Asteroids monitoring with 1.2m Baldone Schmidt (code 069) telescope

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60th anniversary of the Baldone Astrophysical observatory

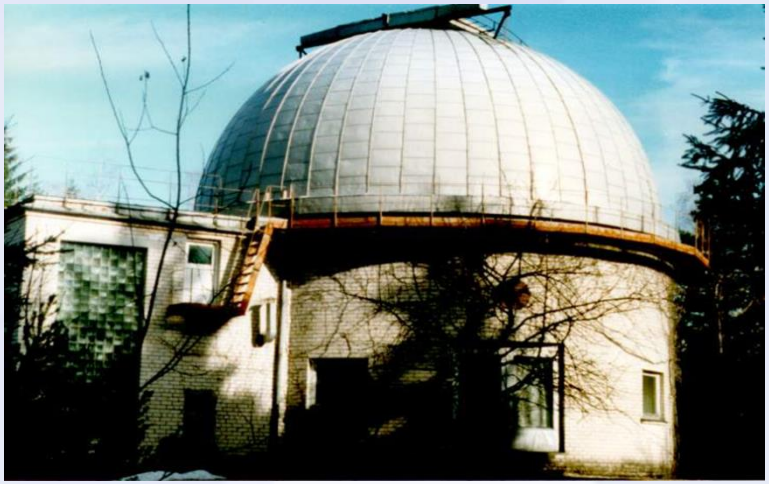
Jānis Ikaunieks (1912-1969)

Doctor of Physics, founder of Baldone Astrophysical observatory and its first director (1958-1969). All his life devoted to creating the modern astronomical observatory in Latvia. He is founder of radioastronomical investigations in Latvia.

1957 – in the next area of the Observatory 5km from Baldone near Nut Hill was built the first laboratory building, known as the "White House".

From history

In the autumn of 1965, the construction of the Schmidt Telescope Pavilion was completed



From 1972 until 1992, solar radiation was detected at 755, 610 and 326 megahertz frequencies with the RT-10 ten-meter radio telescope

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Baldone Schmidt telescope of Astrophysical observatory

"Carl Zeiss Jena" manufactured Schmidt system telescope operates in Baldone Astrophysical observatory from December 1966.
Baldone Schmidt is the twelfth largest telescope of this type in the world with 120cm spherical main mirror, 80cm entrance aperture and 240cm focal length. The field of view is 5 degrees .
Telescope installed with four degree objective prism.
2004/05 – in Jena (Germany) was coated main mirror of Schmidt telescope and installed of small CCD 3.6 megapixel camera.

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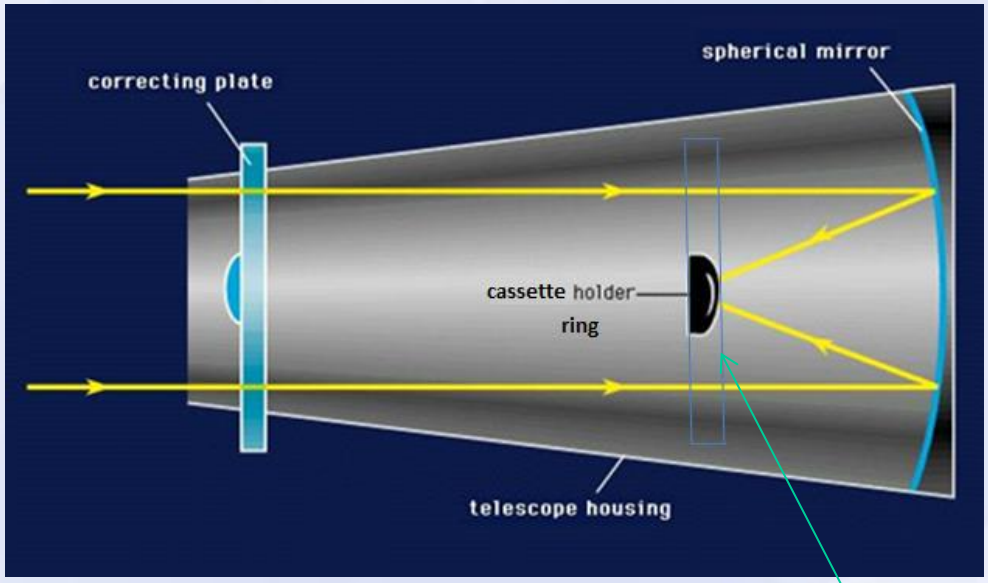
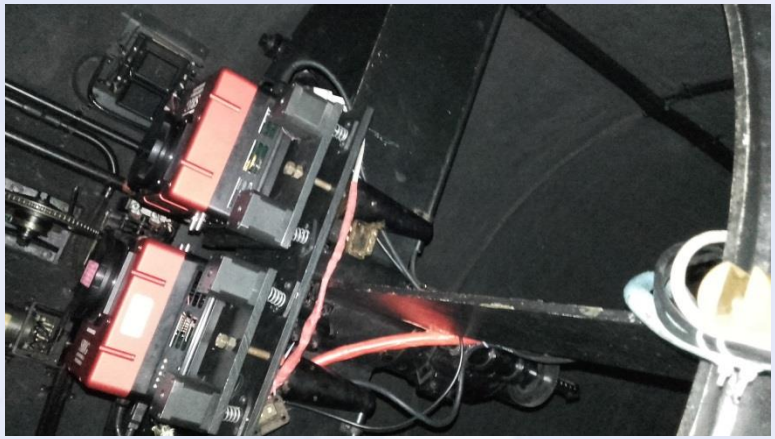
Schmidt-type telescope problem successful solution



