行政院及所屬各機關出國報告
(出國類別：其他)

# 出席「SC08 Conference」國際研討會報告

服務機關：教育部（電子計算機中心）

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出國期間：2008 年 11 月 16 日~22 日

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# 摘　要

SC（Supercomputing）研討會從 1988 年開始辦理，今年是創辦的第 20 年，是爲針對高速計算、網路的儲存與分析的研討會，今年增加的特色爲針對全世界最近科學和科技創新；展示一些新創意、新發現和生產是如何進行；以及如何改變教育。

大會內容有演講、論文發表、論文張貼(Poster)、民間企業的超級電腦展示、研討會回顧展示、座談、競賽頒獎等。另外，爲培育下一代人才和推廣超級電腦應用於教學，特別有教育團隊的教學應用發表。本報告綜整做一簡略的大會過程、心得與建議等整理。

# 目　　錄

## 一、目的

為增廣見聞，了解全球資訊網路相關趨勢，擬對未來業務推動有所幫助。

## 二、會議簡介及過程

SC（Supercomputer）研討會從 1988 年開始辦理，至今已有 20 年了，為針對高速計算、網路的儲存與分析的研討會。今年增加的特色為針對全世界最近科學和科技創新；展示一些新創意、發現和生產是如何進行；以及如何改變教育。

今年 SC08 一系列展示活動、工作坊和論文發表等之所有活動期間為 2008 年 11 月 15 日至 21 日，地點在美國德州奧斯丁(Austin)Convention Center，展示日期是 11 月 18 日至 20 日，教育課程是 11 月 15 日至 18 日，工作坊則為 11 月 16 日至 17 日，各項活動各有開放時段和開放方式。

此研討會是上百個企業、學術、政府和研究實驗室的付出而產生，是由 ACM 和 IEEE 電腦社群共同贊助，豐富的展示會場提供出席者有機會探索最近先進的高速計算、網路儲存、分析、資料管理、科學虛擬和科技合作，今年接受發表之技術論文有 59 篇，54 件張貼論文，接受 21 項 ACM Gordon Bell 獎勵作品，最後將錄取 6 件並進行頒獎。5 件 ACM 學生研究競賽（SRC）之競賽作品並同時會做展示。今年註冊人數破去年的紀錄，達 1 萬 1 百人。

（一）議程（Schedule）

大會的內容非常多樣化，20 多類的節目議程分項列出每一天的各項時段，以下僅列出本次註冊參與的部分（全部項目請參見附錄）。

| Events | NOV.17<br>Monday | NOV.18<br>Tuesday | NOV.19<br>Wednesday | NOV.20<br>Thursday |
|---|---|---|---|---|
| Exhibits | 7:00p-9:00p | 10:00a-6:00p | 10:00a-6:00p | 10:00a-4:00p |
| Keynote | - | 8:30a-10:00a | - | - |
| Invited Speakers | - | | 8:30a-10:00a | 8:30a-10:00a |
| Poster | - | 5:15p-7:00p | - | - |
| Masterworks | - | 10:30a:5:00p | 10:30a-12:00p<br>3:30p-5:00p | 10:30a:5:00p |
| Panels | - | 3:30p:5:00p | 10:30a-12:00p | 3:30p:5:00p |
| Papers | - | 10:30a:5:00p | 10:30a-12:00p<br>3:30p-5:00p | 10:30a-12:00p<br>3:30p-5:00p |
| Workshops | 8:30a-5:00p | - | - | - |

（二）活動內容介紹

1. 展示(Exhibits)

展示區有從世界各地來的科技公司、組織計 200 家；和 120 個研究單位。

展區規劃和單位詳列於副加檔(SC08Floorplan.pdf)。



2. 演講(Keynote and Invited Speakers)

每年的講者包括高速計算科技界的領導者。各場次和主題如下：

(1)Higher Performance : Supercomputing in the Connected Era(主講人：Michael Dell, Dell Inc.)

(2)Developing an interoperable IT Framework to Enable Personalized Medicine(主講人：Kenneth H. Buetow, National Cancer Institute)

(3)Parallel Computing Landscape : A view from Berkeley(主講人：David Patterson, University of California Berkeley)

(4)High Performance Computing and the Energy Challenge : Issue and Opportunities(主講人：Jeffrey Wadsworth)

(5)Computation Frameworks for Subsurface Energy and Environment

Modeling and Simulation(主講人：Mary Wheelar, University of Texas at Autin)

3. 論文張貼(Poster)

每年此項目皆是重要的議題，超過 150 regular 和學生論文張貼經過審查，選出最好的 54 件進入。學生論文張貼有部分是 ACM 的學生研究競賽作品。

4. Masterworks

這個場次定位於真實世界高速計算科技在商業、金融、藝術、醫療、能源等等的應用。展示高速計算如何驅動這寬廣區域的創新和扮演 21 世紀的重要角色，例如，從新教材的發展去研究新的醫療程序，找到新能源的解答和更環保電腦的方法。主題如下所列：

(1)HPC in the Arts
(2)HPC in Transportation
(3)HPC in Finance
(4)HPC in Biomedical informatics
(5)HPC in Alternative Energy Technologies
(6)Green HPC

5. 座談(Panels)

包含此次研討會內容主題的範圍，分別邀請學界、研究室和企業等主持，各場次如下：

(1)Application for Heterogeneous, Massively Paralled Systems
(2)Will Electric Utilities Give Away Supercomputer with the Purchase of a Power Contract ?
(3)My Cloud, Your Cloud
(4)SC Past and Future
(5)Exa and Yotta Scale Data
(6)The hungry Music Monster
(7)Disruptive Technologies: Weapons of Mass Disruption

6. 論文(Papers)

(2)篇數與主題

Papers 從 277 篇中挑選出 59 篇，分 20 sesstions 發表，內容皆爲高速計算和網路儲存與分析的先進和創新科技文章，含括有：

- Application GPUs
- Processor and Switch Architecture
- HPC Systems
- Biomedical Information

- I/O and File Systems
- Grid Resource Management
- Large-Scale Application
- Runtime Systems
- Workflows
- Linear algebra
- Programming models
- I/O Performance
- Scheduling
- Grid Virtualization and Overlays
- Performance Tools
- Visualization and Data Management
- Application: Models and Analysis
- System Performance Optimization

(2)時間表

Tuesday Nov, 18

| Time | Title |
|---|---|
| 10:30AM-11:00AM | Entering the Petaflop Era: The Architecture and Performance of Roadrunner |
| 10:30AM-11:00AM | High Performance Discrete Fourier Transforms on Graphics Processors |
| 10:30AM-11:00AM | Dynamically Adapting File Domain Partitioning Methods for Collective I/O Based on Underlying Parallel File System Locking Protocols |
| 11:00AM-11:30AM | Stencil Computation Optimization and Autotuning on State-of-the-art Multicore Architectures |
| 11:00AM-11:30AM | Bandwidth Intensive 3-D FFT kernel for GPUs using CUDA |
| 11:00AM-11:30AM | Using Server-to-Server Communication in Parallel File Systems to Simplify Consistency and Improve Performance |
| 11:30AM-12:00PM | Scientific Application-based Performance Comparison of SGI Altix 4700, IBM POWER5+, and SGI Altix ICE 8200 Supercomputers |
| 11:30AM-12:00PM | Adapting a Message-Driven Parallel Application to GPU-Accelerated Clusters |
| 11:30AM-12:00PM | Scaling Parallel I/O Performance through I/O Delegate and Caching System |
| 01:30PM-02:00PM | Efficient Management of Data Center Resources for Massively Multiplayer Online Games |
| 01:30PM-02:00PM | Performance Optimization of TCP/IP over 10 Gigabit Ethernet by Precise Instrumentation |
| 01:30PM-02:00PM | A Multi-level Parallel Simulation Approach to Electron Transport in Nano-scale Transistors |
| 02:00PM-02:30PM | Feedback Controlled Resource Sharing for Predictable eScience |

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|---|---|
| 02:00PM-02:30PM | Wide-Area Performance Profiling of 10GigE and Infiniband Technologies |
| 02:00PM-02:30PM | Accelerating Configuration Interaction Calculation for Nuclear Structure |
| 02:30PM-03:00PM | Efficient Auction-based Grid Reservations using Dynamic Programming |
| 02:30PM-03:00PM | Asymmetric Interactions in Symmetric Multicore Systems: Analysis, Enhancements, and Evaluation |
| 02:30PM-03:00PM | Dendro: Parallel Algorithms for Multigrid and AMR Methods on 2:1 Balanced Octrees |
| 03:30PM-04:00PM | Characterizing Application Sensitivity to OS Interference using Kernel-Level Noise Injection |
| 03:30PM-04:00PM | Performance Prediction of Large-scale Parallel System and Application using Macro-level Simulation |
| 03:30PM-04:00PM | A Novel Domain Oriented Approach for Scientific Grid Workflow Composition |
| 04:00PM-04:30PM | Toward Loosely-coupled Programming on Petascale Systems |
| 04:00PM-04:30PM | Early Evaluation of BlueGene/P |
| 04:00PM-04:30PM | Nimrod/K: Towards Massively Parallel Dynamic Grid Workflows |
| 04:30PM-05:00PM | SMARTMAP: Operating System Support for Efficient Data Sharing among Processes on a Multi-core Processor |
| 04:30PM-05:00PM | Lessons Learned at 208K: Toward Debugging Millions of Cores |
| 04:30PM-05:00PM | Applying Double Auctions for Scheduling of Workflows on the Grid |

