November 29, 2009

Professor A.C. Fabian
Institute of Astronomy
Madingley Road
Cambridge, Cambridgeshire CB3 0HA
United Kingdom

Dear Prof. Fabian:

Please accept the attached application for your postdoctoral position to work within the Institute of Astronomy X-ray Group advertised through the AAS Job Register. A major part of my past and on-going research has focused on better understanding feedback from active galactic nuclei (AGN). As such, I have studied, and am deeply interested in, the accretion modes which fuel supermassive black holes to become AGN, the mechanisms which result in relativistic AGN jets, how AGN transport radiative and mechanical energy to an ambient medium, and how that energy alters the environment.

I feel the IoA is an excellent fit for me, and the IoA research environment will benefit from my addition. My expertise in radio and X-ray astronomy – in addition to experience with infrared, optical, and UV analysis – ideally suits me to further study accreting SMBHs using the existing and next generation of facilities/instruments (*i.e.* NuStar, Simbol-X, SOFIA, ALMA, LOFAR). I am also eager to expand my research into theoretical modeling, specifically to consolidate our understanding of radio galaxies and their environments into a unified model which describes isolated FR-Is through FR-IIs in dense clusters.

Along with this letter are my CV, a list of publications, and a summary of my research interests. Letters of recommendation from Megan Donahue, Brian McNamara, and Mark Voit should arrive under separate cover. Please do not hesitate to contact me if there is any further information I can provide as you review my application.

Thank you for your consideration.

Sincerely,

Dr. Kenneth W. Cavagnolo
University of Waterloo

Dr. Kenneth W. Cavagnolo
Curriculum Vitae

Last updated November 27, 2009; Hyperlinks colored blue

University of Waterloo
Department of Physics & Astronomy
200 University Avenue West
Waterloo, Ontario, Canada N2L 3G1

Office: 519-888-4567 ext. 35074
Home: 517-285-9062
E-mail: kencavagnolo@gmail.com
Web: www.pa.msu.edu/people/cavagnolo/

Education

Michigan State University Ph.D., Astronomy & Astrophysics	2005 - 2008
Michigan State University M.S., Astronomy & Astrophysics	2002 - 2005
Georgia Institute of Technology B.S., Physics	1998 - 2002

Research Experience

Postdoctoral Fellow Supervisor: Dr. Brian McNamara, *Univ. of Waterloo*	2008 - Present
Graduate Research Assistant Supervisor: Dr. Megan Donahue, *Mich. St. Univ.*	2003 - 2008
Graduate Research Assistant Supervisor: Dr. Jack Baldwin, *Mich. St. Univ.*	2002 - 2003
Undergraduate Research Assistant Supervisor: Dr. James Sowell, *Geor. Inst. of Tech.*	2000 - 2002

Research Interests

- Galaxy clusters and groups
- Galaxy evolution and formation
- Active galactic nuclei and jets
- Black hole formation and evolution
- Large scale structure and cosmology

Honors

• Referee for ApJ, AJ, and CanTAC	2008 - Present
• Sherwood K. Haynes Award for Outstanding Graduate Student	2008
• MSU College of Natural Science Dissertation Fellow	2007 - 2008
• American Physical Society Member	2002 - Present
• ΣΠΣ National Physics Honor Society Member	2001 - Present
• ΣΞ National Scientific Research Society Member	2009 - Present
• Perimeter Institute Black Hole Reading Group Member	2009 - Present
• Dean's List, Georgia Tech	1998-2002

Scientific Skills

- Extensive experience with X-ray and radio data analysis
- Familiarity with infrared, optical, and UV data analysis
- Understanding of AIPS, CASA, CIAO, and IRAF analysis software
- Fluent in HTML, IDL, LaTeX, and PERL programming languages
- Worked with C, FLASH, FORTRAN, MySQL, PYTHON, SuperMongo, and TCL
- Mastery of DOS, Linux, Macintosh, and Windows computing architectures
- Expert of computer maintenance, system construction, and troubleshooting

Observing Experience

Giant Metrewave Radio Telescope (GMRT) — Jan. 2010
59 hours observing 13 galaxy groups

GMRT — Feb. 2010
109 hours observing 20 galaxy clusters

Chandra X-ray Observatory (CXO) — Jan. 2009
21 hours observing IRAS 09104+4109

Very Large Array Radio Telescope (VLA) — Dec. 2008
39 hours observing 13 giant ellipticals

Proposals & Grants

GMRT Cycle 17, Co-I — 2009
The Power and Particle Content of Extragalactic Radio Sources
PI: Dr. Somak Raychaudhury, *Univ. Birmingham*

GMRT Cycle 17, Co-I — 2009
The Morphology of Steepest Spectrum Radio Sources in Galaxy Cluster Cores
PI: Dr. Alastair Edge, *Durham Univ.*

GMRT Cycle 16, Co-I — 2008
The Content of Giant Cavities in the IGM of Galaxy Clusters
PI: Dr. Somak Raychaudhury, *Univ. Birmingham*

