Spatially Resolved Stellar Populations and Star-Formation Histories of the Largest Galaxies

Although the setup foreseen for the MSE fibre spectrograph does not include an IFU component, in first instance, careful observational planning will still enable spatially resolved spectroscopy of the centres and disks of cluster galaxies out to at least the Coma cluster. The ~1.5 degree field of view will allow simultaneous coverage of the largest local galaxies by multiple fibres in a "closest packing" configuration (a setup similar to that of DensePak on the WIYN telescope; cf. Fig. 1), or alternatively by observing the same target fields with small, subarcsec offsets in both RA and Dec.

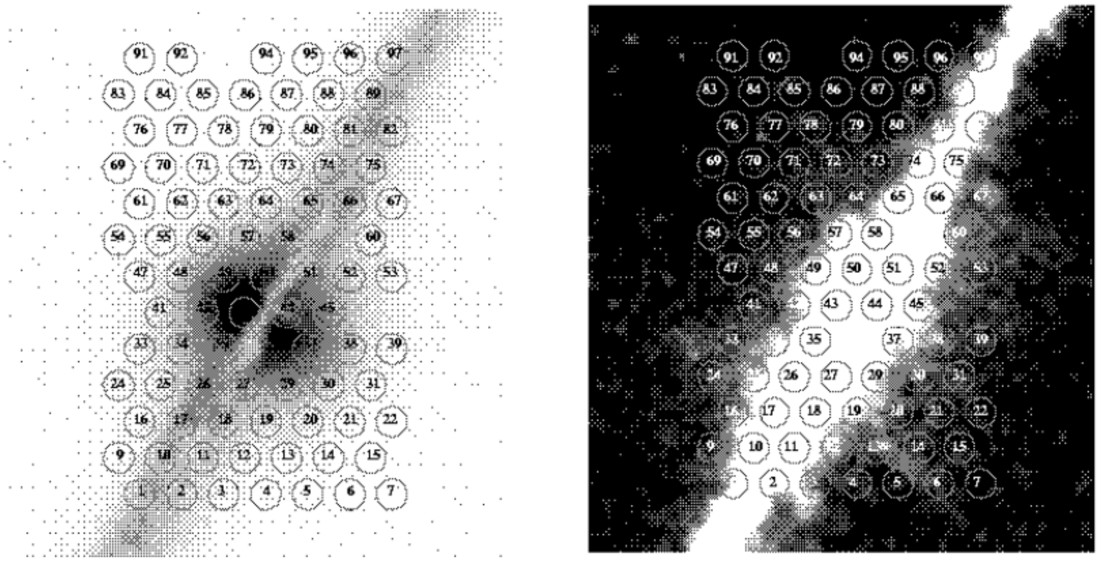

Figure 1: Example of sparsely packed central galaxy coverage by tightly packed fibres (based on WIYN observations with the DensePak instrument of UGC 10043; Matthews & de Grijs 2004).

The key advantages of the MSE with adaptive optics capability and state-of-the-art spectroscopic instrumentation over earlier-generation instrumentation on smaller telescopes are its high(er) spatial resolution, larger field of view, larger light-collecting capability and higher throughput (efficiency). In the context of the nearest galaxy clusters (Virgo, Fornax, Coma), these conditions will, for the first time, allow one to obtain detailed and comprehensive, two-dimensional abundance gradients (cf. Fig. 2), chemical enrichment histories, kinematics and dynamics of the largest nearby galaxies, specifically to derive their star formation timescales and history, and place these in the overall context of galaxy evolution scenarios. This has thus far only been possible for the Milky Way and (to some extent) galaxies in the Local Group. With the enormous field of view foreseen for the MSE, we can now extend detailed studies of the stellar populations and star-formation histories to the large galaxies in the local Universe, to an extent that was not possible before because of previously prohibitive time requests.