Wednesday Nov, 19

| Time | Title |
|---|---|
| 10:30AM-11:00AM | A Novel Migration-based NUCA Design for Chip Multiprocessors |
| 10:30AM-11:00AM | Communication-Avoiding Gaussian Elimination |
| 11:00AM-11:30AM | Extending CC-NUMA Systems to Support Write Update Optimizations |
| 11:00AM-11:30AM | Benchmarking GPUs to Tune Dense Linear Algebra |
| 11:30AM-12:00PM | High-Radix Crossbar Switches Enabled by Proximity Communication |
| 03:30PM-04:00PM | Massively Parallel Genomic Sequence Search on the Blue Gene/P Architecture |
| 03:30PM-04:00PM | The Role of MPI in Development Time: A Case Study |
| 04:00PM-04:30PM | An Efficient Parallel Approach for Identifying Protein Families from Large-scale Metagenomic Data |

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|---|---|
| 04:00PM-04:30PM | An Adaptive Cut-off for Task Parallelism |
| 04:30PM-05:00PM | EpiSimdemics: An Efficient Algorithm for Simulating the Spread of Infectious Disease over Large Realistic Social Contact Networks |
| 04:30PM-05:00PM | Programming the Intel 80-core Network-on-a-chip Terascale Processor |

Thursday Nov, 20

| Time | Title |
|---|---|
| 10:30AM-11:00AM | PAM: A Novel Performance/Power Aware Meta-scheduler for Multi-core Systems |
| 10:30AM-11:00AM | Hiding I/O Latency with Pre-execution Prefetching for Parallel Applications |
| 11:00AM-11:30AM | A Dynamic Scheduler for Balancing HPC Applications |
| 11:00AM-11:30AM | Characterizing and Predicting the I/O Performance of HPC Applications using a Parameterized Synthetic Benchmark |
| 11:30AM-12:00PM | Proactive Process-Level Live Migration in HPC Environments |
| 11:30AM-12:00PM | Parallel I/O Prefetching Using MPI File Caching and I/O Signatures |
| 01:30PM-02:00PM | BitDew: A Programmable Environment for Large-Scale Data Management and Distribution |
| 01:30PM-02:00PM | Scalable Load-Balance Measurement for SPMD Codes |
| 01:30PM-02:00PM | Using Overlays for Efficient Data Transfer over Shared Wide-area Networks |
| 02:00PM-02:30PM | Massively Parallel Volume Rendering Using 2-3 Swap Image Compositing |
| 02:00PM-02:30PM | Capturing Performance Knowledge for Automated Analysis |
| 02:00PM-02:30PM | The Cost of Doing Science in the Cloud: The Montage Example |
| 02:30PM-03:00PM | High Performance Multivariate Visual Data Exploration for Extremely Large Data |
| 02:30PM-03:00PM | Analysis of Application Heartbeats: Learning Structural and Temporal Features in Time Series Data for Identification of Performance Problems |
| 02:30PM-03:00PM | Server-Storage Virtualization: Integration and Load Balancing in Data Centers |
| 03:30PM-04:00PM | Materialized Community Ground Models for Large-scale Earthquake Simulation |
| 03:30PM-04:00PM | Positivity, Posynomials and Tile Size Selection |

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|---|---|
| 04:00PM-04:30PM | A Scalable Parallel Framework for Analyzing Terascale Molecular Dynamics Trajectories |
| 04:00PM-04:30PM | Global Trees: A Framework for Linked Data Structures on Distributed Memory Parallel Systems |
| 04:30PM-05:00PM | Parallel Exact Inference on the Cell Broadband Engine Processor |
| 04:30PM-05:00PM | Prefetch Throttling and Data Pinning for Improving Performance of Shared Caches |

7. 工作坊(Workshops)

今年工作坊(Workshops)場次如下：

Sunday Nov, 16

| Time | Title |
|---|---|
| 08:30AM-05:00PM | Grid Computing Environments (GCE) 2008 |
| 08:30AM-05:00PM | Workshop on Ultra-Scale Visualization |
| 08:30AM-05:00PM | Power Efficiency and the Path to Exascale Computing |
| 08:30AM-05:00PM | Node Level Parallelism for Large Scale Supercomputers |
| 08:30AM-05:00PM | Workshop on High Performance Computational Finance |

Monday Nov, 17

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|---|---|
| 08:30AM-12:00PM | Workshop on Many-task Computing on Grids and Supercomputers (MTAGS) |
| 08:30AM-05:00PM | Petascale Data Storage Workshop |
| 08:30AM-05:00PM | Bridging Multicore's Programmability Gap |
| 08:30AM-05:00PM | Nuclear Energy Advanced Modeling and Simulation: Enhancing Climate and Energy Security Opportunities |
| 08:30AM-05:00PM | High-performance Reconfigurable Computing Technology and Applications (HPRCTA'08) |
| 08:30AM-05:00PM | Supercomputing, Multicore Architectures and Biomedical Informatics |
| 01:30PM-05:00PM | The 3rd Workshop on Workflows in Support of Large-scale Science (WORKS08) |

Friday Nov, 21

| Time | Title |
|---|---|
| 08:30AM-05:00PM | The Fourth International Workshop on High Performance Computing for Nano-science and Technology (HPCNano08) |

8. 其他

(1)獎勵(Awards & Challenges)

此項活動包括有ACM贊助的 Gordon Bell、IEEE贊助的Seymour Cray and Sidney Fernbach Awards、SC08 Conference Challenges等。

SC08 Conference Challenges分爲Bandwidth Challenge 、Cluster Challenge、HPC Storage Challenge、Analytics Challenge。其中特別提出Cluster Challenge，今年有我國代表隊－國立清華大學參賽，由鐘葉青教授帶領大學生參展和簡報，在11月20日的七隊最後決賽中，我國團隊獲得第二名殊榮。

(2)Education Program

Education Program已有許多年，是一項平常即實施的課程活動，包括夏令營、工作坊和線上課程，設計爲永續的；且平日就有社群在辦活動。主題範圍有高速計算圖形處理單元(GPU)操作系統，及融合大量資料(population data)設定以使用Google Maps 支援”spread of disease”課程教學等，此些都針對k12的課程需求。

本次與SC08研討會結合推動，爲將來科學、科技能源、數學等教學做準備。教導(Tutorial)活動舉行日從11月15日至18日，Intel贊助設備，讓老師學習應用計算科學、網路計算和HPC在教育的準備，開放當地高中以上教師報名，約300多位報名，錄取120位，提供參加者住宿、交通等費用，該課程並開放學生、高中教師、教學者等旁聽。

另設有Student Program，讓相關科系學生參加簡報，座談等，由學術、公司、研究學會等引導，注重過程與經驗。K-12 Program，使得k-12教師於創造一未來的教育系統，以縮減數位落差，登錄參與進階數學、科學，給于學生有機會探索科學、科技、工程和數學（STEM）。教師參與論壇，可分享最新資訊、提供教室真實經驗，教師有機會探索計算工具，使用於教室教STEM學問。其他的案例，如OSC(Ohio Supercomputer Center)和OSU(Ohio State University)提供high school學生和教師創意教學和研究環境，協助在科學、科技、工程和數學方面的學習（相關資訊請參閱網站http://www.osc.edu）。

(3)回顧展

SC Conference自1988年開始辦理，今年適逢20周年，主辦單位特別規劃一個區域展示，展示內容包括各屆研討會的主題、召集人和簡介等資訊，同時將超級電腦技術的演進史做個簡介，是不錯的教學展示區。


(4)會議志工

有約 300 位志工學生協助。展示區經過 110 位成員，Scinet 超過一年的策劃，三週的網路安裝和設定，傳輸 200GbpsWAN 的連接，支援會場無線上網(Wireless)。

