BRIEF DESCRIPTION OF MAJOR RESULTS
OBTAINED BY OLEG MAZURENKO
AT THE TROTTIER OBSERVATORY
AS OF 11TH NOVEMBER 2015

- Solar System planetary imaging, imaging of the comets and asteroids
- Deep Sky imaging of the faint distant proto-planet nebulas
- Direct imaging of the exoplanet
- Photometry fields reference imaging
- Photometry measurements and calculating the characteristics of exoplanets systems
- New “thought to be variable” star detection and photometry measurements
- Photometry measurements of other star systems in interest
Details

Planetary Imaging:

Using the video camera imaging with the stacking technique processing using RegiStax the following planets were imaged:

Venus (imaged with video camera):

Jupiter with a moon (imaged with video camera):
Saturn (imaged with video camera):

Uranus and moons (imaged with FLI camera):
Neptune with a moon (imaged with FLI camera) with Red filter and meteor caught in image:

Pluto (imaged with FLI camera):

The imaging and processing of the comets and asteroids are in progress.

Although the results of the planetary images are quite good, the much better would be with a special planetary/guiding imaging camera together with Barlow assembly that currently is being acquired for the observatory.
Proto Planet Nebula M1-92 “Footprint” Imaging:

Imaging of the Footprint proto-planet was a test of the telescope performance on the small faint distanced deep sky objects. The image is a result of stacking and processing of many frames with the different filters that available in filter wheel. The image processed compared to the Hubble telescope image that is on a right side of the image:

“This nebula M1-92 (Minkowski 92) is protoplanetary nebula or preplanetary nebula (Sahai, Sánchez Contreras & Morris 2005) (PPN) is an astronomical object which is at the short-lived episode during a star's rapid stellar evolution between the late asymptotic giant branch (LAGB)[a] phase and the subsequent planetary nebula (PN) phase.” [From Wikipedia]

The apparent dimension of this nebula is 8x16 arcsec and magnitude 11.7.

This resolution image is most likely is the best that can be accomplished with the current equipment, although surely the image can be better advanced by more imaging and applying more specific technique when processing.

Spectrometry measurements attempt of this nebula may bring a very interesting result, although this is a tough task as this nebula is small and faint.
Direct Imaging of the exoplanet GU Piscium b:

The GU Psc b is one of the few exoplanets that have been imaged directly by largest world’s telescopes. This image is a result of first attempt to catch this planet with a SFU telescope. This is within a telescope edge technology. This first attempt shows that it is possible to image extremely faint objects as this planet is dimmer than magnitude 20. For identification and comparison on a right side of the image is “The planet GU Piscium b and its star GU Piscium composed of visible and infrared images from the Gemini South telescope and an infrared image from the CFHT.”

“GU Piscium b (GU Psc b) is a directly imaged planetary-mass companion orbiting the star GU Piscium, with an extremely large orbit of 2,000 AU (3.0×1011 km), and an apparent angular separation of 42 arc seconds” [From Wikipedia]

It is a very difficult task to image this planet, but more imaging with different filters and with advanced imaging processing techniques may allow to catch this exoplanet in a better way.
Photometry reference stars imaging of star cluster M67:
The first photometry single frame reference stars field imaged to understand the optical performance of
the equipment. The results shown the faintest star imaged is magnitude 19.3.

It is advised to perform more frames imaging with different filters, binning, applying flats and darks etc.
and advanced technique processing of this reference field. The results will be better and the faintest start
surely will have a magnitude fainter than magnitude 20.
Photometry measurements and calculated characteristics of exoplanets systems:

There are many exoplanets transits photometry has been observed at SFU observatory. The technique is based on the multi-hours imaging of the star in interest, using MaxImDL photometry tool to produce the data of the stars magnitude over the time of the transit. Uploading data to ETD database site produces the light curve, and measures the orbital elements of the star system.

The difficulty in transits observing depends on a good and stable weather conditions during the course of the imaging and must last for hours. This is also require hours of the non-stop imaging of the same star field and require excellent optical and mechanical parameters of the instruments during imaging.

