SOME THOUGHTS ON PRESENT AND FUTURE DATA MANAGEMENT ISSUES FOR THE MAGNETIC FUSION COMMUNITY

Presented by

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*for the Magnetic Fusion Team**

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GENERAL ATOMICS

MAGNETIC FUSION TEAM

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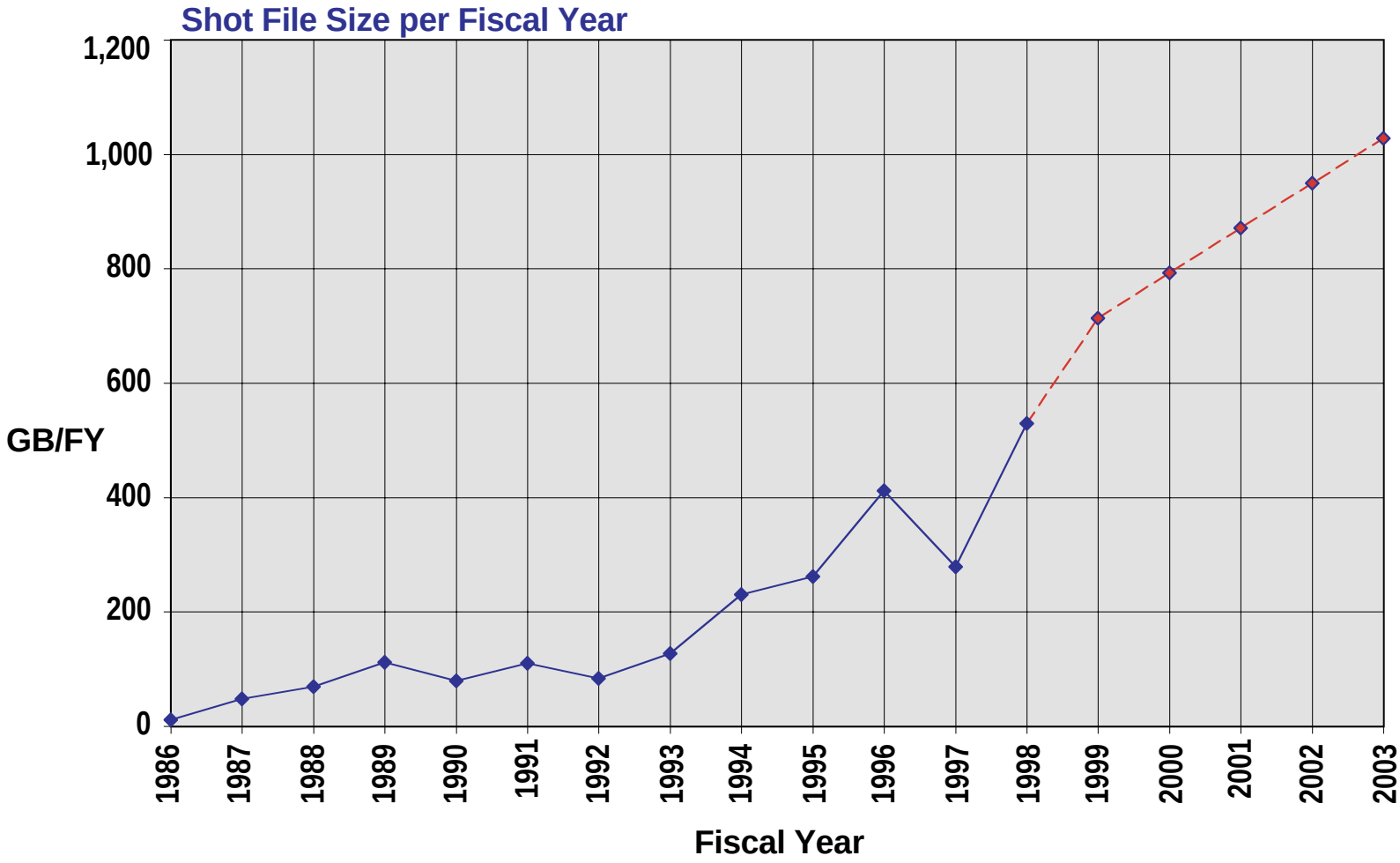
SUMMARY