CCD’s



In 2016 telescope optical system was upgraded. Telescope observation efficiency increased 25 times. In previous years (2008 - 2016), 48 new asteroids were discovered.
In August-September 2017, 21 new asteroids were discovered.

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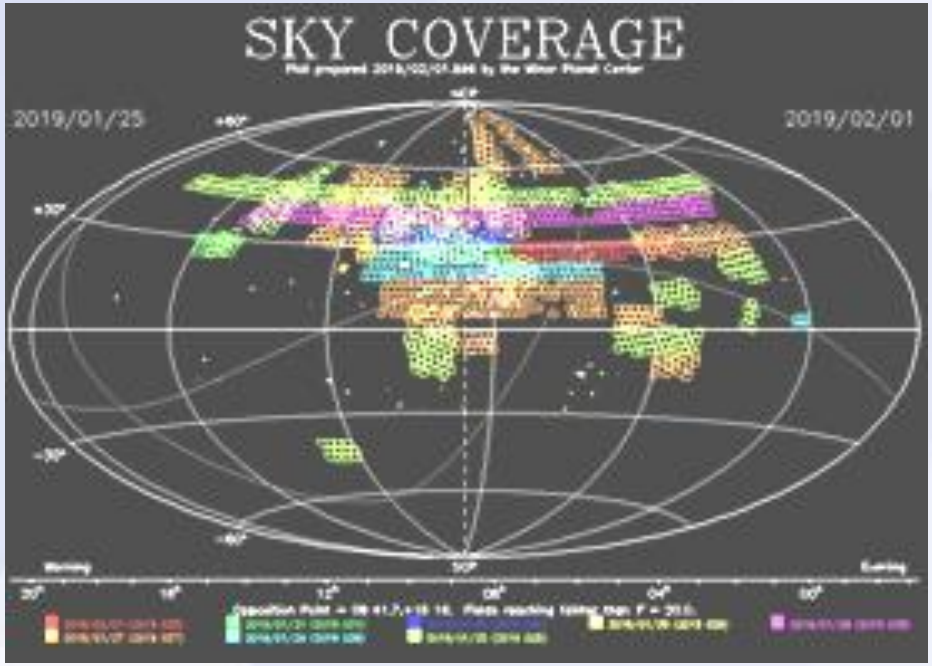
Current data.
Now Baldone Schmidt telescope is installed with two CCD STX-16803 cameras, each one square degree. Obtained CCD's images are processed using softwars Astrometrica and SkySift.
The orbits and the evolution of orbital elements of two interesting asteroids, Nr428694=2008 OS9 from the Apollo group and the Centaur Nr330836=Orius=2009 HW77, were calculated with OpenOrb 4.2 program.
For 36 of newfounded asteroids the precise orbits were calculated, too.
For 10 new asteroids their orbital elements are of low accuracy, thus they need additional astrometric observations.



