References Cited

[1] Tom Abel, Greg L. Bryan, and Michael L. Norman. The Formation of the First Star in the Universe. *Science*, 295(5552):93–98, 2002.

[2] Lawrence Berkeley National Laboratory Applied Numerical Algorithms Group. Chombo—infrastructure for adaptive mesh refinement. `<https://seesar.lbl.gov/ANAG/chombo/>`, 2009.

[3] University of Chicago ASC Flash Center. ASC Center for Astrophysical Thermonuclear Flashes. `<http://flash.uchicago.edu/website/home/>`, 2010.

[4] The HDF Group at The University of Illinois. HDF group—HDF5. `<http://www.hdfgroup.org/HDF5/>`, 2010.

[5] Josh Barnes and Piet Hut. A hierarchical O(N log N) force-calculation algorithm. *Nature*, 324:446–449, December 1986.

[6] M. J. Berger and P. Colella. Local adaptive mesh refinement for shock hydrodynamics. *Journal of Computational Physics*, 82:64–84, 1989.

[7] OpenMP Architecture Review Board. OpenMP: The OpenMP API specification for parallel programming. `<http://openmp.org/wp/>`, 2010.

[8] James Bordner. LCAPERF. `<http://lca.ucsd.edu/projects/lcaperf/>`, 2009.

[9] James Bordner. LCATEST. `<http://lca.ucsd.edu/projects/lcatest/>`, 2010.

[10] Greg L. Bryan, Tom Abel, and Michael L. Norman. Achieving extreme resolution in numerical cosmology using adaptive mesh refinement: resolving primordial star formation. *Sci. Program.*, 10(4):291–302, 2002.

[11] Carsten Burstedde, Martin Burtscher, Omar Ghattas, Georg Stadler, Tiankai Tu, and Lucas C Wilcox. ALPS: A framework for parallel adaptive PDE solution. *Journal of Physics: Conference Series*, 180:012009, 2009.

[12] Carsten Burstedde, Omar Ghattas, Michael Gurnis, Georg Stadler, Eh Tan, Tiankai Tu, Lucas C. Wilcox, and Shijie Zhong. Scalable adaptive mantle convection simulation on petascale supercomputers. In *SC '08: Proceedings of the 2008 ACM/IEEE conference on Supercomputing*, pages 1–15, Piscataway, NJ, USA, 2008. IEEE Press.

[13] Carsten Burstedde, Omar Ghattas, Georg Stadler, Tiankai Tu, and Lucas C. Wilcox. Towards adaptive mesh PDE simulations on petascale computers, June 2008.

[14] Frank Buschmann, Kevlin Henney, and Douglas C. Schmidt. *Pattern-Oriented Software Architecture, Volume 4: A Pattern Language for Distributed Computing.* Wiley, Chichester, UK, 2007.

[15] NASA Goddard Space Flight Center and Drexel University. PARAMESH v4.1: Parallel adaptive mesh refinement. <http://www.physics.drexel.edu/~olson/paramesh-doc/Users_manual/amr.html>, 2008.

[16] P. Colella, D. T. Graves, N. D. Keen, T. J. Ligocki, D. F. Martin, P. W. McCorquodale, D. Modiano, P. O. Schwartz, T. D. Sternberg, and B. Van Straalen. Chombo software package for AMR applications design document. Technical report, Applied Numerical Algorithms Group, Computational Research Division, Lawrence Berkeley National Laboratory, April 2009.

[17] Phillip Colella, John Bell, Noel Keen, Terry Ligocki, and Brian Van Straalen. Performance and scaling of locally-structured grid methods for partial differential equations. In *Journal of Physics: Conference Series*, volume 78, pages 1–13, 2007.

[18] D. C. Collins, H. Xu, M. L. Norman, H. Li, and S. Li. Cosmological Adaptive Mesh Refinement Magnetohydrodynamics with Enzo. *The Astrophysical Journal, Supplement*, 186:308–333, February 2010.

[19] UPC Consortium. UPC language specifications, v1.2. Technical Report LBNL-59208, Lawrence Berkeley national Lab, 2005.

[20] Jack Dongarra, Al Geist, Richard Graham, Bill Gropp, Andrew Lumsdaine, Ewing Lusk, and Rolf Rabenseifner. Message passing interface (MPI) forum home page. <http://www.mpi-forum.org/>, 2010.

[21] Anshu Dubey. What the paradigm shift means for large mature codes like FLASH. <http://gladiator.ncsa.uiuc.edu/PDFs/accelerators/day3/breakouts/astro/dubey.pdf>, 2009.