CXO Cycle 10, PI — 2008
IRAS 09104+4109: An Extreme Brightest Cluster Galaxy

CXO Cycle 10, Co-I — 2008
Conduction and Multiphase Structure in the ICM
PI: Dr. Mark Voit, *Mich. St. Univ.*

Spitzer Cycle 5, Co-I — 2008
Star Formation and AGN Feedback in BCGs
PI: Dr. Megan Donahue, *Mich. St. Univ.*

Spitzer Cycle 5, Co-I — 2008
Infrared Properties of a Control Sample of Brightest Cluster Galaxies
PI: Dr. Megan Donahue, *Mich. St. Univ.*

NSF Grant, Co-I — 2008
Star Formation in the Universe's Largest Galaxies
PI: Dr. Mark Voit, *Mich. St. Univ.*

CXO Cycle 9, Co-I 2007
Quantifying Cluster Temperature Substructure
PI: Dr. Mark Voit, *Mich. St. Univ.*

VLA A-configuration Cycle, Co-I 2007
Radio Feedback in Clusters and Galaxies
PI: Dr. Brian McNamara, *Univ. Waterloo*

Public Outreach

Astronomers Without Borders (AWB) 2009-present
Organized the affiliate chapter of AWB at the University of Waterloo.

International Year of Astronomy (IYA) 2009
Helped with events in Waterloo, Ontario for IYA such as observing nights, public talks, and workshops.

Teaching Experience

Substitute Instructor Fall 2006
Course: "Visions of the Universe"

Honors Physics Tutor Summer 2003
Course: "Introductory Honors Physics I & II"

Graduate Teaching Assistant 2002 - 2003
Course: "Visions of the Universe"

References (ordered by preference)

Dr. Megan Donahue, donahue@pa.msu.edu +00-1-517-884-5618
Tenured professor, Michigan State University

Dr. Brian McNamara, mcnamara@uwaterloo.ca +00-1-519-888-4567 ext. 38170
Tenured professor, University of Waterloo

Dr. G. Mark Voit, voit@pa.msu.edu +00-1-517-884-5619
Tenured professor, Michigan State University

Dr. Chris Carilli, ccarilli@nrao.edu +00-1-505-835-7000
National Radio Astronomy Observatory Chief Scientist

Dr. Jack Baldwin, baldwin@pa.msu.edu +00-1-517-884-5611
Associate Chair for Astronomy, Michigan State University

Dr. Paul Nulsen, pnulsen@cfa.harvard.edu +00-1-617-495-7043
Research Scientist, Center for Astrophysics at Harvard University

Dr. Mike Wise, wise@science.uva.nl +31-0-521-595-564
LOFAR Radio Observatory Chief Scientist

Personal Interests

- Academic: Environmental sciences, "Cradle2Cradle" design, and urban planning
- Athletics: Triathlons, baseball, rock climbing, and Georgia Tech athletics
- Hobbies: Backpacking, reading, building model airplanes, and raising bonsai trees

Dr. Kenneth W. Cavagnolo
List of Publications

Last updated November 27, 2009; Hyperlinks colored blue

In Preparation

"A Relationship Between AGN Jet Power and Radio Luminosity"
K. Cavagnolo, B. McNamara, P. Nulsen, C. Carilli, C. Jones, W. Forman, L. Bîrzan, & S. Murray
In prep. for ApJ

"Gas Uplift and AGN Heating from the Changing-Look QSO in IRAS 09104+4109"
K. Cavagnolo, M. Donahue, B. McNamara, & G.M. Voit
In prep. for ApJ

"A Multiwavelength Analysis of the Galaxy Cluster RBS 797: Evidence for a Cluster-scale Line-of-Sight AGN Outburst"
K. Cavagnolo, B. McNamara, P. Nulsen, M. Wise, M. Gitti, & M. Brüggen
In prep. for ApJ

"Entropy Scaling Relations of ACCEPT Galaxy Clusters"
K. Cavagnolo, G.M. Voit, & M. Donahue
In prep. for ApJ

"Constraining the Spin of Black Holes Using Measured AGN Jet Powers"
M. Rohanizadegan, B. McNamara, F. Kazemzadeh, P. Nulsen, **K. Cavagnolo**, & C. Kirkpatrick
In prep. for ApJL

First Author Refereed Papers

"Intracluster Medium Entropy Profiles for a Chandra Archival Sample Of Galaxy Clusters"
K. Cavagnolo, M. Donahue, G.M. Voit, & M. Sun
ApJ Accepted, 2009

"An Entropy Threshold for Strong Hα and Radio Emission in the Cores of Galaxy Clusters"
K. Cavagnolo, M. Donahue, G.M. Voit, & M. Sun
ApJ Accepted, 2008

"Bandpass Dependence of X-Ray Temperatures in Galaxy Clusters"
K. Cavagnolo, M. Donahue, G.M. Voit, & M. Sun
ApJ Accepted, 2008

