SNAP Near Infrared Observations

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Michael Schubnell
University of Michigan
(for the SNAP Collaboration)

Importance of NIR observations for SNAP

- Tracing evolution of dark energy / EoS
- Providing access to high-z observations (rest frame B-band shifts into NIR for z > 0.9)
- Important constraints on systematic errors
- Substantial increase in science capability

SNAP focal plane

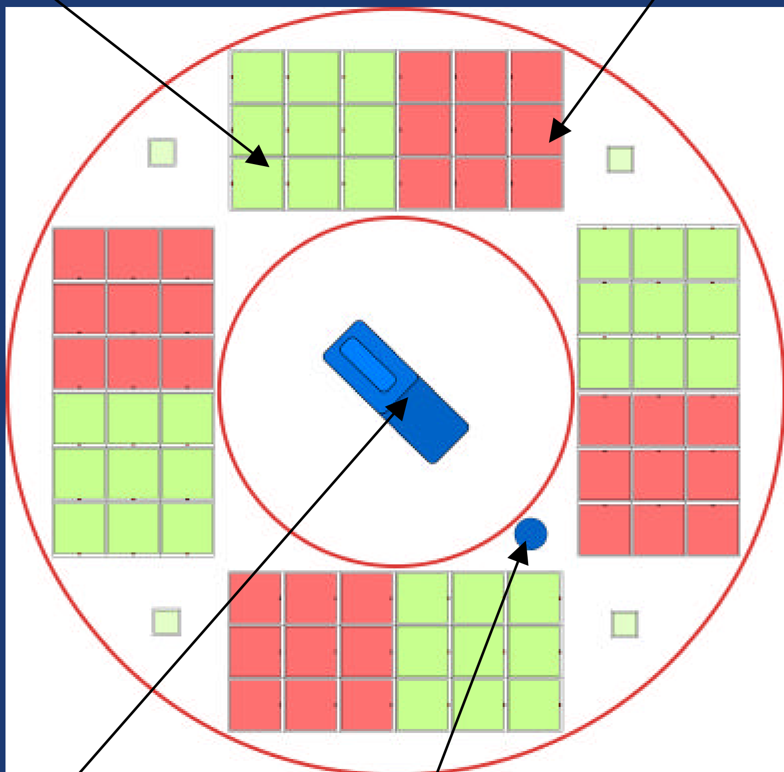
SNAP focal plane will consist of 0.34 sq. deg. visible & 0.34 sq. deg. NIR detectors