[22] R.D. Falgout, J.E. Jones, and U.M. Yang. *Numerical Solution of Partial Differential Equations on Parallel Computers*, volume 51, chapter The Design and Implementation of hypre, a Library of Parallel High Performance Preconditioners, pages 267–294. Springer-Verlag, 2006.

[23] Center for Applied Scientific Computing (CASC) at Lawrence Livermore National Laboratory (LLNL). SAMRAI: SAMRAI source code documentation. <http://wwwrel.ph.utexas.edu/openGR/samrai-dox/html/main.html>, 2005.

[24] Laboratory for Computational Astrophysics at the University of California in San Diego. Enzo. <http://lca.ucsd.edu/projects/enzo/>, 2010.

[25] Sarah F. Frisken and Ronald N. Perry. Simple and efficient traversal methods for quadtrees and octrees. *Journal of Graphics Tools*, 7(7):2002, 2002.

[26] B. Fryxell, K. Olson, P. Ricker, F. X. Timmes, M. Zingale, D. Q. Lamb, P. MacNiece, R. Rosner, J. W. Truran, and H. Tufo. FLASH: An adaptive mesh hydrodynamics code for modeling astrophysical thermonuclear flashes. *Astro. J. Suppl.*, 131:273–334, November 2000.

[27] Erich Gamma, Richard Helm, Ralph E. Johnson, and John Vlissides. *Design Patterns. Elements of Reusable Object-Oriented Software.* Addison-Wesley, March 1995.

[28] Susan L. Graham, Paul Hilfinger, Katherine A. Yelick, and Phillip Colella. Titanium project home page. <http://titanium.cs.berkeley.edu/>, 2006.

[29] Brian T. N. Gunney, Andrew M. Wissink, and David A. Hysom. Parallel clustering algorithms for structured AMR. *Journal of Parallel and Distributed Computing*, 66:1419–1430, 2006.

[30] E. J. Hallman, B. W. O'Shea, J. O. Burns, M. L. Norman, R. Harkness, and R. Wagner. The Santa Fe Light Cone Simulation Project. I. Confusion and the Warm-Hot Intergalactic Medium in Upcoming Sunyaev-Zel'dovich Effect Surveys. *The Astrophysical Journal*, 671:27–39, December 2007.

[31] V.E. Henson and U.M. Yang. BoomerAMG: a parallel algebraic multigrid solver and preconditioner. *Applied Numerical Mathematics*, 2002.

[32] R. W. Hockney and J. W. Eastwood. *Computer simulation using particles.* Bristol: Hilger, 1988.

[33] I. T. Iliev, D. Whalen, G. Mellema, K. Ahn, S. Baek, N. Y. Gnedin, A. V. Kravtsov, M. Norman, M. Raicevic, D. R. Reynolds, D. Sato, P. R. Shapiro, B. Semelin, J. Smidt, H. Susa, T. Theuns, and M. Umemura. Cosmological radiative transfer comparison project - II. The radiation-hydrodynamic tests. *Monthly Notices of the Royal Astronomical Society*, 400:1283–1316, December 2009.

[34] L. V. Kale and Sanjeev Krishnan. Charm++: Parallel programming with message-driven objects. In Gregory V. Wilson and Paul Lu, editors, *Parallel Programming Using C++*, pages 175–213. MIT Press, Cambridge, MA, USA, 1996.

[35] Laxmikant V. Kale, Eric Bohm, Celso L. Mendes, Terry Wilmarth, and Gengbin Zheng. Programming petascale applications with Charm++ and AMPI. In David A. Bader, editor, *Petascale Computing: Algorithms and Applications.* Chapman & Hall/CRC Computational Science, 2007.

[36] A. G. Kritsuk, S. D. Ustyugov, M. L. Norman, and P. Padoan. Simulations of Supersonic Turbulence in Molecular Clouds: Evidence for a New Universality. In N. V. Pogorelov, E. Audit, P. Colella, & G. P. Zank, editor, *Astronomical Society of the Pacific Conference Series*, volume 406 of *Astronomical Society of the Pacific Conference Series*, pages 15–+, April 2009.

[37] Zhiling Lan, Valerie E. Taylor, and Yawei Li. DistDLB: Improving cosmology SAMR simulations on distributed computing systems through hierarchical load balancing. *J. Parallel Distrib. Comput.*, 66(5):716–731, 2006.

[38] Orion Sky Lawlor and Gengbin Zheng. PPL: Parallel objects. <http://charm.cs.uiuc.edu/research/charm/>, 2010.

[39] LBNL and UC Berkeley. Berkeley Unified Parallel C (UPC) project. <http://upc.lbl.gov/>, 2010.

[40] Baptiste Lepilleur. CppUnit - C++ port of JUnit. <http://sourceforge.net/projects/cppunit/>, 2010.

