Variable Stars South Symposium 5 – Christchurch May 6th - 7th, 2018
Preliminary Programme (subject to change)

| SUNDAY   |            |                      |                                      |                                      |                                      |                                      |                                      |
|----------|------------|----------------------|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|
| 7:00 pm  | Welcome    | Mark Blackford       | 7:15 pm                             | Session one                         | Exoplanets and Solar System         | Phil Evans “Confessions of an exoplanet junkie” |
|          |            |                      |                                     |                                     | & Pro-Am collaborations              | Yael Hillman “Novae – where simulations meet observations” |
|          |            |                      |                                     |                                     |                                      | Carl Knight “Exoplanet transits: the challenge” |
|          |            |                      |                                     |                                     |                                      | Carl Knight “Detected precession of asteroid 4963 Kanroku” |
| 9:15 pm  | Supper     |                      |                                     |                                     |                                     |                                      |

| MONDAY   |            |                      |                                     |                                     |                                     |                                      |
|----------|------------|----------------------|-------------------------------------|-------------------------------------|-------------------------------------|                                      |
| 9:00 am  | Session two| Eclipsing Binaries I | Mark Blackford “V883 Sco Period determination” |                                     |                                     |                                      |
|          |            |                      | Tom Richards “When Homer Nods - reconciling our period analysis of V883 Sco with history” |                                     |                                     |                                      |
|          |            |                      | David Moriarty “Determining radial velocities with the broadening function & spectral types of eclipsing binaries in the V magnitude range 9 – 14” |                                     |                                     |                                      |
|          |            |                      | David Moriarty “Photometry, spectroscopy & radial velocities of ST Cen, V775 Cen & TW Cru” |                                     |                                     |                                      |
| 10:30 am | Morning tea|                      |                                     |                                     |                                     |                                      |
| 11:00 am | Session three | Eclipsing Binaries II | Stan Walker “QZ Carinae update” |                                     |                                     |                                      |
|          |            |                      | Ed Budding “The multiple star systems V454 Car and HX Vel” |                                     |                                     |                                      |
| 12 noon  | Lunch      |                      |                                     |                                     |                                     |                                      |
| 1:30 pm  | Session four | Equipment and Techniques | John Drummond “Applying astrophotography skills to astronomical science” |                                     |                                     |                                      |
|          |            |                      | Roy Axelsen “DSLR photometry in white light: a novel concept” |                                     |                                     |                                      |
| 3:00 pm  | Afternoon tea |                      |                                     |                                     |                                     |                                      |
| 3:30 pm  | Session five | Pulsating and Other Variables | Stan Walker “R Centauri - An Interesting and Perhaps Unique Mira Star” |                                     |                                     |                                      |
|          |            |                      | Roy Axelsen “Updated O-C diagrams for the delta Scuti stars RS Gru and V393 Car” |                                     |                                     |                                      |
| 4:30 pm  | Concluding review |                      |                                     |                                     |                                     |                                      |

Posters welcome on all aspects of variable star observing, analysis, equipment, etc.

Abstracts
Phil Evans “Confessions of an exoplanet junkie”

I discuss my work on already published transits for the Exoplanet Transit Database (ETD) and briefly discuss my current work with KFUN, the Kelt Follow-Up Network, demonstrating how to use AstroimageJ, which is the photometry software we use for transit detection and modelling.

Yael Hillman “Novae – where simulations meet observations”

Results of nova simulations show a strong dependence of the white dwarf (WD) mass and mass transfer rate on the observable characteristics - the eruption time and the time between eruptions. Thus, they may be used reversely to determine the WD mass and average mass transfer rate of known systems. Combining these results with Galactic novae databases allows to derive distributions of WD masses and mass transfer rates for classical and recurrent novae, eliminating observational bias. The results of many thousands of consecutive eruptions show how the WD changes on a long-term perspective, e.g., the possibility of the WD to grow and become a SNIa progenitor, the limits on the WD mass and on the mass transfer rate and the consequences of helium flashes on this growth. Including the companion in simulations allows for “live” updating of the binary separation which directly and continually affects the mass transfer rate.