Studies of Solar system small bodies, current data

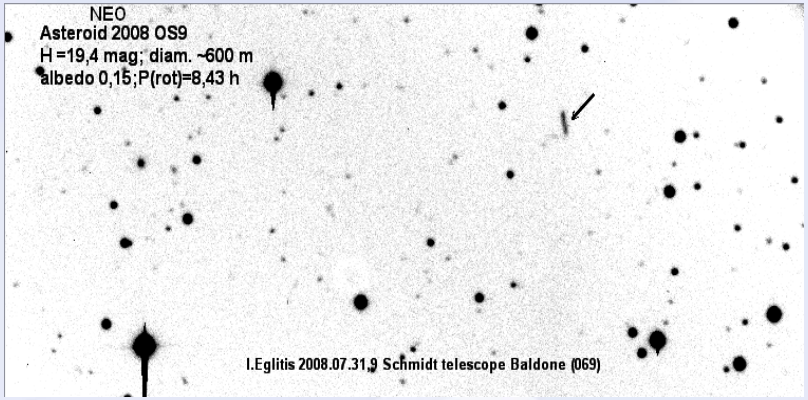
◊ 77 new asteroids are discovered;

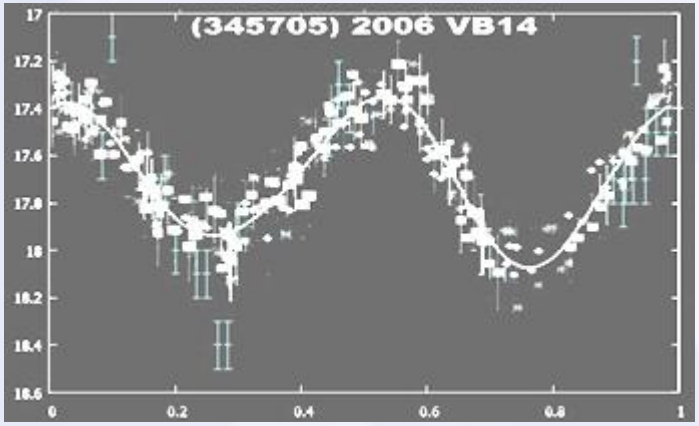
◊ Published in the Minor Planet Center Circular 6452 possition measurements of 1632 asteroids;

◊ Granted names for 10 asteroids.

◊ 84 papers (54 in the last six years) in issues: *Monthly Notices of the Royal Astronomical Society, Open (Baltic) Astronomy*, *Minor Planet Center Circular*

◊ Membership in HORIZON H2020 consortium project "EUROPLANET» (Europlanet 2020 Research Infrastructure for the Future

