Boletim da Sociedade Astronômica Brasileira, **34**, no. 1, 285-289

Discovery of asteroids by secondary students

Marcos Rincon Voelzke[1] & Amauri Jose da Luz Pereira[2]

[1] Cruzeiro do Sul University - Master's and Doctoral Program in Science and Mathematics Teaching email: mrvoelzke@hotmail.com
[2] Astronomical Observatory and Planetarium of the State College of Paraná e-mail: amaurijlp@yahoo.com.br

Abstract. The work reports the preliminary detection of an asteroid by two high school students, guided by two professors from the Longe Laqtve Space Sciences Team (CEELL), linked to the Astronomical and Planetary Observatory of the Colégio Estadual do Paraná. On March 27, 2022, the object designated by the code P21sTCj, discovered by the students among a wide image bank, made available by the program, was included in the preliminary list of asteroid detections of an international campaign, organized and managed by the International Astronomical Search Collaboration (IASC), which is a science program that provides high-quality astronomical data to volunteers around the world. An image bank, captured along the ecliptic, by the 1.8m Pan-STARSS telescope, located in Haleakalã, belonging to the University of Hawaii, allows participants to make important detections of Main Belt asteroids and occasionally trans-Neptunian objects. Teams formed by at least two participants can register in advance and for free from anywhere in the world where they have a computer with Internet access. The CEELL team, registered at the end of last year, and had a window to receive the project's image banks for a period of one month, between March 22 and April 22, 2022. The definitive confirmation of the discovery will go through the sieve of astronomers linked to the project and, if confirmed, will be part of the list that already has more than 1,900 asteroids discovered by the IASC since October 2006. The involvement of students, the possibility of discovering and naming asteroids and, finally, the awakening of the interest in new vocations for professional astronomy is the greatest educational legacy of this project.

Resumo. O trabalho relata a detecção preliminar de um asteroide por dois alunos do Ensino Médio, orientados por dois professores da Equipe de Ciências Espaciais Longe Laqtve (CEELL), ligada ao Observatório Astronômico e Planetário do Colégio Estadual do Paraná. No dia 27 de março de 2022, o objeto designado pelo código P21sTCj, descoberto pelos alunos dentre um amplo banco de imagens, disponibilizado pelo programa, foi incluso na lista preliminar de detecções de asteroides de uma campanha internacional, organizada e gerenciada pela International Astronomical Search Collaboration (IASC), que é um programa de ciência que fornece dados astronômicos de alta qualidade para voluntários de todo o mundo. Um banco de imagens, captado ao longo da eclíptica, pelo telescópio Pan-STARSS de 1,8m, localizado em Haleakalã, pertencente à Universidade do Havaí, possibilita aos participantes, importantes detecções de asteroides do Cinturão Principal e ocasionalmente objetos transnetunianos. Equipes formadas por no mínimo dois participantes, podem se inscrever previamente e de forma gratuita de qualquer lugar do mundo onde disponham de um computador com acesso à Internet. A equipe CEELL, se cadastrou no final do ano passado, e teve uma janela de recepção do bancos de imagens do projeto no período de um mês, entre 22 de março e 22 de abril de 2022. A confirmação em definitivo da descoberta, passará pelo crivo de astrônomos ligados ao projeto e, se confirmada, fará parte da lista que já conta com mais de 1.900 asteroides descobertos pela IASC desde outubro 2006. O envolvimento dos estudantes, a possibilidade de descobrir e nomear asteroides e finalmente, o despertar do interesse de novas vocações para astronomia profissional é o maior legado educacional desse projeto.

Keywords. teaching of astronomy – image processing – data analisys

1. Introduction

The Astronomical Community carries out research in order to study and understand the nature of the astronomical objects, as well as, protect the humankind from cosmic dangers. One of those dangers, which life on our planet has faced, is collisions with asteroids and comets. These objects date back to the formation of our Solar System, 4.6 billion years ago. One of the largest planetary catastrophes was caused by an asteroid, which fell in the area of Yucatán, Mexico. At that time, 64 million years ago, 95 percent of Earth's biosphere had vanished. Astronomers who study the Minor Bodies in the Solar System organize, manage and participate in various scientific and research programs. One of the most successful programs is the International Astronomical Search Collaboration (IASC, Miller 2016).This scientific program enables cadets, students and pupils from universities and colleges to make real astronomical discoveries and search for and follow up asteroids, that are already known. Over 1,113,500 asteroids had been discovered by the end of 2021. The discoveries were made by professional astronomers, amateur astronomers, cadets, students and pupils from universities and colleges from all over the world (Millen and Velseka 2022).

The large number of images captured by modern mountain telescopes in Hawai and Chile make it possible to make professional astronomical image banks available to the entire community interested in collaborating with current astronomical research. Among these initiatives, a very fruitful one has been the IASC, which since 2006 has offered students and volunteers from all over the world the opportunity to search for asteroids, comets and small bodies in the solar system from the telescopes such as the Pan-STARRS that equipped with the largest digital camera in the world today (1.4 gigapixels) maps 1/6 of the night sky each month, generating an image bank so impressive that it needs the help of volunteers from the around the world to debug their preliminary findings (Chambers et al.2016).