Co-Author Refereed Papers

"Direct Evidence for an Outflow of Metal-Enriched Gas Along the Radio Jets of Hydra A"
C. Kirkpatrick, M. Gitti, **K. Cavagnolo**, B. McNamara, L. David, P. Nulsen, & M. Wise
ApJL Accepted, 2009

"A Chandra X-ray Analysis of Abell 1664: Cooling, Feedback and Star Formation in the Central Cluster Galaxy"
C. Kirkpatrick, B. McNamara, D. Rafferty, P. Nulsen, L. Birzan, F. Kazemzadeh, M. Wise, M. Gitti, & **K. Cavagnolo**
ApJ Accepted, 2009

"Conduction and the Star Formation Threshold in Brightest Cluster Galaxies"
G.M. Voit, **K. Cavagnolo**, M. Donahue, D. Rafferty, B. McNamara, & P. Nulsen
ApJ Accepted, 2008

"Star Formation, Radio Sources, Cooling X-Ray Gas and Galaxy Interactions in the Brightest Cluster Galaxy in 2A0335+096"
M. Donahue, M. Sun, C. O'Dea, G.M. Voit, & **K. Cavagnolo**
AJ Accepted, 2007

"s-Process Abundances in Planetary Nebulae"
B. Sharpee, Y. Zhang, R. Williams, E. Pellegrini, **K. Cavagnolo**, J. Baldwin, M. Phillips, & X. Liu
ApJ Accepted, 2007

"Entropy Profiles in the Cores of Cooling Flow Clusters of Galaxies"
M. Donahue, D. Horner, **K. Cavagnolo**, & G.M. Voit
ApJ Accepted, 2006

Presented Work & Talks

TALK: *"The AGN Jet Power and Radio Power Relationship for Isolated Giant Elliptical Galaxies"*
Jun. 2009 – The Monster's Fiery Breath: Feedback in galaxies, groups, and clusters; University of Wisconsin-Madison

INVITED TALK: *"Using Galaxy Clusters as Galaxy Formation Labs"*
Oct. 2008 – Undergraduate Seminar Series; University of Waterloo

INVITED TALK: *"Understanding Cluster Cores: The Role of Core Entropy"*
Sep. 2008 – The Cool, Cooler and Cold - Cluster Cooling Flows in a New Light; Lorentz Center, Leiden University

INVITED TALK: *"Investigating Feedback and Relaxation in Clusters of Galaxies"*
Jul. 2008 – Center for Study of Cosmic Evolution; Michigan State University

INVITED TALK: *"From Cluster Cosmology to Galaxy Formation in Under One Hour"*
Mar. 2008 – Astrophysics Seminar; University of Waterloo

INVITED TALK: *"The Effect of Cluster Feedback on High-Precision Cosmology"*
Feb. 2008 – NASA Space Science and Technology Center; UAH-Huntsville

INVITED TALK: *"Understanding Feedback in Galaxy Clusters"*
Jan. 2008 – Center for Study of Cosmic Evolution; Michigan State University

INVITED TALK: *"Band Dependence of X-ray Temperatures"*
Oct. 2007 – Astrophysics Seminar; University of Michigan

POSTER: *"The Entropy-Feedback Connection and Quantifying Cluster Virialization"*
Oct. 2007 – Eight Years of Science with Chandra; UAH-Huntsville

POSTER: *"Chandra Studies of Dark Matter and Galaxy Formation: Signatures from the Intracluster Medium"*
Dec. 2006 – American Astronomical Society Winter Meeting

PROCEEDING: *"Abundances of s-process elements in planetary nebulae: Br, Kr & Xe"*
Jul. 2006 – International Astronomical Union Symposium

POSTER: *"Studies of Entropy Distributions in X-ray Luminous Clusters of Galaxies"*
Dec. 2005 – American Astronomical Society Winter Meeting

POSTER: *"Entropy Distributions in the Cores of Nearby X-ray Luminous Clusters of Galaxies"*
Dec. 2004 – American Astronomical Society Winter Meeting

POSTER: *"Radio-Free Cluster Cooling Flows"*
Dec. 2004 – American Astronomical Society Winter Meeting

Dr. Kenneth W. Cavagnolo
Statement of Research Interests

Introduction

The gravitational binding energy liberated by active galactic nuclei (AGN), *i.e.* accreting supermassive black holes (SMBHs), plays a vital role in regulating the process of hierarchical structure formation [*e.g.* 1, 2, 3, 4, 5, 6]. Observations robustly indicate most, if not all, galaxies harbor a centralized SMBH which has co-evolved with the host galaxy giving rise to the well-known bulge luminosity-stellar velocity dispersion correlation [7, 8]. Current models for the evolution of dark matter halos (and the baryons within) invoke a feedback loop where the processes of environmental cooling and heating are coupled via AGN [9, 10]. In broad terms, AGN feedback has been segregated into two modes which occur at different cosmic epochs: an early-time radiatively-dominated mode, and a late-time mechanically-dominated mode. While this model is successful in reproducing the bulk properties of the Universe, the details (*i.e.* accretion processes, obscuration, power generation, energy dissipation) are poorly understood. It is these details which interest me most.