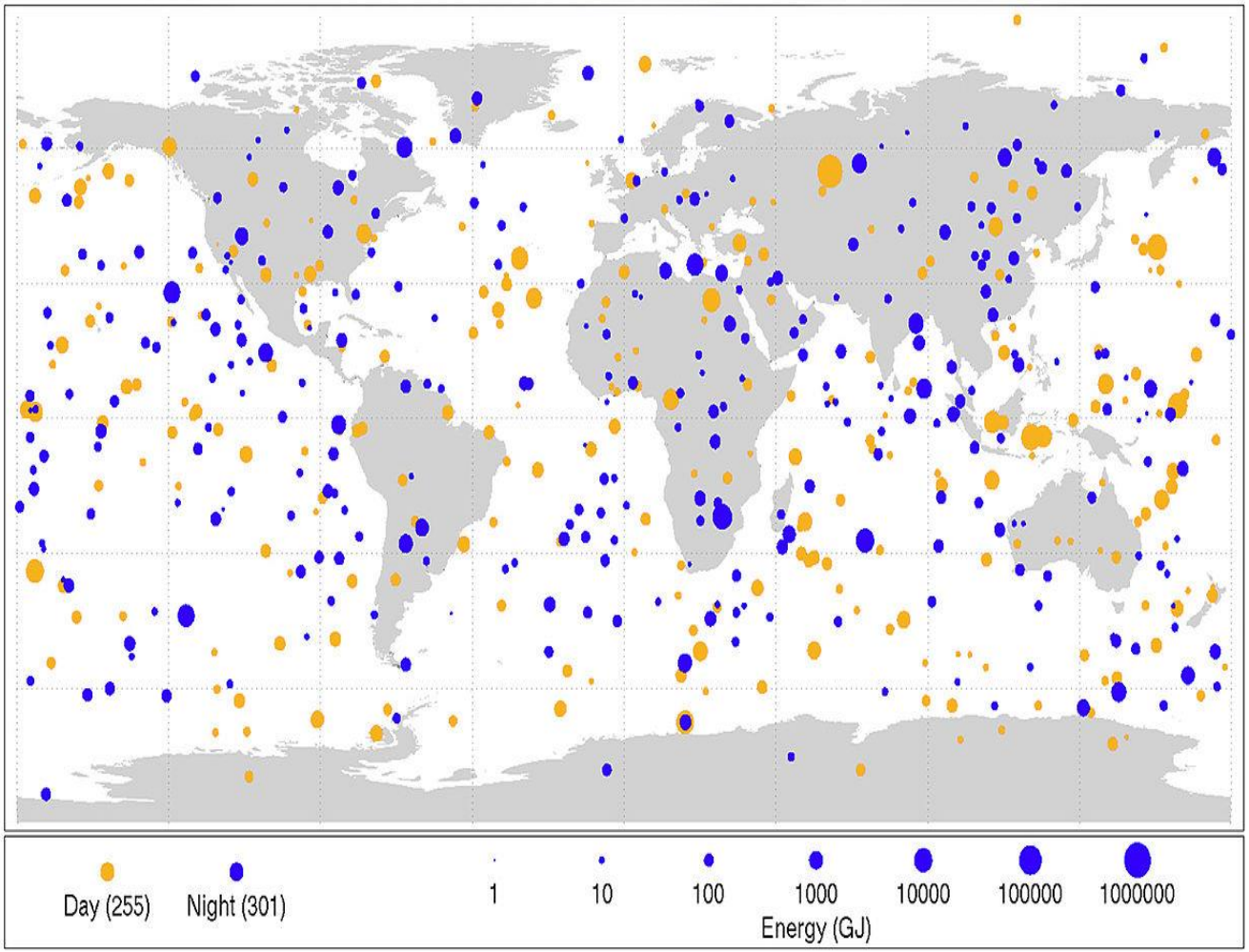




Example of newfound NEO-type asteroid trek on the CCD image discovered with Baldone Schmidt telescope

Bolide events 1994-2013

(Small asteroids that disintegrated in the Earth's atmosphere)



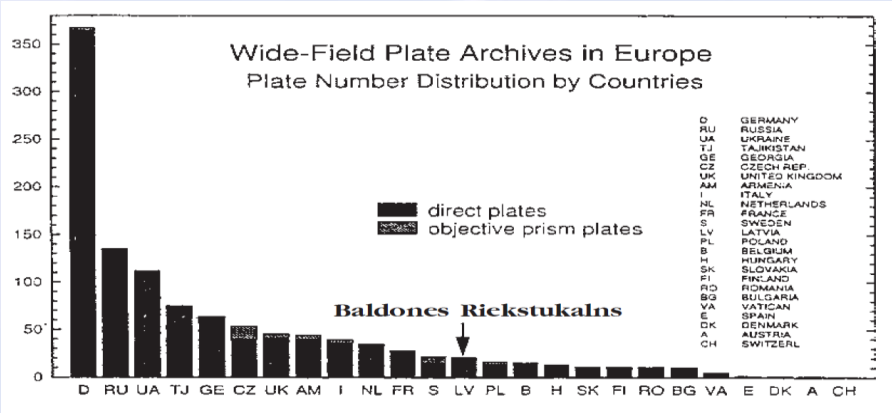
IAU data Near-Earth Objects dicovered 02.02.2019

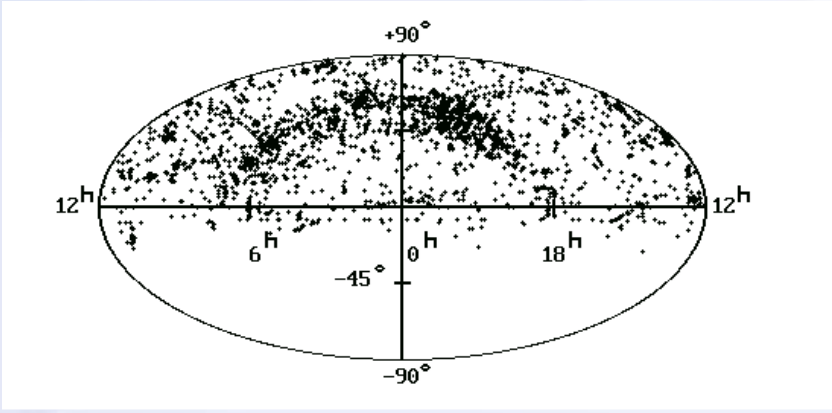
NEO's	19 584
1+ KM NEO's	896
Potentially Hazardous Asteroids	1 968
Near-Earth Comets	107

