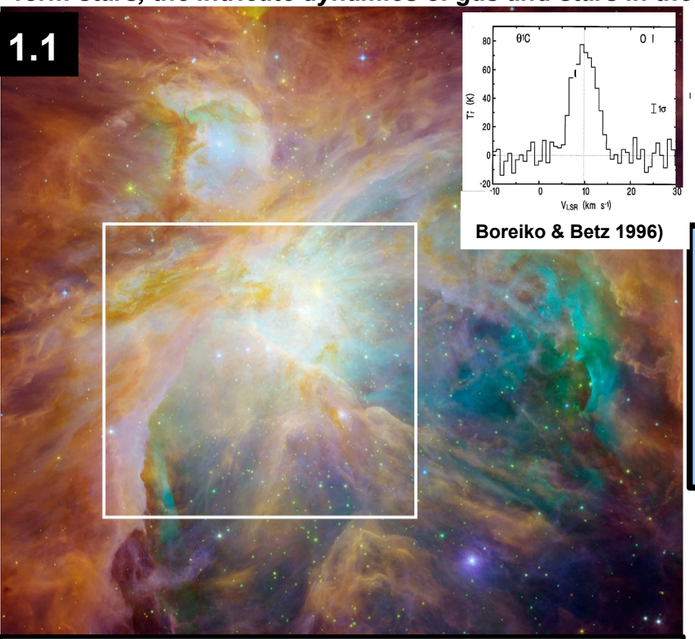
Foldout 1. Science Requirements Flow: ***OCAM's 16 pixel, `Super'-TeraHertz array will provide unprecedented access to the 63μm [OI] line; the dominant cooling line in dense, high luminosity regions. These regions include star forming clouds, jets/shocks, and the centers of galaxies. OCAM observations will contribute significantly to our understanding of how stars form, the life cycle of the interstellar clouds which form stars, the intricate dynamics of gas and stars in the Galactic Center, and help provide a template for interpreting these processes in distant galaxies.***

1.1



Boreiko & Betz 1996)

<u>Above</u>: Orion nebula image obtained (ACS/Hubble and IRAC/Spitzer) illustrates the dynamic nature of the interaction of massive stars with their parental cloud. Top-Right: Single line of sight (LOS) spectra of [OI] (*KAO*) taken toward Orion (T_{pk}~80K). OCAM can observe ~25,000 LOS at higher sensitivity and spectral resolution in a single *SOFIA* flight. *Herschel / HIFI* is <u>not</u> capable of observing this line.

White box (15' x 15') frames OCAM survey region.

OCAM relates strongly to NASA's research objectives of Evolution of Galaxies and Star Formation

Mission Goal

Better understand the nature of the far-infrared Universe by probing the topology and ecology of interstellar gas in the Milky Way and nearby galaxies with the 63μm [OI] line. OCAM will be used to uniquely probe

- radiative interactions of massive stars with their natal clouds.
- interactions of protostellar winds/jets with their natal clouds.
- interactions of massive stars with their environment in the Galactic Center.
- conditions in the nuclei of nearby, face-on galaxies.

Data Products

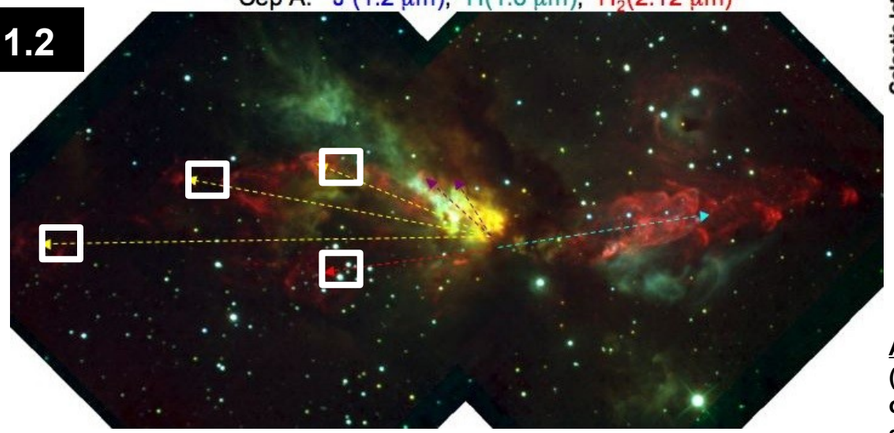
1. Fully sampled, velocity-resolved, large area surveys of [OI] (63μm) line emission and absorption toward the Galactic Center, Orion, Cepheus A, and M33.
2. A database of existing complementary line and continuum surveys will be created.

