



# Planning for Polyglot Programming

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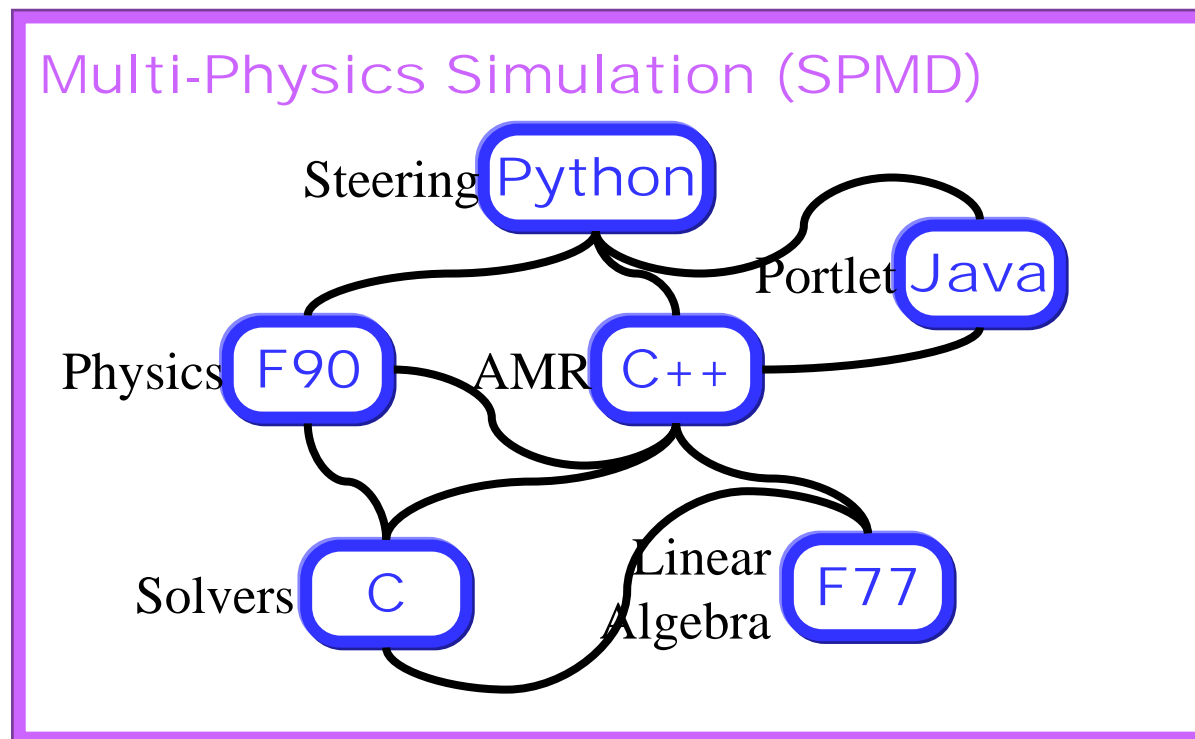
This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under Contract No. W-7405-Eng-48.

