

# Dr. Aarran Shaw

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## EDUCATION AND PROFESSIONAL EXPERIENCE

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**October 2019 - present:** Postdoctoral Research Fellow

University of Nevada, Reno, USA

Postdoctoral Supervisor: Prof. Richard M. Plotkin

**November 2016 - October 2019:** Postdoctoral Research Fellow

University of Alberta, Edmonton, Canada

Postdoctoral Supervisor: Prof. Craig O. Heinke

**September 2012 - October 2016:** PhD in Astrophysics

University of Southampton, Southampton, UK

Thesis title: Multi-wavelength Observations of Galactic Black Hole X-ray Transients (defended September 2016)

Supervisor: Prof. Philip A. Charles

**September 2007 - July 2012:** MPhys (with BSc) in Physics with Astrophysics (with Research Placement)

University of Leeds, Leeds, UK

Graduated with First Class Honours

## RESEARCH INTERESTS

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Accretion physics; Black holes; Neutron stars; White dwarfs; X-ray binaries; Cataclysmic Variables; Timing and variability; Multi-wavelength observational astronomy

## TEACHING EXPERIENCE

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**September 2012 - October 2016:** Mayflower Scholar (Teaching Assistant and demonstrator)

University of Southampton, Southampton, UK

- 1st year course: Energy and Matter (also delivered revision lectures)
- 1st year course: Motion and Relativity
- 1st year course: Physics Skills (Experimental Labs)
- 2nd year course: Quantum Physics of Matter
- 2nd year course: Classical Mechanics
- 2nd year course: Physics from Evidence (Python labs)
- 3rd/4th year course: Computer Techniques in Physics (Advanced Python labs)

## STUDENTS

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**Ava Covington (Summer 2020 - present)** - Ava is a UNR undergraduate working with me on investigating the low-flux states of intermediate polars. In the spring semester 2021 Ava won a Nevada Undergraduate Research Award to help fund the project, and we are working towards Ava's first first author peer-reviewed publication.

**Alexis Tudor (Fall 2019 - Spring 2021; co-advisory role)** - Alexis majored in Computer Science but worked in a cross-disciplinary fashion with Prof. Plotkin (her main advisor) and I through her senior year and Master's year to develop Photometry+, a photometric pipeline designed for use with the 0.7m Great Basin Observatory. During her Master's year, Alexis focused on the Human Computer Interaction (HCI) of the software. She published her results in the proceedings of HCI International 2021 and presented Photometry+ at the 237th meeting of the American Astronomical Society.

## **PUBLIC ENGAGEMENT**

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### **UNR; October 2019 - present:**

- 11 March 2021, virtual school visit to the Grade 2 class of John C. Fremont Elementary School, Carson City NV - ask an astronomer Q&A session
- "Virtual coffee break" discussion for the Great Basin Observatory (GBO). I talk about how I use the Great Basin National Park's 0.7m telescope for my research, in an informal and accessible setting. This series was set up by the GBO as a way to engage with the public during COVID-19: <https://youtu.be/aw5B7h0rZGg>

### **U of A; November 2016 - October 2019:**

- 10 September 2018, public talk: "Black holes don't suck," Royal Astronomical Society of Canada regular meeting
- 16 May 2018, public talk: "Radio Astronomy through the ages," Northern Alberta Radio Club monthly meeting
- 16 March 2017, public talk: "Life after death: The violent nature of black holes," University of Alberta public observing evening
- Interview for "Astro 101: Black Holes" online course, short videos discussing black holes and neutron stars available on YouTube

### **University of Southampton; September 2012 - October 2016:**

- Team member, 'Southampton Astrodome' - Inflatable planetarium shows at primary and secondary schools, University open days, BBC stargazing live open evenings. Other duties included leading astronomy demonstrations at National Science Week at Winchester Science Centre.

## **AWARDS**

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### **July 2009 - August 2011:** Summer Research Placement, Universities of Leeds and Leicester

Awarded stipend from University of Leeds Physics department to conduct a Research Placement for three years every summer. I gained valuable experience with observational astronomy in a research environment before commencing my PhD. In 2011 I studied Pulsar Wind Nebulae with the Fermi Gamma-ray Space Telescope at the University of Leicester.

