Chapter 9
Science Archives at the Wide Field Astronomy Unit

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Abstract The Wide Field Astronomy Unit (WFAU) at the Royal Observatory, Edinburgh (ROE) has been producing archives of astronomy data for more than a decade. It houses a collection of over 80 billion individual detections spread across five major astronomical surveys dating back over 60 years. As well as these surveys, we also host copies of external surveys to allow the cross-referencing of sources in our surveys with those detected with other instruments. This article details the data held by WFAU and the services we provide to our users.

9.1 The Wide Field Astronomy Unit

Beginning life as the UK Schmidt Telescope Unit, which developed SuperCOSMOS [7], the Wide Field Astronomy Unit (WFAU), based at the Royal Observatory, Edinburgh (ROE), has helped develop the VISTA Data Flow System (VDFS) [4] which handles data from the Visible and Infrared Survey Telescope for Astronomy (VISTA) [5] and the UKIRT Infrared Deep Sky Survey (UKIDSS) [8]. More recently, WFAU have become involved with other data archive projects such as the Gaia-ESO Science Archive (GES) and the OmegaCAM Science Archive (OSA).

9.2 The Science Archives at WFAU

As a result of the last decade or more of research, WFAU now houses a collection of different online science archives. A summary of the available data can be seen in Table 9.1, while a more detailed description of each archive follows below.

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Table 9.1 A summary of data held in WFAU science archives

Survey	Main filters	# of detections	# of sources	Time period
SSA	B, R, I	6,354,116,532	1,899,775,021	1949–2002
WSA	Z, Y, J, H, K	9,510,576,982	1,445,199,704	2005–
VSA	Z, Y, J, H, Ks	62,317,337,036	1,325,979,729	2009–
OSA	u, g, r, i, z	4,178,356,501	88,689,046	2011–
GES		(Spectra) 65,046	33,887	2012–

The SuperCOSMOS Science Archive (SSA) WFAU's first major data archive resulted from the SuperCOSMOS project to digitise photographic plates. The ESO/SERC Southern Sky Survey was a survey of the southern sky performed between 1974 and 1994 taken by the UK Schmidt Telescope (UKST) in Australia [1] (blue band observations in range 3,950–5,400 Å) and the ESO-Schmidt telescope in Chile [12] (red band observations in range 6,300–6,900 Å). A second red band epoch was then taken by the UKST between 1984 and 2000.

To complement this, plates from the second Palomar Observatory Sky Survey (POSS II)[10] were also digitised, providing a complete northern hemisphere survey in blue (4,000–5,700 Å), red (6,100–7,000 Å) and near-IR (7,400–9,400 Å) bands taken between 1987 and 1999. A second epoch was provided by scanning the earlier POSS I [9] plates taken between 1949 and 1958.

A database was created to contain all of these data and it was made available online (http://surveys.roe.ac.uk/ssa).

The WFCAM Science Archive (WSA) After creating the SSA, WFAU became involved in the VDFS project [4]. The first stage of this was to create a processing pipeline and online archive of data from WFCAM [3] for UKIDSS [8], commencing in May 2005. Over the next 7 years, 10 incremental releases of data were created. Initially viewable only by the survey teams, all ten releases, as well as many non-survey data releases, are now publically viewable online (http://surveys.roe.ac.uk/wsa).

As UKIDSS was ending, UKIRT began the UKIRT Hemisphere Survey (UHS), a large area J-band survey following on from the UKIDSS observations which commenced in May 2012. At the date of writing, these data are still being collected and fed into the WSA with a view to a future data release.

The VISTA Science Archive (VSA) The VISTA telescope [5] came online in 2009 and data collection began in November of that year. All the data observed by VISTA are fed into the VSA, and we are currently releasing regular consortium releases, which later become publically available, for 5 of the 6 surveys. Non-survey data releases are also created on a slightly more ad hoc basis. A full list of the available data releases can be found on the VSA website (http://surveys.roe.ac.uk/vsa).

The OmegaCAM Science Archive (OSA) The OSA hosts data observed with the OmegaCAM mounted on the VLT Survey Telescope (VST) [2] in Chile. Primarily we are responsible for the data from the VST ATLAS survey [11]. As with the

WSA and VSA, the OSA is used to create consortium database releases, with the first public release now available (http://surveys.roe.ac.uk/osa).

The Gaia-ESO Science Archive (GES) In a slight departure from previous archives, GES consists of a collection of calibrated one- and two-dimensional spectra for stars observed in the Gaia-ESO Survey [6], and many astrophysical parameters derived from these spectra. Starting from 2012, GES now contains 65,046 spectra for 33,887 individual sources.

9.3 Value Added Services at WFAU

As well as creating the searchable databases of astronomical data and providing access to the original pixel files, as multi-extension FITS files, WFAU also provide extra data products for our users. One example is variability information which we include in our databases for sources which have multi-epoch data and which show obvious variability. We combine multiple observations to create merged filter catalogues of sources. Where multiple epochs of the same filter and pointing exist, we stack the images to create deep products in order to enable the study of fainter sources.

Flags are applied to the data to warn users of reasons why the data might be imperfect, such as deblended sources, saturated source images, or the source being close to a detector boundary. Users can then easily filter out affected sources if they feel this would be a problem.

We provide neighbour tables which makes it easy to compare sources between archives. The "neighbour table" is a table in the database that matches the identifier for a source to the identifier from another database for a source in the same position (within a matching radius). As well as neighbour tables for our own surveys (e.g. to match the VSA with the SSA), we provide neighbour tables for up to 35 external surveys. These include different SDSS releases and many popular surveys such as 2MASS, WISE, DENIS, EROS, AKARI, SPITZER, and XCS. To ensure our users can access these other surveys quickly and easily, we maintain copies of these survey databases on our servers in Edinburgh.

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