Instrumenting the Future
(an attempt to explain myself)

SPECC-2012

Dr. Steven E. Koonin, CUSP Director (steven.koonin@nyu.edu)
December 18, 2012

Experimental tools to watch reactions

Volume 70B, number 1 PHYSICS LETTERS 12 September 1977

PROTON PICTURES OF HIGH-ENERGY NUCLEAR COLLISIONS

Steven E. KOONIN[1]
The Niels Bohr Institute, Copenhagen, Denmark

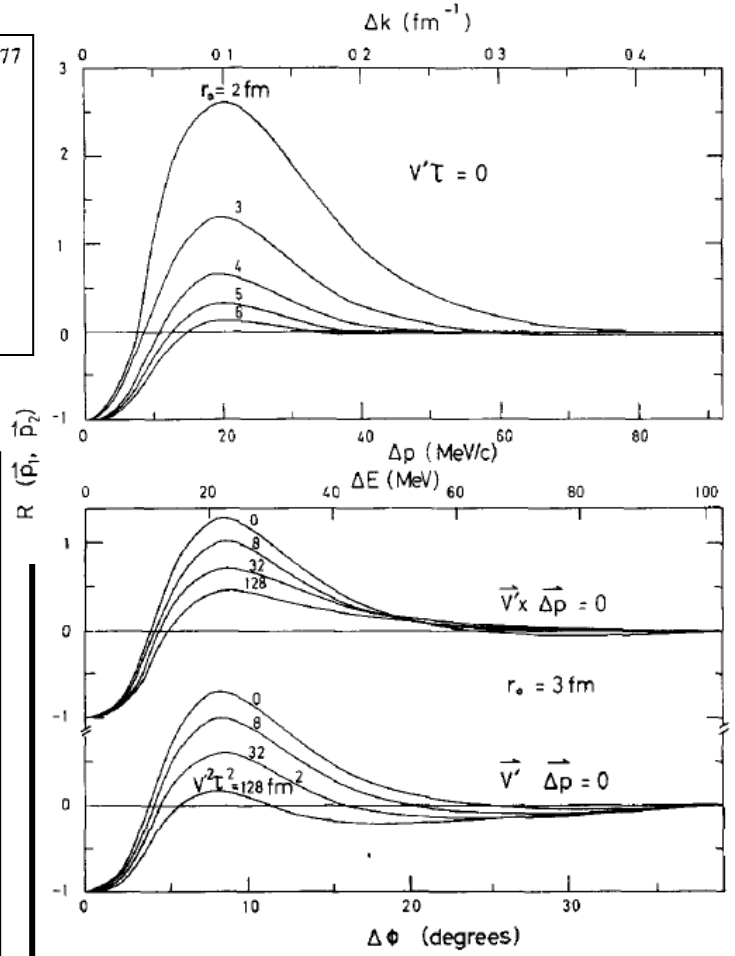
Received 9 June 1977

Phys. Rev. Lett. 39, 680–684 (1977)

Knock-Out Nucleons from Relativistic Nuclear Collisions

Steven E. Koonin
The Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen Ø, Denmark, and The Weizmann Institute of Science, Rehovot, Israel

A nonequilibrium single-scattering mechanism is proposed to describe the inclusive proton spectrum from relativistic heavy-ion collisions. Data from ^{20}Ne + U and ^{4}He + U collisions are shown to be consistent with a simple model of the knock-out process. Two-proton azimuthal angle correlations are suggested as a unique signature of this reaction mechanism.

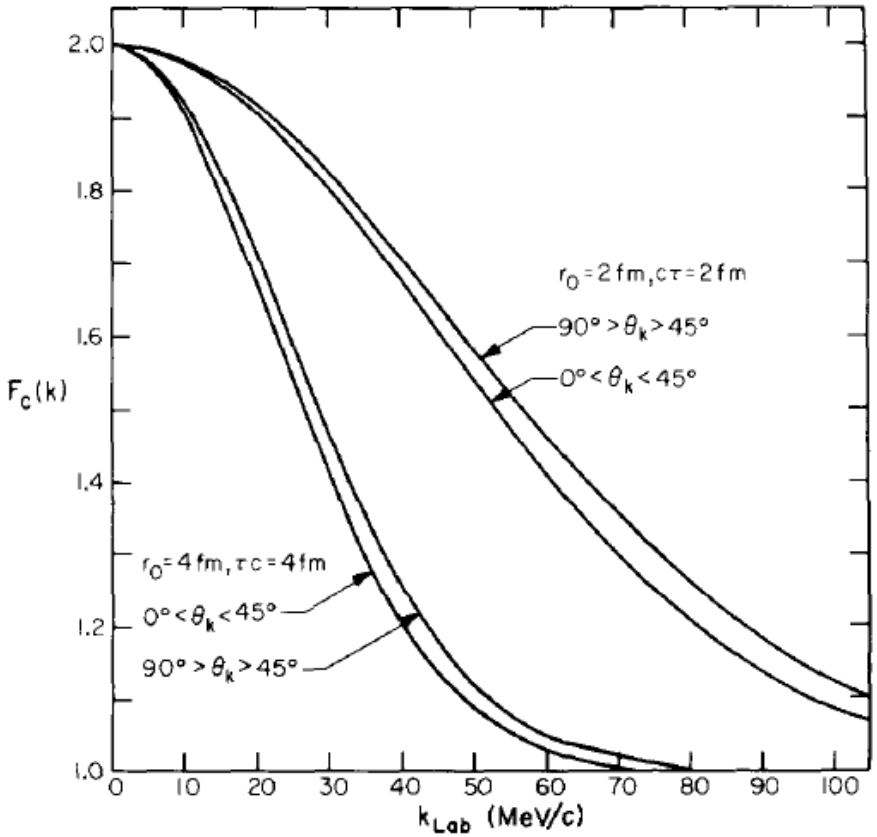


DETERMINING PION SOURCE PARAMETERS IN RELATIVISTIC HEAVY-ION COLLISIONS ☆

F.B. YANO [1] and S.E. KOONIN [2]
W.K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, CA 91125, USA

Received 8 June 1978

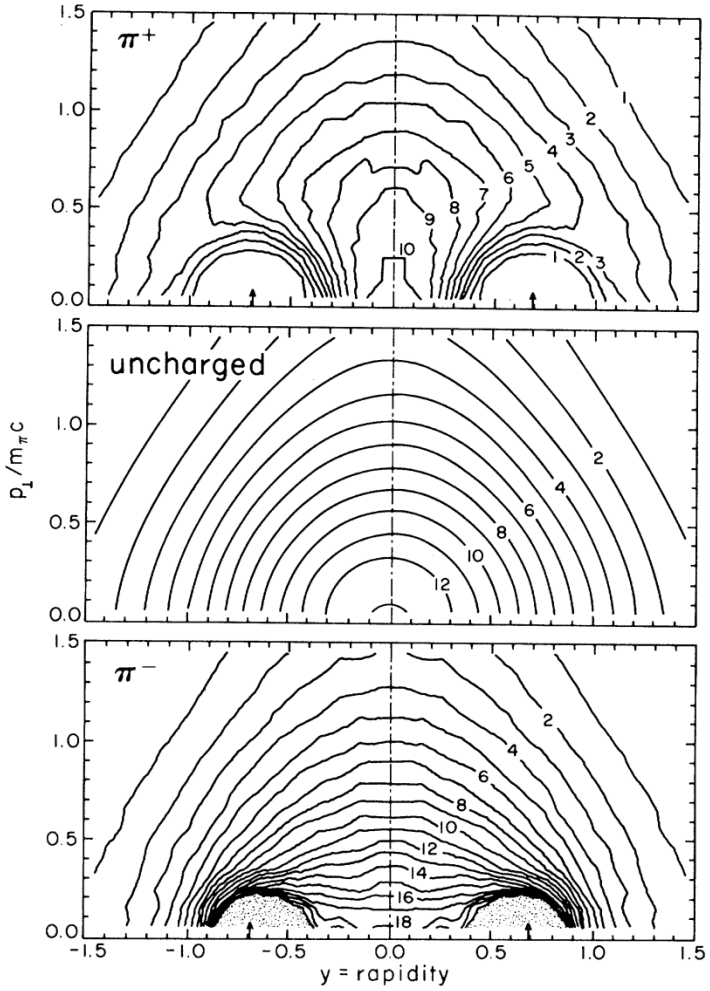
Two-pion inclusive spectra from relativistic heavy-ion collisions are related to single-particle inclusive measurements in a Lorentz-invariant formulation of the Hanbury–Brown–Twiss effect. A thermal pion source with a gaussian space–time distribution is assumed. The angular anisotropy and moments of the correlation function are computed to facilitate the determination of pion source parameters from the ratios of the two-pion to single-pion inclusive data.



