Single-thread Performance Evaluation of the latest Intel Platforms

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Youngsung Kim

(Application Scalability and Performance Group, NCAR)

Test Platforms and a compiler

KNL

CPU Model Name : Intel(R) Xeon Phi(TM) CPU 7250 @ 1.40GHz
Compiler : ifort (IFORT) 17.0.0 20160315

SNB

CPU Model Name : Intel(R) Xeon(R) CPU E5-2670 0 @ 2.60GHz
Compiler : ifort (IFORT) 17.0.0 20160315

HSW

CPU Model Name : Intel(R) Xeon(R) CPU E7-8890 v3 @ 2.50GHz
Compiler : ifort (IFORT) 17.0.0 20160315

KNC

CPU Model Name : Genuine Intel(R) CPU @ 2.60GHz
Compiler : ifort (IFORT) 17.0.0 20160315

Climate KGen Kernels

* Available from https://github.com/NCAR/kernelOptimization
* Extracted using KGen(https://github.com/NCAR/KGen)
  from CESM, HOMME, PORT(RRTMG), and MPAS

(0) ./advance_clubb_core
(1) ./CLUBB_adv_clubb_core/kernel
(2) ./CLUBB_adv_windm_edsclrm/kernel
(3) ./CLUBB_pdf_closure/kernel
(4) ./CLUBB_pdf_closure_execution_part/kernel
(5) ./homme/homme_div_sphere
(6) ./homme/homme_grad_sphere
(7) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk
(8) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk2
(9) ./homme/homme_laplace_sphere_wk/homme_laplace_sphere_wk3
(10) ./limiter_optim_iter_full
(11) ./MG2_CAM5_INTEL
(12) ./MG2r/opt
(13) ./MG2r/opt2
(14) ./MG2r/opt3
(15) ./MG2r/opt4
(16) ./MG2r/orig
(17) ./MPAS_rrtmg_lw/kernel
(18) ./POP_comp_co3terms
(19) ./POP_merged_streamfunction
(20) ./port/port_binterp
(21) ./port/rrtmg_lw_cldprmc
(22) ./port/rrtmg_lw_inatm
(23) ./port/rrtmg_lw_rad
(24) ./port/rrtmg_lw_rtrnmc
(25) ./port/rrtmg_lw_setcoef
(26) ./port/rrtmg_sw_cldprmc
(27) ./port/rrtmg_sw_inatm
(28) ./port/rrtmg_sw_rad
(29) ./port/rrtmg_sw_reftra
(30) ./port/rrtmg_sw_setcoef
(31) ./port/rrtmg_sw_spcvmc
(32) ./port/rrtmg_sw_taumols
(33) ./port/rrtmg_sw_vrtqdr
(34) ./preq_hydrostatic
(35) ./preq_omega_ps
(36) ./remap_q_ppm
(37) ./vlaplace_sphere_wk
(38) ./vorticity_sphere
(39) ./WACCM/imp_sol
(40) ./WACCM/lu_fac

How to rerun the tests:

>> git clone https://github.com/NCAR/kernelOptimization.git

>> cd kernelOptimization

>> git checkout [snb_tag_org|hsw_tag_org|knc_tag_org|knl_tag_org]

>> ./scripts/test_kernels.py .

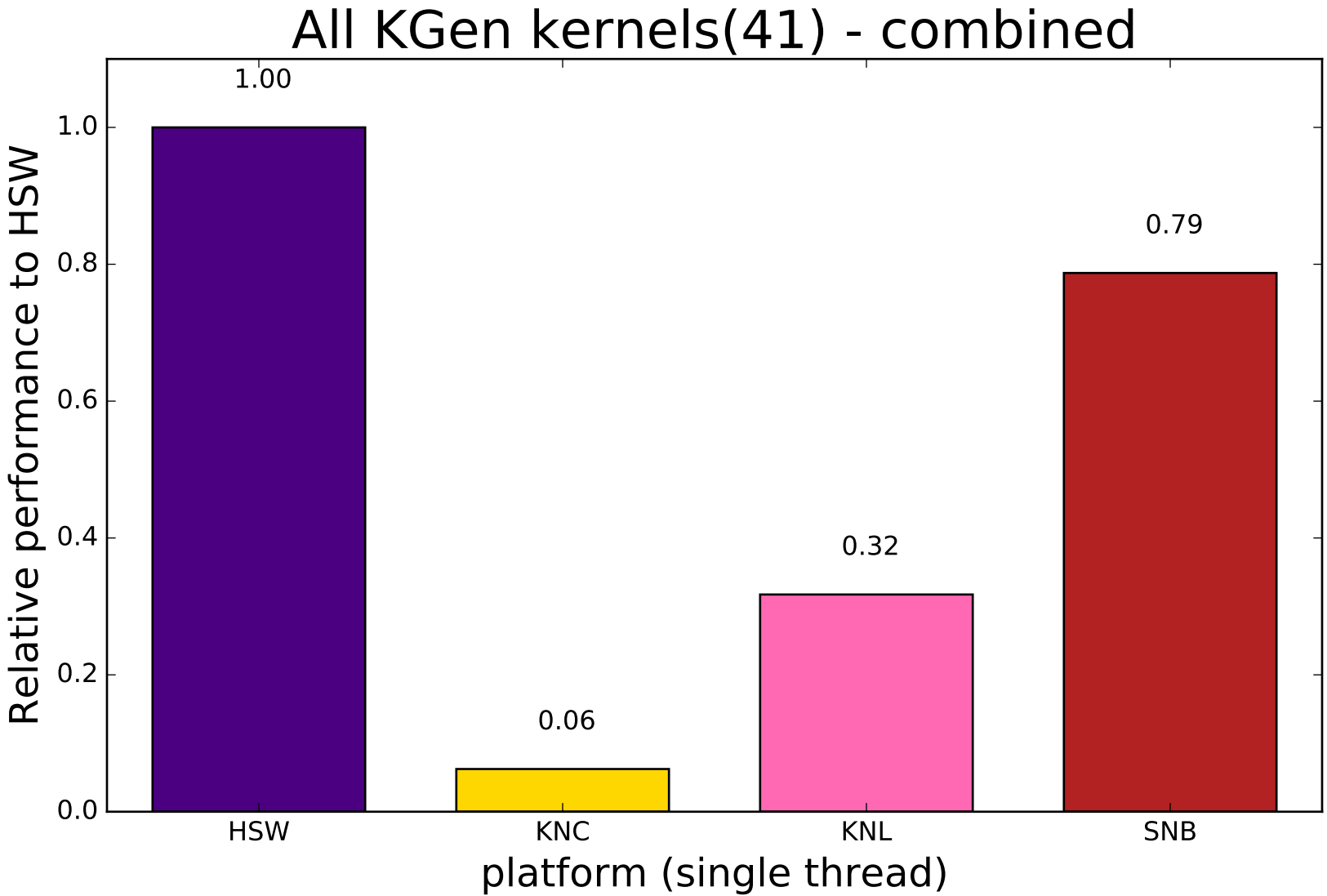
NOTE: It is assumed that you are on one of test platforms.

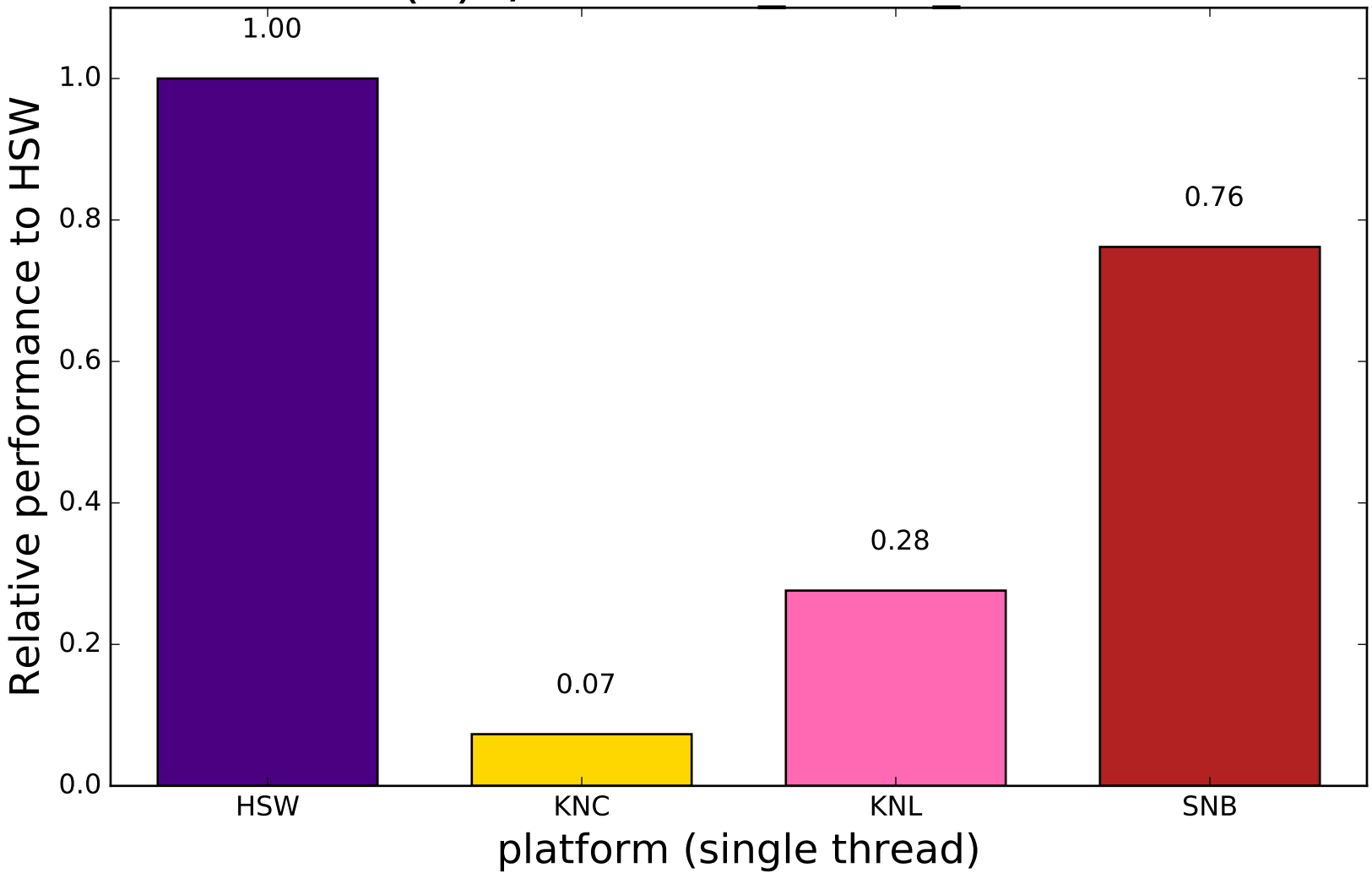
You may need to modify Makefile(s) to fit to your test env.

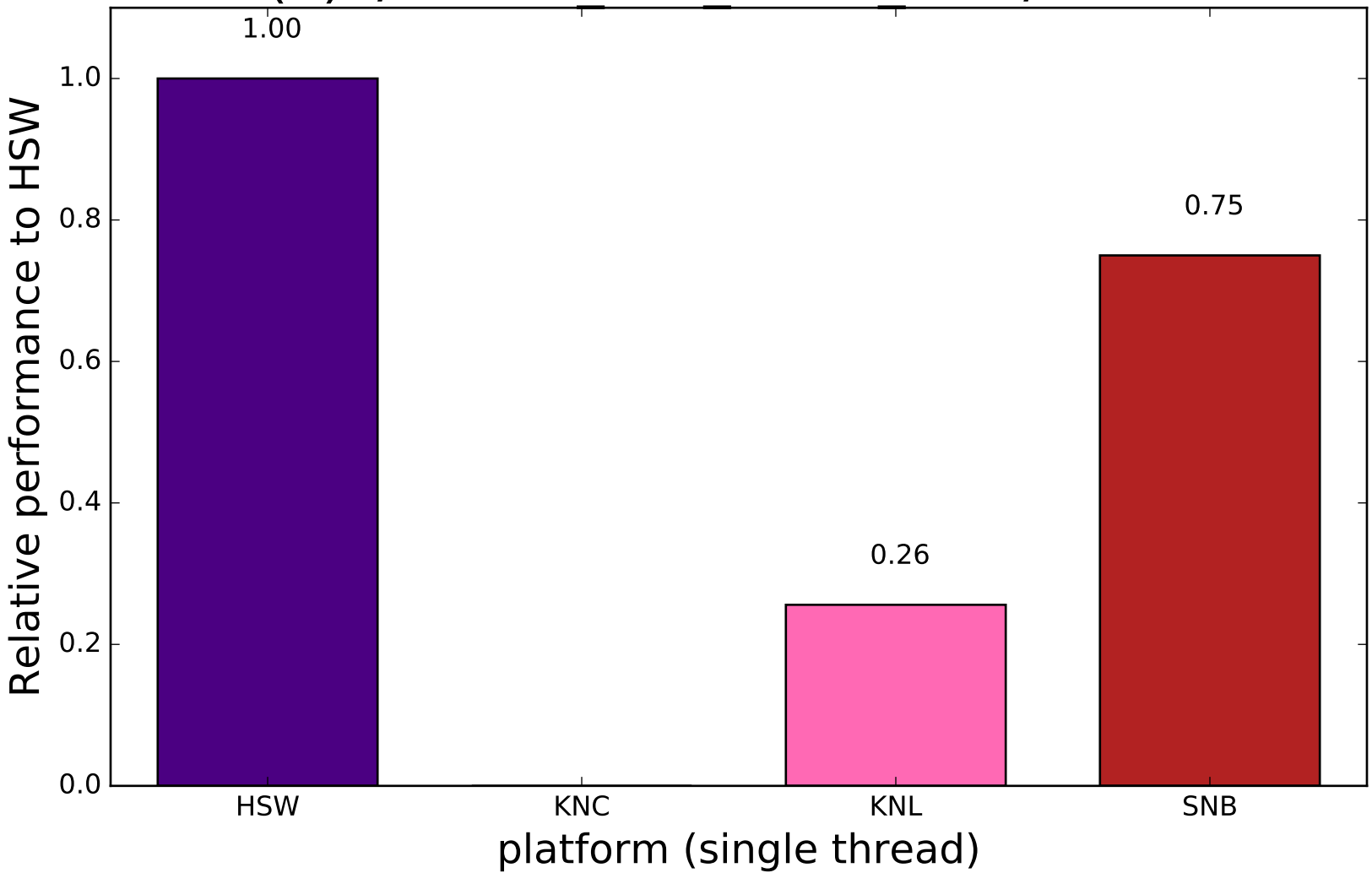
Raw test results for this report are available:

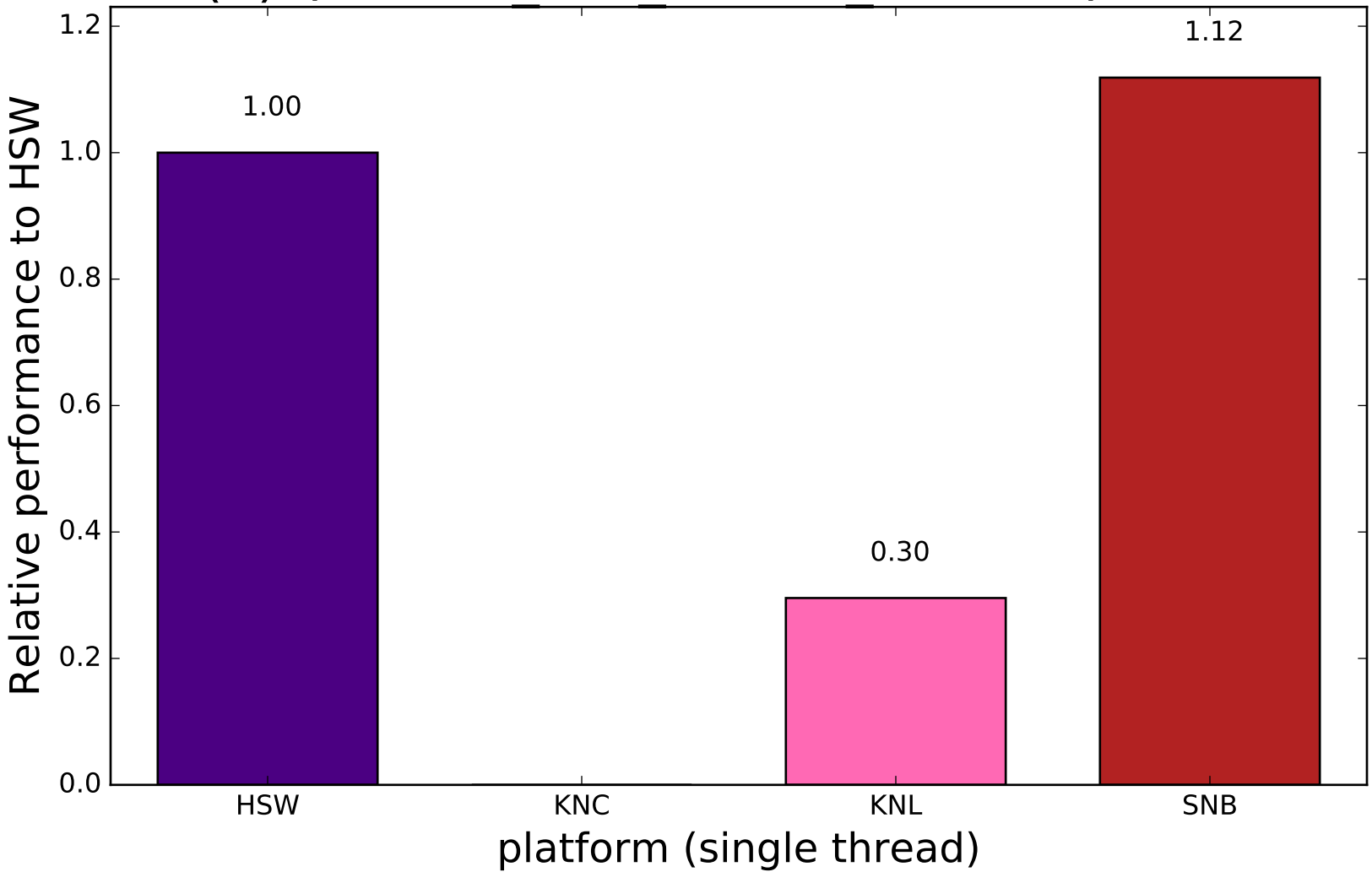
>> cd testdata/May_05_2016

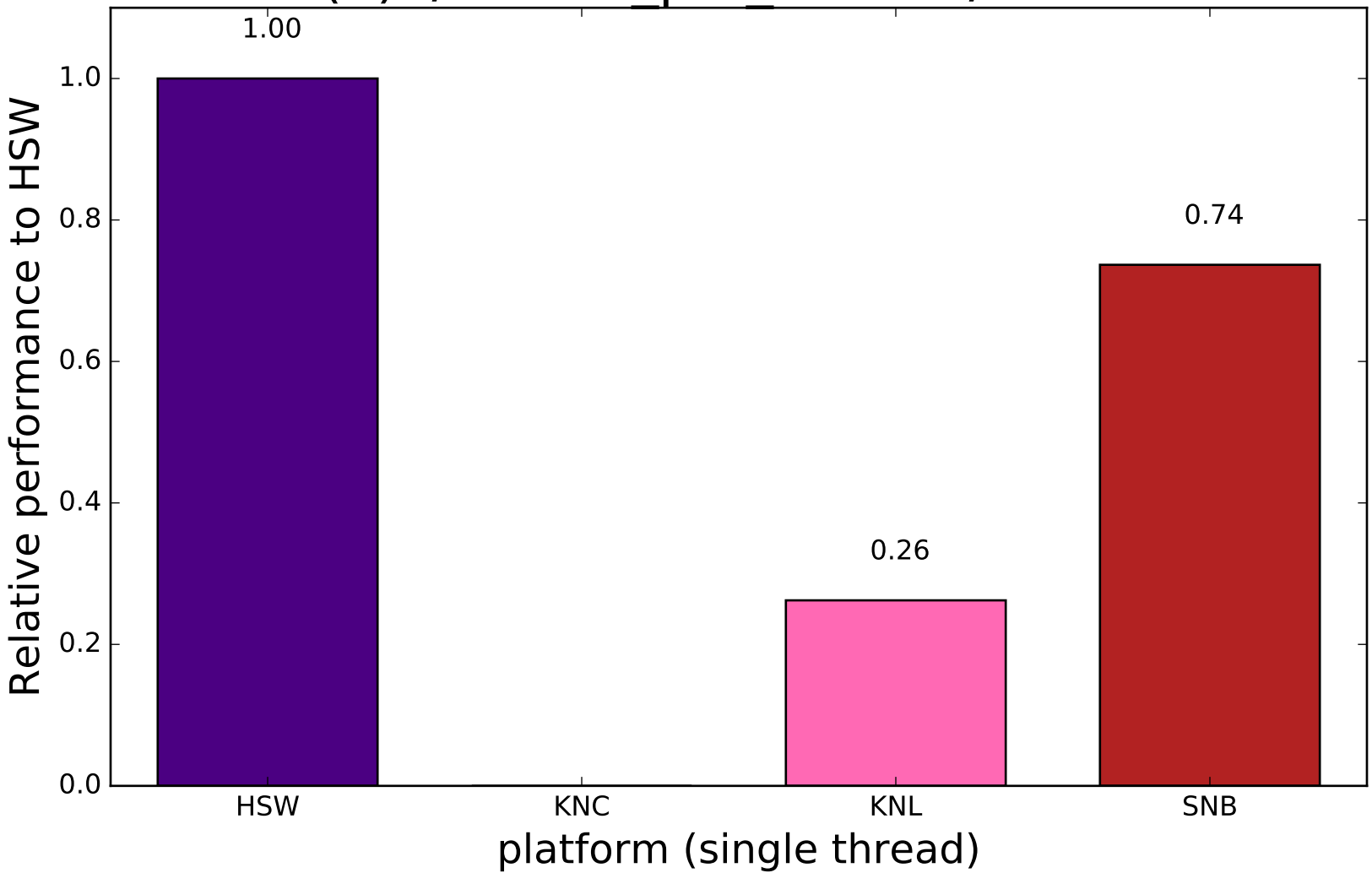
Performance Comparison to HSW (Single Thread)

