Tloops
RAJA-Like Transformations in Kripke

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Overview

- **Kripke** - With a "RAJA-like" approach
- **Simple loops** – What's going wrong?
- **Conclusion**

Kripke with a “RAJA” approach?

- Kripke is an Sn transport Mini-App
  - Proxy for ARDRA
  - 2k lines of C++
  - Supports Group-Set and Direction-Sets (PDT)
  - Supports 6 data layouts (“nestings”)
    - Explicit code for each layout
  - For details see NECDC 2014 presentation
- Kripke Templated Loops Variant (“tloops”)
  - Used templates to abstract:
    - Data layout
    - Loop nesting order
    - Loop bodies
    - Loop header
  - Why: Can write a kernel once, and use it for any data layout, any threading model, any architecture, etc. (Same reasons you would use RAJA)

Example *Pseudo* Code

Master Variant (DGZ):

```
Foreach(d in D){
    Foreach(nm in NM){
        Foreach(g in G){
            Foreach(z in Z){
                PHI[nm][g][z] = L[d][nm] *
                                PSI[d][g][z]
            }
        }
    }
}
```

Tloops Variant:

```
Index<NEST> idx;
Loop<NEST>(
    MomDirLoop(),
    GroupLoop(),
    ZoneLoop(),
    [=]{
        PHI[idx.Phi()] = L[idx.L()] *
                         PSI[idx.Psi()]
    }
)
```

