KEPLER MISSION EXTENSION, "K2", FIELD 0 CAMPAIGN

M. Fanelli (NASA-Ames & BAERI), P. Marcum (NASA-Ames)

The Kepler Extragalatic Science Community

Science Drivers

Kepler's combination of high-photometric precision and near-continuous observing cadence provides a unique insight on variabiity in extragalactic systems, by opening up the time domain in previously unavailable detail. Long-term monitoring of galaxies is sensitive to both continuous variability, especially low-level variations from embedded active nuclei, and random episodic events, such as supernovae. The primary objectives are (a) to define the photometric baseline of galactic systems over a range of amplitudes and timescales, (b) quantify the frequency of and amplitude of optical AGN signals in galaxy cores, both quasi-continuous and episodic, (c) provide a direct measure of supernovae rates across galaxy types, complementary to ground-based supernova searches, and (d) quantify the early brightening of supernova as the explosion rises to peak luminosity, which provides critical diagnostics of the origin and shock breakout physics of supernova explosions.

Kepler was designed as a stellar and exoplanet astrophysics mission; exploitation of extragalactic astrophysics initially lagged behind the more obvious science. The case for observations of galaxies has been detailed in the Kepler prime mission GO programs of Carini, Mushotzky, Wehrle, Olling, Fanelli, and Garnavich. First results, all concerning analysis of the power spectrum of optical flucuations from AGN, have been presented by Mushotzky+ 2011 (ApJL 743, 12); Carini+ 2012 (ApJ 749, 70); Edelson+ 2013 (ApJ 766, 16) and Wehrle+ 2013 (ApJ 773, 89). Recently Olling etal (2013, 2nd Kepler Conference) have identified a few supernova candidates in the Kepler data, and the statistics of observed variabilty described by Fanelli etal (2013, 2nd Kepler Conference).

While the Cycle 0 FOV is also close to the galactic plane as was the primary Kepler field, we have identified about 100 galaxies with V < 15 mag and ~10 AGN. These sources should serve as an excellent pilot program to test the viability of extragalactic science for the entire K2 program. Follow-on fields, esp, Field 1 contain a much richer collection of extragalactic targetrs.

Targets & the FOV

Using the field center defined in the K2 target proposal call, we executed a radial search for bright galaxies using NED and a few galaxy catalogs. Field "0", like the original Kepler FOV, is located close to the galactic plane and suffers the same lack of information regarding extragalactic sources, especially optical-band photometr, and AGN candidates. Only the 2MASS near-IR extended source catalog provides a significant number of galaxies, as was true for the prime mission. We have identified ~100 viable targets in the K2-0 field, including several AGN candidates. Note that the 2MASS data is fully incorporated into NED. Only galaxies with known redshifts were selected.

AGNs: ~10 AGNs have been identified in this field; we used the Vernon-Cetty AGN Catalog & a search radius of 10deg from the field center. Several of the galaxy targets are also possible AGNs, based on their detection in radio and x-ray surveys. Candidates with V > 19.5 were excluded.

Brightness estimates: This field lies outside of the Sloan Survey footprint, therefore little high quality optical photometry exists for galaxies. We used Zwicky photographic magnitudes combined with K-band data from 2MASS; all targets had one or the other measure. A typical (V-K) color for galaxies is ~ +3. Accounting for foreground extinction we estimated the V mag as K+3.5. For objects which also possessed a Zwicky mag, the resulting (m_p-V) color was ~ 0.4 - 1.0 which is reasonable for normal galaxies.

Priority: Since the number of targets which might be selected in uncertain, we triaged our list. In the 2nd target table, we assigned a priorty of 1 to AGNs, bright galaxies and sources which had strong radio or x-ray detections. All other galaxies were given priority=2.

Apertures: Since these are extended sources, the source magnitude - assigned Kepler aperture relation does not cover the entire source and should be augmented. Unlike KepMags from the KIC, the magnitude estimates provided here are reliable. Most of the galaxies extend 30-45" in diameter, so a 10-12 square pixel aperture will capture the source. Adding 2-3 halos should suffice.

Target sheet: The target sheet is provided in TXT format, as described on the Kepler Science Center webpage. That table, as specified, provides no means to assign a name to each target. Following the specified Table, we also list the targets by name, ra, dec, mag, band, priority and comments.