Relevant Completed and On-going Research

Up to now, my research has focused primarily on understanding the mechanical feedback from AGN and the associated effects on galaxy clusters. I have devoted particular attention to intracluster medium (ICM) entropy distribution [11], the process of cluster virialization [12], the mechanisms by which SMBHs might acquire fuel from their environments to become AGN [13], and how those mechanisms correlate with properties of clusters cores [14].

From these studies it has become apparent that certain conditions must be established within a cluster core (and presumably any environment which supplies fuel for a SMBH, *e.g.* a brightest cluster galaxy (BCG) corona [15]), namely that the mean entropy (K) of the large-scale environment hosting a SMBH must be $K \lesssim 30$ keV cm^2. Coincidentally, this is the entropy scale above which thermal electron conduction is capable of stabilizing a cluster core against the formation of thermal instabilities, hinting at a method for coupling AGN feedback energy to the ICM and establishing a self-regulating feedback loop. This result is made more interesting if the heat-flux-driven-buoyancy instability [HBI, 16] is an important process in clusters with central cooling times $\ll H_0^{-1}$. Full MHD simulations have shown that the HBI, in conjunction with reasonable magnetic field strengths ($\sim 1\ \mu$G), modest heating from an AGN ($\sim 10^{43}$ erg s^{-1}) and subsonic turbulence, can feasibly stabilize a core against catastrophic cooling [17, 18]. In addition, recent radio polarization measurements for Virgo cluster galaxies suggest the large-scale magnetic field of Virgo's ICM is radial oriented [19]. This result is tantalizing since it suggests the magnetothermal instability [20] may be operating within Virgo, furthering the case that conduction is a vital component of understanding galaxy cluster evolution. In total, these studies touch on a larger subject which is of great interest to me: magnetic fields in clusters.

LOFAR came online fall 2009, and the order of magnitude improvement in angular resolution and sensitivity at low radio frequencies opens a new era in studying ICM magnetic fields via polarimetry [21]. Polarization measurements made with LOFAR will enable direct detection of ICM field strengths and structure on scales as small as cluster cores ($\lesssim$ 50 kpc) and as large as cluster virial radii ($\sim$ few Mpc). A systematic study of a cluster sample using LOFAR will expand our view of magnetic field demographics and how they relate to cluster properties like temperature gradients, core entropy, recent AGN activity, and the structure of cold gas filaments in cluster cores. In addition, we will be able to investigate the origin and evolution of the fields: were they seeded by early AGN activity? Are they amplified by mergers? Is there evidence of draping or entrainment? Understanding cluster magnetic fields will also place constraints on ICM properties, like viscosity, which govern the microphysics by which AGN feedback energy might be dissipated as heat, *e.g.* via turbulence and/or MHD waves.

My most recent research has focused on the SMBH engines which underlie AGN. One study recently completed [22] investigates a more precise calibration between AGN jet power ($P_{\rm jet}$) and emergent radio emission ($L_{\rm radio}$) for a sample of giant ellipticals (gEs) and BCGs. In this study we estimated $P_{\rm jet}$ using cavities excavated in the ICM as bolometers, and measured $L_{\rm radio}$ at multiple frequencies using new and archival VLA observations. We found, regardless of observing frequency, that $P_{\rm jet} \propto 10^{16} L_{\rm radio}^{0.7}$erg s^{-1}, which is in general agreement with models for confined heavy jets. The utility of this relation lies in being able to estimate total jet power from monochromatic all-sky radio surveys for large samples of AGN at various stages of their outburst cycles. This should yield constraints on the kinetic heating of the Universe over swathes of cosmic time, and as a consequence, can be used to infer the total accretion history and growth of SMBHs over those same epochs.

An interesting result which has emerged from our work, and which is investigated in [23], is that FR-I radio galaxies (classified on morphology and not $L_{\rm radio}$) appear to be systematically more radiatively efficient than FR-II sources. This may mean there are intrinsic differences in radio sources (light and heavy jets), or possibly that all jets are born light and become heavy on large scales due to entrainment. One way to investigate this result more deeply is to undertake a systematic study of the environments hosting radio galaxies utilizing archival *Chandra* and VLA data.