Coulomb Distortion of Pion Spectra from Heavy-Ion Collisions

K. G. Libbrecht and S. E. Koonin
W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125
(Received 11 September 1979)

The effects of final-state π-nucleus electromagnetic interactions in heavy-ion collisions are investigated in a covariant classical formulation. Experimentally observed mid-rapidity peaks in π^+ spectra are reproduced by a simple model and are shown to be sensitive to the gross features of the time-dependent nuclear charge distribution.

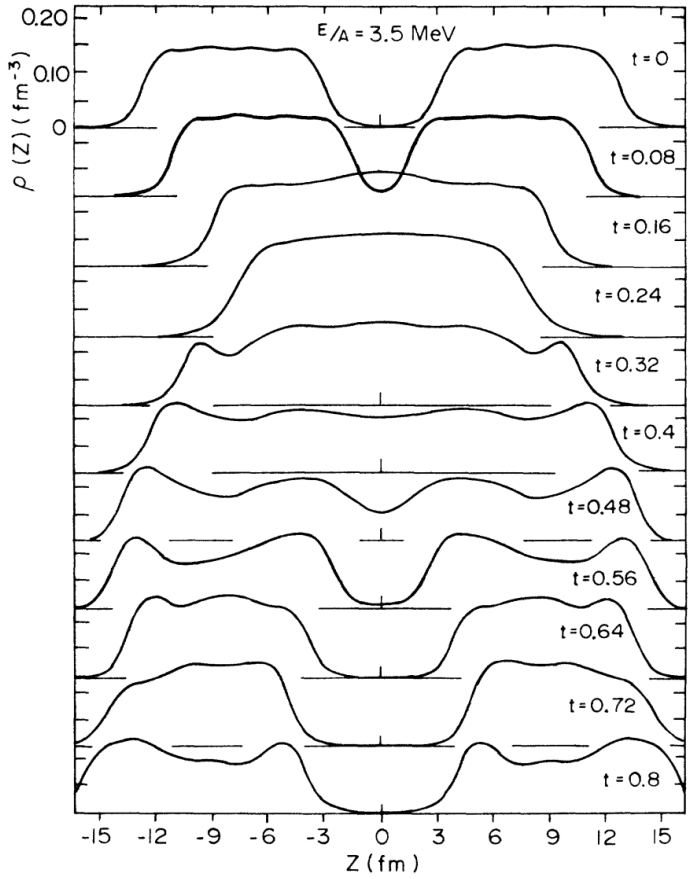


Watching nuclear collisions thru TDHF

PHYSICAL REVIEW C VOLUME 13, NUMBER 3 MARCH 1976

One-dimensional nuclear dynamics in the time-dependent Hartree-Fock approximation*

P. Bonche,† S. Koonin,‡ and J. W. Negele§
Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139
(Received 14 October 1975)



PHYSICAL REVIEW C VOLUME 15, NUMBER 4 APRIL 1977

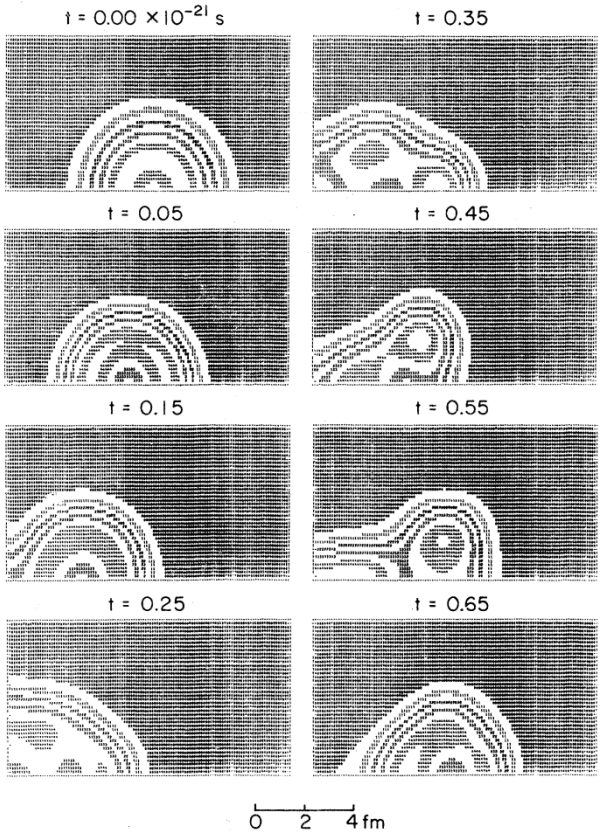
Time-dependent Hartree-Fock calculations for $^{16}O + {}^{16}O$ and $^{40}Ca + {}^{40}Ca$ reactions*

S. E. Koonin†
Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125

K. T. R. Davies, V. Maruhn-Rezwani, H. Feldmeier,‡ and S. J. Krieger§
Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830

J. W. Negele¶
Laboratory for Nuclear Science and Department of Physics, Massachusetts Institute of Technology, Cambridge, Massachusetts 02135

(Received 20 September 1976)



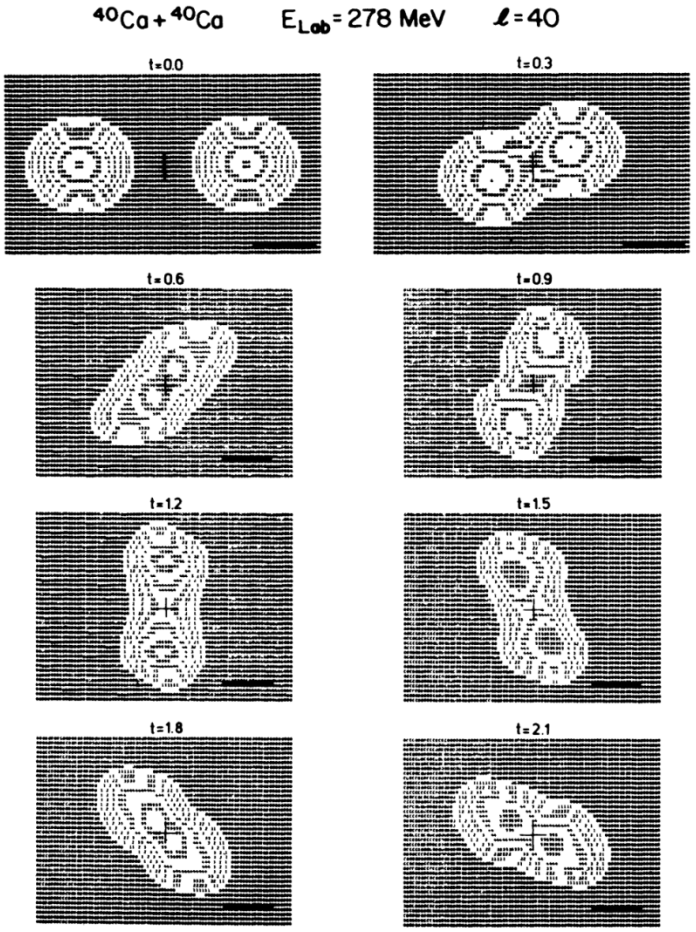
PHYSICAL REVIEW C VOLUME 17, NUMBER 5 MAY 1978

Three-dimensional time-dependent Hartree-Fock calculations of $^{16}O + {}^{16}O$ and $^{40}Ca + {}^{40}Ca$ fusion cross sections*

P. Bonche and B. Grammaticos†
Service de Physique Théorique, CEN-Saclay, B. P. No. 2, 91190 Gif-sur-Yvette, France

S. Koonin‡
The Niels Bohr Institute, University of Copenhagen, DK-2100 Copenhagen Ø, Denmark
and W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, California 91125 §

(Received 22 November 1977)

