

## **How Do I...**

### *Find data for quasars?*

The SDSS has measured images and spectra for about 75,000 quasars. You can get complete data for these quasars, including their photometric and spectroscopic data, as well as their images and spectra. You can return various types of photometric and spectroscopic data, including magnitudes and redshifts.

To get magnitudes and redshift, see the directions for using the **Spectroscopic Query Form** below. To specify quasars by position, see the directions for **To find quasars in a range of positions** below. To specify quasars by magnitude, see the directions for **To find quasars in a range of magnitudes** below. You can also find data for quasar candidates as found in SDSS photometric data, even if they were not observed spectrally, by doing a color cut.

To get images and spectra for quasars, see the guide *How do I get images and spectra for quasars?*.

## To use the Spectroscopic Query Form:

1. Go to the Spectroscopic Query form. From the main page, click **Spectro Query**. You will see a screen like this:

The screenshot shows the 'Spectroscopic Form Query' interface. At the top, there's a 'Submit Request' button and a text box for 'Limit number of output rows (0 for unlimited) to 50'. Below that is the 'Output Format' section with radio buttons for HTML, XML, and CSV. The 'Parameters to return' section has two columns: 'Spectroscopy' and 'Imaging'. The 'Spectroscopy' column has a dropdown menu with options: minimal, typical, reddec, and bestObjID. The 'Imaging' column has a dropdown menu with options: none, minimal, typical, reddec, and model\_mags. There are also checkboxes for 'TARGET Imaging' and 'BEST Imaging'. Below this is the 'Position Constraints' section with radio buttons for 'Rectangle', 'Cone', 'Proximity', and 'None'. The 'Cone' option is selected, showing fields for 'center', 'ra', 'dec', and 'radius'. The 'Proximity' option is also visible, showing a list of 'ra, dec, sep' values. At the bottom is the 'Spectroscopy Constraints' section with fields for 'min redshift', 'max redshift', 'confidence', and a 'Classification' dropdown menu with options: ALL, STAR, and STAR\_LATE.

2. In the **Limit number of output rows** textbox, enter the number of quasars you would like the search to return. If you want unlimited number of rows returned, enter 0.
3. In the **Output Format** textbox, enter the format you want for your output. **HTML** will output results as a table in your browser. **CSV** output can be read by many graphing programs.
4. In the *Parameters* section, select what types of **Spectroscopy** and **Imaging** data you would like returned. *Typical* returns the most common parameters, including the redshift ( $z$ ) and the  $r$  magnitude. You can select any parameters from the menu. To select more than one, hold down CTRL while clicking on each one.

5. You can use the **Filters** checkboxes to choose which filter names to return. The Imaging Query Form will return only the names of the filters, not the images. You can then use the filter names as part of a query to the Data Archive Server (DAS).
6. Skip the *Position Constraints* options for now, so you can specify that you want only quasars. Under *Spectroscopy Constraints*, select both *QSO* and *HIZ\_QSO*. This will ensure that the tool will only return results for quasars.
7. If you want to specify a redshift range, enter it in the **min** and **max** boxes of *redshift*.
8. If you want to specify a range of redshift confidence, enter it in the **min** and **max** boxes of *confidence*. Confidence is a number between 0 and 1; it is usually a good idea to limit spectroscopic searches to objects with a redshift confidence greater than 0.35.
9. If you want to specify quasars that were targeted in any specific way, select them from the *Target Flags* menu.
10. Read on to learn how to specify other constraints, or click **Submit Request** to send your search to the database.
11. You can also search for quasars with the **SQL Search** tool. Specifying that you want to search for quasars is simple; you only need to add the following line to your queries of any of the spectroscopic data (*SpecObj*, *SpecPhoto*, etc.)

```
WHERE (specClass = 3 or specClass = 4)
```

For example, here is a query to search for quasars with redshifts greater than 4:

```
SELECT top 100 bestObjid, ra, dec, z
FROM specObj
WHERE (specClass = 3 or specClass = 4)
      AND z > 4
```

## To find quasars in a range of positions (RA and Dec):

One of the constraints you can use is to find quasars only in a specific part of the sky. Use the *Position Constraints* box to choose constraints. You can choose not to use any position constraints (*None*), or you can choose one of three types (*Rectangle*, *Cone*, and *Proximity*).

1. *Rectangle* finds objects within a rectangle between a minimum and maximum RA and Dec. Enter minimums and maximums for RA and Dec, either in decimal degrees or in HMS/DMS. HMS input can be formatted as either HH:MM:SS.ss or HH MM SS.ss.

