Gerrit Schellenberger

Curriculum Vitae

Smithsonian Astrophysical Observatory
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Professional summary

Responsibilities

Chandra X-ray Observatory mission support — perform diagnosis for innovative anomaly resolution. Monitor health and quantify performance of the HRC science instrument, develop new calibration techniques, algorithms, and analyses.

Core team member of LEM (proposed $1B NASA X-ray mission) to transform the future of X-ray astronomy.

Leading SAO contribution to the Athena collaboration (future $1.4B European mission) for an improved understanding of X-ray detector background systematics.

Research — 71 publications (13 as first author) – 1340 citations – h-index 20

Leadership — Student/PostDoc advisory, (Co-)Investigator on grants/projects totalling over $1.2M

Communication — education, lecturing and mentorship – press releases and interviews including Quanta, Forbes online, Astronomy Now, Chandra Science Highlight

Synergy — Member on advisory committees – invited expert on time allocation committees

Skills — Programming Python/C/IDL/SQL – writing papers, proposals – presentations – projects involving AI techniques – analysis of large and noisy datasets (X-ray, radio, sub-mm)

Grades — MSc Astrophysics (GPA 3.9); PhD summa cum laude (with highest honors) GPA 4.0; award for best thesis in Physics and Astronomy

Research interest

Structure formation in the Universe

Galaxy clusters are excellent probes to trace the formation and **growth of structure in the Universe**. I have published the **first cosmological cluster X-ray study with individually determined cluster masses (HICOSMO)** allowing to quantify the various biases, and am expending this to larger samples (eeHIFLUGCS). For this work I combine X-ray datasets with from scratch written, high performance C programs to run MCMC simulations.

AGN feedback mechanism

Clusters are filled with a hot plasma that outweighs all their member galaxies and cools within a billion years. Giant supermassive black holes located in the centers of the dominant galaxies are thought to provide the **reheating mechanism that balances the cooling**: As the cooling gas is accreted by the black hole, jets of relativistic particles are ejected that reheat the surrounding plasma. My novel approach **combines accretion and jet emission models** over a broad spectral energy distribution, allowing for the **first time to link the macroscopic effects** of reheating, and connect it with the **condensation of molecular gas** from the cooling X-ray phase, all the way to the jets from the central supermassive black hole.

Systematic uncertainties in X-ray observations

Future X-ray instruments will no longer limited by statistical uncertainties, instead systematics in the calibration and the background will play a crucial role for any science application. I have demonstrated that the **current major X-ray observatories, Chandra and XMM-Newton, are not consistent due to uncertainties in the effective area calibration**, and quantified the effect on cosmological measurements. As part of the IACHEC collaboration I develop effective area calibration schemes. The particle background from high-energetic cosmic ray particles present in current X-ray instruments marks an irreducible threshold of 5-10% due to the uncertainties connected with it (variability, energy signatures). **Using background-reduction techniques where I exploit the spatial correlation between cosmic-ray particle tracks and secondary events**, I verify simulations, and reach a deeper understanding of the various background components.

Academic Career

since 2023 Promoted to permanent member of the **Chandra HRC Instrument Principal Investigator Team** at the *Smithsonian Astrophysical Observatory*, Cambridge, MA.

2021-2023 **Astrophysicist** at the *Smithsonian Astrophysical Observatory*, Cambridge, MA. Working with Ralph Kraft, Paul Nulsen on investigations of background reduction algorithms for Athena WFI.

2016-2021 **SAO PostDoc Fellow** at the *Center for Astrophysics | Harvard & Smithsonian*, Cambridge, MA. Working with Jan Vrtilek, Larry David, Ewan O'Sullivan, Bill Forman and Christine Jones on multiwavelength observations of galaxy groups and clusters.

2016 **PostDoc bridge funding** awarded by the *Bonn-Cologne Graduate School of Physics and Astronomy*, January and February 2016

2012-2016 **PhD,** *Astrophysics,* University of Bonn, Argelander-Institute for Astronomy.