I will present a handful of aspects from short-term and long-term nova simulations, that may contribute to the determination of the properties of known nova systems, predict future eruptions and detect potential progenitors of type Ia SN.

Carl Knight “Exoplanet transits: the challenge”

My exoplanet work is very early days. I am, after a number of attempts, wrestling issues with my mount into submission - including writing an ASCOM driver for my mount from scratch - finally getting good light curves of exoplanet transits. This presentation seeks to provide a record of this venture in the hope that others may short cut some of my most basic errors in this pursuit. I also include the analysis of the type of information present in a real (as opposed to ideal) exoplanet light curve.

Carl Knight “Detected precession of asteroid 4963 Kanroku”

4963 Kanroku is a main belt asteroid that I was asked to take photometry of as part of assistance requested of VSS in 2016. The project has involved observatories sited in both hemispheres and around the globe. This presentation is the second paper from the project (the first being of 2121 Sevastopol) and arguably the most exciting as we have detected a precession of the spin axis of the asteroid 4963 Kanroku and coupled with a late breaking possible detection of mutual phenomena is suggestive of a second body being present. i.e. 4963 is likely a binary asteroid.

Mark Blackford, Neil Butterworth, Tom Richards “V883 Sco Period determination”
In 2015 Neil Butterworth attempted to record eclipses of V833 Scorpii however predicted eclipse times using the accepted 1.29484 day period and HJD 2443285.794 epoch were clearly wrong. In order to determine the correct period we needed a large set of homogeneous, high quality observations recorded over several years. The All Sky Automated Survey is an excellent source of such observations for stars between V magnitudes 6 and 12, or so.

Data for V833 Sco from the ASAS archive was imported into David Benn’s excellent VStar light curve plotting and analysis software. After rejecting several obviously discrepant data points (possibly due to clouds or image artifacts), the Discrete Fourier Transform algorithm in VStar was employed to find candidate periods. The strongest signal from the DFT analysis was for a period of 2.1706 d, however this produced a folded light curve with two overlapping eclipses. Replotting with period twice that (4.3412 d) worked very well, showing slightly shallower secondary eclipses offset from the midpoint between successive primary eclipses. This period was further refined to 4.341164(11) d using data from INTEGRAL-OMC and Neil’s DSLR observations.

Tom Richards, Neil Butterworth, Mark Blackford “When Homer Nods - reconciling our period analysis of V883 Sco with history”

V883 Sco is an eclipsing binary with a V magnitude of 7.3 and widely quoted period of 1.29484 d. Observations at Townsville Observatory by NDB over three observing seasons showed this period was very wrong. MDB analysed NDB’s data and derived an incommensurate period of 4.3412 d, which moreover fitted with analysis of INTEGRAL-OMC and ASAS3 data. This paper will present the original photometric data and provide an analysis method showing how that data, though apparently supporting the original period, are consistent with and support our period.

David Moriarty “Determining radial velocities with the broadening function & spectral types of eclipsing binaries in the V magnitude range 9 – 14”

Radial velocities for several eclipsing binary systems are being determined with the broadening function on spectra observed with the ANU 2.3m telescope and Wide Field Spectrograph. This instrument has 2 gratings with low and medium resolution (R=3000 and 7000). The broadening function was developed by Slavek Rucinski to extract velocities from the complex, convolved spectra of rapidly rotating, contact eclipsing binaries. It gives more accurate results for close binary systems than the cross correlation function; it provides information on relative luminosities as well as velocities and it allows analysis of triple and multiple systems. All of the contact systems that I have analysed are multiple systems, mostly triple.

