

Cyber-enabled Discovery and Innovation (CDI)

*Enhance American competitiveness by enabling
innovation through the use of computational thinking*



Cyber-Enabled Discovery and Innovation (CDI)

- Multi-disciplinary research seeking contributions to more than one area of science or engineering, by innovation in, or innovative use of **computational thinking**
- Computational thinking refers to computational...
 - ...Concepts
 - ...Methods
 - ...Models
 - ...Algorithms
 - ...Tools

CDI is Unique within NSF

- five-year initiative; minimum of \$26M in FY 2009 (promised min of \$26M in FY 2008, awarded \$40M)
- to create *revolutionary* science and engineering research outcomes
- made possible by innovations and advances in computational thinking
- emphasis on bold, multidisciplinary activities
- radical, paradigm-changing science and engineering outcomes through computational thinking

Transformative Research

- NEW in NSF Review Criteria:
 - To what extent does the proposed activity suggest and explore creative, original, **or potentially transformative** concepts?
- ADDITIONAL CDI REVIEW CRITERIA:
 - The proposal should define a bold multidisciplinary research agenda that, through computational thinking, promises paradigm-shifting outcomes in more than one field of science and engineering.
 - The proposal should provide a clear and compelling rationale that describes how innovations in, and/or innovative use of, computational thinking will lead to the desired project outcomes.
 - The proposal should draw on productive intellectual partnerships that capitalize upon knowledge and expertise synergies in multiple fields or sub-fields in science or engineering and/or in multiple types of organizations.
 - potential for extraordinary outcomes, such as,
 - revolutionizing entire disciplines,
 - creating entirely new fields, or
 - disrupting accepted theories and perspectives... as a result of taking a fresh, multi-disciplinary approach.

Special emphasis will be placed on proposals that promise to enhance competitiveness, innovation, or safety and security in the United States.

Long-term Funding for Cyber-enabled Discovery and Innovation

- ▶ All NSF directorates are participating in this activity (*subject to budget approval*)

	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012
Total request/plan	\$48M (\$52M)	\$100M	\$150M	\$200M	\$250M
In Solicitation	\$26M	\$26M			
Actual	\$40M				

Three CDI Themes

CDI seeks transformative research in the following general themes, via innovations in, and/or innovative use of, computational thinking:

- **From Data to Knowledge:** *enhancing human cognition and generating new knowledge from a wealth of heterogeneous digital data;*
- **Understanding Complexity in Natural, Built, and Social Systems:** *deriving fundamental insights on systems comprising multiple interacting elements;* and
- **Building Virtual Organizations:** *enhancing discovery and innovation by bringing people and resources together across institutional, geographical and cultural boundaries.*

Types of Projects

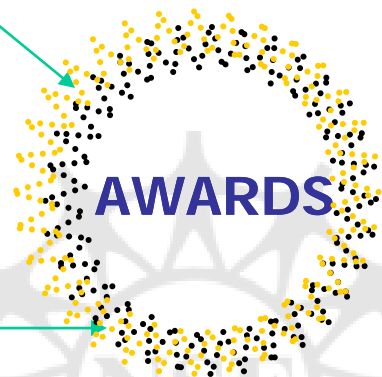
- CDI defines research modalities
- Project size not measured by \$\$
- Projects classified by magnitude of effort
- Three types are defined: Types I (~2 PI, 2 GRA), II (~3 PI, 3 GRA, 1 post-doc), and III (center scale).
- Type III, center-scale efforts, will not be supported in the first year of CDI