(5)場地其他服務：有報到專區、上網服務區(Email Station：採用 FireFox、Start Office)。

（三）相關網站：

2008 年研討會 http://sc08.supercomputing.org

出席者服務資訊 http://scyourway.nacse.org/conference/

教育課程 http://sc-education.org

部分文章分享 http://super08.supercomputing.org

## 三、心得與建議

SC08 Conference 已經是舉行多年的研討會，節目相當多元，除了 ACM、IEEE 之外，並有相當多的科技公司贊助，可說集世界高速計算科技於此一會議。

今年的會議志工有約 300 位志工學生協助。展示區經過 110 位成員，Scinet 超過一年的策劃，三週的網路安裝和設定，傳輸 200GbpsWAN 的連接，支援展場無線上網(Wireless)。

建置有研討會專屬的網站(網址爲

http://scyourway.naacse.org/conference/)，內容有清楚的活動分類，類別有 Paper、Posters、Panels and Workshop、Exhibits、Masterworks 等，查詢時可以針對不同主題分類查詢顯示，註冊參加也已是分類報名，註冊的類別有 5 種類型的身份，大會針對身份有不同的 ID 卡，皆使用電腦處理。各身分至不同的 session 都有工作人員管理進入權。並經由 SC-Your Way 網站對出席者提供相關參與活動的生活資訊服務。

爲非常大型的研討會，有相當多元的節目，因此，參加人數眾多，報到處是電腦處理並做身分確認，註冊、進場的管理與服務非常的專業，更特別的是有音樂欣賞室，結合音樂、音樂家、愛樂者和科學、科學家，測試聽者對不同電腦產生的音樂聽覺，並可做彈奏，讓與會者可以透過音樂放鬆與休息。

高速電腦的使用爲非常高科技的應用範疇，由此次研討會了解到，除了鼓勵創新技術的研發之外，也同時爲未來的教育做準備中，許多 HPC 在教育的應用，逐漸推廣應用於大學生、高中學生，甚至是 k-12 課程的學習與體驗，因此，建議我國學生的資訊教育培養，也可逐步推動高速計算的應用，對大學生、高中生的學習機會活動進行策劃，爲培養下一代高速人才與培養學生具備科技創意做準備。

建議相關的獎勵和競賽活動訊息，蒐集給各大學教師了解，並鼓勵報名參加，以落實資訊教育國際交流的推動。此次會場並已經展示出明年的展示櫃和邀約海報，有意願角逐者可以開始摩拳擦掌了。

# 附錄：研討會相關資料

## 1.Chair’ s Welcome

# Chair's Welcome

Welcome to Austin, Texas, the Austin Convention Center and SC08, the 21st International Conference for High Performance Computing, Networking, Storage and Analysis. This year, in addition to featuring the latest scientific and technical innovations in the field from around the world, and demonstrating how these developments are driving new ideas, discoveries and industries, and changing education, we are celebrating the 20th anniversary of the first SC Conference, then called Supercomputing, which was held in Orlando, Florida in 1988. This important milestone is a focus of this year's conference, with the nucleus being a large lobby display that recounts the progression of high performance computing (HPC) and our community, and the impact of the SC Conference on HPC and society at large. As part of the 20th Anniversary Initiative, SC08 attendees receive a souvenir DVD, which includes a video that highlights the past 20 years, and have access to a newly-established digital archive with noteworthy photos, videos and textual anecdotes, which provide a historical perspective of the SC conference series. In addition, on Friday, a panel of former SC General Chairs will review the past 20 years and, with the help of you and your colleagues, will predict the next 20!

Remarkably, considering its size, breadth and depth, this conference is the product of the efforts of hundreds of volunteers from industry, academia, government agencies and research laboratories, with whom I have had the pleasure to work. Together, we have planned and collaborated over the past three years to bring you SC08, which is co-sponsored by the ACM and IEEE Computer Society. The tireless efforts of the SC08 volunteers and contractors have resulted in outstanding technical, educational and outreach programs, as well as a rich exhibits floor that offers attendees the opportunity to explore the latest advances in high performance computing, networking, storage, analysis, data management, scientific visualization and collaborative technologies, showcased in a record-breaking 200 Industry and 120 Research Exhibits from the world's leading companies and organizations. In addition, Exhibitor Forum presentations will highlight the latest advances of our Industry Exhibitors, including new products and upgrades, recent R&D efforts as well as future plans and roadmaps. And, thanks to the efforts of a 110-member networking team, the Austin Convention Center is the home, for seven days, to one of the most powerful networks in the world — SCinet, which took more than one year to plan and three weeks to install

and configure. SCinet will deliver almost 200 Gbps WAN connectivity to SC08 exhibitors.

Given the impressive response from the community to our Call for Participation, the SC08 Technical Program promises to be outstanding. This year we broke a number of records for submissions — 277 technical papers, 177 posters and 102 BoFs. Although many of the technical papers were of high quality, because of space limitations, the reviewers accepted 59 — these papers represent some of the most exciting developments in applications, architecture, grids, networks, performance and system software. We received 21 ACM Gordon Bell Prize submissions and accepted six as finalists for two prizes, peak and special; the finalists will give presentations on Wednesday and Thursday. The referees accepted 55 (of 151 submitted) regular posters and five (of 19 submitted) ACM Student Research Competition (SRC) posters, which will be displayed in the lobby of the convention center; the Poster Reception at 5-7 p.m. on Tuesday will give you the opportunity to converse with poster presenters, and a special Wednesday evening session will showcase the ACM SRC semi-finalists. During the week, 53 BoFs will give you plenty of opportunities to discuss topics of common interest in informal settings. In addition, the Doctoral Showcase will give potential employers as well as prospective Ph.D. candidates a glimpse of the research being conducted by 15 (out of 44 aspirant) Ph.D. candidates, three of whom are the first-ever ACM/IEEE Computer Society High Performance Computing (HPC) Ph.D. Fellows.

The Technical Program also features seven panels, including one focused on Disruptive Technologies, which is complemented by five exhibits that focus on innovative technologies or products that threaten to overturn their dominant counterparts in today's marketplace; and four Challenges — Analytics, Bandwidth, Cluster and Storage, which exploit the competitive spirit of the participants. There are also 13 independently planned, full-, half- and multi-day workshops, being held on Sunday, Monday and Friday in conjunction with SC08 and extending its impact by providing greater depth in the associated technical areas. As usual, a wide range of topics is covered by SC Tutorials — 25 (of 49 submitted), which are scheduled on Sunday and Monday. This year, there are 10 half-day and 15 full-day tutorials, relevant to various levels of expertise, taught by leaders in the field.

Being in Austin, it is fitting that the conference will commence on Tuesday with a presentation by Michael Dell, the SC08 keynote speaker. Subsequently, on Wednesday and Thursday, four renowned plenary speakers will focus on topics related to SC08's Technology Thrusts, Biomedical Informatics and Energy, as well as the challenges presented by many-core/multi-core processors. Moreover, during the week, 16 invited Masterworks presenters will illustrate innovative ways of applying high performance computing, networking, storage and analysis in the

fields of biomedical informatics, energy, finance, transportation and the humanities.

SC08 continues the conference's efforts in broadening participation in the conference and engaging individuals from around the globe in groups and disciplines that traditionally have been underrepresented in HPC or at the SC Conference. Accordingly, the conference hosts Education, Broader Engagement (BE) and Student Volunteer programs. This year, SC08 is hosting 200 student volunteers, up to 90 BE participants and 120 Education Program participants, as well as BE's first Student Job Fair for the nearly 300 students involved in these programs. In addition, BE is expanding its mentoring activity, which pairs participants in these programs with volunteer mentors, i.e., guides-on-the-side with respect to the conference, the exhibits and career paths, and BE participants, student volunteers and committee members are staffing the SC Your Way booth, which like its web counterpart, can help you get the most out of your trip to Austin - help you find a hotel room and restaurants, view the Technical Program schedules, navigate a route through the Exhibits and get around the city.

The multi-year Education Program, which includes summer week-long workshops and an on-site program during the conference, was designed to be sustainable. This summer, the SC08 Education Program hosted 250 participants and 11 workshops that focused on a wide range of curricular issues involved in integrating supercomputing technologies with the chemistry, biology, nanotechnologies, parallel computing, physics, engineering and mathematics disciplines. For the first time, workshops were hosted outside the Continental U.S. -- one in Puerto Rico and one in Costa Rica. Complementing the workshops, the on-site program, themed "Desktop to Grids," showcases and leverages technologies on the exhibits floor that can impact curriculum design. Topics range from high performance computing using graphics processing units (GPUs) in an operating systems course to the melding of large population data sets with Google maps to support teaching of the "spread of disease" curriculum requirement in K12. To support post-conference curriculum development, the SC08 and SC09 Education Chairs recently deployed "Edu-Grid," a dedicated HPC resource for use by educators for curriculum development - they received the 2008 Campus Technologies Innovator award for this endeavor! Associated curriculum materials are accessible from CSERD, the Computational Science Education Reference Desk, a Pathways project of the National Science Digital Library funded by NSF; in the future, these materials will be cross-referenced with the ACM and IEEE digital libraries. Recognition of the value of the SC Education Program is demonstrated by the 320 applications for the on-site program -- and the 120 who were selected to join us at SC08 in Austin.

