Photometry DM 1.1: VO/DML Update

Jesus Salgado, Mireille Louys

IVOA Interoperability meeting 04/11/2021

Photometry DM 1.0

Recommendation since
5 October 2013

Implementations

- Filter Profile Service
- Cone Search with Photometry Extension
- Use of utypes in several TAP servers

Pending
Needed VO/DML view in order to allow proper annotation

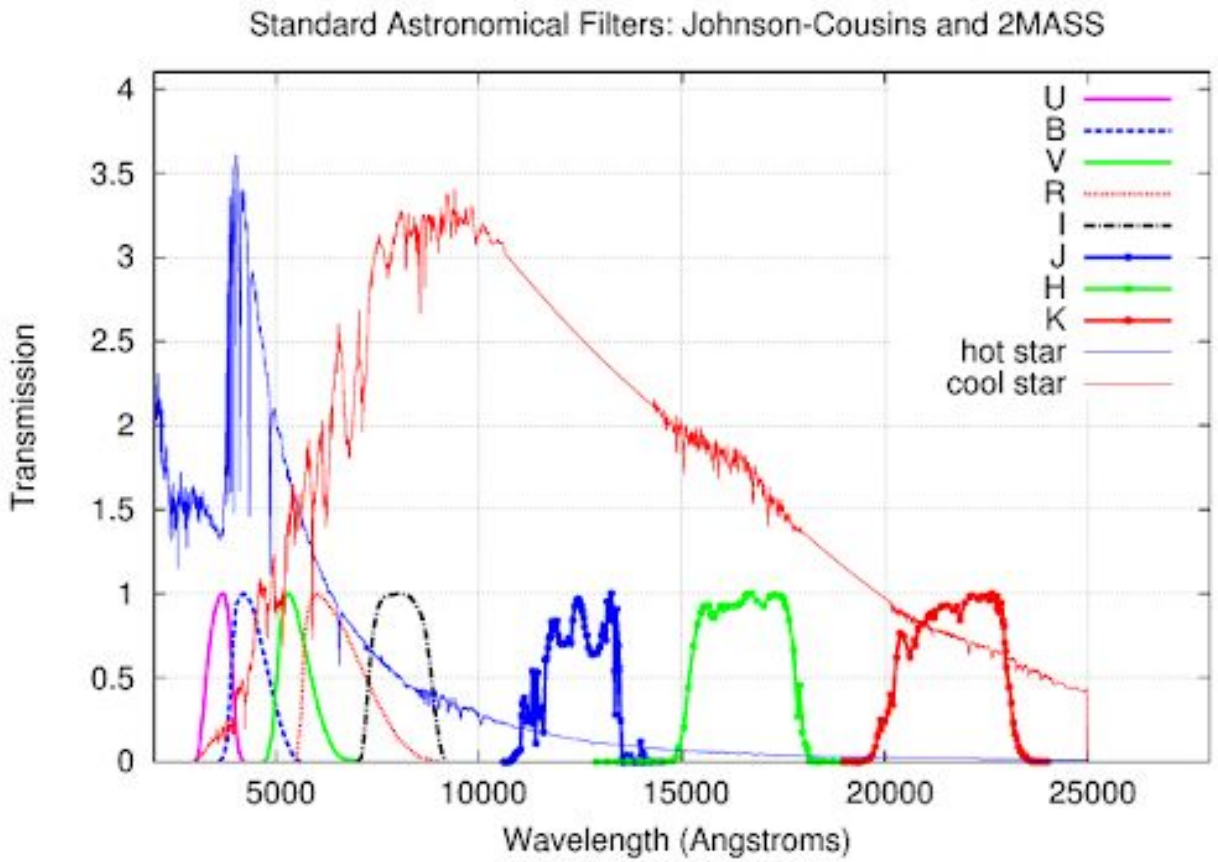
Astronomical Photometry

Pros

- Most of the astronomical photometry shown as relative magnitude
- Easy to calibrate using, e.g. calibration stars like Vega