### **Spring semester 2021:** Nevada Undergraduate Research Award (NURA) mentor stipend

Awarded a stipend from the University of Nevada, Reno to mentor and advise Physics undergraduate Ava Covington during the 2021 spring semester. Ava won the NURA with a project to study and analyze the light curves of intermediate polars in low flux states.

## **PROFESSIONAL MEMBERSHIP**

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Member of the American Astronomical Society (AAS)

## **OTHER RELEVANT EXPERIENCE**

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Committee Member of the NuSTAR User's Committee (2020-present)

Referee for Monthly Notices of the Royal Astronomical Society

Referee for the Astrophysical Journal

Reviewer for the Swift Time Allocation Committee

Reviewer for the Chandra Time Allocation Committee

## COMPUTING SKILLS

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**Data reduction packages:** XSELECT, IRAF/pyRAF, Chandra CIAO, XMM-Newton SAS, ESOREX/REFLEX  
**Astronomy analysis software:** HEASOFT/FTOOLS (including XSPEC and XRONOS), Starlink, DS9, T. R. Marsh's software (Molly, Doppler), AstrOmatic software (SExtractor, SCAMP, SWarp), pgplot, GNUplot  
**Programming:** Python, bash, TCL, limited html  
**Operating Systems:** Linux, macOS, Windows

## CONFERENCE PRESENTATIONS AND INVITED TALKS

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**Invited talk:** *TBA: Vasto Accretion Meeting 2021*, TBA (postponed due to COVID-19), Vasto, Italy  
**Invited talk:** *New results on magnetic cataclysmic variables*: Michigan State University astro seminar, 7 April 2021 (virtual due to COVID-19)  
**Invited talk:** *Radio and X-ray observations of stellar mass black holes*: COSPAR 2021, 28 January-4 February 2021, Sydney, Australia (virtual due to COVID-19)  
**Invited talk:** *Measuring the masses of white dwarfs with X-rays: A NuSTAR Legacy Survey*: AAVSO 109th annual meeting, 13-15 November 2020, virtual due to COVID-19)  
**Invited talk:** *The Swift Bulge Survey - in search of the faintest X-ray transients*: SRL Seminar, 26 September 2017, Caltech, Pasadena, CA, USA

**Contributed talk:** *Measuring the masses of Intermediate Polars with NuSTAR: A Legacy Survey*: COSPAR 2021, 28 January-4 February 2021, Sydney, Australia (virtual due to COVID-19)  
**Contributed Talk:** *Studying Magnetic Cataclysmic Variables with GBO*: STARFEST III, 24 October 2020 (virtual due to COVID-19)  
**Contributed Talk:** *Observations of the disk/jet coupling of X-ray binaries during their descent to quiescence: The case for rapid follow-up*: Chandra Frontiers in Time-Domain Science, 7-30 October, (virtual due to COVID-19)  
**Contributed Talk:** *Measuring the masses of Intermediate Polars with NuSTAR: A Legacy Survey*: 235th Meeting of the American Astronomical Society, 4-8 January 2020, Honolulu, HI, USA  
**Contributed Talk:** *Probing the physics of compact objects with the TMT*: TMT Science Forum, 10-12 December 2018, Pasadena, CA, USA  
**Contributed talk:** *Swift J1753.5-0127 - the black hole that just wouldn't stay quiet*: Time for Accretion, 6-10 August 2018, Sigtuna, Sweden  
**Contributed talk:** *Measuring the masses of Intermediate Polars with NuSTAR*: COSPAR 2018, 14-22 July 2018, Pasadena, CA, USA  
**Contributed talk:** *The radius of the quiescent neutron star in M13*: COSPAR 2018, 14-22 July 2018, Pasadena, CA, USA  
**Contributed talk:** *The Swift Bulge Survey - in search of the faintest X-ray transients*: 16th HEAD Divisional Meeting, 20-24 August 2017, Sun Valley, ID, USA  
**Contributed talk:** *The Swift Bulge Survey - in search of the faintest X-ray transients*: CASCA 2017, 29 May-1 June 2017, University of Alberta, Edmonton, AB, Canada  
**Contributed talk:** *On the orbital period of MAXI J1305-704: 7 years of MAXI: Monitoring X-ray Transients*, 5-7 December 2016, RIKEN, Tokyo, Japan  
**Contributed talk:** *No evidence for a low mass black hole in Swift J1753.5-0127*: New Results in X-ray Astronomy, 28 September 2016, MSSL, Dorking, UK  
**Contributed talk:** *An unusual soft state in Swift J1753.5-0127*: New Results in X-ray Astronomy, 28 October 2015, University of Leicester, Leicester, UK  
**Contributed talk:** *The curious new state of Swift J1753.5-0127*: The Extremes of Black Hole Accretion, 8-10 June 2015, ESAC, Madrid, Spain  
**Contributed talk:** *A 420-day X-ray/optical modulation and extended X-ray dips in the short-period transient Swift J1753.5-0127*: New Results in X-ray Astronomy, 16 September 2013, University of Southampton, Southampton, UK