The best results were achieved over the summer 2015 when the sky and weather conditions were the best and the tracking issues were minimal and when the time was allocated for the uninterrupted imaging.

Of the tens of the exoplanets observed the best results are for the planet Tres-3 b. There were 2 separate observation sessions over 2 months summer period that allowed calculating the orbital rotation period of the planet in addition to other orbital elements.

Based on these observations and using orbital mechanical calculation laws and formulas the following elements of the system were manually calculated:

Tres-3 b Orbital Elements Measurements (2015.07.19):

Exoplanet radius: 1.347 RJ
Exoplanet volume: 3.745E+15 km3
Orbital period: 1.306 days
Orbit's semi-major axis: 0.0228 AU
Inclination: 82.20 degree

These calculated measurements perfectly correspond to the catalog orbital elements. After calculations the data uploaded to ETD database for their measurements and revealed a perfect match within minimal difference.

The light curves and orbital elements produced for those 2 measurements are:
02 July 2015. Observation #1:

In TRESCA database (uploaded 2015.07.27):

TrES-3 b
Trotter Observatory
Oleg Mazurenko

Jd: 0.80689

Změřená geometrie systému

<table>
<thead>
<tr>
<th>katalogové údaje</th>
<th>změřené parametry</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_j$: 1.305 +/- 0.09 $R_{Jup}$</td>
<td>$1.228_{-0.011}^{+0.011}$ $R_{Jup}$</td>
</tr>
<tr>
<td>$R_s$: 0.813 +/- 0.027 $R_{Jup}$</td>
<td>fixed, errors included in $i$</td>
</tr>
<tr>
<td>$A_i$: 0.0226 +/- 0.0013 AU</td>
<td>fixed, errors included in $i$</td>
</tr>
<tr>
<td>Per: 1.30618608 days</td>
<td>fixed</td>
</tr>
<tr>
<td>$i$: 82.15 +/- 0.21 °</td>
<td>81.81 _{[-0.111,0.121]}^{[-0.121,0.121]}_a_1 =_0^\circ$</td>
</tr>
</tbody>
</table>

Catalogue geometry

Measured geometry
19 July 2015. Observation #2:

In TRESCA database (uploaded 2015.07.27):

TrES-3 b

Transit begin

Transit end

Jůnidi 0.7963

Změřená geometrie systému

<table>
<thead>
<tr>
<th>katalogové údaje</th>
<th>změřené parametry</th>
</tr>
</thead>
<tbody>
<tr>
<td>$R_J$</td>
<td>$1.305 \pm 0.09 R_{\text{Jup}}$</td>
</tr>
<tr>
<td>$R_*$</td>
<td>$0.813 \pm 0.027 R_{\text{Jup}}$</td>
</tr>
<tr>
<td>$A_0$</td>
<td>$0.0228 \pm 0.0013$ AU</td>
</tr>
<tr>
<td>$P$</td>
<td>$1.30618608$ days</td>
</tr>
<tr>
<td>$i$</td>
<td>$82.15 \pm 0.21$ $^\circ$</td>
</tr>
</tbody>
</table>

Catalogue geometry

Measured geometry
The stars reference field for both observations is:
New “thought to be variable” star detection and photometry measurements

During the exoplanets photometry sessions it was found a new “thought to be” a variable star in one of the reference fields. Over two hours session there is a declination in star’s brightness. After checking with the main variable stars catalogs this star was not defined in the catalogs. The consultation has been made with the professional group of exoplanet researchers and it was defined so far that this star “most likely” is a new variable star. The star was magnitude 14.

In order to confirm that this is a variable star and not an exoplanet and not an “another KIC 8462852 type star” - more observation required.
Photometry measurements of other star systems in interest

After the “star in interest” made the news in October 2015, there was a curious type of photometry measurements was done on the star KIC 8462852. The observation was last for about 2 hours and a declination was detected (blue top curve - is one of the a reference star):
It is a very advisable to continue a photometry and spectrometry of the same transit bright exoplanet star. A correlation of the data in one transit could be very interesting in order to continue this and other exoplanets systems. American Association of Variable star observers issued an alert to encourage professionals and amateurs to photometry this star as much as possible, so observation is extremely desirable.