

Spectral Metadata

The keywords listed below are required, recommended or optional for all FITS files headers: either the primary (P) or extension (E) HDUs, for all files that contain spectra. Recommended keywords, if absent, will be computed and inserted prior to ingest; suggested keywords would be beneficial to archival users if present. Headers must also include the [basic structural FITS keywords](#) and the list of [common keywords](#).

The following table(s) of HLSP metadata, to be included in science products, are color-coded:

	Required
	Recommended
	Suggested

One-dimensional spectra are commonly organized as an image or as a table (or a table row); two-dimensional spectral images may contain multiple spectra. Spectra may be represented in a FITS IMAGE or a BINTABLE extension. These cases are discussed below.

Metadata Common to All Spectra

	Keyword	HDU	Notes
	APERTURE	P or E	Name of aperture used for exposure
	DETECTOR	P or E	ID of detector used for exposure
	DISPRS	P or E	Name of dispersive element used, or 'MULTI' if more than one defined the passband.
	DISPR nn	P or E	Name(s) of dispersive element(s) used for exposure if more than one was used, with nn (zero-padded) incrementing from 1. Note that this information can alternatively be represented in a PROVENANCE extension. See Provenance Metadata for details.
	XPOSURE	P or E	Effective exposure duration in seconds, exclusive of dead time

Metadata for Spectra Stored as Images

In this case, spectral pixel values are stored in an image array (primary or extension), and header keywords contain the parameters of the dispersion relation (i.e., mapping of pixel to wavelength). Multiple arrays would be used to contain concomitant quantities, such as variance and data quality.

	Keyword	HDU	Notes
	BUNIT	P or E	Brightness unit for array values, e.g., $\text{erg/cm}^2/\text{s}/\text{\AA}$ or Jy for flux density
	CD i_j	P or E	Transformation matrix between pixel axis j and intermediate coordinate axis i . The indices range from 1 to the value of NAXIS. Note: if the alternative PC i_j notation is used, these keywords must not appear in the header.
	CDEL T_i	P or E	Increment of the world coordinate at the reference point for axis i , in units of deg/pixel. Used in conjunction with PC notation for transformation matrix; ignored for CD notation.
	CRPIX j	P or E	Location of the reference point in the image for axis j , in array pixel units.
	CRVAL i	P or E	World coordinate value at the reference location for axis i
	CTYPE i	P or E	World coordinate type for axis i .
	CUNIT i	P or E	Physical units of CRVAL for axis i . Note: units for celestial coordinate systems must be degrees.
	PC i_j	P or E	Alternative to CD notation for transforming pixel axis j to intermediate coordinate axis i . Must be used with CDEL T_i and must not be present if CD i_j keywords are present.
	RADESYS	P or E	Mnemonic for celestial coordinate reference system (typically 'FK5' or the preferred 'ICRS'), if applicable.
	WCSAXES	P or E	Number of axes in WCS description, which may exceed the number of pixel array axes

Metadata for Spectra Stored as a BINTABLE

Only the keywords common to all spectra are required. However, certain content is required or suggested for fields (columns) in the table. The following specific field names are suggested, and would appear as values of the `TTYPEN` keywords in the table header. Units should be specified, where applicable, with the `TUNITn` keywords. Note that spectra may be organized such that the values for each field run sequentially with row number; alternatively each table row may contain a spectrum, where non-scalar table cells contain 1-D arrays.

	Field Name	Notes
	FLAGS	Data quality (binary) flags, with zero indicating no anthologies

FLUX	Could also be called "FLUX_DENSITY" or something similar, depending upon the quantity stored. Flux(es) for the associated wavelength(s), in units of the value of the TUNIT keyword for this column.
VARIANCE	Variance in the flux(es) at the associated wavelength(s)
WAVELENGTH	Wavelength(s) for the associated flux(es), in units of the TUNIT keyword for this column.