## OBSERVING PROPOSALS

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**Observing proposal summary:**

Accepted observing proposals as PI: 43

Accepted observing proposals as co-I: 46

Funding secured from observing proposals: \$181,058

**Selection of accepted observing programmes as PI:**

The nature of accretion and outflow in the Intermediate Mass X-ray binary V4641 Sagittarii;

2019-2020; 75ks, Chandra/HETGS

Cycle 21; 2019-2020; 75ks

*75ks Chandra grating observation of V4641 Sgr, the first grating observation of this system. Triggered Feb. 2020.*

The nature of the cataclysmic variable population in the globular cluster NGC 6397

2018-2019; 100ks; NuSTAR

*100ks NuSTAR observation of NGC 6397 in order to characterize the spectrum of the CV population. If they are magnetic CVs then we will be able to derive the average mass of CVs in NGC 6397.*

Measuring White Dwarf masses with NuSTAR: A Legacy Survey

2017-2020; 985ks; NuSTAR

*Legacy survey designed to measure the hard X-ray spectrum of magnetic CVs in order to derive their masses*

**PUBLICATIONS**

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**Publication record summary:**

Refereed publications as first author: 10

Refereed publications as co-author: 19

Non-refereed publications as first author: 12

Non-refereed publications as co-author: 30

**Refereed publications as first author:**

**A. W. Shaw**, R. M. Plotkin, J. C. A. Miller-Jones, J. Homan, E. Gallo, D. M. Russell, J. A. Tomsick, P. Kaaret, S. Corbel, M. Espinasse, J. Bright: *Observations of the Disk/Jet Coupling of MAXI J1820+070 During its Descent to Quiescence*, 2021, ApJ, 907, 34

**A. W. Shaw**, C. O. Heinke, K. Mukai, J. A. Tomsick, V. Doroshenko, V. F. Suleimanov, D. J. K. Buisson, P. Gandhi, B. W. Grefenstette, J. Hare, J. Jiang, R. M. Ludlam, V. Rana, G. R. Sivakoff: *Measuring the masses of magnetic white dwarfs: A NuSTAR Legacy Survey*, 2020, MNRAS, 498, 3457

**A. W. Shaw**, C. O. Heinke, T. J. Maccarone, G. R. Sivakoff, J. Strader, A. Bahramian, N. Degenaar, J. A. Kennea, E. Kuulkers, A. Rau, R. Wijnands, and J. J. M. in 't Zand, L. E. Rivera Sandoval, L. Shishkovsky, S. J. Swihart, A. J. Tetarenko, R. Wijnands, and J. J. M. in 't Zand: *The Swift Bulge Survey: Optical & near-IR follow-up featuring a likely symbiotic X-ray binary & a focused wind CV*, 2020, MNRAS, 492, 4344 (Erratum in MNRAS, 494, 5081)

**A. W. Shaw**, B. E. Tetarenko, G. Dubus, T. Dinçer, J. A. Tomsick, P. Gandhi, R. M. Plotkin, D. M. Russell: *The Curious Case of Swift J1753.5-0127: A Black Hole Low-mass X-ray Binary Analogue to Z Cam Type Dwarf Novae*, 2019, MNRAS, 482, 1840