36 HgCdTe (2k x 2k) = 151 Mpixel

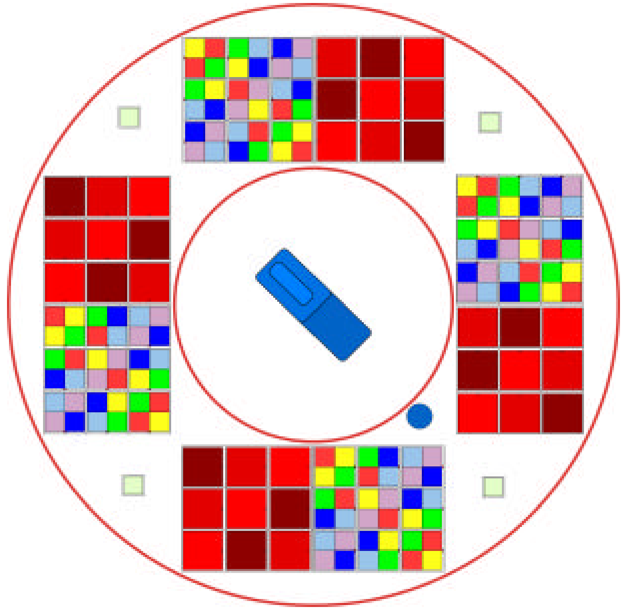
pixel size: 18 µm x 18 µm

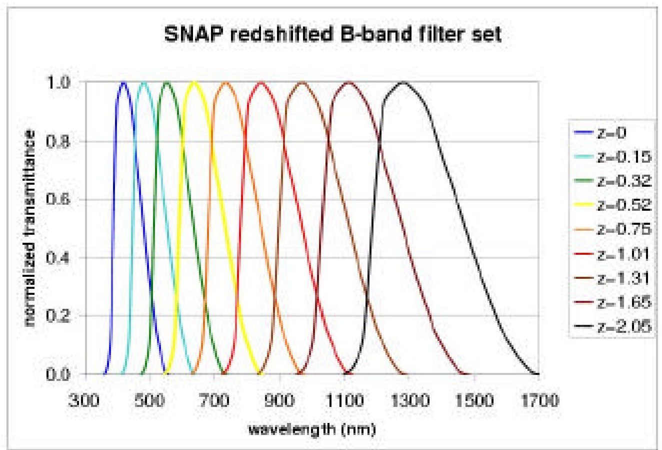
36 CCDs (3.5k x 3.5 k) = 462 Mpixel

pixel size: 10.5 µm x 10.5 µm



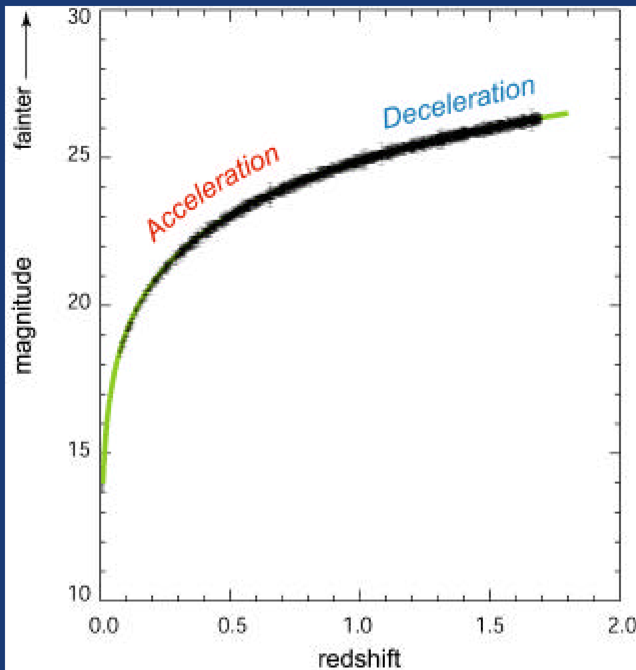
Spectrograph   Spectr. port





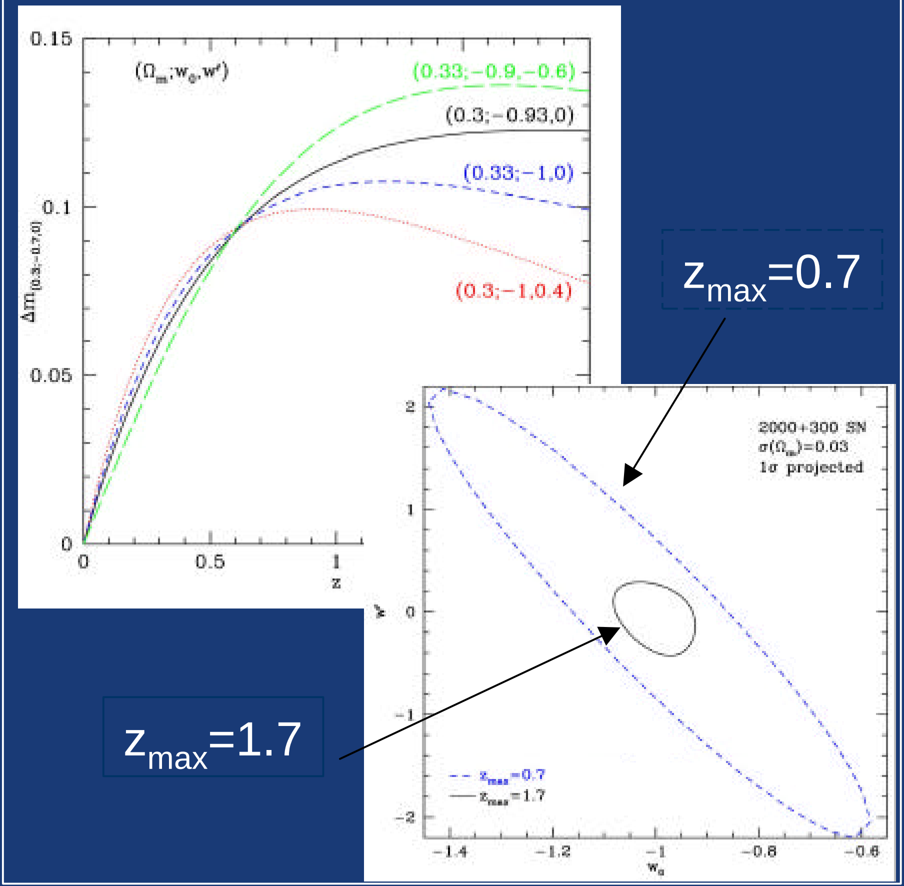
NIR is essential to SNAP primary mission