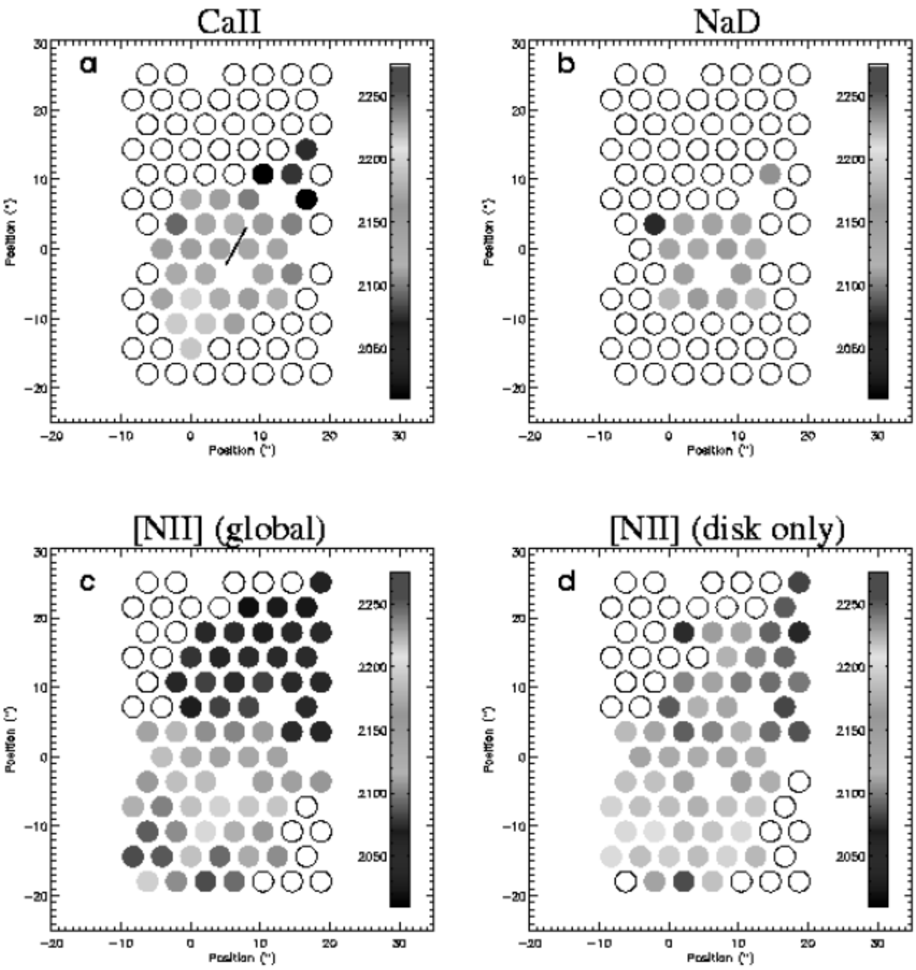

Figure 2: With DensePak we obtained observations of UGC 10043 over the wavelength range containing the redshifted Hα λλ6562.8Å and [NII] λλ6548.0,6583.4Å lines to probe the kinematics of the ionized gas, and over the wavelength range containing the CaII infrared triplet (λλ8498.0,8542.1,8662.1Å) to measure the stellar kinematics (Matthews & de Grijs 2004).

Secondly, MSE-enabled surveys will provide us with an unprecedented opportunity to gain an improved understanding of starburst galaxies (including circumnuclear star-forming regions/rings) and the mechanisms responsible for both triggering and propagation of their activity. To achieve this, we need to map the dynamics, reddening and age distributions of individual star-forming regions to distinguish between stochastic and sequential star formation. Star-formation rates can be determined from dereddened Hα fluxes (reddening values can obtained quite straightforwardly from Hα and Ca II triplet equivalent widths). For the prevailing nuclear starbursts, both Hα and Hβ are needed to correct for reddening in the ionized gas. The key advantage of using the MSE for this science is the expected high spatial resolution, given that most nuclear starbursts are usually 5–10 arcsec across. This links very closely with key outstanding questions, in particular those related to the nature of the merger/starburst–AGN connection in galactic nuclei and their relation to the mechanism(s) driving large-scale galactic winds.

Reference:
- Matthews, L. D., de Grijs, R., 2004, AJ, 128, 137