, number of displayed meteors and the calculation method are saved in the ASCII file.

3.8.2 EXPLAINING TEXT

The Environment will be commented with some explaining text.

3.8.3 (x, y) AS (α, δ)

Generally, the grid indices of the distribution array are of little use for other software. Therefore, Radiant saves the original equatorial co-ordinates instead. Be careful with displays which lie near a celestial pole. Although grid indices are almost equidistant the spherical co-ordinates are not.

3.8.4 SPREADSHEET

Values of one line of the distribution array are also stored in one line in the ASCII file. Therefore, the item “ (x, y) as (α, δ) ” has no influence.

3.8.5 DEL. SPACE, DEL. COMMA, DEL. SEMICOLON

Select the appropriate delimiter for your software importing Radiant results. Other delimiters can be defined in the configuration file at “ASCIIDel=”. You can use any character by its ASCII code there.

3.8.6 EXPORT ASCII

The complete density distribution can be saved in ASCII format. Before saving ASCII files find out which delimiters are required by the software reading Radiant’s data. The extension .TXT is not required. Use the button “Area” to export parts of the density distribution (see p. 34). You may also export cross-sections through the density distribution to ASCII files with the button “Cros” described on p. 33.

3.9 The Menu Item “PRINT”

3.9.1 PRINT

This item makes quality prints with 9- and 24-pin printers being able to print in graphics mode. Also HP DeskJet and LaserJet II compatible printers are supported. The latter give reproducible results for publications. Before printing check the right printer in the “Configure” menu. The procedure prints the distribution window as you see it on the screen. However, the number of grey steps depends on the printer type resulting in slightly different density representation. Overflowing areas are hatched. Note that you can also print meteor distributions created with the button “Dist”. The pixel resolution (in dots per inch) influences the size of the drawing:

- 240×216 dpi \rightarrow 128mm \times 142mm
- 300×300 dpi \rightarrow 136mm \times 136mm
- 300×300 dpi \rightarrow 68mm \times 68mm (option “Fast Print”)

3.9.2 CONFIGURE

Opens a menu offering the supported printer families and three parallel ports. Select the appropriate items and save the configuration with “PROGRAMME: Save State” to make the printer settings permanent. The “HP LJ Microtoner” item supports the micro-toner system of Laserjet III and higher printers which allows more grey levels. Try both the Laserjet and Microtoner printing to find out which produce the best results.

3.9.3 TEXT LINE

You can give a self-defined text line to annotate the result with some additional information.

3.9.4 COLOUR STRIP

The graduations of grey will be printed with the corresponding values of the density distribution as well as the number of displayed meteors.

3.9.5 CALC. ADJUSTMENTS

Prints the centre of the display, the pixel size, the geocentric velocity, the meteor height, the daily motion, the reference solar longitude and the used calculating method.

3.9.6 FAST PRINT

Prints three times faster with 9-pin Epson or 24-pin IBM printers. It is useful to print comprehensive analyses or to print an empty gnomonic chart since the equatorial grid is not affected. The distribution elements, however, look rather messy. Prints four times faster with HP Printers. The density distribution has only half the size of normal prints. All features are scaled down correctly.

3.10 The Menu Item “BACKGRND”

The menu “Background” helps estimate the prominence of radiant and to filter certain regions. The importance of the background noise is often overlooked. You can only estimate a prominence of a radiant if you included all the meteors being plotted in the whole region around the investigated radiant. If

you select meteors by their shower association prior to the radiant calculation you get a sharp radiant anyway. Therefore, a reliable density distribution should contain a well defined noise. The prominence of the radiant is then expressed by its height above the mean background.

3.10.1 INCLUDE

This item is only active if parts of the display were excluded from the background determination via “Exclude” or “Exclude All”. Use this function to include parts of the array. See p. 10 for details on defining the included region.

