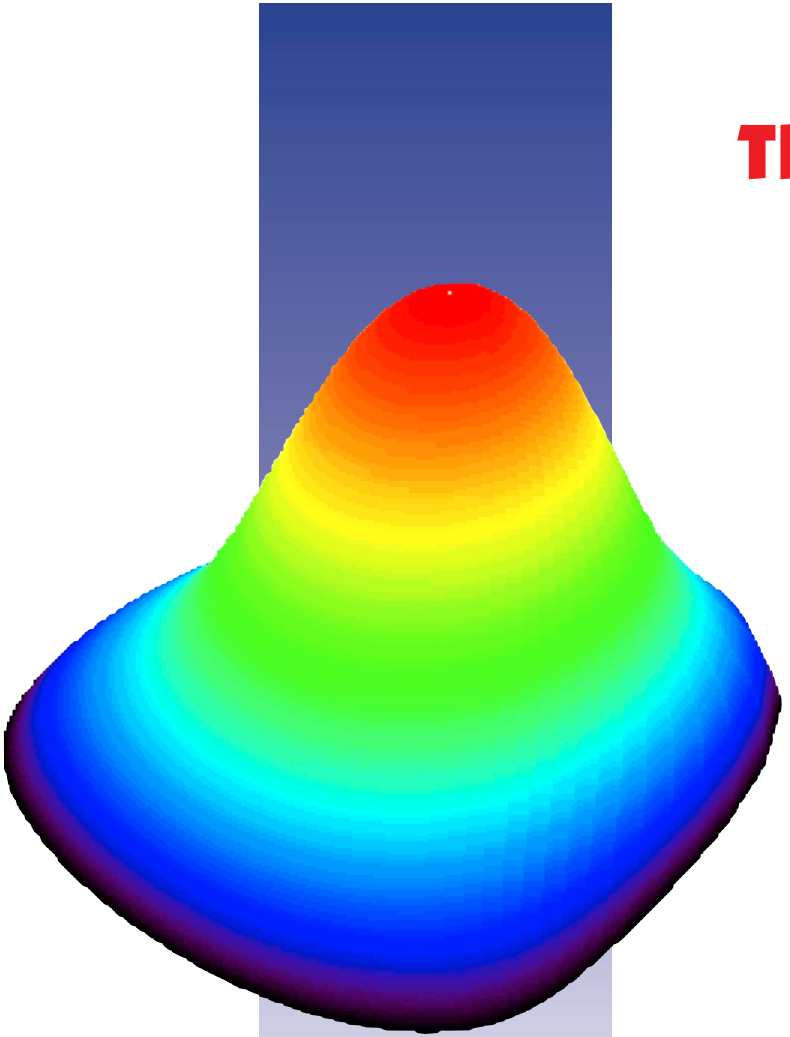


NIMROD simulated pressure stored in MDSplus and visualized with IDL

THOUGHTS ON INTEGRATING AG TECHNOLOGY INTO THE U.S. MAGNETIC FUSION PROGRAM

D.P. Schissel

Presented at
The 2002 Access Grid Retreat

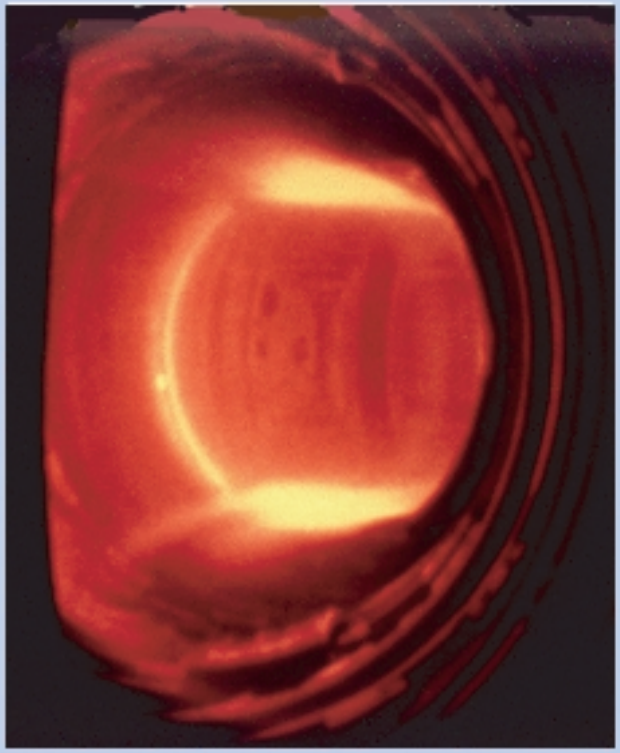
March 5, 2002
La Jolla, CA

GENERAL ATOMICS

OUTLINE OF PRESENTATION