2. *Cone* finds objects within a radial patch of sky defined by a center RA/Dec and a radius. The maximum search radius is 30 arcminutes.
3. *Proximity* finds objects near to a list of positions. You give the list, either by pasting into the textbox or by uploading a file. You can optionally specify a maximum separation in which to search.
4. When you have finished entering all your constraints, click **Submit Request**. The tool will return only the objects you asked for, in the output format you specified.
5. If you would rather use SQL to search by position, change your query so that you use one of the position functions, either *dbo.fGetNearbyObjEq(ra,dec,radius)* or *dbo.fGetObjFromRect(ra1,ra2,dec1,dec2)*. Specify the function in the **FROM** block, and be sure to check that the object IDs are the same in the **WHERE** block. So here is a query to search a radial patch of sky for quasars, returning IDs, positions, and redshifts:

```
SELECT s.objid, s.ra, s.dec, s.z
FROM SpecPhoto s, dbo.fGetNearbyObjEq(180,0.2,20) n
WHERE s.objID = n.objID
      AND (s.specClass = 3 OR s.specClass = 4)
```

Don't forget the first line of the **WHERE** block (where `s.objID = n.objID`), or else the query will return the whole database!

Here is a query to search a rectangular patch of sky for quasars, returning IDs, positions, and redshifts:

```
SELECT s.objid, s.ra, s.dec, s.z
FROM SpecPhoto s, dbo.fGetObjFromRect(1.0,1.25,0,0.25) n
WHERE s.objID = n.objID
      AND (s.specClass = 3 OR s.specClass = 4)
```

## To find quasars in a range of redshifts:

Instead of, or in addition to, searching by position, you can also tell the Spectroscopic Query Form to search by redshift. To do this, use the *Spectroscopy Constraints* section. The default is no constraints (that is, to return quasars at all redshifts).

1. First, select the **Redshift**. Enter the **minimum** and **maximum** redshift to search.

2. Enter the **Confidence** of the redshift measurement. Confidence is a number from 0 to 1, with higher numbers meaning more confidence that the redshift is correct. Generally it is a good idea to restrict your sample to objects with a redshift confidence of greater than 0.35.
3. Select the spectral **Classification**. For quasars, be sure to select both *QSO* and *HIZ\_QSO*.
4. You can also search for the presence or absence of specific target flags.
5. When you have finished entering all your constraints, click **Submit Request**. The tool will return only the objects you asked for, in the output format you specified.
6. You will see your results in a new window.
7. If you would rather search by magnitudes with an [SQL Search](#) (new window), be sure to search in the specObj or specPhoto tables, and remember that the SDSS object IDs are referred to as bestObjID in these tables.

### **To find quasars in a range of magnitudes:**

Instead of, or in addition to, searching by position, you can also tell the Spectroscopic Query Form to search by magnitude. To do this, use the *Imaging Constraints* section. The default is no constraints (that is, to return quasars with any magnitudes).

1. First, select the **Type** of magnitude on which you would like to search: *Petrosian*, *Model* (the better fit of a DeVaucouleurs and exponential profile), or *PSF*.
2. Next, enter the magnitudes you would like to search for in the **Magnitudes** textbox. You can enter constraints on any of the SDSS's five filters (u, g, r, i, z), and you can enter minimums and/or maximums for each value.
3. You can also search for specific colors using the **Colors** textboxes, or for specific object types with the **Obj Type** checkboxes.
4. You can also search for the presence or absence of specific flags. See the document *How do I check quality of SDSS photometry for an object (photo flags)?* to see what flags mean and how to use them.
5. When you have finished entering all your constraints, click **Submit Request**. The tool will return only the objects you asked for, in the output format you specified.
6. If you would rather search by magnitudes with SQL, add the following line to the **WHERE** block of your query:

```
WHERE modelmag_g < 17
```

Substitute any of the filters, the operator (=, <, >, <=, >=, !=), and the value. You can also use BETWEEN to specify a range of magnitudes. If you want another type of magnitude (such as Petrosian), substitute that instead:

```
WHERE petromag_g BETWEEN 15 and 17
```

For example, here is a query to find quasars with Petrosian r magnitudes between 15 and 19:

```
SELECT top 100 objid,ra,dec,petromag_r,z  
FROM SpecPhoto  
WHERE (specClass = 3 OR specClass = 4)  
AND petromag_r BETWEEN 15 and 19
```

### **To find quasar candidates in photometric (rather than spectroscopic) data:**

The SDSS finds quasars by first observing candidate objects in imaging, then following them up automatically for spectroscopic observation. However, you can also use the SQL Search tool find quasar candidates directly from imaging.

This query is based on a query from Dr. Xiaohui Fan of the University of Arizona.

```
SELECT objID, ra, dec, u, g, r, i, z
FROM star
WHERE ( u - g > 2.0 or u > 22.3 )
      AND ( i < 19 )
      AND ( i > 0 )
      AND ( g - r > 1.0 )
      AND ( r - i < (0.08 + 0.42 * (g - r - 0.96)) or g - r > 2.26 )
      AND ( i - z < 0.25 )
```

Here are the first three quasar candidates that the query returns:

<b>objID</b>	<b>ra</b>	<b>dec</b>	<b>u</b>	<b>g</b>	<b>r</b>	<b>i</b>	<b>z</b>
587722953309749483	249.618417	0.214784	15.633	13.397	10.496	10.09	10.319
587722953309618862	249.274942	0.297358	22.537	20.693	18.508	18.402	18.529
587722983917814186	249.169629	0.473121	17.986	15.898	13.626	12.923	13.342