Spectrum 1.2
Jonathan McDowell - SAO

- Upgrade to Spectrum data model
- Makes use of (Salgado et al) Photometry Cal model
- Used by SED model

Standard Evolution:
- Spectrum 1.03   Adopted 2007
- Spectrum 1.1   Minor corrections
- Spectrum 1.2   Photometry support

Key point:
   if a document meets the 1.03 or 1.1 standard
   then it also meets the 1.2 standard.

Spectrum 1.1 – Differences from 1.03

- No change to schema
- Added some utype names and some FITS keywords for those utypes for which they hadn't been defined
- Text clarifications
- Most changes due to careful reading by B. Rino – thanks Bruno!

Spectrum 1.2 – Differences from 1.1

- Back compatible
- Added use of PhotCal from Salgado et al document
- Added FluxFrame object to contain it, within CoordSys
- Schema updated (with reference to PhotCal)
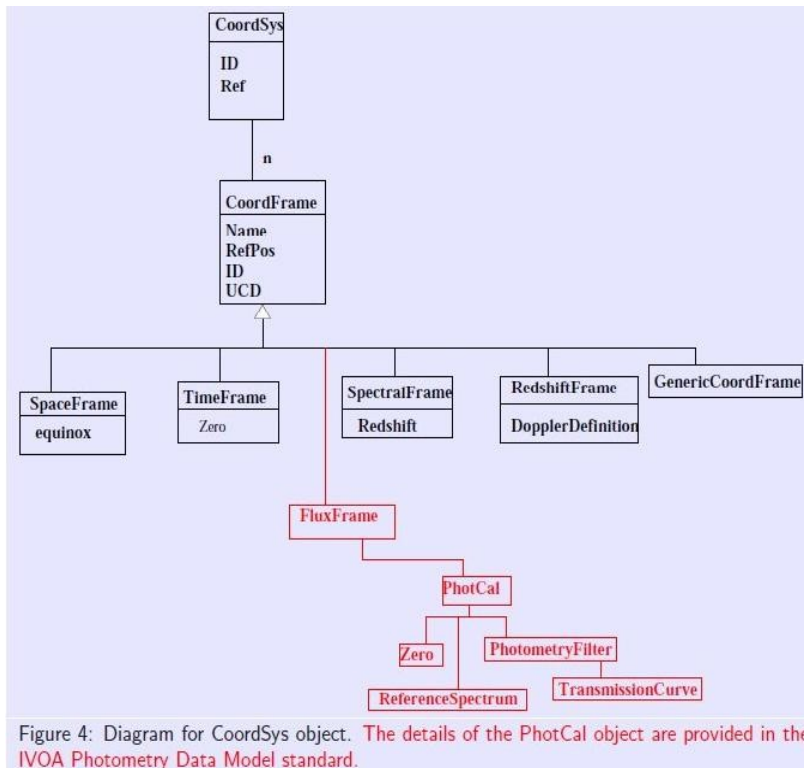- New FITS keywords suggested for PhotCal and other new utypes

Figure 4: Diagram for CoordSys object. The details of the PhotCal object are provided in the IVOA Photometry Data Model standard.