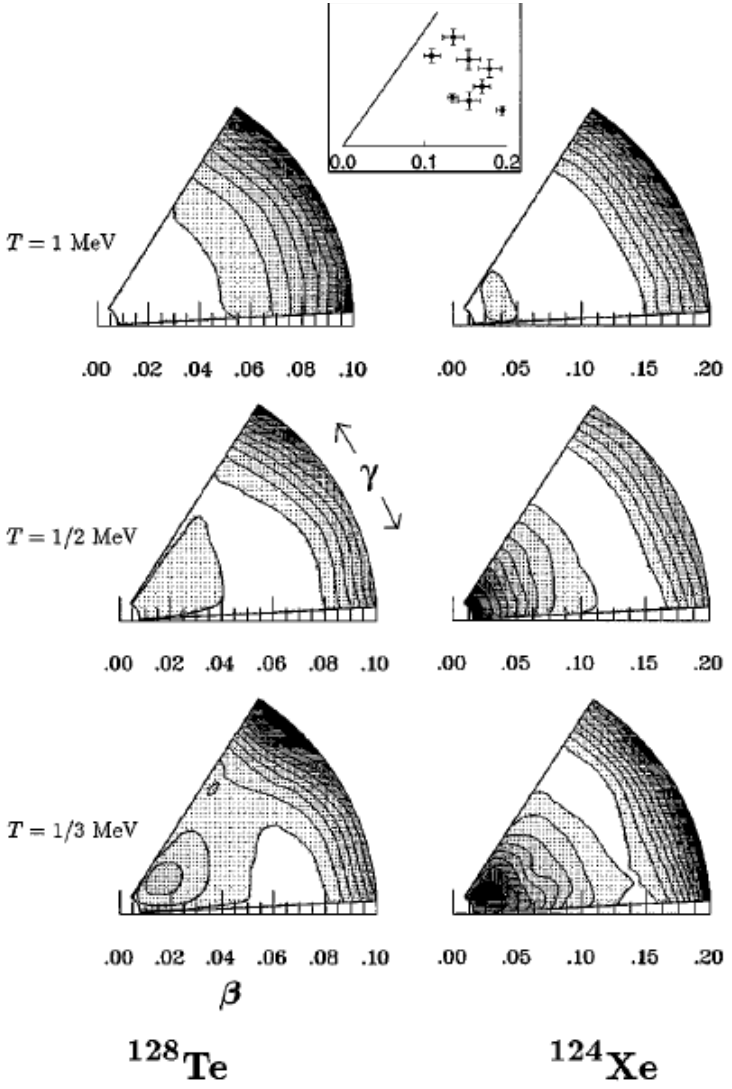


Shell Model Monte Carlo Studies of γ-Soft Nuclei

Y. Alhassid,[1] G. F. Bertsch,[2] D. J. Dean,[3,4] and S. E. Koonin[3]

[1] *Center for Theoretical Physics, Sloane Physics Laboratory, Yale University, New Haven, Connecticut 06520*
[2] *Department of Physics and Institute for Nuclear Theory, University of Washington, Seattle, Washington 98195*
[3] *W. K. Kellogg Radiation Laboratory, 106-38, California Institute of Technology, Pasadena, California 91125*
[4] *Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831*

(Received 10 August 1995)



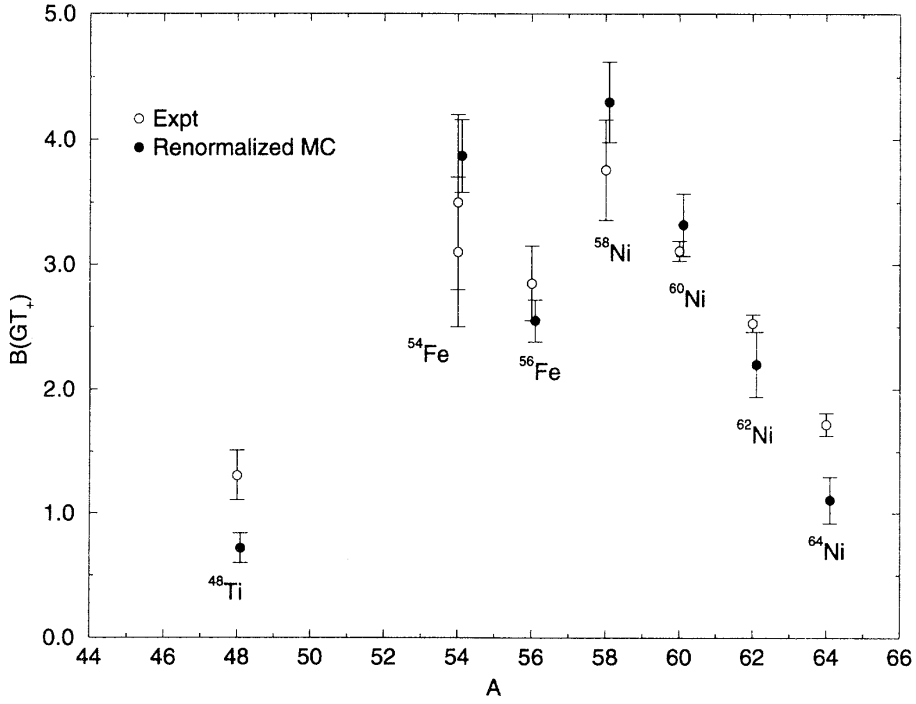
PHYSICAL REVIEW C VOLUME 52, NUMBER 2 AUGUST 1995

Shell-model Monte Carlo studies of *fp*-shell nuclei

K. Langanke,[1] D. J. Dean,[1] P. B. Radha,[1] Y. Alhassid,[2] and S. E. Koonin[1]

[1] *W. K. Kellogg Radiation Laboratory, 106-38, California Institute of Technology, Pasadena, California 91125*
[2] *Center for Theoretical Physics, Sloane Physics Laboratory, Yale University, New Haven, Connecticut 06511*

(Received 21 March 1995)



CUSP
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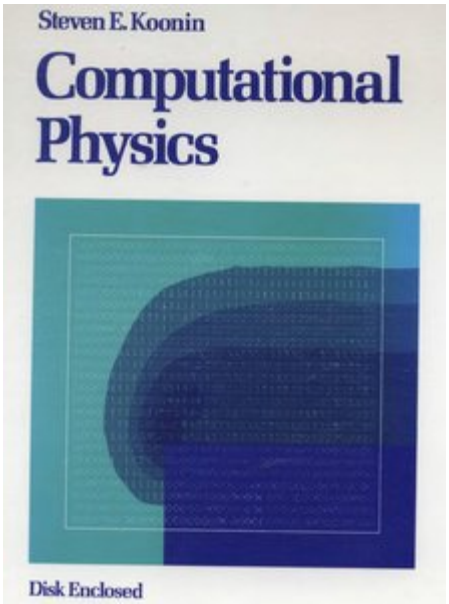
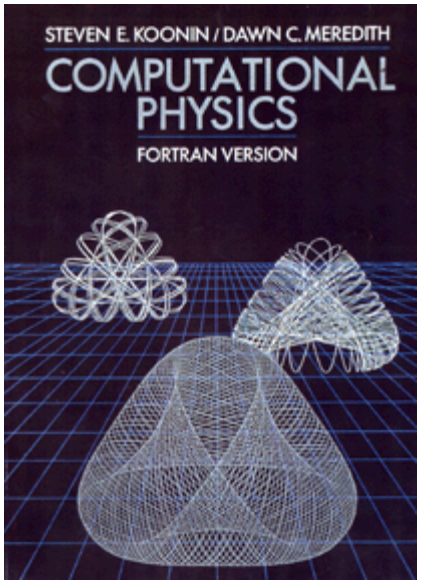
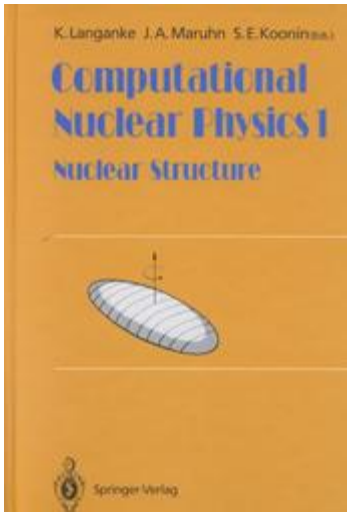
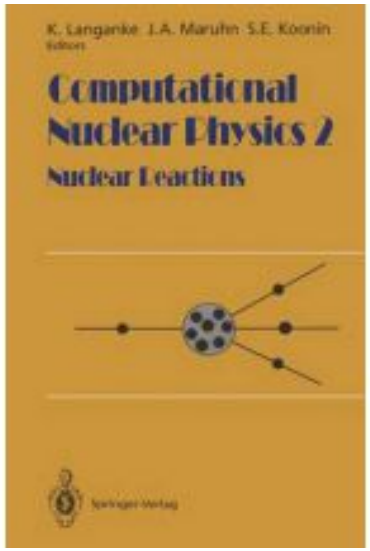






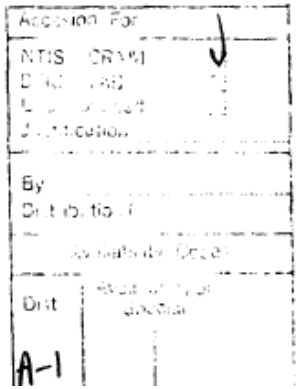


CHAMMP Review

H. Abarbanel
P. Collela
A. Despain
S. Koonin
C. Leith
H. Levine
G. MacDonald
N. Metroplis
W. Nierenberg
G. North
O. Rothaus
A. Semtner
J. Vesecky

January 1992

JSR-90-306



CHAMMP (Computer Hardware, Advanced Mathematics and Model Physics) is a new DOE program designed to move climate models from the current generation of supercomputers to massively parallel computers of the future. The general computing goal of CHAMMP is to provide a ten thousandfold increase in computing speed. Within the current climate modeling community, the primary motivation for increased speed is the desire to achieve much higher geographical resolution in the models, which would allow the "regional" predictions desired by policy makers. As planning for CHAMMP has evolved, issues other than those of spatial resolution have received increased attention. These issues include predictability, improvement of model performance by use of modern software engineering, the relationship of CHAMMP to other proposed modeling efforts, etc. This report provides an overview of these issues.