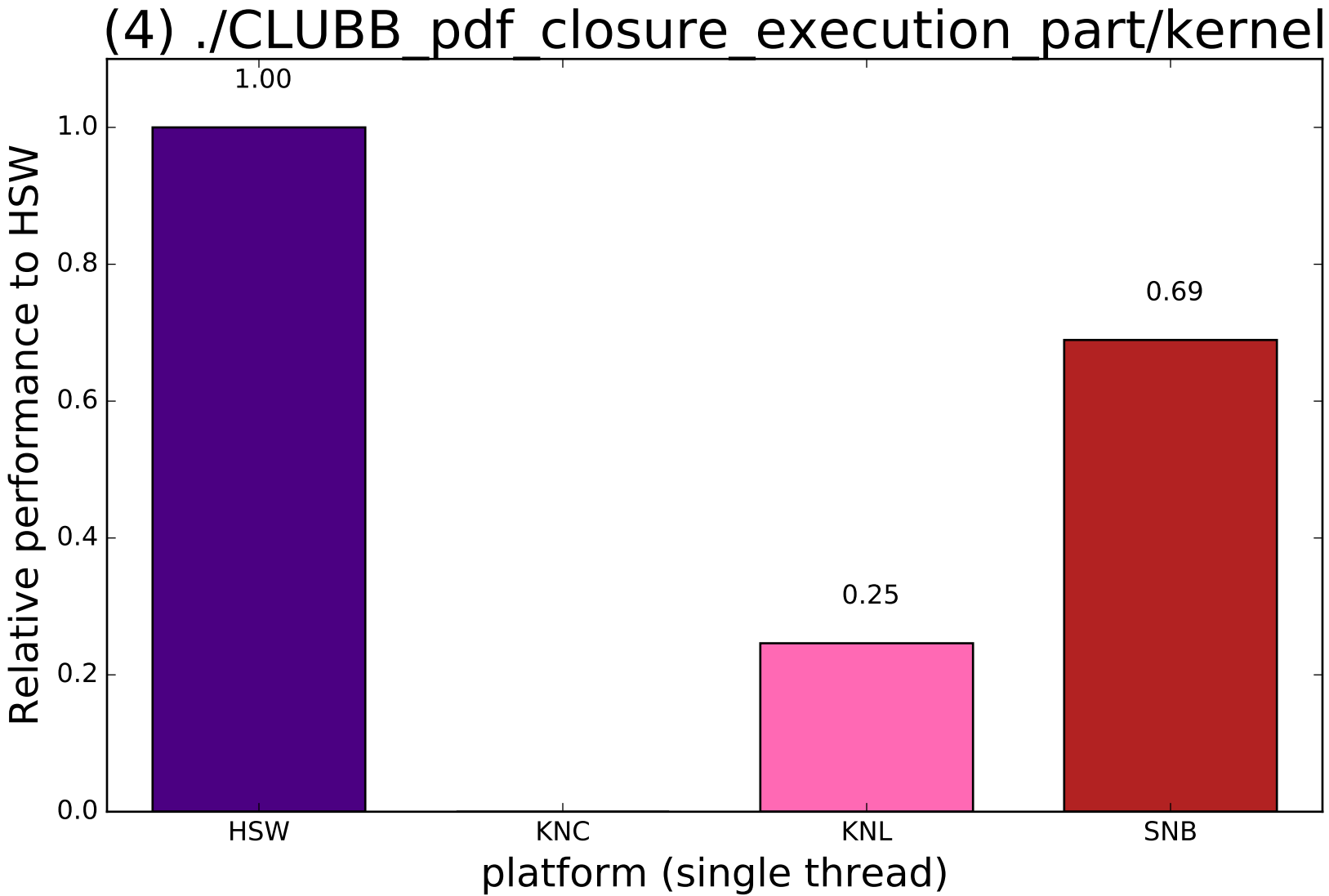

All KGen kernels(41) - combined
Relative performance to HSW
1.00
0.79
0.32
0.06
1.0
0.8
0.6
0.4
0.2
0.0
HSW
KNC
KNL
SNB
platform (single thread)

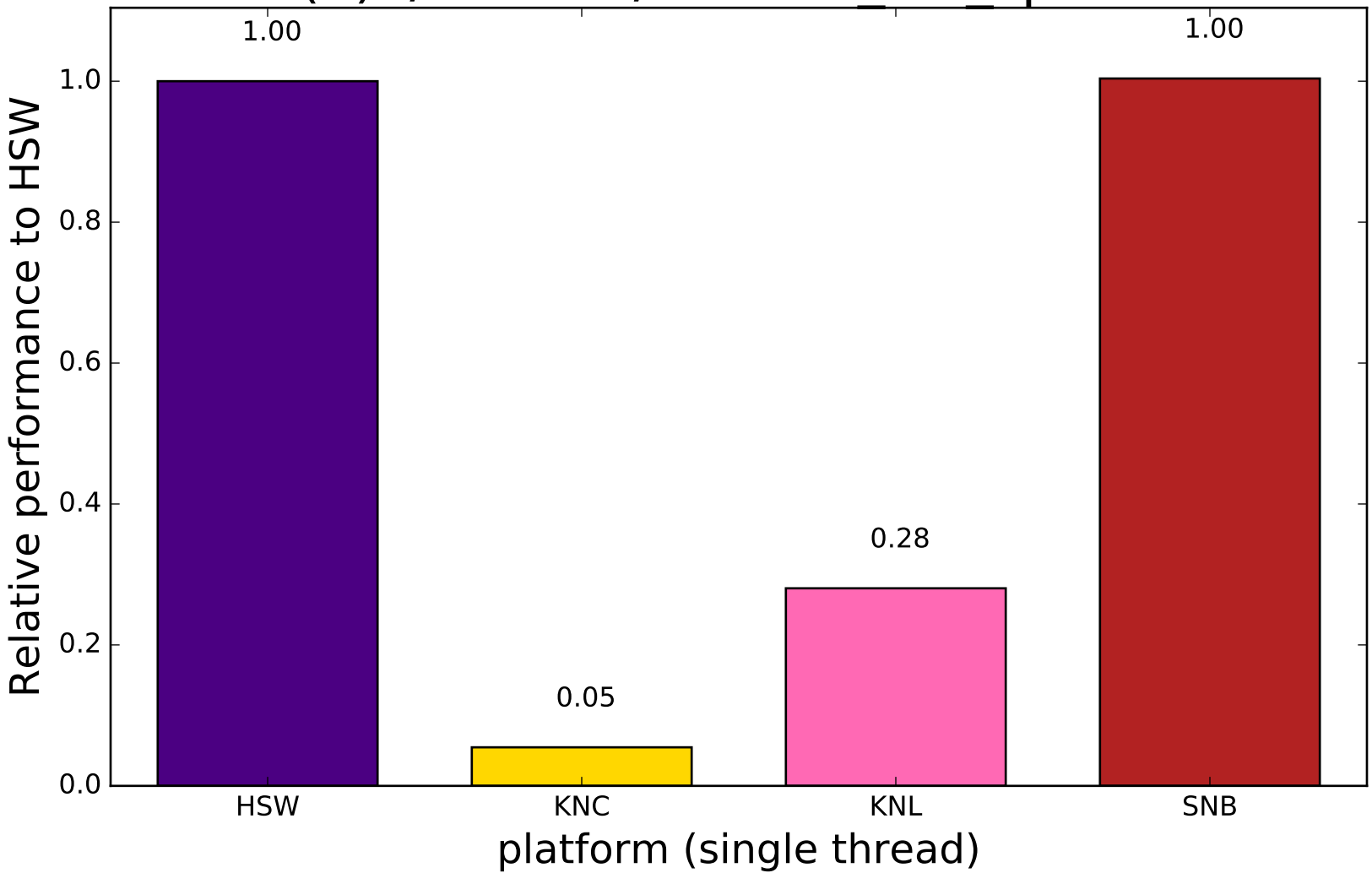

(0) ./advance_clubb_core
Relative performance to HSW
platform (single thread)
1.00
0.07
0.28
0.76
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

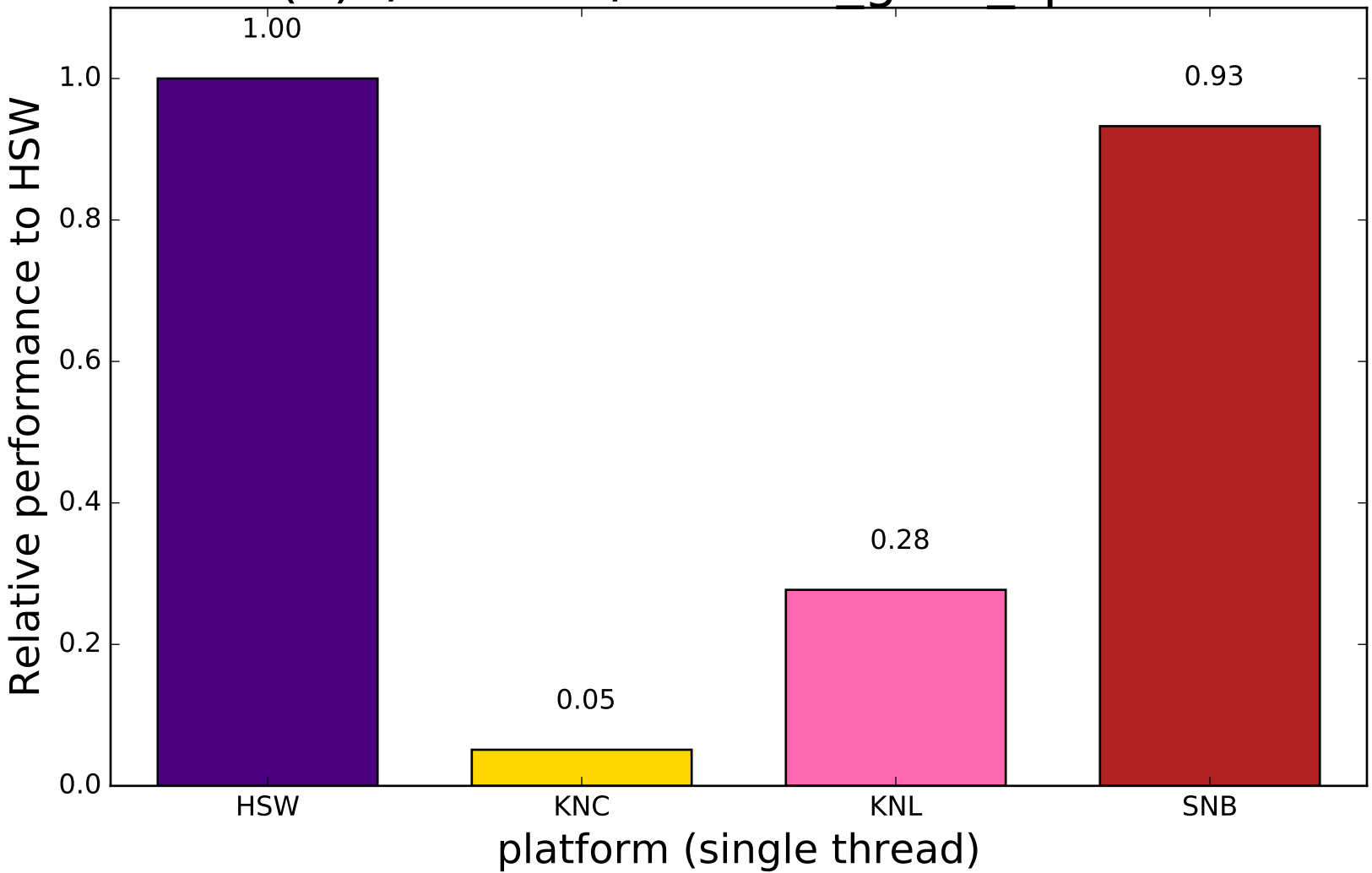

(1) ./CLUBB_adv_clubb_core/kernel
Relative performance to HSW
1.00
0.75
0.26
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

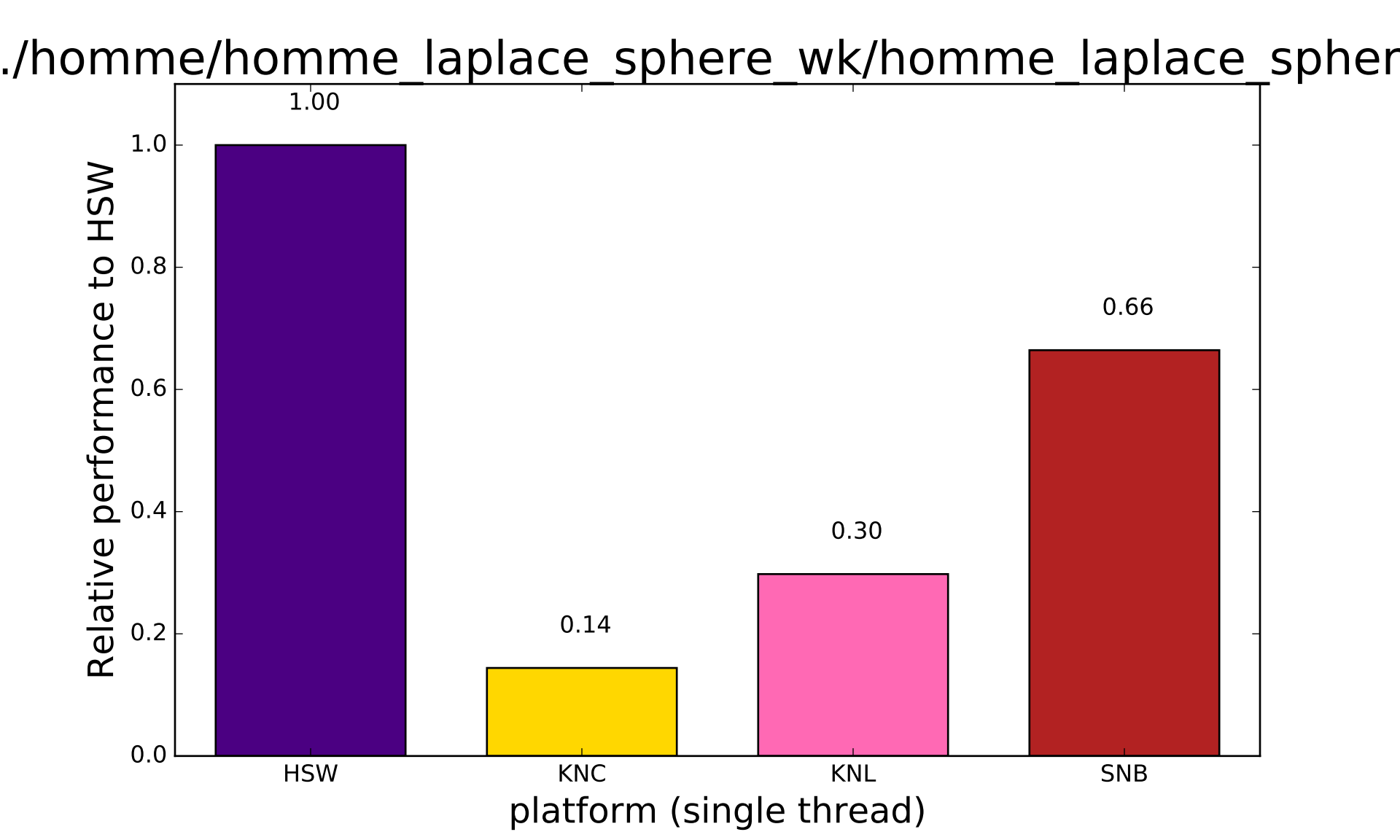

(2) ./CLUBB_adv_windm_edsclrm/kernel
Relative performance to HSW
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1.00
0.30
1.12
HSW
KNC
KNL
SNB
platform (single thread)

