



# heliocentriccorr

January 26, 2021

## Abstract

Calculates Heliocentric velocity from the local satellite frame in the target direction

## 1 Instruments/Modes

Instrument	Mode
RGS	Spectroscopy

## 2 Use

pipeline processing	no
interactive analysis	yes

## 3 Description

### 3.1 Introduction

Due to the motion of the Earth around the Sun and the motion of the spacecraft around the Earth, the observed wavelength of a line emitted by a celestial object is affected by the Doppler effect induced by the spacecraft velocity component in the direction of the target. Spectral lines measured from a high-resolution spectroscopy instrument, such as RGS, must then be corrected for the projected component of the satellite's velocity.

**heliocentriccorr** task calculates, for a given time, the observed radial velocity of the spacecraft with respect to the Sun in the target direction, taking into account the spacecraft attitude and the Earth's motion around the Sun. This value is stored in the VHELIOCOR keyword in the SPECTRUM header of the input spectrum.

In this version, **heliocentriccorr** does not apply the Heliocentric velocity correction to wavelength values in the spectrum file. It only writes in a keyword (VHELIOCOR) with the Heliocentric velocity.



**heliocentriccorr** can be used in two ways:

- Introducing as inputs an RGS spectrum set + RGS source list file:  
In this case, **heliocentriccorr** gets the source coordinates from the source list file to calculate the spacecraft attitude. Then, it gets the time stamp corresponding to the mid point of the observation. Finally, the Heliocentric velocity is calculated and written into the VHELIOCOR keyword.
- Introducing as inputs the RA and DEC of the source + time stamp:  
With these three values, **heliocentriccorr** calculates the Heliocentric velocity and writes the result on the screen.

## 4 Parameters

This section documents the parameters recognized by this task (if any).

Parameter	Mand	Type	Default	Constraints
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<b>srclist</b>	no	string		name of source list file
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RGS source list file, needed to extract the source coordinates

<b>spectrumset</b>	no	string		name of RGS spectrum file
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spectrum file where the Heliocentric velocity value will be written as a keyword.

<b>srcra/srcdec</b>	no	string		source coordinates
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If *toscreen* is set to true the coordinates of the celestial source have to be specified through these parameters in the equatorial, earth-centered J2000 reference frame. Recognized formats are for *srcra* (Right Ascension)

1. 123.45678 (decimal degrees)
2. 23 59 59.1223
3. 23h59m59.1234s

and for *srcdec* (Declination)

1. 123.45678 (decimal degrees)
2. 20 18 59.1223
3. 20o18'59.1234"



<b>time</b>	no	real		0
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A single time on which to perform the barycentric correction. Only used if *toscreen* is enabled.

<b>ephemeris</b>	no	string	DE200	DE200—DE405
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Name of an ASCII earth ephemeris file extension in the JPL format to be used in lieu of a standard one. This file contains barycentric vectors needed by the TDB conversion algorithm.

## 5 Errors

This section documents warnings and errors generated by this task (if any). Note that warnings and errors can also be generated in the SAS infrastructure libraries, in which case they would not be documented here. Refer to the index of all errors and warnings available in the HTML version of the SAS documentation.

### **ThisIsNotXMM** (*error*)

No XMM data set given

### **SourceNotFound** (*error*)

source identifier not found

### **NoEphemerisFile** (*error*)

The JPL ephemeris file was not found

### **NoPositionData** (*error*)

There is no position data available for a particular time — set time to NaN

## 6 Input Files

1. RGS source list + RGS spectrum files

## 7 Output Files

1. the input spectrum data set with VHELIOCOR keyword added.

## 8 Algorithm

```
subroutine heliocentriccorr
```

```
    locate ODF orbit file
```

```
    locate earth ephemeris file
```



```
calculate XMM-Newton attitude
```

```
calculate Earth velocity
```

```
Get the time of the observation mid point
```

```
calculate Heliocentric correction
```

```
end subroutine heliocentriccorr
```

## 9 Future developments

## References

## References