Science measurement requirements drive instrument design

Science Measurement Requirements

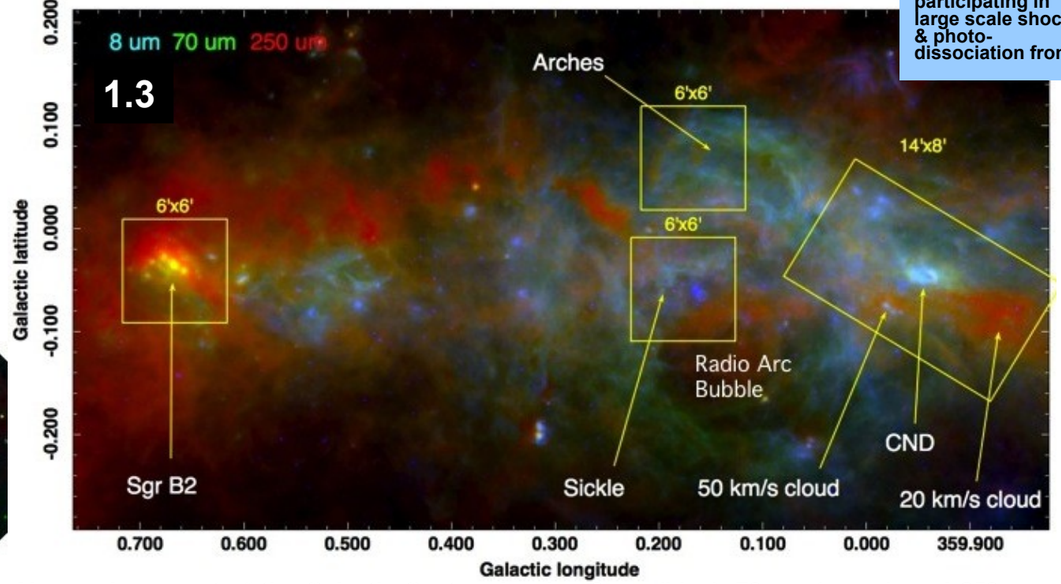
Science Objective	Science Measurement Requirement	Instrument Functional Requirement	Mission Functional Requirement
Probe the energetics and dynamics of high luminosity regions	Spectrally-resolved maps of the 63 micron [OI] line	4.7 THz heterodyne receivers	SOFIA required for measurable atmospheric transmission
Observe global environments of star formation and cloud dissipation	Large maps spanning significant fractions of a square degree	Mapping speed >100 arcmin^2 per flight leg requires array receiver with 16 spatial pixels	SOFIA flight legs ~3 hours in order to complete a map
Spatially resolve cloud (sub) structure at the Galactic Center	<10" angular resolution	>2m primary antenna	2" pointing knowledge
Spectrally resolve interstellar cloud structure	< 1 km/s velocity resolution	Spectrometers with <16 MHz resolution	1 Mbps data rate
Span large range of Galactic radial velocities	>300 km/s instantaneous velocity coverage	IF & spectrometer bandwidth >5 GHz per pixel	1 Mbps data rate
Measure warm gas participating in large scale shocks & photo-dissociation fronts	Detect N(O) >2x10^{17}cm^{-2}, or T_B<1K km/s in 30 sec	T_{rec} < 2000K DSB: Hot electron bolometer mixer receivers at 4Kelvin	Closed cycle 4K cryostat Optimal SOFIA altitude >39 kft

1.2



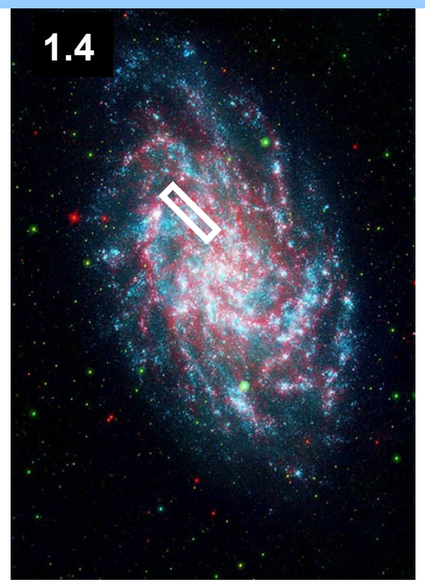
<u>Above</u>: Cepheus A outflow complex in the near IR. The 15 M_o protostar HW2 appears to drive a pulsed, precessing jet; three yellow arrows mark the 1st three pulses; 2 maroon arrows mark the two most recent eruptions. 63 μm [OI] spectroscopy with OCAM is needed to measure the radial velocities of the components on the left (~3' x 3') white boxes) to confirm or deny the pulsed/precessing jet hypothesis.

1.3



<u>Above</u>: Inner part of the Galactic Center showing 8 um (blue), 70 um (green), and 250 um (red) dust emission. OCAM observations of the Galactic Center will provide a unique opportunity for studying the physical and chemical conditions of the interstellar medium and star formation process in galactic nuclei. In its 3 science demonstration flights, OCAM will perform extensive high spectral/spatial resolution [OI] surveys towards the central black hole circumnuclear disk (CND) orbiting the Galactic black hole, the most massive molecular cloud in the galaxy (Sagittarius B2), and one of the most spectacular HII regions in the Milky Way (the Sickle HII region, surrounding a massive young cluster). [OI] is expected to be the dominant cooling line in each region (gold boxes). The OCAM high spectral/spatial resolution surveys will help disentangle the energetics and dynamics of the Galactic Center and provide a Rosetta Stone for interpreting lower resolution [OI] observations of more distant galaxies.

1.4



<u>Above</u>: M33 image obtained by GALEX and Spitzer. Far-UV light from young stars glimmers blue, near-ultraviolet light from intermediate age stars glows green, while the red traces PDRs. High spectral resolution [OI] maps of a 4x2' region of M33 (white box) will provide insight into the destruction of GMCs and the recycling of their material into low-density gas.