Seeing in this initiative the opportunity to join this world team of volunteers, high school students, linked to the Astronomical Observatory of the State College of Paraná through a Space Team, called Longe Laqtve (which in Latin means up and up) signed up for an IASC image observation campaign, with observation window in March 2022.

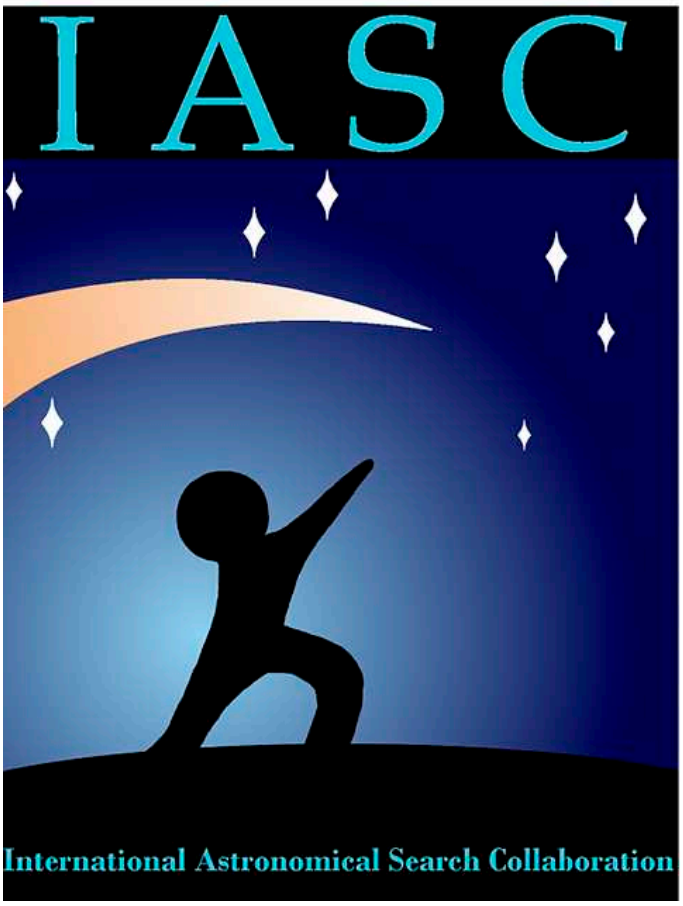

Figure 1. IASC logo designed by Matthew Davis

On March 27, 2022, the object designated by the code P21sTCj, by the students among a wide image bank was discovered, made available by the program, was included in the preliminary list of asteroid detections.

The International Astronomical Search Collaboration was founded in October 2006 at Hardin-Simmons University(HSU) in Abilene, TX (Miller et al. 2008). Since then, Program Director has been the Professor of Mathematics and Astronomy – Dr. Patrick Miller, who also teaches introductory astronomy and astronomical research methods at HSU. This is iniciative is a citizen science program that provides high-quality astronomical data to citizen scientists around the world. These citizen scientists are able to make original astronomical discoveries and participate in hands-on astronomy. This service is provided at no cost. Asteroid Search Campaigns are the primary focus of IASC. A "campaign" is a month-long event in which teams search for asteroids. This gives them the opportunity to make real astronomical discoveries of new objects – asteroids, to contribute to specifying of the orbital elements of the observed objects – asteroids, comets and trans-Neptunian objects (Miller 2017).

In order to enjoy the best nights for imaging, the observation campaign "months" are chosen to start in a 1st quarter and end in a 3rd quarter.

It is worth noting that IASC is not, despite its appearances, an asteroid discovery program. It is an online educational program made available to teachers. The IASC focuses on ensuring that the service works when they need it and that it is easy to integrate into their classrooms. To a large extent, even teachers organized by one of the numerous organizations IASC works with. Fig.1 shows the IASC logo

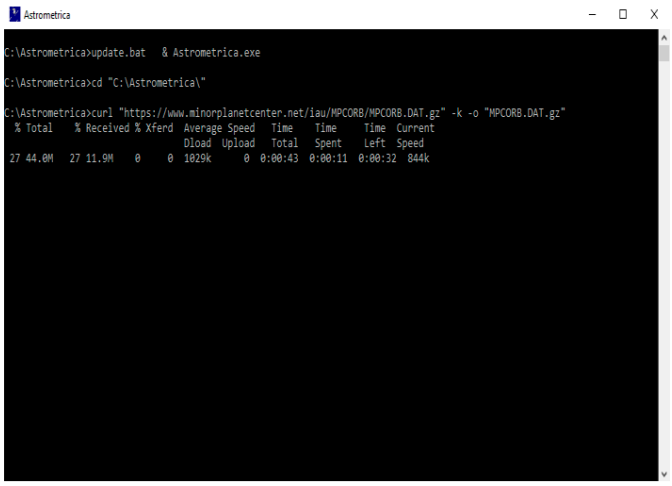

Figure 2. Minor Planet Center (MPC) Database Update Window

2. Methodology

There are two major observatories currently within the IASC collaboration:

a) The Pan-STARRS telescopes belongs to Institute for Astronomy University of Hawai, Honolulu, HI Pan-STARRS has the 1.8-m PS1 and b) PS2 telescopes located on Haleakala, Maui. Attached to Pan-STARRS is the world's largest CCD camera that covers 7,2° fields, each containing 1.4 Gpx (Chambers et al. 2016).

