A NEW SET OF MEDIUM-BAND FILTERS FOR USE AT MOSAIC: In the last few years, the ASU group and their collaborators (PI: Rogier Windhorst) had a unique set of 15 medium-band filters made. These have a typical $\Delta\lambda/\lambda \simeq 0.05 - 0.10$ and cover the entire atmospheric range 3200–10,000$\AA$, but are sandwiched between the brightest and most variable night-sky lines. Fan et al. (1996) describe the 15 medium-band filter set, which has been used since 1993 at the 0.6m Schmidt telescope of the Beijing Astronomical Observatory at Xing Long Station, using a 2048^2 Loral CCD with 1 sq. degree field. Other results from this Beijing-Arizona-Taiwan-Connecticut survey are described by Shang et al. (1998), Zheng et al. (1999), and Yan et al. (2000). The 15 medium-band filter set is also known as the "BATC" set.

The ASU group and their collaborators will make filters 1–11 of their their 15 MOSAIC-size medium-band filters available to KPNO users in the A semesters of each observing year, starting with Semester 2002A. It is the intention to make the full filter set available for community use starting in a future semester, presumably within two years after the 11 bluest filters have been made available. These medium-band filters can be used for a wide variety of purposes, e.g. high-accuracy photometry of stellar populations in our galaxy and nearby galaxies, the search for galactic or extragalactic emission-line objects, measurement of accurate photometric redshifts, etc. A few specific examples are discussed below.

PHYSICAL SIZES: Our 15 medium-band filters are precisely 146×146 ×12.0 mm in size to accommodate both the KPNO and CTIO MOSAIC's, amongst others.

THROUGHPUT CURVES: Fig. 1 shows the throughput curves of the 2.0×2.0 inch versions of the 15 medium-band filter set superimposed on the AZ night-sky. Two complete sets of the 2 inch filters exist — one resides permanently at Beijing Astronomical Observatory to carry out the BATC survey, and the other is being used for imaging and photometric calibrations both at Taiwan as well as in Arizona. The 5.75 inch filter set has by design nearby identical through-put curves as the 2 inch filter sets (Fan et al. 1996). It was measured by the manufacturer and confirmed to be consistent to within 1% with the throughput of the 2 inch filter sets (see Fig. 1). The throughput of the 5.75 inch filters will also be confirmed with the NOAO filter throughput densitometer (in collaboration with A. Saha) later in 2001.

UNIFORMITY AND CENTRAL WAVELENGTH CHANGE: The 5.75 inch filters have the same uniformity as our 4×4 inch PF-CCD filters (Keel et al. 1999). Center-to-edge variations are very small across the FOV (<<1% in transmission; Yan et al. 2000; 2001). Medium and narrow-band filters will show a systematic shift towards the blue when used for imaging in a fast collimated beam. In the f/3.5 beam of the NOAO 4 m telescopes, the maximum wavelength shift from center to the edge of the FOV is no more than about 20$\AA$ for the blue filters, or about 6% of their FWHM. In other words, unless a spectral feature of interest exists at the edge of the FOV right at the blue edge of a given filter, it will likely not be shifted out of the filter bandpass over the MOSAIC FOV.

GAIN IN SKY-BRIGHTNESS: All medium-band filters were designed to be as much as possible sandwiched between the night sky-lines, and avoid the most variable lines to prevent fringing. For $\lambda > 6000\AA$, the medium band filters provide a *significantly* lower sky-brightness compared to their broad-band counterparts, in good part offsetting the need for longer integrations in the narrower filters to achieve the same S/N. This is illustrated in Table 1. A first set of MOSAIC observing runs with the 5.75 inch filter set showed that fringing is much reduced in these medium-band filters, and virtually absent in the 748 nm, 801 nm and 847 nm filters. The 918 nm and 974 nm filters had a maximum fringe amplitude about an order of magnitude less than in the standard Johnson I or Gunn z filters, so allowing for imaging to very faint surface brightness levels with natural dark skies at these wavelengths. Imaging in the 918 nm and 974 nm filters was possible to within 0.5 hour from sunrise without a significant increase in sky-brightness. They permit to do very uniform and faint low-SB imaging (to AB=28–29 mag/arcsec^2; Shang et al. 1998, Zheng et al. 1999) and very uniform catalog generation (to AB=26 mag on 4m class telescopes; Campos et al. 1999, Keel et al. 1999).

