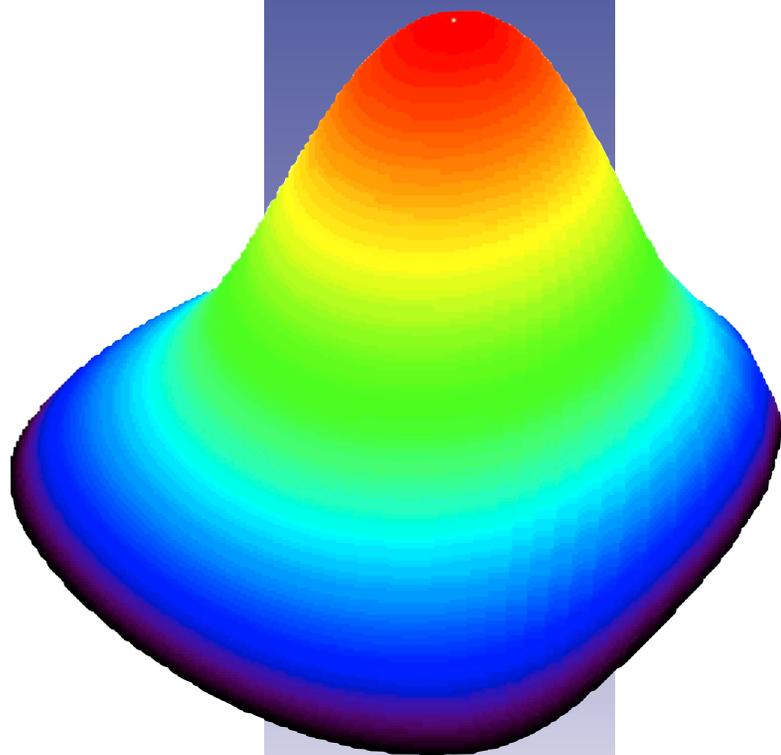


THOUGHTS ON INTEGRATING AG TECHNOLOGY INTO THE U.S. MAGNETIC FUSION PROGRAM

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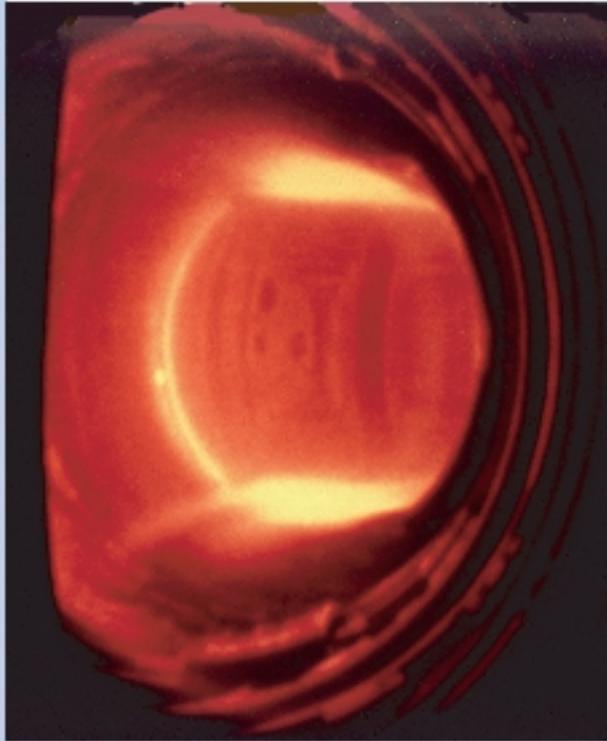


*NIMROD simulated pressure stored
in MDSplus and visualized with IDL*

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>)