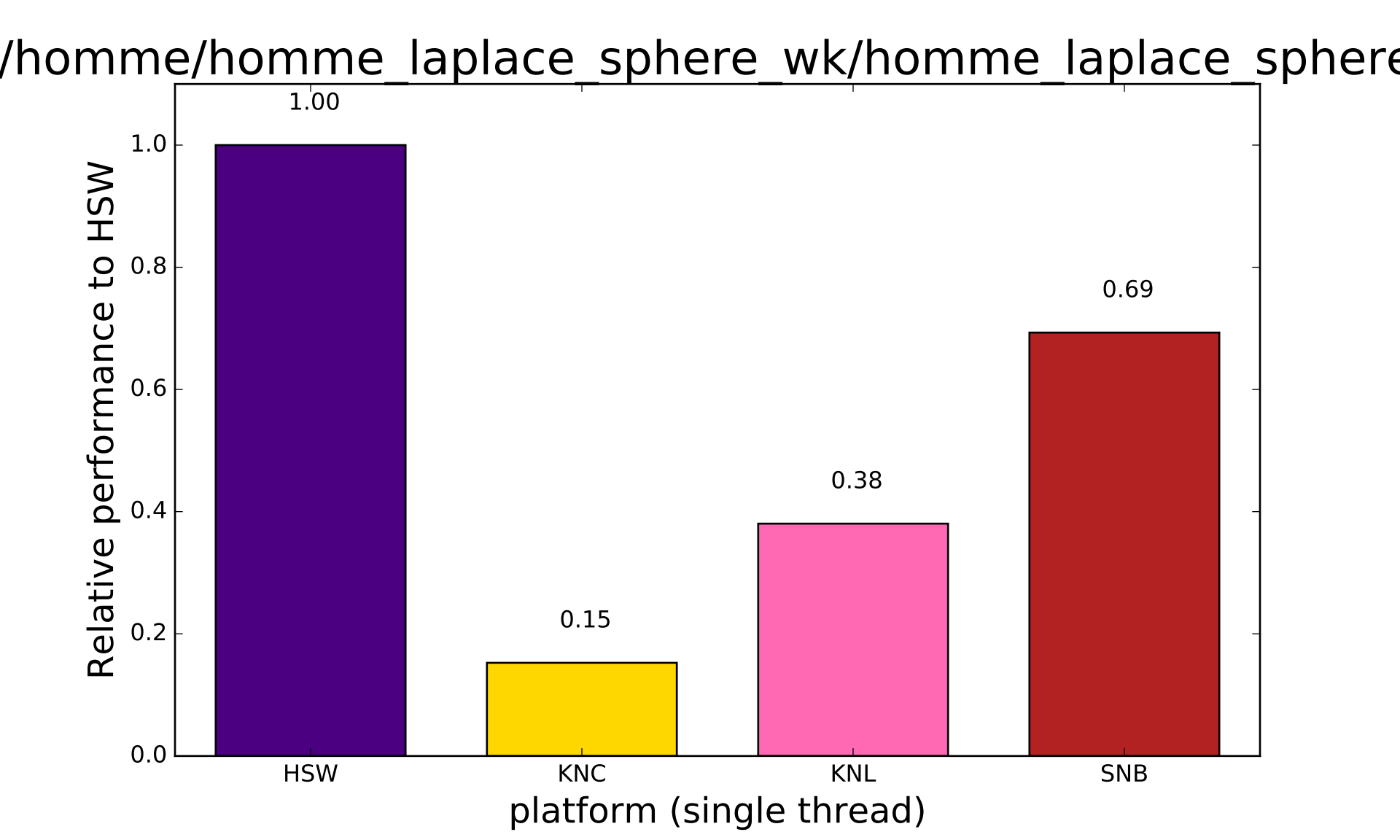

(3) ./CLUBB_pdf_closure/kernel
Relative performance to HSW
platform (single thread)
1.00
0.74
0.26
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB

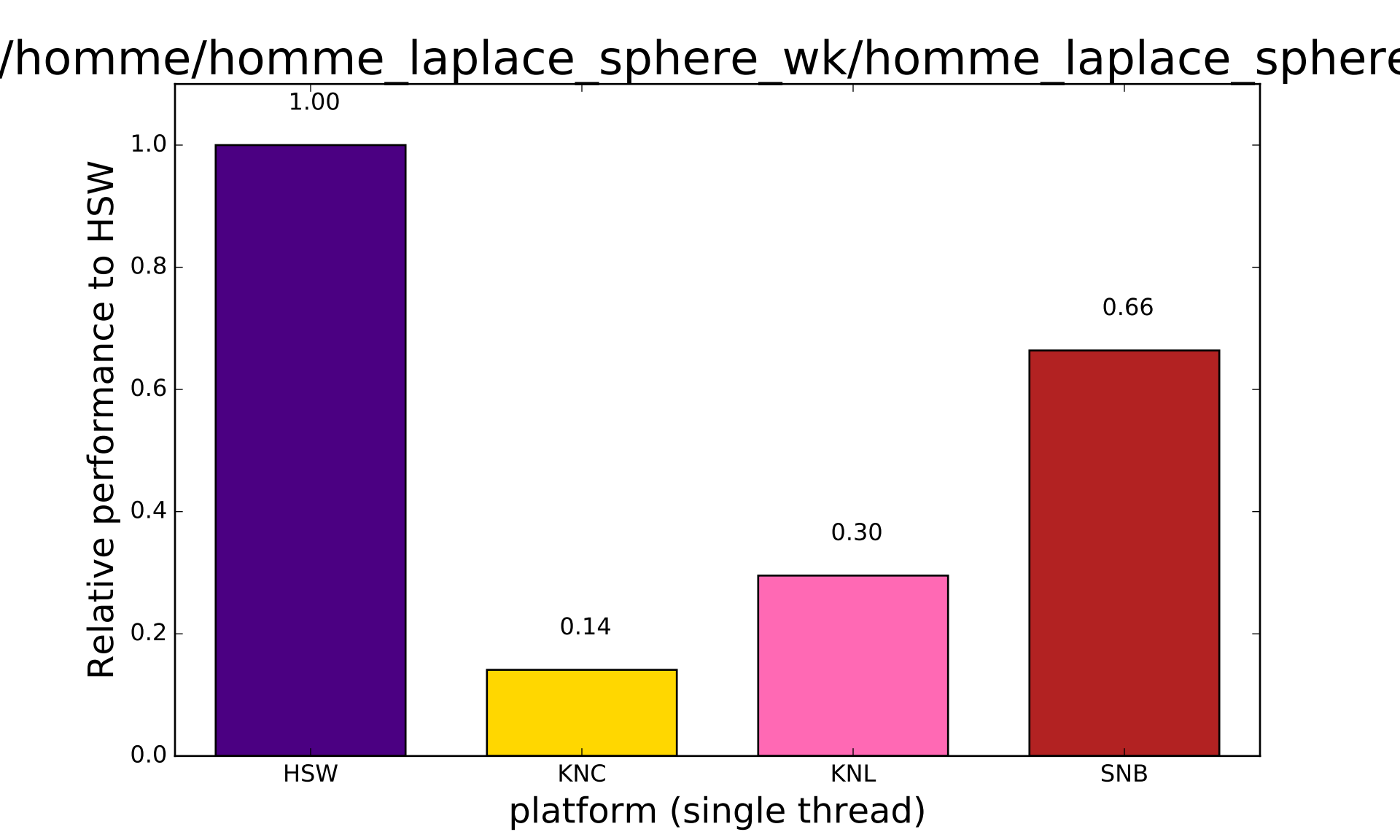

(4) ./CLUBB_pdf_closure_execution_part/kernel
Relative performance to HSW
1.00
0.69
0.25
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

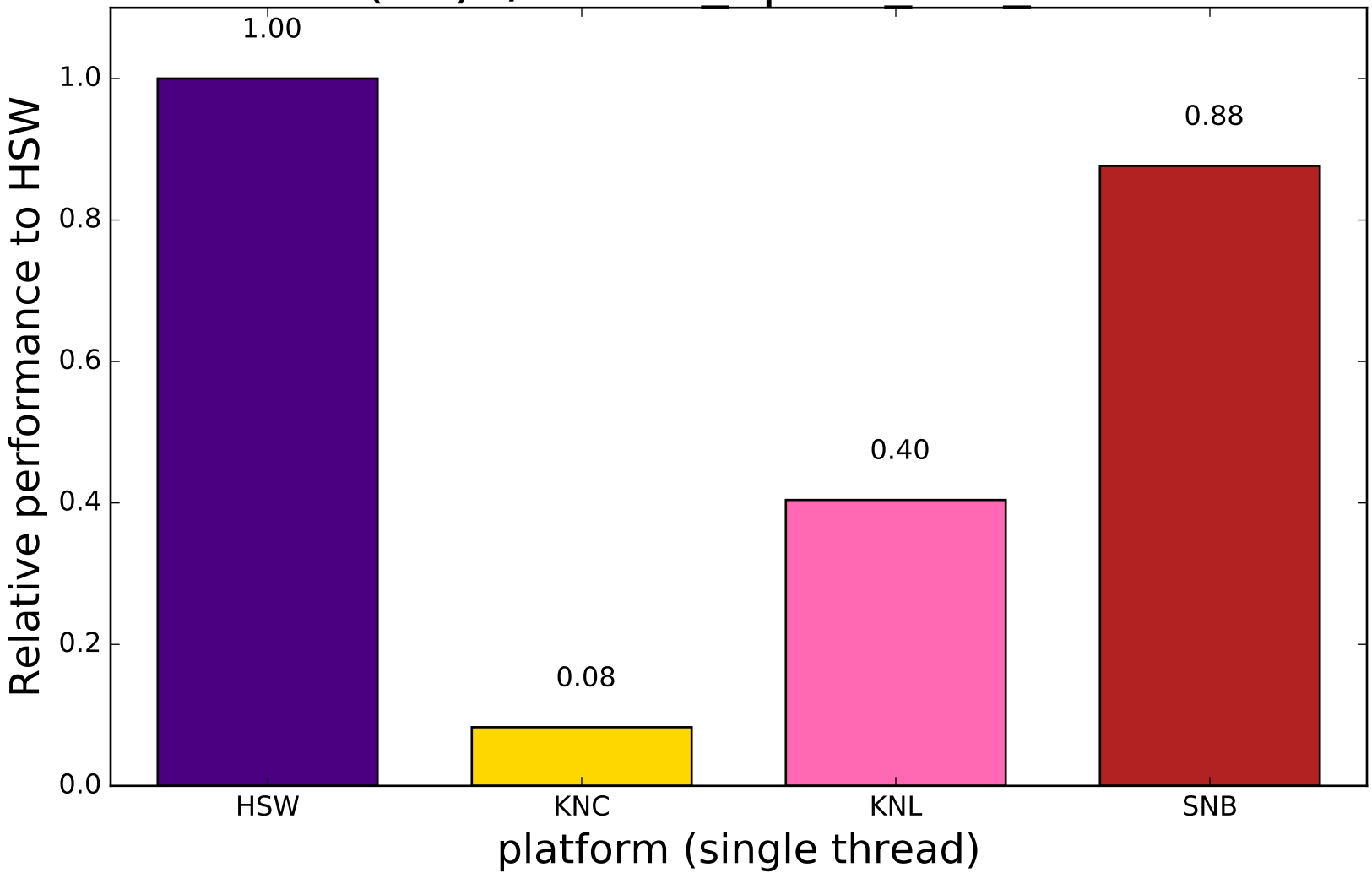

(5) ./homme/homme_div_sphere
Relative performance to HSW
platform (single thread)
1.00
1.00
0.28
0.05
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB

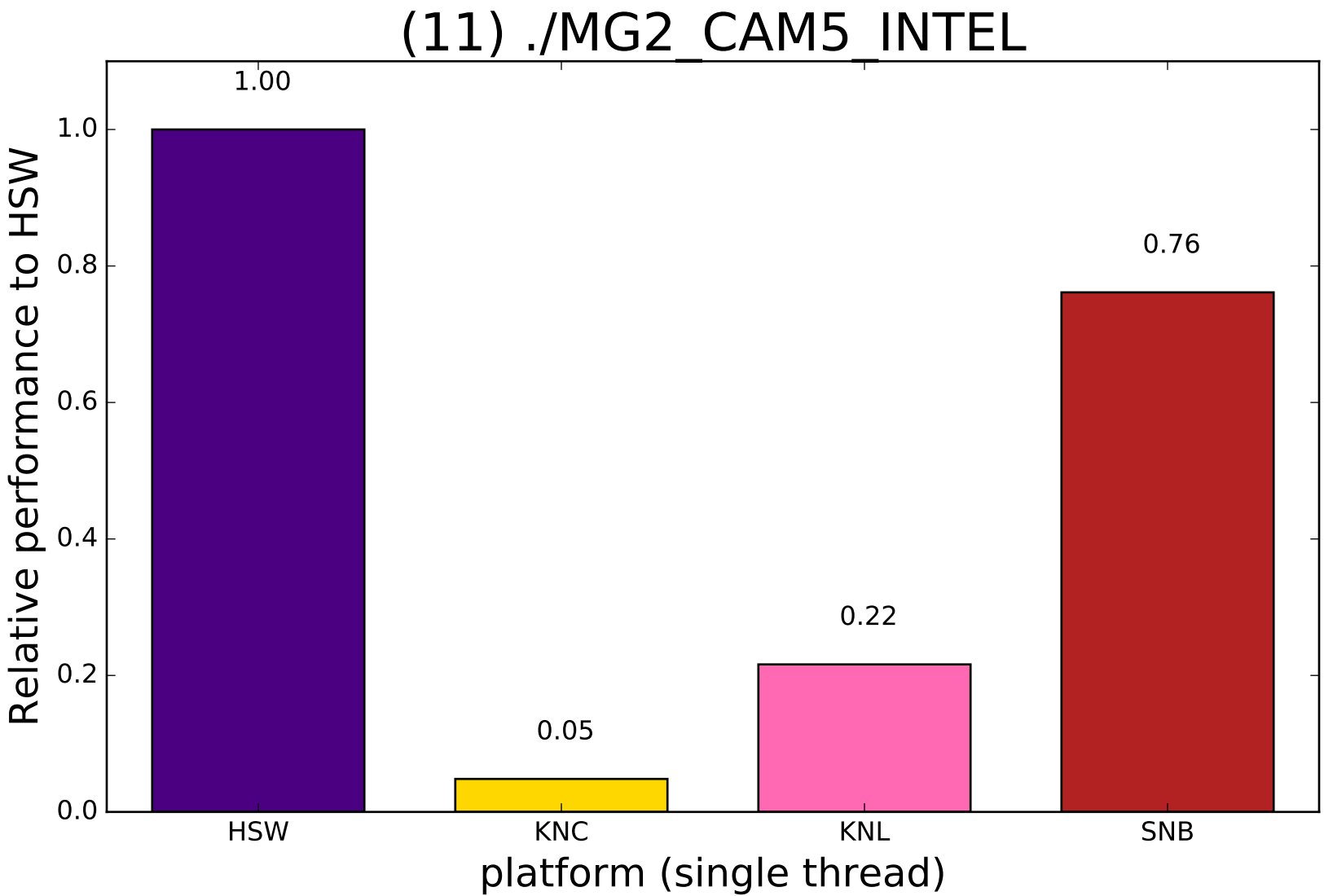

(6) ./homme/homme_grad_sphere
Relative performance to HSW
platform (single thread)
1.00
0.05
0.28
0.93
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

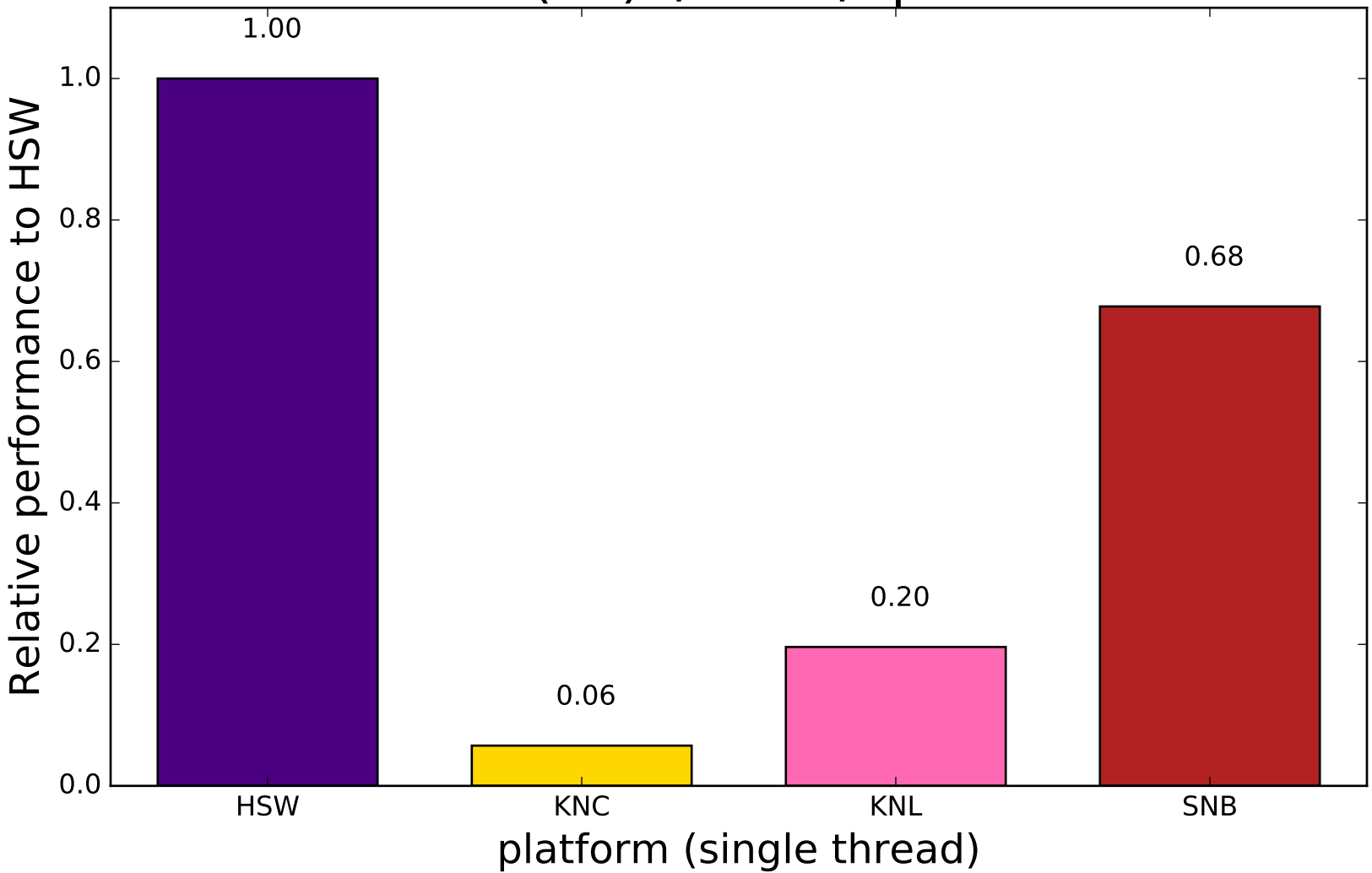

./homme/homme_laplace_sphere_wk/homme_laplace_spher
1.00
0.14
0.30
0.66
1.0
0.8
0.6
0.4
0.2
0.0
Relative performance to HSW
HSW
KNC
KNL
SNB
platform (single thread)