David Moriarty “Photometry, spectroscopy & radial velocities of ST Cen, V775 Cen & TW Cru”

ST Centauri is a close eclipsing binary pair of F9 stars with some characteristics of RS CVn systems. Photometric observations and analysis between 2013 and 2017, combined with those of earlier studies, show that there has been no change in its period of 1.22 days for the past 40 years. The radial velocities were 127 ± 9, 142 ± 6 and -4 km/s for each component and the system. Photometric and spectroscopic analyses of V0775 Cen, a near contact binary with a period of 16 hours and TW Cru, a contact binary with a period of 9 h, indicate both are triple systems. The V0775 Cen spectra are consistent with catalogue values of F0 IV for the primary component; its mass is 1.6 solar and radius 1.7 solar. The effective temperature of the secondary star indicates it has a spectral type of about K4, and its mass is 0.5 solar, yet with a radius of 1.1 solar, it has evolved past terminal age main sequence. Episodes of emission in the H Balmer and metal lines of TW Cru confirm the conclusion from previously published photometric studies that it is chromospherically active.
Stan Walker “QZ Carinae update”

Ed Budding “The multiple star systems V454 Car and HX Vel”
We present combined photometric and spectroscopic analyses of the southern close binary systems V454 Car and HX Vel. High-resolution spectra of these systems were taken at the University of Canterbury Mt. John Observatory in the years 2009-15.

Absolute parameters for the triple (at least) system V454 Car confirm its young and near-Main-Sequence nature. We find:
M1 = 6.30+/-0.20, M2 = 5.86+/-0.18,
R1 = 3.12+/-0.05, R2 = 3.04+/-0.04, (all in solar units);
T1 ~19000, T2 ~18500 (K);
photometric distance ~ 550 (pc).

The close binary is found to be the major component (A) of a multiple star, whose other main component (B) is also probably a binary. The two components are in eccentric orbits about a common centre of gravity with a period of ~ 1900 d. Analysis of the radial velocity curves is strongly suggestive that the mass of component B is greater than that of its visible member, while the measured radial velocities of this visible star show irregularities incompatible with reasonable measurement accuracies. These variations occur on a timescale of days to weeks.

For HX Vel we find absolute parameters as follows:
M1 = 9.6+/-0.4, M2 = 5.6+/-0.3,
R1 = 4.80+/-0.18, R2 = 3.05+/-0.16, (all in solar units);
T1 ~25000, T2 ~17000 (K);
photometric distance ~ 390+/-30 (pc).

HX Vel, the brighter component of the visual pair CCDM J08423-4806 AB is often considered to be the brightest member of the cluster IC 2395. There appears to be an inconsistency in the distance estimates, however. The ~400 pc distance of our determination would make the system a likely member of the Sco-Cen OB2 Association within Gould's Belt.

John Drummond
Roy Axelsen “DSLR photometry in white light: a novel concept”

Results of DSLR photometry are usually derived from the data collected via each of the three channels of the camera sensor (green, blue and red) if multicolour photometry is the aim. If data from only one channel is processed, it is almost always from the green channel, perhaps supplemented by blue channel data for transformation coefficients. Green channel magnitude determinations are based on signal from only 50% of the sensor. This presentation describes the determination of non-transformed magnitudes in white light, using data from all three channels combined, thus making use of signal from 100% of the sensor. The method was tested on time series data from the delta Scuti star V703 Sco. Non-transformed white light magnitude results were compared with non-transformed magnitudes from the green channel alone, and magnitudes transformed to the V standard. Lomb-Scargle Fourier analysis revealed that the discovered pulsation frequencies and power spectra were identical for non-transformed white light magnitudes and for the magnitudes in V. Light curves were almost identical for the three methods of analysis, but with slightly greater amplitudes and with slightly smoother light curve segments in white light. For most light curve peaks, times of maximum differed little between the three methods. Check star white light data showed slightly smaller ranges and standard deviations than those for non-transformed green magnitudes and V magnitudes. Time series DSLR photometry in white light is thus considered a valid procedure under the conditions described, with a precision at least as good, if not better, than that from green channel data alone.