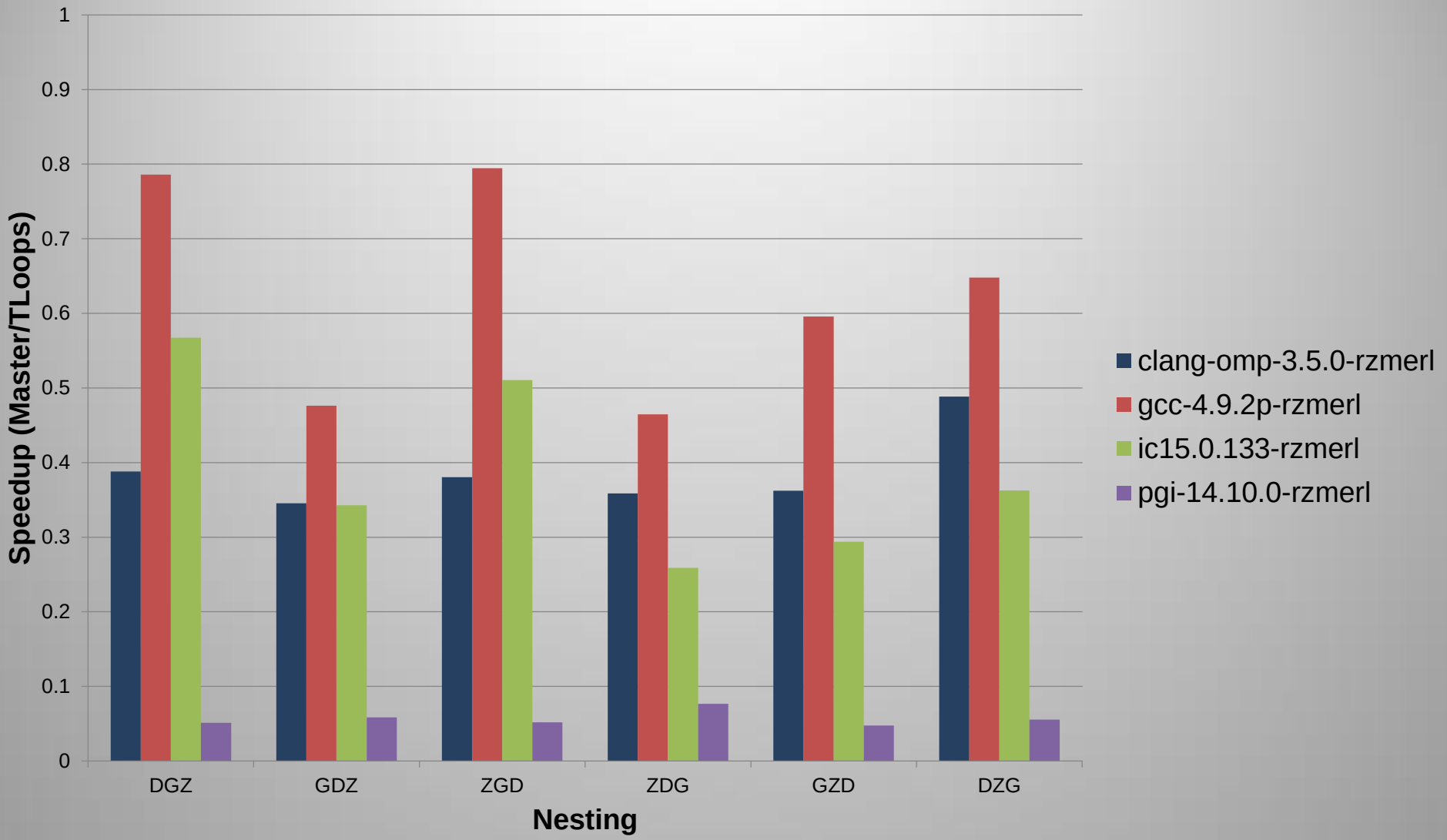
Abst. Loop Nesting

Abst. Loop Headers

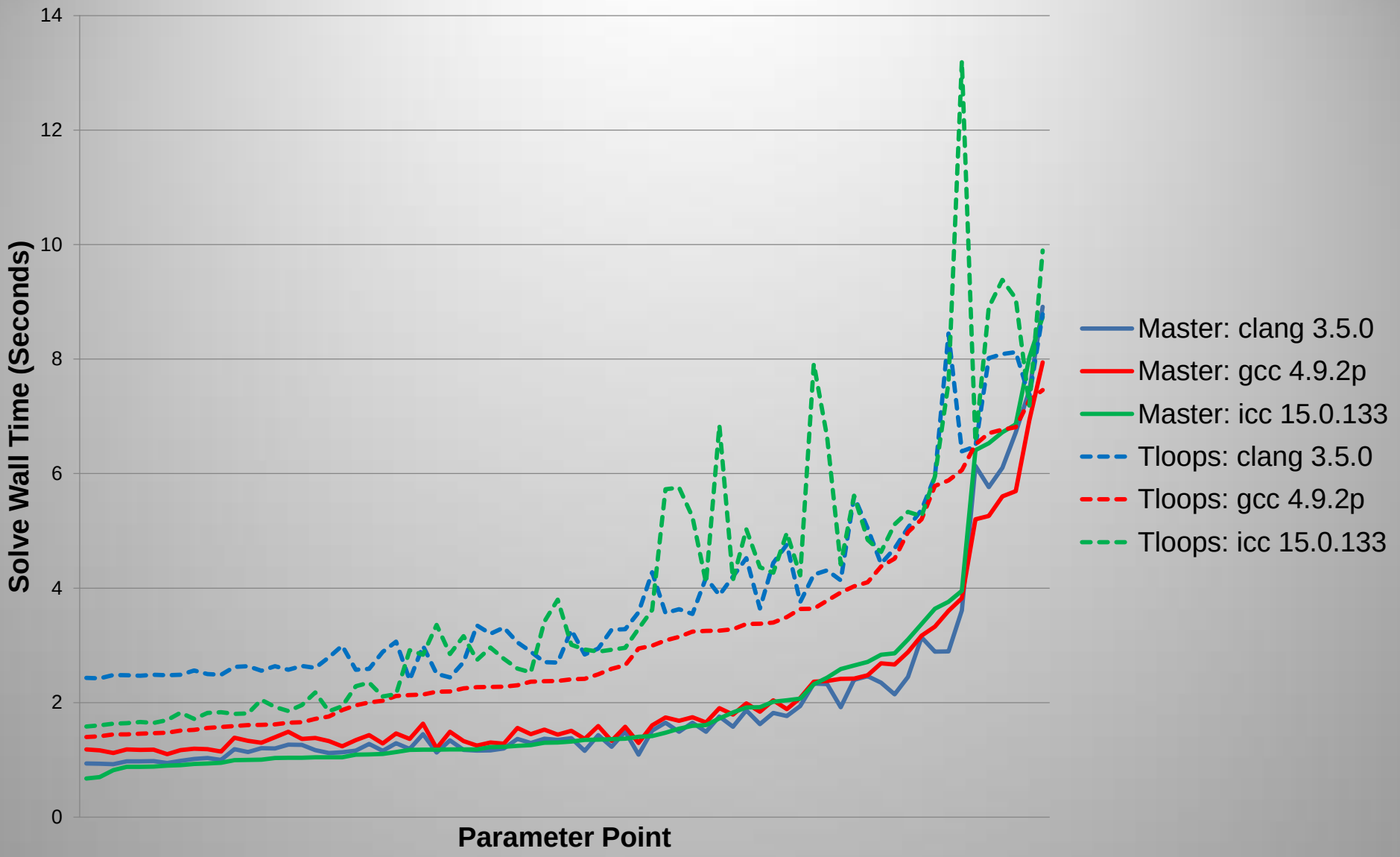
Lambda Loop Body

Abst. Data Layout

Solver Performance for KP0
Speedup of TLoops over Master
Running on RZMERL (TLCC2)



Kripke Serial Perfromance vs. Run Parameters
KP0 on RZMERL (TLCC2) with Various Compilers

