

# Simple Spectral Access using SIAP

**Pedro Osuna and Jesus Salgado**  
**ESA/European Space Astronomy Center**  
**Villafranca Del Castillo**  
**MADRID SPAIN**

This note is a summary of the proposal we made on Nov 7 2003 about the possibility to include access to Spectra using a slightly modified SIAP protocol. A link to a working version of the proposal is given at the end.

We propose to use the same mechanism as the one described in the SIAP protocol but adding a single parameter in the http line called "imagetype" that can either be:

- spectrum
- image
- all

with obvious meanings.

By default (i.e., not including the imagetype), the answer will only be images, fully SIAP compatible thus.

For the metadata information for the spectra in the VOTable output, this is what we propose to have:

- **FIELD\_ID="AXES" ucd="VOX:Spectrum\_axes datatype="char" arraysize="\*"**

This one indicates the axes names (in our case corresponding to the keyword names in our fits files) that ought to be used from the spectrum product to do a display of the spectrum

- **FIELD ID="UNITS" ucd="VOX:Spectrum\_units" datatype="double" arraysize="\*"**

This one indicates the units in which each of the axes is represented

- **FIELD ID="FORMAT" ucd="VOX:Spectrum\_Format"**

This is a mime format for spectrum products in fits format.

As the aforementioned quantities would not be enough to be able to overlap or represent different spectra coming from different instruments, etc., we believe that we have found a solution by introducing the following fields:

- **FIELD ID="DIMEQ" ucd="VOX:Spectrum\_dimeq" datatype="char" arraysize="\*/>**

This one represents the dimensional equation of the units in each of the axes. More on this later. The dimensional equation is based on the fundamental dimensionless quantities M,L,T,Q for Mass, Length, Time and Charge respectively. We represent the equation by, e.g:

MLT<sup>-2</sup>

where any number after the quantity means (exponential), i.e, the equation above should be read MLT<sup>-2</sup>

(this could be changed if it does not result too clear)

- **FIELD ID="SCALEQ" ucd="VOX:Spectrum\_scaleq" datatype="char" arraysize="\*/>**

This one represents the scaling factor needed to transform the dimensional equation (dimensionless by definition) to the International System of Units. More on this later.

With these two quantities, one can always transform from any system of units to other, and with the scaling factor it is possible to display and overlay different scaled spectra. We give some explanation of what we mean below with a working example.

### **Use of dimensional equation for the metadata**

Our data fluxes, in the case of LWS, are given in "w/cm<sup>2</sup>/um", whereas the data for SWS are given in Jy.

We thus need a way to convert from one to the other. Let's try to convert the LWS spectrum units (w/cm<sup>2</sup>/s) to the SWS spectrum units (in Jy) and then display both in the same browse tool.

According to our server, the SWS flux (in Jy) dimensional equation is:

[SWS] = MT<sup>-2</sup>

and the LWS (w/cm<sup>2</sup>/um) dimensional equation is:

[LWS] = MLT<sup>-3</sup>

So, to represent one with respect to the other, we will have to divide both dimensional equations:

$$\frac{[SWS] \quad MT^{-2}}{[LWS] \quad ML^{-1}T^{-3}} = LT$$

as the only quantities we can use in the transformation are those coming from the conversion between "wavelength" and "frequency", to go from one to the other we will have to use a combination of "LAMBDA" and "c" (wavelength and light velocity). So the above equation has to be equal to:

$$LT = [LAMBDA]^n [c]^m = L^n [LT^{-1}]^m = L^{(n+m)} T^{-m}$$

Which means (by equaling the exponents):

$$\begin{aligned} n+m &= 1 \\ -m &= 1 \end{aligned}$$

and thus:

$$\begin{aligned} m &= -1 \\ n &= 2 \end{aligned}$$

so to go from SWS spectrum to LWS one, we will have to multiply by:

$$[LAMBDA]^2/[c]$$

which is as expected from physical reasonings (please check page 82 of the ISO Handbook - Vol 1. MISSION OVERVIEW at [http://www.iso.vilspa.esa.es/manuals/HANDBOOK/gen\\_hb/](http://www.iso.vilspa.esa.es/manuals/HANDBOOK/gen_hb/) ).

(In case the above 2x2 system of equations is not solvable, then the two spectra could be not comparable. In more complex spectral cases, as XRAY spectra with eV units, other quantities could appear (in this case, the Planck constant) making the equation a 3X3 one).

This would give the dimensionless equation. To get to International System units, we would simply have to do:

$$\text{FLUX(SWS units)} = \text{Flux(LWS units)} [\text{LAMBDA}]^2 [\text{c}]^{-1} [\text{SWS scale}] / [\text{LWS scale}]$$

$$\begin{aligned} \text{FLUX(SWS units)} &= \text{Flux(LWS units)} [\text{LAMBDA}]^2 [\text{c}]^{-1} 10^{-26} 10^{-10} \\ &= 10^{-36} \text{Flux(LWS units)} [\text{LAMBDA}]^2 [\text{c}]^{-1} \end{aligned}$$

where obviously, LAMBDA and c should be given in international system units (LAMBDA in International Units is deducible from the LAMBDA given in the spectrum times its Spectrum\_scaleq factor).

This procedure might look cumbersome, but once the algorithm is understood a computer can do it without problems.

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We believe this way of presenting metadata in this type of simple access a la SIAP makes it easy to access our spectra and might be used for other spectra as well, at least for those in fits format.

This does not clash in our view with the more complicated and general SSAP work which is going thoroughly on, but simply tries to give access to our spectra products in an easy way.

You can access a fully working service to access ISO spectra in this way at:

<http://pma.iso.vilspa.esa.es:8080/aio/jsp/siap.jsp?POS=10,41&imageType=spectrum>

or to access Images and spectra:

<http://pma.iso.vilspa.esa.es:8080/aio/jsp/siap.jsp?POS=10,41&imageType=all>

(as usual in our system, a "format=html" can be input to see a human-readable html page with the outputs)