- *Present experimental and modeling data storage requirements are modest*
  - *on the order of 10 TB for experiments*
  - *on the order of 1 TB for simulations*
- *Real time computing during experiments has a large benefit*
  - *Experiments are pulsed events typically lasting on the order 10 seconds*
  - *Between 30 and 40 pulses per day with 10 minutes between pulses*
  - *Pulse length will increase with newer machines*
  - *This is primarily a CPU issue*
- *Geographically diverse group of research scientists*
  - *Remote participation in experimental and theoretical research is required*
- *Future data storage requirements can grow substantially*
  - *Tools are needed to deal with larger datasets*
  - *More data is acquired per pulse every year with faster sample rates*
  - *More detailed transport simulations will require more CPU power and data storage*
  - *Simulations that move from the transport time scale (100 ms) to the MHD time scale (< 1 ms) will have large storage requirements*

RAW SHOT DATA FILE SIZE CONTINUES TO INCREASE

- More diagnostics, faster digitization rates, potentially longer pulse lengths
- Assume 15 weeks in FY98 and 18 weeks thereafter (today 200 MB/pulse)



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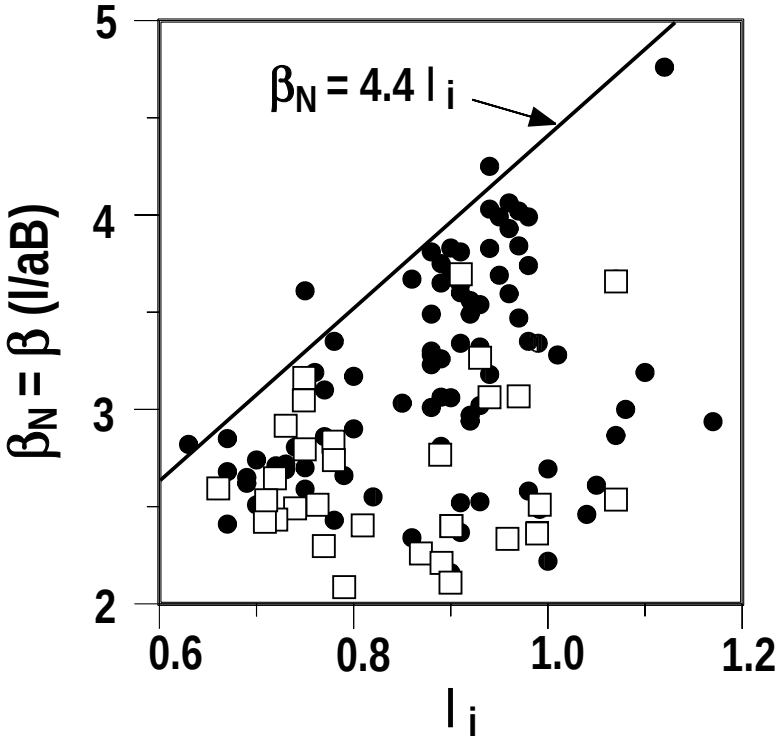
DISRUPTIONS ARE AVOIDED BY KNOWLEDGE OF THE MHD STABILITY BOUNDARY

- MHD time scales are several orders of magnitude smaller than for energy transport
- Detailed experimental data and theoretical modeling will have large storage needs