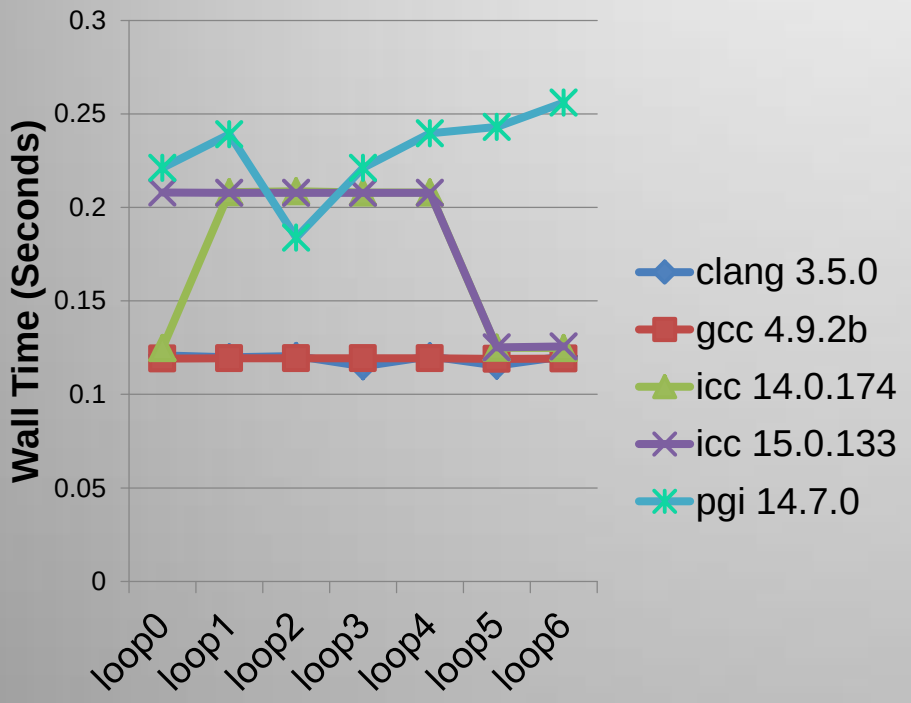


Simplified Loop: X = cY

- Try and figure out what the compiler does and doesn't like about Tloops variant of Kripke
  - Kripke Tloops is fairly complex, so it's difficult to determine what constructs cause problems for compiler optimizers
- Try simple vector scaling kernel
- Loop0 thru loop6
  - Loop0 is simplest, "easiest" to vectorize loop
  - Loop1-6 add more and more of the loop abstractions we have in Tloops.
- "Loop0 should be easy for a compiler to optimize!" – My Assumption

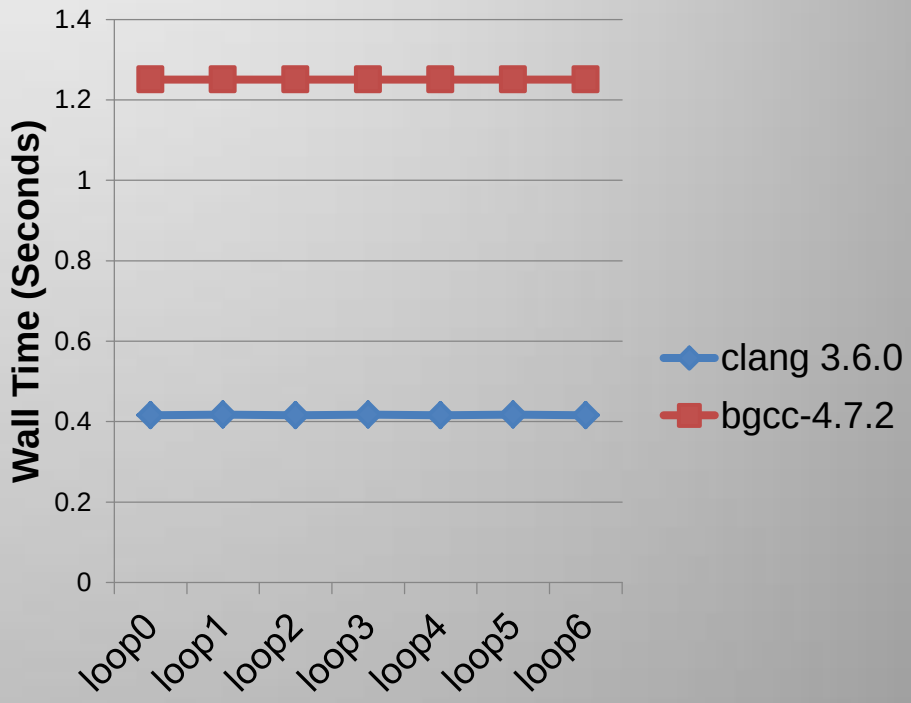
Simplified Loop Results

X=cY Kernel Performance With Increasing Level of Abstraction Running on RZMERL (TLCC2)



No Abstraction ----------> Most Abstraction

X=cY Kernel Performance With Increasing Level of Abstraction Running on RZUSEQ (BG/Q)



No Abstraction ---> Most Abstraction

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