From total PHA 66 000
29.7%

Digitization of archive of Baldone Schmidt system telescope 1967-2005

Archive contain 22 000 direct and 2 300 spectral plates





Direct observations

U	ZU21 + UG1	ORWO
B	ZU21 + GG13	ORWO
V	A600 + ZS17	KAZNIIFOTOPROJEKTK
R	ZP1 + RG1	ORWO
I	IN + KS19	KODAK

◊ Using A3 format Epson Expression 3,2 D scanners for scanning and seven core PC for processing of scans;

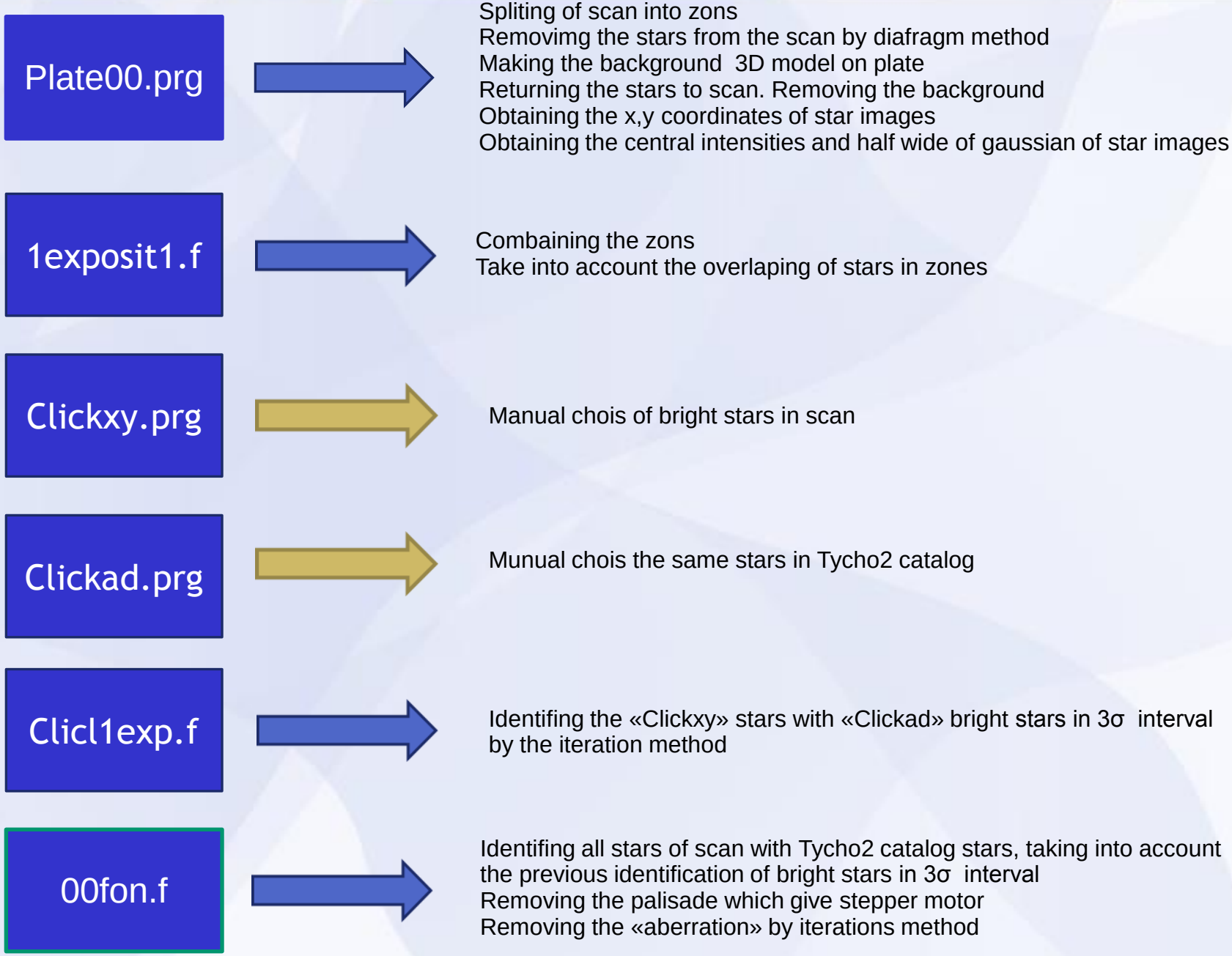
◊ On this time digitized whole 22000 direct plates;

◊ Copy of scans are displacing on the server ftp.schmidt.lu.lv;

◊ Processed Pluto and asteroids positions with an accuracy of O - C = ± 0.5 arc sec.

