



# Proxy Applications Demo: HACC

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## AGENDA

Introduction to HACC

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HIPify'ing mini-HACC

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Building and running mini-HACC

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Profiling mini-HACC

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Additional Applications

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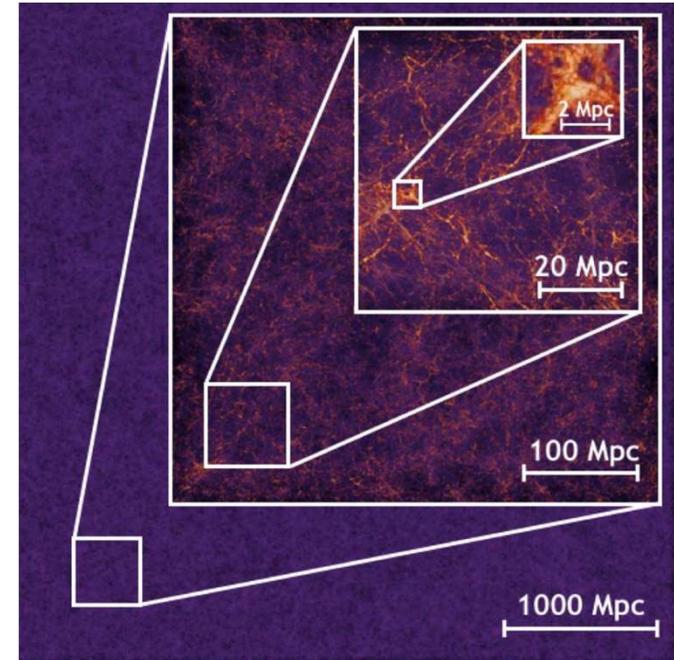


# Introduction to HACC



## Intro to HACC

- **Hardware Accelerated Cosmology Code**
- Simulates time-evolution of universe
- **HIP success story:**
  - **Ported in an afternoon**
  - **...but not 20 minutes**
- **Profiling:**
  - 10% of time is spent in the tree walk
  - >80% in the short force kernels
    - **(GPU kernel: mini-HACC)**
  - 5% in the 3d Transposes / FFTs



$$f_{SR} = (s + \epsilon)^{-3/2} - f_{grid}(s)$$

where,

$$s = \mathbf{r} \cdot \mathbf{r}$$

and,

$$f_{grid}(s) = POLY_5(s)$$



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# HIP'ifying mini-HACC

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## Hipify'ing mini-HACC

- On poplar: */home/users/coe0000/mini-HACC-demo*
  - Compile with *nvcc -std=c++11 -O3 driver.cu -o mini-HACC*

```
nbody1_kernel<<<dim3(blocks), dim3(threads)>>>(count, count1,  
dev_data1, dev_data2, fcoeff, fsrrmax, rsm);
```



```
[coe0000@poplar mini-HACC]$ /opt/rocm/binhipify-perl driver.cu
```

```
hipLaunchKernelGGL((nbody1_kernel), dim3(blocks), dim3(threads),  
0, 0, count, count1, dev_data1, dev_data2, fcoeff, fsrrmax, rsm);
```



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# Building and running mini-HACC

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## Building mini-HACC

- On poplar:
  - ***/home/users/coe0000/mini-HACC-demo***

```
[coe0000@poplar mini-HACC-demo]$ ls  
build_and_run.sh mini-HACC
```

- Script is a guided tour through what you need to build and run mini-HACC (environment/modules, command lines, etc.)
- Copy script to your home directory and run or use it as a guide

## Running mini-HACC

- `srun -n1 -N1 ./mini-HACC nbody1.dat`

```
[coe0000@poplar mini-HACC]$ srun -n1 -N1 ./mini-HACC nbody1.dat
VMAX=6140
found numdevices = 4
device name = Vega 20
can run concurrent kernels = 1
got count = 334, count1 = 6135
got fcoeff = 7.570089e-04, fsrrmax = 3.116326e+00, rsm = 7.000000e-03
reading arrays ...
calling nbody1 GPU kernel...
H2D Time = 104.90 microsec
Kernel Time = 59.13 microsec
D2H = 835.18 microsec
```



# Profiling HACC



## Start simple!

- **Export KMDUMPISA=1; make**

```
[coe0000@poplar mini-HACC]$ ls  
dump-gfx906.hsaco dump-gfx906.isa dump-gfx906.isabin driver.cpp  
makefile mini-HACC nbody1.dat nbody2.dat nbody4.dat
```

- **more dump-gfx906.isa**  
wavefront\_sgpr\_count = 55  
workitem\_vgpr\_count = 39  
ScratchSize: 0

## rocProfiler

- `srun -n1 -N1 /opt/rocm/bin/rocprof ./mini-HACC nbody1.dat`

```
[coe0000@poplar mini-HACC]$ more results.csv  
Index,KernelName,gpu-id,queue-id,queue-index,tid,grd,wgr,lds,scr,vgpr,sgpr,fbar,sig  
0,"nbody1_kernel(long, long, float*, float*, float, float, float)",0,0,4,31909,85504,256,96,0,0,0,0,0x2aaaaab0a780
```

## HIPified (ported) codes

Quicksilver

HACC

PENNANT

SW4LITE

Laghos

NAMD

QMCPACK

And many more...

## Wrap up



Questions?  
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