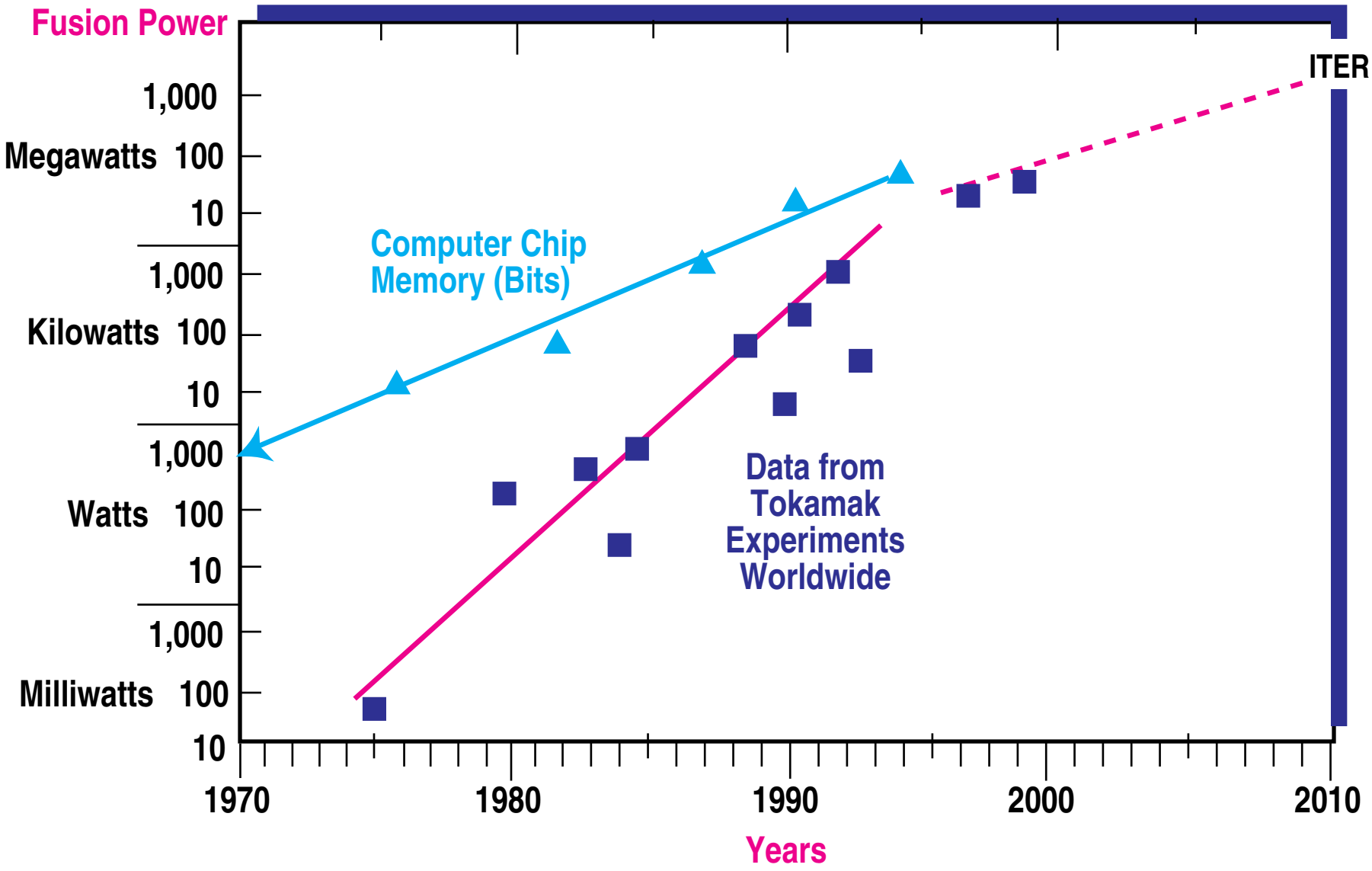
- Fusion is nature's fundamental power source
  - Fusion is the power source of the sun and all the stars in the universe
- Magnetic fusion research is spread across the United States
  - Approximately 1000 scientists at 80 sites in 37 states
- Present AG node "cost" indicates only a few U.S. sites could obtain a node
  - Fiscally conservative: reduction in U.S. funding by a factor of 4 in 20 yrs
- An AG node at the $10K price point would mean all U.S. sites could adopt
- Can enough functionality be retained to make a smaller node attractive?
  - The U.S. fusion program is willing to work towards determining specs
  - The SciDAC Fusion Collaboratory (http://www.fusiongrid.org)