In a campaign with 100 schools, IASC receives 12 images from PS1 that are partitioned into 2,496 sub-images (208 per image) and distributed to the schools. Each school receives 24-25 sub-images to analyze using Astrometica (Miler 2017).

The work of the teams, which take part in the IASC program is organized and divided into observational campaigns with varying durations from 20 to 45 days each. The participants receive astronomical images in an Internet space, which is different for each team. The sets of images contain a minimum of three images, most commonly four, captured in sufficiently short time intervals by large telescopes, equipped with CCD. For the fulfillment of the scientific tasks of the IASC program, are used the large telescopes of the international astronomical programs Catalina, Pan-STARRS and Faulkes Telescopes. The program is supported by National Aeronatics and Space Administration (NASA). Among the IASC program partners is Rozhen National Astronomical Observatory (Miller 2016).

During the campaign, the Astrometrica software will be used, which can be accessed for free and even provide a manual from its official website, but only the participants of this campaign will be given a user name and password with which they will receive previously after the preparation process. To develop this experience, it is necessary to download the set of instructions provided by the campaign. The following steps must be followed:

Step 1: As seen in the Fig. 2 unzip the archive of satellite images and place them in a folder (previously created) with the same name as the downloaded file, then open the Astrometric software and wait a few minutes until it is finished initializing (two windows will open, which must remain open throughout the process of analyzing the images).

Step 2: As seen in the Fig. 3, it is verified that the telescope PS2 seleted in the software is the same as the one used to capture the images.

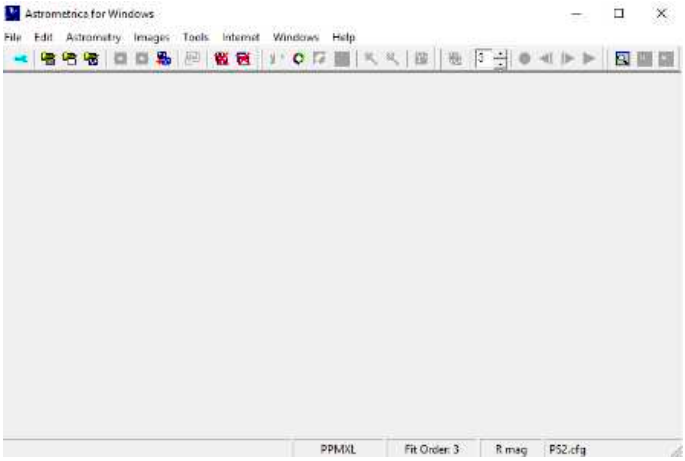

Figure 3. Window of the Software Astrometrica,Pan-STARRS

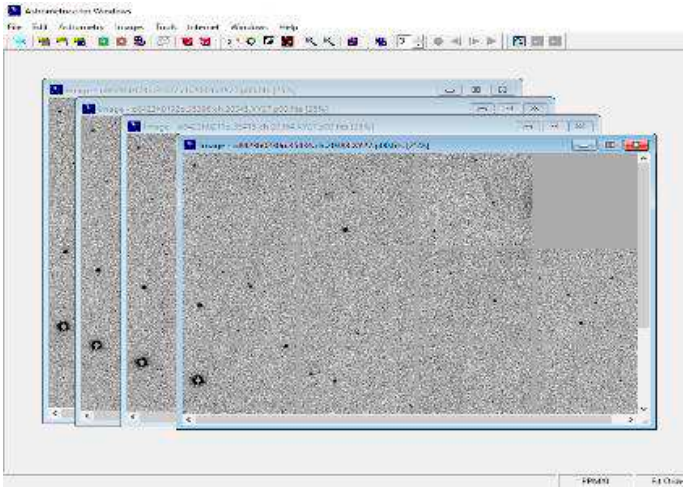

Figure 4. Astrometric Software Window, Pan-STARRS Telescope Images

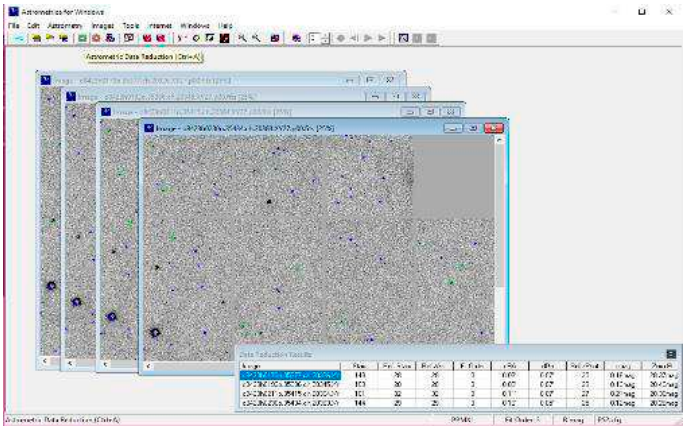

Figure 5. Window of the Astrometrica Software, Stars Present in the Images of the Pan-STARRS Telescope

Step 3: As seen in the Fig. 4, one proceed to load the Pan-STARRS telescopic images (all images in the folder must be selected).

