SEARCHING FOR KBO FLYBY TARGETS FOR THE NEW HORIZONS MISSION. M. W. Buie[1], J. R. Spencer[1], A. H. Parker[2], S. A. Stern[1], M. J. Holman[2], D. J. Tholen[3], D. Borncamp[1], D. E. Trilling[4], D. J. Osip[5], P. L. Gay[6], C. Fuentes[4], J. J. Kavelaars[7], J.-M. Petit[8], S. Fabbro[9], S. D. Benecchi[10], S. S. Sheppard[10], F. DeMeo[11], R. P. Binzel[11], L. H. Wasserman[12], A. J. Steffl[1], T. Fuse[13], H. Karoji[14], D. Kinoshita[15], T. Yanagisawa[16] S. Miyazaki[17], H. Furusawa[18], F. Yoshida[18], T. Yamashida[18], A. Tajitsu[18]. [1]Southwest Research Inst. (buie@boulder.swri.edu), [2]Harvard-Smithsonian Center for Astrophys., [3]U. Hawaii, [4]Northern Arizona U., [5]Las Campanas Obs., [6]Southern Illinois U., [7]Hertzberg Inst. Astrophys., [8]U. Franche Comté, [9]U. Victoria, [10]Carnegie Inst. Washington, [11]Massachusetts Inst. Technology, , [12]Lowell Obs., [13]Natl. Inst. Information Communications Tech., Tokyo, [14]U. Tokyo, [15]National Central, U., Taiwan, [16]JAXA, [17]Grad. U. Advanced Studies, Tokyo, [18]Natl. Astron. Obs. Japan.

Introduction: NASA's New Horizons mission [1] will fly by Pluto in July 2015 and will then continue deeper into the Kuiper Belt, providing the possibility of a close encounter with one or more small Kuiper Belt objects. This will be the only opportunity for close-up observations of small KBOs for the foreseeable future. However, potential targets must first be discovered, and we are thus currently engaged in a search for targetable KBOs. Objects numerous enough to be targetable with available delta-V are likely to be in the 50 km size range, with apparent R magnitudes near 26 [2]. The search area lies in the Milky Way, in Sagittarius, so KBOs must be found against a very high density of background stars. Large telescopes with wide-field imagers and excellent seeing are thus required.

The Search: A preliminary search was carried out in 2004 and 2005 with SuprimeCam at the Subaru telescope. The search area was then about 7 deg^2. A deeper search is now under way, starting in 2011, again using Subaru SuprimeCam and also Megacam and IMACS on Magellan and MegaPrime on CFHT: the search area is now only ~2 deg^2.

Data Reduction: Separation of KBOs from the dense star background is challenging. We visit each field multiple times and make difference images, after matching PSFs [3], to remove static background sources. Nevertheless, images are dominated by subtraction artifacts, and the discovery rate is a very strong function of seeing: only with seeing <0.6" does detection efficiency (estimated by implanting artificial KBOs) approach that expected from sky noise alone. Search of background-subtracted images has been done both by the team and using the citizen science "Ice Hunters" web site, with similar results.

Results so Far: We have identified 24 KBOs in the 2004/2005 data, some with arc lengths up to 1 year, and so far about 18 unique KBOs in the 2011 data (Table 1), though analysis of the 2011 data is not yet complete. No KBO yet found is reachable by New Horizons, but the closest one to the NH trajectory would require less than twice the available onboard delta-V to be targeted, so we expect that continued data reduction, and continued searching in 2012, has a good chance of finding the object that will become the first small KBO to receive a visitor from Earth.

References: [1] S. A. Stern (2008) *Space Sci. Rev., 140* 3 -21. [2] J. R. Spencer et al. (2003) *Earth, Moon, Planets, 92,* 483-491. [3] C. Alard, R. H. Lupton (1998). A Method for Optimal Image Subtraction *ApJ 503*, 325.

Table 1: KBOs Found So Far

Internal Name	arc length, days	Distance from Earth	inclination
Subaru 2004/2005			
NI001	1.0	40(2)	4(2)
NI002	61.8	32.1(4)	9.1(7)
NI003	420.0	40.94(3)	3.164(2)
NI004	35.9	39(1)	13(2)
NI005	2.1	45(3)	34(15)
NI006	2.1	38(2)	4(1)
NI007	37.0	42(1)	3.0(3)
NI008	1.0	42(2)	11(4)
NI009	420.0	45.04(3)	3.063(2)
NI010	50.9	37.9(6)	7.1(5)
NI011	36.9	41(3)	4(2)
NI012	1.0	40(2)	4(1)
NI013	51.0	37.3(4)	8.5(5)
NI014	2.1	37(2)	5(2)
NI016	21.7	33(1)	0.96(6)
NI017	420.0	43.3(2)	2.272(5)
NI018	54.9	36.5(7)	6.2(7)
NI019	37.0	37(1)	19(3)
NI020	420.0	43.3(2)	6.64(1)
NI021	1.0	43(2)	3(2)
NI022	2.1	45(3)	13(5)
NI025	1.0	33(2)	0.8(2)
NI030	37.9	36(2)	7(2)
NI034	46.9	45.6(8)	2.5(3)
Subaru 2011 Only			
NI023	33.8	31.8(9)	3.7(4)
NI024	0.2	45(4)	4(10)
NI031	0.3	40(2)	6(5)
NI032	0.3	41(3)	4(5)
NI3016	0.2	41(3)	22(13)
NI3017	0.2	43(3)	7(12)
Magellan 2011 Only			
NI2000	29.1	42.6(4)	1.87(2)
NI2001	33.0	42.2(2)	2.60(6)
NI2003	33.0	46.6(2)	6.7(2)
NI2006	26.0	42.7(6)	3.2(2)
NI2007	30.1	42.6(4)	2.43(4)
NI2008	5.1	34(12)	19(23)
NI2009	5.1	51(4)	5.6(4)
NI2010	0.1	31(18)	25(38)
Subaru+Magellan 2011			
NI015	65.2	36.5(1)	14.5(2)
NI027	62.2	35.2(2)	13.0(3)
NI028	65.2	46.2(3)	3.30(7)
NI033	60.0	27(3)	31(18)

(number in parentheses is the uncertainty in the last digit)