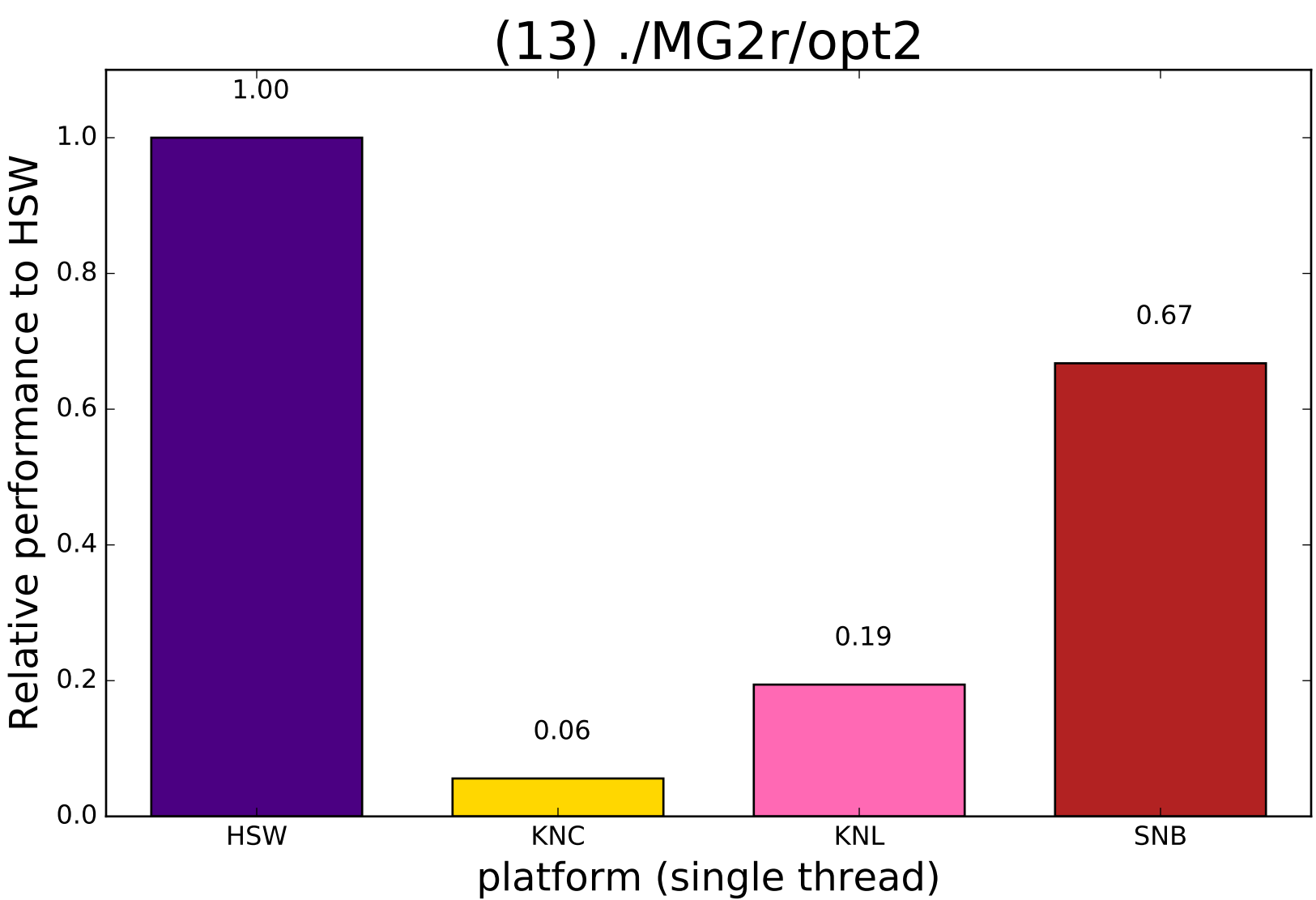

/homme/homme_laplace_sphere_wk/homme_laplace_sphere
Relative performance to HSW
platform (single thread)
HSW
KNC
KNL
SNB
1.00
0.15
0.38
0.69
0.0
0.2
0.4
0.6
0.8
1.0

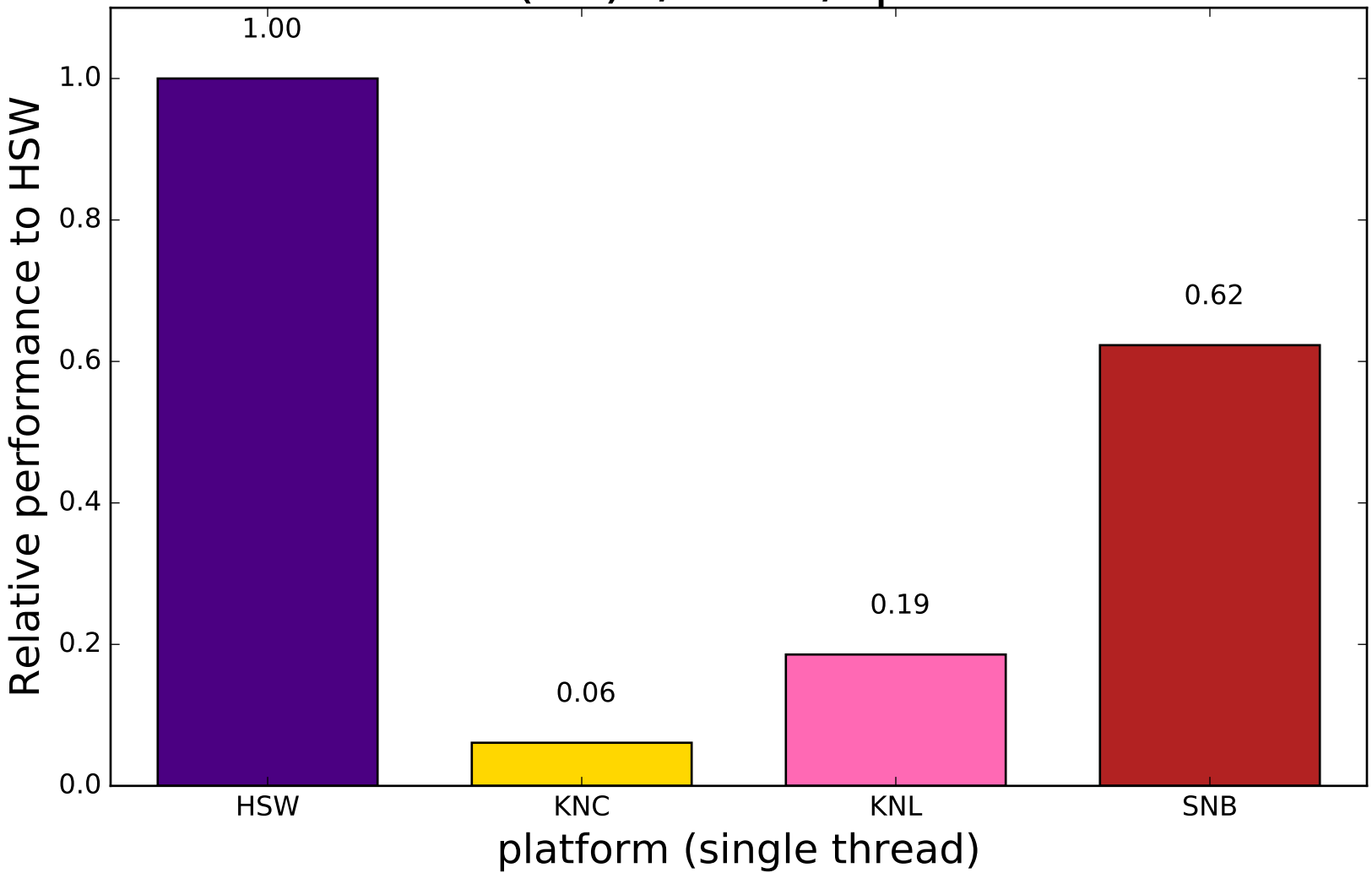

/homme/homme_laplace_sphere_wk/homme_laplace_sphere
1.00
0.14
0.30
0.66
1.0
0.8
0.6
0.4
0.2
0.0
Relative performance to HSW
HSW
KNC
KNL
SNB
platform (single thread)

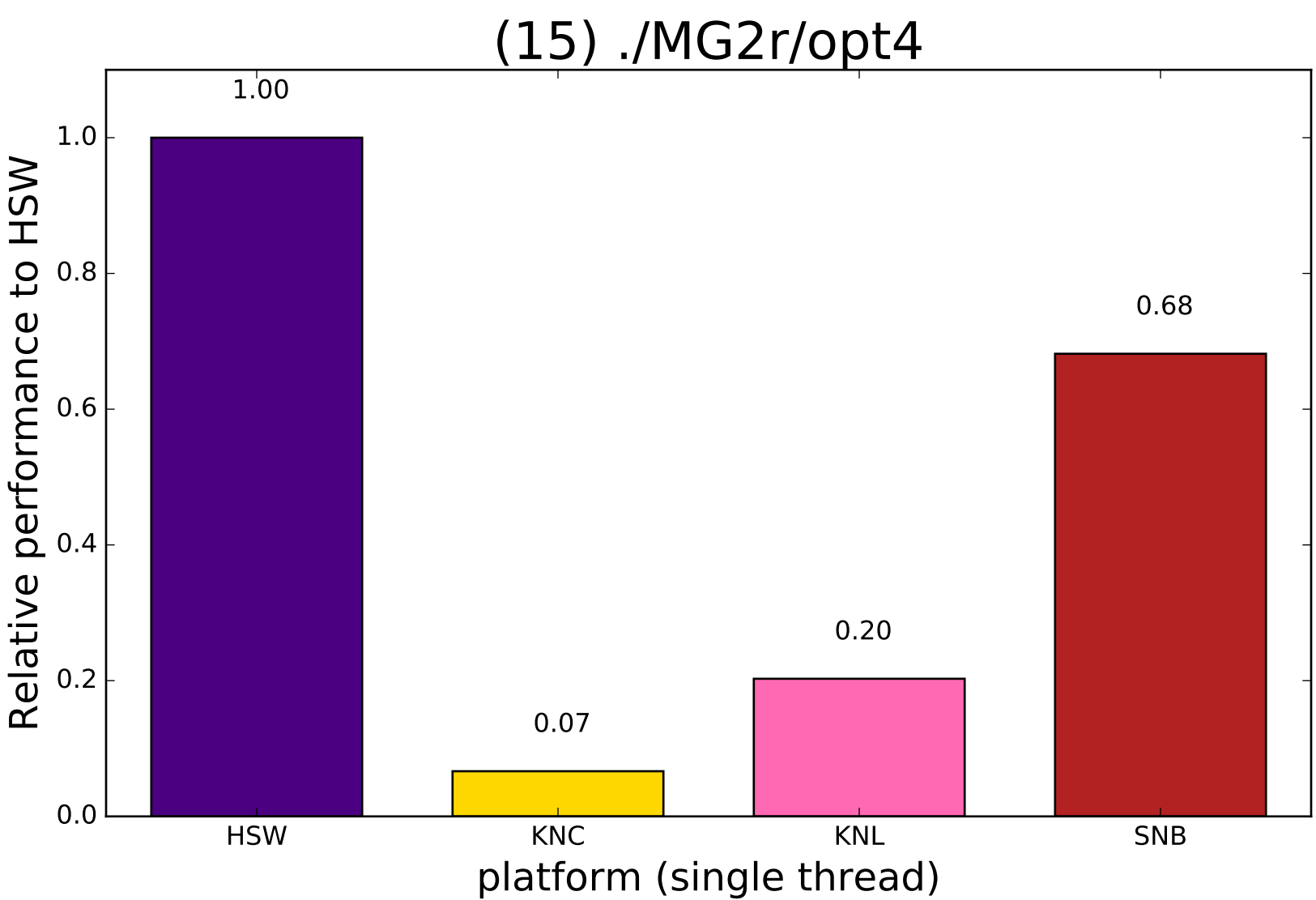

(10) ./limiter_optim_iter_full
Relative performance to HSW
platform (single thread)
1.00
0.08
0.40
0.88
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

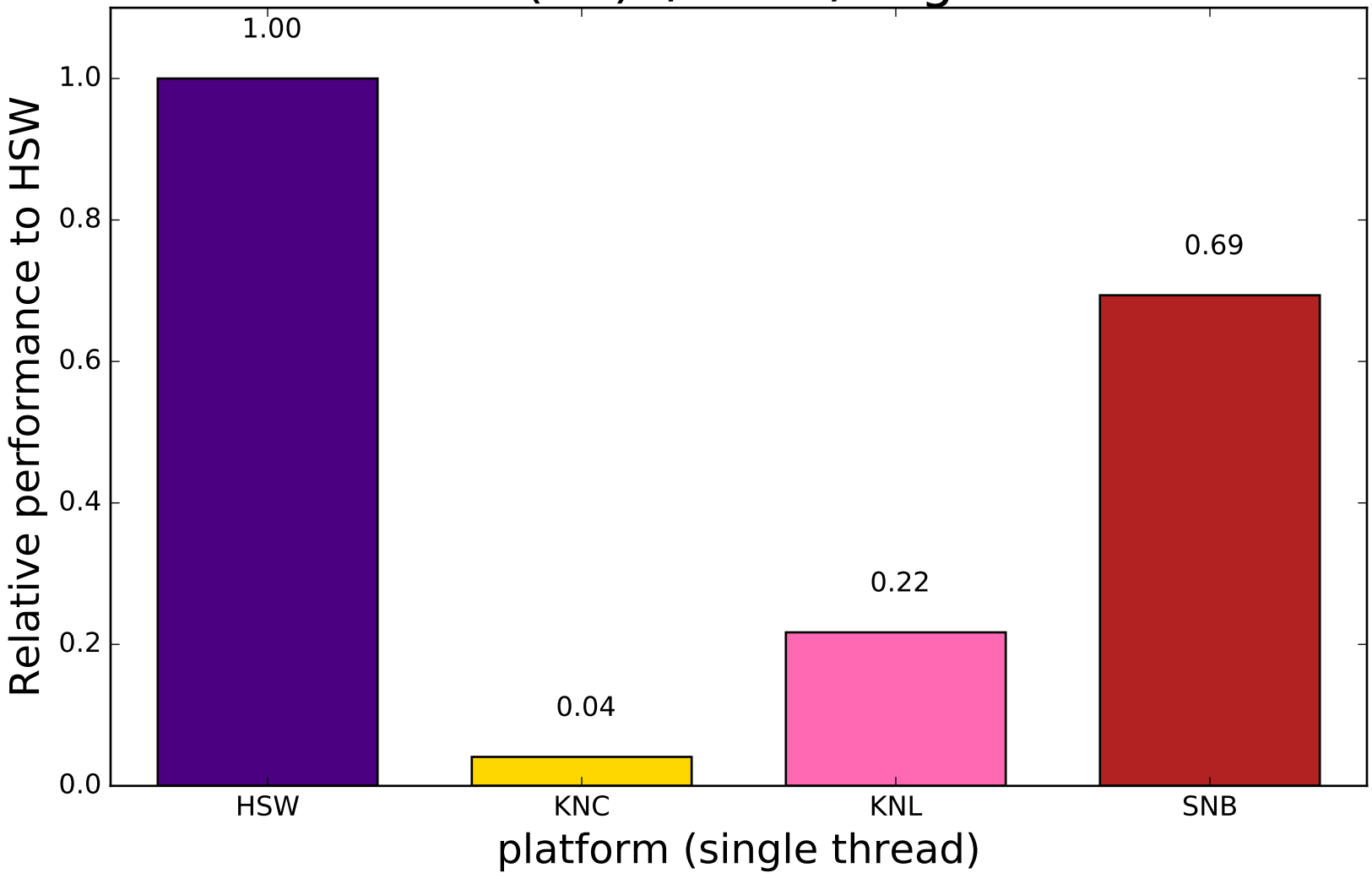

(11) ./MG2_CAM5_INTEL
Relative performance to HSW
platform (single thread)
1.00
0.05
0.22
0.76
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

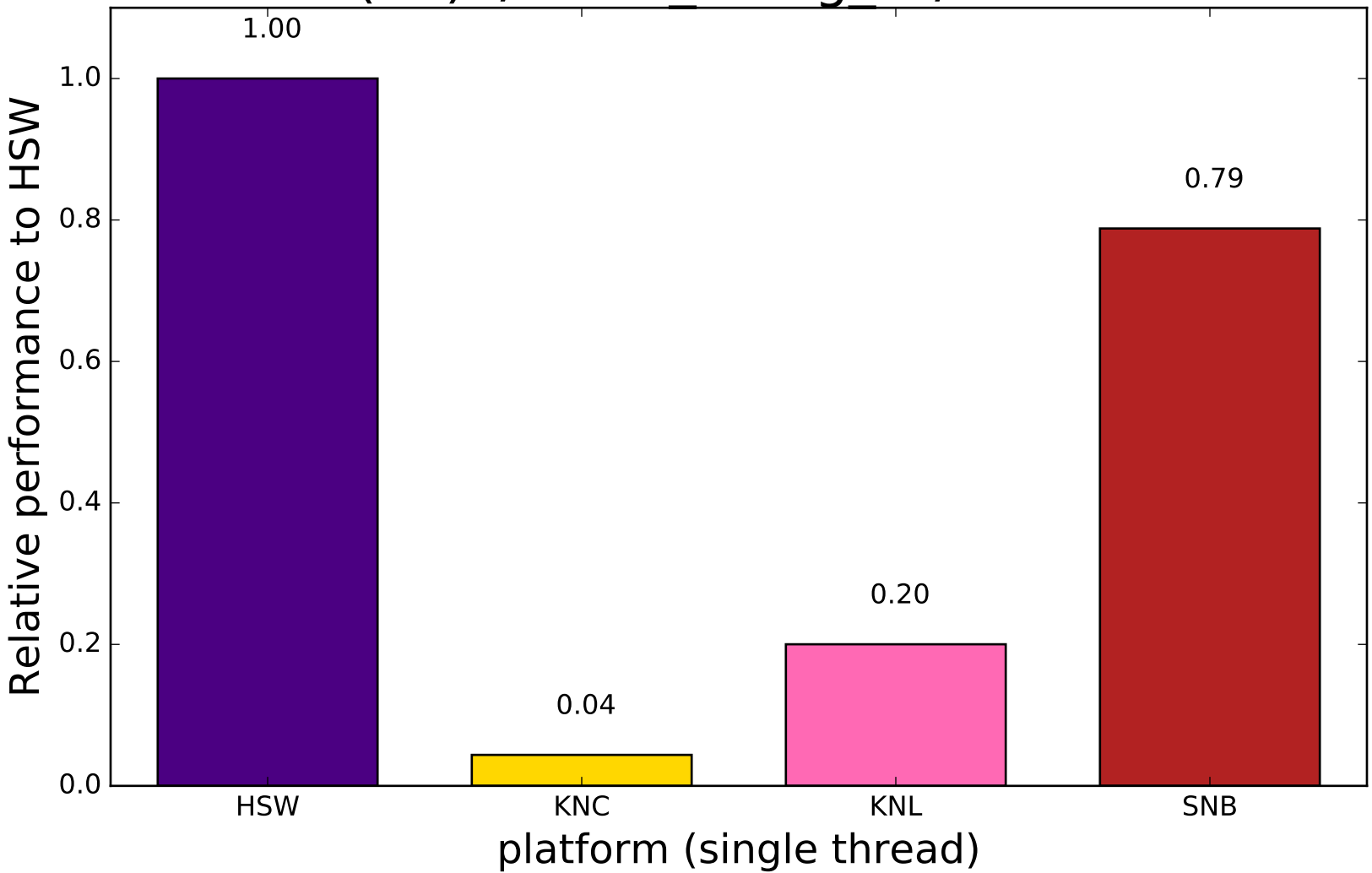

(12) ./MG2r/opt
Relative performance to HSW
1.00
0.06
0.20
0.68
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