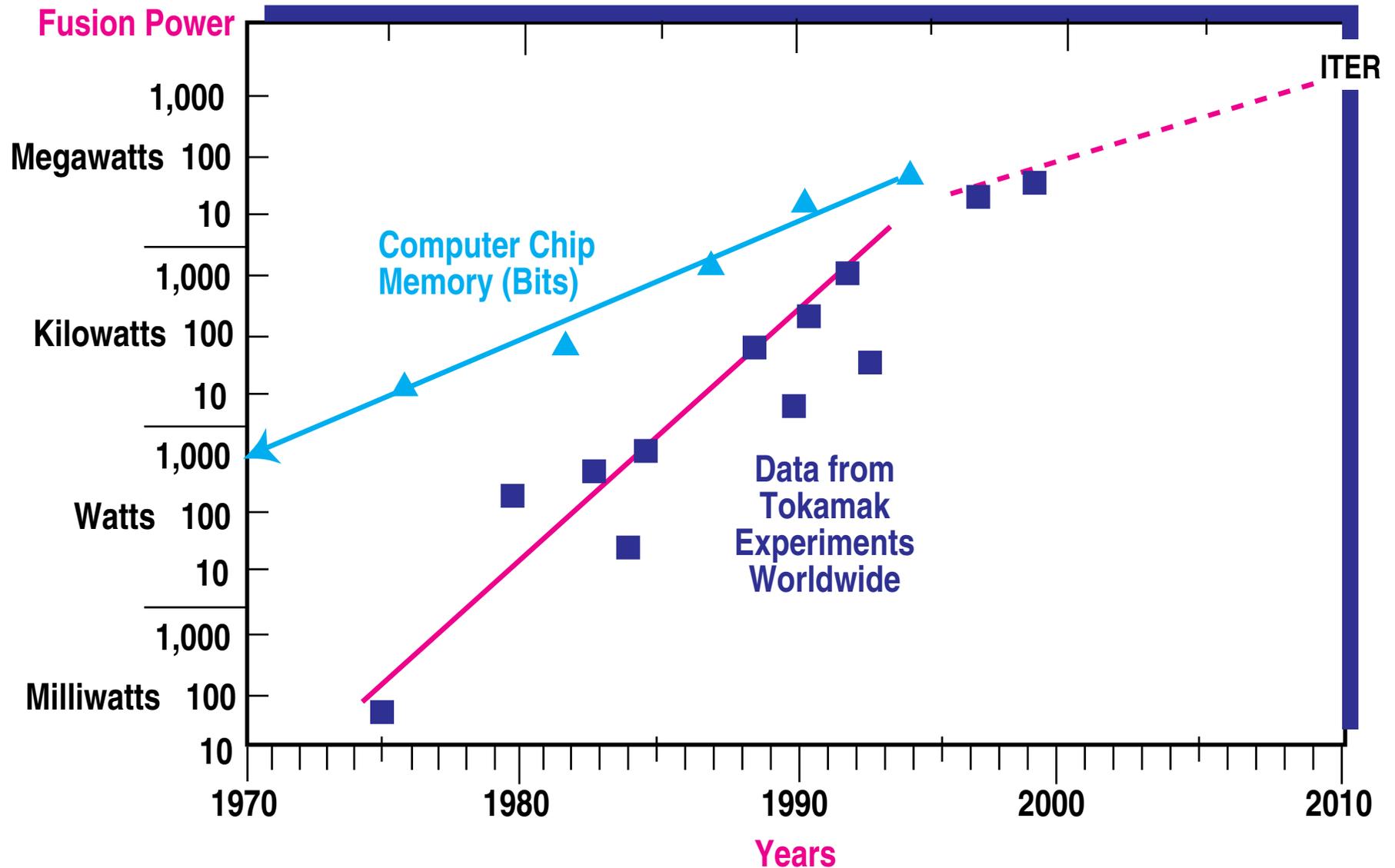
FUSION REPRESENTS A NEARLY INEXHAUSTIBLE ENERGY SOURCE