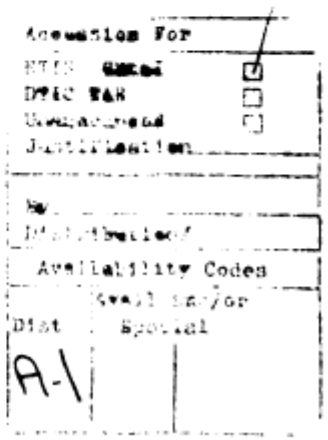
Small Satellites and RPAs in Global-Change Research

P. Banks
J. Cornwall
F. Dyson
N. Fortson
R. Garwin
S. Koonin
C. Max
G. MacDonald
S. Ride
M. Ruderman
S. Treiman
J. Vesecky
R. Westervelt
F. Zachariasen

December 1992

JSR-91-330

JASON
The MITRE Corporation
7525 Colshire Drive
McLean, Virginia 22102-3481
(703) 883-6997

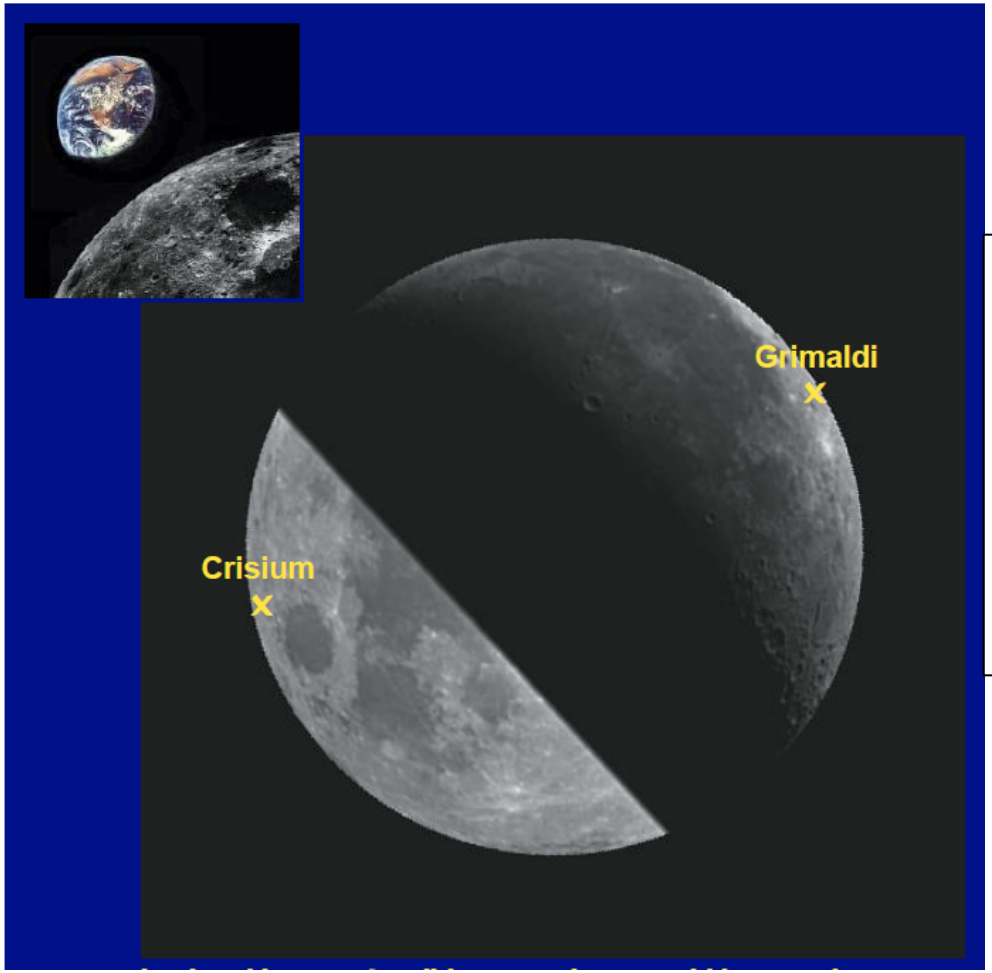


Global Change and the Dark of the Moon

S. Flatte, S. E. Koonin, and G. MacDonald

Report JSR-91-315

The MITRE Corporation, Mclean VA, 1992



Geophysical Research Letters, 2001

Earthshine Observations of the Earth's Reflectance

P. R. Goode,[1] J. Qiu, V. Yurchyshyn, J. Hickey

Big Bear Solar Observatory, New Jersey Institute of Technology, Newark, NJ 07102

M-C. Chu

Department of Physics, The Chinese University of Hong Kong, Shatin N.T., Hong Kong

E. Kolbe

Departement für Physik and Astronomie, Universität Basel, Basel, Switzerland

C. T. Brown, S. E. Koonin

W. K. Kellogg Radiation Laboratory, California Institute of Technology, Pasadena, CA 91125

JSR-97-315 October 7, 1997

Human Genome Project

Study Leader:
S. Koonin

Contributors Include:
S. Block
J. Cornwall
W. Dally
F. Dyson
N. Fortson
G. Joyce
H. J. Kimble
N. Lewis
C. Max
T. Prince
R. Schwitters
P. Weinberger
W. H. Woodin

1.3 Study charge

- **Technology:**
  - Survey the state-of-the-art in sequencing.
  - What are the alternatives beyond gel electrophoresis?
  - What strategies should be used for inserting new technologies into production sequencing?
  - What are the broader uses of sequencing technologies?
  - What are the technology needs beyond those of the Human Genome Project?
- **Quality Assurance and Quality Control:**
  - What are the end-to-end QA/QC issues and needs of the Human Genome Project?
  - What levels of sequence quality are required by various users of genome data?
  - What steps can be taken to ensure these various levels of quality?
- **Informatics:**
  - Survey the current database issues, including data integrity, submission, annotation, and usability?
  - What is the current state of algorithm development for finishing and annotating sequence?

Science 2 January 1998:
Vol. 279 no. 5347 pp. 36-37
Policy Forum: BIOMEDICINE
An Independent Perspective on the Human Genome Project
Steven E. Koonin

Civilian Biodefense

JSR-99-105

July, 1999

Study leader: **S. Koonin**

JASON contributors include:

H. Abarbanel
M. Cornwall
P. Dimotakis
S. Drell
F. Dyson
N. Fortson
R. Garwin
R. Henderson
R. Jeanloz
G. Joyce
J. Katz
N. Lewis
R. Schwitters
C. Stubbs
J. Sullivan
P. Weinberger
C. Young

Study origin and scope

- DARPA Director asked for studies by JASON, DSRC, and ISAT on defense of *civilians* against bioweapons/bioterrorism
- CIA's Non-Proliferation Center and Clandestine MASINT Operations Center are interested in BW intelligence collection and signatures
- Scope from intelligence through preparations through event to response and attribution
- Focus on technical and organizational issues
- Four notional scenarios to focus thinking