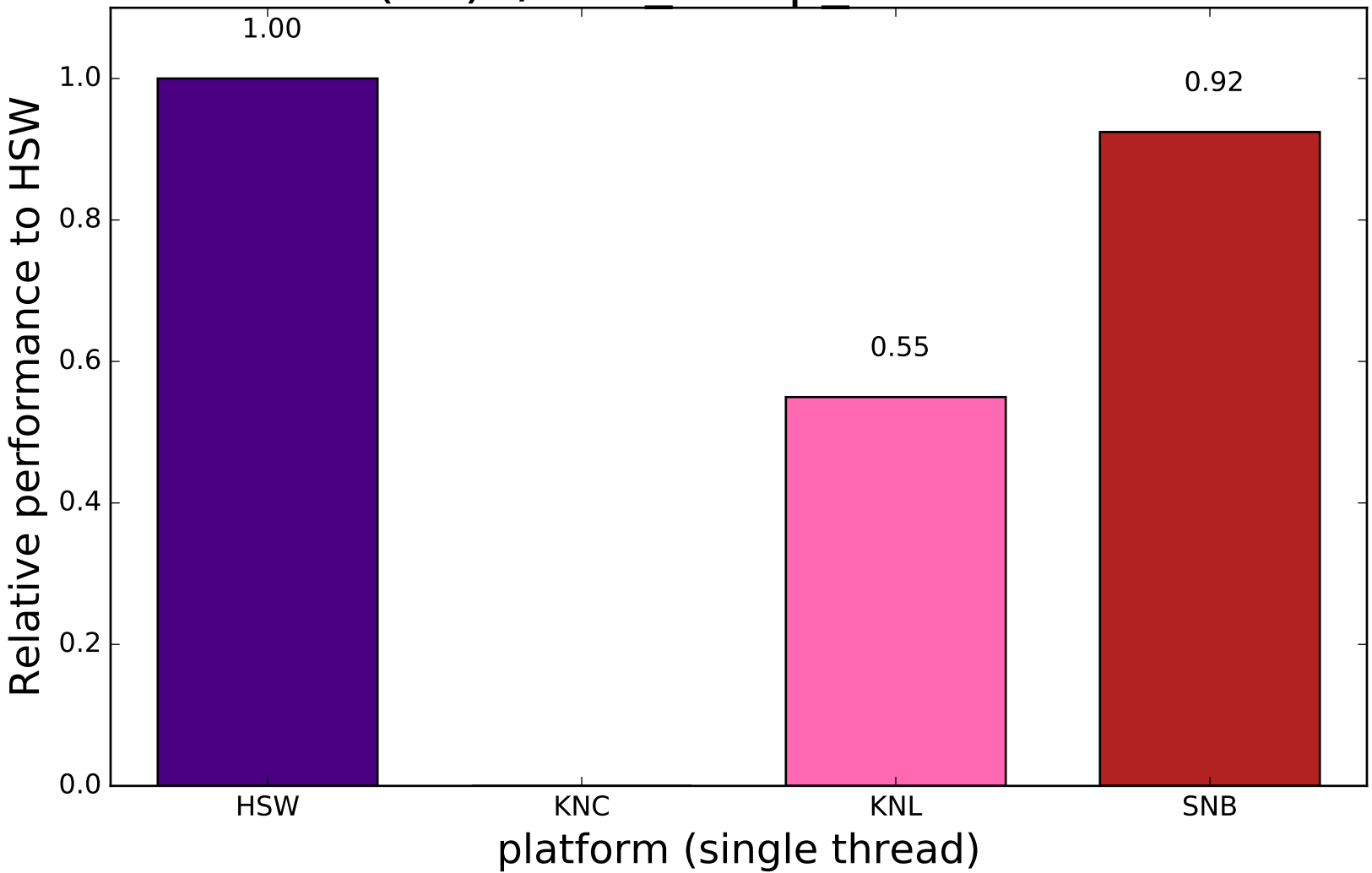

(13) ./MG2r/opt2
Relative performance to HSW
platform (single thread)
1.00
0.06
0.19
0.67
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB

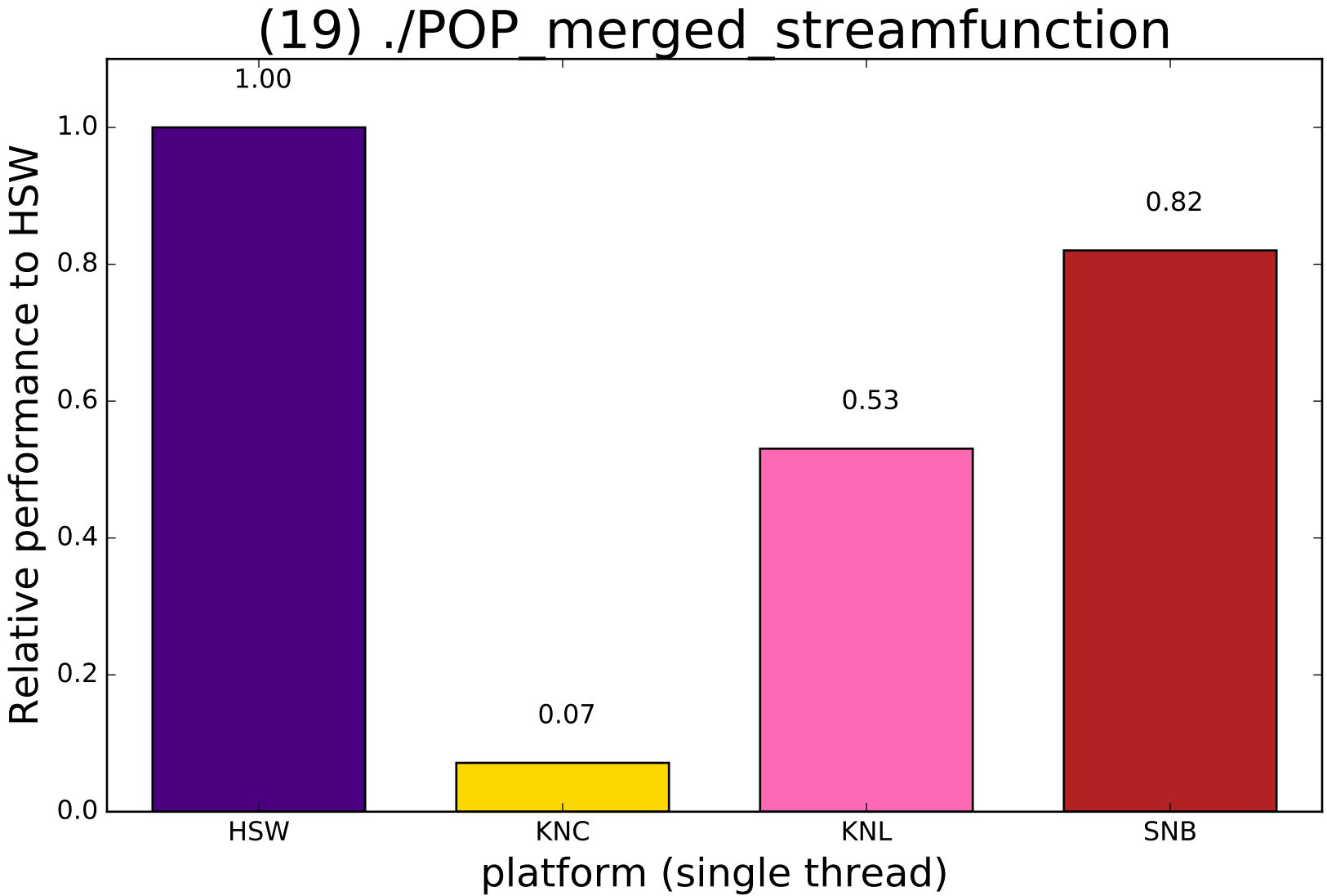

(14) ./MG2r/opt3
Relative performance to HSW
1.00
0.06
0.19
0.62
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

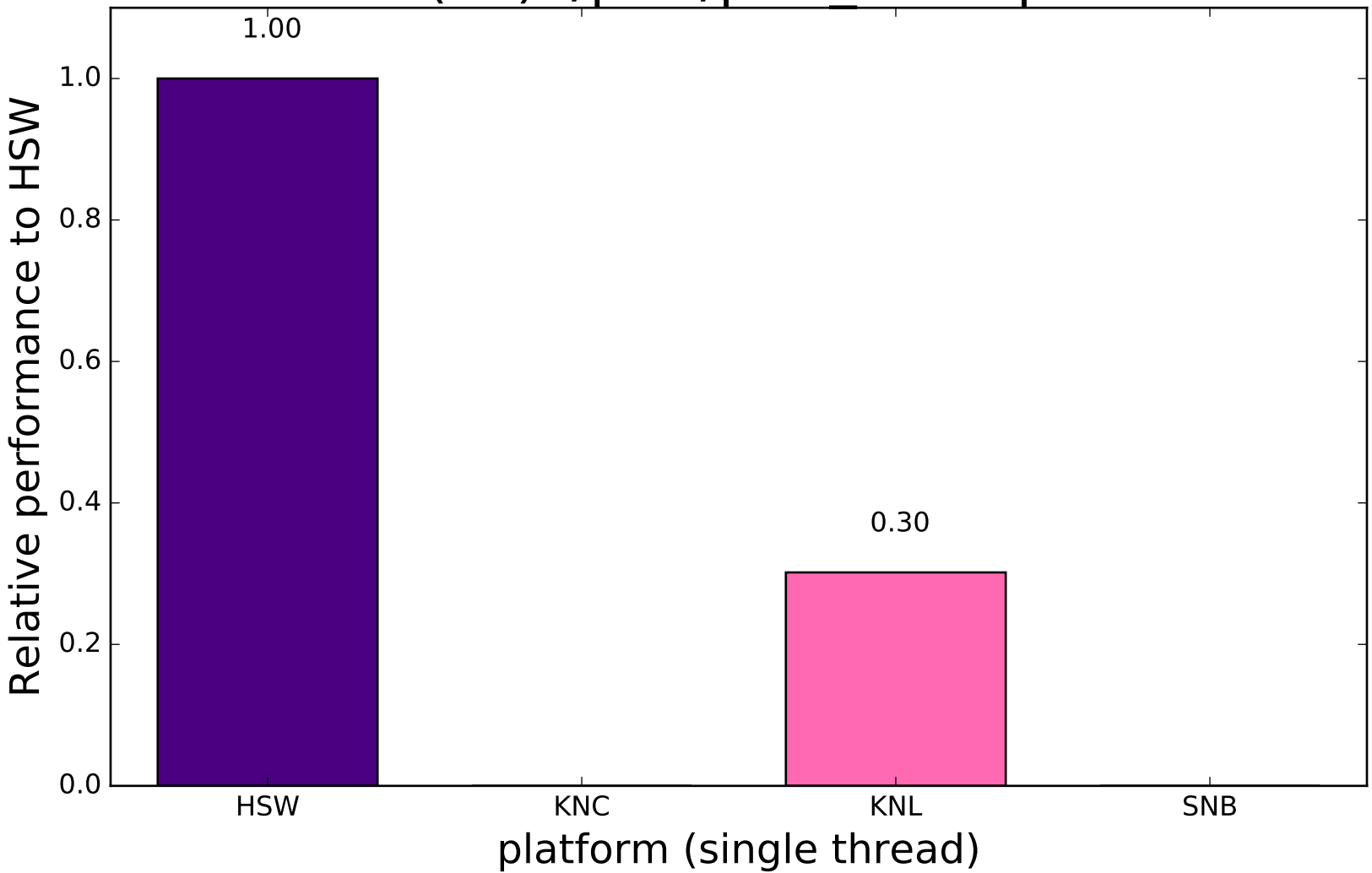

(15) ./MG2r/opt4
Relative performance to HSW
1.00
0.07
0.20
0.68
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

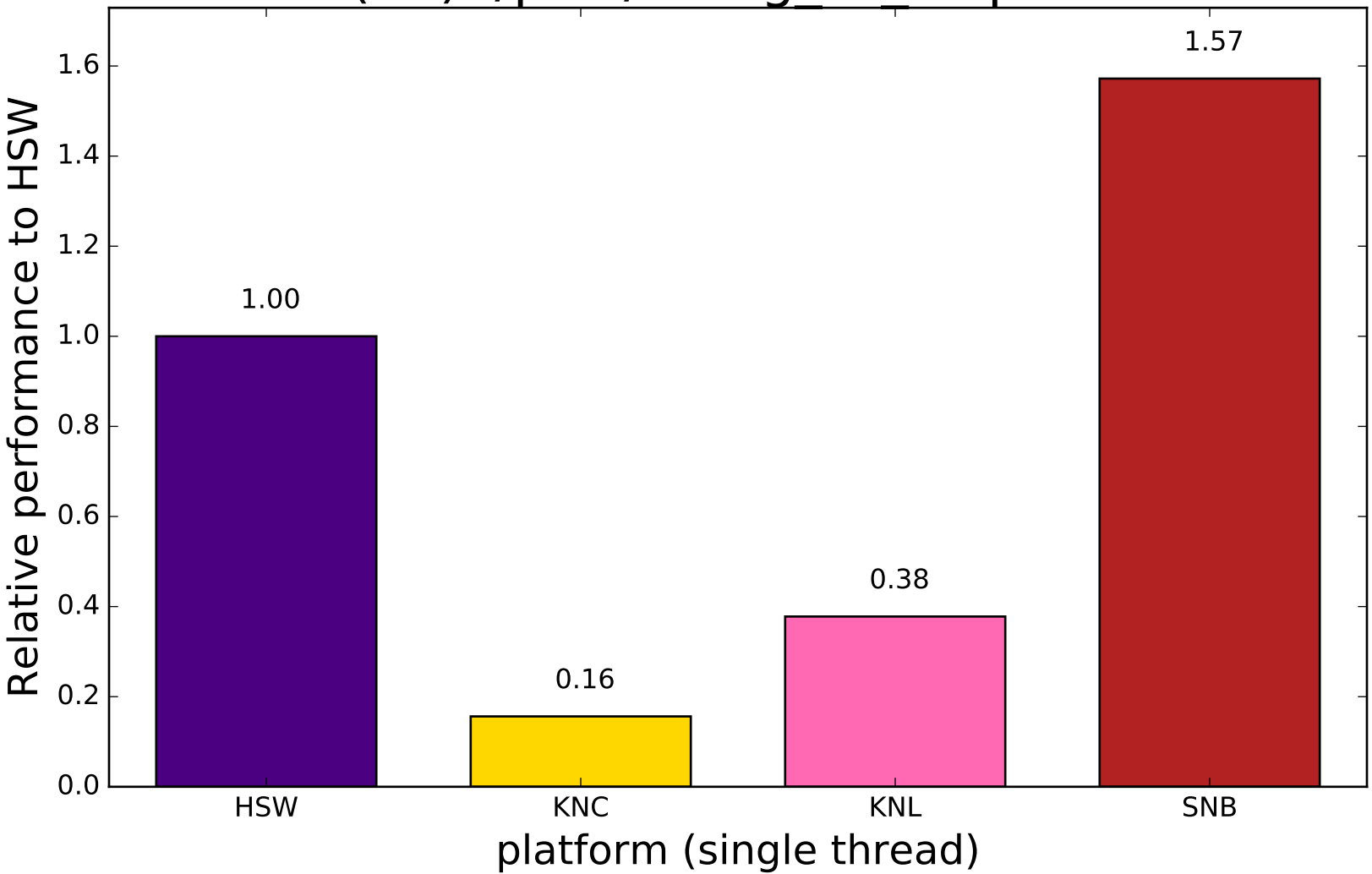

(16) ./MG2r/orig
Relative performance to HSW
1.00
0.04
0.22
0.69
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

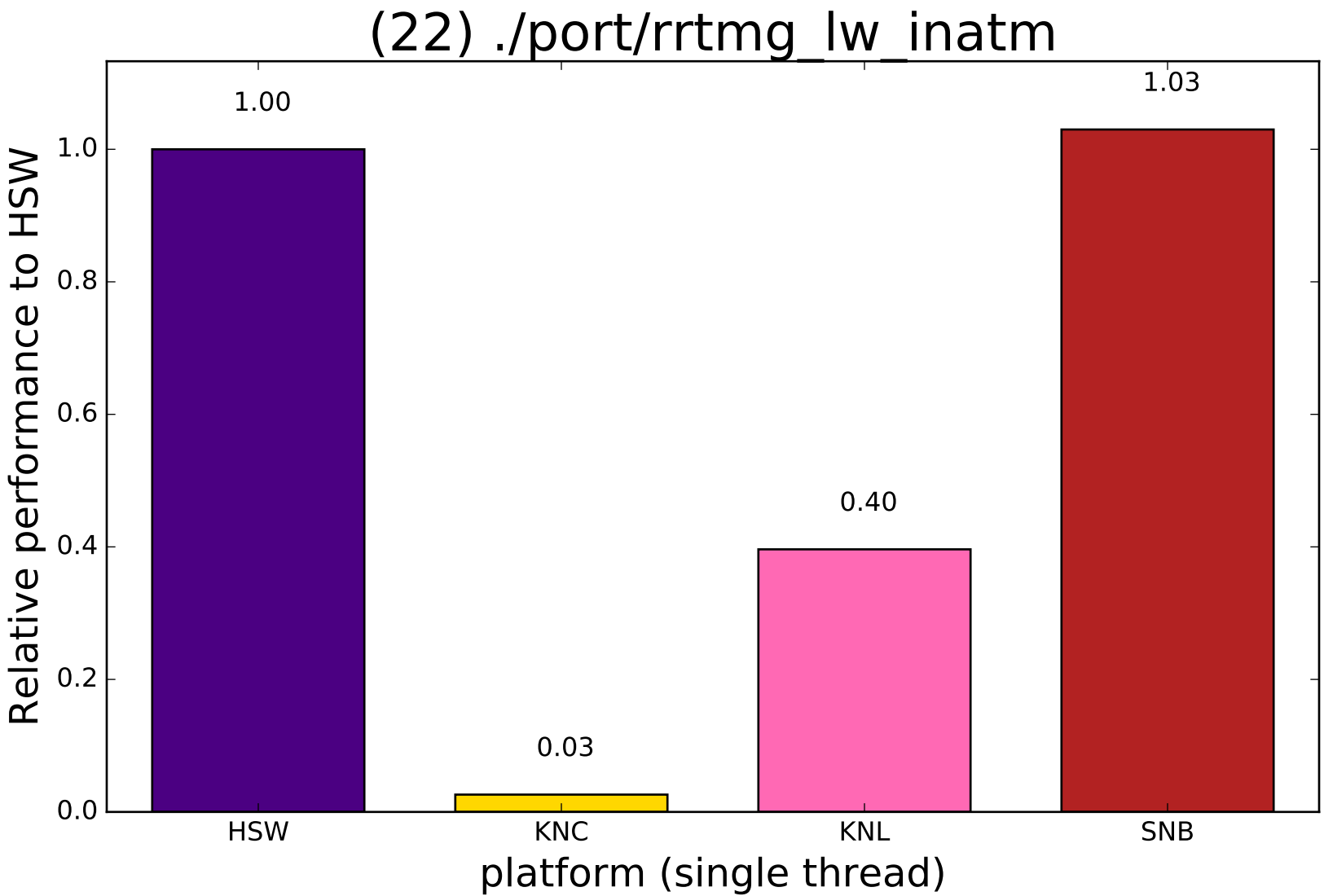

(17) ./MPAS_rrtmg_lw/kernel
Relative performance to HSW
platform (single thread)
1.00
0.04
0.20
0.79
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

