



# **Overview of Trilinos Linear and Eigen-Solver Capability Area**

## **Trilinos Users Group Meeting**

**Tuesday, November 3<sup>rd</sup>, 2009**

**SAND #2009-7662P**

**Jonathan Hu**



Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.





## Who Are (Some of) the Current Developers?

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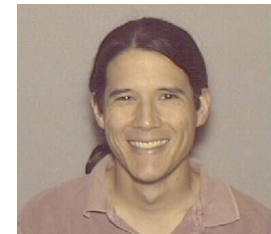
Heidi Thornquist



Ray Tuminaro



Eric Cyr



Jonathan Hu



Chris Siefert



Mike Heroux



Alan Williams



Mike Parks



Clark Dohrmann



Michael Gee



Chris Baker



Vicki Howle



David Day



Joe Kotulski





## Capabilities in a Nutshell

### Eigensolvers

Anasazi

### Direct methods

Pliris  
(dense)

Amesos  
(sparse)

### Krylov methods

Belos

Aztecoo

Komplex  
(equiv. real forms)

### Preconditioners

Ifpack  
(ILU/DD)

ML  
(multigrid)

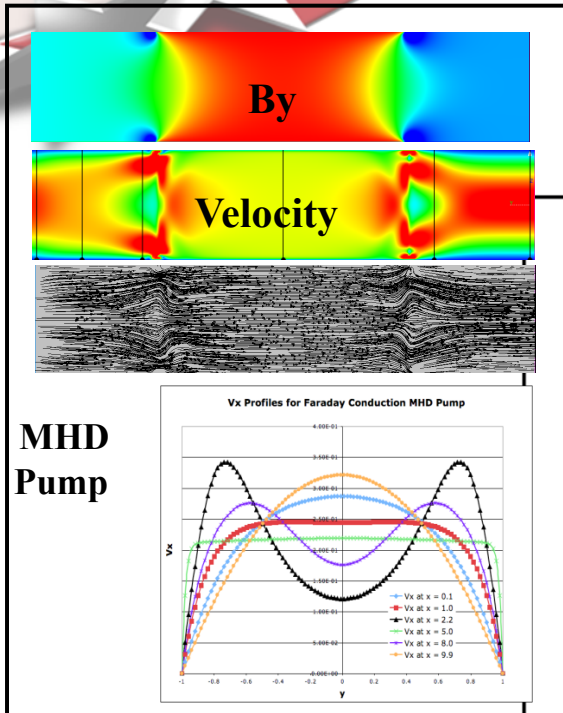
Meros

Claps  
(DD)

Teko

# Scalability

(MHD Pump, Cray XT3)