Identifying the Long Term Technology Priorities for BP

Long Term Technology Strategy
Group Technology
June 2005

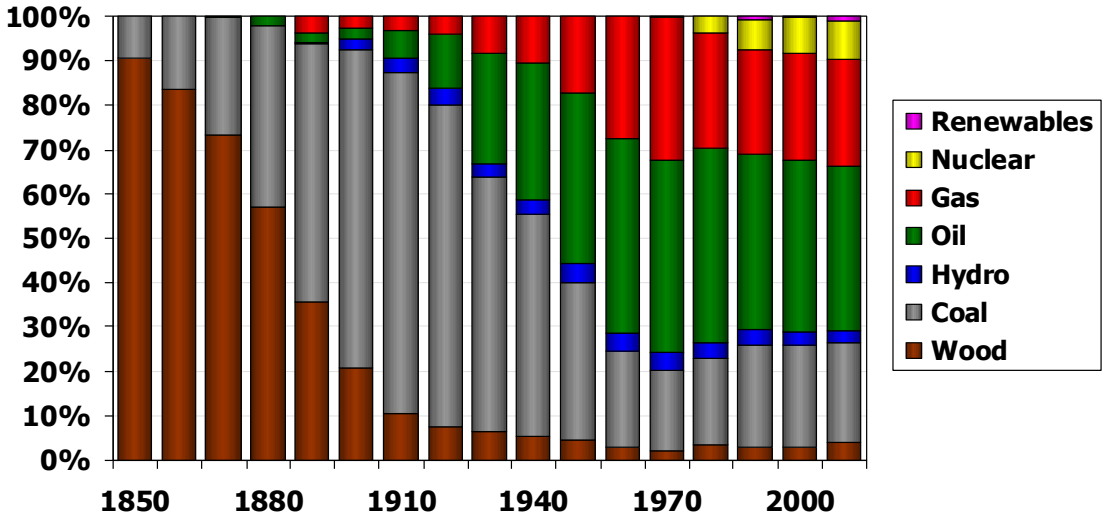
Draft Version 4_23June05

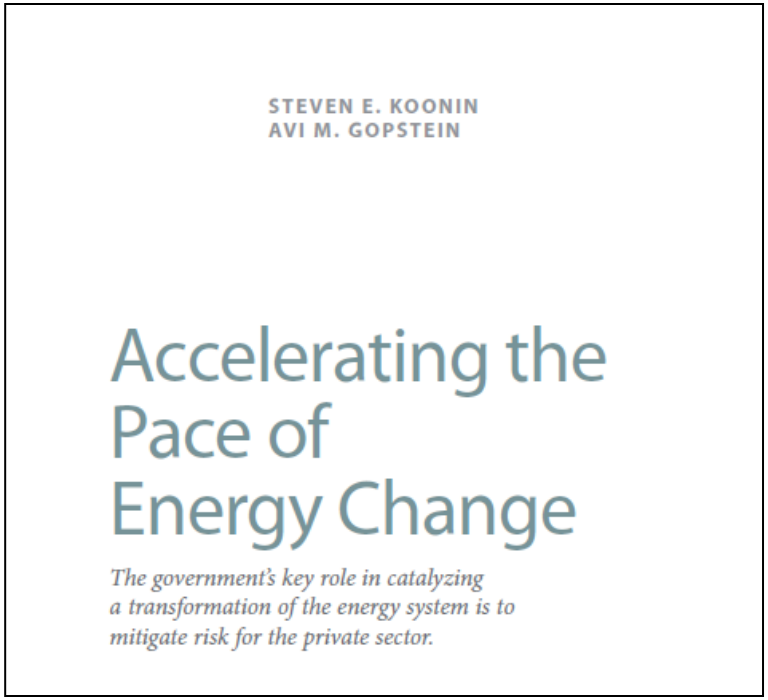
U.S. DEPARTMENT OF ENERGY

QTR

REPORT ON THE FIRST
QUADRENNIAL TECHNOLOGY REVIEW

September 2011





Issues in S&T *Winter, 2011*

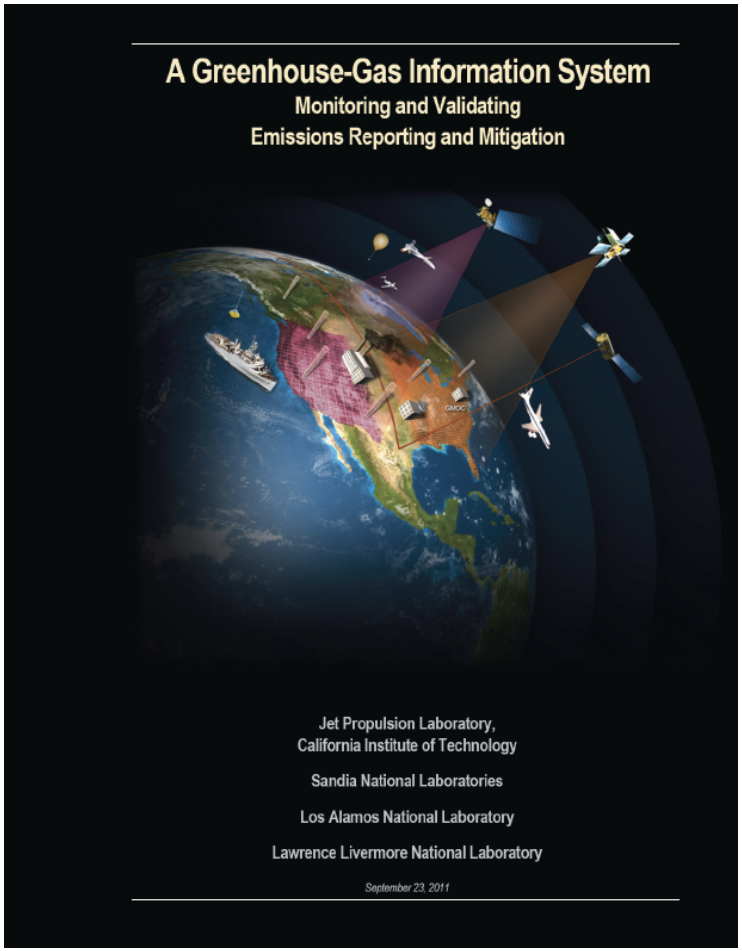
New technology is only part of a solution

- "*Moonshot*", "*Manhattan Project*", "*Inventing the Clean Energy Future*", …
- Structural features retard/mitigate the impact of technology change
- Societal levers are as (or more) important
  - Regulation, Economics, Behavior, Perceptions
  - Operation of existing technology, introduction of new technology
  - These are different from, but not independent of the technology
- US has had mixed success in combining the technical and societal dimension to accelerate change
- Social science has been with us for several centuries

So what's new???

Big data can be brought to bear on societal issues

- Greenhouse Gas Treaty Verification methodology
  - Fuse surveys, direct measurements, proxies to independently verify GHG emissions



What does it mean to "instrument a city"?

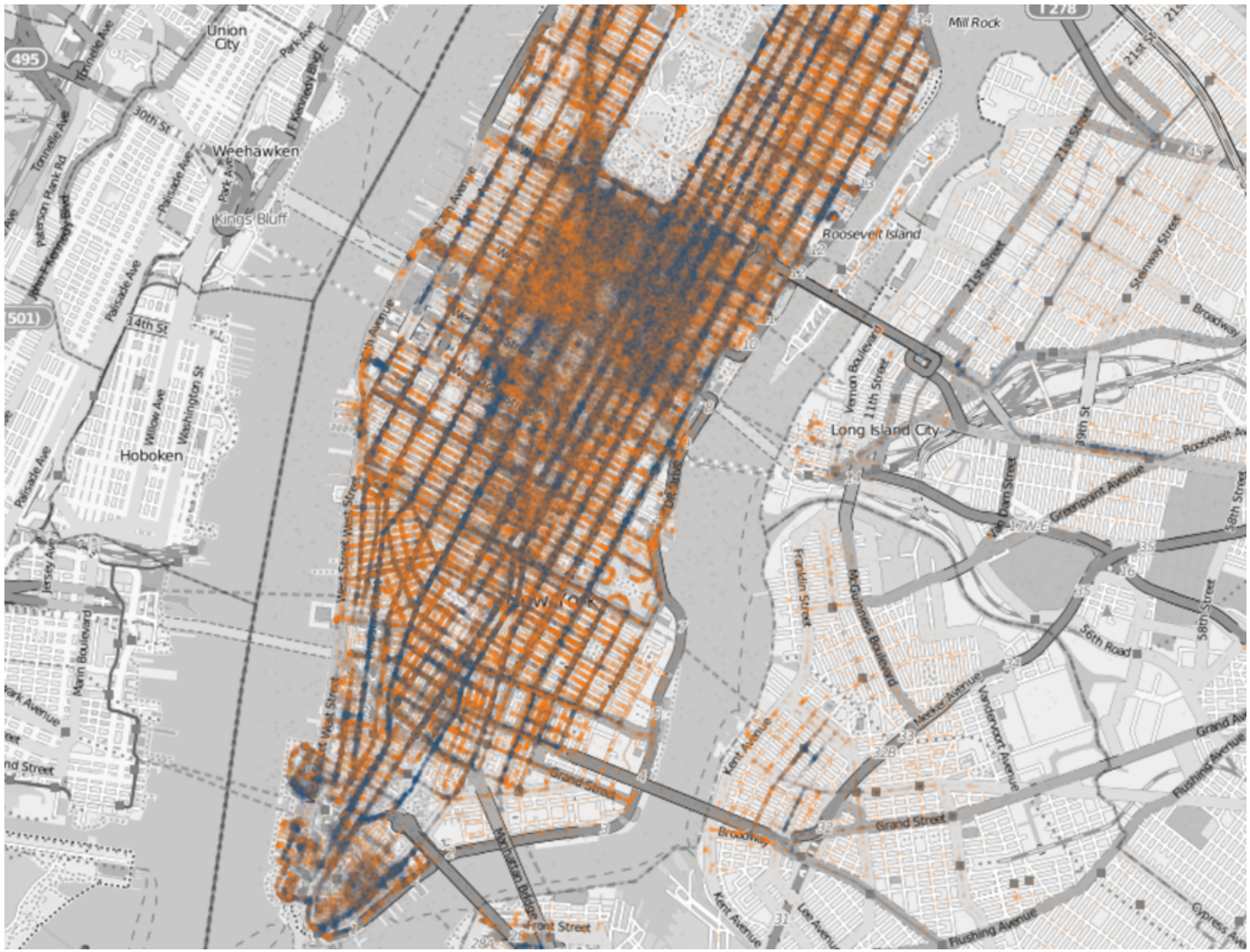
- Cities deliver services to citizens through infrastructure and processes
  - Shelter, safety/security, health, food, water, waste, energy, mobility, …
- How do these systems operate and interact?
- How can we optimize?
  - Early successes in predictive policing, traffic management
- We need to instrument
  - Infrastructure (condition, operation)
  - Environment (meteorology, pollution, noise, …)
  - People (location, economic and communication activities, health, …)

