Thomas Patrick Downes

Education

2002–2009	**The University of Chicago, Kavli Institute for Cosmological Physics** **PhD Physics, MS Physics**
dissertation	The Population of Submillimeter Galaxies and Its Impact on the Detection of the Sunyaev-Zel'dovich Effect, under advisement of Stephan Meyer
1997–2002	**University at Buffalo – The State University of New York** **BS Physics, BS Computer Science**, minor mathematics *summa cum laude*

Professional Experience

2019–present **HPC Cloud Consultant**, *Univa Corporation (Chicago, IL)*
- As lead of the new Professional Services team, have designed repeatable processes for our customer engagements and reduced time to success.
- Engagement that I led with a Fortune 500 life sciences company resulted in positive customer testimonial to our partner, Amazon Web Services.
- Facilitate installations of Navops Launch, a rules-based automation engine and cost-management tool for bursting Univa Grid Engine (UGE) into major cloud providers.
- Create Infrastructure-as-Code solutions that can be maintained by customers.
- Lead customer demonstrations in series of Meetups to promote Navops Launch.
- Created Consul-based solution to burst several thousand UGE nodes on GCP in 5 minutes.

2015–2019 **Senior Scientist**, *Leonard E Parker Center for Gravitation, Cosmology and Astrophysics*
- Supervise a team that provides services in support of LIGO research including software integration/containerization, distributed access to data, wikis, and database portals.
- As Co-Investigator, contributed to the development of several grant applications, including a successful NSF award for a $900k upgrade of NEMO computing cluster.
- Manage group's relationship with campus information technology staff to ensure that its infrastructure and security requirements are met. During this period, we partnered with campus to migrate from our aging group-built data center to a new campus-built data center, saving money on both sides.
- Lead LIGO's relationship with developers of the HTCondor cluster orchestration software.
- Designed and implemented a continuous deployment tool that publishes all LIGO software to LIGO and Open Science Grid computing sites, easing their use by researchers.
- Re-designed analysis portal from self-hosted to highly-available solution using Kubernetes on Amazon Web Services that will ensure failures of individual components do not impact services necessary for success of multi-messenger astronomical observations.
- Continued duties listed under succeeding section.

2012–2015 **Associate Scientist**, *Leonard E Parker Center for Gravitation, Cosmology and Astrophysics*
- Lead team responsible for computing services in support of LIGO and CGCA researchers.
- Responsible for managing maintenance and operations budget for the group's data center, including electrical/cooling systems and all contractor supervision and bid solicitation.
- Responsible for the execution of the NEMO cluster, a 6000 CPU-core & 50,000 GPU-core computing resource on which to detect and analyze multiple sources of gravitational waves.
- Designed, installed, and maintained group's VMWare platform and storage area network.
- Developed expertise in configuration automation, virtualization, large-scale storage technologies and federated identity management through InCommon and Shibboleth services.
- Serve on collaboration committees and working groups to establish computing policies.

2002–2011 See *Research Experience*

Research Experience

2009–2011 **Postdoctoral Scholar**, *California Institute of Technology.* Supervisor: Sunil Golwala
- Part of the MUSIC collaboration studying cosmological history by deploying a mm/submm camera, making observation of astrophysical sources with multiplexing MKIDs.
- Re-deployed the spectrometer instrument Z-Spec from the CSO in Hawai'i to the APEX telescope in Chile, to measure the redshifts of the South Pole Telescope sample of strongly lensed dusty, star-forming galaxies, observable only from the Southern Hemisphere.

2002–2009 **Graduate Research Assistant**, *The University of Chicago.* Advisor: Stephan Meyer
- Using targeted observations of galaxy clusters by the AzTEC instrument, estimated the impact that dusty, star-forming galaxies have on surveys of the Sunyaev-Zel'dovich effect.
- Corrected the AzTEC analysis software's estimation of its nonlinear filtering effects
- Performed the optical and electrothermal characterization of Frequency Sensitive Bolometers (FSBs), a cryogenic detector to enable cameras with multi-chroic pixels.

Skills

- Public speaking at variety of technical levels
- Team supervision and direction setting
- Manage equipment acquisition and support (>$1M)
- Terraform creation of AWS/GCP infrastructure
- Management of kubernetes cluster on EC2
- Secure web service management
- Python/shell/C/C++/Java/Go

- Identity management via SAML federation
- Continuous integration/deployment via GitLab
- Configuration automation via Chef, Puppet
- Operation of VMWare cluster
- Operation of highly available storage area network
- High performance cluster operation (6,000 cores)
- Large-scale filesystem (ZFS) management

Teaching & Public Outreach

2007 **Teaching Assistant**, *The University of Chicago*
- Led recitation and lab sections for an introductory physics course for non-scientists.