1800 LoIs

1300 Preliminary Proposals

204 Full Proposals

AWARDS

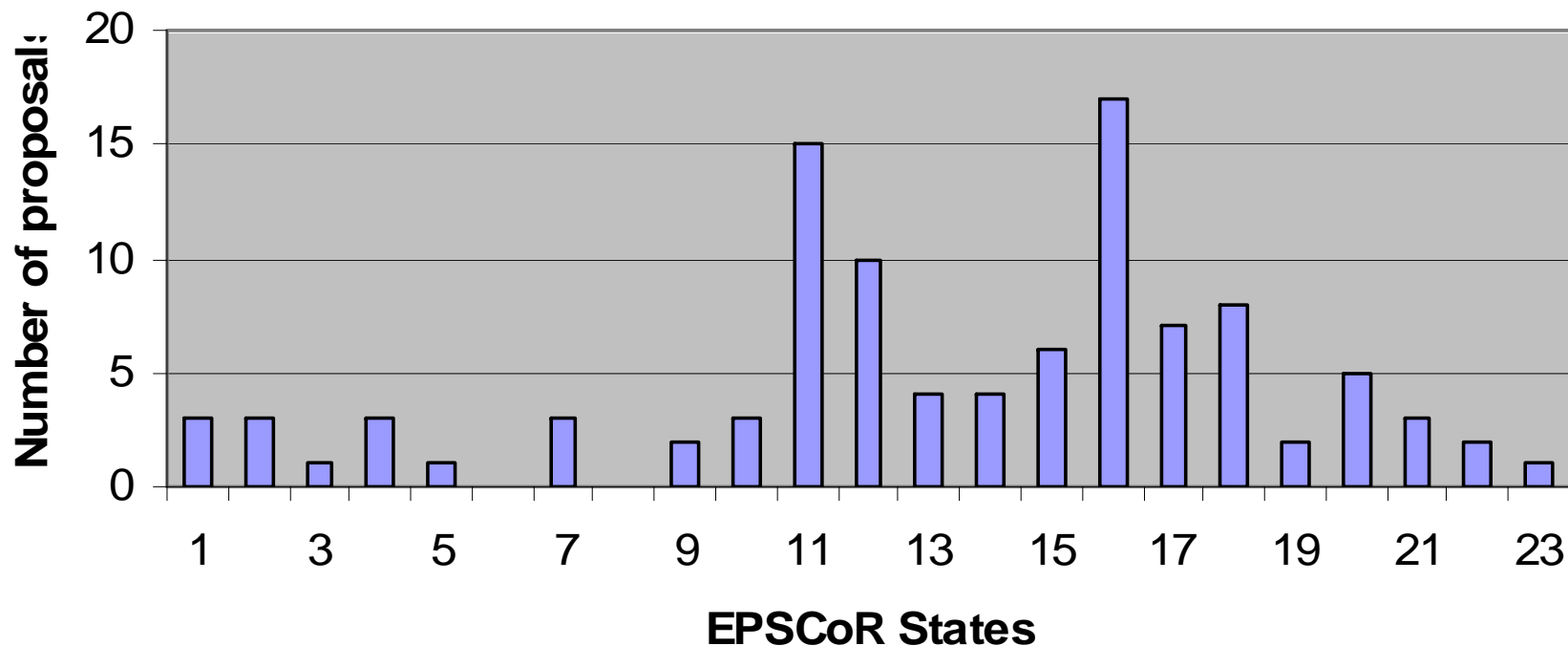


EPSCoR Participation

! Two no-shows, median: 3 prelim proposals per EPSCoR state

! Total number of submissions: 103 out of 1300

CDI preliminary proposal submissions



TYPE I AWARDS

0835839	Baden	U of Cal San Diego	\$602,017	CDI-Type I: A computational database for cyber-assisted discovery of oceanic mixing processes in multi-resolution, feature-driven simulations
0835800	Broadbelt	Northwestern University	\$620,000	CDI-Type I: Discovery of Novel Biochemical Pathways
0835824	Clementi	William Marsh Rice Univ	\$520,154	Collaborative Proposal: CDI-Type I: A multidisciplinary, multiscale approach to discover organizing principles in macromolecular dynamics and functions.
0835712	Maggioni	Duke University		
0835762	Cutler	Rensselaer Polytech Inst	\$670,000	CDI-Type I: Fundamental Terrain Representations and Operations
0835532	Ford	U of Massachusetts Amherst	\$542,000	CDI-Type I: Collaborative Research: Cyber Enabled Engineering of Particle Based Materials and Devices using Energy Landscapes
0835549	Bevan	Johns Hopkins University		
0835789	Foufoula-Georgiou	U of Minnesota-Twin Cities	\$390,000	CDI-Type I: Geometric image analysis for computational knowledge discovery in geosciences
0835572	Gupta	U of MD College Park	\$550,000	CDI-Type I: High-Performance Simulations and Interactive Visualization for Automated Nanoscale Assembly
0835601	Koltun	Stanford University	\$570,000	CDI Type I: Virtual Worlds: Scalability and Content Creation
0835632	Kothare	Lehigh University	\$499,999	Collaborative Research: CDI Type I: Optimal and predictive control of neural prostheses using intracortical Brain Machine Interfaces
0835554	Thakor	Johns Hopkins University		
0835863	Lin	U of Cal Los Angeles	\$670,000	CDI Type I. Mixing the Data to Knowledge direction: Computational Thinking for Faint Feature Detection by Feedback Control and Sensitivity/Resolution Enhancement of Matrix Images
0835734	Mac Low	Amer Museum of Nat Hist	\$575,192	CDI-Type I: Combined Global Physical, Chemical, and Mineralogical Models of Protoplanetary Disks
0835592	Rose	Rutgers Univ New Brunswick	\$740,000	CDI Type I:A Communications Theory Approach to Morphogenesis and Architecture Maintenance
0835735	Russell	Univ of Connecticut	\$550,488	CDI Type-I: Quantum Diffusion and Quantum Random Walks in Physical Systems
0835767	Scassellati	Yale University	\$700,000	CDI-Type I: Understanding Regulation of Visual Attention in Autism through Computational and Robotic Modeling