- Dark energy can be detected at low redshift (SCP, High-z). To determine what it is requires measurements over both the acceleration and deceleration epochs.
- This long reach breaks essential degeneracies which low redshift data alone cannot.



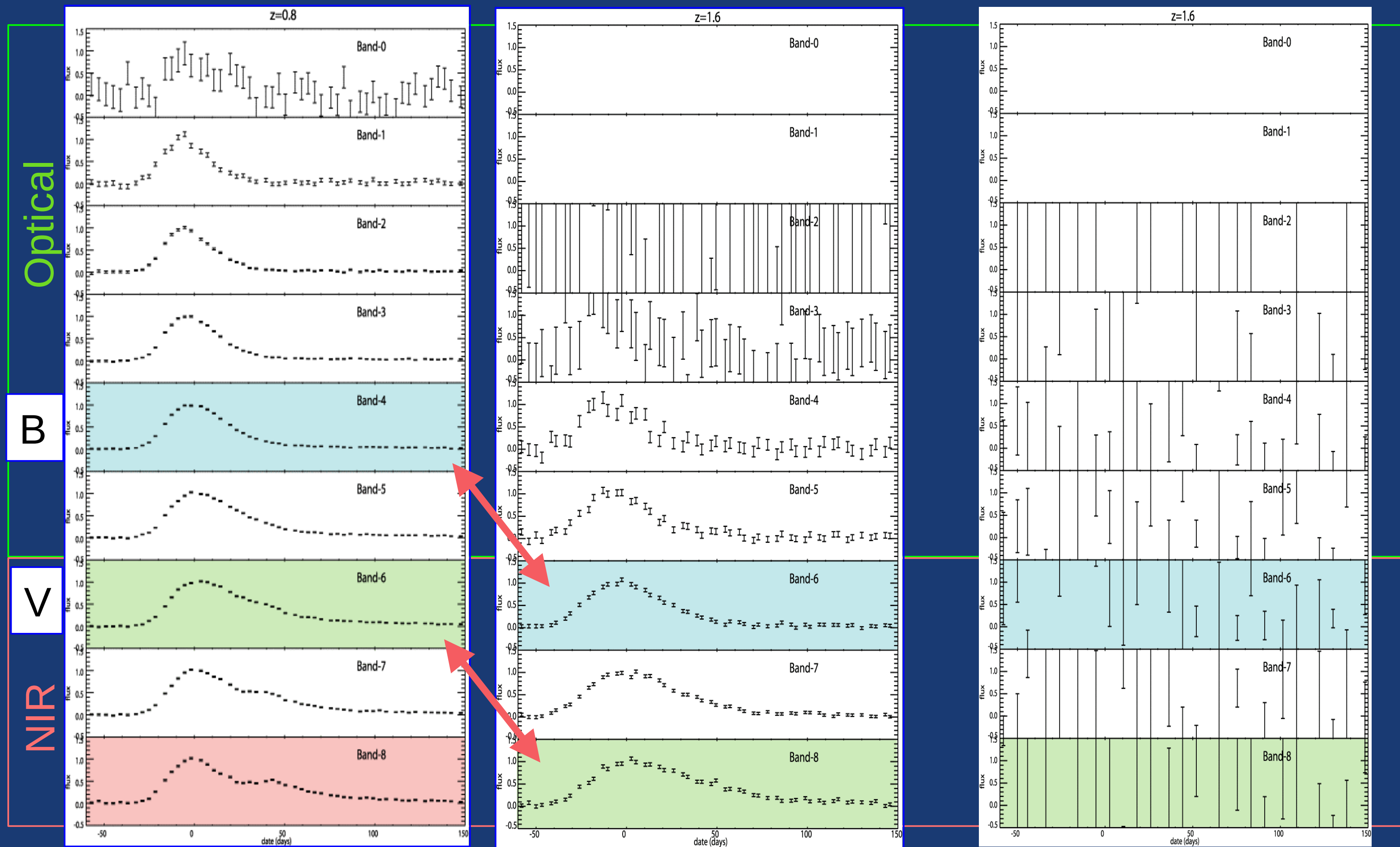
SNAP will

- ✓ probe the variability of w, providing an essential clue to the nature of DE.
- ✓ measure w_0 precisely to determine whether it is a cosmological constant.