Cons

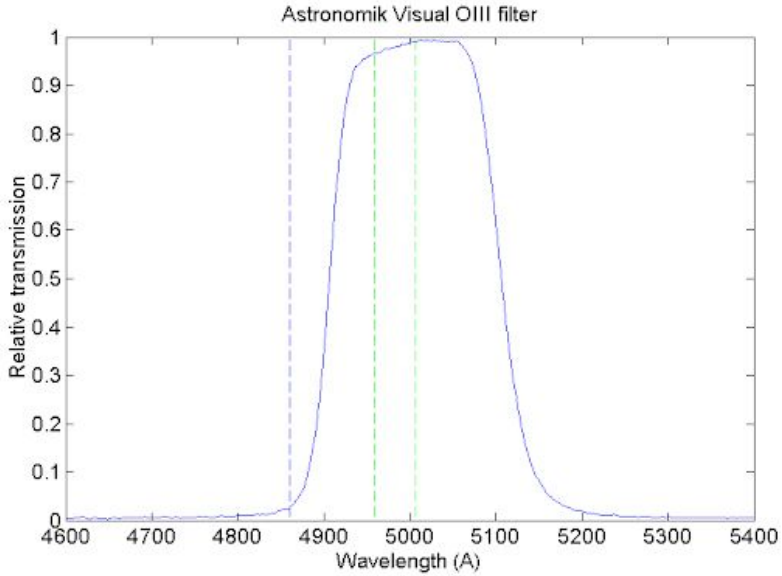
- Creation of SEDs is quite complex as magnitudes have meaning within the project
- Use of standard photometric systems or photometric filters is not totally accurate


Standard Astronomical Filters: Johnson-Cousins and 2MASS
Transmission
Wavelength (Angstroms)
0
0.5
1
1.5
2
2.5
3
3.5
4
5000
10000
15000
20000
25000
U
B
V
R
I
J
H
K
hot star
cool star