[41] Randall J. LeVeque, Jan Olav Langseth, Marsha Berger, David McQueen, Donna Calhoun, Peter Blossey, and Sorin Mitran. CLAWPACK. <http://www.amath.washington.edu/~claw/>, 2006.

[42] Jay F. Lofstead, Scott Klasky, Karsten Schwan, Norbert Podhorszki, and Chen Jin. Flexible IO and integration for scientific codes through the adaptable IO system (ADIOS). In *CLADE '08: Proceedings of the 6th international workshop on Challenges of large applications in distributed environments*, pages 15–24, New York, NY, USA, 2008. ACM.

[43] Peter MacNeice, Kevin M. Olson, Clark Mobarry, Rosalinda deFainchtein, and Charles Packer. PARAMESH: A parallel adaptive mesh refinement community toolkit. *Computer Physics Communications*, 126:330–354, 2000.

[44] Damin A. Malln, Guillermo L. Taboada, Carlos Teijeiro, Juan Tourio, Basilio B. Fraguela, Andrs Gmez, Ramn Doallo, and J. Carlos Mourio. Performance evaluation of MPI, UPC and OpenMP on multicore architectures. In *Recent Advances in Parallel Virtual Machine and Message Passing Interface*, Lecture Notes in Computer Science, pages 174–184. Springer Berlin / Heidelberg, 2009.

[45] Michael Mascagni and Ashok Srinivasan. Algorithm 806: SPRNG: a scalable library for pseudorandom number generation. *ACM Trans. Math. Softw.*, 26(3):436–461, 2000.

[46] Steve McConnell. *Code Complete, Second Edition*. Microsoft Press, Redmond, WA, USA, 2004.

[47] M. L. Norman, D. R. Reynolds, and G. C. So. Cosmological Radiation Hydrodynamics with Enzo. In I. Hubeny, J. M. Stone, K. MacGregor, & K. Werner, editor, *American Institute of Physics Conference Series*, volume 1171 of *American Institute of Physics Conference Series*, pages 260–272, September 2009.

[48] Kevin Olson. PARAMESH: A parallel adaptive grid tool. In A. Deane, A. Ecer, G. Brenner, D. Emerson, J. McDonough, J. Periaux, N. Satofuka, and D. Tromeur-Dervout, editors, *Parallel Computational Fluid Dynamics 2005: Theory and Applications: Proceedings of the Parallel CFD Conference, College Park, MD, U.S.A.*, pages 341–348. Elsevier, 2006.

[49] Kevin Olson and Peter MacNeice. An overview of the PARAMESH AMR software package and some of its applications. In Tomasz Plewa, Timur Linde, and V. Gregory Weirs, editors, *Adaptive Mesh Refinement-Theory and Applications, Proceedings of the Chicago Workshop on Adaptive Mesh Refinement Methods*, volume 41 of *Lecture Notes in Computational Science and Engineering*, pages 315–330. Springer Berlin Heidelberg, 2005.

[50] Brian W. O'Shea, Greg Bryan, James Bordner, Michael L. Norman, Tom Abel, Robert Harkness, and Alexei Kritsuk. Introducing Enzo, an AMR cosmology application. In

Adaptive Mesh Refinement—Theory and Applications, Lecture Notes in Computational Sciences and Engineering, pages 341–349. Springer-Verlag, 2004.

[51] Brian W. O'Shea, Kentaro Nagamine, Volker Springel, Lars Hernquist, and Michael L. Norman. Comparing AMR and SPH cosmological simulations: I. dark matter & adiabadic simulations. astro-ph/0312651, May 2005.

[52] P. Padoan, A. Kritsuk, Michael, L. Norman, and Å. Nordlund. Brown dwarfs from turbulent fragmentation. *Memorie della Societa Astronomica Italiana*, 76:187–192, 2005.

[53] Manish Parashar and Xiaolin Li. GrACE: Grid adaptive computational engine for parallel structured AMR applications. In *Advanced Computational Infrastructures for Parallel and Distributed Adaptive Applications*, pages 249–263. John Wiley & Sons, Inc., 2010.

[54] D. R. Reynolds, J. C. Hayes, P. Paschos, and M. L. Norman. Self-consistent solution of cosmological radiation-hydrodynamics and chemical ionization. *Journal of Computational Physics*, 228:6833–6854, October 2009.

[55] Kirk Schloegel, George Karypis, and Vipin Kumar. Parallel multilevel diffusion algorithms for repartitioning of adaptive meshes. Technical report, University of Minnesota, Department of Computer Science and Army HPC Center, 1997.

[56] Erik Schnetter. Carpet—Adaptive mesh refinement for the Cactus framework. `<http://www.carpetcode.org/>`, 2009.