Step 4: As seen in Fig. 5, one proceed to load the Pan-STARRS telescopic images (all images in the folder must be selected).Select in the menu bar the icon "Astrometric Data Reduction" to highlight the stars present in the images.

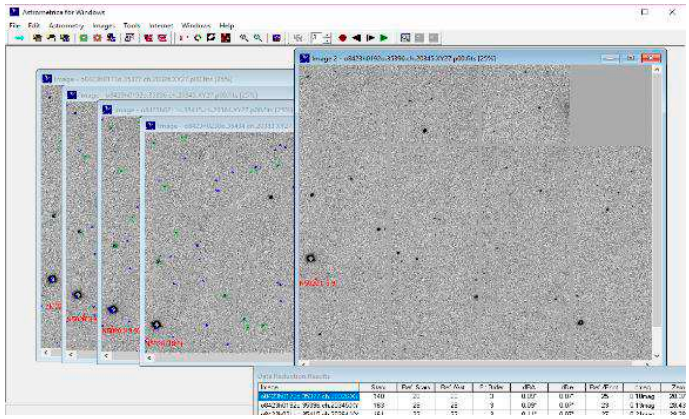

Figure 6. Moving Objects in the Pan-STARRS Telescope Images

Step 5: As seen in Fig. 6, select in the menu bar the icon "Known Object Overlay" to highlight the objects that have movements in the image. Then select the "Blink current images" icon so that the software can create a small gif by placing the images in succession and thus identify the moving objects present in the set of images.

Step 6: In the new window a kind of "gif" is shown where we will proceed to look for objects that present movement. In the case of locating a moving object, we should pause the "blinked" and place the pointer as close as possible to the center of the object. After this, a new window will open with the characteristics of the selected object. As seen in Fig. 7, one must take into account the following considerations to recognize the right asteroid:

- The white dots displayed in the verification window should be distributed very close to the red line.
- The signal to noise ratio (SNR) must be greater than 5.
- The declination and right ascension of the object should be very close to 0.00.
-The selected object must maintain a straight line movement.

It is clear to take into account these parameters because many times it can be confused with hot pixels, background fluctuations with asteroids. Not all things that seem to move in the images will be asteroids.

Step 7: As seen in Fig. 8, once the analysis of the set of images is finished, a report of the discoveries must be made. This report is quite simple because the software to do this automatically. The only thing that we must do is to copy the MPC report in a notepad (it must take as name the set of analyzed images) that later we will send to an e-mail to Dr. Patrick Miller, who will be in charge of confirming or discarding a newly discovered asteroid.

When a student finds a moving object and it's not in the official database maintained by the Minor Planet Center (MPC), the race is on! Students have Astrometrica prepare a written report of the discovery and related observations. They next e-mail that report to IASC. It's evaluated by the IASC Data Reduction Team (IDaRT) and forwarded to the MPC, which is chartered by the International Astronomical Union (IAU) to maintain the world's official asteroid database. Confirmation images are taken and more measurements are made.

Before recognizing a discovery, the MPC requires that follow-up observations be made within 7 to 10 days of the initial sighting. IASC obtains second images from collaborators located around the globe.

The numbered objects are cataloged by the International Astronomical Union (IAU). Names have been proposed to the