3.10.2 EXCLUDE

If several radiants are on the display you should exclude the disturbing radiants from the background determination. See p. 10 for details on defining excluded regions. Do not exclude the radiant itself from the noise determination. Otherwise it would not give an impression of the sharpness of the radiant. Hence, very large radiants have smaller prominence than sharp ones, since large radiants shift the background mean up. Consequently, the prominence value is comparable only for displays with equal pixel size and resolution. If you double the pixel size and re-calculate the display you get a larger prominence but less information on the radiant position.

3.10.3 INCLUDE ALL

This item is only active if parts of the display were excluded from the background determination via “Exclude” or “Exclude All”. Use this function to make the complete display available for the background estimate again.

3.10.4 EXCLUDE ALL

Excludes the complete display from the background determination.

3.10.5 GET NOISE

All included parts of the display (non-hatched areas) are used to determine the mean density of the distribution. A small window shows the mean value, the standard deviation and the prominence value

$$z = (\nu_{x,y} - \bar{\nu})/\sigma$$

where $\nu_{x,y}$ is the grid value at the cursor position, $\bar{\nu}$ the mean and σ , the standard deviation. z can be applied to compare the prominence of radiants. Please note the remarks given under “Exclude” considering the prominence of a radiant.

3.10.6 RANGE

F6

Defines the scale limits of the colour strip. This can be useful to suppress the background noise or to suppress a strong radiant in the vicinity of a weaker one. This function is internally called by the buttons “ σ ”, “ 2σ ” and “ 3σ ”, too. Note that probability distributions show percentages at the colour strip. You can use these percentages also for the range limits. Any change of the grid values (Calculate, Load, Add, “Smth”, “Log”, “eXp”, “Grad”, “Clr”) reset the scale limits. The button “ClrR” (ALT+R) clears the range as well.

w2	w1	w2
w1	w0	w1
w2	w1	w2

Figure 3.4: Weights of neighbour pixels for the Smooth function.

3.11 The Button Bar

3.11.1 ZOOM

Z

The density distribution will be magnified twice. Due to simplification of the displaying procedures the button always magnifies the centre.

3.11.2 SMTH

S

This abbreviation stands for “Smooth”. For every square the weighted average with the surrounding eight squares is calculated (see Figure 5):

$$\nu'_{x,y} = \frac{\nu_{x,y} + r_s(\nu_{x-1,y} + \nu_{x+1,y} + \nu_{x,y-1} + \nu_{x,y+1}) + \frac{r_s}{2}(\nu_{x-1,y-1} + \nu_{x-1,y+1} + \nu_{x+1,y-1} + \nu_{x+1,y+1})}{1 + 4r_s + 2r_s}$$

where ν means the distribution elements and r_s the smoothing rate (see p. 19).

3.11.3 FIND

F

A certain part of the density distribution can be framed with the mouse or the cursor keys to estimate the average radiant position from the currently visible display. With x and y being the indices in horizontal and vertical direction it is the simple arithmetic mean in the interval $[x_1, y_1] [x_2, y_2]$ weighted by the grid values:

$$\bar{i} = \frac{\sum_{k=y_1}^{y_2} \sum_{i=x_1}^{x_2} i \times \nu_{i,k}}{\sum_{k=y_1}^{y_2} \sum_{i=x_1}^{x_2} \nu_{i,k}}, \quad \bar{j} = \frac{\sum_{l=y_1}^{y_2} \sum_{j=x_1}^{x_2} j \times \nu_{j,l}}{\sum_{l=y_1}^{y_2} \sum_{j=x_1}^{x_2} \nu_{j,l}}$$

with ν the distribution elements and i, j, k and l the array indices. The appearing window shows the converted mean position in α, δ and the standard deviation

$$\sigma = \sqrt{\sigma_x^2 + \sigma_y^2}$$

with σ_x and σ_y the standard deviations in both directions. The σ given in the window is also converted into degrees.