UCRL-PRES-204176



# Prediction

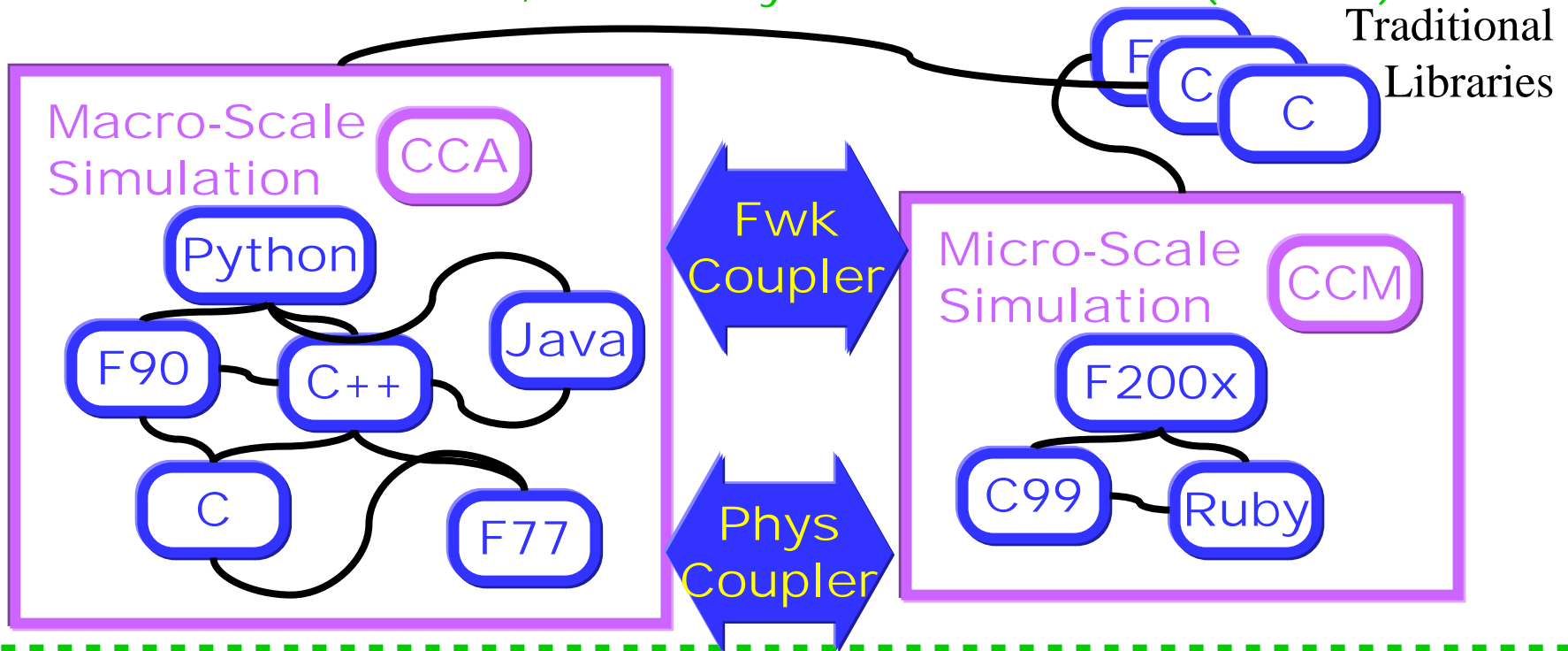
**By 2015, HPC Programming will be essentially the same...**



# Prediction

**By 2015, HPC Programming will be essentially the same... only moreso!**

Multi-Scale, Multi-Physics Simulation (MPMD)



# Conclusions

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- **New languages for HPC will not replace the current patchwork**
- **Success of new languages in HPC may depend on how effectively they contribute to the patchwork**

# Interesting Story

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- **Current patchwork evolved in spite of significant barriers to interoperability**
  - ▶ **Type System**
  - ▶ **Programming Model**
  - ▶ **Support Tools**
  - ▶ **Libraries**

# Interoperability Problems with Type Systems

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## ● 32 bit integer

- ▶ ANSI C: `short`, `int`, `long`, or `long long` (depends on platform) (use `int32_t`)
- ▶ Fortran 77: `INTEGER*4` (as long as not compiled with fancy flag)
- ▶ Fortran 90/95:  
`integer( selected_int_kind(9) )`  
“not guaranteed by standard, just empirically so” –T.E.

## ● F90 Arrays

# Interoperability Problems With the Programming Model

- **Fortran common blocks vs. OOP and strong encapsulation**
- **Scripting vs. immature support for dynamic loading in compiled codes**
  - ▶ **e.g.**
    - **Matlab has cmex/fmex compilation scripts to deal with platform specifics of building DLLs...**
    - **MPI often has mpi\_cc scripts to handle flags and libraries for MPI**
    - **How to build a MEX file that launches a parallel run on the backside?**

# Interoperability Problems With the Support Tools

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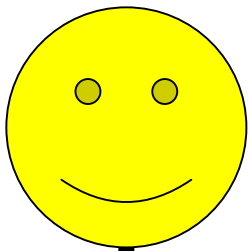
- **Java and Make don't mix**
  - ▶ **Difficult/Impossible to determine minimum set of files to recompile**
- **Fortran 90 allows linker symbols with '.', '%', or '\$ in them (Lahey does '.')**
  - ▶ **One F90 coupling tool uses emacs to globally find and replace strings in .o files (binary files overflow sed's buffers)**
- **Fortran 90 Module files and Make have issues too**



# Interoperability Problems and Library Design

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- **MPI-1.1 doesn't let communicators be passed from one language to another**
- **MPI-2 fixes some of this:**
  - ▶ **for important language pairs**  
(e.g. `MPI_Comm_f2c`)
- **IMPI (in progress?) to handle interoperable MPI implementations**