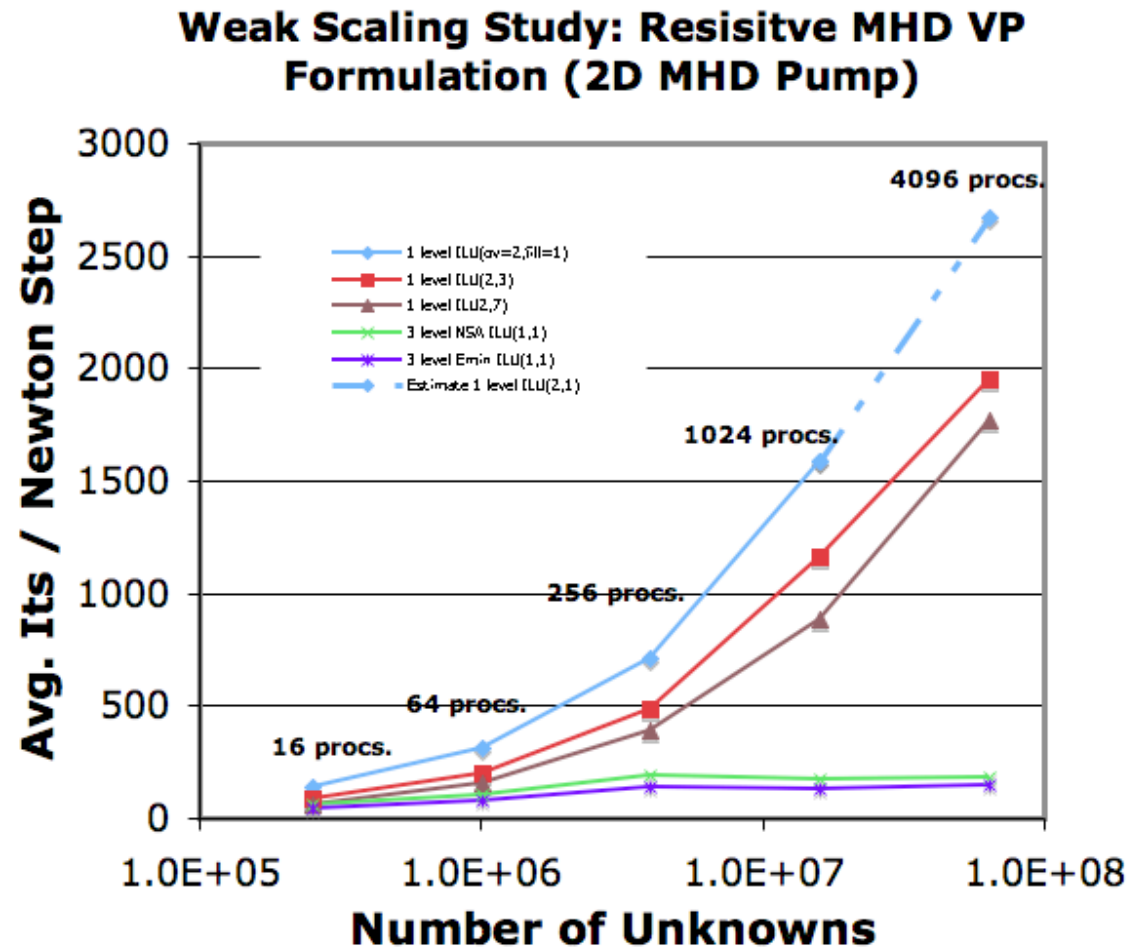


MHD Pump

Preconditioners

- 1-level ILU(2,1)
- 1-level ILU(2,3)
- 1-level ILU(2,7)
- 3-level ML(NSA, Gal)
- 3-level ML(EMIN, PG)

ML: Tuminaro, Hu  
Ifpack: Heroux



(slide courtesy of Roger Pawlowski)



## FY09 Activities by Package

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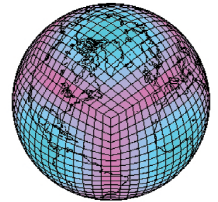
- **Belos**
  - Multi-precision capabilities due to the release of Tpetra.
  - New iterative solvers: recycling CG and TFQMR.
- **Ifpack**
  - Block Chebyshev
  - Multicore domain decomposition
- **Teko**
  - Block preconditioning for multiphysics
  - See Eric Cyr's talk today @ 3:45pm
  - Can apply many linear solvers/precond. to blocks
  - Target apps: MHD, drift diffusion



# New FY10 Application Interactions

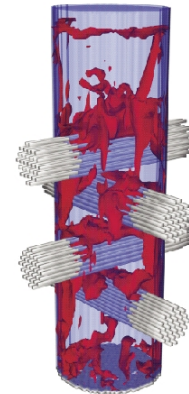
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- **Climate modeling (Siefert, Salinger)**
  - Block and multilevel methods for POP ocean model and HOMME atmospheric codes



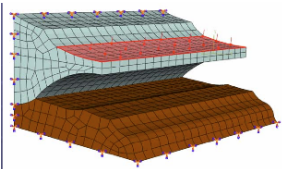
Evans, Taylor, et al.

- **MFIX (Hu)**
  - Multilevel methods for multifluid flow
  - ASCR SciDAC TOPS project



Guenther, Foss  
mfix.org

- **Ice fracture modeling (Tuminaro, Boman)**
  - Multilevel preconditioning for XFEM discretizations
  - ASCR SciDAC



H. Waisman et al.

- **Denovo, (Baker)**
  - Multiscale transport code
  - Integration of Belos and Anasazi



## **Planned FY10 Package Activity**

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- **New AMG preconditioning package**
- **Continued development of Tifpack, templated algebraic preconditioning package (Alan Williams)**
- **CLAPS – incorporation of GDSW and non-pivoting direct solvers that currently reside in Sierra**
- **Incorporation of Teko into Trilinos**