3.11.4 LOG

L

The fainter parts of the display can be made more evident by taking the logarithms of the distribution values to a certain base defined under “OPTIONS: Image”. The default base is 2.7. To avoid negative

values (the probability functions give values smaller than 1) the term $\log_a(x+1) = \ln(x+1)/\ln a$ is used. The distribution values are always scaled to a maximum of 10. Hence, the influence of the curvature of the logarithmic function the same on all images.

3.11.5 EXP X

The most dense parts of the display can be made very distinct by raising a certain base (defined in “OPTIONS: Image”) to the power of each element of the density grid. To use exactly the inverse term as taking the logarithms, the exponential term is $a^x - 1 = e^{x \ln a} - 1$. The default base is $a = 2.7$. The distribution values are scaled to a maximum of 10. Hence, floating point overflows are prevented.

3.11.6 GRAD G

Estimates the magnitude of the gradient in each pixel with the formula

$$\nu'_{x,y} = \sqrt{(\nu_{x,y-1} - \nu_{x,y+1})^2 + (\nu_{x-1,y} - \nu_{x+1,y})^2}$$

where x and y are the indices of the distribution array and ν are the densities. The diagonal elements are not considered.

3.11.7 CLR C

The screen is reset to the original display as it was calculated. Hatched areas which were excluded from noise calculations by “BACKGRND: Exclude” are included again, noise, mean-radiant and radiant-displacement windows are closed. The colour range is set to the complete density range.

3.11.8 DIST ALT+D

If meteors are selected, it shows the distribution of the meteors around the centre of the display. The three circles represent 30°, 60° and 90° distance. The vertical line is directed to the north pole, the horizontal line is the perpendicular great circle through the centre. A pink circle indicates the Maximum Distance (see p. 17). The field covered by the gnomonic projection is indicated by a pillow-like frame. Meteors contributing to the display are white-coloured the others are grey.

Note: This chart is not gnomonic; hence, the straight meteors are only an approximation, but start and end points are correct.

3.11.9 CROS ALT+C

Define a certain cross-section line through the display with the mouse or with the cursor keys. The values can be fitted with single and double Gaussian distributions in a special window. The approximation is a stepwise method, searching for the best improvement of the quadratic error. This function was implemented to find a statistical way to resolve double radiants. However, there is still no value deciding if a double peak is real or an artifact. We put the single Gaussian to

$$y = l e^{-\frac{(x-m)^2}{2\sigma^2}} + c$$

where l is the amplitude, m the mean and σ the standard deviation of the Gaussian, and c is a constant which can be defined by the user to subtract the background noise. The constant is not changed by the approximation. The double Gaussians are expressed by

$$y = l_1 e^{-\frac{(x-m_1)^2}{2\sigma_1^2}} + l_2 e^{-\frac{(x-m_2)^2}{2\sigma_2^2}} + c$$

the indices referring to the two assumed superimposed distributions. The step width decreases during the approximation until it reaches the minimum defined by the buttons “10%”, “1%”, “0.1%”. This is the final accuracy of the Gaussian parameters since the next approximation of a parameter is determined by

$$p_{t+1} = p_t \pm p_t \Delta$$

where t is the index of iteration and Δ is the step width. An accuracy of 1% means, the step width falls down to 0.01.