Transmission Curve

Filter Response

Evaluation of the filter Response only

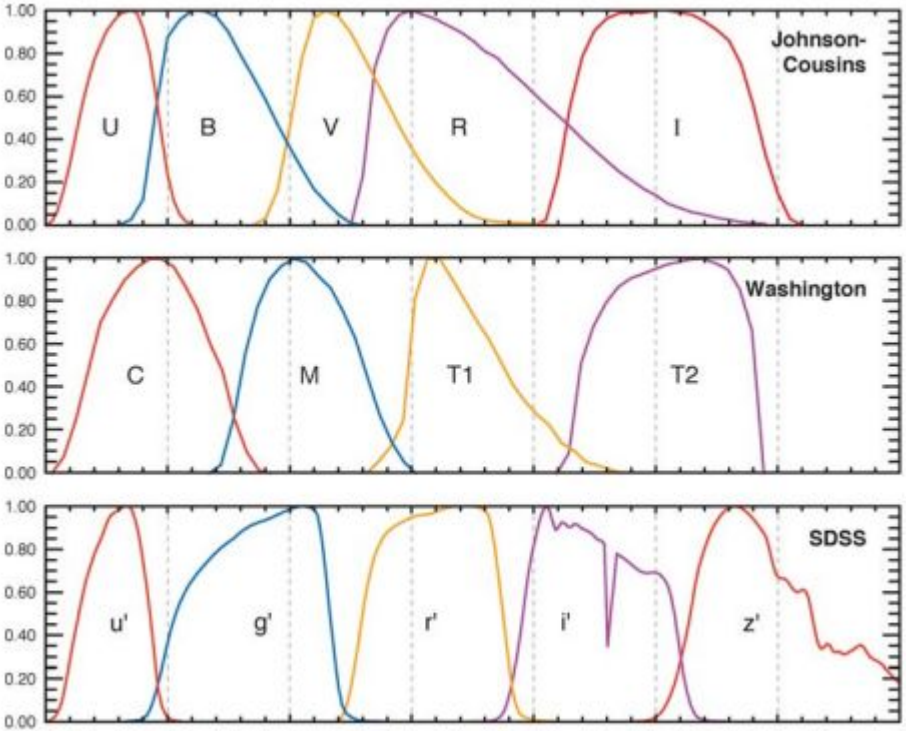


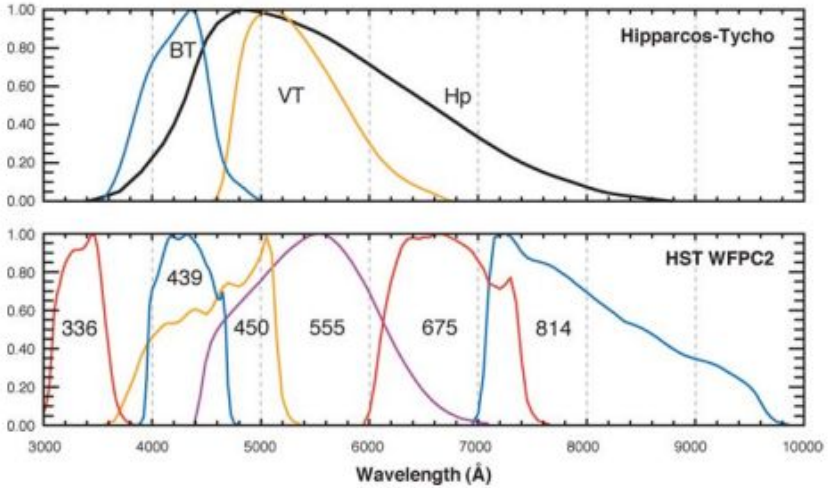
Instrumental Response

Instrumental response impacts the real final response of the system

$$< F_R >= \int F_R(x) T(x) dx$$

Photometric Systems





Bessel, 2005

Photometry based Reference Spectrum

Vega

Used (mainly) Vega star to create the reference spectrum

$$m_{AB,\nu} = 0$$

$$f_\nu = 3.63 \times 10^{-20}\, erg\, cm^{-2}\, s^{-1}\, Hz^{-1}$$

ABν and STλ

Use constant flux density per unit frequency and constant flux density per unit wavelength

$$m_{ST,\lambda} = 0$$

$$f_\lambda = 3.63 \times 10^{-9}\, erg\, cm^{-2}\, s^{-1}\, \text{Å}^{-1}$$

Zero point type: Conversion to Flux

Pogson

Quite common in astronomy

$$f = f_0 \, 10^{-(m - m_R)/2.5}$$

Asinh

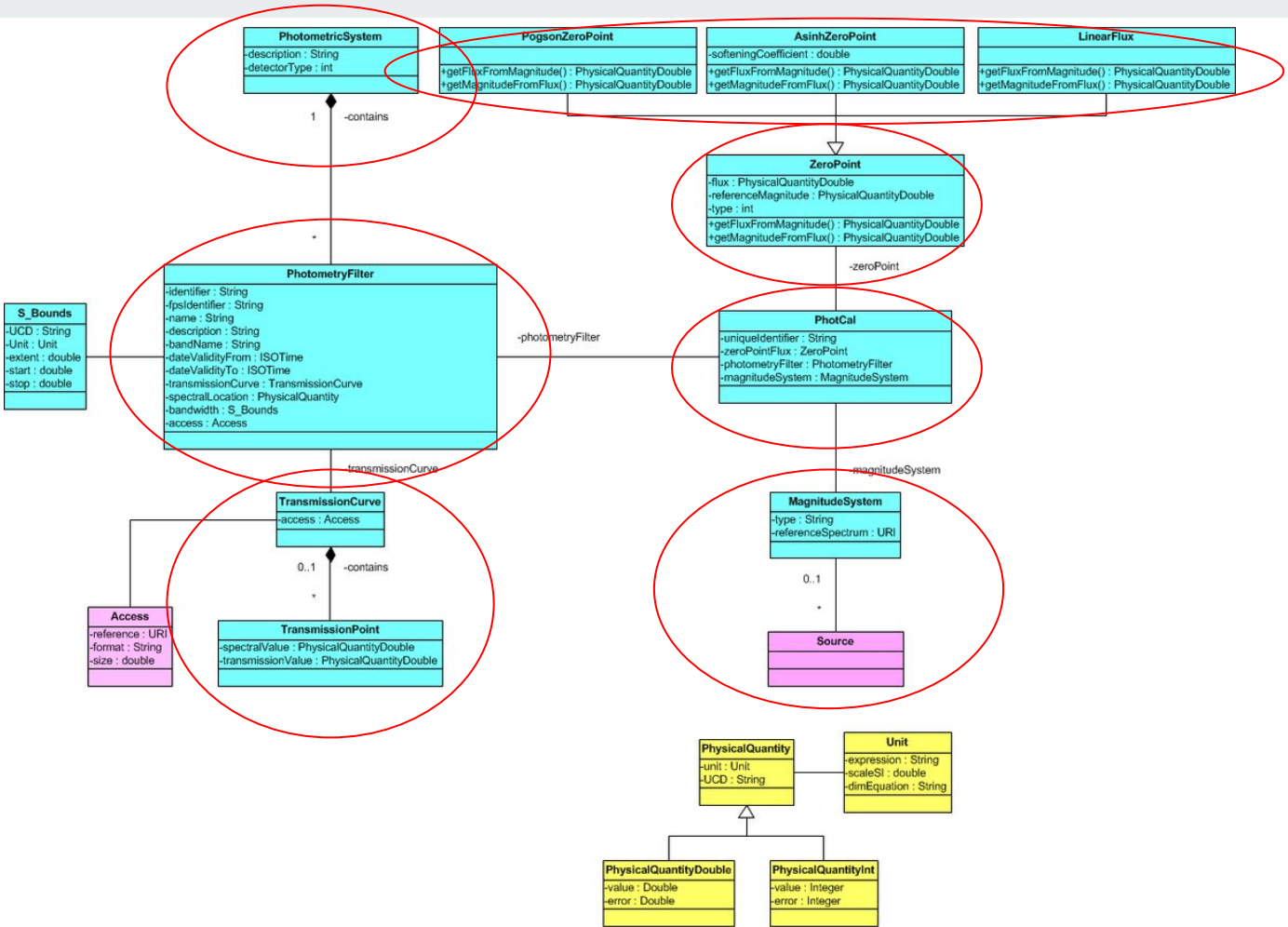
Also called luptitudes. They have a softening parameter