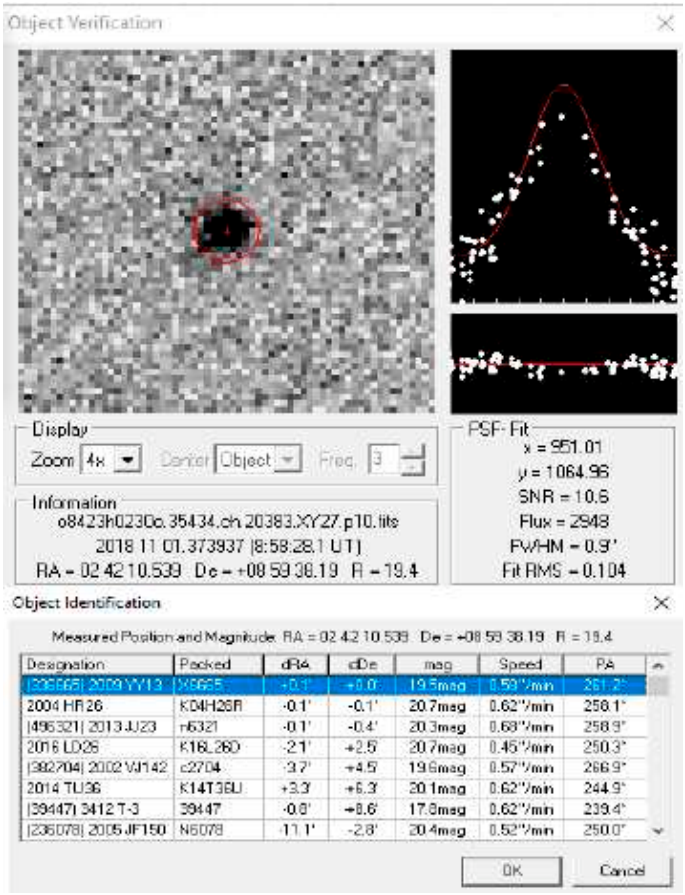

Figure 7. Astrometric Parameters

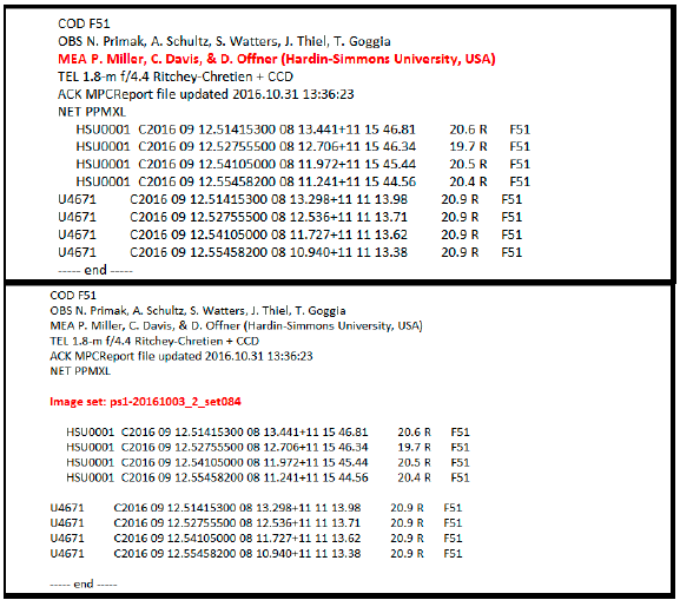

Figure 8. MPC Report Model

IAU by theirstudent discoverers. The process to move from aprovisional designation to a numbered or named designation takes on the order of 6 to 10 years (to capture the majority of the orbit), so this is not a direct or swift process.

IASC works with 15 organizations around the world which organize schools and teachers who participate in the campaigns. The year is divided into 7 search campaigns timed with the 3rd quarter moon. Each search campaign is made up of multiple entities, the majority of them are regional (e.g. India or Iran), although some can be international in focus as well as a special 'Asteroid Day' campaign. From 3rd to 1st quarter (through the new Moon) IASC receives images from professional observatories. These are partitioned and distributed to 100 schools in each campaign,with each school receiving its own unique set. The online distribution site is found at http://iasc.hsutx.edu. The schools have 30 day suntil the next 3rd quarter to analyze the images. objects include comets

3. Results

Below in Fig. 9 is the list of preliminary findings from the IASC's March 2022 campaign. It is possible to verify in 11th line the codename chosen by the team "Infinity CEELL CEP" and the abbreviation of the first two names that are of the students and the last two that are of the guiding professors

A curiosity that may lead the reader to question from Fig. 9 is that the campaign started on March 29 and the inclusion of the preliminary observation of the asteroid dates from March 27. This happened because the images analyzed, in which the registration was made, are prior to the start date of the campaign.

There is a heavy reliance on teachers to integrate the program into their classroom. Different teachers do it different ways. Some teachers, first thing in the morning, for a class of 30 students go through all of the images with their class. Other teachers will wait until labtime and get smaller groups of students look at it. Typically, classes start off very enthusiastic searching for asteroids and the first few days of a campaign many reports from students will bereceived. By the end of the campaign the classwould be narrowed down to 2 or 3 students who have a particular interest still participating (Zieliniski and Miller 2014).This fact was also verified in our team during the March 2022 campaign.

This opportunity to make discoveries and contribute to the goals of protecting Earth from asteroid collisions and exploring new and/or potentially dangerous asteroids is a unique experience, which can be voluntarily accessed and serves to a waken interest in professional astronomy in young students

Acknowledgements. Our sincere thanks to Dr Patrick Miller and Dr Rchard Wainscoat for creating and making available the IASC and PAN-STARRS as a global citizen astronomy project and to Prof Dr Marcos Rincon Voelzke for guiding the presentation of this work to the Brazilian Astronomical Society as well as CAPES for the Doctoral scholarship that enables the execution of works like these with Brazilian students

