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Extracting Photometry Measurements from VizieR Catalogues

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Abstract. Photometry measurements in astronomical catalogues cover a wide range of spectral bandpasses with many different photometric systems and units. The VizieR Catalogue service has recently extended the standardized description of catalogues to include photometry meta-data. This includes the observed frequency and bandwidth in GHz and conversion of magnitudes and other units to flux densities in Jy. We present various prototype interfaces for extracting and combining photometry across multiple catalogues and discuss the uses and limitations of this service.

Photometry in VizieR catalogues

The VizieR¹ catalogue service (Ochsenbein et al. 2000) at the Centre de Données de Strasbourg (CDS²) provides access to more than eleven thousand astronomical catalogues. Many of these catalogues contain brightness measurements of astronomical sources, and over the whole collection, these measurements cover a wide range of the electromagnetic spectrum. Combining photometric measurements from multiple catalogues is important for a range of science use cases from obtaining a quick overview of the existing measurements for a particular source or region of the sky as a function of wavelength/frequency, to combining data to build up a Spectral Energy Distribution (SED). The VizieR Photometry Service is designed to make it easy to find and extract photometry measurements from multiple catalogues, allowing users to query the service by sky position and radius, and returning the extracted photometric measurements in uniform units of flux density (Jy) and frequency (GHz).

Photometry Meta-data

Photometry measurements in astronomical catalogues are described in many ways, reflecting the different conventions and techniques used across different spectral domains. To combine data from multiple catalogues requires a standardized description, and so we have undertaken the task of curating photometry meta-data for catalogues as an ex-

¹<http://vizier.u-strasbg.fr/>

²<http://cds.u-strasbg.fr/>

Table 1. VizieR Photometry Meta-data

Field	Unit	Description	Example
photid		ID of the photometry system	UKIDSS
ucdid		Wavelength range in UCD1+	em.IR.H
filter		Name of filter in the system	H
lambda0	micron	Effective wavelength	1.631
dlambda	micron	Effective width	0.292
freq0	GHz	Effective frequency	1.838×10^5
dfreq0	GHz	Effective frequency width	32900.
Fmag0	Jy	Flux F_0 (Jy) for $m=0$ (Vega)	1019.
Comments		Provenance comments	2006MNRAS.367..454H

tension to the VizieR catalogue meta-data. The meta-data fields being collected are shown in Table 1 along with an example of the UKIDSS H band filter.

This information is taken from the original catalogue and published article where possible, but often this is not present or is incomplete. In these cases information is sought from observatory instrument manuals, on-line information or from services providing access to astronomy filters or bandpasses (e.g. ADPS (Moro & Munari 2000), SVO filter profile service³) and values of effective wavelength, effective width and F_0 have been computed from the transmission curve.

Presently some 900 bands are described in the system. The distribution of the bandpasses as a function of wavelength is shown in Figure 1, extending from X-ray to radio wavelengths with a peak for the many optical-IR bandpasses that are included.