0835605	Treacy	Arizona State University	\$509,030	Collaborative Research: CDI-type I: Discovery and design of new microporous zeolites.
0835586	Rivin	Temple University		
0835843	Vardy	U of Cal San Diego	\$765,000	Collaborative Research: CDI-Type I: Realizing the Ultimate Potential of List Error-Correction: Theory, Practice, and Applications
0835782	Zhang	Case Western Reserve		
0835814	Guruswami	U of Washington		

TYPE II AWARDS (1)

0835812	Bruno	California Inst of Tech	\$1,000,001	CDI-Type II: Collaborative Research - Simulation of ultrasonic-wave propagation with application to cancer therapy.
0835795	Cleveland	Boston University		
0835804	Roy	Amer Inst of Math		
0835851	Conrey	Amer Inst of Math	\$1,211,433	CDI -Type II: Collaborative Research: Bibliographic Knowledge Network
0835463	Willinsky	Stanford University		
0835500	King	Harvard University		
0835773	Pitman	U of Cal Berkeley		
0835714	Daniilidis	U of Pennsylvania	\$1,450,001	CDI-Type II: Collaborative Research: Cyber Enhancement of Spatial Cognition for the Visually Impaired
0835637	Roumeliotis	U of Minnesota-Twin Cities		
0835645	Manduchi	U of Cal Santa Cruz		
0835689	Giudice	University of Maine		
0836656	Doerschuk	Cornell University	\$1,500,000	Collaborative Research: CDI-Type II: Discovery of Succinct Dynamical Relationships in Large-Scale Biological Data Sets
0836649	Mishra	New York University		
0836720	Mitter	MIT		
0835706	Friedman	Cornell University	\$1,500,000	CDI Type II: Complex Dynamics in the Internet: A Computational Analytic Approach
0835794	Hall	North Carolina State U	\$1,499,992	CDI Type II Computational Discovery of Unusual Nucleic-Acid-Based Nanostructures
0835718	Jakobsson	U of Ill Urbana-Champaign	\$1,838,185	CDI-Type II: Hierarchical Modularity in Evolution and Function
0835541	Subramaniam	U of Cal San Diego		
0835651	Tilson	U of NC Chapel Hill		
0835677	Grama	Purdue University		
0835847	Khammash	U of Cal Santa Barbara	\$2,049,998	Collaborative Research: CDI-Type II: Advanced Theory and Computational Methods for Modular Analysis and Design of Complex Gene Networks
0835623	Van Oudenaarden	MIT		
0835579	Mandel	U of Colorado Denver	\$1,650,253	CDI-Type II: Collaborative Research: The Open Wildland Fire Modeling E-community: a virtual organization accelerating research, education, and fire management technology
0835598	Coen	UCAR		
0835821	Johnson	University of Utah		
0835614	McFarland	Stanford University	\$1,186,174	CDI-Type II: What drives the dynamic creation of science?

