A S T R O N O M I C K Ý Ú S T A V
Slovenská akadémia vied
059 60 Tatranská Lomnica
Slovenská republika

Studijní oddelení – doktorské studium
Ke Karlovu 3,
121 16 Praha 2
Česka Republika

Tatranská Lomnica, 7.9.2016

Dear Sir/Madam,
let me evaluate the strengths, weaknesses, and report on
the recency, methods, new results, and form of the PhD. thesis:
Determination of accurate fundamental stellar properties of stars
via analyses of suitable binary and multiple systems,
by Jana Alexandra Nemravova.

Strengths :

Thesis is devoted to the study of binary and multiple stellar systems.
For this purpose, author collected high quality observations obtained
at world class telescopes using modern astronomical techniques.
These include not only classical photometry and spectroscopy
but also state of the art optical interferometry.
Most of the results were published in renowned journals.
I have counted 10 papers in A&A coauthored by the researcher.
Researcher is the first author in three of them.
Researcher clearly and honestly explains her own contribution to
the papers and the whole thesis represents an impressive amount
of work.

New original results that were obtained include:
- orbits of all components of xi Tau
- physical properties of three stellar members of the xi Tau system
(Aa, Ab, B components) and a distance to the star
- dynamical interaction between the components of xi Tau was explained
and utilized in the study
- an interferometric confirmation that beta Lyr has a Roche lobe
filling donor and a gainer immersed in the circumstellar material
in the form of an optically thick accretion disk.

Researcher clearly mastered photometric, spectroscopic,
and also interferometric observations, data analysis & interpretation
including the modelling of the data.

For this purpose, she wrote several computer codes in Python and C++ (ERV, FRV, FV, Pyterpol) and is developing another one called DV. These codes will be appreciated by the astronomical community.

The thesis is clear, has good logical structure, is written in English and uses proper scientific terms.

Weaknesses:

I do not have any serious censure of the thesis.
There are a few misprints or confusing statements mentioned below.
At a few places, more information could have been provided and incorporated directly into the main stream of the thesis so that it is easier to read and understand.
From the formal point of view, the thesis might have been more complete if there were devoted sections such as 'a goal' and ' conclusions'.
These 'weaknesses' do not lower the great value of the work and results obtained by the author.

Questions/Comments/Suggestions:

Misprints:
Eqs.1.2, 1.6, 2.4
p.13 ... Stromgren's narrow-band ubvy ...
p.27 Keplerian ...rotation velocity scales with the radius as r^-1...

p.4,5
Author is using the term Roche limit.
However, the author probably meant the Roche lobe rather than the Roche limit.

Eq.2.5
Delta lambda is not the difference between the two pixels of the detector as mentioned. It is the spectral purity which is usually dominated by the slit width.

p.37, Eq.3.15
If the bolometric albedo in the interacting binaries were a ratio of the reflected to the absorbed energy as mentioned, how is it possible that the temperature given by Eq.3.15 would increase with increasing albedo?

p.40, 83
Author may want to consult the publicly available program SHELLSPEC (Budaj & Richards 2004). It contains almost everything what is on the list for the program DV to do in the future.
This includes spectra, light-curves, 2D images of an interacting

binary with Roche geometry, limb & gravity darkening, reflection effect, all immersed in a moving circumstellar material.
The output of the code might be used to calculate visibilities, etc.
It might save the author a lot of time and effort
in creating a more sophisticated model for the beta Lyr
in the future.

p.61
It was mentioned that B component of xi Tau could be
a slowly pulsating B star. Is it possible to show its position
in the HR-diagram with the instability strip?

p.62
It would be of a great help for the reader if the light-curve
with eclipses and radial velocity curve of xi Tau were presented
here as well.

p.78, Fig.5.3
It is mentioned that primary star of beta Lyr refers to the gainer
which is hotter (but immersed in a cool disk) while secondary is
the cooler star.
It was also mentioned that the model does not fit the secondary
eclipses very well.
Please, can you clarify which star is eclipsed during
the secondary eclipse?
Assuming that the secondary eclipse is the shallower one and that
it is the primary which is eclipsed during the secondary eclipse,
one might indeed consider a less opaque disk with temperature
increasing towards the star.
Alternatively, can you rule out presence of a cold material
in the vicinity of the L2 point eclipsing the secondary star?
On the other hand, assuming that the secondary star is eclipsed
during the secondary minimum, could it be that the day side
temperature of the secondary is underestimated by the model?
It is seen in the Fig. 5.5.
This could happen if the gravity darkening (which tends
to drag the temperature to "zero" in the L1 point) was included
but the reflection effect (which tends to increase the temperature
at the sub-stellar point) was ignored.

Final statement:

The thesis proves that the author is capable of independent
thinking and creative scientific work.
I have no doubt that the author fulfills the conditions required
to receive the PhD title upon the successful defense of the thesis.

Sincerely Yours,

Jan Budaj
Astronomical Institute
05960 Tatranská Lomnica
Slovak Republic
(budaj@ta3.sk, +421-52-7879147)