Rest frame B and V shift to NIR

Rest frame peak brightness measurements and spectral SN type identification rely on NIR



Z = 0.8

Z = 1.6

Z = 1.6 (from ground)

Confronting systematic errors

SNe Ia population evolution

- Shifting distribution of progenitor mass / metallicity / C-O
- Shifting distribution of SN physics parameters

Gravitational Lensing (de)amplification

Dust/Extinction

- Dust that reddens
- Evolving gray dust
- Host galaxy extinction

Observational biases

- Malmquist Bias
- non-SN Ia contamination
- K-correction uncertainty
- Color zero-point calibration

NIR fixes these

NIR substantially enhances auxiliary science

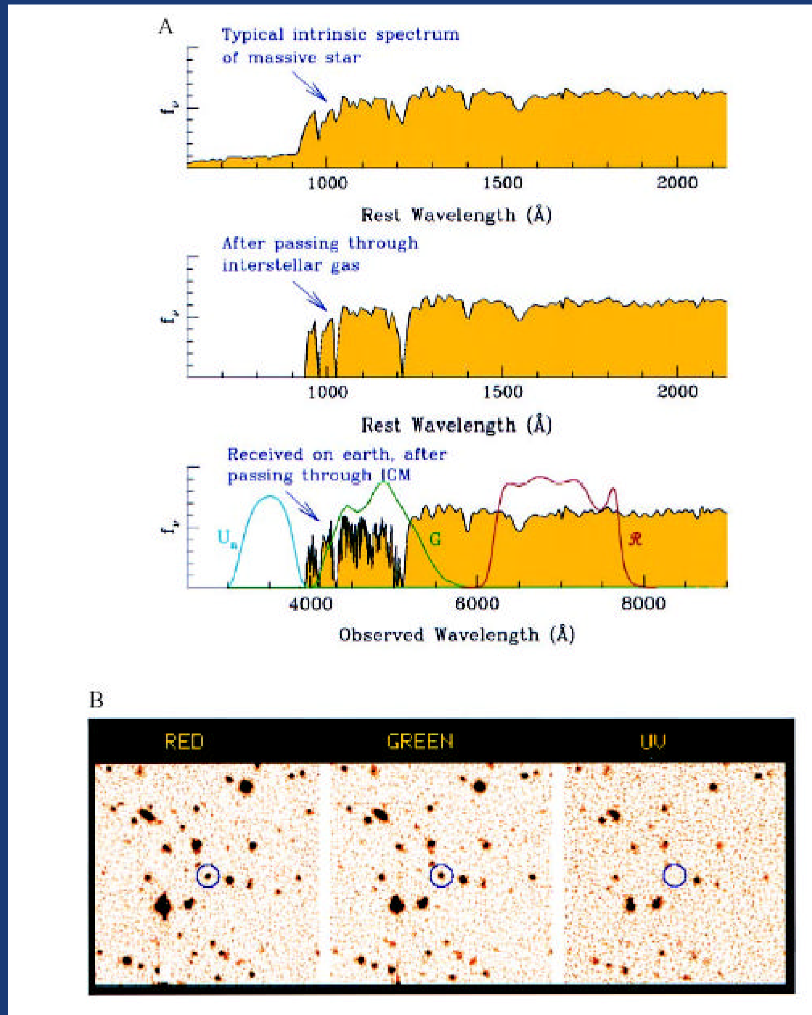
- Galaxy studies: evolution and clustering, a census of R, I, z, and J band dropout galaxies
- Galaxy clusters: identification of high redshift galaxy clusters, faint and small constituents
- High-z quasar studies: mapping the quasar luminosity function to z=10, probing the structure of re-ionization
- Transients; GRBs, QSO / AGN, outer solar system objects
- Cool stars in the Milky Way
- Lensing: evolution of the galaxy-mass correlation to z=1, cluster masses, etc…
- Targets: Identification of targets for JWST, CELT, etc…

Galaxies in the near infrared

A census of R, I, z, and J band dropout galaxies

Photo-z can be estimated from the 4000 Å break for galaxies out to about z=3.5.