Stan Walker & Giorgio di Scala “ R Centauri - An Interesting and Perhaps Unique Mira Star”

The first recorded maximum of R Centauri was in 1871 but reasonable coverage dates from only 1891. It displays two clear maxima, which characteristic is shared by less than a dozen others of the thousand or so well studied Mira stars. We present observations of the changing light curve shape and amplitudes with supplementary UBV and BVRI measures which appear to differ dramatically from other Miras. The pulsation period is also changing, believed to be the result of a helium flash, the onset of the period change in 1922 being perhaps the only one observed.

Roy Axelsen “Updated O-C diagrams for the delta Scuti stars RS Gru and V393 Car”

RS Gru has a period of about 3.5 hours. Between 1952 and 1988 an O-C diagram by others showed a decrease in the period at a constant rate. Since then, there have been two period jumps, associated with constant periods between, followed by an increase in the period at a constant rate, and most recently, several years during which the period has remained constant. This paper details these changes from the study of O-C diagrams created from personal data, the AAVSO International Database and data from the literature. A linear ephemeris calculated by the present author from his own DSLR photometric observations gathered from 2011 to 2017 indicates that the period during that time was 0.147 012 015 (+/- 0.000 000 002) day, or 3 hr 31 min 41.8381 (+/- 0.0002) sec.

V393 Car has a period of about 3.4 hours. There are only 3 publications, in 1984, 2001 and 2014, with the latter by the present author. Data from 1977 to 1979 (the 1984 publication) and the author’s data from December 2013 to March 2014 suggested that the period had changed very little from the initial 1970s observations. The 2001 publication reported only a single time of maximum, which is either discrepant, or represents a dramatic change in the period of the star, which subsequently reversed. More recent DSLR photometry by the author suggests strongly that there has been a change in period, with no relationship to
the data published in 2001. A linear ephemeris calculated from personal data gathered between late 2013 and early 2017 indicates that the period during that time was 0.1412950 (+/- 0.000 000 2) day, or 3 hr 23 min 27.89 (+/- 0.02) sec.
Speaker biographic notes

Roy Axelsen

Roy Axelsen has been studying variable stars for about 15 years, commencing with visual observations of long period variables, then moving the PEP of delta Scuti stars and more recently DSLR photometry, mostly of delta Scuti variables but also of other types. Results of delta Scuti studies have been published in the Journal of the AAVSO. He is a member of the Astronomical Society of Queensland, where he has served as a Councillor for two terms, in the most recent of which he has been Treasurer (2014 to 2016) and General Secretary (2017 and ongoing). He is also a member of VSS and of the AAVSO, where, some years ago, he served as the only Australian member of the Comparison Star Database Team, which digitized star data from all of the existing comparison star charts. The resulting database was the ancestor of that behind the current VSP (Variable Star Plotter).

Mark Blackford

Mark has been a member of the Astronomical Society of NSW since 1980, and both AAVSO and Variable Stars South since about 2010. He worked at ANSTO for 36 years, initially as an environmental physicist then as an electron microscopist, working mainly in the physical sciences. Since retiring out of Sydney in 2016 Mark has built an observatory on the NSW Mid North Coast from where he observes, mainly, eclipsing binary stars. Mark is currently director of Variable Stars South.

Ed Budding

Currently Honorary Research Fellow, School of Chemistry and Physical Sciences, Victoria University of Wellington and Carter Observatory, Wellington, and Dept of Physics and Astronomy, University of Canterbury, Christchurch. Ed has served as President of the Royal Astronomical Society NZ, and was editor of its journal Southern Stars for 12 years. His contributions were recognised by being appointed a Fellow of the Royal Astronomical Society NZ.

Ed’s publications include more than 150 scientific cited papers in refereed journals, 2 books with personal authorship (Introduction to Astronomical Photometry, Cambridge University Press), 3 books/journal volumes as editor (including 3rd Asian-Pacific IAU Meeting, Kyoto, 1984), 12 published book reviews and numerous contributions to non-refereed journals.