“Bckg”:	B	A certain background level can be defined with the mouse in the diagramm. The background is indicated with a red line and is used as the constant c in the Gaussian. The value appears in the upper part of the window.
“PcBk”:	CTRL+B	Pick background: The mean background noise is determined (considering excluded areas) to be used as c . This is the recommended way to determine c .
“ClrB”:	ALT+B	Clear background: Puts the constant c to zero.
“PcL1”:	L	Pick l1: Sometimes it happens that one of the l 's becomes zero. Use this button to put it to another starting value.
“PcL2”:	SHIFT+L	See “PcL1”.
“Save”:	F2	Saves the current cross-section or area as a text file to export Radiant displays to other statistics or image processing software. The extension for the filename is always .TXT. The contents is defined in “ASCII”.
“Fxm1”:	SHIFT+1	The mean m_1 can be fixed, whence it is not changed during the approximation.
“Fxm2”:	SHIFT+2	Same as “Fxm1” with m_2 .
“M1”:	ALT+1	It might be that the approximation finds unreasonable means. If you are sure about the mean m_1 press this button and set the mean in the diagram with the mouse.
“M2”:	ALT+2	Same as “M1” with m_2 .
“Stop”:	SPACEBAR	Interrupts the current approximation. It may take the procedure some time to react on your pressing. Press the mouse button until the screen button pushes in.
“Sgl”:	S	Starts the approximation of a single Gaussian distribution.
“Dbl”:	D	Starts the approximation of a double Gaussian distribution.
“Quit”:	ESC	Leaves the cross-section window.
“10%”:	1	The approximation stops at step<0.1 (resulting in 10% accuracy).
“1%”:	2	The approximation stops at step<0.01 (resulting in 1% accuracy).
“0.1%”:	3	The approximation stops at step<0.001 (resulting in 0.1% accuracy).

The values above the graph mean: “max1”, “max2” the first and second maximum (l_1 , l_2), “ α_1 ”, “ δ_1 ”, “ α_2 ”, “ δ_2 ” the co-ordinates of both maxima. “ Σ ” is the sum of error squares. The “X2” line is some kind of a χ^2 -value. However, it is not comparable with tables which refer to degrees of freedom; the distribution values are not sample numbers.

3.11.10 AREA

ALT+A

Define a certain part of the density distribution with the mouse or the cursor keys. The values can be fitted with a two-dimensional Gaussian distribution in a special window. The approximation is a stepwise method, searching for the best improvement of the quadratic error. This function was implemented to prove the existence of a radiant assuming that it has Gaussian shape. Currently, it is not yet applicable to find a value which decides statistically whether or not the selected region contains a radiant. We put the Gaussian function to

$$z = l e^{-\frac{(x-m_x)^2}{2\sigma^2}} \times e^{-\frac{(y-m_y)^2}{2\sigma^2}}$$

where l is the maximum, σ is the standard deviation (only circular Gaussians are fitted) and m_x and m_y are the means in x and y direction respectively. See the description of the button “Cros” for details on the buttons in the window. Some other functions are:

“PcBk”:	CTRL+B	Pick background: The background noise is applied to the constant c in the above equation.
“ClrB”:	ALT+B	Clear background: Sets the constant c to zero.
“Draw”:	D	If this button is on, the approximation draws every step of iteration in the diagram being a very slow process.
“Sun”:	S	The diagram is illuminated by some kind of “light” source.
“Fram”:	F	The surface elements are framed.
“Line”:	L	Only the outlines of the array are drawn. This is the fastest method to draw the diagram.
“Calc”:	ENTER	Starts the approximation.
“Val”:	V	Shows the selected distribution values in the diagram.
“Curv”:	C	Shows the current approximation.
“10% “:	1	The approximation stops at $\text{step} < 0.1$ (resulting in $\pm 10\%$ accuracy).
“1%” :	2	The approximation stops at $\text{step} < 0.01$ (resulting in $\pm 1\%$ accuracy).
“0.1%”:	3	The approximation stops at $\text{step} < 0.001$ (resulting in $\pm 0.1\%$ accuracy).

The values above the graph mean: “max” the maximum l of the Gaussian, “ α ”, “ δ ” the co-ordinates of the approximated peak in equatorial co-ordinates.

3.11.11 σ 1

Radiant calculates the mean background noise and puts the lower colour limit to the mean plus the standard deviation.

3.11.12 $2\sigma, 3\sigma$ 2, 3

Puts the lower colour limit to the mean plus two/three times the standard deviation resp.