TYPE II AWARDS (2)

0835797	Mitchell	Carnegie Mellon University	\$2,100,000	CDI-TYPE II: From Language to Neural Representations of Meaning
0835742	O'Hern	Yale University	\$1,850,003	CDI-Type II: Collaborative Research: Computational Homology, Jamming, and Force Chains in Dense Granular Flows
0835571	Behringer	Duke University		
0835611	Kondic	NJIT		
0835621	Mischaikow	Rutgers Univ New Brunswick		
0835713	Pfister	Harvard University	\$1,993,877	CDI Type II: Scientific Computation for Astronomy, Neurobiology and Chemistry using Graphics Processing Units and Solid-State Storage
0835582	Plechac	U of Tennessee Knoxville	\$1,599,984	Collaborative Research CDI-Type II: Hierarchical Stochastic Algorithms for Materials Engineering.
0835548	Vlachos	University of Delaware		
0835673	Katsoulakis	U of Massachusetts Amherst		
0835543	Rehr	U of Washington	\$864,000	CDI-Type II BEYOND KOHN-SHAM DENSITY FUNCTIONAL THEORY IN TIME-DEPENDENT DYNAMICS
0835652	Rinard	MIT	\$1,450,000	CDI-Type II: Exploiting Collective Human Knowledge to Understand and Evolve Complex Networked Systems
0835607	Schnoor	University of Iowa	\$899,391	CDI-Type II: Understanding Water-Human Dynamics with Intelligent Digital Watersheds
0835745	Wheeler	U of Texas Austin	\$2,000,000	CDI-Type II: Collaborative Research: Computational Models for Evaluating Long Term CO2 Storage in Saline Aquifers
0835436	Parashar	Rutgers Univ New Brunswick		
0835373	Wigderson	Inst For Advanced Study	\$1,750,000	CDI Type II: Pseudorandomness
0835531	Yu	U of Cal Berkeley	\$1,758,855	CDI Type II: Collaborative Research: Sparse Inference: New Tools for Structural Knowledge Discovery
0835550	d'Aspremont	Princeton University		

More Information on CDI:

- CDI Overview, References, Calendar of Events, FAQ:
 - <http://www.nsf.gov/crssprgm/cdi/index.jsp>
- Contact the CDI Working Group:
cdi@nsf.gov ; (703)292-8080

Key Dates and URL:

- Preliminary Proposals due: December 8, 2008 (Type I) and December 9, 2008 (Type II)
- Full proposals due: May 20, 2009
 - Full proposals by invitation only!
- Awards: no later than October 2009
- For more information:
 - Solicitation:
http://www.nsf.gov/publications/pub_summ.jsp?ods_key=nsf08604
 - FAQ, examples, resources:
<http://www.nsf.gov/crssprgm/cdi> .

Questions? Comments?



Contact and More Information on CDI:

- Contact members of CDIWG.
 - Contact the CDI Co-chairs Mary Lou Maher (CISE), Tom Russell (MPS), Eduardo Misawa (ENG) or members of the team listed in the solicitation
- cdi@nsf.gov ; (703) 292-8080
- <http://www.nsf.gov/crssprgm/cdi/>