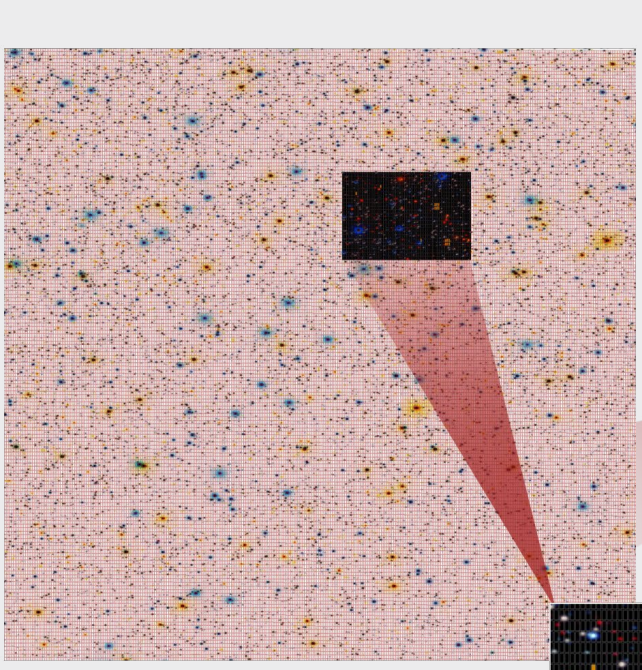
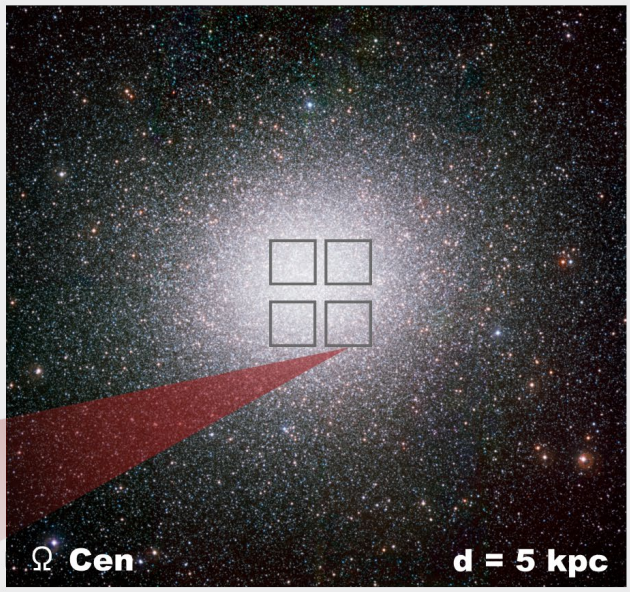
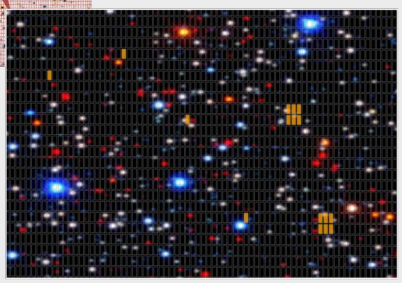
NASA's James Webb Space Telescope:
Spectroscopy in Dense Stellar Fields



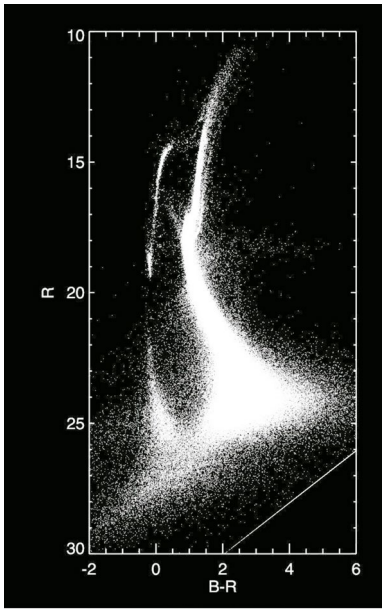




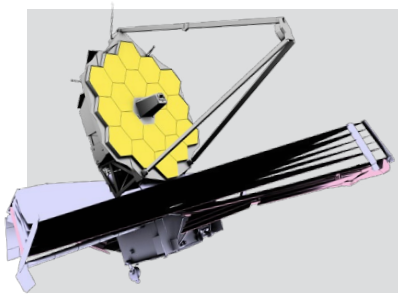
NIRSpec covers 1 - 5 μm at R ~ 100, 1000, and 2700 over a 3.4 arcmin FOV.

249,660 individually configurable 0.2 x 0.45 arcsec shutters.

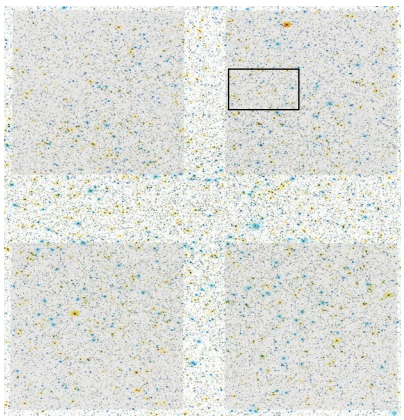
The density of shutters is high enough to cover even the densest stellar fields.