PRIVACY!!!

Diverse interests in "instrumenting a city"

- Government (Local, Federal, Citizens)
- Private sector (retail, insurance, financial, political)
- Security organizations (local, national, international)
  - "Needle in the haystack" vs "Shape of the haystack"
- Social scientists
  - beyond surveys or aggregate data flows
  - "Pulse of the City"

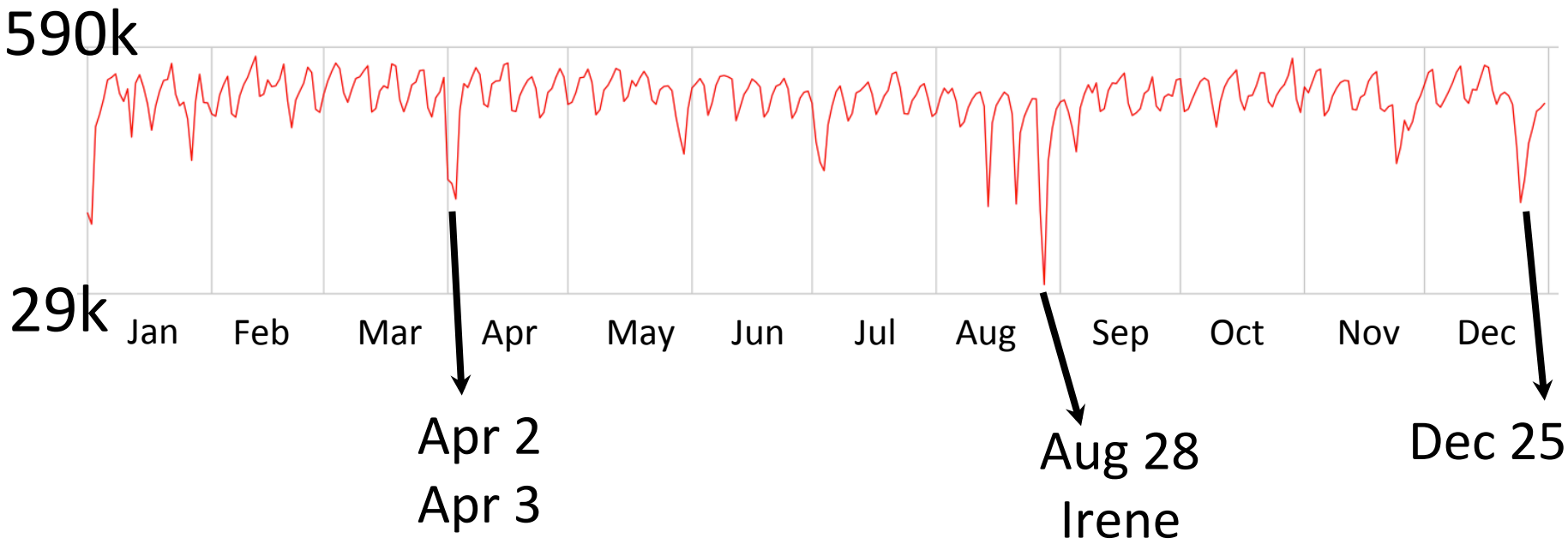
Visualization of TLC GPS data



Most drop-off's occur on the avenues, most pick-up's on the streets

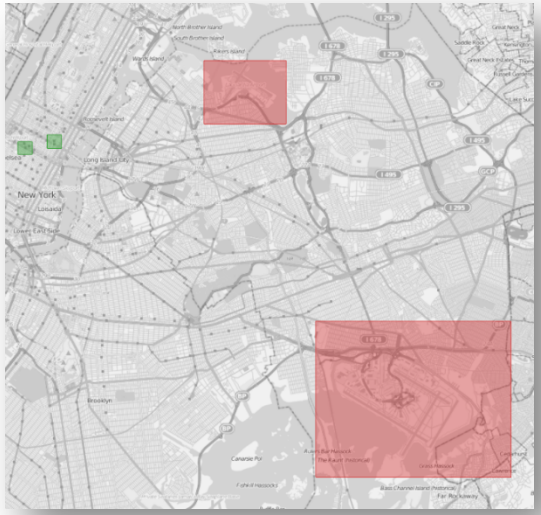
Lauro Lins, Fernando Chirigati, Nivan Ferreira,Claudio Silva and Juliana Freire - NYU Poly
(Data obtained from TLC on June 6th, 2012)

NY Taxi Rides by Day in 2011



Lauro Lins, Fernando Chirigati, Nivan Ferreira,Claudio Silva and Juliana Freire - NYU Poly
(Data obtained from TLC on June 6th, 2012)