2005 **Outreach Volunteer**, *Yerkes Summer and Winter Institutes and Chicago Public Schools*
- Designed and constructed *Spudnik*, a potato cannon that demonstrated pressure, the theme for the 2005 *Space Explorers* program for students aged 10-17.
- With the students aged 10-17, used a professional telescope to measure and estimate the period of a variable star to demonstrate radiation pressure.

1998–2002 **Instructor**, *University at Buffalo Computing Help Desk*
- Developed materials for and taught computing workshops for faculty, staff and students on topics ranging from Microsoft Office to Unix to the HTML language.

Honors

2003 Sachs Fellowship for summer support, Department of Physics, *The University of Chicago*
2002–2003 McCormick Fellowship, Department of Physics, *The University of Chicago*
2002 Inducted into Phi Beta Kappa
2002 Outstanding Graduating Senior, Department of Physics, *University at Buffalo*
1999-2000 Sekula Memorial Scholarship, Department of Physics, *University at Buffalo*

Publications and Talks

Recent conference presentations

Downes, T. P. *Automatic for the People: Containers for LIGO software development on the Open Science Grid and other diverse computing resources.* SnowPAC 2018. 2018.

Downes, T. P. *Effective Use of Cgroups with HTCondor*. HTCondor Week 2017. May 2017.

— *The relationships that enabled LIGO Computing*. Internet2 Global Summit: Executive Track. May 2016.

— *The MUSIC instrument for millimeter and submm astrophysics*. The University of Colorado: USNC-URSI National Radio Science Meeting. Jan. 2011.

Discoveries by the LIGO Scientific Collaboration and Partners

The LIGO Scientific Collaboration and the Virgo Collaboration. "GW151226: Observation of Gravitational Waves from a 22-Solar-Mass Binary Black Hole Coalescence". In: *Phys. Rev. Lett.* 116 (24 June 2016), p. 241103. DOI: 10.1103/PhysRevLett.116.241103.

— "Observation of Gravitational Waves from a Binary Black Hole Merger". In: *Phys. Rev. Lett.* 116 (6 Feb. 2016), p. 061102. DOI: 10.1103/PhysRevLett.116.061102.

— "Observing gravitational-wave transient GW150914 with minimal assumptions". In: *Phys. Rev. D* 93 (12 June 2016), p. 122004. DOI: 10.1103/PhysRevD.93.122004.

— "GW150914: First results from the search for binary black hole coalescence with Advanced LIGO". In: *Phys. Rev. D* 93 (12 June 2016), p. 122003. DOI: 10.1103/PhysRevD.93.122003.

— "Properties of the Binary Black Hole Merger GW150914". In: *Phys. Rev. Lett.* 116 (24 June 2016), p. 241102. DOI: 10.1103/PhysRevLett.116.241102.

— "The Rate of Binary Black Hole Mergers Inferred from Advanced LIGO Observations Surrounding GW150914". In: *Astrophys. J.* 833 (2016), p. 1. DOI: 10.3847/2041-8205/833/1/L1.

— "Astrophysical Implications of the Binary Black-Hole Merger GW150914". In: *The Astrophysical Journal Letters* 818.2 (2016), p. L22. DOI: 10.3847/2041-8205/818/2/L22.

— "Tests of General Relativity with GW150914". In: *Phys. Rev. Lett.* 116 (22 May 2016), p. 221101. DOI: 10.1103/PhysRevLett.116.221101.

— "Localization and Broadband Follow-up of the Gravitational-wave Transient GW150914". In: *The Astrophysical Journal Letters* 826.1 (2016), p. L13. DOI: 10.3847/2041-8205/826/1/L13.

— "GW170817: Observation of Gravitational Waves from a Binary Neutron Star Inspiral". In: *Phys. Rev. Lett.* 119 (16 Oct. 2017), p. 161101. DOI: 10.1103/PhysRevLett.119.161101.

The LIGO Scientific Collaboration, the Virgo Collaboration and 50 teams of electromagnetic/neutrino astronomers. "Multi-messenger Observations of a Binary Neutron Star Merger". In: *The Astrophysical Journal Letters* 848.2 (2017), p. L12. DOI: 10.3847/2041-8213/aa91c9.

Refereed articles

Aretxaga, I. et al. "AzTEC millimetre survey of the COSMOS field - III. Source catalogue over 0.72 deg^2 and plausible boosting by large-scale structure". In: MNRAS 415 (Aug. 2011), pp. 3831–3850. DOI: 10.1111/j.1365-2966.2011.18989.x.