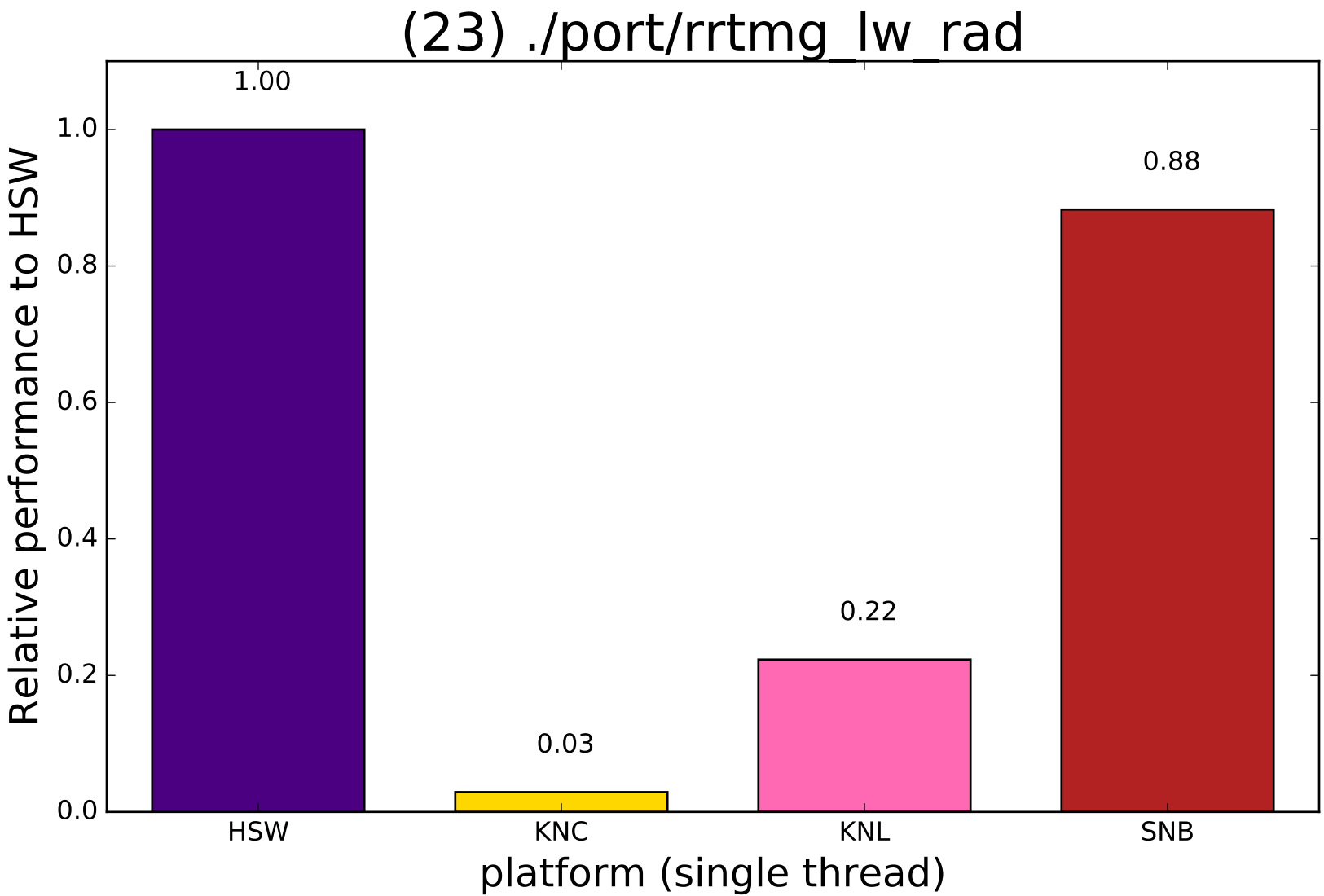

(18) ./POP_comp_co3terms
Relative performance to HSW
1.00
0.92
0.55
1.0
0.8
0.6
0.4
0.2
0.0
HSW
KNC
KNL
SNB
platform (single thread)

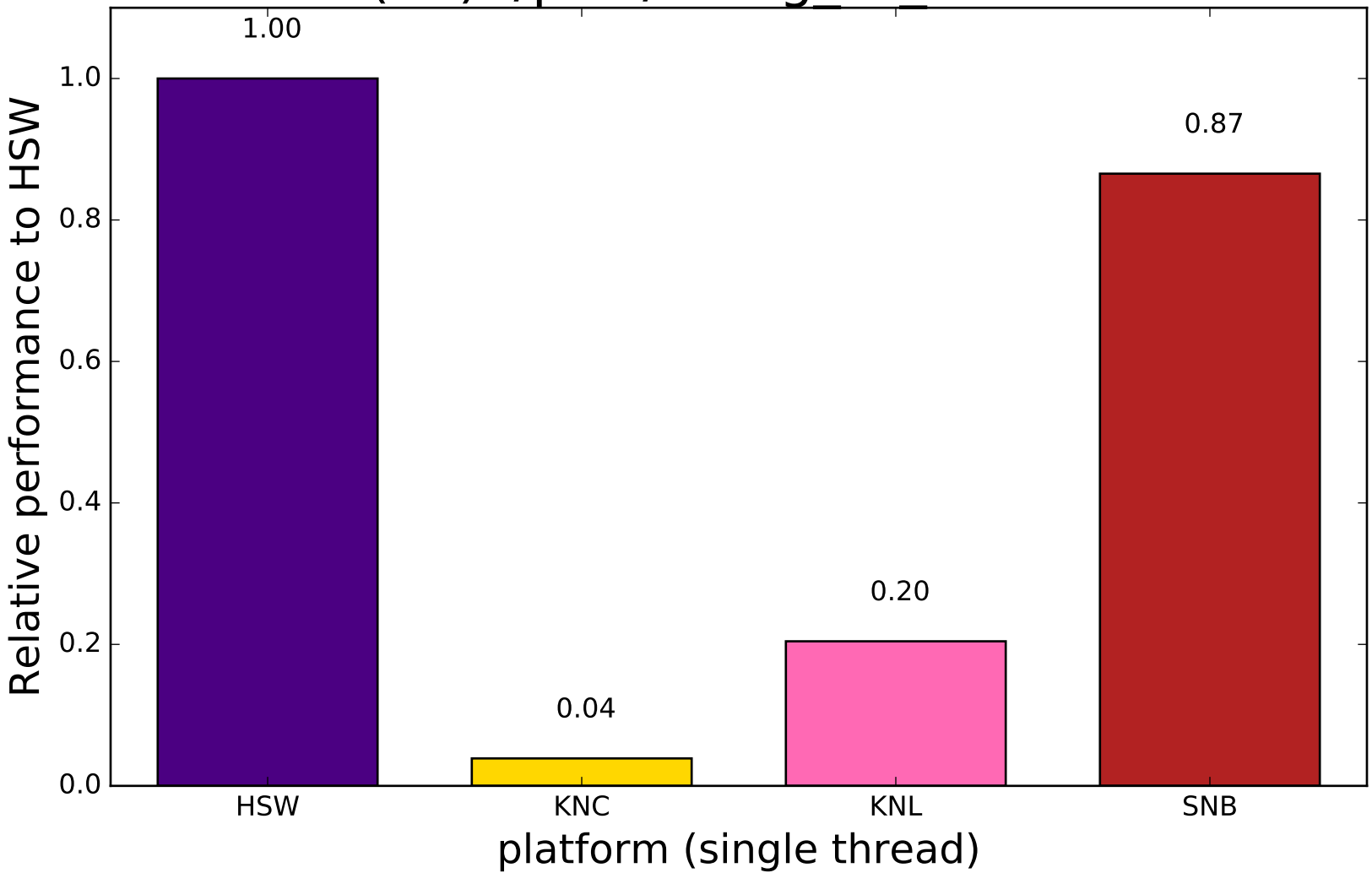

(19) ./POP_merged_streamfunction
Relative performance to HSW
1.0
0.8
0.6
0.4
0.2
0.0
1.00
0.07
0.53
0.82
HSW
KNC
KNL
SNB
platform (single thread)

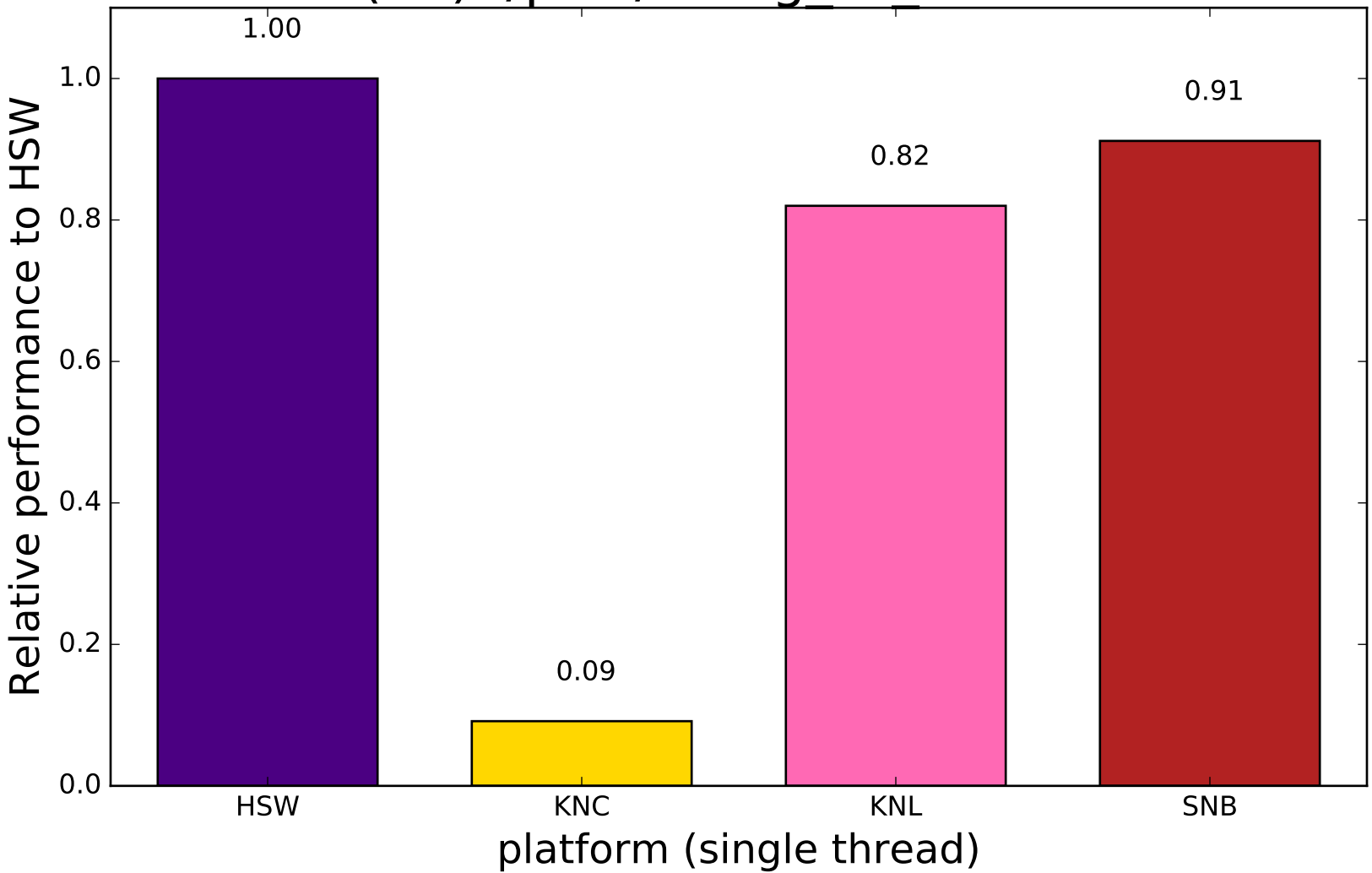

(20) ./port/port_binterp
1.00
0.30
Relative performance to HSW
1.0
0.8
0.6
0.4
0.2
0.0
HSW
KNC
KNL
SNB
platform (single thread)

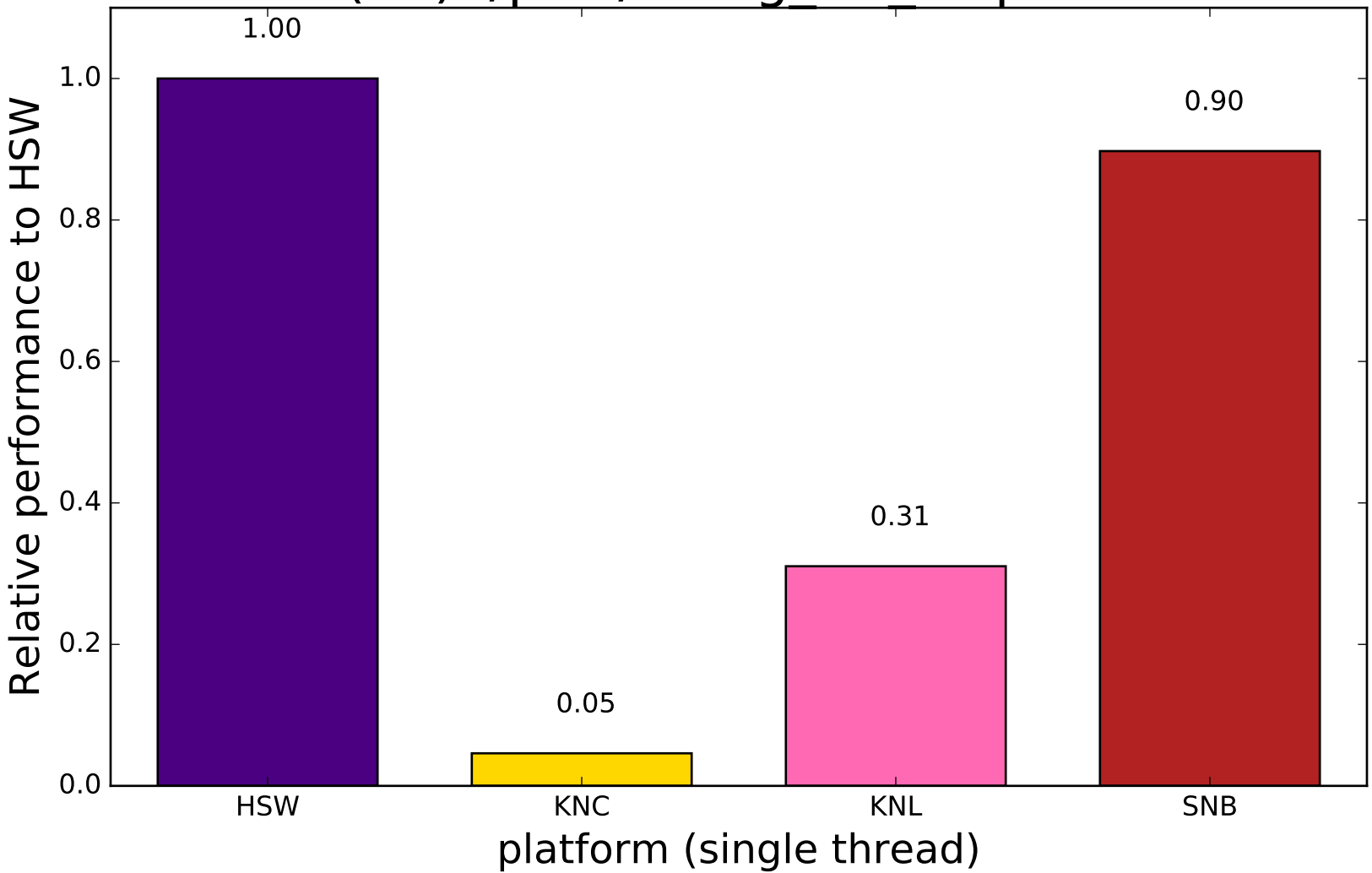

(21) ./port/rrtmg_lw_cldprmc
Relative performance to HSW
platform (single thread)
HSW
KNC
KNL
SNB
1.00
0.16
0.38
1.57
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6

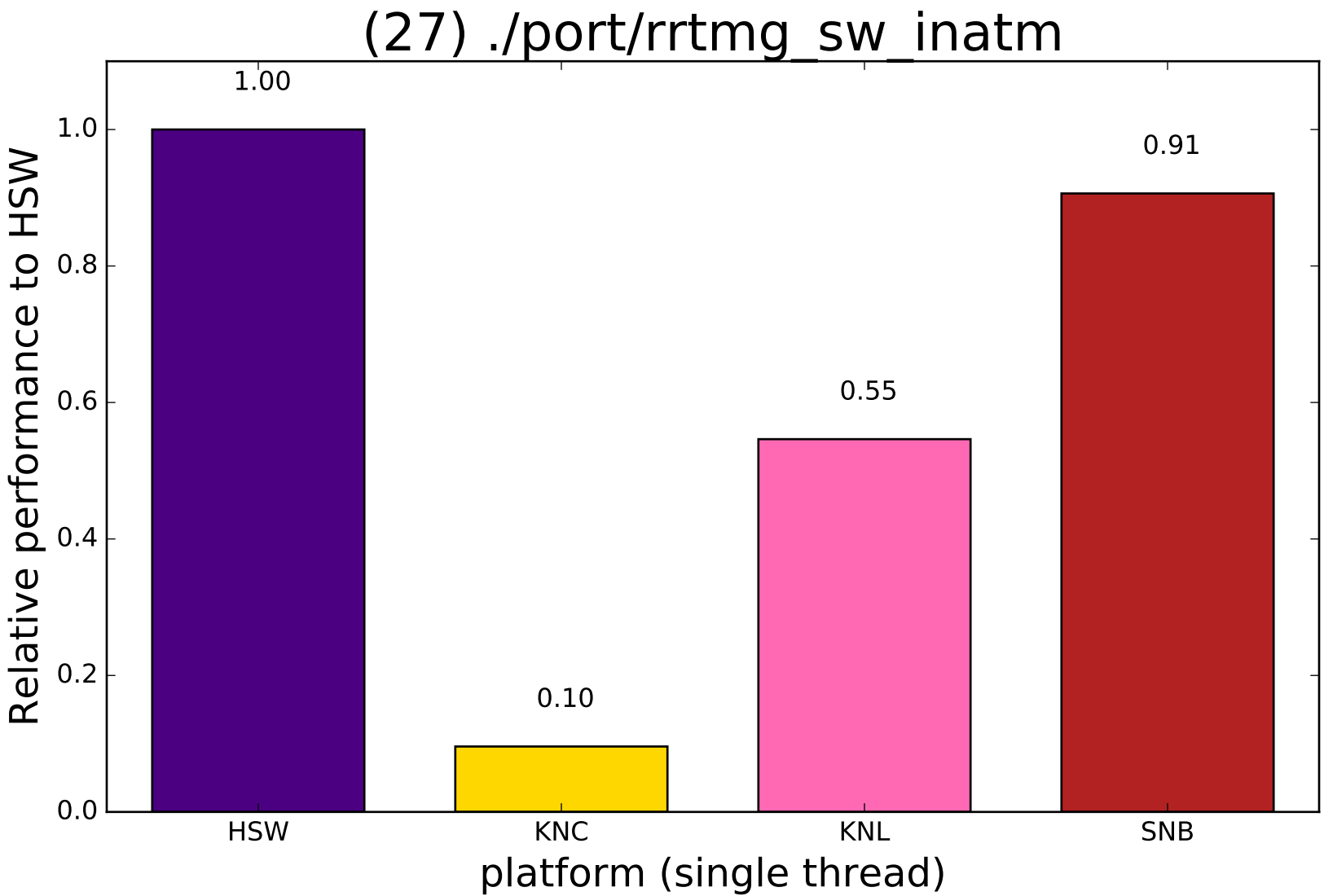

(22) ./port/rrtmg_lw_inatm
Relative performance to HSW
platform (single thread)
1.00
0.03
0.40
1.03
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