With tighter observational constraints on the kinetic properties of AGN jets, of interest to me is re-visiting existing models for relativistic jets in an ambient medium. Utilizing observationally-based estimates of jet power, it is possible to better understand the growth of a radio source including effects like entrainment and evolution of jet composition [á la 24]. Another interesting use of a universal $P_{\rm jet}$-$L_{\rm radio}$ relation is using radio luminosities, lobe morphologies, and age estimates to predict ambient gas pressures: $p_{\rm amb} \propto (t_{\rm age} L_{\rm radio})/V_{\rm radio}$. This yields an estimate of ambient densities when basic assumptions are made about environment temperatures: $\rho_{\rm amb} \propto p/T$. With an estimate of ambient densities, X-ray observing plans for very interesting radio sources which reside in faint group environments (*i.e.* FR-I sources) can be robustly prepared. An observationally-based estimate of $P_{\rm jet}$ also enables the investigation of relations between observable mass accretion surrogates (*i.e.* Hα luminosity, molecular/dust mass, or nuclear X-ray luminosity) and AGN energetics for the purpose of establishing clearer connections with accretion mechanisms and efficiencies.

Future Research

The study of mechanically-dominated AGN feedback has advanced quickly in the last decade primarily because the process is readily observed at low-redshifts, and the hot gas phase which this mode of feedback most efficiently interacts is accessible with the current generation of X-ray observatories. However, our understanding of radiative feedback, and the associated early era of rapid SMBH growth, has not progressed as quickly. This is mostly because cold/dusty gas is required for high efficiency radiative feedback, but the presence of cold/dusty gas is typically accompanied by significant optical obscuration which prevents direct observational study [25]. Luckily, the quality and availability of multi-frequency data (radio, sub-mm, IR, optical, UV, and X-ray) needed to probe the epoch of SMBH growth and obscuration is poised to improve with new facilities and instruments coming on-line (*i.e.* LOFAR, Herschel, SCUBA-2, SOFIA, ALMA, NuStar, Simbol-X). As such, there are a number of questions regarding the formation and evolution of SMBHs that I would like to pursue.

(1) What is the evolutionary track from young, gas-rich, dusty galaxies to present-day old, parched gEs? It has been argued that high-*z* sub-mm galaxies (SMGs) are the progenitors for low-*z* Magorrian spirals and ellipticals, suggesting SMGs are useful for studying the co-evolution of SMBHs and host galaxies. It has been shown SMGs are found in very dense environments and have high AGN fractions ($\gtrsim$ 50%) [26], so they are excellent for identifying the rapidly cooling high-*z* gas-rich regions where star formation and AGN activity can be fueled. Hence, SMGs identify a population primed for follow-up with far-IR and X-ray spectroscopy to study feedback and cooling in unique environments. In total, SMGs may be the missing piece to understanding how SMBH evolution and AGN activity regulate the transition from gas-rich progenitors to "red and dead" ellipticals. It has also been posited that SMGs are high-*z* analogs of low-*z* ULIRGs (objects typically associated with the sites of merging gas-rich spirals). If this is the case, insight to ULIRG evolution can be gained from studying SMGs. ULIRGs are an interesting population on their own, one for which limited X-ray spectroscopic studies have been undertaken. We know these systems to, on average, be dominated by star formation, however, some systems may have significant contribution from AGN, and these systems can be used to further understand the nature of evolving gas-rich systems.

(2) How does SMBH activity depend on environment? Specifically what is the relationship between redshift, environment, and feedback energy? The answer thus far is unclear, most likely because the influence of environment on AGN jets (through entrainment and confinement) has been neglected or treated too simply in models. This is where observations step in to place interesting constraints on the problem. To this end, a study of the faint radio galaxy population using archival *Chandra* and VLA data would be interesting. Undertaking a systematic study of radio galaxy properties (*i.e.* jet composition, morphologies, outflow velocities, magnetic field configurations) as a function of environment (*i.e.* ambient pressure, halo compactness) can help address how AGN energetics couple to environment, which ultimately suggests how accretion onto the SMBH couples to environment on small and large scales. Deep *Chandra* observations for a sample of FR-I's (a poorly studied population in the X-ray) would also be useful for such a study, using the $P_{\rm jet}$-$L_{\rm radio}$ relation to define robust observation requests.

(3) How does the transition from an obscured to unobscured state correlate with AGN feedback and SMBH growth? As suggested by the low AGN fraction in the *Chandra* Deep Fields, a significant population of obscured AGN must exist at higher redshifts. One method of selecting unbiased samples

of these objects is to assemble catalogs of candidate AGN using hard X-ray (*i.e.* NuStar), far-IR (*i.e.* SOFIA), and sub-mm (*i.e.* SCUBA-2) observations. Because current models suggest the luminous quasar population begins in an obscured state, and rapid acquisition of SMBH mass may occur in this phase because of high accretion rates (possibly exceeding $10-100\ L_{\rm Edd.}$), understanding the transition from obscured to unobscured states is vital. How does accretion proceed and where does the accreting material come from: gas cooling out of the atmosphere? Gas stripped from merging companions? Is accretion spherical and dictated by local gas density (*e.g.* Bondi)? A key component which has been neglected in AGN studies is the contribution of dust (which should be a significant component in the atmospheres of obscured AGN) in increasing the allowed Eddington luminosity for an accreting SMBH (*i.e.* $L_{\rm Edd.} \propto \mu$). A curiosity which has emerged in recent years which may be interesting, particularly during the obscured stage when the merger rate is presumably high, is the role of multiple SMBHs within the core of a host galaxy. At a minimum, SMBH mergers occur on a timescale determined by dynamical friction, which for a typical dense bulge is $\gtrsim 1$ Gyr, which is $\gg t_{\rm cool}$ of an obscuring atmosphere. If the SMBHs which are merging have their own accretion disks, then it is reasonable to question how the atmospheres surrounding a host galaxy with multiple AGN is affected, particularly since the transition from obscured to unobscured should proceed more quickly.