◊ Processed the ultraviolet (U) plates in 314 fields and visual (V) plates in 700 fields of North sky.

LINUXMIDAS/ROMAFOT 64 bit



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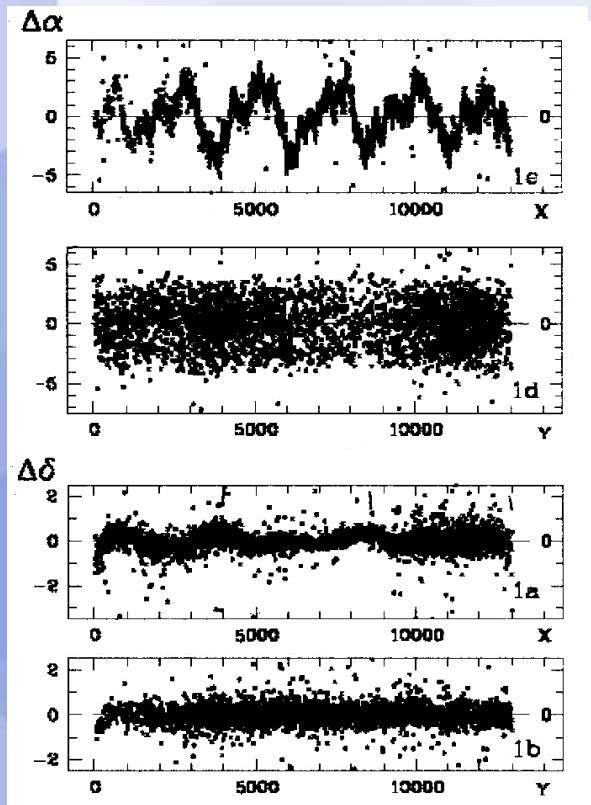
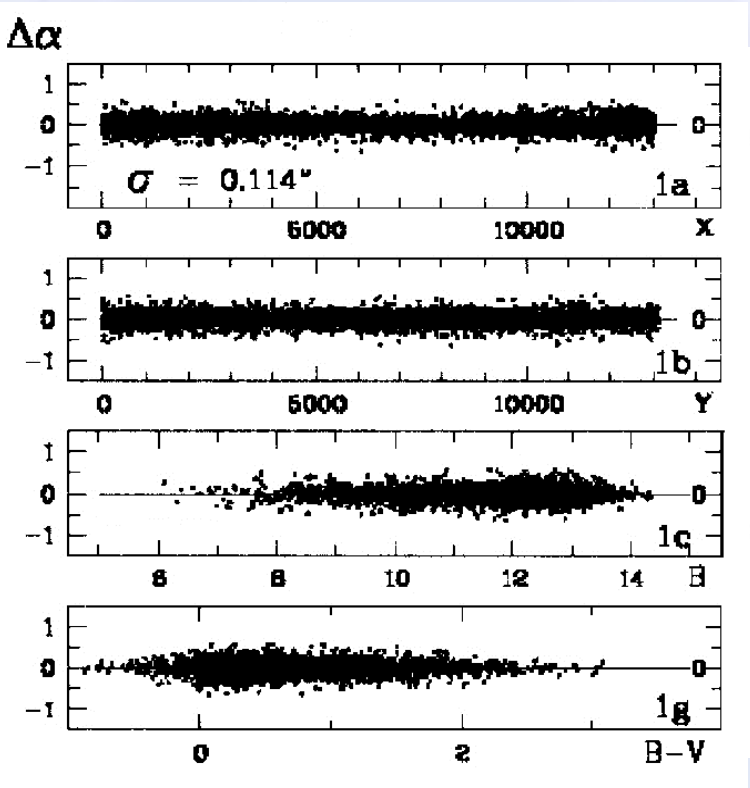
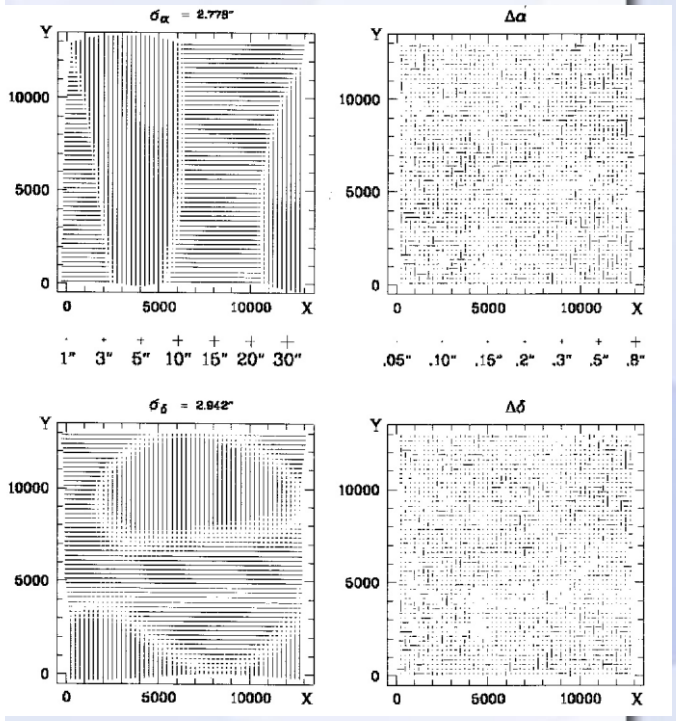
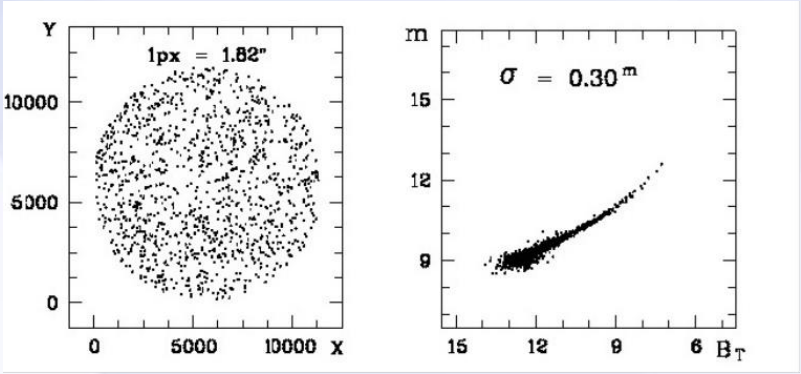