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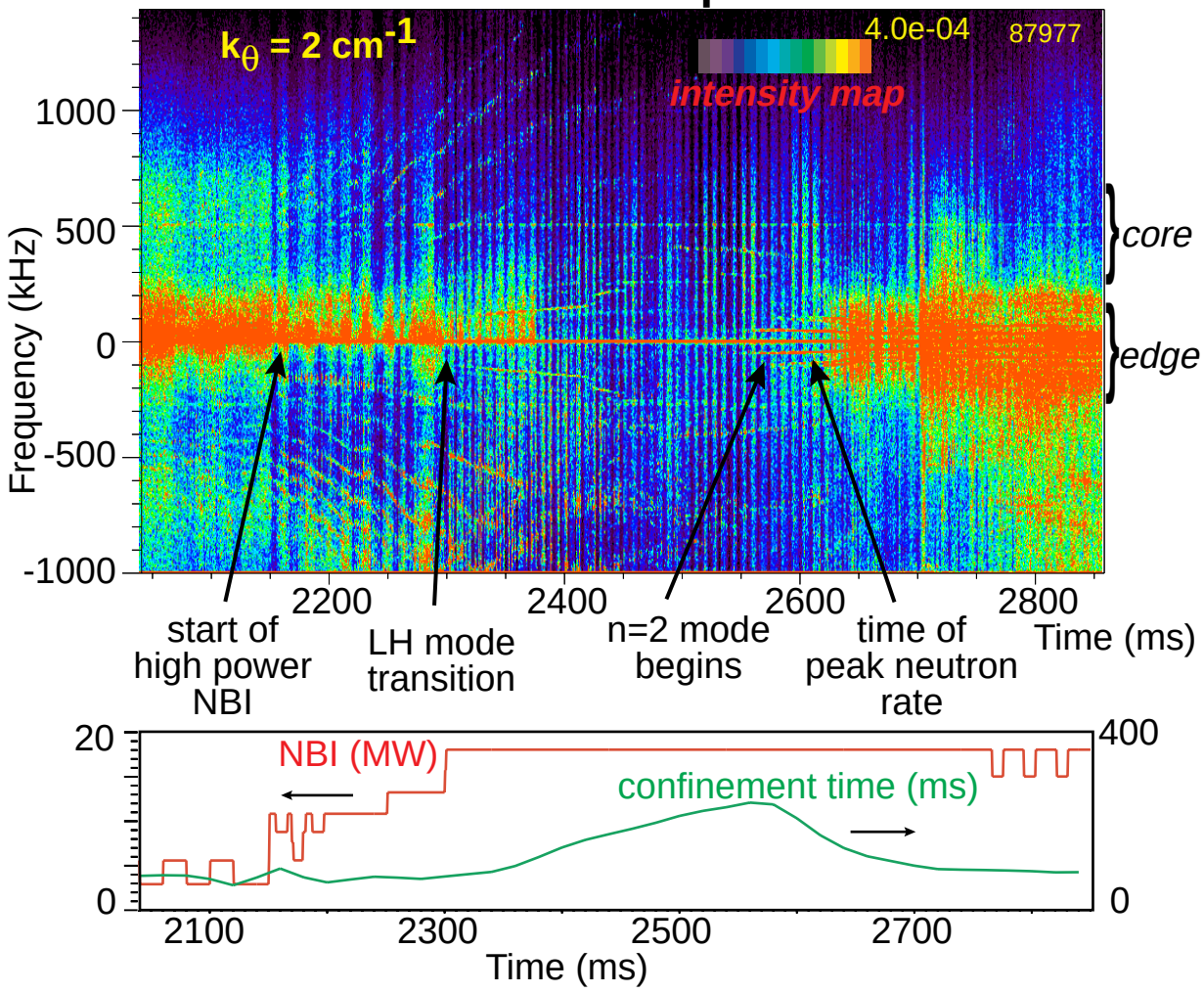
Highest Performance Achieved with Core Transport Barrier when Core Fluctuations Reduced

- **Core fluctuations observed at start of heating phase are completely suppressed prior to peak confinement time and reactivity.**

- **Termination of high performance phase accompanied by larger fluctuations.**

Color Enhanced Contour Plot of Measured Fluctuation Spectrum Evolution



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POTENTIAL LARGER DATA STORAGE