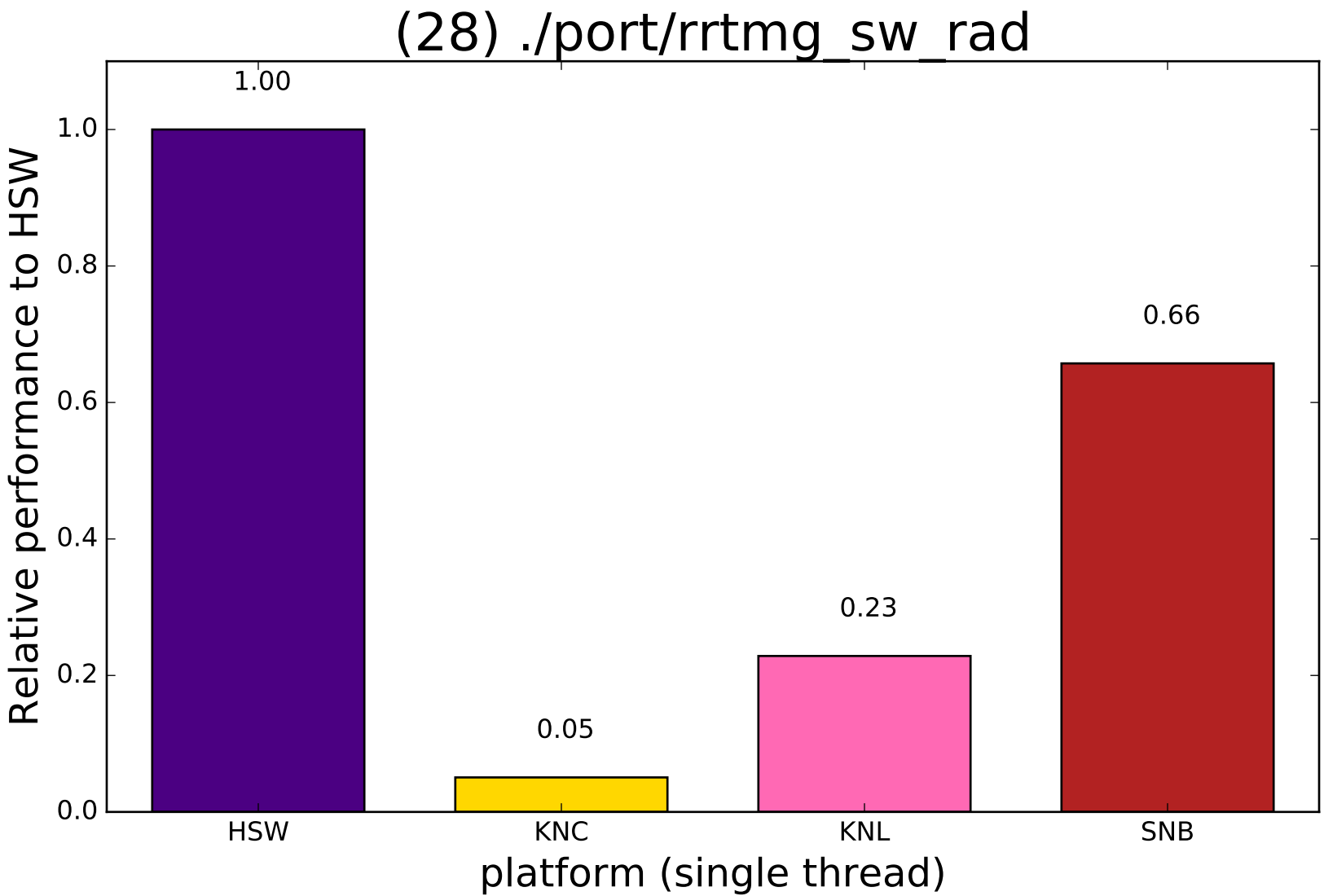

(23) ./port/rrtmg_lw_rad
Relative performance to HSW
platform (single thread)
1.00
0.03
0.22
0.88
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

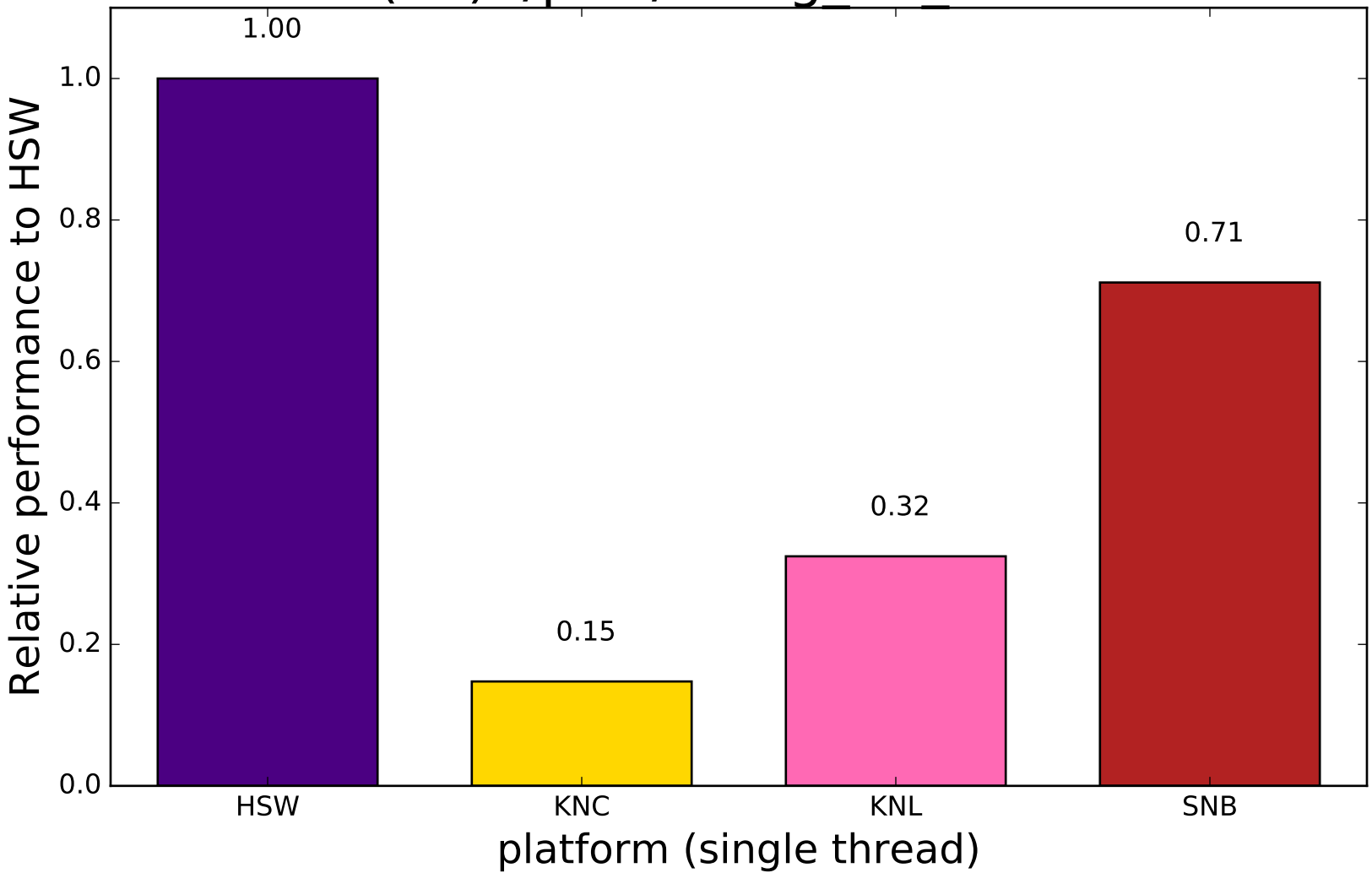

(24) ./port/rrtmg_lw_rtrnmc
Relative performance to HSW
platform (single thread)
1.00
0.04
0.20
0.87
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

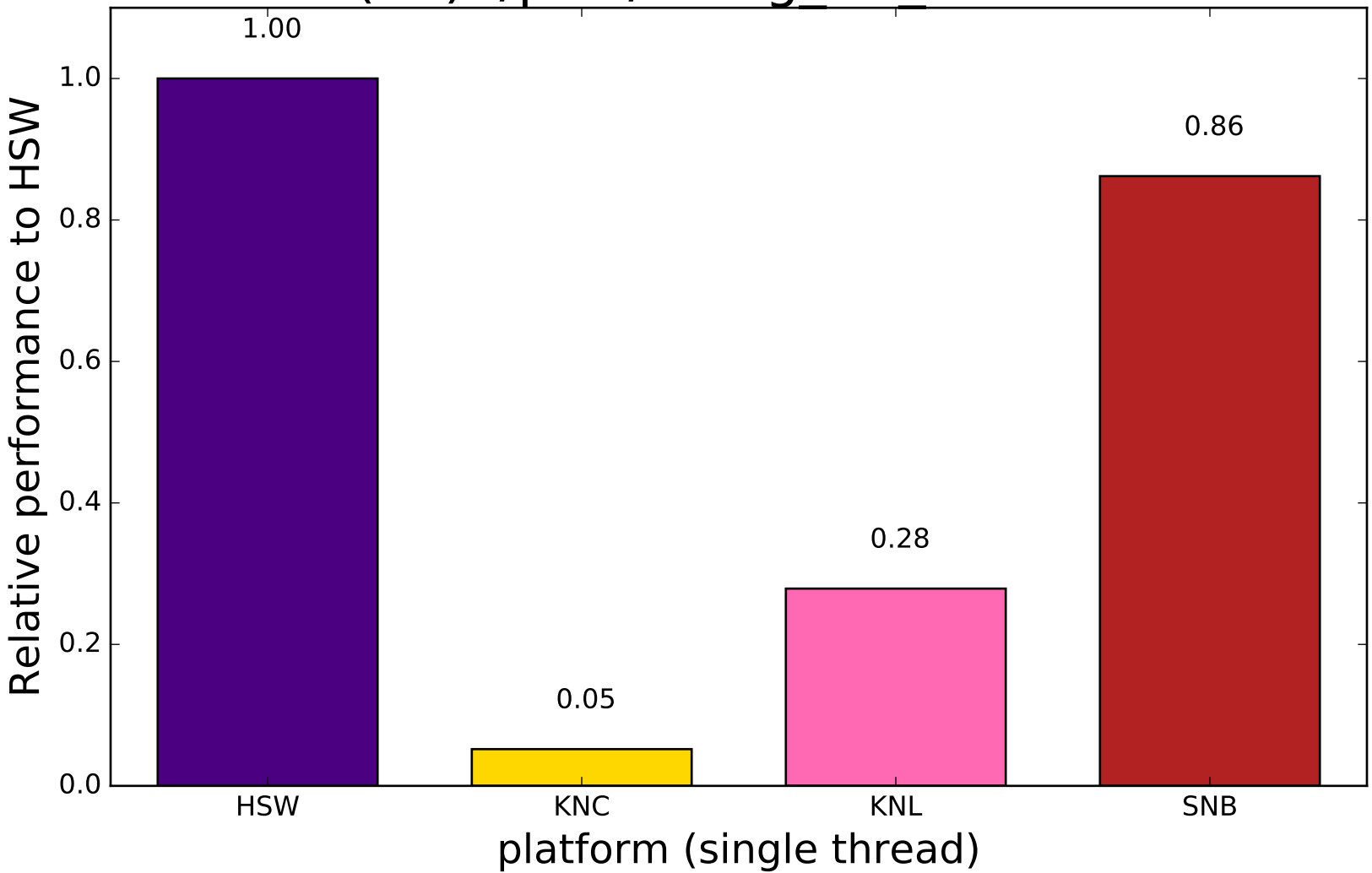

(25) ./port/rrtmg_lw_setcoef
Relative performance to HSW
platform (single thread)
1.00
0.09
0.82
0.91
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

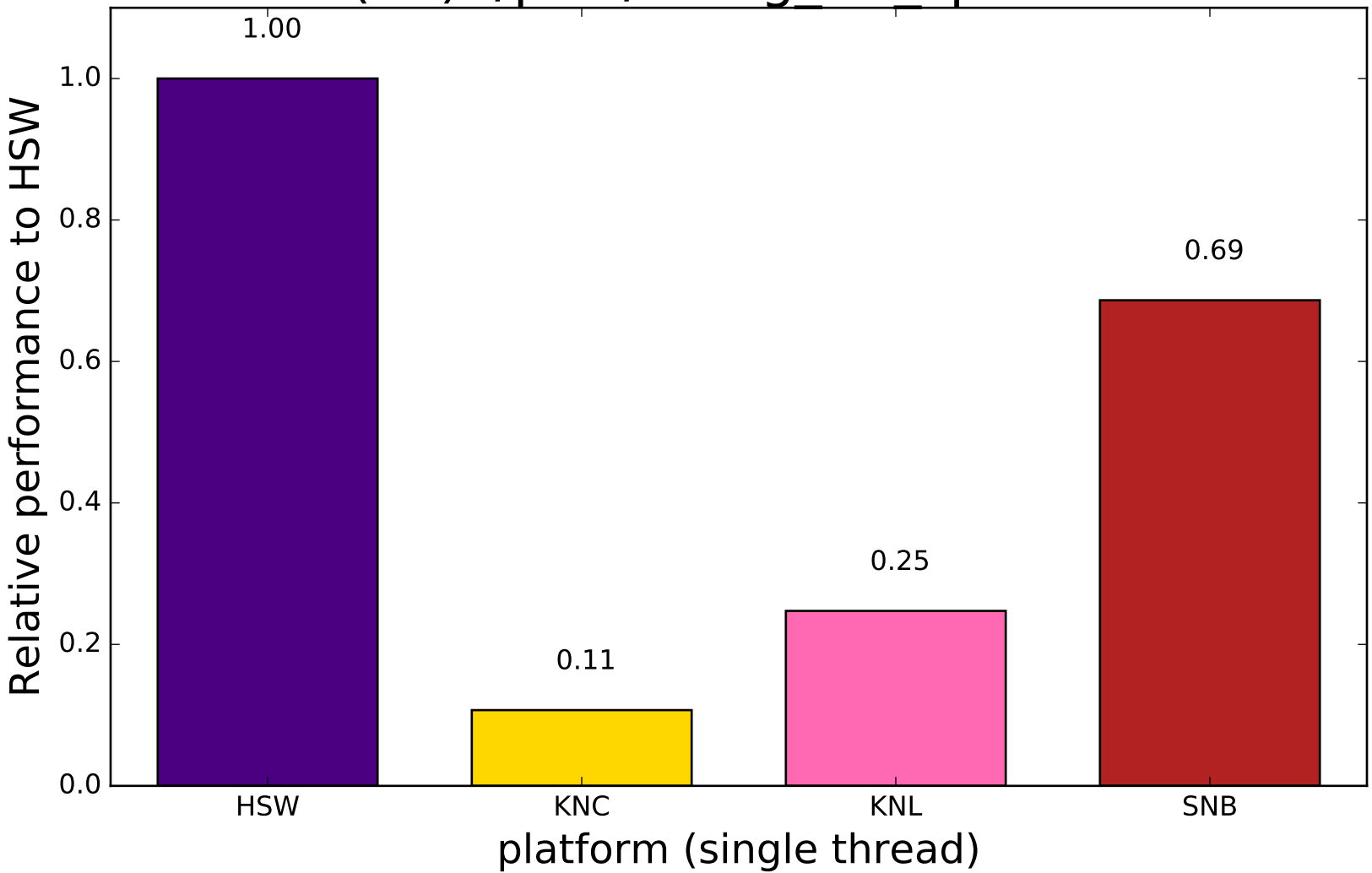

(26) ./port/rrtmg_sw_cldprmc
Relative performance to HSW
platform (single thread)
1.00
0.05
0.31
0.90
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

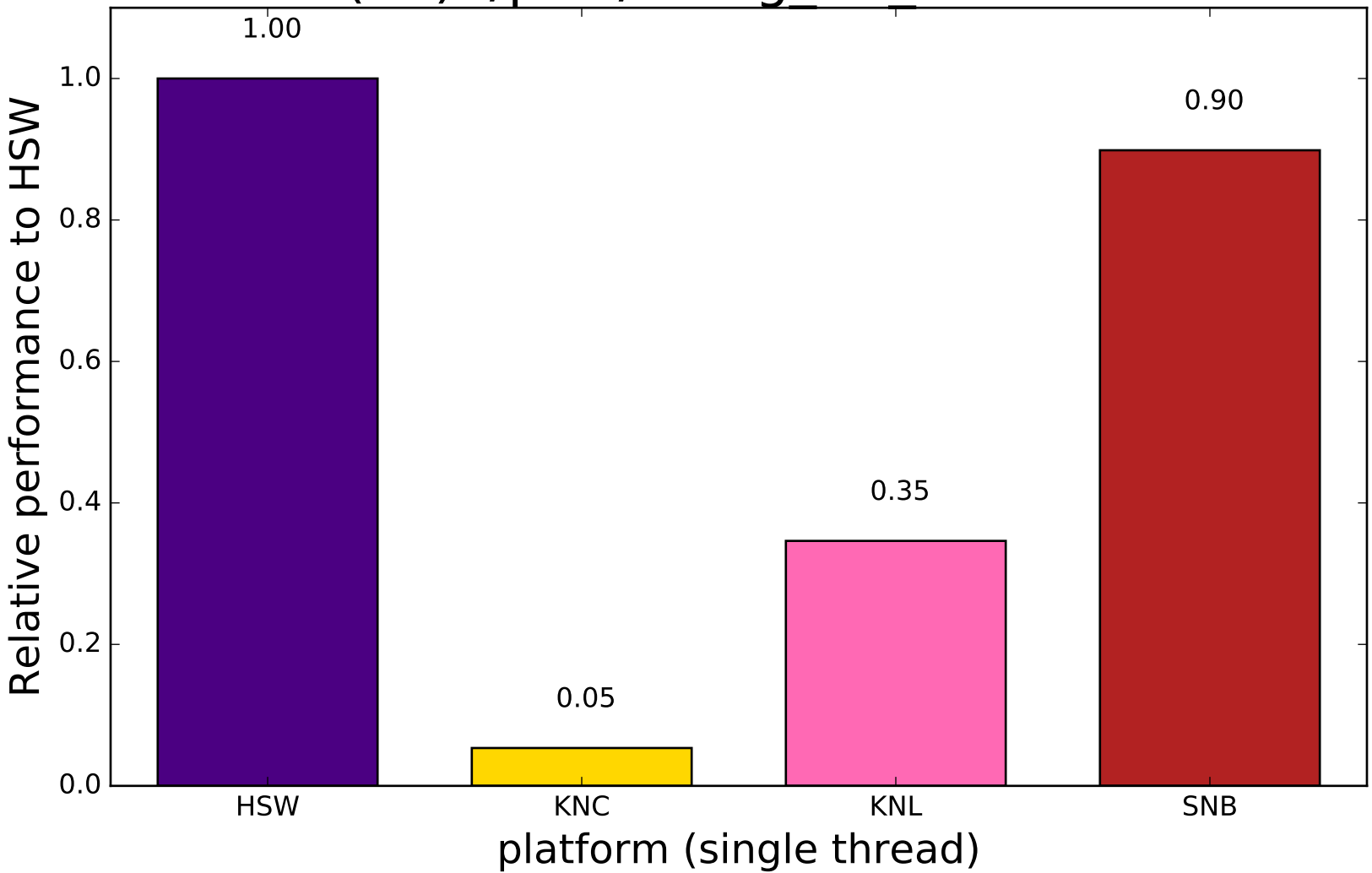

(27) ./port/rrtmg_sw_inatm
Relative performance to HSW
platform (single thread)
1.00
0.10
0.55
0.91
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

