KMTNet Synoptic Survey of Southern Sky (KS4)

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Wide-field imaging survey of Southern Sky (filling the gaps) ~1600 hrs over 4 years 37 people from SNU, KASI, KNU, KU, KIAS, Yonsei, SAAO, Swinburne

Title: KMTNet Synoptic Survey of Southern Sky (KS4)

Research Team

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KS4 in a nutshell

• BVRI observation of the southern sky area with little data (yellow marked)

• Up to 7000 deg²

• Depth ~ 23 AB mag



Observing method

Depth: BVRIz: 23.5 to 21.5
 - 3 x 120sec = 6min/filter
 - 4 x 120sec = 8min/filter

• Image quality: < 1.6"

Dark time: B,V,RBright time: I,(z)

Filter	AB mag (5-sigma)		
В	23.5		
V	23.2		
R	23.2		
I	22.5		
Z	21.5		

Comparison with the existing surveys

• PS1: deg > -30

• SkyMapper: Shallow, low res

• DES/VST: Limited area, Others: limited filters

Survey	Time/wavelenth	Southern Sky Coverage	Filters	Depth (AB)	FWHM(arcsec)
PS1	Current/Optical	All of Dec > -30	grizy	23	2.0
SkyMapper	Current/Optical	All	griz	21.5	2.5
DES	Current/Optical	4000 deg2, Dec > -60	grizY	24.7(22.7)	0.9
VSTATLAS	Current/Optical	4500 deg2, Dec > -40	ugriz	22.7	0.9
MagLiteS	Current/Optical	1200 deg2, Dec < -60	gr	>23	0.8-1.5
LSST	2023/Optical	All of Dec $>$ -60	ugrizY	24.5-28	0.7
VHS	Current/NIR	All	JK(YH)	19.8-20.9	1.0
ALLWISE	Current/MIR	All	3.6–24 micron	19.4-20.6*	6.0*
SPHEREX	2023/NIR	All	0.75-5 micron	Low res spec	6.0
Euclid	2022/NIR	15000 deg2 of darkest	YJH	24	0.1
KS4	2020-23/Optical	7000 deg2, Dec < -30	BVRIz	23(21.5)	1.5
eROSITA	2019/X-ray	All			

Detection method (Image subtraction)



2014.01.07

(Gaussian convolution)

SN 2014L In M99 LOAO data



2014.02.11





GW EM counterparts (2021 ~)

& 4-80 EM producing events (e.g, BNS) or sqrt(4 x 80) = 18 (Im's formula) & Mostly ∼150 Mpc events

& EM counterparts will be faint! (R ~ 22)

R-band



Paek, G. et al. in prep

Scientific Motivation

○ 1/3 of S-Sky is left less-explored in optical now

 Deep reference images are necessary for identification of EM counterpart of GW events

Synergy with other wavelength data: NIR, MIR, FIR, X-ray

 high-z quasars, galaxy clusters, transients, stellar
 population, satellite galaxies, solar system objects,

• Images in BVRIz for many science topics for years to come

Expected results

- Serve the world-wide astronomical community by providing deep reference image for 1/3 of S-Sky
- First identification of GW EM counterparts: ~6 events per year
- Discovery of high-z quasars (1?@z=8, 3@z=7, 30@z=6, +more)
- 17,000 galaxy clusters at $z > \sim 1$, matched with X-ray
- Many other exciting science results: Magellanic stream, satellite galaxies, stars in our galaxy, small bodies of solar system



Observation started at Oct. 2019 (SAAO) Main survey will start at Oct. 2020 So far, ~400 deg² (BVRI), ~600 deg²(partially)

DATE(UT) Phase (begin) Note 2019B Last quarter Now Moon 2010P 20190 2020A Eirct auartar First quarte FEB 09 - FEB 18 2020 Full Moon 2020A

• 121 (Orange) → 4 bands and 3 dithering • 276 (Green) → < 4 bands or < 3 dithering





• R-band seeing & depths



Synergy with other surveys

• VISTA Hemisphere Survey

O SkyMapper Survey

• MagLite Survey

O DECam eROSITA Survey

• SPHEREx, eROSITA,

VISTA Hemisphere Survey (VHS – JK + Y)

• J, K ~ 20 AB mag







 W
 CCV
 VELS
 SHARKS
 VISION
 VINOUE

Ks



• 7000 deg2 BVRI imaging of S-Sky

 Transient search ref. image
 Multiple science programs – high-z qso, galaxy clusters, solar system objects, etc



• Team workshop this year

7-dimensional telescope (7DT)

40-50 x 0.36m Wide-field telescopes
Each telescope observes different wavelength

Example: 56 medium-band filters

• Width: 20nm

• Central wavelength displacement: 10nm

○ R ~65 low resolution spectra







BVRI vs griz



Current Status

- ~600 deg2 data have been taken (~22.8 AB mag, 2.5")
 Other wavelength data (VISTA JK, DECam griz) are being downloaded, archived
- Tiling strategy is modified (3pt \rightarrow 4pt dither)

• Cluster, quasar selection can start soon

Data reduction plan

Bias/Flat/Cross-talk/rough reduction: Regular KMTNet pipeline

• Astrometry, cosmic ray removal, photometry calibration: SNU KMTNet pipeline, ready

• Source extraction: Software tools ready

Data release plan (internal)

• Raw images/KMTNet-reduced images: immediately

• Catalogs+reduced images: < 1 month

 Band-matched/enhanced products: < 6 month (or besteffort)

Data release (public)

• Raw/KMTNet-reduced images: 1 year (normal)

• Catalogs/reduced images: 1.5-2 years initially, then 1 year after the data acquisition (data quality issue)

• Band-matched/enhanced products: best-effort