Spectrum 1.2 – example with PhotCal

```xml
<GROUP utype="Spectrum.CoordSys.FluxFrame">
 <PARAM name="FluxAxisID" utype="Name"  value="V"/>
 <PARAM name="FluxAxisUCD" utype="UCD"  value="phot,mag"/>
 <GROUP utype="PhotCal">
  <GROUP utype="PhotometryFilter">
   <PARAM name="FluxAxisID" utype="filterName"  value="FLWO CCD V"/>
   <PARAM name="FluxAxisDesc" utype="filterDescription"  value="Johnson V magnitude photometry"/>
   <PARAM name="FluxAxisGID" utype="bandName"  value="V"/>
   <PARAM name="Trans" utype="filterTransmissionCurve" value="ivo://cfa.harvard.edu/vo/bands/FLWOCCD/V"/>
  </GROUP>
  <GROUP utype="ZeroPoint">
   <PARAM name="FluxAxisRefVal" utype="Flux" value="3548.0" unit="Jy" ucd ="phot.flux.density;em.freq"/>
   <PARAM name="ZPType" utype="Type" value="Pogson"/>
  </GROUP>
  <GROUP utype="MagnitudeSystem">
    <PARAM name="FluxAxisRefSpec" utype="ReferenceSpectrum" value="ivo://cfa.harvard.edu/vo/templates/Vega"/>
    <PARAM name="RefSpecType" utype="Type" value="VEGmag"/>
  </GROUP>
 </GROUP>
</GROUP>
</GROUP>
```

```xml
<GROUP utype="Spectrum.Data">

<GROUP utype="Spectrum.Data.FluxAxis">
 <FIELDref ref="Flux1"/>
 <GROUP utype="Spectrum.Data.FluxAxis.Accuracy">
  <FIELDref ref="ErrorLow"/>
  <FIELDref ref="ErrorHigh"/>
 </GROUP>
</GROUP>

</GROUP>

<FIELD name="Flux" ID="Flux1" utype="Spectrum.Data.FluxAxis.value" ucd="phot.flux.density;em.wavelength"
            datatype="double" unit="mag"/>
<FIELD name="ErrorLow" ID="ErrorLow" utype="Spectrum.Data.FluxAxis.Accuracy.StatErrLow"
            datatype="double" unit="mag"/>
<FIELD name="ErrorHigh" ID="ErrorHigh" utype="Spectrum.Data.FluxAxis.Accuracy.StatErrHigh"
            datatype="double" unit="mag"/>

<DATA>
<TABLEDATA>
<TR><TD>15.52</TD><TD>0.02</TD><TD>0.015</TD></TR>
</TABLEDATA>
</DATA>
</TABLE>
</RESOURCE>
</VOTABLE>
```

PhotCal info is given in the CoordSys.FluxFrame

The actual magnitude and error is given in the table data

Spectrum 1.2 – new data model fields

```
CoordSys.FluxFrame.Name               name for band
CoordSys.FluxFrame.ID                 URI to an external PhotCal instance
CoordSys.FluxFrame.UCD                UCD for PhotCal  (e.g. phot.mag)


PhotCal.UniqueIdentifier               ID for band
PhotCal.referenceMagnitude.Value       zero point mag, usually 0.0
PhotCal.referenceMagnitude.Unit        unit for ref. mag., usually 'mag'
PhotCal.referenceMagnitude.UCD         UCD for ref.mag, usually 'phot.mag'


PhotCal.ZeroPointFlux.Value           Zero point  (e.g.   0  mag = 4410 Jy)
PhotCal.ZeroPointFlux.Unit            unit for zero point (e.g. Jy)
PhotCal.ZeroPointFlux.UCD             kind of zero point (e.g. phot.flux.density)
PhotCal.ZeroPoint.Type                usually 'Pogson' (default)
PhotCal.ZeroPoint.softeningCoefficient

PhotCal.MagnitudeSystem.ReferenceSpectrum    URI to reference spectrum (eg Vega)
PhotCal.MagnitudeSystem.Type

PhotCal.PhotometryFilter.filterName       Band name
PhotCal.PhotometryFilter.BandName      generic name
PhotCal.PhotometryFilter.filterDescription   Description
PhotCal.PhotometryFilter.fpsIdentifier
PhotCal.PhotometryFilter.filterTransmissionCurve
```

Spectrum 1.2 – new data model fields

We also add two fields to encode the aperture correction for a photometry point. This introduces a new high level object to the model, a 'Correction' object which we can extend it future for other kinds of correction.

We need these fields because photometric measurements are often done within a (hardware or software) aperture significantly smaller than the total PSF size. The data may be supplied either as "we measured 5 mJy and this needs to be corrected by a factor 1/0.92" or "the corrected flux is 5.4 mJy, which we got by dividing by 0.92 which we think was the fraction of the true flux within the aperture"

Correction.FluxAxis.ApFrac.Value   Aperture fraction (0.0 to 1.0)
Correction.FluxAxis.ApFrac.Applied   Aperture fraction applied or not?