**A. W. Shaw**, C. O. Heinke, A. W. Steiner, S. Campana, H. N. Cohn, W. C. G. Ho, P. M. Lugger, M. Servillat: *The radius of the quiescent neutron star in the globular cluster M13*, 2018, MNRAS, 476, 4713

**A. W. Shaw**, C. O. Heinke, K. Mukai, G. R. Sivakoff, J. A. Tomsick, V. Rana: *Measuring the masses of Intermediate Polars with*

*NuSTAR: V709 Cas, NY Lup and V1223 Sgr*, 2018, MNRAS, 476, 554

**A. W. Shaw**, C. O. Heinke, N. Degenaar, R. Wijnands, R. Kaur, L. M. Forestell: *Near-infrared counterparts of three transient very faint neutron star X-ray binaries*, 2017, MNRAS, 471, 2508

**A. W. Shaw**, P. A. Charles, J. Casares, J. V. Hernández Santisteban: *No evidence for a low-mass black hole in Swift J1753.5–0127*, 2016, MNRAS, 463, 1314

**A. W. Shaw**, P. Gandhi, D. Altamirano, P. Uttley, J. A. Tomsick, P. A. Charles, F. Fürst, F. Rahoui, D. J. Walton: *A low-luminosity soft state in the short period black hole X-ray binary Swift J1753.5–0127*, 2016, MNRAS, 458, 1636

**A. W. Shaw**, P. A. Charles, A. J. Bird, R. Cornelisse, J. Casares, F. Lewis, T. Muñoz-Darias, D. M. Russell, C. Zurita: *A 420-day X-ray/optical modulation and extended X-ray dips in the short-period transient Swift J1753.5–0127*, 2013, MNRAS, 433, 74

#### **Refereed publications as co-author:**

R. M. Ludlam, A. D. Jaodand, J. A. García, N. Degenaar, J. A. Tomsick, E. M. Cackett, A. C. Fabian, P. Gandhi, D. J. K. Buisson, **A. W. Shaw**, D. Chakrabarty: *Simultaneous NICER and NuSTAR Observations of the Ultra-compact X-ray Binary 4U 1543-624*, 2021, accepted for publication in ApJ, arXiv:2012.10461

R. M. Plotkin, A. Bahramian, J. C. A. Miller-Jones, M. T. Reynolds, P. Atri, T. J. Maccarone, **A. W. Shaw**, P. Gandhi: *Toward a Larger Sample of Radio Jets from Quiescent Black Hole X-ray Binaries*, 2021, accepted for publication in MNRAS, arXiv: 2103.02178

B. E. Tetarenko, **A. W. Shaw**, E. R. Manrow, P. A. Charles, T. D. Russell, A. J. Tetarenko: *Using Optical Spectroscopy to Map the Geometry and Structure of the Irradiated Accretion Discs in Low-mass X-ray Binaries: The Pilot-Study of MAXI J0637-430*, 2021, MNRAS, 501, 3406

A. Bahramian, C. O. Heinke, J. A. Kennea, T. J. Maccarone, P. A. Evans, R. Wijnands, N. Degenaar, J. J. M. in 't Zand, **A. W. Shaw**, L. E. Rivera Sandoval, S. McClure, A. J. Tetarenko, J. Strader, E. Kuulkers, G. R. Sivakoff: *The Swift Bulge Survey: Motivation, strategy, and first X-ray results*, 2021, MNRAS, 501, 2790

D. J. K. Buisson, A. C. Fabian, P. Gandhi, E. Kara, M. L. Parker, **A. W. Shaw**, J. A. Tomsick, D. J. Walton, J. Wang: *MAXI J1820+070 with NuSTAR II. Flaring during the hard to soft state transition with a long soft lag*, 2020, MNRAS, 500, 3976