John Drummond
Phil Evans

Phil is a former high school physics and maths teacher turned businessman. He ran the Cook Islands News, a daily newspaper, for 19 years before taking early retirement to pursue his astronomical interests. He now remotely operates a small telescope 1600 metres up at the southern end of the Atacama desert. For the past eight years he has concentrated on exoplanet observing and is a member of KFUN (KELT Follow-Up Network) and TFOP (Tess Follow-Up Programme). He has also cooperated with professional astronomers on a variety of exoplanet studies.

Yael Hillman

Yael Hillman has a PhD from the Tel-Aviv University, Israel, her dissertation was on the characteristics and the evolution of white dwarfs in novae producing binaries. She is a post-doc at the American Museum of Natural History, NY, USA and currently stationed as a visiting scientist at the Weizmann Institute of Science, Israel, focusing her work on self-consistent long-term evolution of novae.

David Moriarty

David has been a member of the Astronomical Association of Qld since 1982. He was a member of the Astronomical Society of South Australia during his student years 1957 - 1969. He is an Honorary Senior Fellow with the Astrophysics group at The University of Queensland (UQ). His professional field is microbial biochemistry and ecology. He was a research scientist with CSIRO and an Honorary Professor in the Centre for Marine Studies, UQ.
Qualifications: B.Ag. Sc. (Hons.); Ph.D., D.Sc. FASM

Carl Knight

Software developer for the past 30 odd years.

Always keen on astronomy. Became seriously involved in astronomy whilst living in the UK where he bought his Meade 12” SCT and joined the British Astronomical Association. Discovered Variable Stars and began to specialise in late stellar evolution.

Joined Variable Stars South on his return to New Zealand. Began promoting astronomy as a practical subject for secondary education in the Manawatu and Rangitikei regions.

Has been observing for Pulkovo Observatory, Russia since late 2015 on binary asteroids and more recently exoplanet transits.

Married to Louise with three adult children - of which only the youngest has any interest at all in Dad's geeky obsession.
Dr Tom Richards, FRAS

Tom was a mathematical logician, ending up academically as a computer science professor and founding a very successful software research and development company. Retiring from all that he returned to variable stars, in particular eclipsing binaries. In 2009 he was appointed Director of the Variable Star Section of the RASNZ, to revive it as Variable Stars South. Tom was awarded the Murray Geddes Prize of the Royal Astronomical Society of NZ in 1959 and the Berenice Page Medal of the Astronomical Society of Australia in 2006, for his research work as an amateur astronomer. He is a past president of the Astronomical Society of Victoria and an Honorary Member of the RASNZ.

Stan Walker

I began observing double stars about 1964 and graduated to visual variable star observing in 1967. Visual flare star programmes convinced me that the 50cm telescope at Auckland Observatory would be much more effective using photoelectric photometry and with the collaboration of Brian Marino and Harry Williams, and many helpers throughout New Zealand, this system - one of the best in the southern hemisphere - was operating by 1969. A wide variety of observational papers with a few more theoretical ones, particularly in the cataclysmic variable field, were published in the next two decades. The Auckland group were instrumental with Murray Lewis of the Carter Observatory in setting up the successful pro-am PEP conference series.

I was invited to join the International Astronomical Union in 1970 as an amateur member of the Variable Stars commission, followed by similar invitations to Close Binary Stars (mainly CVs) and Photometry and Polarimetry in 1976. My observing was mainly concerned with CVs, after 1995 in collaboration with the CBA, but also UBV colour photometry of interesting Miras such as BH Crucis, R Centauri and many others. Also measures of a wide range of other astronomical objects. I joined the Royal Astronomical Society about 1972 and am an award member of the Auckland Astronomical Society and a fellow of the RASNZ and a past director of that society's photometry and variable stars sections (Variable Stars South).