FUSION REPRESENTS A NEARLY INEXHAUSTIBLE ENERGY SOURCE



- Fusion: the joining of two light nuclei releasing energy (E=mc2)
  - Pickup truck of fusion fuel = 21,000 railcars of coal
- Like charges repel so fusion requires high temperature (velocity)
- High temperature rips the electrons away – plasma

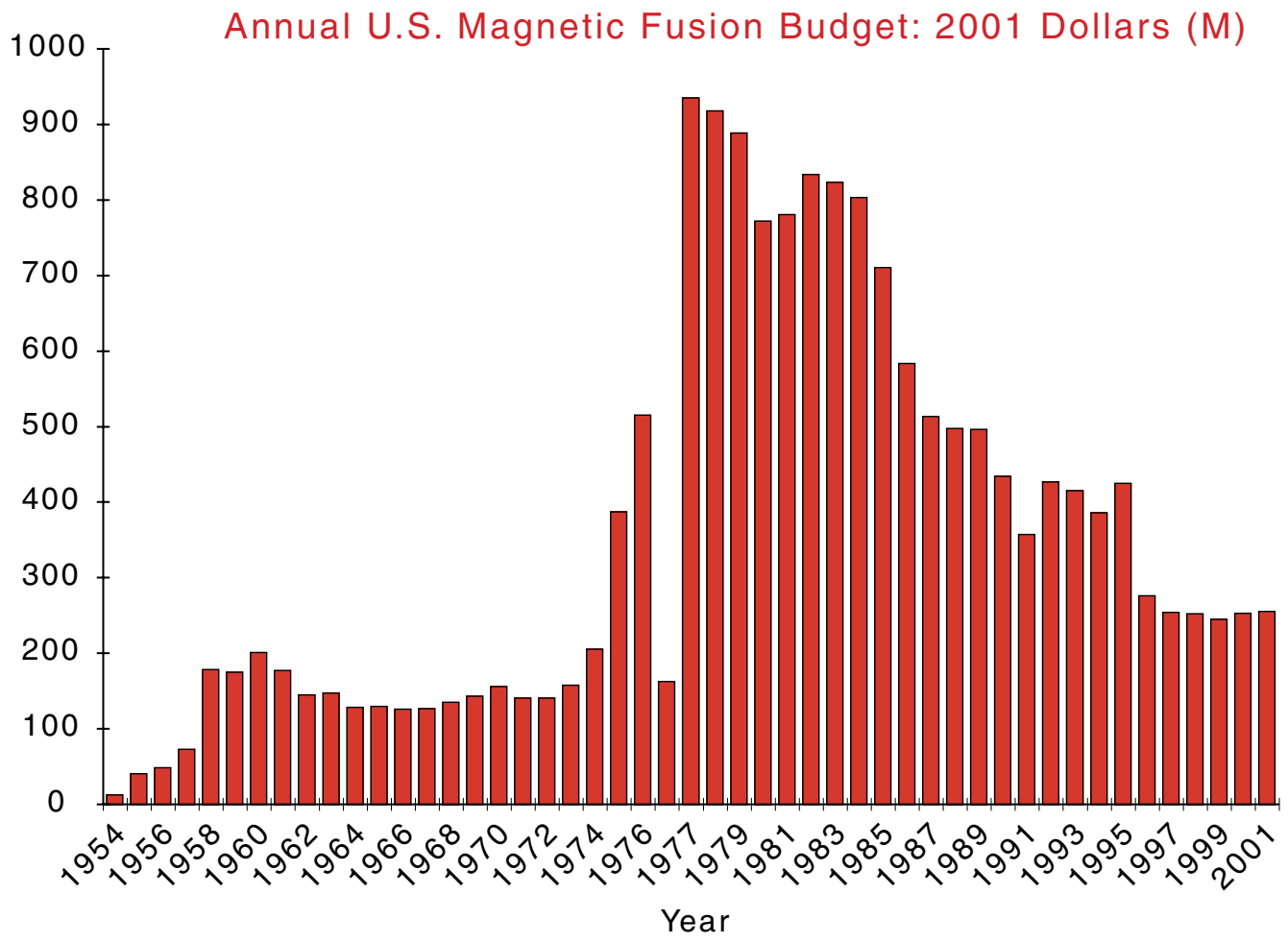
PROGRESS IN MAGNETIC FUSION RESEARCH
FUSION POWER FROM MICROWATTS TO MEGAWATTS



GENERAL ATOMICS

164-00/rs