Summary

My research interests span the formation and evolution of SMBHs, particularly during their accreting mode as AGN. The general picture of structure formation is complete, and the influence of SMBHs is undeniably important, but missing is a better understanding of the details of accretion, interaction with ambient atmospheres, and energy redistribution via AGN. To this end, more observational constraints are needed, particularly using multiwavelength datasets from upcoming missions. I am well-positioned to make meaningful contributions in such a pursuit, and would like to do so as an IoA post-doc.

References

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[12] K. W. Cavagnolo, M. Donahue, G. M. Voit, and M. Sun. Bandpass Dependence of X-Ray Temperatures in Galaxy Clusters. *ApJ*, 682:821–834, August 2008.

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[26] D. M. Alexander, F. E. Bauer, S. C. Chapman, I. Smail, A. W. Blain, W. N. Brandt, and R. J. Ivison. The X-Ray Spectral Properties of SCUBA Galaxies. *ApJ*, 632:736–750, October 2005.

Application for Employment – Cover Sheet - PD18

UNIVERSITY OF CAMBRIDGE

The information given will be processed for employment selection and statistical purposes. Applications will be retained for the successful candidate. Applications from unsuccessful candidates will be retained for up to twelve months. If you require this in an alternative format, contact the department to which you are applying.

This form is broken down into three parts. Part I contains information that will be used in the selection process. This should be completed by all applicants. Part II contains information for additional vetting. This is required for some posts and you will be advised accordingly. Part III is requested of all applicants and provides equal opportunity information. This information is not used as part of the selection process.

Position applied for	**Postdoctoral researcher with the astronomy group led by Prof. Andy Fabian.**
Department	**Institute of Astronomy**
Vacancy Reference	**LG02509**

PART I

PERSONAL DETAILS

Forename(s) **Kenneth**	Surname **Cavagnolo**	Title **Dr**.
Current Address : **601-307 Queen St. South** **Kitchener, ON, Canada** Post code: **N2G 4V3**	Contact details: (1) Daytime telephone: **1-517-285-9062** (2) Mobile: **1-517-285-9062** (3) E-mail address: k**cavagno@uwaterloo.ca**	
	Do you require a work permit/permission to work in the UK? Yes ☒ No ☐	
Current salary and any financial benefits: **$48,000 CAD; full medical**	Current notice period: **None required**	

WORK REFERENCES

References should normally be work related references and include your present employment (or your most recent employer) or course tutor if currently a student. For academic appointments, one of the references should be external to the University. The job advertisement should indicate whether you are required to submit two or three references.
Name: **Dr. Megan Donahue**
Position: **Michigan State University Professor**
Address: **Department of Physics and Astronomy; Michigan State University** **Biomedical Physical Sciences Building** **East Lansing, MI, 48824-2320, USA**
Telephone number: **00-1-517-884-5618**
E-mail address: **donahue@pa.msu.edu**
Do we have permission to contact this referee before the interview? Yes ☒ No ☐

Name: **Dr. G. Mark Voit**
Position: **Michigan State University Professor**
Address: **Department of Physics and Astronomy; Michigan State University** **Biomedical Physical Sciences Building** **East Lansing, MI, 48824-2320, USA**
Telephone number: **00-1-517-884-5619**
E-mail address: **voit@pa.msu.edu**
Do we have permission to contact this referee before the interview? Yes ☒ No ☐

Third Reference

Name: **Dr. Brian McNamara**
Position: **University of Waterloo Professor**
Address: **University of Waterloo; Department of Physics & Astronomy** **200 University Avenue West** **Waterloo, Ontario, Canada N2L 3G1**
Telephone number: **00-1-519-888-4567 ext. 38170**
E-mail address: **mcnamara@uwaterloo.ca**
Do we have permission to contact this referee before the interview? Yes ☒ No ☐

APPLICANT DECLARATION & DATA CONSENT

- I confirm that the information I have given in this application for employment form and any supporting documents is correct and complete.
- I understand that failure to disclose any relevant information or the provision of false information may lead to dismissal and subsequent termination of contract of employment.
- I understand that the University of Cambridge will carry out a verification process and will check all or any of the information provided on the application form, given in references and presented as proof of identity.
- I agree for release of information under the provisions of the Data Protection Act 1998
- I understand that an appointment, if offered, may be subject to a satisfactory medical examination.
- If I have been required to submit Part II as part of the application process, I understand that the University of Cambridge will verify the information given in Part II, which might include referral to an appropriate third party for purposes of security clearance.