The first results obtained from the scans of digitized astroplate

Modern approach to processing early photographic observations with new technologies can be an effective instrument for rediscovery of asteroids and obtain correction their orbits. We analyzed the results of observations of clusters in UBVR bands and some ultraviolet plates of other star fields made on the 1.2-m Baldone Schmidt telescope.

At the moment, 87 known minor planets on 70 plates with 9.8 - 17.1 stellar magnitude were identified. The catalog of positions and magnitudes of the searching asteroids was compiled. Among them are detected positions for 10 asteroids which at the time of observation were the earliest of the world's known observations of these asteroids. All asteroids positions were compared with the ephemeris JPl DE431.

Nplates= 2492 rmsRA= .143, rmsDE= .827

Object (disovering year)	Observing UT moment	observed coord.	B	O-C	
1556 Wingolfia (1942 AA)	1973-01-01 20:51:22	055435.437 +231218.651	15.51	-.17	.06
1837 Osita (1971 QZ1)	1973-01-01 20:51:22	055856.896 +241308.495	15.86	-.50	-1.15
1964 Luyten (1960 P-L)	1973-01-01 20:51:22	060210.229 +205211.523	15.81	-.57	-.22
2222 Lermontov (1977 ST1)	1973-01-01 20:51:22	055721.505 +232045.485	14.81	-.51	-.68
3008 Nojiri (1938 WA)	1973-01-01 20:51:22	055658.683 +221453.503	16.10	-.72	-1.73
4095 Ishizuchisan (1987 SG)	1973-01-01 20:51:22	060542.953 +215512.142	16.51	-.77	.14
5588 Jennabelle (1990 SW3)	1973-01-01 20:51:22	061027.128 +234945.758	16.47	.04	-2.02
5877 Toshimaihara (1990 FP)	1973-01-01 20:51:22	055151.011 +232720.324	16.63	-.04	2.92
7346 Boulanger (1993 DQ2)	1973-01-01 20:51:22	055558.049 +211841.800	16.77	.00	2.06
8260 (1984 SH)	1973-01-01 20:51:22	060916.957 +215506.721	16.98	-.33	.60
11974 Yasuhidefujita (1994 YF)	1973-01-01 20:51:00	060112.028 +214939.849	16.96	.73	.51
14221 (1999 WL)	1973-01-01 20:51:22	055455.643 +223031.625	16.47	.19	.09
15554 (2000 FH46)	1973-01-01 20:51:22	055916.685 +214255.736	17.23	-.99	.60
26629 Zahller (2000 GZ132)	1973-01-01 20:51:22	055505.199 +225921.891	17.11	.95	-.23