THE U.S. FUSION COMMUNITY IS FISCALLY CONSERVATIVE



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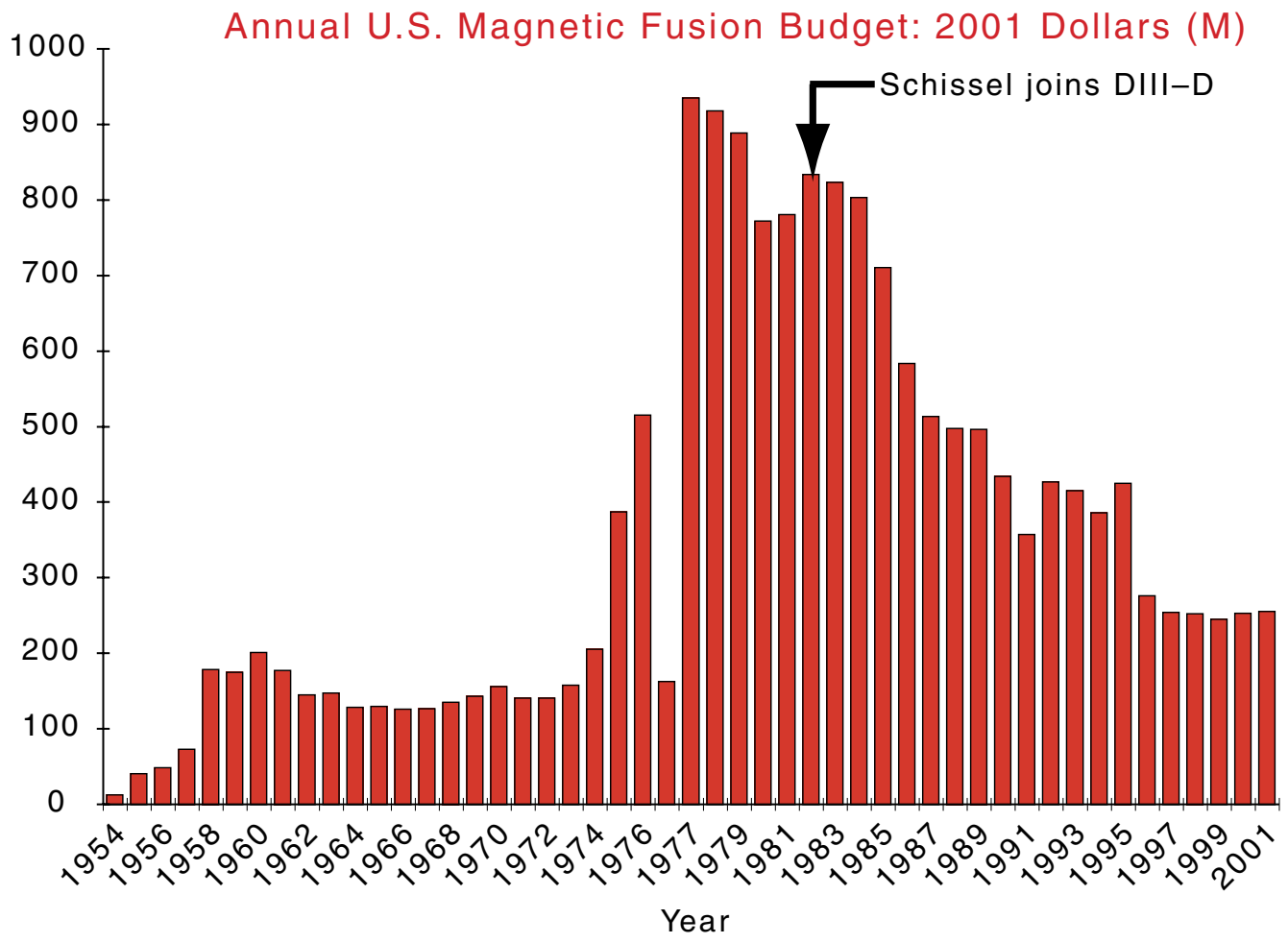
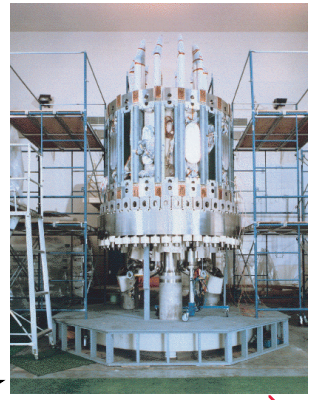
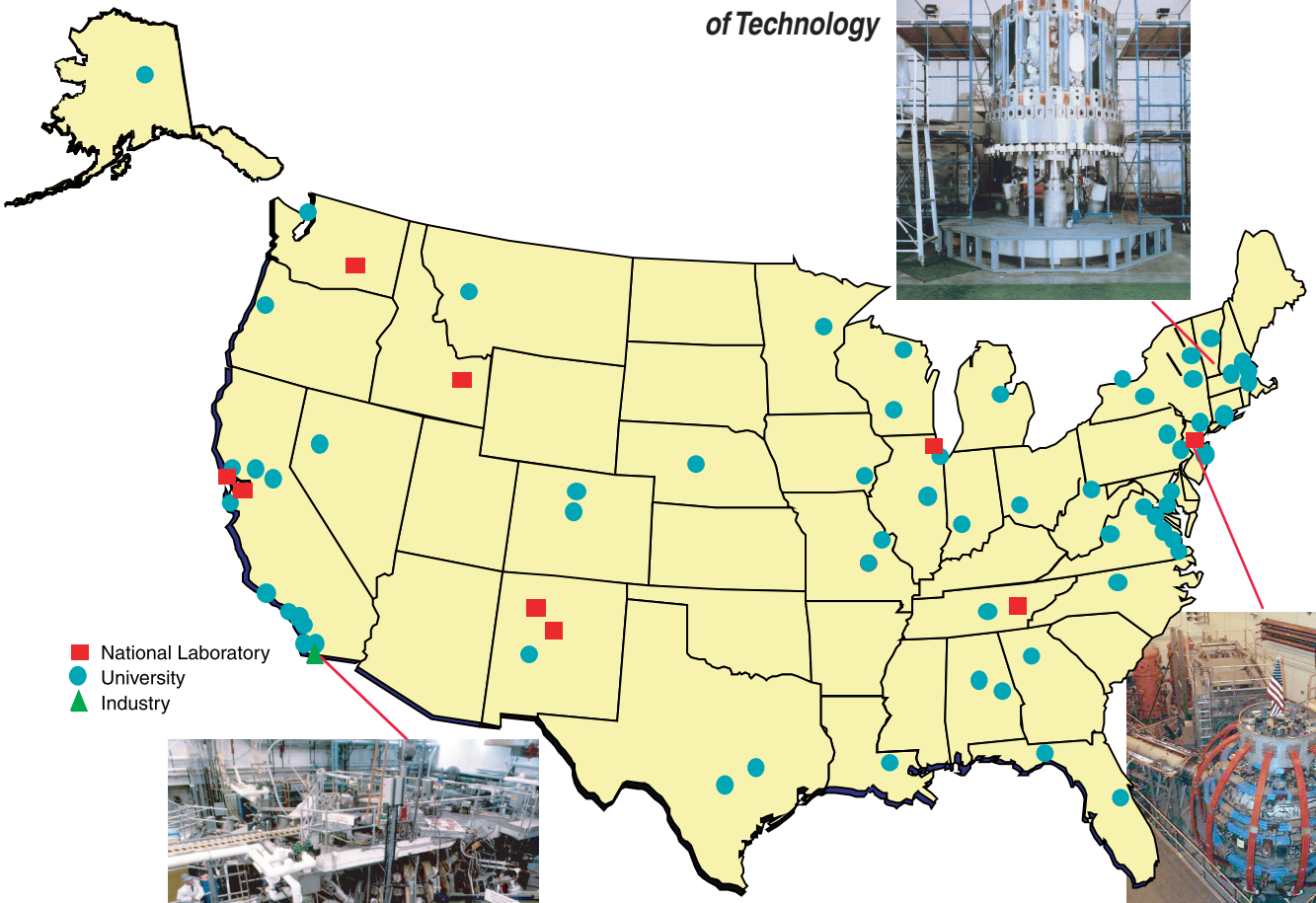