Given that Austin is the Live Music Capital of the World, SC08 would not be complete without the SC08 Music Initiative, which endeavors to bring together music, musicians, music lovers,

science and scientists. Accordingly, the Technical Program features a panel, a Masterworks session and a tutorial related to music and HPC. In addition, ViSCiTunes explores the relationship between scientific visualization and music; DigiVibes tests your ability to differentiate computer-generated music from music played on musical instruments; and a Music Room at the convention center provides a place where you can take a break and either play or listen!

As you can see, there is a lot to avail yourself of at SC08. And, I didn't even mention the Awards Session on Thursday — be sure to attend it and help celebrate the success of your colleagues, and the Technical Program attendees' Thursday night social event, "Ways of the West — Texas Style", which will showcase the music, food and culture of three diverse populations of Texas. The SC08 Committee and I sincerely hope that you enjoy the conference, the exhibits, the people, the parties and the great city of Austin.

**Patricia J. Teller**
SC08 General Chair
20 Years - Unleashing the Power of HPC

2.General Information

# General Information

**SC08** is the premier international conference on high performance computing, networking, storage and analysis. Since the first SC conference in 1988, SC has continued to expand as the frontiers of high performance computing have expanded, offering new initiatives and experiences for attendees each year. As it marks its 20th anniversary, SC08 will provide special exhibits and presentations looking back at the history of the conference and the field of high performance computing. At the same time, the conference will continue its long tradition of providing a look at what the future holds.

This conference program is your guide to what's happening in Austin the week of November 15- 21, 2008. As always, SC will host an exceptional technical program, tutorials, workshops, educational program, an exhibit area filled with displays from industry and research leaders, and many other activities. In addition, SC08 also offers many opportunities for socializing and networking with colleagues. Over the years, the conference has grown to include scientists, researchers, software developers, network engineers, visualization programmers, policy makers, corporate managers, CIOs and IT administrators in universities, industry and government worldwide.

Attendees learn about state-of-the-field developments in technology, applications, vendor products, research results, national policy and national/ international initiatives. They see how tomorrow's technology can be applied to real-world challenges and how high performance computing, networking, storage and analysis effects the way we understand and interact with our world. If there is one common theme of all SC conferences, it is that the impacts of HPC and related technologies are many and far reaching; they extend to education and using modeling and simulation to enhance classroom learning to using computing power to solve heretofore unsolvable problems in nanoscience, biotechnology, climate research, astrophysics, chemistry, fusion research, drug research, homeland defense, nuclear technologies and many other fields.

We look forward to your participation in SC08 and urge you to use this program as your guide to programs and special events throughout the week. Also keep in mind that SC is much more than what you will find between the pages of this guide. Take the time to visit the exhibits, talk with leaders from industry and academia, share ideas with your colleagues at Birds-of-a-Feather sessions, or offer your insights to a promising student or new conference participant. Finally, as a salute to our host city which is celebrated for its live music scene, the SC08 Music Initiative offers you the opportunity to combine music, sound and computing in a number of ways, from playing your own music to exploring how music can complement scientific visualization. Tune in and enjoy!

We welcome you to Austin and look forward to your participation.

## Registration Desk/ Conference Store

The registration desk and conference store are located in the convention center lobby.

### Registration Desk & Conference Store Hours

| | |
|---|---|
| Saturday, Nov. 15 | 1 p.m. - 6 p.m. |
| Sunday, Nov. 16 | 7:30 a.m. - 6 p.m. |
| Monday, Nov. 17 | 7:30 a.m. - 9 p.m. |
| Tuesday, Nov. 18 | 7:30 a.m. - 6 p.m. |
| Wednesday, Nov. 19 | 7:30 a.m. - 6 p.m. |
| Thursday, Nov. 20 | 7:30 a.m. - 5 p.m. |
| Friday, Nov. 21 | 8 a.m. - 11 a.m. |

## Registration Categories

### Tutorials

Full-day and half-day tutorials are offered on Sunday and Monday, November 16 and 17. Tutorials are not included in the Technical Program registration fee and require separate registration and fees. Attendees may choose a one-day or two-day passport, allowing them to move freely between tutorials on the selected day(s). Tutorial notes and luncheons are provided for each registered tutorial attendee.

### Tutorial Notes

Registered tutorial attendees will receive a copy of all tutorial notes on a computer-readable medium; no hardcopy notes will be distributed or available. Some of the tutorials will have hands-on components. For these, attendees must bring their own laptops with SSH software installed. Rooms used for hands-on tutorials will be equipped with wired network drops, Ethernet cables, SCinet wireless networking, and power drops, but there will be no computer support available. Please arrive early, as there may be tutorial-specific software to install on your laptop.

### Technical Program

Technical Program registration provides access to plenary talks, posters, panels, BOFs, papers, exhibits, challenges, awards, Masterworks, the Doctoral Showcase, and workshops.

### Exhibitor

Exhibitor registration provides access to the exhibit floor and to limited Technical Program events for attendees affiliated with organizations with exhibits on the show floor.

### Exhibits Only

Exhibits Only registration provides access to the exhibit floor for all three days of the exhibition during regular exhibit hours. It does not provide access to the Monday Night Gala Opening. Children under age 12 are not permitted on the floor except during Family Hours (4-6 p.m., Wednesday, November 19), and must be accompanied by a family member who is a registered conference attendee.

### Education Program

Education Program registration provides access to all events except Tutorials and the exhibit hall.

### Proceedings

Attendees registered for the Technical Program will receive one copy of the SC08 proceedings on a USB flash drive.

### Lost Badge

There is a $40 processing fee to replace lost badges.

### Member, Retired Member and Student Registration Discounts

To qualify for discounted registration rates, present your current IEEE, IEEE Computer Society, ACM, or ACM SIGARCH membership number or a copy of a valid full-time student identification card when registering. You may complete the IEEE Computer Society and/or ACM membership application provided in your conference bag and return it to the Special Assistance desk in the registration area to receive the member discounted registration rate.

## Student Volunteers

Undergraduate and graduate student volunteers assist with the administration of the conference and in exchange receive free conference registration, housing and most meals.

Student volunteers have the opportunity to experience and discuss the latest HPC technologies and to meet leading researchers from around the world while contributing to the success of the conference. SC08 attendees are encouraged to share information about the SC Student Volunteers program with their colleagues and to encourage their students to apply for future conferences.

## Registration Pass Access

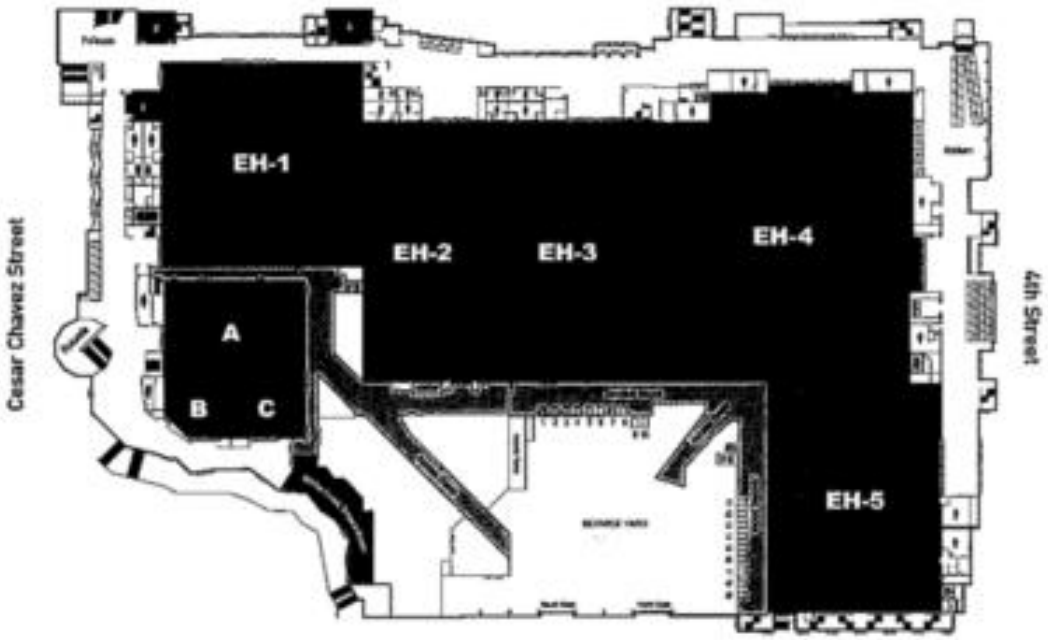
Each registration category provides access to a different set of conference activities, as summarized below.