$$f = f_0 \, 10^{-(m - m_R)/2.5} \left[1 - b^2 \, 10^{2(m - m_R)/2.5} \right]$$

Linear

Quite common in high energy

$$f = f_0 \, \frac{m}{m_R}$$


PhotometricSystem
-description : String
-detectorType : int
PogsonZeroPoint
+getFluxFromMagnitude() : PhysicalQuantityDouble
+getMagnitudeFromFlux() : PhysicalQuantityDouble
AsinhZeroPoint
-softeningCoefficient : double
+getFluxFromMagnitude() : PhysicalQuantityDouble
+getMagnitudeFromFlux() : PhysicalQuantityDouble
LinearFlux
+getFluxFromMagnitude() : PhysicalQuantityDouble
+getMagnitudeFromFlux() : PhysicalQuantityDouble
1
-contains
*
ZeroPoint
-flux : PhysicalQuantityDouble
-referenceMagnitude : PhysicalQuantityDouble
-type : int
+getFluxFromMagnitude() : PhysicalQuantityDouble
+getMagnitudeFromFlux() : PhysicalQuantityDouble
-zeroPoint
S_Bounds
-UCD : String
-Unit : Unit
-extent : double
-start : double
-stop : double
PhotometryFilter
-identifier : String
-fpsIdentifier : String
-name : String
-description : String
-bandName : String
-dateValidityFrom : ISOTime
-dateValidityTo : ISOTime
-transmissionCurve : TransmissionCurve
-spectralLocation : PhysicalQuantity
-bandwidth : S_Bounds
-access : Access
-photometryFilter
PhotCal
-uniqueIdentifier : String
-zeroPointFlux : ZeroPoint
-photometryFilter : PhotometryFilter
-magnitudeSystem : MagnitudeSystem
-transmissionCurve
-magnitudeSystem
TransmissionCurve
-access : Access
0..1
-contains
*
MagnitudeSystem
-type : String
-referenceSpectrum : URI
0..1
*
Access
-reference : URI
-format : String
-size : double
TransmissionPoint
-spectralValue : PhysicalQuantityDouble
-transmissionValue : PhysicalQuantityDouble
Source
PhysicalQuantity
-unit : Unit
-UCD : String
Unit
-expression : String
-scaleSI : double
-dimEquation : String
PhysicalQuantityDouble
-value : Double
-error : Double
PhysicalQuantityInt
-value : Integer
-error : Integer

Use cases

- Create SED with photometry from different catalogues
  - Convert to flux
  - TAP annotations - VO/DML!
- Synthetic photometry
  - For theoretical spectra
  - For future observations (e.g. for proposals)
- Photometry filters classification

Phot DM 1.1

Generation of XML VODML document / M.Louys

- Phot DM1.1 IVOA discussion page at

  https://wiki.ivoa.net/twiki/bin/view/IVOA/PhotDMv1-1

  with all products attached :

- *xmi:* New version of the model in Modelio 3.8
- translation to:
  - *xml*: new version of the VO-DML XML description of the data model.
  - *html:* documentation of the model in HTML

Changes PhotDM1.0 --> PhotDM 1.1

- Very few changes in order to preserve backward compatibility
- Simple types for attributes are now based on the VODML *ivoa:* template types.
- Deprecates the use of PhotDM1.0 PhysicalQuantity class, whose granularity does not fit the one adopted in VODML.
- Define components classes : Bandwidth , SpectralLocation used in PhotometryFilter
- include *referenceMagnitude* attributes directly in ZeroPoint class

Discussion points

- Keep Utypes tables in the specification (backward compatibility)
- Components classes of PhotometryFilter have been renamed —> roles and leaves classes are now in sync
- PhotDM 1.0 uses more advanced types than what is defined currently in the *ivoa:* template
  - UCD —> derived from *ivoa:string*
  - ISOTime —> derived from *ivoa:datetime*
    currently these are derived in the PHOTDMv1.1 schema
  - Question for future use:
    shall we insert them in the *ivoa:* template model instead

Calendar ?

Please review the document currently at https://github.com/ivoa-std/PhotDM

a message to the list will be issued on dm list

proceed for PR and RFC before January 30, 2022