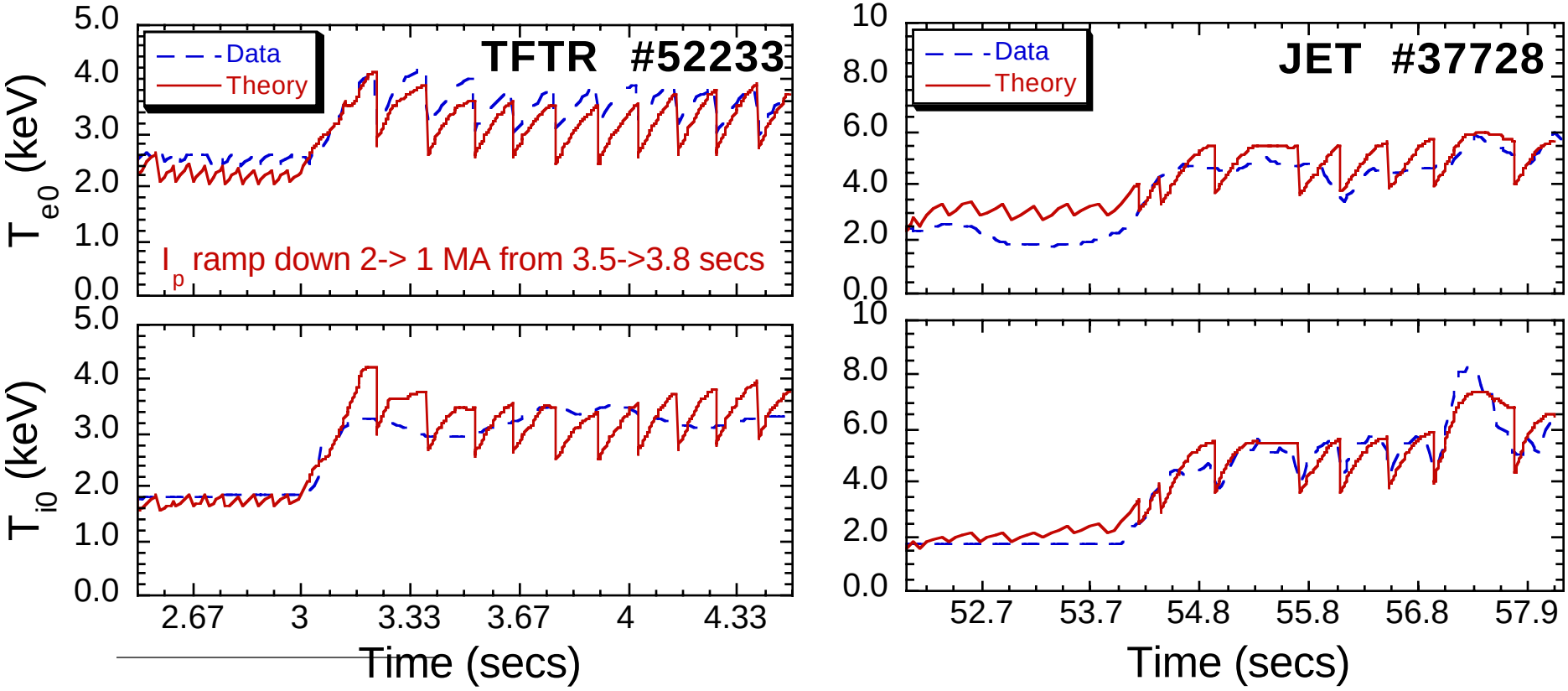
- *Far Infra–red Scattering Diagnostic measures plasma density fluctuations*
  - *Fluctuations correlated to increased energy transport*
  - *Allows close coupling of experiment and theory*
  - *Sampled to give as 1 MHz response for 0.5 seconds*
  - *Sample at 25 MHz for 5 seconds for a total of 500 MB per pulse which will double the size of the DIII–D pulse file*
- *Such increases desirable with other diagnostics (e.g. Reflectometer)*
  - *Electron density every 100 micro–seconds for 5 seconds (2 GB/pulse)*
- *Longer pulse lengths*
  - *From 5 seconds to minutes and possibly hours*

REAL TIME PLASMA CONTROL

- *Better use of experimental time by making something happen*
- *Computationally intensive*
- *Potential near term examples*
  - *Real time magnetic equilibrium reconstruction*
  - *Disruption avoidance*
  - *Real time ray tracing for RF control*
  - *Real time neutral beam power deposition for control of heating profile*

Multi-mode Model Successfully Predicts Full Time History For Many Discharges

- *Time evolution of profiles well described using MM model in the BALDUR transport code*
  - *Predicted temperatures for TFTR Ip ramp-down discharge #52233 and JET low nustar discharge #37728 shown below[1]*