CALIBRATION: The nearly identical 2.0×2.0 inch set of 15 medium-band filters has been calibrated at the 60 cm Schmidt telescope at Xing Long station in China, as well as with the Steward 61 inch telescope on Mt. Bigelow in AZ. On the AB flux-scale, the absolute zero-points for all filters are known to better than 1–2%, while color terms for these medium-band filters are minimal (Fan et al. 1996, Yan et al. 2000, 2001).

HIGH PRECISION PHOTOMETRY DONE WITH THESE FILTERS: Accurate (∼1–1.5%) spectrophotometry has been done with these 15 medium-band filters on open clusters, as well as surface photometry to very faint SB levels on nearby galaxies. The stellar population in the open cluster M67 was delineated at high precision, including its *binary* main sequence and initial mass function (Fan et al. 1996). We call attention to the very high quality of the multi-band HR-diagrams in Fan et al. (1996). The BATC filters also yielded very deep images with *no fringing* on the edge-on spiral NGC 5907. The sky in the 6660$\mathring{A}$ filter is 16×fainter compared to broad-band R, resulting in a SB limit of ∼28.6 mag/arcsec^2 over one full deg^2. This was essential to show that the "red halo" reported earlier around N5907 is caused by an elliptical ring of stars pulled out during an encounter with a nearby dwarf galaxy, hence no longer requiring a halo of brown dwarfs (Shang et al. 1998, Zheng et al. 1999). Searches for and imaging of high redshift emission line objects have been done with medium-band filters like those in the BATC set, with results reported by e.g., Pascarelle et al. (1996, 1998), Francis et al.(1997), Thompson et al. (1999), and Windhorst et al. (1998).

TESTS OF THE MOSAIC SIZE FILTER: Engineering runs with the KPNO 0.9m MOSAIC in Febr. 2000, as well as a first observing run our with the CT-4m MOSAIC2 in June 2000 showed that all medium-band filters were par-focal with each other and with the broad-band Mosaic filter set. All had the expected, very repeatable flat field properties. With the stringent criteria imposed on filter fabrication, the filter quality is as good as we expected (Yan et al. 2001).

DETAILS OF PUBLIC AVAILABILITY OF THE MEDIUM-BAND FILTERS: The medium-band filters will permanently reside at the NOAO filter library in Tucson, under the supervision of NOAO. When not at the telescopes, they will stay in Tucson in a pre-heated, N_2-purged chamber under construction at ASU, to assure stability and longevity.

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Table 1: Broad-Band and *Medium-Band* Sky-brightness and AB-flux limits

Filter	λ_c (Å)	FWHM (Å)	Dark sky (AB-mag arc^{-2})	KPNO– (10σ Dark	–limits 8-hr) Bright	CTIO– (10σ Dark	–limits 8-hr) Bright
U	3600	530	23.56	26.95	25.85	26.95	25.85
B	4420	1100	22.71	26.91	26.41	27.21	26.61
V	5480	1100	21.92	26.80	26.60	27.10	26.80
R	6460	1200	21.27	26.61	26.50	26.90	26.70
I	8290	1900	20.02	26.03	25.93	26.33	26.23
z	9150	1650	19.19	25.5	25.5	25.8	25.8
a	3372	271	23.83	26.59	25.48	26.57	25.47
b	3907	260	23.33	26.57	25.46	26.55	25.45
c	4194	327	23.03	26.21	25.83	26.65	26.10
d	4540	259	22.89	26.08	25.71	26.53	25.98
e	4925	280	22.80	26.11	25.74	26.55	25.99
f	5267	290	22.65	26.27	26.01	26.54	26.28
g	5790	231	21.75	26.15	25.90	26.43	26.17
h	6074	245	21.83	26.14	25.98	26.41	26.26
i	6656	359	*22.08*	26.36	26.20	26.63	26.48
j	7057	179	*22.00*	25.98	25.82	26.26	26.10
k	7546	151	*21.75*	25.91	25.75	26.18	26.02
m	8023	228	*21.19*	25.32	25.22	25.60	25.49
n	8484	166	*20.74*	25.17	24.93	25.44	25.34
o	9182	182	*20.10*	25.22	25.12	25.50	25.39
p	9738	200	*19.77*	25.28	25.17	25.55	25.45
J	12500	1850	16.58	24.0	24.0	24.2	24.2
H	16400	2800	14.95	23.6	23.6	23.8	23.8
K	22200	3900	14.80	23.4	23.4	23.4	23.4