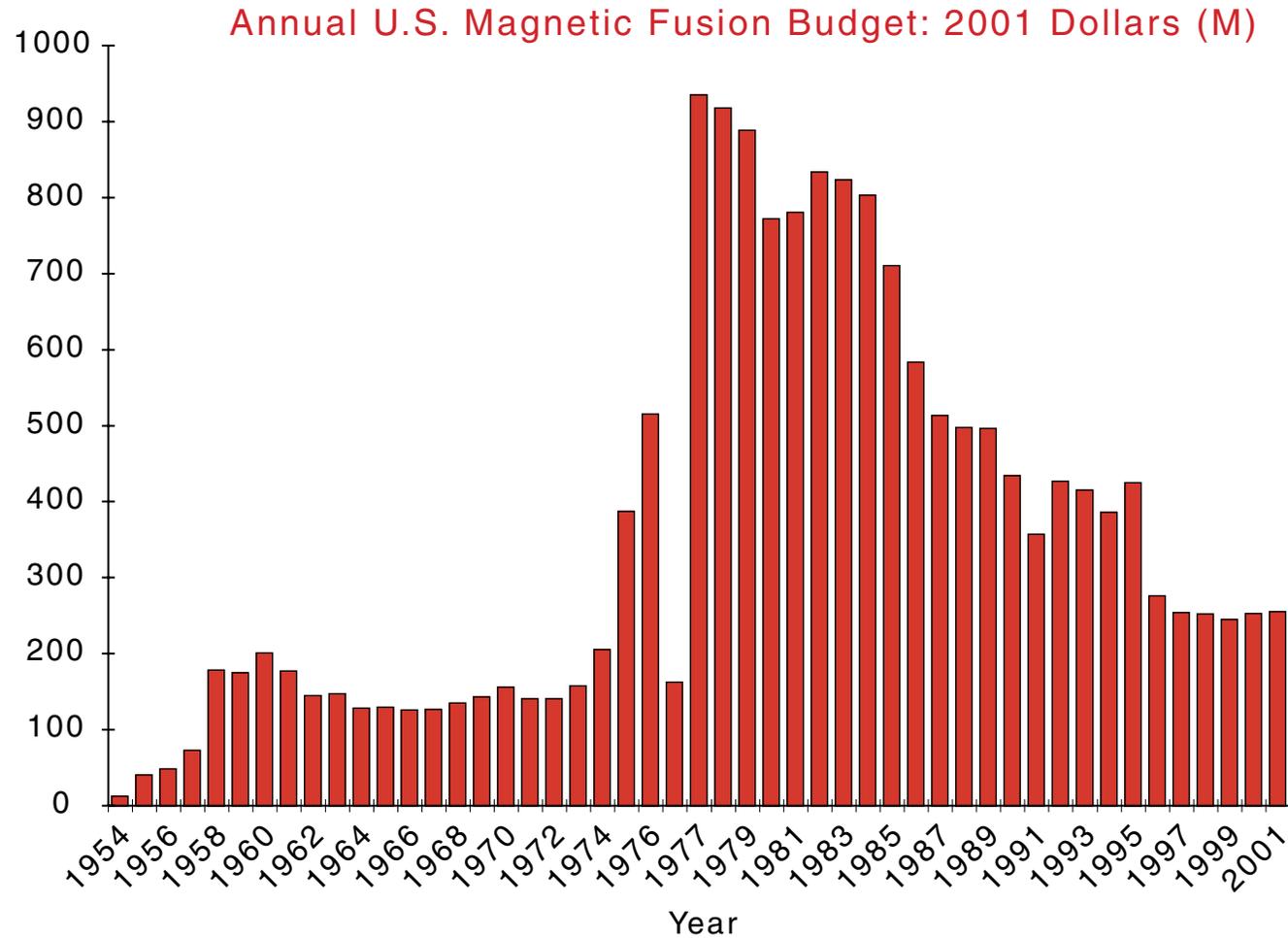
- Fusion: the joining of two light nuclei releasing energy ($E=mc^2$)
 - Pickup truck of fusion fuel = 21,000 railcars of coal
- Like charges repel so fusion requires high temperature (velocity)
- High temperature rips the electrons away – plasma