Nplates= 3511 rmsRA= .094, rmsDE= .089

100 Hekate (1868)	1974-03-12 21:16:54	055923.688 +204851.962	13.87	.32	-.18
1289 Kutaissi (1933 QR)	1974-03-12 21:16:54	061635.658 +213538.168	16.22	.37	-.43
1449 Virtanen (1938 DO)	1974-03-12 21:16:54	060012.752 +235304.757	16.67	.10	-.44
1560 Strattonia (1942 XB)	1974-03-12 21:16:54	061402.673 +224236.856	16.45	.73	.45
2659 Millis (1981 JX)	1974-03-12 21:16:54	060658.341 +222218.864	16.77	.41	-.18

Nplates= 15645 rmsRA= .106, rmsDE= .096

501 Urhixidur (1903 LB)	1987-03-24 19:47:30	074632.476 +400933.168	15.30	-.01	.89

Nplates= 15677 rmsRA= .100, rmsDE= .093

501 Urhixidur (1903 LB)	1987-03-29 19:18:33	074743.384 +393027.554	15.36	-1.25	-.08

*With red labeled observations many year before discovering date of asteroids.

Future visions

1. The studies of small bodies of the Solar system:
   - ◊ Photometry of asteroids;
   - ◊ Measurements of diameters of asteroids by covering of stars;
   - ◊ The monitoring of comets and asteroids in ecliptic zone and NEO observations in Polar region;
   - ◊ Low-resolution spectral observations of asteroids.
2. The digitization of Baldone Schmidt telescope astronomical archive:
   - ◊ Establishment of Latvian Astronomical Virtual Observatory;
   - ◊ Establishment of Ultraviolet sky survey on astronomical archive base;
   - ◊ Research the properties of clusters;
   - ◊ Investigations of nonstationarity of stars, especially of carbon stars;
   - ◊ Monitoring of Near Earth Objects *(NEO)* and comets on archive plates.
3. Technical improvements at Baldone Astrophysical Observatory
   - ◊ To increase efficiency of Schmidt telescope optical system by fly-eye method;
   - ◊ Complete automation of Schmidt telescope control system.

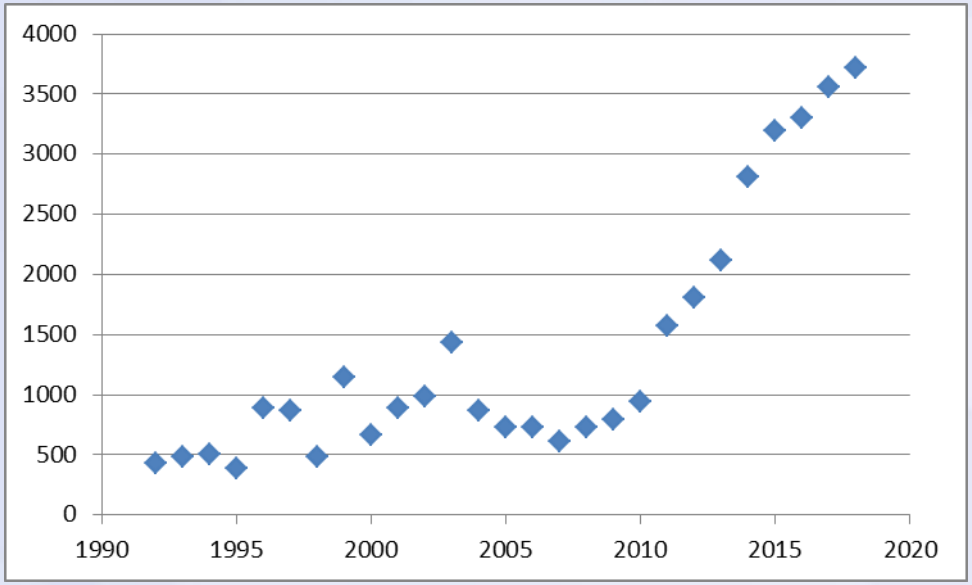
Popularization of Science

In 2012 was created the Planetarium in Schmidt telescope dome pavilion;

Baldone Observatory are managed scientifically popular lectures in astronomy and physics;

Established Baldone Astrophysical Observatory website: www.baldonesobservatorija.lu.lv

Baldone Astrophysical Observatory is included as tourist attraction place Latvia-travel website.



Number of visitors at the Baldone Astrophysical observatory

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Thanks for attention