At higher redshifts the Lyman-α break can be used (for optical imager beyond z=3, and for NIR beyond redshift 10)



[Steidel, PNAS (1999)]

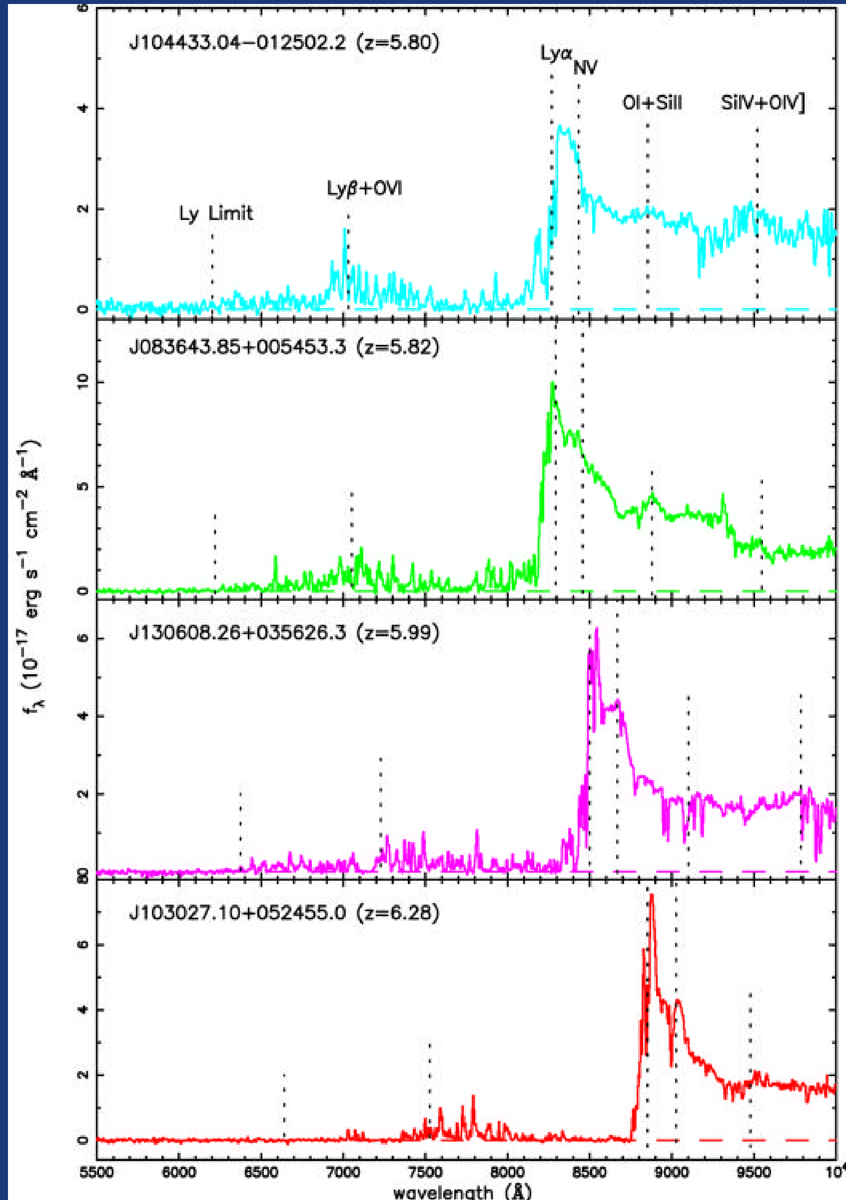
Probing the epoch of re-ionization

Universe was ‘re-ionized’ after recombination

Highest redshift SDSS quasars (at $z \geq 6$) show evidence for Gunn-Peterson trough associated with neutral IGM $\rightarrow$ possibly signature of trailing edge of re-ionization epoch.

Structure in re-ionization is unknown: caused by variations in UV flux from early stars & quasars

SNAP discovered $z > 6$ quasars (+ JWST spectroscopy) can map the spatial structure of re-ionization.



