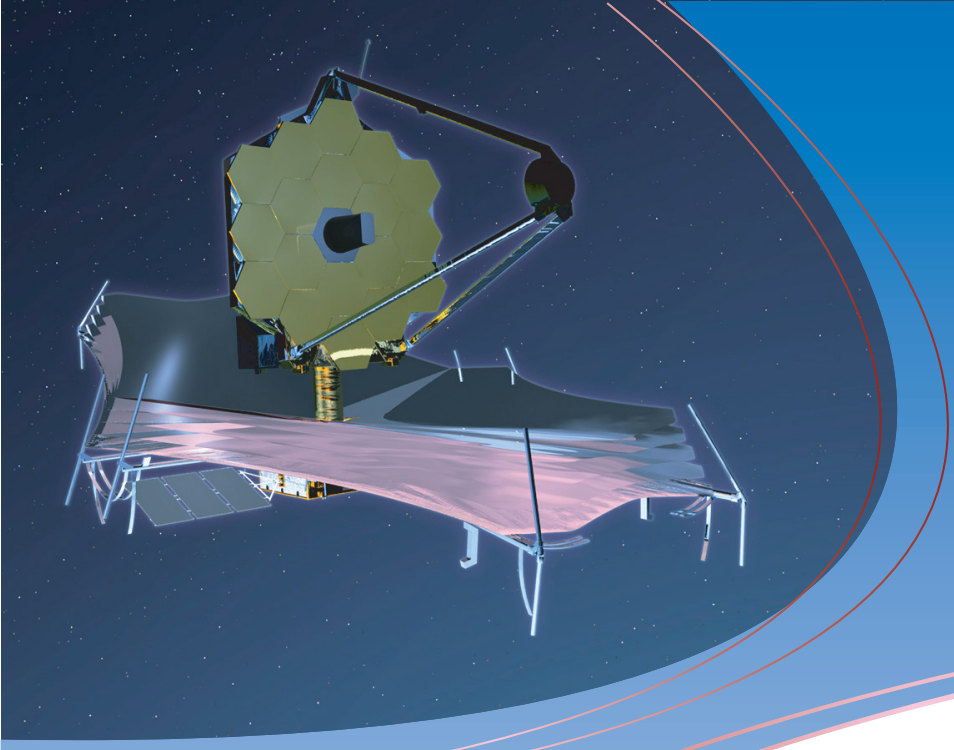

Near Infrared Spectrograph (NIRSpec)

spectrograph for the James Webb Space Telescope capable of simultaneously observing more than 100 sources over a field-of-view (FOV) larger than 3'x3'. The primary goal for NIRSpec is enabling large surveys of faint galaxies (1<z<5) and determining their metallicity, star formation rate, and reddening. NIRSpec is being built for the European Space Agency by the Astrium consortium with Peter Jakobsen leading its development as the European Space Agency project scientist. Six gratings will yield resolving powers of R=1000 and 3000 in three spectral bands, spanning the range 1.0-5.0 μm. A single prism will yield R=100 in the 0.6-5 μm.

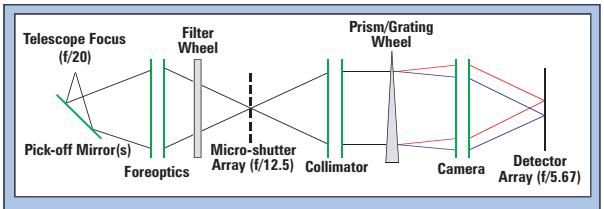

Figure 1: Schematic of the NIRSpec optics

The region of sky to be observed is transferred from the JWST OTE to the spectrograph *aperture focal plane* (AFP) by a *pick-off mirror* (POM) and a system of fore-optics (see Figure 1) that includes a filter wheel for selecting bandpasses and introducing internal calibration sources. The nominal scale at the AFP is 2.516"/mm.