References

Chambers, K. C. et al., 2016. The Pan-STARRS1 Surveys
Millen S. R. Veselka, 2022, Detecting and Tracking Asteroids in The International Astronomical Search Collaboration Science Program, Aeronautical Research and Development, v. 1, p. 58-69
Miller, J. P. et al., 2008, An International Asteroid Search Campaign,"Astronomy Education Review, v. 7, n. 1, p. 57-83
Miller, J. P., 2016, International Astronomical Search Collaboration, Space News, v. 1, n.60, p. 16-17
Miller, J. P., 2017, International Astronomical Search Collaboration: An Online Outreach Program in Astronomical Discovery for High School and College Students, Robotic Telescopes, Student Research and Education Conference, San Diego, California, June, p. 18-21
Zieliniski, L.F., Miller, J.P., 2014, "From Space to School," Sky and Telescope, June, v. 1, p. 53-57

International Asteroid Search Campaign

March 29 - April 22, 2022

Provisional	#	Object	Students	School	Location	Status	Date	Linked
Total 94		P21sOCx	D. Li, T. Kessler	Chiany	China/Germany	Preliminary	03/25/22	KLI0001
		P21sODv	S.Seyedhatami, S.Vahedi, M.Zarei, V.B.Shahab	Afaghrahbar Azarbaijan	Iran	Preliminary	03/25/22	ARA1212
		P21sOEB	S.Seyedhatami, S.Vahedi, M.Zarei, V.B.Shahab	Afaghrahbar Azarbaijan	Iran	Preliminary	03/25/22	ARA3698
		P21sOEu	S.Seyedhatami, S.Vahedi, M.Zarei, V.B.Shahab	Afaghrahbar Azarbaijan	Iran	Preliminary	03/25/22	ARA8598
		P21sOEl	M. Nezamdoost, B. Nezamdoost	AstroTrack	Iran	Preliminary	03/25/22	NBK0005
		P21sOD2	H. Liu	Asteroid Seeker	Taiwan	Preliminary	03/25/22	ASS1001
		P21sOEA	s. harris, N. Cho, S. Harris	Falcon	USA	Preliminary	03/25/22	FAL0228
		P21sOEw	s. harris, N. Cho, S. Harris	Falcon	USA	Preliminary	03/25/22	FAL0230
		P21sOEz	s. harris, N. Cho, S. Harris	Falcon	USA	Preliminary	03/25/22	FAL0229
		P21sTE8	C. Willemoës, A. Machado	Buscadores de Asteroides de Ringuelet	Argentina	Preliminary	03/27/22	WM0002
		P21sTCj	G. Andreola, E. Ramos, A. Pereira, P. Lagos	Infinity - CEELL CEP	Brazil	Preliminary	03/27/22	CEP0001
		P21sTCU	R. Prá	Skywalker	Brazil	Preliminary	03/27/22	RDP0002
		P21sTEi	J.Bhagawati	Andromeda	India	Preliminary	03/27/22	RJT0011
		P21sTDF	M.Naderifard, N.Ghasemi, S.H.Aledavod, B.Salehi	Afaghrahbar Azarbaijan 2	Iran	Preliminary	03/27/22	ARA1121
		P21sTDG	M.Naderifard, N.Ghasemi, S.H.Aledavod, B.Salehi	Afaghrahbar Azarbaijan 2	Iran	Preliminary	03/27/22	ARA1241
		P21sTDH	M.Naderifard, N.Ghasemi, S.H.Aledavod, B.Salehi	Afaghrahbar Azarbaijan 2	Iran	Preliminary	03/27/22	ARA1255
		P21sTcd	S. Boozarpour, B. Soufinejad	Saba School Team 2	Iran	Preliminary	03/27/22	SSA9021
		P21sTCD	D. Saghir, F. Batool, N. Rauf, R. Ayub	IST - Beta	Pakistan	Preliminary	03/27/22	IST2141
		P21sTEg	O. Tercu, G. Neagu, D. Manole	Calin Popovici" Astroclub - Gala?i"	Romania	Preliminary	03/27/22	TNM002
		P21sTCt	R. Kumaragamage	Team Titan	Sri Lanka	Preliminary	03/27/22	TTN0034
		P21sTob	L. Lo	Asteroid Seeker	Taiwan	Preliminary	03/27/22	ASS0002
		P21sTE2	L. Lo, H. Liu	Asteroid Seeker	Taiwan	Preliminary	03/27/22	ASS1002
		P21sTF0	B. Karagöz, A. Ileri, Y. Paksoy, E. Genç, I. Akkus, N. Çetinkaya, M. Yildiko	KCT-Orion	Turkey	Preliminary	03/27/22	ALP1006
		P21sTCn	s. harris, N. Cho, S. Harris	Falcon	USA	Preliminary	03/27/22	FAL0231