| Type of Event | Tutorials (on day of passport) | Technical Program | Exhibits Only | Exhibitor | Education |
|---|---|---|---|---|---|
| Education Program Meals | | | | | • |
| All Tutorial Sessions | • | | | | |
| Tutorial Lunch | • | | | | |
| Exhibitor Party | | | | • | • |
| Monday Exhibits Gala Opening | | • | | • | • |
| Tuesday Keynote | | • | | • | • |
| Tuesday Poster Reception | | • | | | • |
| Wednesday Plenary (Invited Speakers) | | • | | | • |
| Thursday Plenary (Invited Speakers) | | • | | | • |
| Thursday Night Reception | | • | | | • |
| Birds-of-a-Feather | | • | | • | • |
| Challenge Presentations | | • | | • | • |
| Exhibitor Forum | | • | • | • | • |
| Exhibit Floor | | • | • | • | • |
| Masterworks | | • | | | • |
| Panels (Friday Only) | | • | | • | • |
| Panels (Except Friday) | | • | | | • |
| Papers | | • | | | • |
| Posters | | • | • | • | • |
| SCinet Wireless Access | • | • | • | • | • |
| Workshops | | • | | | • |

## 3.Maps

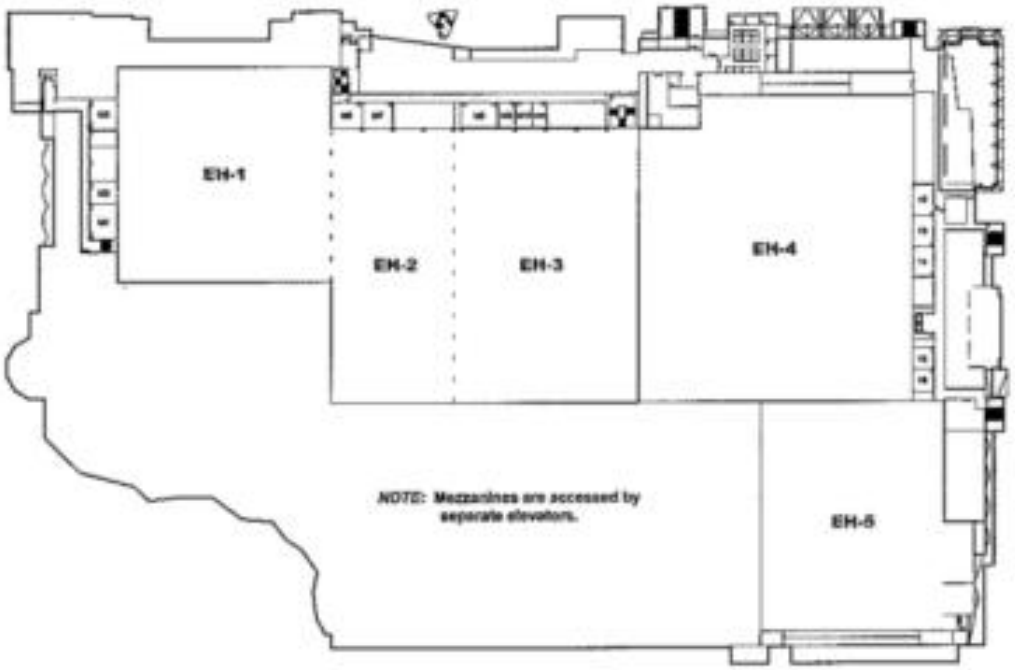
**Level 1**

Trinity Street



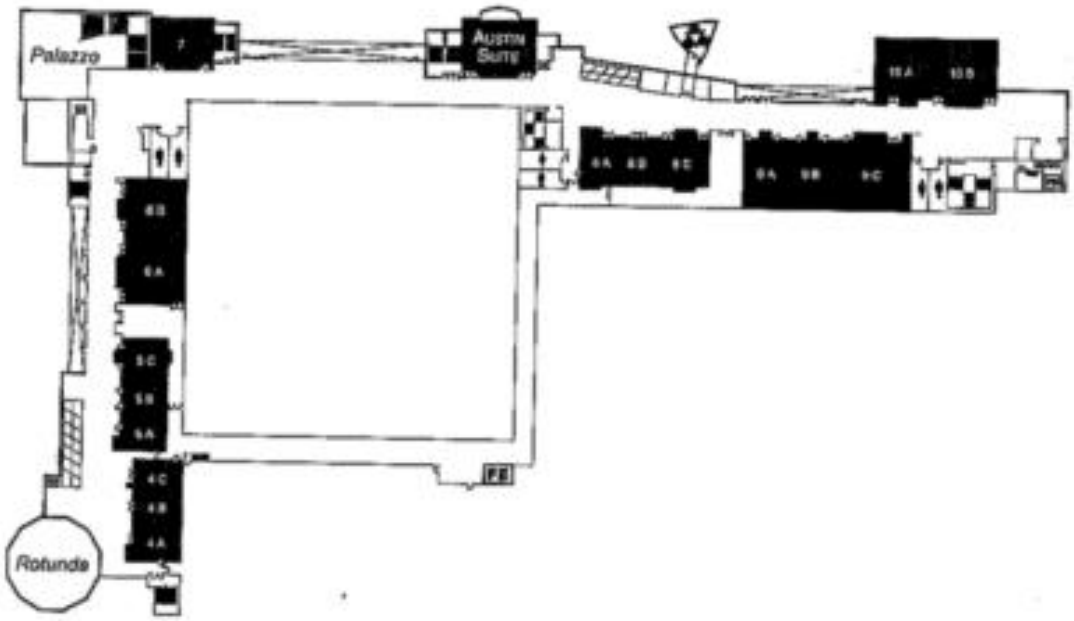

**Level 2**

Mezzanines and Show Offices



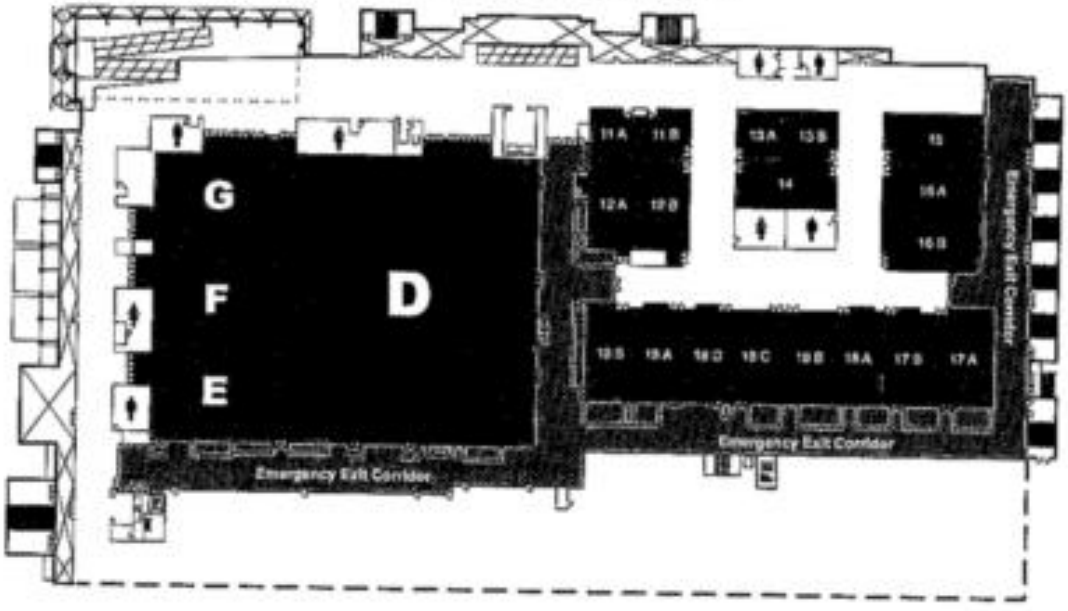
## Austin Convention Center

### Level 3




### Level 4

Grand Ballroom and Meeting Rooms



# Tutorials

The SC08 Tutorials Program offers in-depth instruction regardless of your level of expertise. For those relatively new to high performance computing, networking, storage and analysis, there are opportunities to get up to speed in the field with basic tutorials. For 20-year veterans, there are advanced tutorials on special topics and new developments, taught by leaders in the field. And there are plenty of offerings for everyone in between.

This year, 10 half-day and 15 full-day tutorials are offered. There are nine new tutorials scheduled and 16 that have been presented at previous SC conferences. Many of the "old" tutorials have been significantly updated since their last outing.