J. van den Eijnden, N. Degenaar, T. D. Russell, D. J. K. Buisson, D. Altamirano, M. Armas Padilla, A. Bahramian, N. Castro Segura, F. A. Fogantini, C. O. Heinke, T. Maccarone, D. Maitra, J. C. A. Miller-Jones, T. Muñoz-Darias, M. Özbey Arabaci, D. M. Russell, **A. W. Shaw**, G. Sivakoff, A. J. Tetarenko, F. Vincentelli, R. Wijnands: *The variable radio counterpart of Swift J1858.6-0814*, 2020, MNRAS, 496, 4127

C. O. Heinke, M. G. Ivanov, L. Chomiuk, H. N. Cohn, S. Crothers, T. de Boer, N. Ivanova, E. W. Koch, A. K. H. Kong, N. Leigh, P. M. Lugger, L. Nelson, C. J. Parr, E. W. Rosolowsky, A. J. Ruiter, C. L. Sarazin, **A. W. Shaw**, G. R. Sivakoff, M. van den Berg: *The X-ray Emissivity of Low-Density Stellar Populations*, 2020, MNRAS, 492, 5684

D. J. K. Buisson, A. C. Fabian, D. Barret, F. Fürst, P. Gandhi, J. A. García, E. Kara, K. K. Madsen, J. M. Miller, M. L. Parker, **A. W. Shaw**, J. A. Tomsick, D. J. Walton: *MAXI J1820+070 with NuSTAR I. An increase in variability frequency but a stable reflection spectrum: coronal properties and implications for the inner disc in black hole binaries*, 2019, MNRAS, 490, 1350

Y. Zhao, C. O. Heinke, S. S. Tsygankov, **A. W. Shaw**: *Soft excess in the quiescent Be/X-ray pulsar RX J0812.4-3114*, 2019, MNRAS, 488, 4427

P. R. Hebbard, C. O. Heinke, G. R. Sivakoff, **A. W. Shaw**: *X-ray spectroscopy of the candidate AGN in Henize 2-10 and NGC 4178*:

G.-B Zhang, F. Bernardini, D. M. Russell, J. D. Gelfand, J.-P. Lasota, A. Al Qasim, A. AlMannaei, K. I. I. Koljonen, **A. W. Shaw**, F. Lewis, J. A. Tomsick, R. M. Plotkin, J. C. A. Miller-Jones, D. Maitra, J. Homan, P. A. Charles, P. Kobel, D. Perez, R. Doran: *Bright mini-outburst ends the 12-year long activity of the black hole candidate Swift J1753.5-0127*, 2019, ApJ, 876, 5

D. Mata Sánchez, T. Muñoz-Darias, J. Casares, P. A. Charles, M. Armas Padilla, J. A. Fernández-Ontiveros, F. Jiménez-Ibarra, P. G. Jonker, M. Linares, M. A. P. Torres, **A. W. Shaw**, P. Rodríguez-Gil, T. Van Grunsven, P. Blay, M. D. Caballero-García, A. Castro-Tirado, P. Chinchilla, C. Farina, A. Ferragamo, F. Lopez-Martinez, J. A. Rubiño-Martin, L. Suárez-Andrés: *The 1989 and 2015 outbursts of V404 Cygni: a global study of wind-related optical features*, 2018, MNRAS, 481, 2646

A. J. Tetarenko, A. Bahramian, R. Wijnands, C. O. Heinke, T. J. Maccarone, J. C. A. Miller-Jones, J. Strader, L. Chomiuk, N. Degenaar, G. R. Sivakoff, D. Altamirano, A. T. Deller, J. A. Kennea, K. L. Li, R. M. Plotkin, T. D. Russell, **A. W. Shaw**: *A radio frequency study of the accreting millisecond X-ray pulsar, IGR J16597- 3704, in the globular cluster NGC 6256*, 2018, ApJ, 854, 125

P. Gandhi, M. Bachetti, V. S. Dhillon, R. P. Fender, L. K. Hardy, F. A. Harrison, S. P. Littlefair, J. Malzac, S. Markoff, T. R. Marsh, K. Mooley, D. Stern, J. A. Tomsick, D. J. Walton, P. Casella, F. Vincentelli, D. Altamirano, J. Casares, C. Ceccobello, P. A. Charles, C. Ferrigno, R. I. Hynes, C. Knigge, E. Kuulkers, M. Pahari, F. Rahoui, D. M. Russell, **A. W. Shaw**: *An elevation of 0.1 light-seconds for the optical jet base in an accreting Galactic black hole system*, 2017, Nature Astronomy, 1, 859