Note: The expected depths in AB-mag for 8-hr integrations were obtained from the NOAO exposure time simulators for these instruments (www.noao.edu/scope/ccdtime/) for typical seeing at KPNO (1″.1 FWHM) and at CTIO (0″.9 FWHM), and properly rescaled for 8-hr integrations per filter at the 6.5m telescopes (in 0″.8 FWHM seeing). Calculations were done for sky-brightness at Moon phase=0 (Dark) and =7 days (Bright). Note that the medium-band sky (col. 4) is typically darker than broad-band at the same wavelength by +0.06 mag in U, +0.23 mag in B, +0.35 mag in V, +0.78 mag in R, and +0.91 mag in I (Fig. 3). The medium-band calculations were appropriately rescaled for this gain in sky-darkness, which is especially significant *in the red*. **All fluxes were converted to AB-magnitudes.**

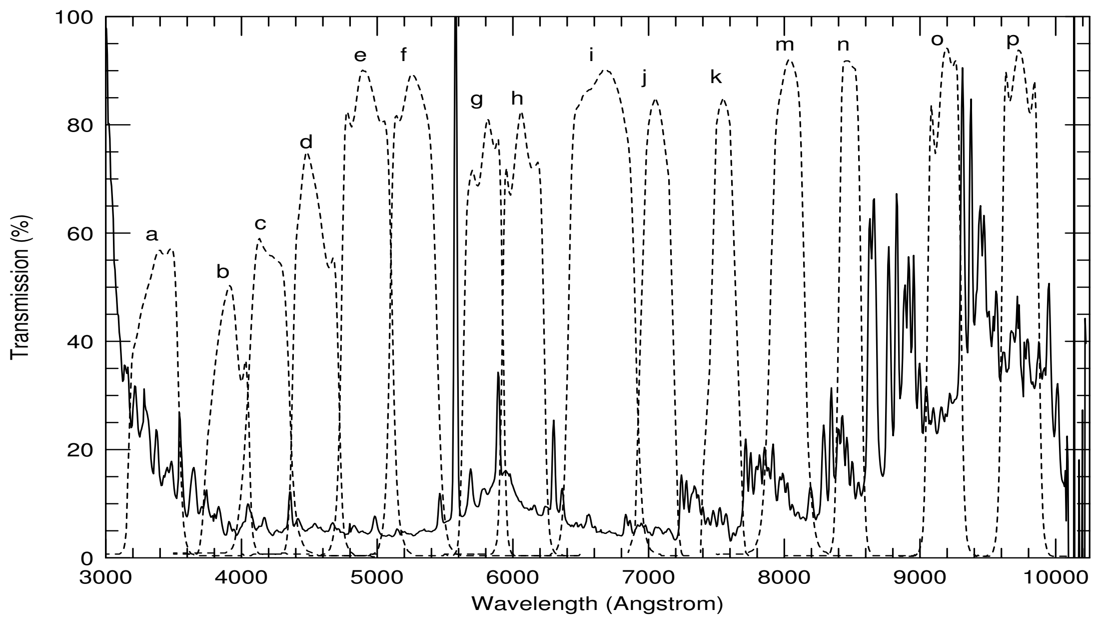

Fig. 1. Throughput curves for the 2.0×2.0 inch 15 medium-band filter set superimposed on the MMT night-sky. The 15 MOSAIC size 5.75×5.75 inch filters have nearly identical throughput curves. All filters are as much as possible sandwiched in between the night sky lines and avoid the most variable lines to prevent fringing. For the BATC filters, the zeropoints are known to within ∼1–2% accuracy (c.f., Fan et al. 1996, Yan et al. 2000).