**Topics include:**

- parallel, distributed and multi-core computing
- parallel programming and debugging
- high performance programming languages and systems
- performance modeling, analysis and tuning
- software tools and libraries
- networking
- file systems and I/O

And, for a truly out-of-the-box topic, consider the Computer Music Tutorial — an SC first-linked to the Music Initiative. Attendees may choose a one-day or two-day passport, allowing them to move freely between tutorials on the selected days. Tutorial notes and luncheons are provided for each registered tutorial attendee.

Note: No hardcopy notes will be distributed. Each registered tutorial attendee will receive a copy of all the tutorial notes on a computer-readable medium only.

Some of the tutorials (S03, S06, S07, S08, M03, M04, M11) will have hands-on components. For these, attendees must bring their own laptops with SSH software installed. The tutorial rooms will have wired network drops, Ethernet cables, SCinet wireless and power drops, but there will be no computer support available. Please arrive early, as there may be tutorial-specific software to install on your laptop.

5.Papers

# Papers

The SC08 Technical Papers program offers an exciting forum for disseminating important advances and innovations in high performance computing, networking, storage and analysis. Fifty-nine papers, chosen from 277 submissions, will be presented in 20 sessions during the course of the technical program.

Nearly as impressive as the quality is the diversity of the papers, which cover the full range of SC08 technical areas, including Applications, Architecture, Grids, Networks, Performance and System Software.

The sessions will feature three presentations each and cover the following topics:

- Applications on GPUs
- HPC Systems
- I/O and File Systems
- Grid Resource Management
- Large-Scale Applications
- Networks
- Large-Scale System Performance
- Runtime Systems
- Workflows
- Linear Algebra
- Processor and Switch Architecture
- Biomedical Informatics
- Programming Models
- I/O Performance
- Scheduling
- Grid Virtualization and Overlays
- Performance Tools
- Visualization and Data Management
- Applications: Models and Analysis
- System Performance Optimization

Papers that are candidates for awards are identified in this section. Awards are presented for best technical paper and best student paper and will be announced at the conference Awards Ceremony at 1:30 p.m. Thursday, Nov. 20.

# Panels

The SC08 Panels program aims to bring out the best, or at least the most interesting and challenging, ideas at the conference. Designed to promote discussion on large and small topics, panels bring together great thinkers, practitioners, and the occasional gadfly to present and debate various topics relevant to high performance computing, networking, storage and analysis. Audience participation is always encouraged. Drop by a panel and enjoy the show.

This year's panels cover a range of topics, including many conference themes:

- Applications for Heterogeneous, Massively Parallel Systems
- Will Electric Utilities Give Away Supercomputers with the Purchase of a Power Contract?
- My Cloud, Your Cloud
- SC Past and Future
- Exa and Yotta Scale Data
- The Hungry Music Monster
- Disruptive Technologies: Weapons of Mass Disruption

# Awards & Challenges

The SC Conference continues to serve as the venue for announcing professional awards that recognize key contributions to high performance computing, networking, storage and analysis. The distinguished Sidney Fernbach Memorial Award and the Seymour Cray Computer Science and Engineering Award are highlighted at SC08 in a plenary technical program session on Wednesday, Nov. 19.

The Best Paper, Best Student Paper and Best Poster awards recognize the finest of the many outstanding papers in a highly competitive technical program. Other recognitions of achievement include the Gordon Bell Prize winner, awards for Challenges, ACM Student Research Competition and the HPC Ph.D. Fellowship. These prestigious honors are presented in a special awards session on Thursday, Nov. 20, 1:30 - 3:30 p.m. in Ballroom D.

# ACM Gordon Bell Prize

The ACM Gordon Bell Prize has been awarded since 1987 to recognize outstanding achievement in high performance computing. It is now administered by the Association for Computing Machinery (ACM), with financial support for the stipend (currently $10,000) provided by Gordon Bell, a pioneer in high performance and parallel computing.

The purpose of the award is to track the progress of leading-edge technical computing, namely simulation, modeling and large-scale data analysis, as applied to science, engineering and other fields. Recent winners have been recognized for landmark computations at performance rates that have in some cases topped 100 teraflop/s. In addition to the main ACM Gordon Bell Prize, the Bell Prize Committee may, at its discretion, grant a special award to recognize an achievement in a related area such as price/performance, usage of innovative techniques or non-traditional types of computation.

Abstracts from this year's Gordon Bell Prize Finalists follow. The winner (or winners) will be announced at the Thursday awards program.

# Wednesday, Nov. 19

## Gordon Bell 1

***Chair:*** *Mateo Valero (Barcelona Supercomputing Center)*

**Ballroom G**

**3:30 p.m. - 5 p.m.**

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### High-frequency Simulations of Global Seismic Wave Propagation using SPECFEM3D_GLOBE on 62K Processors

*Laura Carrington (University of California, San Diego), Dimitri Komatitsch (University of Pau), Mustafa Tikir, Michael Laurenzano and Allan Snavely (University of California, San Diego), David Michéa (University of Pau), Jeroen Tromp (California Institute of Technology), Nicolas Le Goff (University of Pau)*

SPECFEM3D_GLOBE is a spectral-element application enabling the simulation of global seismic wave propagation in 3D anelastic, anisotropic, rotating and self-gravitating Earth models at unprecedented resolution. A fundamental challenge in global seismology is to model the propagation of waves with periods between 1 and 2 seconds, the highest frequency signals that can propagate clear across the Earth. These waves help reveal the 3D structure of the Earth's deep interior and can be compared to seismographic recordings. We performed a 3D simulation reaching a shortest period of 3 seconds, setting a new record using 12K processors of the Cray XT4 Franklin at NERSC. Final results aim to break the 2-second barrier using 62K processors of the Ranger supercomputer at TACC, and

approach the 1-second shortest period. There will be no need to pursue smaller periods, because higher frequency signals do not propagate across the entire globe.

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## Multi-teraflops Simulations of Disorder Effects on the Transition Temperature of the High Tc Superconducting Cuprates

*Gonzalo Alvarez, Michael S. Summers, Markus Eisenbach and Jeremy S. Meredith (Oak Ridge National Laboratory), Jeffrey M. Larkin and John M. Levesque (Cray Inc.), Thomas A. Maier, Paul R. Kent, Eduardo D'Azevedo, and Thomas C. Schulthess (Oak Ridge National Laboratory)*

Staggering computational and algorithmic advances in recent years now make possible systematic Quantum Monte Carole (QMC) simulations of high temperature (high-Tc) superconductivity in a microscopic model, the two dimensional (2D) Hubbard model, with parameters relevant to the cuprate materials. Here we report the computational advances that enable us to study the effect of disorder and nano-scale inhomogeneities on the pair-formation and the superconducting transition temperature. The simulation code is written with a generic and therefore extensible approach and is tuned to perform well at scale. On the Cray XT4 at the National Center for Computational Sciences, for example, we currently run production jobs on 31 thousand processors and thereby routinely achieve a sustained performance that exceeds 100 teraflop/s . We present here a study of how random disorder in the effective Coulomb interaction strength affects the superconducting transition temperature in the Hubbard model.

## Scalable Adaptive Mantle Convection Simulation on Petascale Supercomputers

*Carsten Burstedde and Omar Ghattas (University of Texas at Austin), Michael Gurnis (California Institute of Technology), Georg Stadler (University of Texas at Austin), Eh Tan (California Institute of Technology), Tiankai Tu and Lucas Wilcox (University of Texas at Austin), Shijie Zhong (University of Colorado)*

Mantle convection is the principal control on the thermal and geological evolution of the Earth. Mantle convection modeling involves solution of the mass, momentum,and energy equations for a viscous, creeping, incompressible non-Newtonian fluid at high Rayleigh and Peclet numbers. Our goal is to conduct global mantle convection simulations that can resolve faulted plate boundaries, down to 1 km scales. Uniform resolution leads to trillion element meshes, which are intractable even on petascale supercomputers. Thus parallel mesh adaptivity is essential. We present Rhea, a new generation mantle convection code designed to scale to hundreds of thousands of cores. Rhea is built on ALPS, a parallel octree-based adaptive finite element library that supports new distributed data structures and parallel algorithms for dynamic coarsening, refinement, rebalancing, and repartitioning of the mesh. Using Texas Advanced Computing Center's 580-teraflop/s Ranger system, we demonstrate excellent weak and strong scalability on problems with O(10^10) unknowns.