R. M. Plotkin, J. Bright, J. C. A. Miller-Jones, **A. W. Shaw**, J. A. Tomsick, T. D. Russell, G. -B. Zhang, D. M. Russell, R. P. Fender, J. Homan, P. Atri, F. Bernardini, J. D. Gelfand, F. Lewis, T. M. Cantwell, S. H. Carey, K. J. B. Grainge, J. Hickish, Y. C. Perrott, N. Razavi-Ghods, A. M. M. Scaife, P. F. Scott, D. J. Titterton: *Up and down the black hole radio/X-ray correlation: The 2017 mini-outbursts from Swift J1753.5-0127*, 2017, ApJ, 848, 92

F. Rahoui, J. A. Tomsick, P. Gandhi, P. Casella, F. Fürst, L. Natalucci, A. Rossi, **A. W. Shaw**, V. Testa, D. J. Walton: *The nova-like nebular optical spectrum of V404 Cygni at the beginning of the 2015 outburst decay*, 2017, MNRAS, 465, 4468

A. P. Rushton, **A. W. Shaw**, R. P. Fender, D. Altamirano, P. Gandhi, P. Uttley, P. A. Charles, M. Kolehmainen, G. E. Anderson, C. Rumsey, D. J. Titterton: *Disk-jet quenching of the Galactic black hole Swift J1753.5-0127*, 2016, MNRAS, 463, 628

P. Gandhi, S. P. Littlefair, L. K. Hardy, V. S. Dhillon, T. R. Marsh, **A. W. Shaw**, M. D. Caballero-Garcia, D. Altamirano, J. Casares, P. Casella, P. A. Charles, Y. Dallilar, S. Eikenberry, R. P. Fender, R. I. Hynes, C. Knigge, E. Kuulkers, K. Mooley, T. Muñoz-Darias, M. Pahari, F. Rahoui, D. M. Russell, J. V. Hernández Santisteban, T. Shahbaz, D. M. Terndrup, J. A. Tomsick, D. J. Walton: *Furiously fast and red: Sub-second optical flickering in V404 Cyg during the 2015 outburst peak*, 2016, MNRAS, 459, 554

F. Bernardini, D. M. Russell, **A. W. Shaw**, F. Lewis, P. A. Charles, K. I. I. Koljonen, J. P. Lasota, J. Casares: *Events leading up to the Jun 2015 outburst of V404 Cyg*, 2016, ApJ, 818, L5

#### Conference proceedings:

**A. W. Shaw**, P. A. Charles, J. Casares, D. Steeghs: *The orbital period of MAXI J1305-704*, 2017, 7 years of MAXI: Monitoring X-ray Transients, proceedings, ed. M. Serino, M. Shidatsu, W. Iwakiri & T. Mihara, p. 45

P. A. Charles, **A. W. Shaw**, M. Coriat, P. Gandhi, L. J. Townsend, P. Woudt, J. Casares, M. M. Kotze, D. Steeghs, R. P. Fender, A. A. Zdziarski: *Multi-wavelength Studies of High Latitude Black Hole X-ray Transients*, 2015, Proceedings of the SALT Science Conference 2015, proceedings, ed. D.A.H. Buckley, & A.C. Schröder, id 23

**A. W. Shaw**, P. A. Charles, A. J. Bird, R. Cornelisse, J. Casares, V. S. Dhillon, R. P. Fender, M. Kolehmainen, F. Lewis, T. Muñoz-Darias, D. M. Russell, C. Zurita: *The Black Hole transient Swift J1753.5-0127 - A 420 day X-ray/optical modulation and extended X-ray dips*, 2014, Suzaku-MAXI 2014: Expanding the Frontiers of the X-ray Universe, proceedings, ed. M. Ishida, R. Petre & K.

Mitsuda, p.214