Signature ……**Kenneth W. Cavagnolo**...……..

Date ……**11/21/2009**……..

PART II

For additional vetting purposes, you are required to complete Part II of the application form. As instructed, please complete only the relevant section(s) below.

A. FOR SELECTED APPLICATIONS

I Personal Details

Maiden Name (if applicable)	
Date of birth: **January, 27th 1980**	Place of birth: **Snellville, GA, USA**
Nationality: **American**	National Insurance Number: **N/A**
Driving Licence No.: **C125465870072 Issued: MI, USA**	Passport No. and Issue Date: **207705508 Issued: 31 Jan 2003**

II Personal Referees

Please complete the contact details for two referees who have known you in a personal capacity over the last five years. We may prefer to seek a written reference before the interview.

Name: **Mr. Josh Winston**	Name: **Mr. Chris Johnson**
Position: **Senior Electrical Engineer**	Position: **Entertainment Editor, Silicon Valley Business Journal**
Address: **10700 Academy Rd. NE** **#1411** **Albuquerque, NM, USA** Postcode: **87111**	Address: **700 Cypress Lane** **Campbell, CA, USA** Postcode: **95008-2111**
Telephone number: **1-505-917-9957**	Telephone number: **1-408-679-9996**
E-mail address: **jwinstongt@yahoo.com**	E-mail address: **cjphoto@gmail.com**
How long have they known you? **Seven years**	How long have they known you? **Ten years**
In what capacity have they known you? **College flatmate and close friend**	In what capacity have they known you? **Long time friend and brother-in-law**
Do we have permission to contact this referee before the interview? Yes ☒ No ☐	Do we have permission to contact this referee before the interview? Yes ☒ No ☐

III Previous Address

If you have lived at your current address for less than 5 years, please give details of all addresses for the previous five years with dates below. (Continue on additional sheet if required.)

From:	**06/2004**	To:	**08/2008**	
	(month/year)		(month/year)	Postcode: **48823**
Address: **1111 Kimberly Dr., Apt #7, East Lansing, MI, USA**				
From:		To:		
	(month/year)		(month/year)	Postcode
Address				

a. for SELECTED applications Cont'd **PART II Cont'd**

IV Additional Checks

***** I authorise the Driver and Vehicle Licensing Agency to supply any information with the exception of any medical information that may be held on its driver computer record, relating to myself and my driving entitlement past and present including any valid endorsement, disqualifications etc (within the meaning of the Road Traffic Offenders Act 1988), to an external security service.

Signature …**Kenneth W. Cavagnolo**…… Date …**11/21/2009**……

***** I authorise the United Kingdom Passport Agency to supply any information held in its records regarding the details of my passport submitted with this application to an external security service.

Signature …**Kenneth W. Cavagnolo**…… Date …**11/21/2009**……

* I request the information to be sent to external security service.

* I hereby consent to the external security service passing the results of the security vetting process to the University of Cambridge for the purpose of my application.

Signature …**Kenneth W. Cavagnolo**…… Date …**11/21/2009**……

B. FOR APPLICATIONS TO POSTS WORKING WITH CHILDREN AND VULNERABLE ADULTS OR TO SECURITY SENSITIVE AREAS

The University of Cambridge actively promotes equality of opportunity for all, as stated in our Equal Opportunities policy. Any declaration would be treated in confidence and would not be used against applicants unfairly. A conviction does not automatically prevent you from being approved, however failure to declare will lead to immediate action.

Where it is a requirement of the post to submit an Enhanced Disclosure application to the Criminal Records Bureau this information will be treated in confidence. Any disclosed information will be discussed with short listed applicants. Any applicant that fails to reveal information relevant to the position applied for that is subsequently revealed on Disclosure may have their conditional offer of employment withdrawn.

This post is subject to the Rehabilitation of Offenders Act 1974. You should complete this section if you have any court action pending against you, been cautioned, or have criminal convictions that are not considered 'spent' under the Rehabilitation of Offenders Act 1974.

Have you ever been cautioned / convicted of a criminal offence / have any hearings pending? Yes ☐ No ☒

If 'YES' please give further information

If you are applying for a post that is exempt from the provisions of the Rehabilitation of Offenders Act 1974 you must disclose ALL criminal convictions found against you (spent and unspent). The recruiting department will confirm if the post is exempt and therefore, what you must declare.

EQUAL OPPORTUNITIES MONITORING SLIP **PART III**

The University is an Equal Opportunities employer and is committed to treating all job applications on their merits. The information provided here will not be used in considering your application but will be collected centrally to check that the University is treating all applicants on the basis of their ability to carry out the duties of the post irrespective of gender, race or disability. Please tick the boxes below. The information will be separated from the application form and will not be given to the selection panel.