# Thursday, Nov. 20

## Gordon Bell 2

*Chair: Jack Dongarra (University of Tennessee, Knoxville)*

**Room: Ballroom G**

**10:30 a.m. - noon**

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### 0.365 Petaflop/s Trillion-particle Particle-in-cell Modeling of Laser Plasma Interactions on Roadrunner

*Kevin J. Bowers (D.E. Shaw Research), Brian J. Albright, Benjamin K. Bergen, Lin Yin, Kevin J. Barker and Darren J. Kerbyson (Los Alamos National Laboratory)*

We demonstrate the outstanding performance and scalability of the VPIC kinetic plasma modeling code on the heterogeneous IBM Roadrunner supercomputer at Los Alamos National Laboratory. VPIC is a three-dimensional, relativistic, electromagnetic particle-in-cell code that self-consistently evolves a kinetic plasma. VPIC simulations of laser plasma interaction (LPI) will be conducted at unprecedented fidelity and scale-up to 1.1 x 1012 macro particles on as many as 1.3 x 108 computational voxels-to accurately model the particle trapping physics occurring within a laser-driven hohlraum in an inertial confinement fusion experiment. On these calculations, sustained performance of 0.365-petaflop/s is expected. This capability opens up the exciting possibility of using VPIC to model, in a first-principles manner, an issue critical to the success of the multibillion dollar Department of Energy/National Nuclear Security Administration National Ignition Facility.

### 350-450 Teraflop/s Molecular Dynamics Simulations on the Roadrunner General-purpose Heterogeneous Supercomputer

*Sriram Swaminarayan, Kai Kadau, and Timothy C. Germann (Los Alamos National Laboratory)*

We present timing and performance numbers for a short-range parallel molecular dynamics (MD) code, SPaSM, that has been rewritten for the heterogeneous Roadrunner supercomputer. Each Roadrunner compute node consists of two AMD Opteron dual-core microprocessors and four PowerXCell 8i enhanced Cell microprocessors, so that each node has four MPI ranks, with one Opteron and one Cell each. The computation of forces and updates of particle positions and velocities are performed on the Cells (each with one PPU and eight SPU cores), while the Opterons direct inter-rank communication and perform periodic I/O-heavy analysis, visualization, and checkpointing tasks. Modest load balancing is accomplished by periodically adjusting the (nonuniform) rectilinear spatial decomposition. The nearly perfect weak scaling extrapolation of the performance measured for our initial implementation of a standard Lennard-Jones pair potential benchmark indicates a 320 Teraflop/s double-precision floating-point performance on the full Roadrunner system, expected to reach 350-450 teraflop/s after optimization.

**Linear Scaling Divide-and-conquer Electronic Structure Calculations for Thousand Atom Nanostructures**

*Lin-Wang Wang, Byounghak Lee, Hongzhang Shan, Zhengji Zhao, Juan Meza, Erich Strohmaier and David Bailey (Lawrence Berkeley National Laboratory)*

We present a new linear scaling three-dimensional fragment (LS3DF) method for large-scale ab initio electronic structure calculations. LS3DF is based on a divide-and-conquer approach, which incorporates a novel patching scheme that effectively cancels out the artificial boundary effects due to the subdivision of the system. As a consequence, the LS3DF method yields essentially the same results as direct density functional theory (DFT) calculations. The fragments of the LS3DF algorithm can be calculated independently, which leads to almost perfect parallelization up to tens of thousands of processors. We have been able to achieve 35 teraflop/s, which is 40% of the theoretical speed on 17,280 Cray XT4 processors. Our simulation of a 13,824- atom ZnTeO alloy is 400 times faster than a comparable direct DFT calculation. These results demonstrate the potential of using the LS3DF method for nanostructure calculations as well as the advantages of using linearly scaling algorithms over conventional O(N3) methods.

# Seymour Cray and Sidney Fernbach Awards

The Seymour Cray Computer Science and Engineering Award recognizes innovative contributions to high performance computing systems that best exemplify the creative spirit of Seymour Cray. The award consists of a crystal model, certificate and $10,000 honorarium. The Sidney Fernbach Memorial Award honors innovative uses of high performance computing in problem solving. A certificate and $2,000 honorarium are given to the winner. Sponsored by the IEEE Computer Society, these prestigious honors are presented during the conference awards session on Thursday afternoon beginning at 1:30 in Ballroom D.

# The 2008 Seymour Cray Computer Science and Engineering Award

## *Steven J. Wallach*

Steven J. Wallach, whose career has ranged from cofounding Convex Computer to advising investors and government agencies, is the recipient of the 2008 Seymour Cray Computer Science and Engineering Award. Wallach's award cites his "contribution to high performance computing through a distinguished career in industry and through acts of public service."

Currently Chief Scientist of Convey Computer, an advisor to CenterPoint Venture Partners and consultant to the U.S.

Department of Energy ASC program, Wallach is a member of the National Academy of Engineering (NAE) and has been issued 33 patents. Prior to his current projects, he was vice president of technology for Chiaro Networks and served as co-founder, chief technology officer, and senior vice president of development of Convex Computers, a leading supercomputer company acquired by Hewlett-Packard in 1995. The designer of the Convex C-Series, the world's first affordable supercomputer, he also developed the Exemplar Scalable Parallel Processor (SPP) system for technical and commercial applications. While at Data General Corp. in the late 1970s, he was the principal architect of the 32-bit Eclipse MV supercomputer and, as part of this effort, participated in the design of the MV/6000, MV/8000, and MV/10000 (chronicled in the Pulitzer Prize-winning book "The Soul of a New Machine," by Tracy Kidder). After Hewlett-Packard bought Convex, Wallach became the chief technology officer of HP's Large Systems Group. He was a visiting professor at Rice University from 1998 to 1999 and manager of advanced development at Data General from 1975 to 1981.

Wallach was elected to the National Academy of Engineering in 1995, is an IEEE Fellow and a recipient of the Charles Babbage Award. His 33 patents range from numerical algorithms, virtual memory structures, object creation and management, system methodologies, cache structures, and vector pipeline designs.

# The 2008 Sidney Fernbach Memorial Award

## *William Gropp*

William Gropp, the Paul and Cynthia Saylor Professor of Computer Science at the University of Illinois at Urbana-Champaign (UIUC), is the recipient of the 2008 Sidney Fernbach Memorial Award. Gropp is being recognized "For outstanding contributions to the development of domain decomposition algorithms, scalable tools for the parallel number solutions of PDEs, and the dominant HPC communications interface."

Prior to joining the UIUC, Gropp worked at Argonne National Laboratory for 17 years, beginning as a staff scientist in 1990. At Argonne, he served as Associate Division Director of the Mathematics and Computer Science Division and Deputy Scientific Director of the High-Performance Computing Research Facility. While at Argonne, he also held a joint appointment at the University of Chicago. Prior to joining Argonne, Gropp was a professor of computer science at Yale University for eight years.

Parallel computing has become the dominant paradigm in high performance computing (HPC), but harnessing and using that power efficiently in advancing science has been a major challenge. Gropp has been a leader in developing innovative parallel algorithms, libraries, and interfaces, which have greatly enhanced the application of HPC to computational science.

Some of Gropp's earliest research involved applying parallel algorithms to address questions in computational science, which also necessitated the early development of parallel programs and analysis.

Together with co-authors such as David Keyes and Xiao-Chuan Cai, he developed and analyzed key scalable parallel algorithms for adaptive mesh refinement and domain decomposition methods, which are now widely used in parallel applications.

In the 1990s, the need for better parallel programming methods for numerical libraries led Gropp to work on, and play a major role in, the development of the Message Passing Interface (MPI). In addition, during the standardization process, he designed and developed MPICH, the first functional implementation of MPI. This freely available software remains one of the most widely used implementations of MPI, with nearly 2,000 downloads per month. In 2006, he was selected as an ACM Fellow for his "contributions to message passing protocols."

In addition to developing parallel algorithms and programming interfaces, Gropp has also developed world class software for scientific computing on parallel computers. In particular, he initiated development on the Portable, Extensible Toolkit for Scientific Computation (PETSc). This software, developed in collaboration with Barry Smith, includes nonlinear and linear equation solvers that employ a variety of Newton techniques and Krylov subspace methods.

His publications include seven books, 14 book chapters, 48 journal articles, nearly 150 conference papers, nearly 90 technical reports, and 12 manuals. In addition, he has taught over 30 tutorials, many at the most prominent conferences in the field, and he has co-authored a two-volume report for the Department of Energy entitled "A Science-based Case for Large-scale Simulation." Gropp is also the co-inventor of a patent on a parallel data delivery method.

## SC08 Conference Challenges

The SC conference series has a long history of challenging the supercomputing community to reach higher than ever before, and this year that tradition continues with four Challenges that will showcase the expertise and high performance computing resources at SC08. The Challenges - Bandwidth, HPC Storage, Analytics and the Cluster Challenge - will provide a way to showcase both expertise and high performance computing resources at SC08 in friendly yet spirited competitions with other participants.

- The Bandwidth Challenge, now in its ninth year, is an annual competition for leading-edge network applications developed by teams of researchers from around the globe.

- The HPC Storage Challenge showcases innovation in storage architecture and implementation. Entrants first describe their implementations and present measurements of performance, scalability and storage subsystem utilization in submission proposals.