Bothwell, M. S. et al. "SPT 0538-50: Physical Conditions in the Interstellar Medium of a Strongly Lensed Dusty Star-forming Galaxy at z = 2.8". In: ApJ 779, 67 (Dec. 2013), p. 67. DOI: 10.1088/0004-637X/779/1/67.

Czakon, N. G. et al. "Galaxy Cluster Scaling Relations between Bolocam Sunyaev-Zel'dovich Effect and Chandra X-Ray Measurements". In: *The Astrophysical Journal* 806.1 (2015), p. 18. DOI: 10.1088/0004-637X/806/1/18.

Downes, T. P. et al. "Calculating the transfer function of noise removal by principal component analysis and application to AzTEC deep-field observations". In: MNRAS 423 (June 2012), pp. 529–542. DOI: 10.1111/j.1365-2966.2012.20896.x.

Greve, T. R. et al. "Submillimeter Observations of Millimeter Bright Galaxies Discovered by the South Pole Telescope". In: ApJ 756, 101 (Sept. 2012), p. 101. DOI: 10.1088/0004-637X/756/1/101.

Perera, T. A. et al. "Optical performance of frequency-selective bolometers". In: Appl. Opt. 45 (Oct. 2006), pp. 7643–7651. DOI: 10.1364/AO.45.007643.

Sayers, J. et al. "Sunyaev-Zel'dovich-measured Pressure Profiles from the Bolocam X-Ray/SZ Galaxy Cluster Sample". In: ApJ 768, 177 (May 2013), p. 177. DOI: 10.1088/0004-637X/768/2/177.

Sayers, J. et al. "The Contribution of Radio Galaxy Contamination to Measurements of the Sunyaev-Zel'dovich Decrement in Massive Galaxy Clusters at 140 GHz with Bolocam". In: ApJ 764, 152 (Feb. 2013), p. 152. DOI: 10.1088/0004-637X/764/2/152.

Singer, L. P. et al. "The First Two Years of Electromagnetic Follow-up with Advanced LIGO and Virgo". In: ApJ 795, 105 (Nov. 2014), p. 105. DOI: 10.1088/0004-637X/795/2/105.

Weiß, A. et al. "ALMA Redshifts of Millimeter-selected Galaxies from the SPT Survey: The Redshift Distribution of Dusty Star-forming Galaxies". In: ApJ 767, 88 (Apr. 2013), p. 88. DOI: 10.1088/0004-637X/767/1/88.

Yefremenko, V. et al. "Low temperature thermal transport in partially perforated silicon nitride membranes". In: *Applied Physics Letters* 94.18, 183504 (2009), p. 183504. DOI: 10.1063/1.3127232.

CONFERENCE PROCEEDINGS

Chang, C. L. et al. "Design and Fabrication of Absorber Coupled TES Microbolometers on Continuous Silicon-Nitride Windows". In: *Journal of Low Temperature Physics* 151 (Apr. 2008), pp. 245–248. DOI: 10.1007/s10909-007-9639-8.

Czakon, N. G. et al. "Optimization of MKID noise performance via readout technique for astronomical applications". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Vol. 7741. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. July 2010. DOI: 10.1117/12.857866.

Datesman, A. et al. "Frequency selective bolometer development at Argonne National Laboratory". In: *2008 IEEE Conference on Applied Superconductivity*. Ed. by William D. Duncan et al. Vol. 7020. Marseille, France, Aug. 2008. DOI: 10.1117/12.790034.

Duan, R. et al. "An open-source readout for MKIDs". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Vol. 7741. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. July 2010. DOI: 10.1117/12.856832.

Golwala, S. R. et al. "Status of MUSIC, the MUltiwavelength Sub/millimeter Inductance Camera". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Vol. 8452. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. Sept. 2012, p. 5. DOI: 10.1117/12.926055.

Maloney, P. R. et al. "MUSIC for sub/millimeter astrophysics". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Vol. 7741. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. July 2010. DOI: 10.1117/12.857751.

Schlaerth, J. A. et al. "MKID multicolor array status and results from DemoCam". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Vol. 7741. Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series. July 2010. DOI: 10.1117/12.857688.

Silverberg, R. F. et al. "A bolometer array for the SPEctral Energy Distribution (SPEED) Camera". In: *Society of Photo-Optical Instrumentation Engineers (SPIE) Conference Series*. Ed. by C. M. Bradford et al. Vol. 5498. Presented at the Society of Photo-Optical Instrumentation Engineers (SPIE) Conference. Oct. 2004, pp. 659–666. DOI: 10.1117/12.552477.

Silverberg, R. F. et al. "A bolometer array for the spectral energy distribution (SPEED) camera". In: *Nuclear Instruments and Methods in Physics Research A* 520 (Mar. 2004), pp. 421–423. DOI: 10.1016/j.nima.2003.11.350.