3.11.13 ClrR ALT+R

Clears the current colour range. The lower limit is put to zero, the upper, to the maximum value of the distribution.

3.11.14 HELP F1

Calls the help window. If you are not in a settings or input window you get the help index where you can select a topic. Otherwise you get context help about the current input with access to the index, too. See page 10 for details on the help system.

3.11.15 ESC ESC

This button can be used to leave any kind of input or settings menus.

3.11.16 Buttons with “□”

This button closes small windows with results.

Mean background window: ALT+F4

Mean radiant window: ALT+F5

Shifted radiant window: ALT+F6

Chapter 4

The Project Editor PRJ14.EXE

Comprehensive analyses may require lots of calculating hours. Several density distributions with similar computational environment are to be created. It seems most inconvenient to execute these calculations one by one, since after each display the selections must be changed or environmental data have to be adjusted. Therefore, a small programme was implemented to create tasks which contain all the data necessary for a complete calculation. These tasks are stored in so called project files. There is one example project RAD14.PRJ in the working directory of Radiant. If the editor is started without parameters a new project is created. You may call the editor with

`prj14 projectname`

to edit an existing project. Otherwise you can load a project with F4. The example project file RAD14.PRJ contains some pre-defined showers. As soon as you open it you will see a list of keywords of these showers on the right hand side of the screen. Every item in this list is a task. The keyword is identical with the name of the display file being saved after the calculation of the task. The large box on the left side is the input area, where the task can be specified. You are always editing the task on top of the list window.

The first field is the Filename which can consist of 8 characters. The tasks in the list on the right side are sorted alphabetically as soon as you write the first letter of the filename. Observers, Sitecodes, Charts, Period, Limiting Magnitude and Accuracy can be filled like the input box "OPTIONS: Selection" in Radiant (see p. 15). One exception is the period: The format is MM/DD (do not forget the slash; the 8th August is 08/08 not 8/8) for dates or SSS.S for solar longitudes. The distinction between dates and solar longitudes is made by Radiant; but do not mix them in one task. Note that these selective criteria are only valid for importing of meteors from dBase files. If you calculate meteor lists of Radiant (extension .M) the criteria cannot be considered.

The fields Pixel Size, Geocentric Velocity, Minimum and Maximum Angular Speed, Maximum Distance and the Ratio Distance/Length represent the menu item "OPTIONS: Calculation" (see p. 16). The minimum intersection angle cannot be adjusted for compatibility reasons. Centre α , Centre δ defines the gnomonic projection centre and Daily Motion, Ref. Solar Longitude the radiant motion in ecliptical longitude.

The field Meteor File records the name of the Radiant meteor list, the PosDat header file or the FIDAC file containing the meteors for this task. Meteors from PosDat and FIDAC files are extracted applying the selective criteria given above. You only need to write the direct path from Radiant to this file, however, it is safer to give the disk drive with the complete path. The Data File field is needed for PosDat import as this database stored the individual meteor co-ordinates in a separate file. Since data and header filename normally differ in the letters HEAD→DATA, you may write ... in the Data File field. Hence if you want to use PDHEAD-S and PDDATA-S just enter Meteor File=PDHEAD-S.DBF and Data File=... The check boxes have emphasized letters. Press this letter together with ALT to check or uncheck the item (example: ALT+S for Scale Correction). Tasks can be enabled for calculation with the Active field. If the project is executed by Radiant, the activated tasks are done one after another without interruption. If you want to have one task calculated do not forget to check the field Active.