- The Cluster Challenge will feature teams competing in real time on the exhibit floor, where they will run a workload of real-world problems on clusters of their own design.

- The Analytics Challenge showcases solutions created by researchers and industry that embody all facets of high performance computing, from processing to data visualization.

# Cluster Challenge

The Cluster Challenge showcases the amazing power of clusters and the ability to harness open source software to solve interesting and important problems. Teams compete in real time on the exhibit floor, where they run a workload of real-world problems on clusters of their own design. The winning team will be chosen based on workload accomplished, benchmark performance and overall architectural design.

Building on the success of last year, the Cluster Challenge is featuring seven teams this year. The rules are simple: 26 amps (@110 volts), and up to six team members- no one can have a degree. .The goal of the event is for teams to out compute one another by executing the HPC Challenge benchmarks faster and complete more of the application runs than the competition.

Teams assemble their clusters over the weekend prior to the Exhibit Hall opening. They are introduced and the race begins as the Exhibit Hall opens. For the next 44 straight hours, teams work toward the finish, when judges will arrive to view the results and interview the teams. The winner will be announced during the Awards Ceremony on Thursday afternoon.

Last year one team achieved 420 gigaflop/s on Linpack. Will we reach a teraflop this year, or more? Please plan to visit the Cluster Challenge area during Exhibit Hall hours Monday through Thursday and talk to the teams as they showcases how powerful and accessible clusters have become.

### Team 1: Team Cluster Meister

The 2008 Olympics pits countries against one other in contests of speed and prowess. The 2008 Cluster Challenge features Technische Universitaet Dresden, Germany, and the Open Systems Lab of Indiana University, US, combining forces to make a dash for the coveted Cluster Challenge Gold Medal. This year, the "Cluster-Meister", our multinational team, fueled by bratwurst and soda promises to keep you on the edge of your seat as they compute faster on their IBM cluster than an Indy car drives on the autobahn.

### Team 2: University of Alberta

Team University of Alberta, from Edmonton, Alberta, Canada, is led by students and faculty from the department of computing science. We were excited to win the Cluster Challenge in 2007, and we know the competition will be even stronger in 2008. But, we play to win. Therefore, once again, our vendor partner is SGI and our system is based on the latest revs of the Altix XE platform running Linux. The team's secret sauce is a melange of excellent hardware, talented students, and coaches with strong opinions but with a hint of the ability to agree to disagree.

### Team 3: Arizona State University

Arizona State University, partnered with Microsoft Corporation and the Arizona State University High Performance Computing Initiative, brings a diverse and dedicated team to the competition. We will stand out with the latest in cluster technology, including a brand new Intel-based blade system, DDR Infiniband, and the never-before-entered Windows HPC Server 2008 platform. We also plan to engage the audi-

ence with novel audio and haptic data interfaces. Watch out for the blazing blades of the Sun Devils!

### Team 4: University of Colorado

From the beautiful Rocky Mountains comes Team CU. A team of six University of Colorado undergraduates in conjunction with industry leader Aspen Systems have designed a high performance Intel computing cluster which combines the best of commercial and open source technologies modified to meet the specifications of the Cluster Challenge. The University of Colorado's mascot, Ralphie the Buffalo, will be leading our team's charge to win this year's Cluster Challenge competition!

### Team 5: National Tsing Hua University

Team NTHU, from National Tsing Hua University, comes from Taiwan. Our vendor partners are Hewlett-Packard Development Company (HP) and Intel Corporation. We have designed a system based on HP's BL2x220c double density blades with special low-power configuration running a customized Linux kernel. With the latest CPU provided by Intel, we have connected 80 3-Ghz cores with HP's high bandwidth InfiniBand network in our system. Due to the super power of our cluster and our efforts, we believe that the final victory will come to us.

### Team 6: Massachusetts Institute of Technology

Team GPU from MIT believes that Graphics Processing Units (GPUs) will be a key component in the design of future HPC clusters. We have designed a system that takes advantage of the special purpose processing capacity of the GPU and combines that with the traditional general processing capabilities of the CPU. We have made some unique heat removal modifications to lower our relatively high watts-to-flops ratio.

### Team 7: Purdue University

If the 2008 Cluster Challenge was on St. Patrick's Day, the "greener" entry from Purdue University, along with vendor partner SiCortex, would be right at home. The Purdue/SiCortex system is well suited for power-conscious HPC, potentially providing more flops-per-watt than conventional systems-nearly a teraflop of computation for less than 4 kilowatts of power. The system boasts 972 567-MHz, 64-bit MIPS processor cores and a unique high-speed interconnect fabric for parallel communication that can make it as capable as more power-hungry clusters.

Team members come from Purdue's College of Technology, Computer Sciences Department, and Electrical and Computer Engineering School as well as domain sciences. The team brings together undergraduate students being educated in all facets of high performance computing, from hardware design to parallel algorithms and programming to best practices in designing and operating HPC cluster systems. The 2008 Boilermaker Clustering Team looks forward to competing at SC08 in Austin and leaving the competition green with envy.

8.Posters and BoFs

# Posters and BoFs

The Posters track is a highlight of the SC conference every year, and SC08 will be no exception. More than 150 regular and student posters were submitted for review and the best of these — 54 regular entries, three graduate student and two undergraduate student posters — will be featured at the Posters reception on Tuesday, Nov. 18, 5:15 p.m. - 7 p.m.

Student Posters are part of the ACM's Student Research Competition. The students present their work in a special session during the Technical Program on Wednesday from 10:30 a.m. - noon.

Birds of a Feather (BoF) sessions provide forums for conference attendees to discuss topics of mutual interest. BoFs are open to all conference attendees, including exhibitors and exhibits-only badge holders.

9. Education Program

# Education Program

The SC08 Education Program is a year-long program working with undergraduate faculty, administrators, college students and collaborating high school teachers to integrate computational science and high performance computing and communications technologies highlighted through the SC Conference into the preparation of future scientists, technologists, engineers, mathematicians and teachers.

## Education Program in Austin

The SC08 Education Program in Austin during SC08 runs runs from Saturday, Nov. 15 to Tuesday, Nov. 18. Participants engage in hands-on activities where they learn to apply computational science, grid computing and high performance computing resources in educational settings. Housing, travel and meal costs are provided for participants. The program is open to undergraduate faculty, undergraduate and graduate students, and high school teachers. Instructors who work with students with learning and physical challenges also participate in the education program. Thank you to Intel for their generous hardware support.

## Student Program

The SC Education Student Program allows undergraduate and graduate students to attend a wide range of presentations, round tables and panels led by representatives from academia, industry and research institutions. Talks address a broad spectrum of topics, including education, jobs, internships, career paths and experiences in high performance computing and computational science. Students learn to optimize graduate school applications, obtain internships and fine-tune their resumes. All students attending SC08 are strongly encouraged to take part in the Education Program's Student Program.

## K-12 Program

The K-12 Teacher's Day gives teachers a voice in creating a future educational system that bridges the digital divide, broadens participation in advanced mathematics and science, and gives students ample opportunities to explore careers in science, technology, engineering and math (STEM). Teachers will participate in a forum where they will share the latest information about how to bridge the digital divide and the how to nurture a more diverse STEM workforce for the future. Teachers will have the chance to offer their input, based on their real-world classroom experiences. They will also have the chance to explore computational tools that can be used in the classroom to teach STEM disciplines.

## Learning & Physical Challenges Education Program

The Learning & Physical Challenges Education Program provides K-12 and undergraduate instructors, special education teachers and students with the knowledge and resources to empower all students to become users of cyberinfrastructure and computational science resources, both during their education and throughout their professional careers.

10.Exhibitor Events

# Exhibitor Events

At SC08, industry and research exhibits from the world's leading companies and organizations are showcased in a dynamic, interactive environment. High performance computing, networking, storage, data management, scientific visualization and collaborative technologies are featured.

Industry exhibits demonstrate the latest advancements in HPC technology, often long before it is available commercially. Large and small vendors showcase new hardware, software, services and innovations. More than 200 industry exhibitors will take part in SC08.

Research exhibits provide an international venue for scientists and engineers to display the latest computational science advances, research and development plans, new concepts and initiatives, software and other technologies. Over 130 research research exhibitors will participate in SC08.

A complete guide to the SC08 Exhibits is published separately and can be found in many locations in the Austin Convention Center.

**Exhibit Hours**

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| **Monday, Nov. 17** | **7 p.m. - 9 p.m.** |
| **Tuesday, Nov. 18** | **10 a.m. - 6 p.m.** |
| **Wednesday, Nov. 19** | **10 a.m. - 6 p.m.** |
| **Thursday, Nov. 20** | **10 a.m. - 4 p.m.** |