		P21t53D	N. Abdulredah, A. Al_Shehab, M.Alqassab	Bahrain Stargazers	Bahrain	Preliminary	04/02/22	MNH0020
		P21t5Jn	F. Santos, P. Santos, V. Nunes	Chorumela	Brazil	Preliminary	04/02/22	CHO0019
		P21t5Jq	F. Santos, P. Santos, V. Nunes	Chorumela	Brazil	Preliminary	04/02/22	CHO0017
		P21t5Jl	C. Araujo, L. Silva, M. Santos, L. Santos, J. Morais	Guardiões da Galáxia - CPM Ilhéus BA	Brazil	Preliminary	04/02/22	LJML002
		P21t54v	D. Das, S. Kundu, Y. Das	Astronomy Lovers of Udayan Pally	India	Preliminary	04/02/22	DSY0030
		P21t55N	D. Das, S. Kundu, Y. Das	Astronomy Lovers of Udayan Pally	India	Preliminary	04/02/22	DSY0031
		P21t54q	S. Shubham, S. Soarbh	Beyond The Universe	India	Preliminary	04/02/22	BTU0002
		P21t55L	S. Shubham, S. Soarbh	Beyond The Universe	India	Preliminary	04/02/22	BTU0003
		P21t5GK	T. Sharma, Y. Joshi, C. Khatri, M. Banerjee, G. Patti	Discoverers	India	Preliminary	04/02/22	DSC0040
		P21t54J	M.Naderifard, N.Ghasemi, S.H.Aledavod, B.Salehi	Afaghrahbar Azarbaijan 2	Iran	Preliminary	04/02/22	ARA2137
		P21t53E	J. Kotarzewski, B. Kwiatek	KK Collaboration	Poland	Preliminary	04/02/22	KKC0021
		P21t55E	F. Polewaczyk	Sky Hunters	Poland	Preliminary	04/02/22	SKH0402
		P21t53A	R. Anghel, A. Anghel, D. Anghel	PS Observatory	Romania	Preliminary	04/02/22	PSO0003
		P21t5Jo	A. Rakcheev	KosmoKing	Russia	Preliminary	04/02/22	KVK0013
		P21t55a	L. Lo, H. Liu	Asteroid Seeker	Taiwan	Preliminary	04/02/22	ASS1004
		P21t55H	L. Lo, H. Liu	Asteroid Seeker	Taiwan	Preliminary	04/02/22	ASS1003
		P21t53I	U. Gercek, A. Sak	Asteroit Kasifi	Turkey	Preliminary	04/02/22	AKI0006
		P21t55s	A. Stelzer, J. Bray-Ali, C. Valencia	Mt. San Antonio College	USA	Preliminary	04/02/22	MSC0102
		P21t55u	D. Crowson, J. Philpot	Space Rock Hounds	USA	Preliminary	04/02/22	SRH0730
		P21tgSd	C. Willemoës, A. Machado	Buscadores de Asteroides de Ringuelet	Argentina	Preliminary	04/07/22	WM0014
		P21tgez	F. Santos, P. Santos, V. Nunes	Chorumela	Brazil	Preliminary	04/07/22	CHO0021
		P21tgSa	D. Santos, M. Ribeiro, M. Oliveira, A. Barreto, Í. Silva	Equipe Asteroid Miner CPM Ilhéus - BA	Brazil	Preliminary	04/07/22	DAS0002
		P21tgSb	D. Santos, M. Ribeiro, M. Oliveira, A. Barreto, Í. Silva	Equipe Asteroid Miner CPM Ilhéus - BA	Brazil	Preliminary	04/07/22	DAS0003
		P21tgSk	D. Santos	Equipe Blue Tech CPM Ilhéus - BA	Brazil	Preliminary	04/07/22	DAS0001
		P21tgdA	A. Binow	Lolivlet	Brazil	Preliminary	04/07/22	AGB0001
		P21tgdE	A. Binow	Lolivlet	Brazil	Preliminary	04/07/22	AGB0001
		P21tgeP	G. Nobre	OARIU-2022b	Brazil	Preliminary	04/07/22	GHN0067
		P21tget	G. Nobre	OARIU-2022b	Brazil	Preliminary	04/07/22	GHN0066
		P21tgeK	R. Prá	Skywalker	Brazil	Preliminary	04/07/22	RDP0006
		P21tgeM	R. Prá	Skywalker	Brazil	Preliminary	04/07/22	RDP0007
		P21tgdo	A. Atanasov, S. Boteva, V. Radeva, D. Dimitrov	Student Space Society - Naval Academy	Bulgaria	Preliminary	04/07/22	RBAD001
		P21tgcW	D. Li, T. Kessler	Chiany	China/Germany	Preliminary	04/07/22	KLI0009
		P21tgfA	E. Sit	Asteroid Searcher	Hong Kong	Preliminary	04/07/22	EXO0414
		P21tgSc	E. Sit	Asteroid Searcher	Hong Kong	Preliminary	04/07/22	EXO0415
		P21tgeF	A. Zreke, F. Mhajna, A. Mhajna, A. Mhajna, A. Laham, E. jbareen, M. Mhameed, Khadege, H. Ganem	AstroFinders - Umm al-Fahm 3	Israel	Preliminary	04/07/22	AFU7200