[Becker et al., AJ, 122, 2850 (2001)]

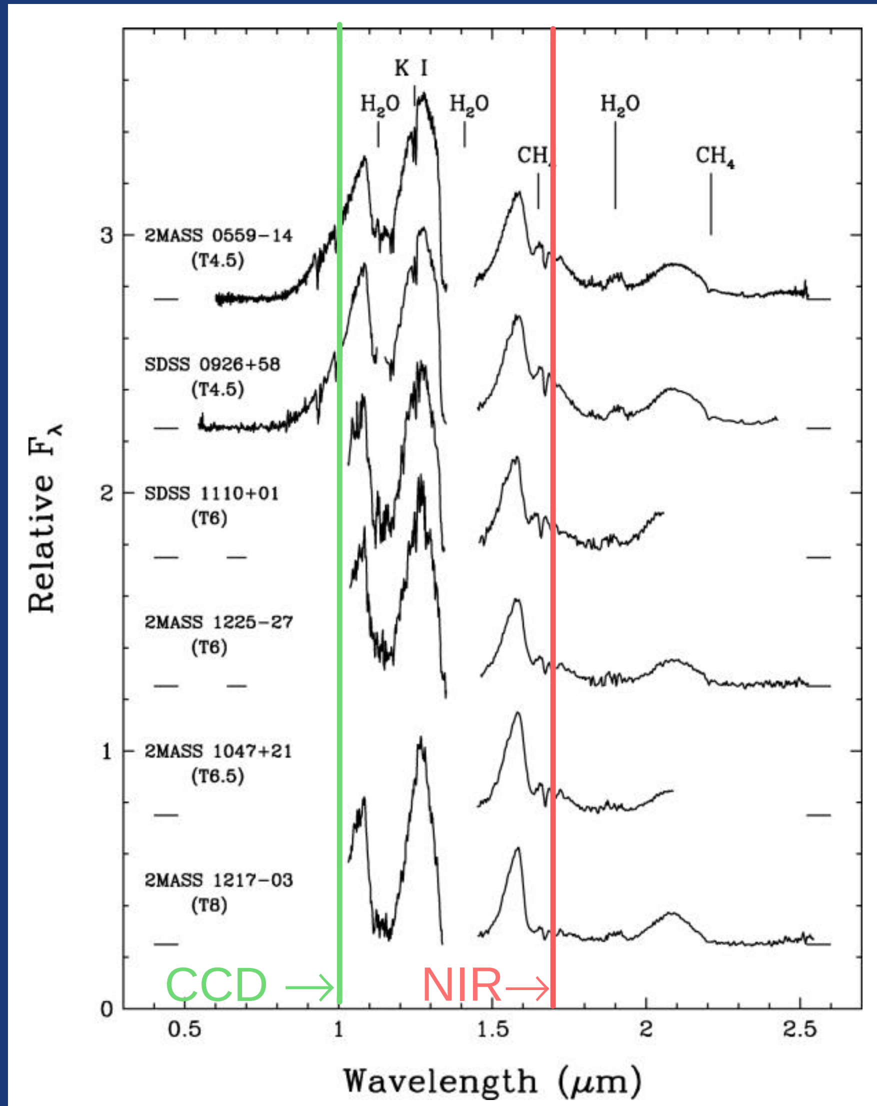
Cool objects

Discovering the coolest nearby objects

SNAP NIR observations can also be used to probe very sensitively the restframe NIR emission from nearby objects. Of particular interest would be a census of low-mass L and T stars and brown dwarfs. (Can be seen by SNAP to ~10 kpc)

Discovery of outer solar system objects

SNAP time series data will provide an excellent probe of faint, cool, objects in the Kuiper belt and beyond.



[Geballe et al., ApJ (2002)]

Summary

Near infrared observations (in space) are essential to understanding the nature of the dark energy.

The SNAP focal plane is instrumented with a wide-field, large area imager equipped with equal coverage of large format optical CCDs and HgCdTe near infrared detectors.

The wavelength reach into the infrared will:

- provide rest frame B and V to z=1.7
- provide control of systematics
- greatly expand the SNAP science potential by high statistics, high-z, wide-field measurements.

More information about SNAP can be found at:

http://snap.lbl.gov

and in Session 126: SNAP [Thursday 10:00 – 11:30, 608-609]