Wide Infrared redshifts: ARea & Depth, in Australia: (WIZARD of Oz)

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1 Scientific Case

We now believe that peak of star-formation activity in the Universe was around $z = 2$ and has declined since. Since a $z = 1$ the number of stars in galaxies that have cessed star-formation has doubled. One of the most significant challenges in astrophysics today is to explain this evolution of galaxies. Specifically we need to understand the processes that stimulate, regulate and ultimately supress star-formation.

The boundary conditions of the problem are well defined. Thanks to CMB experiements (e.g. WMAP) and local redshift surveys such as 2dFGRS & SDSS the linear physics framework in which models of galaxy formation are constrained is now well understood. Thanks again to 2dFGRS and SDSS the end-point of galaxy evolution, the statistical properties of galaxies today (luminosities, colours and dependancies of these properties on immediate environment) are well understood. The theoretical tools that can join-the-dots exist in the form of semi-anlaytic models, but the complex non-linear physical processes are poorly understood and represented by relatively unconstrainded parameters.

The observational challenge of this decade is to provide those constraints. Broadly speaking there are two possible observational approaches to this. To go as deep as possible, accessing L_* galaxies at very high redshifts $*z > 2$) in small volumes - this is the approach taken by deep surveys such as HDF and GOODS. The complementary approach is to undertake wide surveys > 10 sq. deg. which produce significantly samples of L_* galaxies at $z \sim 1$ and representative samples of extreme objects at higher redshifts. It is in the exploitation of the wide surveys that AAOmega can excel and the SWIRE fields are the most well studied of fields on this scale. The SWIRE fields have (or will have) exceptional multi-wavelength coverage from X-ray (XMM, Chandra), UV (Galex), Optical (VST, proposed), NIR (UKIRT/VISTA), Mid-IR (Spitzer - IRAC), FIR (Spitzer - MIPs, Herschel).

The Southern SWIRE fields cover 24 sq.deg. (at $z = 1, \Delta z = 0.14$ this is the same volume as 2400 sq. deg at $z < 0.08$). The wealth of data and the FIR data in particular make it easy to cherry pick the sources in this volume to address our science goals and that are easier for AAOmega to observe. With existing optical data we can pre-select on photo-z to maximise the efficiency of target selection. With multiple exposures we can also tailor the exposures on different sources to efficiently use AAOmega to address different science goals.

Our proposal will be to select large, statistically significant samples of galaxies in the range $z < 2$ from these fields. We can then explore the questions of star-formation, star-formation as a function of stellar mass, the role of environment in these functions, and the relation between AGN and star-formation over this active period in the Universe's history.

A very provisional, indicative, sample selection might be as follows.

- moderate 24 μ sources: $S_{24} > 200\mu$Jy, $V < 22$, 10,000s galaxies, sampling SFR and AGN activity $\langle z \rangle \approx 1$. 8hr exposures, 28 nights
- faint 24 μ sources: $S_{24} > 200\mu$Jy, $V < 23$, 5,000s galaxies, sampling SFR and AGN activity $\langle z \rangle \approx 2$. 16hr exposures, 28 nights

- passive red galaxies: $V < 21$ 4hr exposures, 10,000 galaxies, 14 nights
- faint, assorted unusual objects, high-z candidates, 8hr exposures, 2400 objects 7 nights

Total: 27.5 k galaxies, 77 (clear) nights = 130 nights total. Enables source characterization of around 50 galaxies in each of 600 bins, e.g. 4 galaxy types, 6 luminosity bins, 5 redshifts, and 5 different environments.

2 Managment Plan

The project is going to be focussed at two institutions in the UK: Sussex -strong role in SWIRE and Durham -strong role in UKIDSS-DXS. These two institutions have been working closely together on TISWAZ a 2dF precursor to this project and the VST proposal to map the Southern SWIRE fields. Some additional UK institutions may play a small role, e.g. Imperial. In Australia the project will be more diverse but involving a similar number of people. In the US IPAC (who lead SWIRE) will play a small role in data archiving.

We estimate that for of order 130 nights of data over three years we require a total effort of 10 f.t.e. for data processing and archiving an have allowed an equivalent 10 f.t.e for scientific processing.

The activity is split into: Science managment, Observation Planning, Observations, Data Reduction and Data release. Each activity has a main action and also a quality control group, each of these is led by one main institution. The effort is distributed as in the following table.

Years 3

	Available				Sci. Man	Obs. Plan		Obs		Reduction		Release			Exploitation				
	Faculty	PDRF	DPhil	Effort		Action	Control	Action	Control	Action	Control	Action	Control	Sub-total	Action	Control	Total Resources	Commitment	Nationality
	0.2	1	1																
Total Effort					1.00	2.50	0.50	1.80	0.20	2.50	0.50	1.00	0.10	10.1	8.00	2.00	20.1		
Sussex	2	1	1	7.2	33%	**80%**		20%							20%	20%	4.7	0.7	
Durham	2	1	1	7.2	33%			**30%**		40%	**100%**				20%	20%	4.4	0.6	9.1
AAO	2	1		4.2	34%		**100%**	20%							20%	20%	3.2	0.8	
CSIRO	2	1	1	7.2				20%		**60%**			**100%**		20%	20%	4.0	0.6	
Other Oz	2	1	1	7.2		20%			**100%**						15%	15%	2.2	0.3	9.4
IPAC	1	1		3.6				10%				**100%**			5%	5%	1.7	0.5	1.7
Sum	11	6	4	37	100%	100%	100%	100%	100%	100%	100%	100%	100%		100%	100%	20.1		
Sussex	2	1	1	7.2	0.3	2.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	**2.7**	1.6	0.4	4.7	0.7	
Durham	2	1	1	7.2	0.3	0.0	0.0	0.5	0.0	1.0	0.5	0.0	0.0	**2.4**	1.6	0.4	4.4	0.6	
AAO	2	1		4.2	0.3	0.0	0.5	0.4	0.0	0.0	0.0	0.0	0.0	**1.2**	1.6	0.4	3.2	0.8	
CSIRO	2	1	1	7.2	0.0	0.0	0.0	0.4	0.0	1.5	0.0	0.0	0.1	**2.0**	1.6	0.4	4.0	0.6	
Other Oz	2	1	1	7.2	0.0	0.5	0.0	0.0	0.2	0.0	0.0	0.0	0.0	**0.7**	1.2	0.3	2.2	0.3	
IPAC	1	1		3.6	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.0	0.0	**1.2**	0.4	0.1	1.7	0.5	
Sum	11	6	4	37	1.0	2.5	0.5	1.8	0.2	2.5	0.5	1.0	0.1	10.1	8.0	2.0	20.1	0.5	

Table 1: Distribution of effort vs institution. Top line is total effort required in each activity. Upper panel shows the percentage of this activity undertaken by each institution. Figures in bold indicate the leading institution Lower panel gives this in f.t.e.. The available columns indicate the maximum effort available at each institution and the "commitment" is ratio of required effort to max. available effort.

3 Time-line

Three years. Data public in two releases. Final release 6 months after last data taken.