PROGRESS IN MAGNETIC FUSION RESEARCH

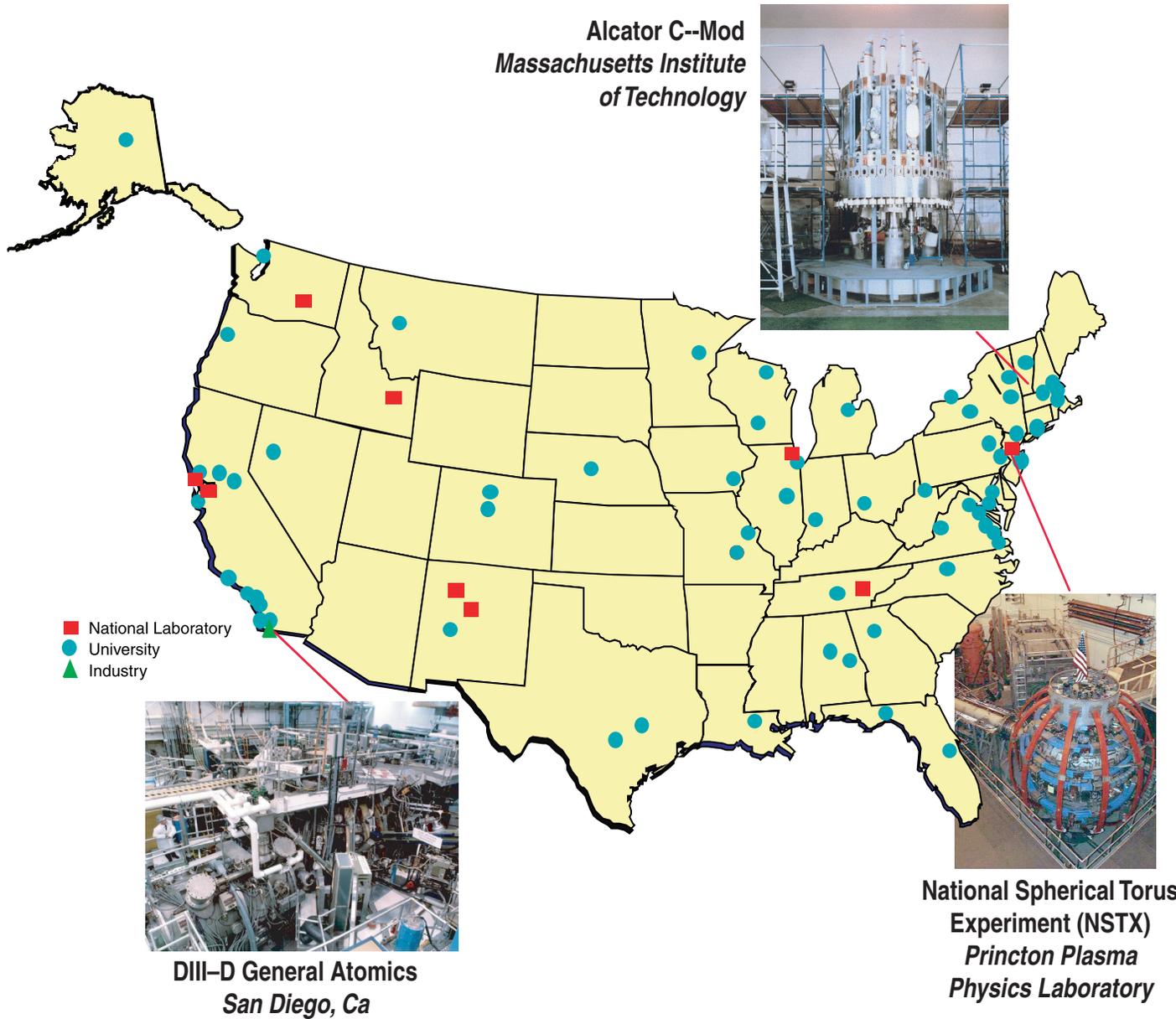
FUSION POWER FROM MICROWATTS TO MEGAWATTS



THE U.S. FUSION COMMUNITY IS FISCALLY CONSERVATIVE



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



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>