[57] Erik Schnetter, Peter Diener, Ernst Nils Dorband, and Manuel Tiglio. A multi-block infrastructure for three-dimensional time-dependent numerical relativity. *Class. Quantum Grav.*, 23:553–578, 2006.

[58] Edgewall Software. The Trac Project. `<http://trac.edgewall.org/>`, 2010.

[59] Olaf Spinczyk, Matthias Urban, Daniel Lohmann, Georg Blaschke, Rainer Sand, and Horst Schirmeier. The home of AspectC++. `<http://www.aspectc.org/>`, 2007.

[60] V. Springel. The cosmological simulation code GADGET-2. *Monthly Notices of the Royal Astronomical Society*, 364:1105–1134, December 2005.

[61] V. Springel, S. D. M. White, A. Jenkins, C. S. Frenk, N. Yoshida, L. Gao, J. Navarro, R. Thacker, D. Croton, J. Helly, J. A. Peacock, S. Cole, P. Thomas, H. Couchman, A. Evrard, J. Colberg, and F. Pearce. Simulations of the formation, evolution and clustering of galaxies and quasars. *Nature*, 435:629–636, June 2005.

[62] Volker Springel. Cosmological simulations with GADGET. `<http://www.mpa-garching.mpg.de/gadget/>`, 2005.

[63] Totalview Technologies. TotalView Technologies - Linux debugger and memory leak detection tool for multi-threaded C/C++ and Fortran. `<http://totalviewtech.com/>`, 2010.

[64] Sergey D. Ustyugov, Mikhail V. Popov, Alexei G. Kritsuk, and Michael L. Norman. Piecewise parabolic method on a local stencil for magnetized supersonic turbulence simulation. *J. Comput. Phys.*, 228(20):7614–7633, 2009.

[65] Brian Van Straalen, John Shalf, Terry Ligocki, Noel Keen, and Woo-Sun Yang. Scalability challenges for massively parallel AMR applications. In *IPDPS '09: Proceedings of the 2009 IEEE International Symposium on Parallel&Distributed Processing*, pages 1–12, Washington, DC, USA, 2009. IEEE Computer Society.

[66] Mike Welcome. UPC AMR status report. UPC Review Presentations, Lawrence Berkeley National Laboratory, <http://upc.lbl.gov/publications/UPCReview-s04/mike-amr-review04.pdf>, 2004.

[67] Tong Wen, Jimmy Su, Phillip Colella, Katherine Yelick, and Noel Keen. An adaptive mesh refinement benchmark for modern parallel programming languages. In *SC '07: Proceedings of the 2007 ACM/IEEE conference on Supercomputing*, pages 1–12, New York, NY, USA, 2007. ACM.

[68] Andrew M. Wissink, Richard D. Hornung, Scott R. Kohn, Steve S. Smith, and Noah Elliott. Large scale parallel structured AMR calculations using the SAMRAI framework. In *Supercomputing '01: Proceedings of the 2001 ACM/IEEE conference on Supercomputing (CDROM)*, pages 6–6, New York, NY, USA, 2001. ACM.

[69] Andrew M. Wissink, David Hysom, and Richard D. Hornung. Enhancing scalability of parallel structured AMR calculations. In *Proceedings of the 17th annual international conference on Supercomputing*, pages 336–347. ACM Press, 2003.

[70] P. R. Woodward and P. Colella. The piecewise parabolic method (PPM) for gas-dynamical simulations. *J. Comp. Phys.*, 54:174–201, 1984.

[71] H. Xu, H. Li, D. C. Collins, S. Li, and M. L. Norman. Formation of X-Ray Cavities by the Magnetically Dominated Jet-Lobe System in a Galaxy Cluster. *The Astrophysical Journal, Letters*, 681:L61–L64, July 2008.

[72] H. Xu, H. Li, D. C. Collins, S. Li, and M. L. Norman. Turbulence and Dynamo in Galaxy Cluster Medium: Implications on the Origin of Cluster Magnetic Fields. *The Astrophysical Journal, Letters*, 698:L14–L17, June 2009.

[73] H. Xu, B. W. O'Shea, D. C. Collins, M. L. Norman, H. Li, and S. Li. The Biermann Battery in Cosmological MHD Simulations of Population III Star Formation. *The Astrophysical Journal, Letters*, 688:L57–L60, December 2008.

[74] Kathy Yelick, Luigi Semenzato, Geoff Pike, Carleton Miyamoto, Ben Liblit, Arvind Krishnamurthy, Paul Hilfinger, Susan Graham, David Gay, Phil Colella, and Alex Aiken. Titanium: A high-performance Java dialect. In *In ACM*, pages 10–11, 1998.