J. Kinsey

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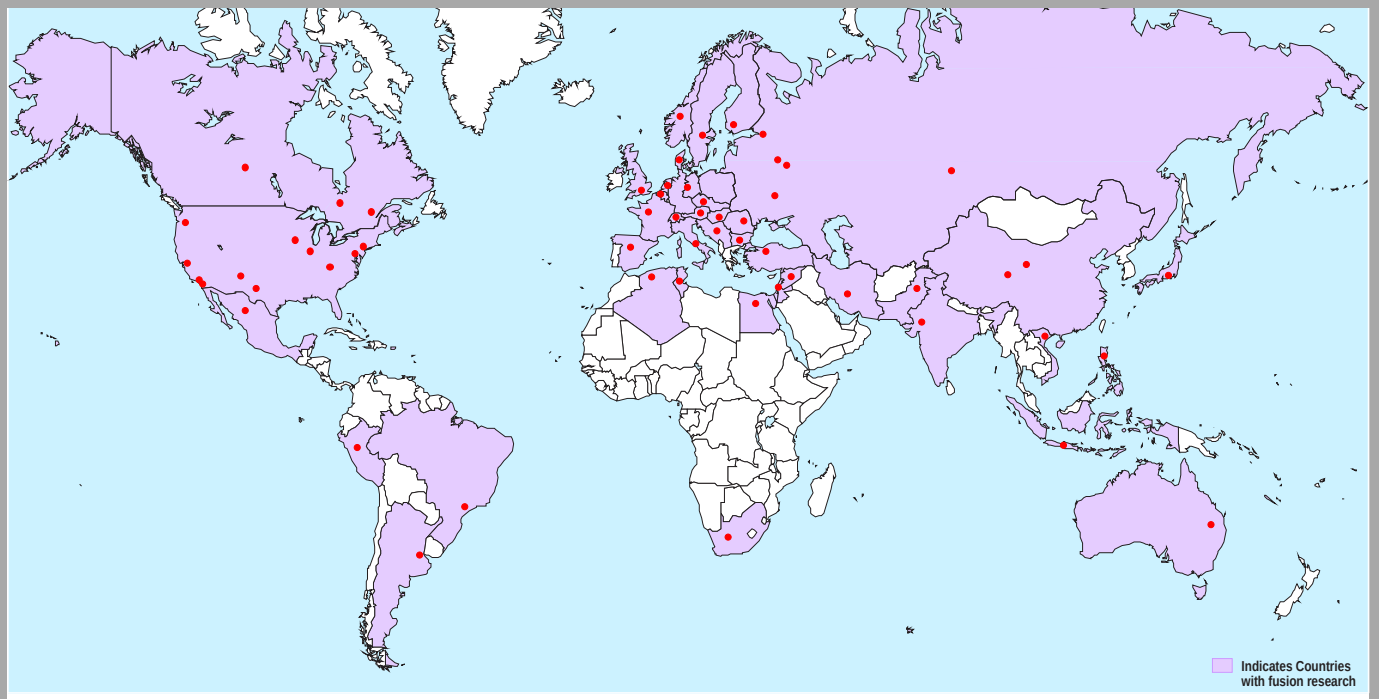
GEOGRAPHICALLY DIVERSE GROUP OF SCIENTISTS

- *International research effort*
- *Lack of common data formats for easy data exchange*
  - *Experimental raw data files*
  - *Simulation results*
  - *MDSplus data system being adopted by more facilities worldwide*
- *Database technology remains with the relational paradigm*
  - *How would object relational queries aid research for large 2D and 3D datasets?*
- *What network speeds will be required for remote analysis?*

Fusion Researchers Come to San Diego From All Over The World



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United Kingdom
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CONCLUSIONS

- *Ability to manage and visualize larger datasets can be beneficial*
  - *More detailed experimental measurements*
  - *More detailed plasma simulations*
- *Greater CPU power will be required to do real time analysis*
  - *Real time meaning during and between pulses*
  - *Will lead to better utilization of experimental time*
- *An ability to easily share data among a geographically diverse group of research scientists will benefit worldwide fusion research*
  - *Database technology will become critical*