Science with the NGST IFMOS

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0.1 The DRM

The core science goals for the NGST mission have been identified by the NGST Ad Hoc Science Working Group and corresponding observing programmes have been developed. These programs are known as the Design Reference Mission (DRM) and are used to guide telescope, instrument, and satellite designs.

For an updated version of the DRM see [http://www.ngst.stsci.edu/studies/drmv2.3/](http://www.ngst.stsci.edu/studies/drmv2.3/). The NIR spectroscopy observations in the DRM are summarized in the following table. The S/N requested for all the observations is 10.

The NIR spectroscopic DRM

<table>
<thead>
<tr>
<th>Rank overall</th>
<th>Title</th>
<th>Target</th>
<th>( \lambda ) ( \mu m )</th>
<th>mag (AB)</th>
<th>diam (&quot;)</th>
<th># per sq.arc.m.</th>
<th># of sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Resolution (100-300)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Form. &amp; Evol. Galaxies II</td>
<td>HDF-N</td>
<td>3.5</td>
<td>29.5</td>
<td>0.4</td>
<td>1700</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>Reionization Epoch</td>
<td></td>
<td>1.3</td>
<td>29.0</td>
<td>0</td>
<td>-</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>SN Cosmology</td>
<td>HDF-N</td>
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<td>28.0</td>
<td>0</td>
<td>0.3</td>
<td>50</td>
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<tr>
<td>12</td>
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<td>Gal plane</td>
<td>2.1</td>
<td>K=25.7</td>
<td>0</td>
<td>100</td>
<td>10 x 1500</td>
</tr>
<tr>
<td>22</td>
<td>Gamma-Ray bursts</td>
<td></td>
<td>2.1</td>
<td>28.5</td>
<td>0.2</td>
<td>-</td>
<td>100</td>
</tr>
<tr>
<td>Moderate Resolution (1000)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Form. &amp; Evol. Galaxies II</td>
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<td>L=27</td>
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<td>2500</td>
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<td>24.5</td>
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<td>25</td>
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<tr>
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<td>3.5</td>
<td>L=27</td>
<td>0.5</td>
<td>500 ?</td>
<td>7x 100</td>
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<tr>
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<td>AGN-galaxy connection (+ absorbers)</td>
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<td>26</td>
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<td>-</td>
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<td>High Resolution (3000-5000/10000)</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Form. &amp; Evol. Galaxies II (kinematics ( H_\alpha ))</td>
<td>HDF-N</td>
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<td>L=27</td>
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<td>Gal plane</td>
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<td>L=23.2</td>
<td>0</td>
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<td>10 x 1500</td>
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<tr>
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<td>Clusters of galaxies</td>
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<td>3.5</td>
<td>L=27</td>
<td>0.5</td>
<td>500 ?</td>
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<td>24.5</td>
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<td>-</td>
<td>16 x 200</td>
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<tr>
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<td>K=26.4</td>
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<td>-</td>
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The full titles are
1. Mapping the dark matter distribution at high redshift with NGST
2. Measuring cosmological parameters with high-z supernovae
3. Probing the intergalactic medium out to the reionization epoch
4. Observing the IR transients of gamma-ray bursts and their host galaxies

5. Microlensing in the Virgo cluster and the role of baryonic dark matter in the universe

6. The formation and evolution of galaxies I: the deep imaging survey(s)

7. The formation and evolution of galaxies II: the deep spectroscopic survey(s)

8. The formation and evolution of galaxies III: cluster galaxies

9. The formation and evolution of galaxies IV: the relation between galaxy evolution and AGN

10. The formation and evolution of galaxies V: obscured star formation at high redshifts

11. The evolution of the cosmic supernova rates

12. Formation and evolution of galaxies: stressing the need for wide-field ultraviolet rest-frame photometry (complement the imaging survey)

13. The age of the oldest stars from the faint end slope of the white dwarf luminosity function in globular clusters

14. A complete initial mass function for old stellar populations

15. The ages and chemistry of the oldest stellar halo populations

16. A study of cool, field brown dwarf neighbors

17. The physics of star formation: understanding the youngest protostars

18. The origin of sub-stellar mass objects: probing brown dwarfs and extra-solar planets in star-forming regions

19. Dynamics and evolution of the interstellar medium: cosmic recycling

20. Evolution of circumstellar disks around young stars: the search for gas and remnant dust

21. Detection and characterization of extra-solar planets

22. Detection and characterization of Jovian Planets and Brown Dwarf Companions in the Solar Neighborhood

23. A survey of the trans-Neptunian region

24. Measuring the physical properties of Kuiper belt objects


More details (including texts of the proposals) can be found at http://www.ngst.stsci.edu/drm/programs.html.
0.2 Spectroscopy with an IFMOS

0.2.1 Low Resolution

An Integral Field Multi Object Spectrograph (IFMOS) of the type described in the ESA Study (see http://astro.estec.esa.nl/NGST/status.html) is suitable to satisfy efficiently the typical requirements outlined in the DRM programmes.

The FOV (40" × 46", possibly upgraded to 67" × 46") and the multiplex capability (of the order of 5 · 10^4 pixels on the sky) is adequate to cover with few exposures the programs Formation & Evolution of Galaxies and SN Cosmology. Programs aimed at studying objects of relatively low surface density like high-z QSOs (Reionization Epoch) or Gamma-Ray Bursters will require individual pointings. Observations of Substellar Mass Objects aim at obtaining 1500 spectra per cluster down to K=25.7. Given the surface density of stars in the proposed clusters (~ 100 per sq.arcmin) this can be accomplished with about 15 exposures of ~ 1h for each of the 10 required star clusters.

An IFMOS has a particular advantage over multi-slit spectrographs in carrying out surveys of sources which could be missed in precursor selections, in particular objects with strong emission lines relatively to the continuum that at faint limits could go undetected in broad-band photometry.

It should be noted that with the present IFMOS concept and design a significant fraction of the Low-Res DRM programme could be carried out in parallel mode, for example while carrying out other higher resolution spectroscopy in the adjacent field of view.

0.2.2 High and Moderate Resolution

The present baseline IFMOS has an high (spectral and spatial) resolution channel with a field of view of 3.8" × 2.6", R = λ/Δλ = 3000 and a pixel size of 0.05". A possible upgrade is the addition of an option with R ≤ 1000 and a FOV ≤ 20" × 15".

In this extended configuration the IFMOS can obviously satisfy the requirements of high and moderate resolution on individual sources, as in the programmes Form.& Evol. Galaxies II (R = 1000, spatially resolved), Gamma-Ray bursts, AGN-Galaxy connection (as far as the observations of the host AGN galaxies is concerned).

Among the programs requiring multiplex, the “upgraded” IFMOS would provide a reasonable number of exposures in the case of Form.& Evol. Galaxies II diagnostics at R = 1000 (~ 50 exposures, possibly in parallel mode) and Cluster of galaxies diagnostics (~ 30 exposures).

The number of exposures appears to be prohibitively large for all the R = 3000 programmes requiring a high multiplex capability like Form.& Evol. Galaxies II (kinematics Hα), Substellar mass objects, Clusters of galaxies (kinematics Hα), AGN-galaxy connection (absorbers).