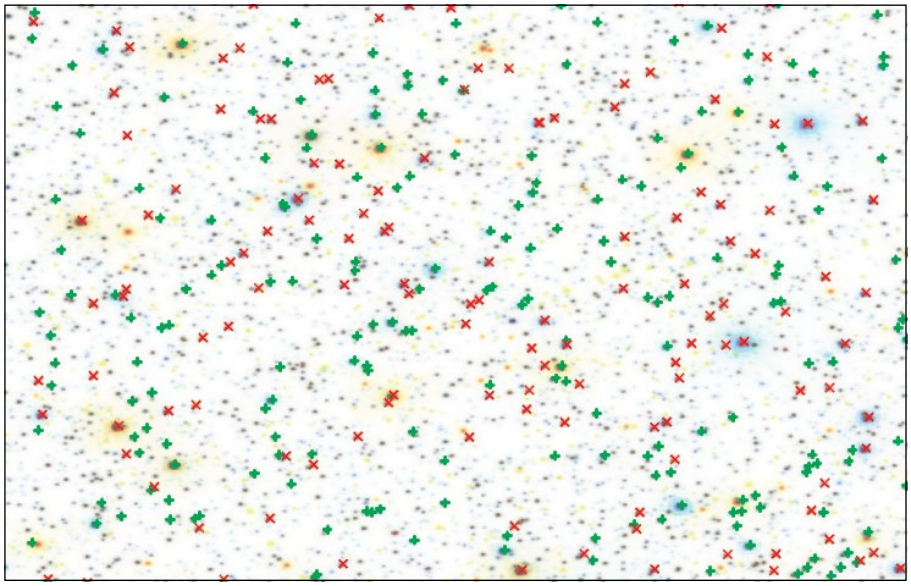
Dense fields of stars are seen in Galactic globular clusters, the bulge, and many star-forming regions. These special places are challenging for spectroscopy, but they are places where stellar kinematics and abundances could be crucial to unraveling the origins and fate of the stars. The galactic globular cluster Omega Cen is hotly debated – it may be a true globular cluster or the surviving core of a stripped dwarf galaxy. JWST's Near-Infrared Spectrograph (NIRSpec) will enable intensive spectroscopy of thousands of Omega Cen stars with its unique Microshutter Array (MSA). The MSA covers a field of 3.4 arcmin on a side, an area in which Omega Cen has 10,000 stars down to 20th magnitude. NIRSpec's 250,000 individually configurable microshutters are denser still, enabling spectroscopy of thousands of stars – limited only by the available time and not by field crowding. These spectra will measure kinematics and elemental abundances, and constrain the chemodynamical history of this enigmatic cluster with unprecedented statistical precision.

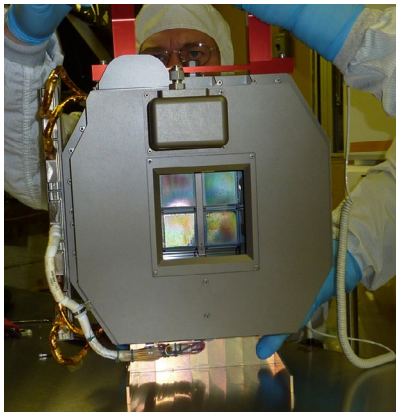


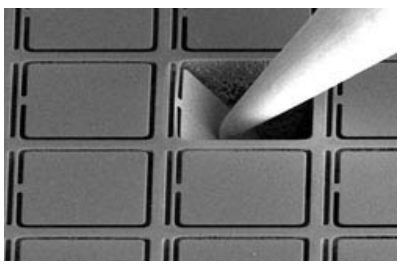
The NIRSpec MSA will also enable intensive spectroscopy in other dense stellar fields where high spatial coverage, resolution, and dynamic range are needed. NIRSpec will examine dense galactic star-forming regions to study both their stars and protostellar disks and jets. Perhaps the most novel application of the MSA is in the Galactic bulge, where the density of stars is still low enough for the MSA to work effectively outside 3 degrees radius (or > 1 kpc). This new JWST capability is sure to open new discovery space for stellar abundances and kinematics in dense fields.



The MSA placed at this position on ΩCen can observe the stars marked +, while stars marked x are behind the inter-shutter bars or the few inoperable shutters. Observable stars in the same row will be covered by seperate configurations of the MSA.







- This entirely new regime in space-based spectroscopy is enabled by NIRSpec's revolutionary Microshutter Array.
- In this particular Ω Cen pointing, NIRSpec can observe about 5000 stars in 30 MSA configurations.
- NIRSpec is also exquisitely sensitive: it will reach S/N = 20 for stars at J = 20 in 15 minutes for each of the three bands covering 1 - 5 μm.
- NIRSpec can work effectively in fields where there is up to 1 star for every 3-5 shutters, such as globular clusters or the Galactic bulge.

Near-Infrared Spectrograph (NIRSpec)

Micro-Shutter Assembly (MSA)
- 4 separate quadrants
- 365 (dispersion) x 171 (spatial) shutters per quadrant
- Observer specifies which shutters to open and close

Fixed slits (FS)
- Always open, no overlap with MSA on detectors
- One 0.4'' x 3.8'' slit
- Three 0.2'' x 3.3'' slits (offset along dispersion axis)
- One 1.6'' x 1.6'' large aperture

Integral Field Unit (IFU)
- 3'' x 3'' field of view (covered when not in use)
- 30 image slices, each 0.1'' (dispersion) x 3'' (spatial)

See more at jwst.stsci.edu and jwst.nasa.gov
and do your own ETC calculations at jwst.etc.stsci.edu

Images courtesy of NASA