Supervision	Prof. Thomas Reiprich
Graduation	March 2016
Thesis Title	X-ray analysis of a complete sample of galaxy clusters
Grade	summa cum laude, top grade
Graduate Schools	**IMPRS** (International Max Planck Research School for Astronomy and Astrophysics, Bonn and Cologne)
	BCGS (Bonn-Cologne Graduate School of Physics and Astronomy)
Other duties	**Student representative** of the IMPRS, 2014–2015

2010-2012 **Master degree in Astrophysics,** University of Bonn, Argelander-Institute for Astronomy

Thesis supervision	Prof. Thomas Reiprich
Master Thesis	*Chandra analysis of a complete sample of galaxy clusters* (top grade)
Overall grade	1.1 (GPA 3.9)

2007-2010 **Bachelor degree in Physics,** University of Bonn

Thesis supervision	PD Jürgen Kerp
Bachelor Thesis	*Optimized averaging technique for HI 21cm observations*

Achievements & Honors

Observing and Grant proposals as PI

X-ray Chandra (4 proposals, 175ks observing time and $233k), XMM-Newton (169ks observing time)

Radio National Radio Astronomy Observatory: VLBA (23h) and VLA (9h), GMRT (42h)

mm Submillimeter Array (53 observations) and Large Millimeter Telescope Alfonso Serrano (4h)

Smithsonian Physical Science Study Grant as Science PI ($44k)

Recent observing proposals approved proposals as Co-I

X-ray Chandra (595ks, PIs O'Sullivan, Rajpurohit), XMM-Newton (1.5Ms, PIs O'Sullivan, Lovsisari, Jones, Reiprich, Eckert, Rajpurohit) NuSTAR (605ks, PI Wik)

Radio VLBA (69h, PI Ubertosi, O'Sullivan), VLA (30h, PI Ubertosi, Rajpurohit), GMRT (207h, PIs O'Sullivan, Vrtilek, Lovisari, Rajpurojhit), GBT (83h, PIs Lim, Romero), Meerkat (80h, PIs O'Sullivan, Rajpurohit, Kolokythas)

mm ALMA (50h, PI O'Sullivan, Burkutean)

Optical CFHT (18h, PI Gendron-Marsolais)

Awards and Honors

12/2024	Nominated for Smithsonian 2024 Secretary's Research Prizes
12/2018	**Lecturer** for special course on statistical methods in X-ray astronomy funded by *DAAD IPID4all* and *Bonn Research Alumni Program*
06/2017	Cash **Award** for best PhD Thesis by Foundation for Physics and Astronomy Bonn
03/2016	**PhD degree** (Dr. rer. nat.) with highest honors (summa cum laude)
2014-2016	**BCGS H2 Honors Branch** member

Professional experience

Data analysis and techniques

Successfully proposed for and experienced in planning, reducing and analysing X-ray, Radio, mm telescopes for imaging and spectroscopic data (e.g. XMM-Newton, Chandra, SMA, VLA, VLBA, GMRT, ALMA). Developed Python-based pipeline for analysis of physical properties.

Programming and computer knowledge

code	Python, IDL, C, C++, Qt, HTML, PHP, SQL, Bash, Tcsh
OS	Linux, Windows, MacOS
Presentation	LaTeX, PowerPoint, Excel, GIMP,
specialized	CASA, ds9, fv, CIAO, XMM/SAS, heasoft

Current collaborations

Athena — **ESA's large X-ray mission** within the Cosmic Vision program to address the Hot and Energetic Universe science theme. Active member of the WFI collaboration and the Athena background team.

Member since 2015. WFI PI: Paul Nandra (MPE, Garching)

Role: Active member of the WFI background working team.

`https://www.the-athena-x-ray-observatory.eu`

X-GAP — Large Programme on XMM-Newton advancing our knowledge of the hot gas in **galaxy groups**

Member since 2021. PI: Dominique Eckert (University of Geneva)

Role: Analysis lead of group dynamical state (paper in prep.)

`https://www.astro.unige.ch/xgap/`

IACHEC — **High energy calibration standards** and cross calibration between different missions.

Member since 2013. Chair: Kristin Madsen

Role: Active member of the Galaxy cluster working group.