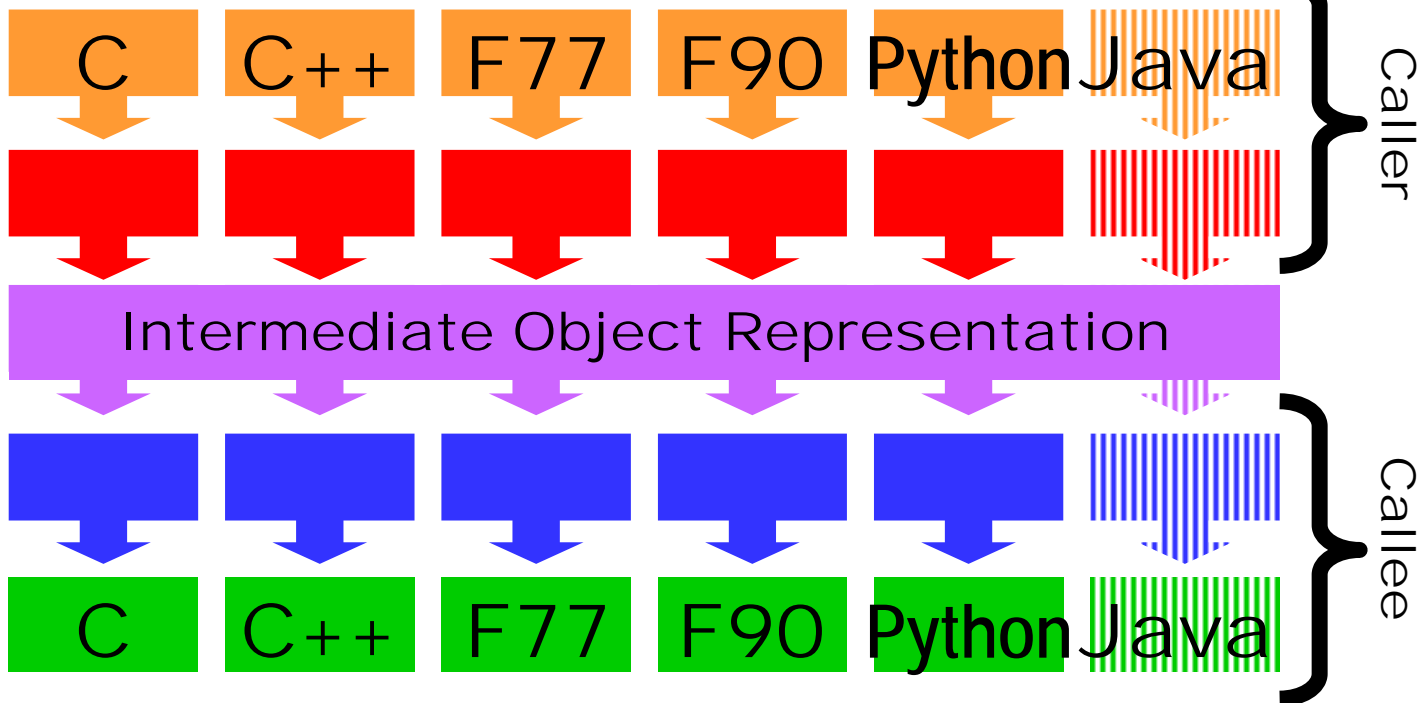


# Babel is an IDL-based language interoperability tool

SIDL

SIDL = Scientific Interface Definition Language

BABEL



# My Questions to the Workshop (1/2)

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- **Is Babel useful for language designers' plans for polyglot programming?**
  - ▶ **We hope so.**
    - Babel is extendable
    - Each language binding is an extension module
    - 3<sup>rd</sup> party extensions in progress at Utah, IU, & SUNY Binghamton
  - ▶ **Unusual/exciting role.**
    - We typically add bindings for languages we're stuck with
    - Never had an opportunity to influence a language design
  - ▶ **May be more useful in Polyglot Programming than a single (say C) API**

# My Questions to the Workshop (2/2)

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- **Is it useful to design Grammars of new languages so SIDL can be extracted easily from source code?**
  - ▶ **Much harder question**
  - ▶ **May require closer collaboration**
  - ▶ **Too creatively constraining?**
    - **Already established SIDL is richer than F77**
    - **SIDL's object model relates only to public APIs and is not quite same as a programming language's type system**

# Closing Remarks:

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- **Interoperability is a tricky thing to get right**
- **If people really want to program in your language, they will find some way to interoperate with it**
- **If interoperability with your language is really easy, more people will want to program in it**
- **Plan for Polyglot Programming**

# Contact Info

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