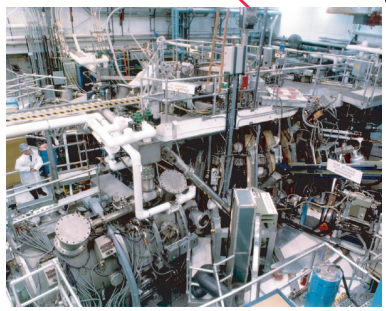
GENERAL ATOMICS

U.S. MAGNETIC FUSION RESEARCH: 80 US SITES IN 37 STATES

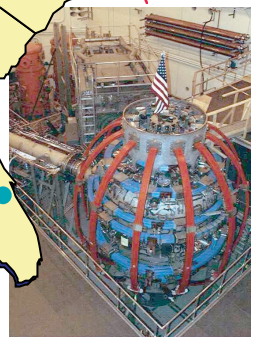
Alcator C--Mod
Massachusetts Institute of Technology







DIII–D General Atomics
San Diego, Ca



National Spherical Torus Experiment (NSTX)
Princton Plasma Physics Laboratory

GENERAL ATOMICS

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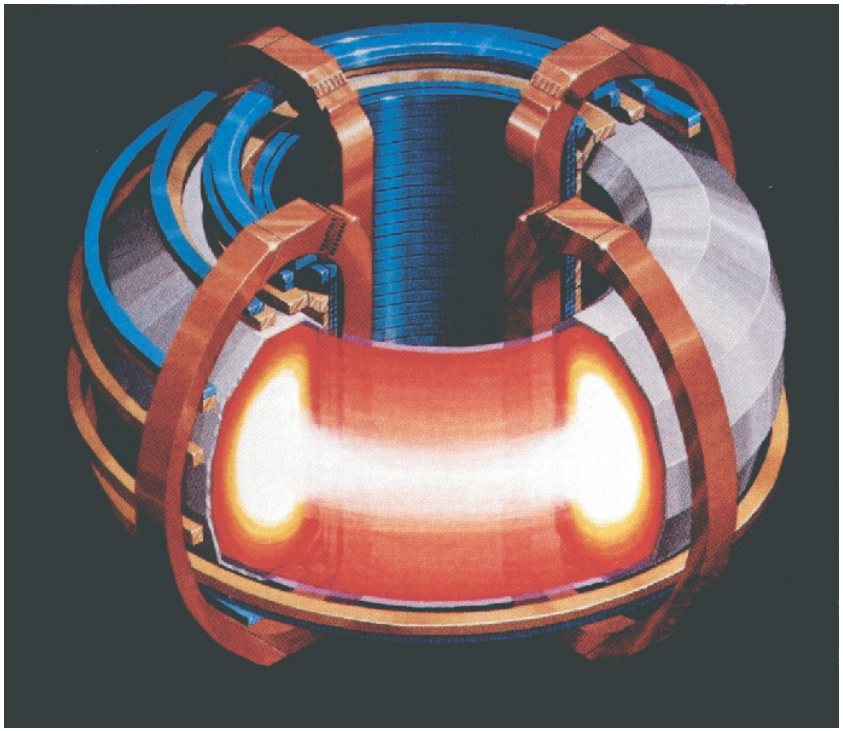
THREE LARGE TOKAMAK EXPERIMENTS IN THE U.S.



- Magnetic bottles: doughnut shaped Tokamak, contains hot fusion plasma
  - Charged particles follow magnetic field lines
- Pulsed devices: 10 sec plasma every 15 min
- Represents a replacement cost of $1B
- Supported by a theoretical & simulation community
- Goal: develop a reliable energy system that is environmentally and economically sustainable

FEW U.S. FUSION SITES WOULD "PURCHASE" AN AG NODE TODAY

- Must be reliable and easy to operate like a telephone
  - These are sites that do not perform computer science research
  - Very limited computer science staff
- Present cost of $100K (hardware plus a person) is too expensive
  - Assume $50k hardware & $50k people
- As an alternative to travel
  - Assume a couple day trip for $3K per trip
  - This implies 30 people–trips
  - Assume 2 trips per person per year implies a 15 person staff
  - Implies $3.75 M annual budget if the AG node eliminated all travel
- Only 9 of the 80 U.S. fusion sites have a budget greater than $5 M
  - 20 above $1M, 44 below $0.5 M

WHAT IF THERE WAS A LOW–COST AG NODE

- **Assume only $10K in hardware, robust & easy to use**
  - Some existing computers and displays might be used
  - All sites could afford this
- **An AG node and experimental operations**
  - 3 large experiments could afford a full–scale AG node
  - Satellite centers have reduced scale node
  - Allows one–to–one interaction with the experimental control room
- **An AG node and theoretical community**
  - A shared meeting to discuss physics results and to debug code
  - Shared among a small number of sites

THE SciDAC FUSION COLLABORATORY CAN PLAY A ROLE IN DEFINING A REDUCED SCOPE AG NODE

- With lower cost comes reduced functionality
- Where is the price/functionality break for the U.S. Fusion community?
  - For example, how many simultaneous video streams?
- Is the $10K price point so low that the technology is not compelling?
- Can reduced functionality nodes not affect performance of full nodes?
- The SciDAC Fusion Collaboratory can play a role in such discussions
  - Can be real world beta testers
  - http://www.fusiongrid.org