F4 opens a project file, F2 saves the project file. ALT+F2 saves the project prompting for the filename. F10 closes the project editor. A new task can be inserted with F3. An empty keyword appears on top of the list on the right side. As tasks of one investigation will be often very similar, you may copy the currently edited task with Ins to a new one with the complete contents. Then also the filename is the same; hence, do not forget to change the filename of the inserted task. Otherwise the result created by the preceding task would be overwritten. F8 deletes the edited task without inquiry. CTRL+DEL switches all tasks off. F5 shows a table of the currently defined tasks. F6 creates a triple of tasks from the currently edited with identical settings except the method is changed. Hence, a certain calculation can be executed with all three methods. Note that the filenames will be modified in order to avoid overwriting files. There is a T, I and P appended to the filename resp. The complete task list can be checked on correctness with F9. Fields are checked on allowed ranges and the database names of active tasks are checked on existence. You also get a hint if no task was enabled. The appearing messages allow one to interrupt the checking procedure with ESC to correct the error. Otherwise you may continue checking with the SPACEBAR.

Chapter 5

Trouble-shooting

5.1 Possible problems

- No meteors are selected. You entered the names of the import databases and virtually the procedure does not find any meteor. Check the selective criteria under “OPTIONS: Selection”. Clear all criteria with F8 for testing and call “METEORS: Import” or “DISPLAY: Calculate” again. Make sure that you use the VMDBSITE.DBF file which is shipped with Radiant 1.4. Older versions of VMDBSITE have a different structure and will cause arbitrary sitecodes. Switch “ENVIRONMENT: Sitecode Inquiry” on and call “Import” again. If you are asked for geographical co-ordinates at any observation you can be sure that you use a wrong VMDBSITE file. Note that if you have a VMDBSITE version in a directory which is included in the DOS path command Radiant reads the sites even if the configured path is wrong.
- No meteor tracings are displayed. What does the Selected Meteors line in the Status Box say? The number should be different from zero. Which areas are covered by the meteors? Check the co-ordinates with “METEORS: List”. Did you set the centre of projection with ”OPTIONS: Centre”? Did you set the “Daily Motion” parameters? The reference date/solar longitude is important, otherwise meteors may be shifted around half of the sky, and you will not get any result although the centre of projection is correct.
- The Calculate procedure asks for databases though meteors are available. This automatic prompt occurs if the selective criteria were changed by “OPTIONS: Selection”. Do not change the choice unless you want to import other meteors. However, if you cancel the import request and call Calculate again the automatism switches off.
- The prints are not complete on laser printers. The laser printer reads the information of a complete page into its memory before starting the output. The size of Radiant prints needs 371K printer memory. Laser printers with 512K memory may not be able to store te complete information. Solutions are using Fast Print which prints only non- reproducible drafts or adding printer memory.
- You cannot enter the sitecode in “INPUT: Meteors”. An error in Radiant only allows sitecode up to 32767 in the direct input. The database import is not affected.

5.2 Messages

- Add DESPITE the DIFFERENCE?

You tried to add two displays that were calculated with different reference solar longitudes. If the difference is slight, you may choose YES.

- Clear display?

This message gives possibility to choose whether or not the display is cleared before calculation. NO means, the data are added to the current display.

- Could you please tell me the path to the VMDBSITE.DBF file?

This message appears when Radiant does not find a VMDBSITE.DBF file in its directory, e.g. if you erased this file since you use the VMDB where such a file is available. Then give the directories and the site file name (e.g. \FOXPRO\VMDBSITE.DBF). This path to the site file must be stored in the configuration file of Radiant with "PROGRAMME: Save State", i.e. you needn't give that path again and again.

- File already EXISTS. Overwrite ?

You gave a name of a distribution file (Radiant or ASCII format), a meteor file or a bitmap file which already exists.

- FILE DOES NOT EXIST

Check the filenames you entered. In the case it is sent by the import procedure METEORS, Import or at "DISPLAY: Calculate" check the names of both the header and the data files. The error message also appears when the file is used by other software in multi-tasking systems.

- Graphics not initialized.

Obviously, the EGAVGA.BGI driver is not in the same directory as Radiant.

- Invalid file name.

The distribution filename or the names data files are incorrect. Please use the Project Editor PRJ14.EXE to check the error.

- Invalid value in date.