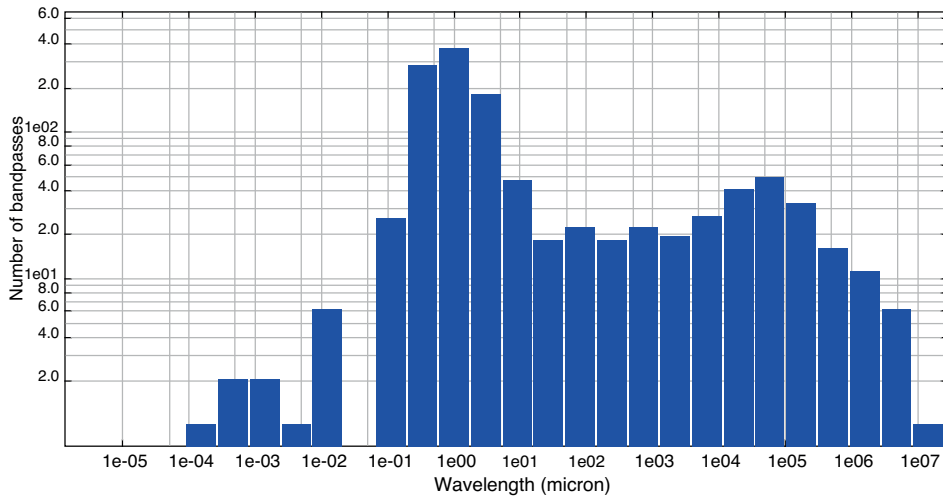


Figure 1. Histogram of bandpasses in VizieR catalogues

³<http://svo2.cab.inta-csic.es/theory/fps/index.php?mode=voservice>

Interfaces to the Photometry Service

A prototype 'widget' web interface for the VizieR photometry service is now available⁴. This allows for input of a simple sky coordinate or an object name (which is resolved to coordinates via Simbad) and a radius in arcseconds, and then extracts the photometry from all the photometry-enabled catalogues in VizieR and plots the results as a function of wavelength – see Figure 2. The points are colour coded and correspond to the catalogue points shown in a small sky map of the query area, allowing one to explore the spatial distributions of the points and the effects of using different radii in the query. The points also correspond to the tabular information with the actual values and links to the original catalogue. Error bars are shown on points from catalogues that also include information on the uncertainties. The prototype service also provides the ability to broadcast the result of the query in VOTable format to applications connected via the IVOA Simple Applications Messaging Protocol (SAMP Taylor et al. (2011)), so that the table can be visualized, used and saved in tools like Aladin and Topcat.

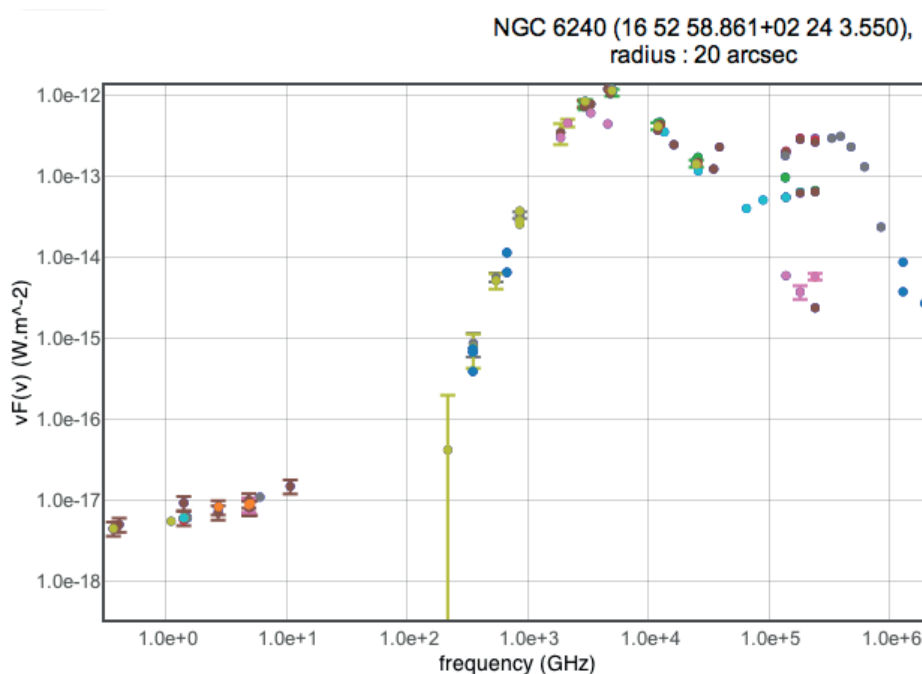


Figure 2. Photometry extracted from VizieR.

The photometry service may also be queried via a URL⁵ to obtain the VOTable result directly, such as is done by the ESA-VO VOSpec tool⁶ so that VizieR photometry can be compared to other spectral data available via the VO. The resulting VOTable conforms to a developing convention for the expression of astronomical photometry

⁴<http://viz-beta.u-strasbg.fr/vizier/sed-widget.gml>

⁵<http://cdsarc.u-strasbg.fr/viz-bin/sed?-c=NGC6240&-c.rs=20>

⁶<http://www.sciops.esa.int/index.php?project=SAT&page=vospec>

in VOTable, and this service is one of the reference implementations for the IVOA Photometry Data model standard.

Uses and Limitations

It is important to remember that the collections of photometric measurements extracted from catalogues in this manner are the result of queries constrained only by a sky coordinate and radius. The result does not represent a curated spectral energy distribution, but is rather a view of the information available in the VizieR catalogues that can help with the construction of SEDs provided that the apertures used, spatial resolution of the observation, and temporal aspects are taken into account. It is also recognized that more control over the constraints of the query would be beneficial, such as to limit the query to specific catalogues, or to apply different radii for the query as a function of wavelength. As a prototype, this service provides a novel and efficient way of extracting photometry information from VizieR, and the framework set up for extracting photometry may also in future provide a good basis for extracting information in similar ways, such as extracting catalogue values as a function of time.

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