Targets in the FOV are normally selected by opening individual shutters in a *micro-shutter array* (MSA, see Figure 2) to form multiple apertures. The MSA itself consists of a mosaic of subunits producing a final array of approximately 750 (spectral) x 350 (spatial) individually addressable shutters with 200x450 milliarcsec openings and 250x500 milliarcsec pitch. Sweeping a magnet across the surface of the MSA opens all operable shutters. Individual shutters may then be addressed and closed electronically.

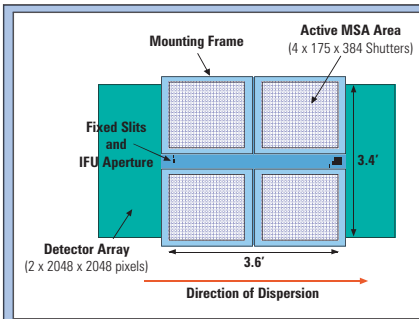

Figure 2: Schematic layout of the NIRSpec slit mask overlaid the detector array projected to the same angular scale.

The nominal aperture size is 1 shutter (spectral) by at least 1 shutter (spatial) at all wavelengths. Multiple spacecraft pointings may be required to avoid placing targets near the edge of an aperture, to eliminate gaps in the spectra due to the physical separation between detectors, and to observe targets with spectra that would overlap if observed simultaneously at the requested roll angle. The nominal slit length is 3 shutters in all wavebands. In the *open* configuration, a shutter passes light from the fore-optics to the collimator. A *slitless* mode can be configured by opening all shutters in the MSA. A *long* slit can also be configured with the MSA.

In addition to the slits defined by the MSA, NIRSpec includes also fixed slits that can be used for high-contrast spectroscopy. They are placed in a central strip of the AFP between sub-units of the MSA and provide redundancy in case the MSA fails. The fixed slits are 4" long and have widths of either 200 or 300 milliarcsec. The strip between MSA sub-units also contains the 3" x 3" entrance aperture for an integral field unit (IFU).

The AFP is re-imaged onto the NIR detector (the focal-plane array: FPA) by a collimator, a dispersing element (gratings or a double-pass prism) or an imaging mirror, and a camera. Three gratings are used for first-order coverage of the three NIRSpec wavebands at R=1000 (1.0-1.8μm; 1.7-3.0μm; 2.9-5.0μm). The same three wavebands are also covered by first-order R=3000 gratings for objects in a fixed-slit or in the IFU. The prism gives R=100 resolution over the entire NIRSpec bandpass (0.6-5μm) but can, optionally, be combined with one of the filters.

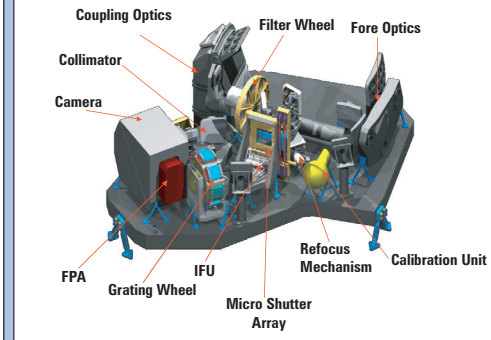

Figure 2: CAD layout of NIRSpec. The instrument measures 190 cm across and weighs close to 200 kg (EADS Astrium).

The FPA consists of sub-units, each 2kx2k, forming an array of 2kx4k sampled at 100 milliarcsec pixels. The detectors will be thinned HgCdTe arrays built by Rockwell Science Center. The NIRSpec also contains a calibration unit with a number of continuum and line sources.

Sensitivity: The NIRSpec limiting sensitivity in 10,000 seconds for point source continuum at 3 mm for R=100 and at S/N=10 is AB=26.2. For emission lines at R=1000 the flux limit at 2mm in 100,000 seconds is 5.2 10^{-19} erg cm^{-2} s^{-1}.

For further information, see

http://www.stsci.edu/jwst/instruments/nirspec/ - the NIRSpec page at STScI

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