Reported by "METEORS: Input". One of the values in the date you just gave exceeds its ranges. It might be that you did not consider the order of YY/MM/DD.

- Help and messages are not available.

The files RAD14.HLP and RAD14.IDX are not in the work directory of Radiant.

- Meteor List does not exist.

The given name of the meteor file was not found. This message also occurs when you load a density distribution with checked "Load Meteors" option which was saved with this option switched off.

- No task actived.

Appears at "DISPLAY: Exec. Project". Use the Project Editor to switch tasks on with Alt+A.

- Not enough disk space to swap meteors.

Meteors are swapped to disk when reading them from a database. 1,000 meteors need 21,000 byte, 65534 meteors need 1.3MB disk space.

- Not enough memory to open the help screen.

All functions of Radiant will work properly except the help. Consider removing some TSR programmes from your configuration which may eat a lot of memory.

- Please load the paper

If this message appears again and again though you loaded the printer with paper, check with Configure which parallel port you selected. Note that only parallel ports 1...3 are supported.

- Site code ... not known

Generally, if Radiant finds an observation made from an unknown (to the current VMDBSITE file) site it is simply ignored. However, if you switched “ENVIRONMENT: Sitecode Inquiry” on then you are asked for the geographical co-ordinates of this site. These co-ordinates stay in memory until the Radiant session is finished. This inquiry also occurs when you tried to put in a meteor seen from an unknown site. Here the inquiry is independent of the switch Sitecode Inquiry.
- Sol.log of screen display ...

see “Add despite the difference”.
- The directory for density distribution and meteor files does not exist.

The configuration file contains a line “DspDirectory=” which specifies the default directory for density distribution and meteor files. Radiant assumes its working directory as default. Change the configuration file with an ASCII editor.
- The environmental data DO NOT SUIT each other.

You tried to add a display from disk which differs from the current on the screen in the centre of display, the size of the gnomonic squares or in the resolution (high, meduim, low).
- The meteor list does not belong to the display.

When Radiant opens a distribution file with the “Load Meteors” option checked, it compares the last-update times of the files. They should be identical if both files belong together. In spite of that you may load the meteors with “METEORS: Open”.
- The minimum angular velocity cannot be larger than the maximum.

Appears at “OPTIONS: Calculation”. Check your angular speed limitations.
- The radiant database RAD14.DBF does not exist.

This file contains the information necessary for “OPTIONS: Radiants” and “ADDIT: Radiants”. Make sure that the file is in the working directory of Radiant.
- There is a fault in the database.

This message can have different causes. 1. The structure of the PosDat files should be absolutely correct. (A character field with a wrong length makes reading this file impossible.) 2. The identification field ID, relating header with data files contains characters different from 000...999 and AAA...ZZZ. Sometimes it happens that there is a blank line in the database, due to any error in an input, appending or other software. In this case simply remove such a line. 3. Most seldom Radiant could find an unexpected end of the databases. This can occur when the file was incorrectly closed or incorrectly created with other software.
- The selceted meteors cover more than three months.

Occurs at “METEORS: Mean Solar Lognitude”. Please select a reasonable period with “OPTIONS: Selection” before importing meteors. As meteors are shifted to a certain reference solar longitude by a daily motion value of limited accuracy the errors become too large for long intervals.
- This display was NOT created BY RADIANT.

You gave the name of a file that was not saved by Radiant. Files of a version before 1.2 are not supported anymore.
- Too many additional sites defined.

Only five additional sites can be defined during a Radiant session. This will be necessary when data import encounters an unknown sitecode and the switch “ENVIRONMENT: Sitecode Inquiry” is on. Please note that these sites are not added to VMDBSITE.DBF and are lost when you leave the programme.

- You are NOT USING a VGA graphics board.

It is impossible to run Radiant with another than VGA graphics board.

- Wrong syntax in date. Use “/” between the values.

Reported by “METEORS: Input”. The format of the date is YY/MM/DD. Try again.