Studying Taxi Patterns

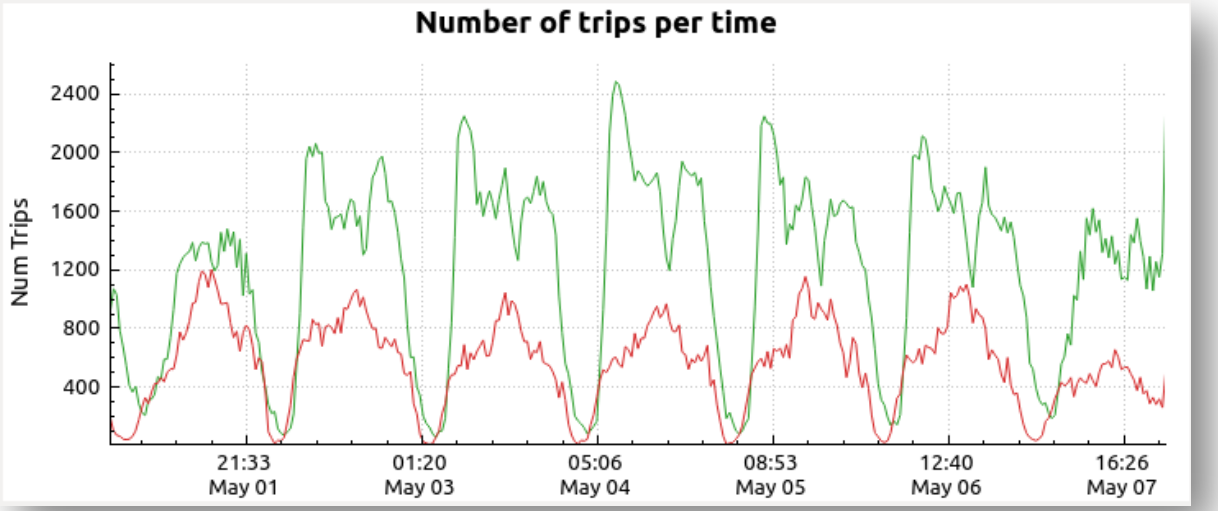


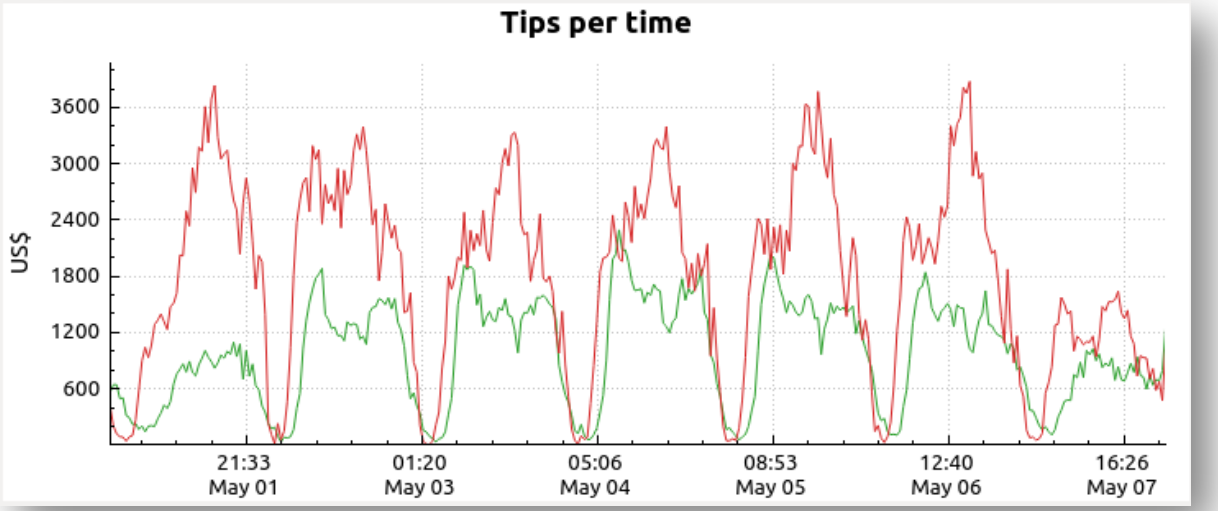
Train Stations

Airports

May 1st – May 7th 2011

3.6 Million Trips





Urban data sources

- **Organic data flows**
  - Administrative records (census, permits, …)
  - Transactions (sales, communications, …)
  - Operational (traffic, transit, utilities, health system, …)
- **Sensors**
  - Personal (location, activity, physiological)
  - Fixed *in situ* sensors
  - Crowd sourcing (mobile phones, …)
  - Choke points (people, vehicles)
  - Remote
- **Opportunities for "novel" sensor technologies**
  - Infrared and spectral imagery
  - LIDAR
  - RF and magnetic
  - Seismic, acoustic
  - Ionizing radiation, biological, chemical
  - …

Looking South from the Empire State Building

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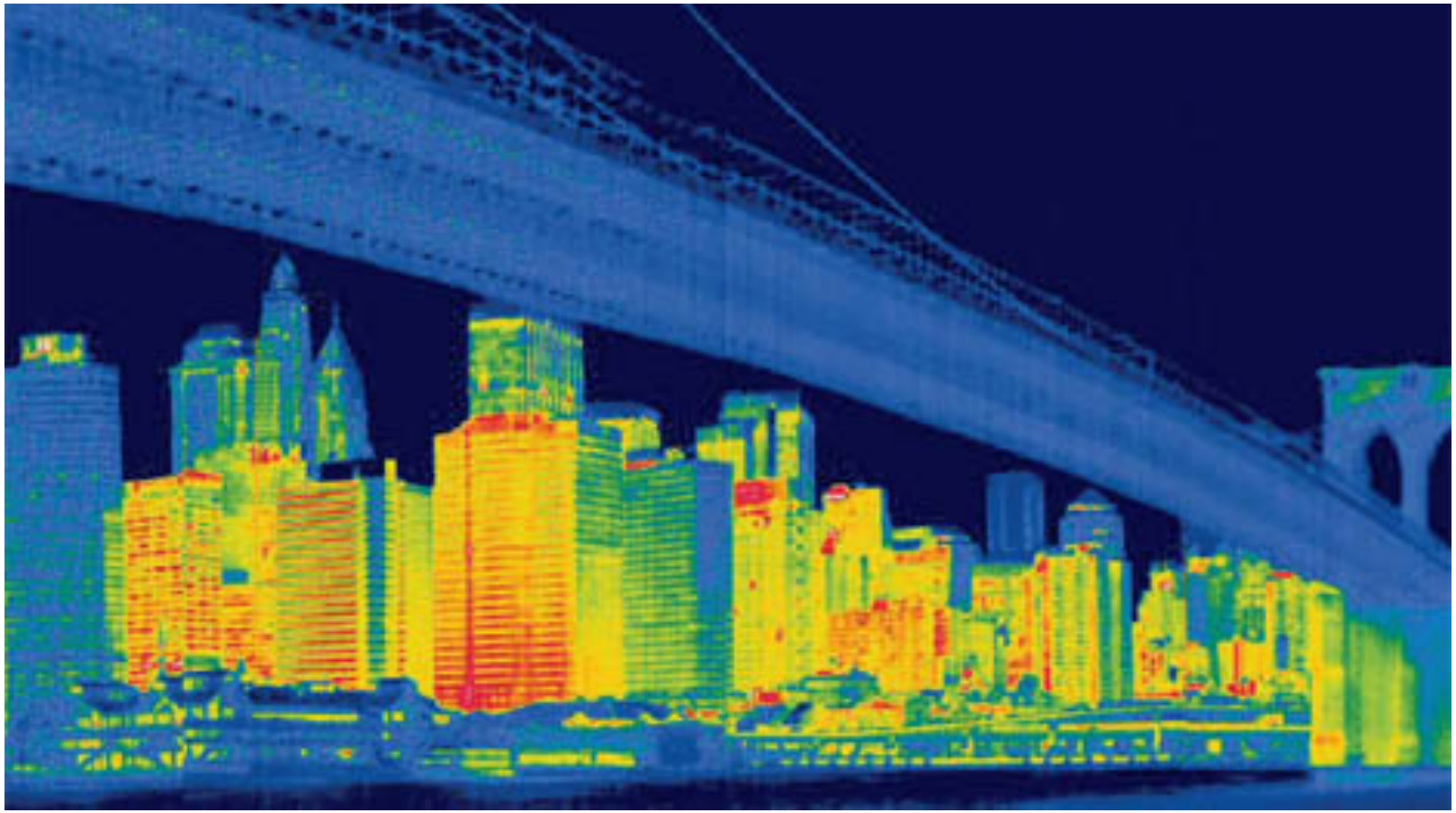
Manhattan in the IR



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What can cities do with the data?

- Optimize operations
  - traffic flow, utility loads, services delivery, …
- Monitor infrastructure conditions
  - bridges, potholes, leaks, …
- Infrastructure planning
  - zoning, public transit, utilities
- Improve regulatory compliance
- Public health
  - Nutrition, epidemiology, environmental impacts
- Abnormal conditions
  - Hazard detection, emergency management
- Monitor/predict effects of natural and deliberate policy experiments
- Better inform the citizenry

The CUSP Partnership

- **The University Partners:**
  - NYU, NYU-Poly, CMU, Univ. of Toronto, Warwick University, CUNY, IIT-Bombay
- **The Industrial Partners:**
  - IBM, Cisco, Siemens, Xerox, Con. Ed., National Grid, ARUP, IDEO, AECOM
- **City and State Agency Partners:**
  - NYC Agencies, MTA, Port Authority

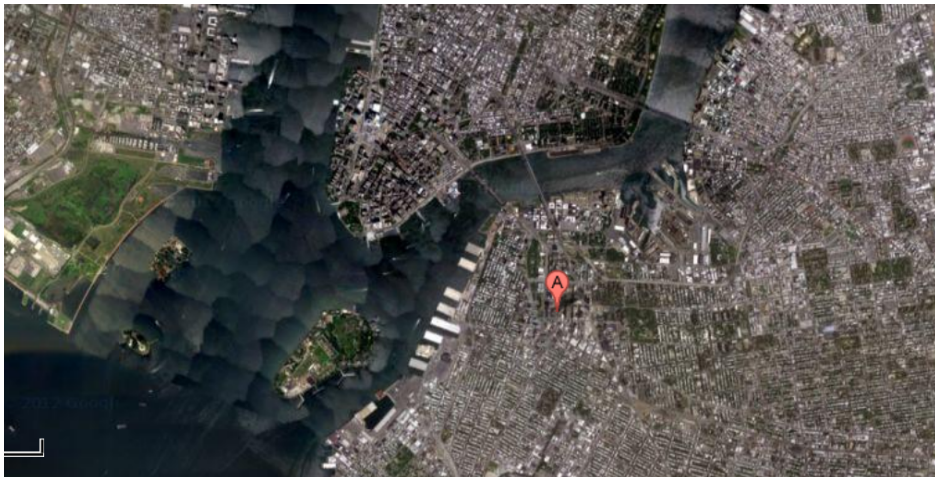
A diverse set of other organizations have expressed interest in joining the partnership

The CUSP Vision includes New York City as its laboratory

The Center for Urban Science and Progress (CUSP) is a unique public-private research center that uses New York City as its laboratory and classroom to help cities around the world become more productive, livable, equitable, and resilient. CUSP observes, analyzes, and models cities to optimize outcomes, prototype new solutions, formalize new tools and processes, and develop new expertise/experts. These activities will make CUSP the world's leading authority in the emerging field of "Urban Informatics"