`http://iachec.org`

eeHIFLUGCS — Exploring the **380 brightest galaxy clusters** for cosmology

Member since 2017. PI: Thomas Reiprich (Bonn University)

Role: Lead analysis of Chandra data, support for X-ray data analysis and cosmological interpretation (papers published as second and third author).

Recent conferences and invited talks

01/2025	245th AAS Meeting, National Harbor, MD (talk)
09/2024	Galaxy Clusters & Radio Relics II, Cambridge, MA (talk)
04/2024	Athena WFI consortium meeting, Prague, Czech Republic (talk)
03/2023	20th HEAD Meeting of the American Astronomical Society, Waikoloa, HI (3 posters)
02/2023	Science with the Line Emission Mapper: From Planets to Galaxies, Cambridge, MA (2 talks)
12/2020	Invited talk at MPE, Garching, Germany (virtual)
11/2020	Invited talk at Argelander-Institute for Astronomy, Bonn, Germany (virtual)
2014-2019	4 Schools and Workshops for Data Analysis

Responsibilities and Activities

Teaching/Advisory

2025 **Supervision** of visiting postdoc (Francesco Ubertosi) and student project (planned)

2024 **Supervision** of a student (Fatma Shaban) at the CfA (5 months)

06/2024 **Expert reviewer** for XRISM General Observer Time Allocation Committee

2022+2024 **Advising** of a PhD student (Francesco Ubertosi) at the CfA (4 months in 2022 and 2 months in 2024)

since 2021 **co-advising** of a PostDoc (Charles Romero) at the CfA

11/2019 **Mentoring** of a predoc student (Ruchika Seth) at the CfA

2019-2024 **Expert reviewer** for GMRT

2018 **Lecturer** for Astrophysics Master intensive course *Statistical Methods in X-ray astronomy*, invited by DAAD/Bonn Research Alumni program

since 2015 **Peer reviewing** for MNRAS, ApJ, and A&A

2011-2015 **Teaching assistant** for the various lectures at Bonn University (X-ray Astronomy, Electronic data processing, Introduction to Radio Astronomy, Wave propagation on coaxial cables/waveguides

Outreach and other responsibilities

02/2023 Participating in outreach event **People of LEM** to introduce the scientific community to the public

02/2023 Member of the CfA HEAD Process Documentation team.

10/2021 Full-day outreach event at **Dexter Southfield School** in Brookline, MA

10/2019 Chandra **press release** on Abell 1758 (also on forbes.com) and selected as **Chandra Highlight**

2016–2020 Organization of the **Galaxies and Cosmology Seminar**, CfA Cambridge, MA

Most relevant publications

71 publications – 13 peer-reviewed first author papers – 1449 total citations Google Scholar

astrophysics data system `https://ui.adsabs.harvard.edu/public-libraries/D2zLOUWJSdy09SQWOHgLNQ`

01/2021 *A new feedback cycle in the archetypal cooling flow group NGC 5044*

Schellenberger, G.; David, L.; Vrtilek, J.; O'Sullivan, E.; Giacintucci, S.; Forman, W.; Jones, C.; Venturi, T.

The Astrophysical Journal, Volume 906, 16

Lead author, discovering a new feedback cycle in the X-ray brightest galaxy group, by analyzing my VLBA data, the modeling the SED with a novel application of advection dominated accretion.

04/2020 *Probing cosmic isotropy with a new X-ray galaxy cluster sample through the LX-T scaling relation*

Migkas, K.; **Schellenberger, G.**; Reiprich, T.; Pacaud, F.; Ramos-Ceja, M.; Lovisari, L.

Astronomy & Astrophysics, Volume 636, id.A15

Anisotropy in the Hubble constant deduced from variability of galaxy cluster brightness. Analysis of all Chandra data and support with tests and interpretation. (142 citations)

03/2015 *XMM-Newton and Chandra cross-calibration using HIFLUGCS galaxy clusters. Systematic temperature differences and cosmological impact*

Schellenberger, G.; Reiprich, T. H.; Lovisari, L.; Nevalainen, J.; David, L.

Astronomy & Astrophysics, Volume 575, id.A30, 25 pp.

Most important cross calibration study to quantify the calibration difference between Chandra and XMM-Newton from galaxy cluster temperature. (164 citations)