		P21tgSB	S. Thepdawala, A. Mahmood, K. Batool, H. Ahmad	IST - Alpha	Pakistan	Preliminary	04/07/22	IST1241
		P21tgSu	S. Abid, U. Ilyas, F. Basil, U. Ahmed	IST - Charlie	Pakistan	Preliminary	04/07/22	CHR2231
		P21tgdw	S. Abayan, P. Germio, Z. Oliveros	NEU - Terra	Philippines	Preliminary	04/07/22	NEU0001
		P21tgSy	F. Polewaczyk	Sky Hunters	Poland	Preliminary	04/07/22	SKH0405
		P21tgfJ	R. Anghel, A. Anghel, D. Anghel	PS Observatory	Romania	Preliminary	04/07/22	PSO0006
		P21tgdH	L. Lo, H. Liu	Asteroid Seeker	Taiwan	Preliminary	04/07/22	ASS1006
		P21tge8	S. Koçer, E. Koçer, M. Koçer, A. Gorgel	Kusadasi	Turkey	Preliminary	04/07/22	SEM6589
		P21tgcK	Y. Kilic, H.A.Kagihan, M. Altun, S.M.Colak	My Acapella	Turkey	Preliminary	04/07/22	MYA0003
		P21tgd6	Y. Kilic, H.A.Kagihan, M. Altun, S.M.Colak	My Acapella	Turkey	Preliminary	04/07/22	MYA0006
		P21tgd2	M. Hotka, V. Grossi, B. Young	Route 66 Rocks	USA	Preliminary	04/07/22	MAH1006
		P21tgd8	M. Hotka, V. Grossi, B. Young	Route 66 Rocks	USA	Preliminary	04/07/22	MAH1007
		P21tmwb	A. Shehadeh, N. Abdulredah, A. Al_Shehab, M.Alqassab, A.Moh, F.Alhashimi	Bahrain Stargazers	Bahrain	Preliminary	04/09/22	MMJ5000
		P21tmA5	C. Rozario	AstroPhorias	Bangladesh	Preliminary	04/09/22	CHR5678
		P21tmx6	C. Rozario	AstroPhorias	Bangladesh	Preliminary	04/09/22	MAG3003
		P21tmx4	G. Santos	Calisto 15	Brazil	Preliminary	04/09/22	QQQ3333
		P21tmv9	E. Hendges	Colégio Vicentino São José	Brazil	Preliminary	04/09/22	CVS0789
		P21tmA4	D. Santos	Equipe Tropa de Elite CPM Ilhéus - BA	Brazil	Preliminary	04/09/22	DAS0001
		P21tmvc	G. Nobre	OARIU-2022b	Brazil	Preliminary	04/09/22	GHN0068
		P21tmve	G. Nobre	OARIU-2022b	Brazil	Preliminary	04/09/22	GHN0069
		P21tmvg	G. Dumont, N. Dumont	Observatório de Astronomia de Patos de Minas	Brazil	Preliminary	04/09/22	GMD0001
		P21tlJu	D. Li, T. Kessler	Chiany	China/Germany	Preliminary	04/09/22	KLI0011
		P21tlLM	M. Nezamdoost, B. Nezamdoost	AstroTrack	Iran	Preliminary	04/09/22	NBK0012
		P21tlFq	I. Alejo, R. Reventar, M. Lopez	NEU - Astra	Philippines	Preliminary	04/09/22	NEU0001
		P21tmuV	S. Bado, E. Leon, J. Candillas, L. Adducol	NEU - Unknown Discovery	Philippines	Preliminary	04/09/22	NEU0005
		P21tmsM	R. Anghel, A. Anghel, D. Anghel	PS Observatory	Romania	Preliminary	04/09/22	PSO0008
		P21tlFm	A. Rakcheev	KosmoKing	Russia	Preliminary	04/09/22	KVK0016
		P21tmtO	U. Gercek, A. Sak	Asteroit Kasifi	Turkey	Preliminary	04/09/22	AKI0009
		P21tlJ2	K. Laçin, E. Kerpiçdöken, K. Okyay, M. Gür, B. Kurtuldu, A. Turan	KCT-Andromeda	Turkey	Preliminary	04/09/22	KAR1001
		P21tlMb	K. Laçin, E. Kerpiçdöken, K. Okyay, M. Gür, B. Kurtuldu, A. Turan	KCT-Andromeda	Turkey	Preliminary	04/09/22	KAR1004
		P21tlKG	B. Karagöz, A. Ileri, Y. Paksoy, E. Genç, I. Akkus, N. Çetinkaya, M. Yildiko	KCT-Orion	Turkey	Preliminary	04/09/22	ALP1003
		P21tlM4	M. Hotka, V. Grossi, B. Young	Route 66 Rocks	USA	Preliminary	04/09/22	MAH1010
		P21tlJq	D. Crowson, J. Philpot	Space Rock Hounds	USA	Preliminary	04/09/22	SRH0738
		P21tmtQ	D. Crowson, J. Philpot	Space Rock Hounds	USA	Preliminary	04/09/22	SRH0737
		P21tmuc	D. Crowson, J. Philpot	Space Rock Hounds	USA	Preliminary	04/09/22	SRH0735
		P21tmue	D. Crowson, J. Philpot	Space Rock Hounds	USA	Preliminary	04/09/22	SRH0734

Figure 9. IASC International Preliminaries March/April 2022