Some defining characteristics of CUSP

- Part of New York urban fabric
- Academic/corporate/government
- Integrated physical and tabular data
- Multidisciplinary / trans-disciplinary
  - "Sensors to sociologists"
- Real-world research and educational experience
- Citizen/User engagements
  - Living Lab, Open Science
- Open Innovation/Commercialization/ Entrepreneurship



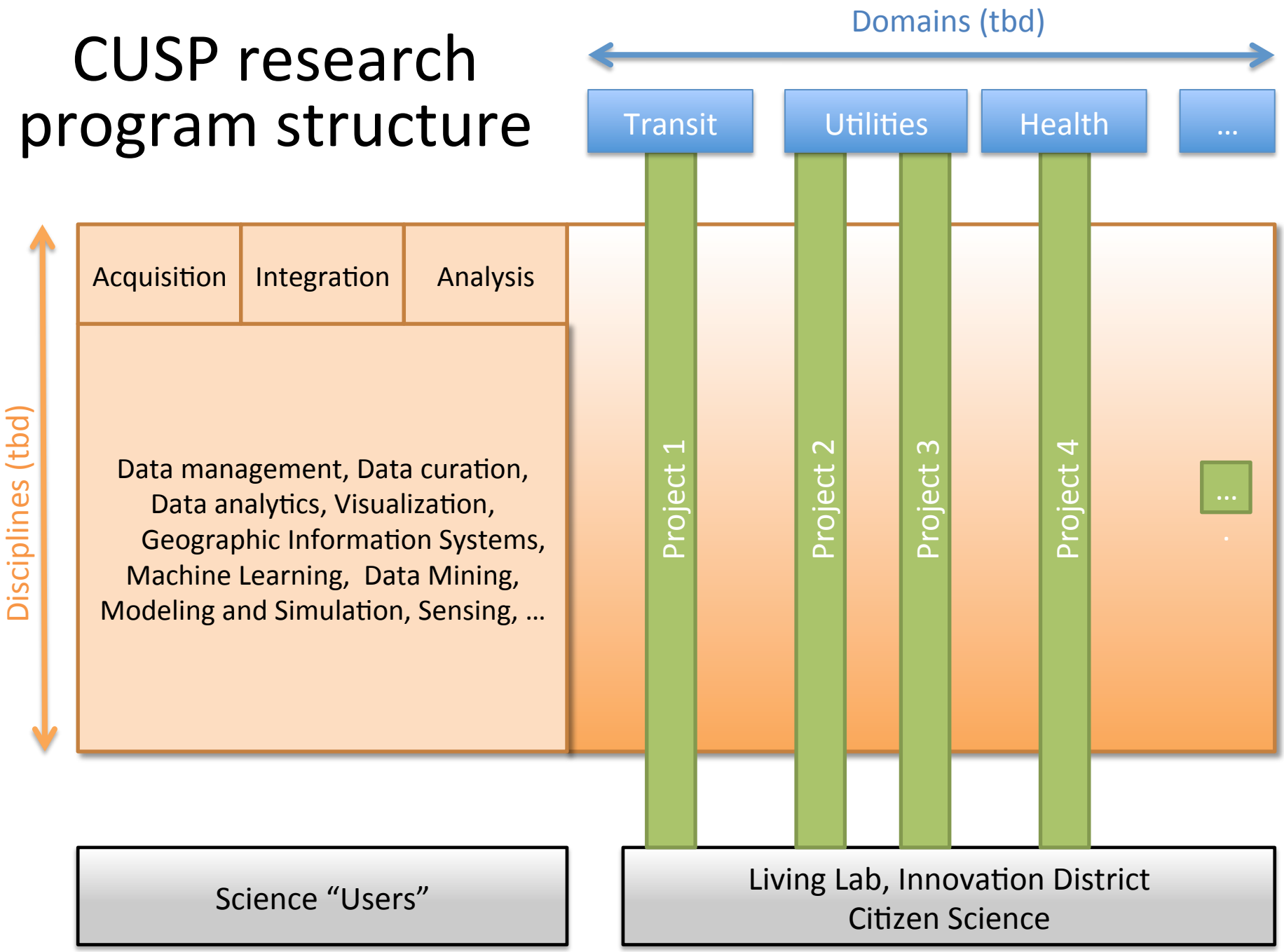
In 5 years, CUSP will be a major center for research and education in Urban Informatics

- 50 full-time senior researchers
  - 30 faculty, 20 industrial
- 30 Postdocs
- 430 Masters students and 100 PhD candidates
- Located in Downtown Brooklyn
  - 60,000 sq ft leased;
  - 150,000 sq ft post-2017 in 370 Jay Street (pending assessment)
- Government (esp. Federal), corporate, philanthropic, academic funding to $70M/yr

CUSP Educational Programs

- **Fall 2013 (FY14) - M.S. in Applied Urban Science and Informatics**
  - 1-year, 3-semester full-time; related certificate program
  - Curriculum of Informatics disciplines + Urban domains + governance / organization /finance /entrepreneurship/…
  - Strong project component
- **Following years**
  - PhD in Urban Systems
  - 2-year, 5-semester full-time M.S. in Urban Systems program
  - Global Executive Masters in Urban Analytics and Innovation program
  - Dual/joint degrees
  - Executive education and corporate training
  - Distance learning options
- Training of future and current people who will know the agencies and know urban informatics
- Employment opportunities through city agencies, corporate suppliers, startups, NGOs

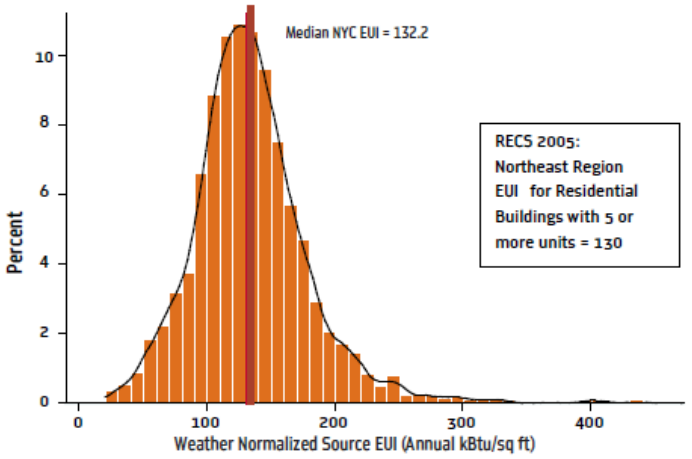
CUSP research program structure



Learnings - Big data

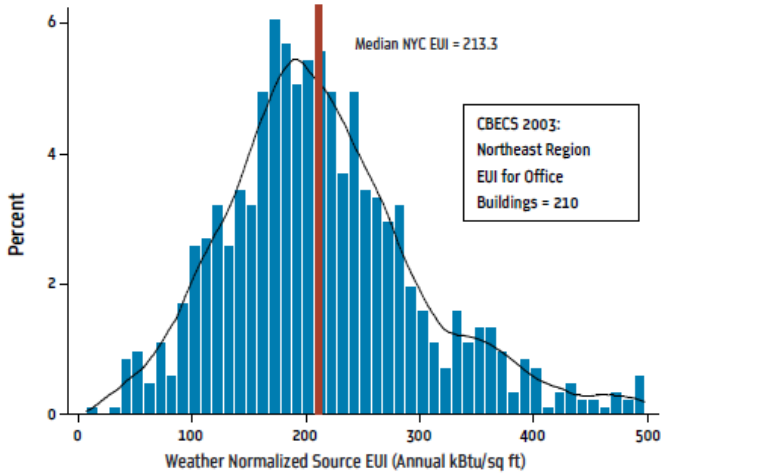
- Big data brings new capabilities
  - Better identification of outliers
  - Finer stratification
  - Better construction of proxies
  - Better validation of models
  - The power of correlation
- Big data brings new challenges
  - Data quality
  - Data in diverse hands
- Data access concerns in several dimensions (CUSP will have a Chief Data Officer)
  - Proprietary
  - Critical infrastructure vulnerabilities
  - Privacy

Figure 17: Histogram of Multifamily EUIs



Source: New York University

Figure 18: Histogram of Office Building EUIs



Source: New York University

D. Hsu and C. Kontokosta, NYC Local Law 84 Benchmarking Report, 2012

Projects under consideration

- Normalization, interoperability of city data sets
- 3D Urban GIS capability
- Multi-data correlations to improve city resource allocation
- Noise / Temperature / Pollution
- Mobility
- Novel sensing of public health
- Building efficiency

Questions/Comments

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