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Galaxy formation and evolution using multi-wavelength, multi-resolution imaging data in the Virtual Observatory

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Observational astronomy is entering an exciting new era with large surveys delivering deep multi-wavelength data over a wide range of the electromagnetic spectrum. The last ten years has seen a growth in the study of high redshift galaxies discovered with the method pioneered by Steidel *et al.* (1995) used to identify galaxies above $z > 1$. The technique is designed to take advantage of the multi-wavelength data now available for astronomers that can extend from X-rays to radio wavelength. The technique is fast becoming a useful way to study large samples of objects at these high redshifts and we are currently designing and implementing an automated technique to study these samples of objects. However, large surveys produce large data sets that have now reached terabytes (e.g. for the Sloan Digital Sky Survey, <http://www.sdss.org>) in size and petabytes over the next 10 yr (e.g., LSST, <http://www.lsst.org>). The Virtual Observatory is now providing a means to deal with this issue and users are now able to access many data sets in a quicker more useful form.

We describe our development of a Spectral Energy Distribution (SED) matching technique that characterises objects at high redshift detected in the ultraviolet to infrared passbands. The observational SEDs are then matched to model SEDs that yield physical parameters of each object such as star formation rates (SFR), star formation histories (SFH), ages, stellar masses and colours. The technique uses model spectral synthesis codes that include those from Bruzual and Charlot (Galaxev), PEGASE and Starburst99. The technique can be broken down into the following sections. Data discovery, source extraction, cross match catalogues, photometric redshift creation, sample selection, model generation, model fitting and ouputs. However, each section has many implementation issues that need to be dealt with in order to produce scientifically viable results. For example, one important step in the source extraction step would be to include upper limits on flux measurements during the fitting process. The outputs would include plots of the best fit models to the data along with tabular data representing the best fit model and the closest matches, a standard error analysis on the various physical parameters and finally a set of image cutouts of the object.

The technique would be implemented as a workflow within the AstroGrid system. The workflow incorporates the step by step procedure that is required to complete the technique from retrieving the raw imaging data to the final outputs listed above. The execution of jobs within a workflow through various applications and services is done in an asynchronous manner as jobs are run can in different locations depending on which applications are used. Thus, the technique is ideally suited for this type of implementation.

We describe the technique, and how this is being developed as an application available through standard Virtual Observatory interfaces, specifically AstroGrid's Common Execution Architecture (CEA, <http://www.astrogrid.org>).