Vacancy Reference …….. Office/Post Title …… For office use

Gender

Tick the appropriate box to indicate your gender

- ☐ Female
- ☒ Male

Ethnic Origin

Choose ONE section from A to E, then tick the appropriate box to indicate your background.

A White:

- ☐ White – British
- ☐ White - Irish
- ☒ White - Other white background

B Mixed:

- ☐ White and Black Caribbean
- ☐ White and Black African
- ☐ White and Asian
- ☐ Any other mixed background

C Asian or Asian British:

- ☐ Indian
- ☐ Pakistani
- ☐ Bangladeshi
- ☐ Any other Asian background

D Black or Black British:

- ☐ Caribbean
- ☐ African
- ☐ Other Black background

E Chinese or Chinese British or other ethnic group:

- ☐ Chinese
- ☐ Any other background

Disability

Do you regard yourself as in any way disabled?

- ☐ Yes
- ☒ No

Advertising

Where did you first learn about this vacancy?

American Astronomical Society Monthly Job Register

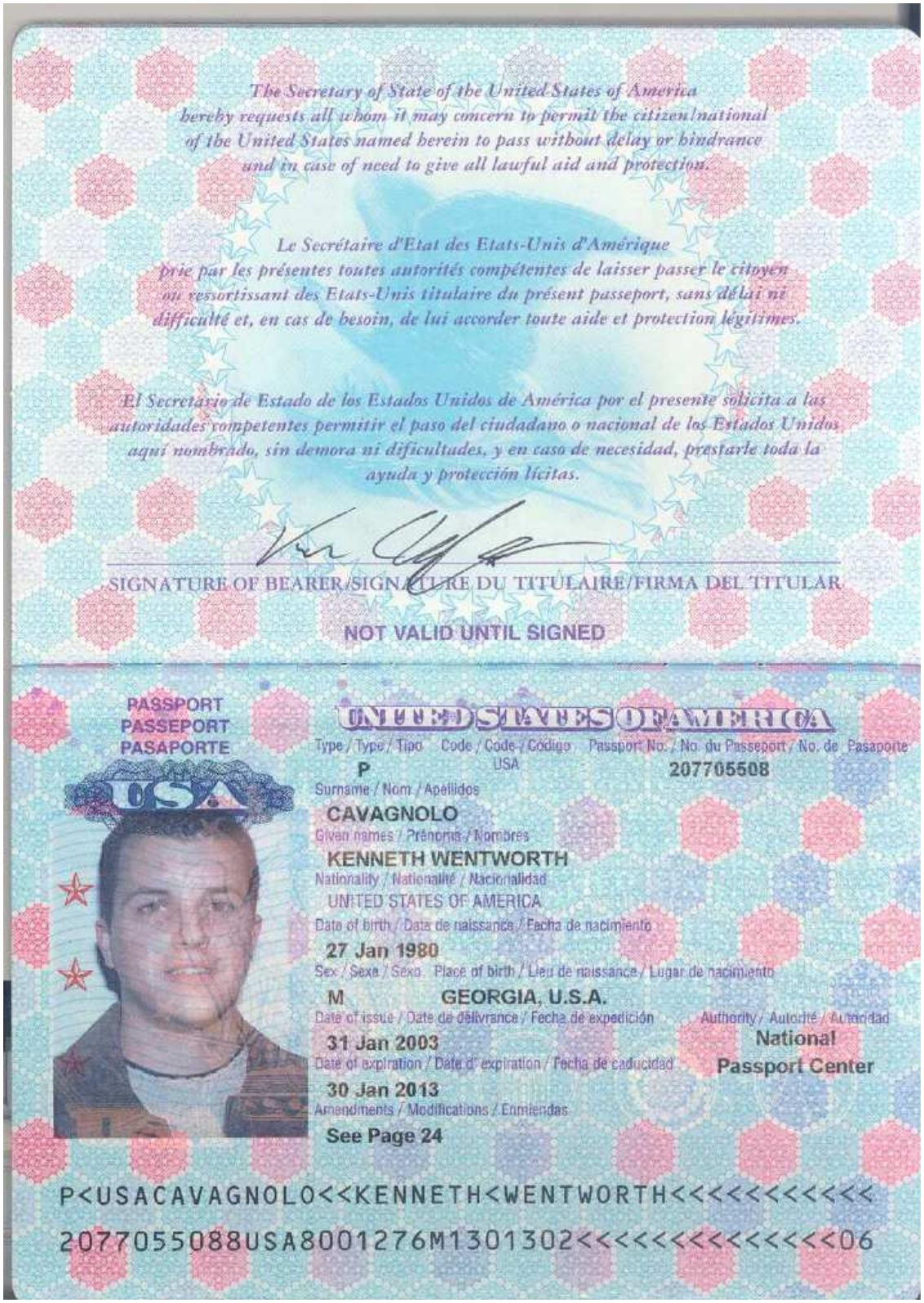

Figure 1: Passport for Kenneth W. Cavagnolo