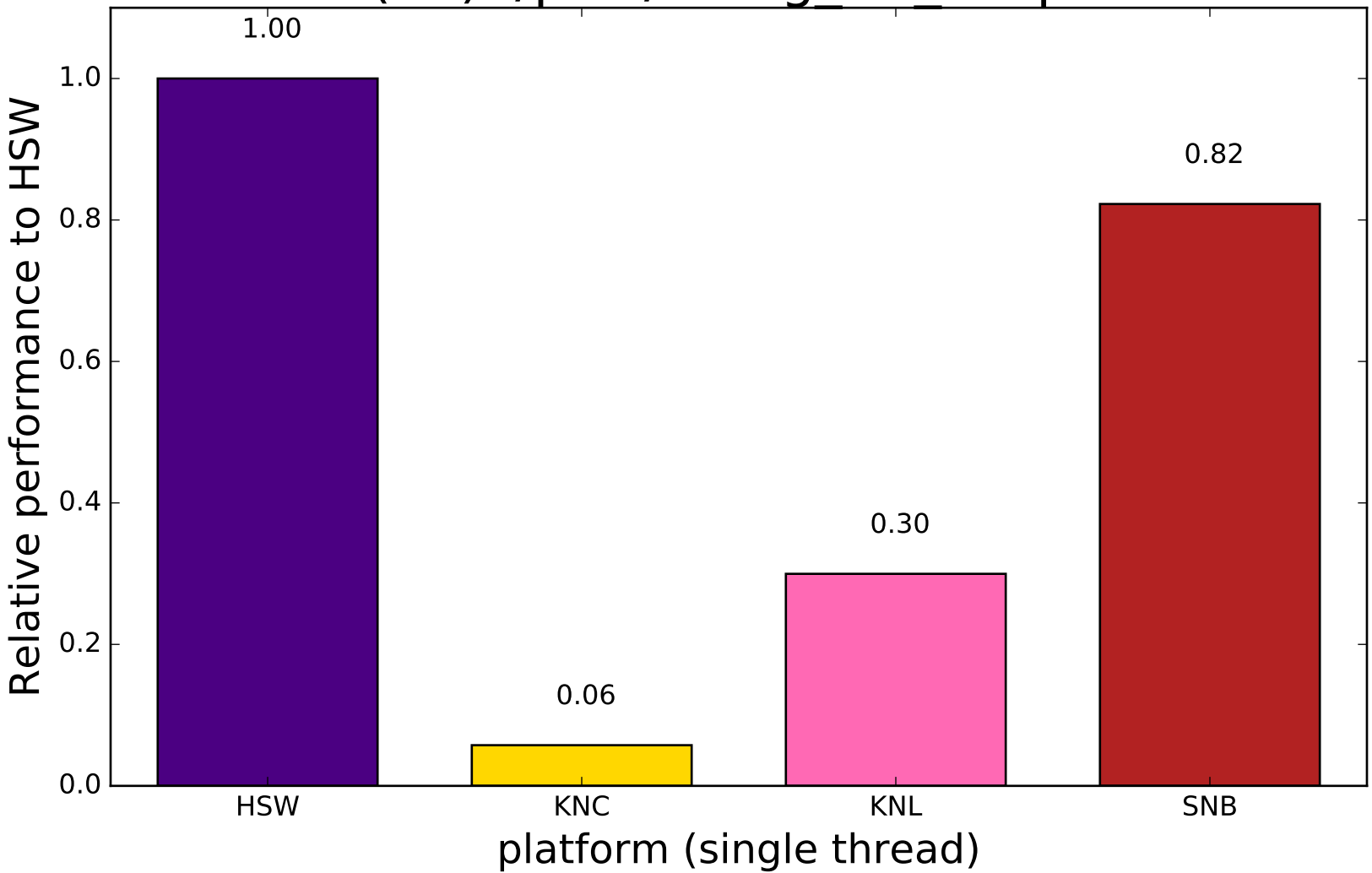

(28) ./port/rrtmg_sw_rad
Relative performance to HSW
platform (single thread)
1.00
0.05
0.23
0.66
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

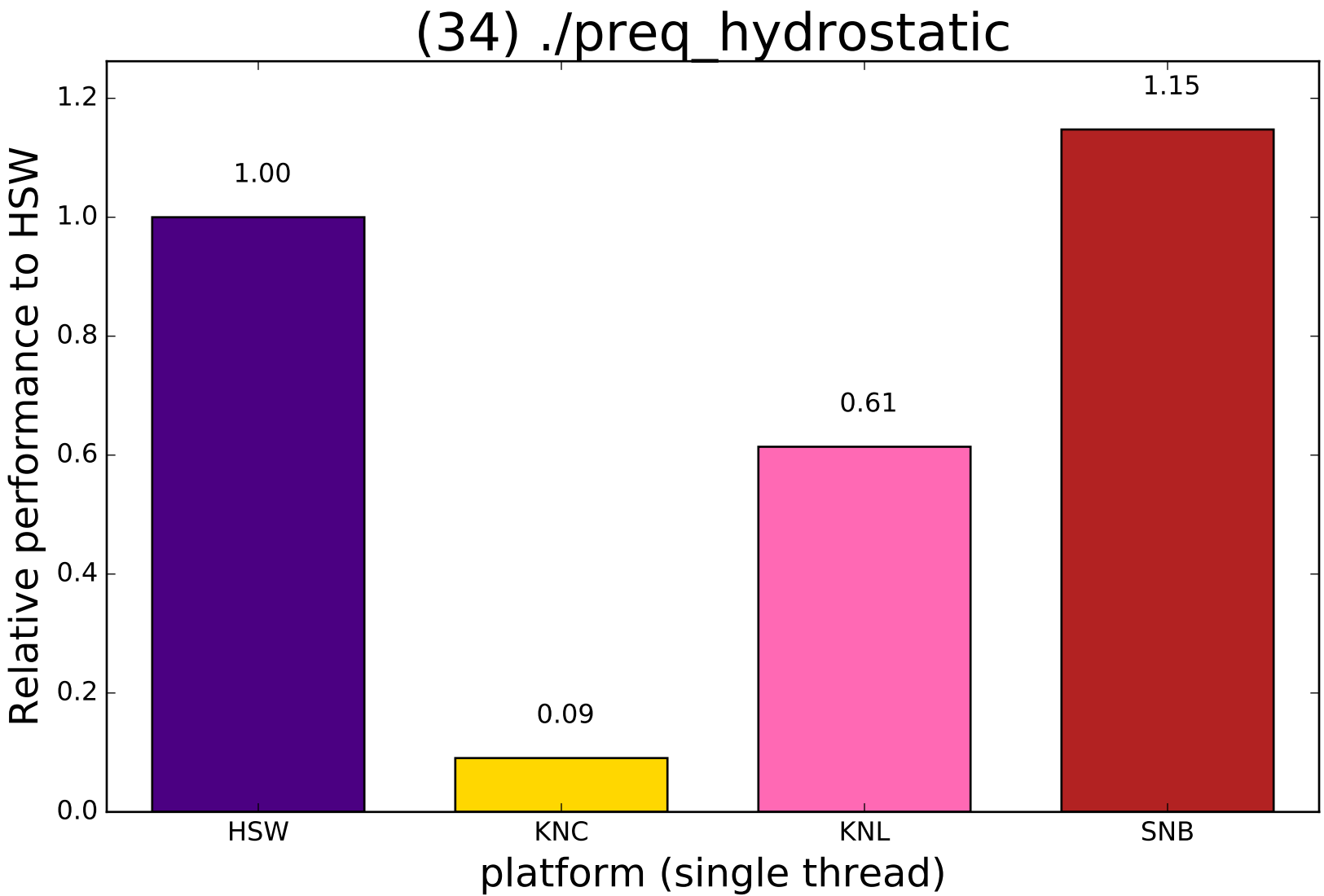

(29) ./port/rrtmg_sw_reftra
Relative performance to HSW
platform (single thread)
1.00
0.15
0.32
0.71
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

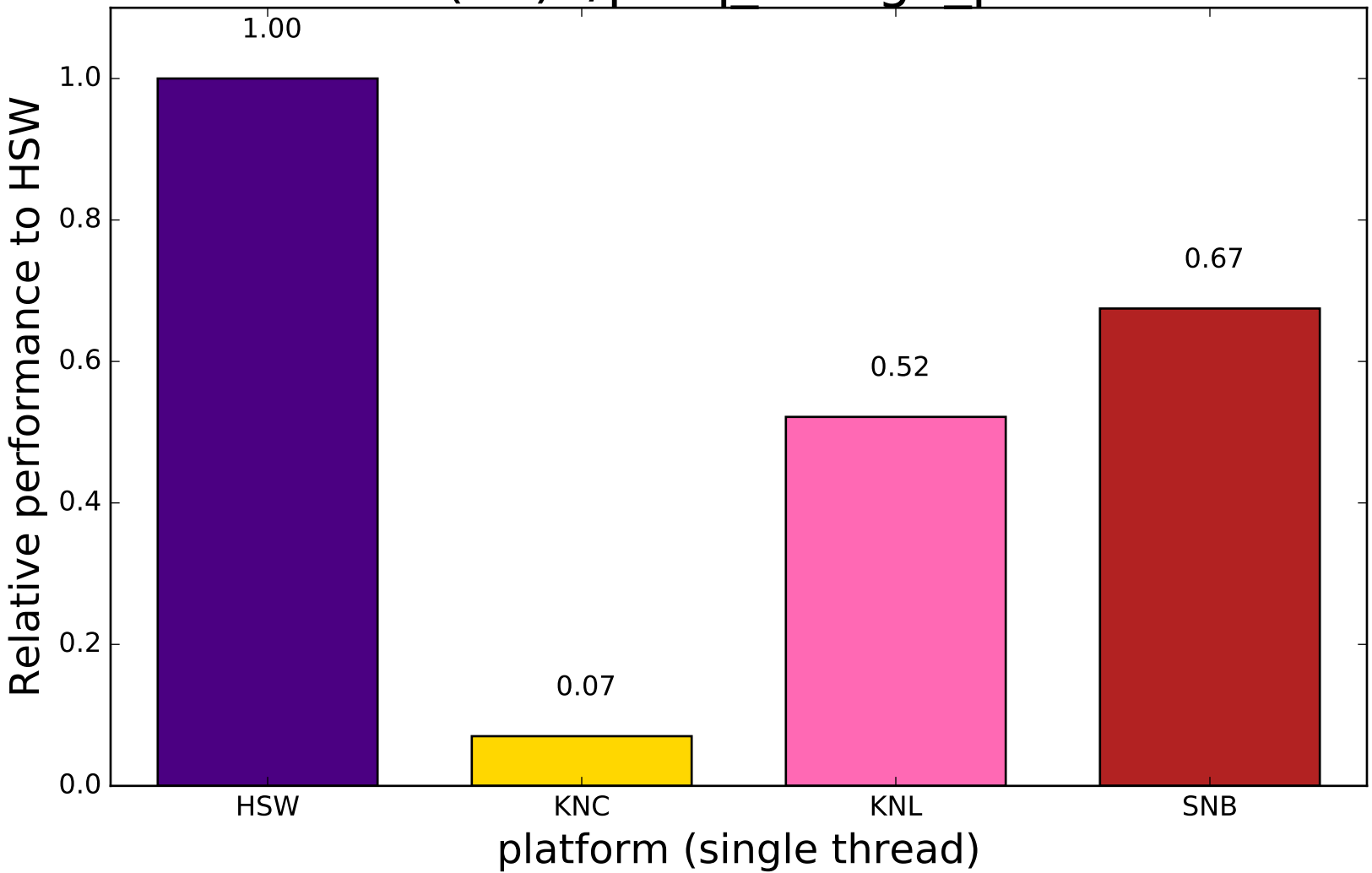

(30) ./port/rrtmg_sw_setcoef
Relative performance to HSW
platform (single thread)
1.00
0.05
0.28
0.86
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

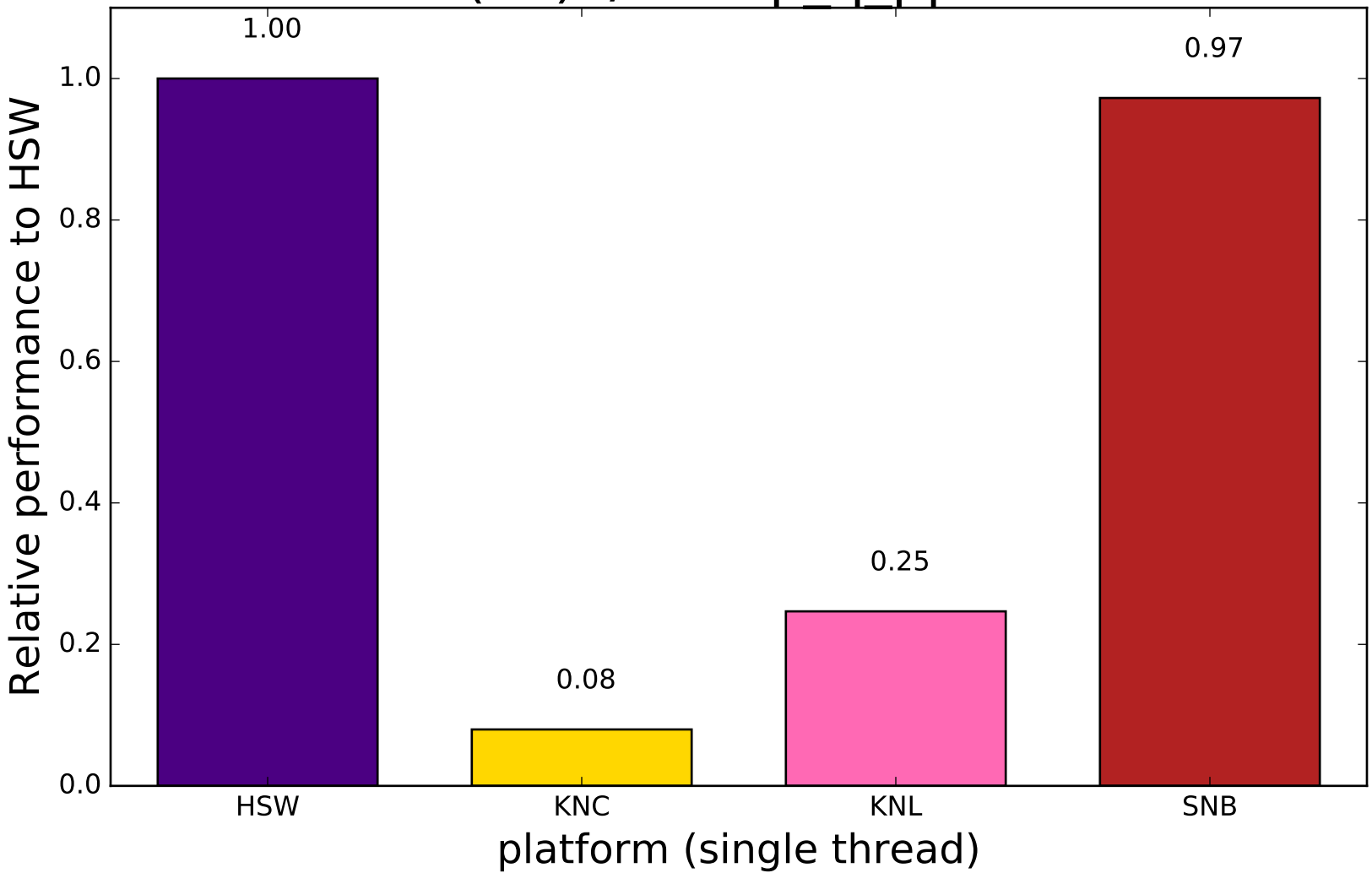

(31) ./port/rrtmg_sw_spcvmc
Relative performance to HSW
1.00
0.11
0.25
0.69
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

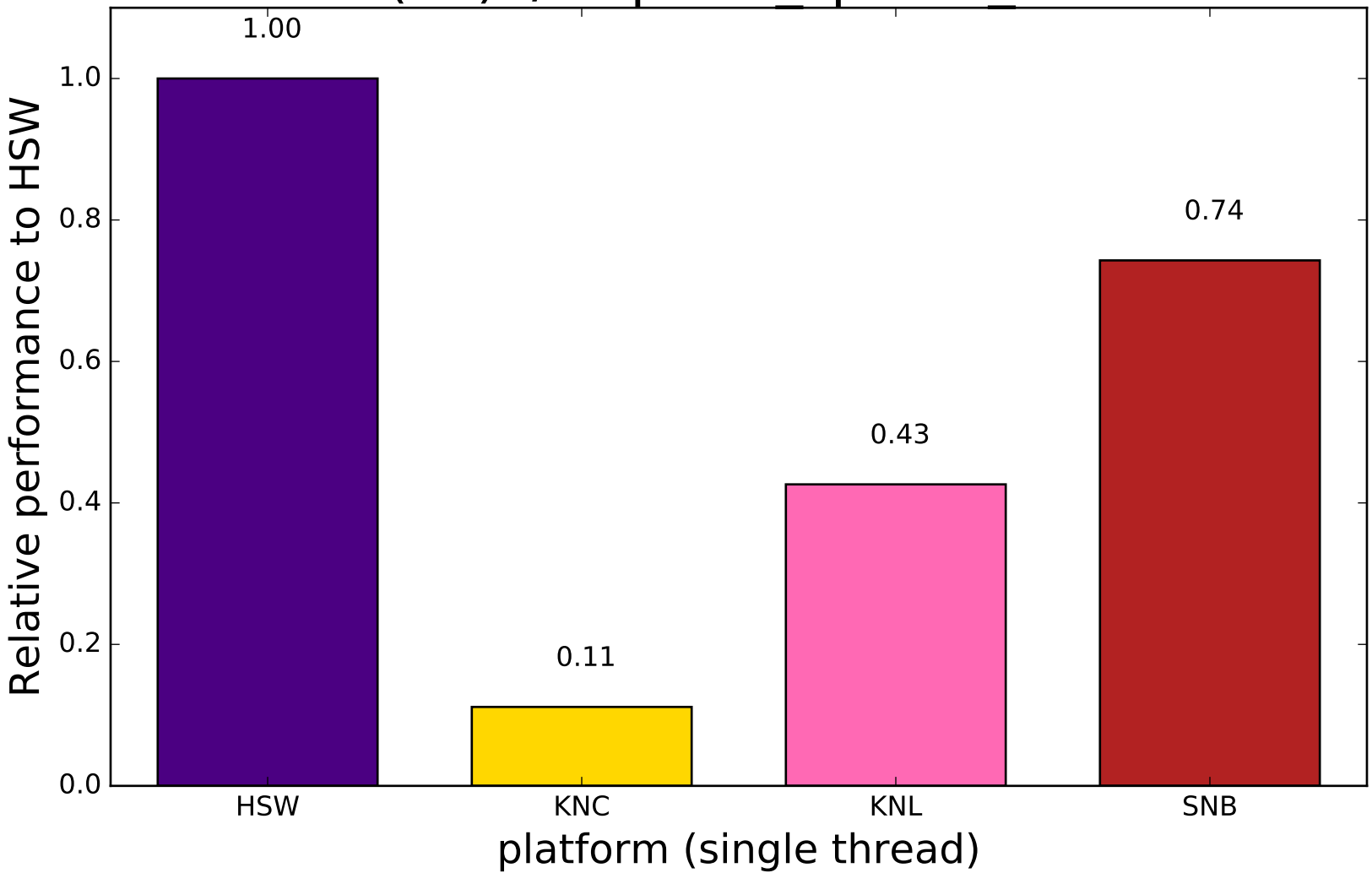

(32) ./port/rrtmg_sw_taumols
Relative performance to HSW
platform (single thread)
1.00
0.05
0.35
0.90
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

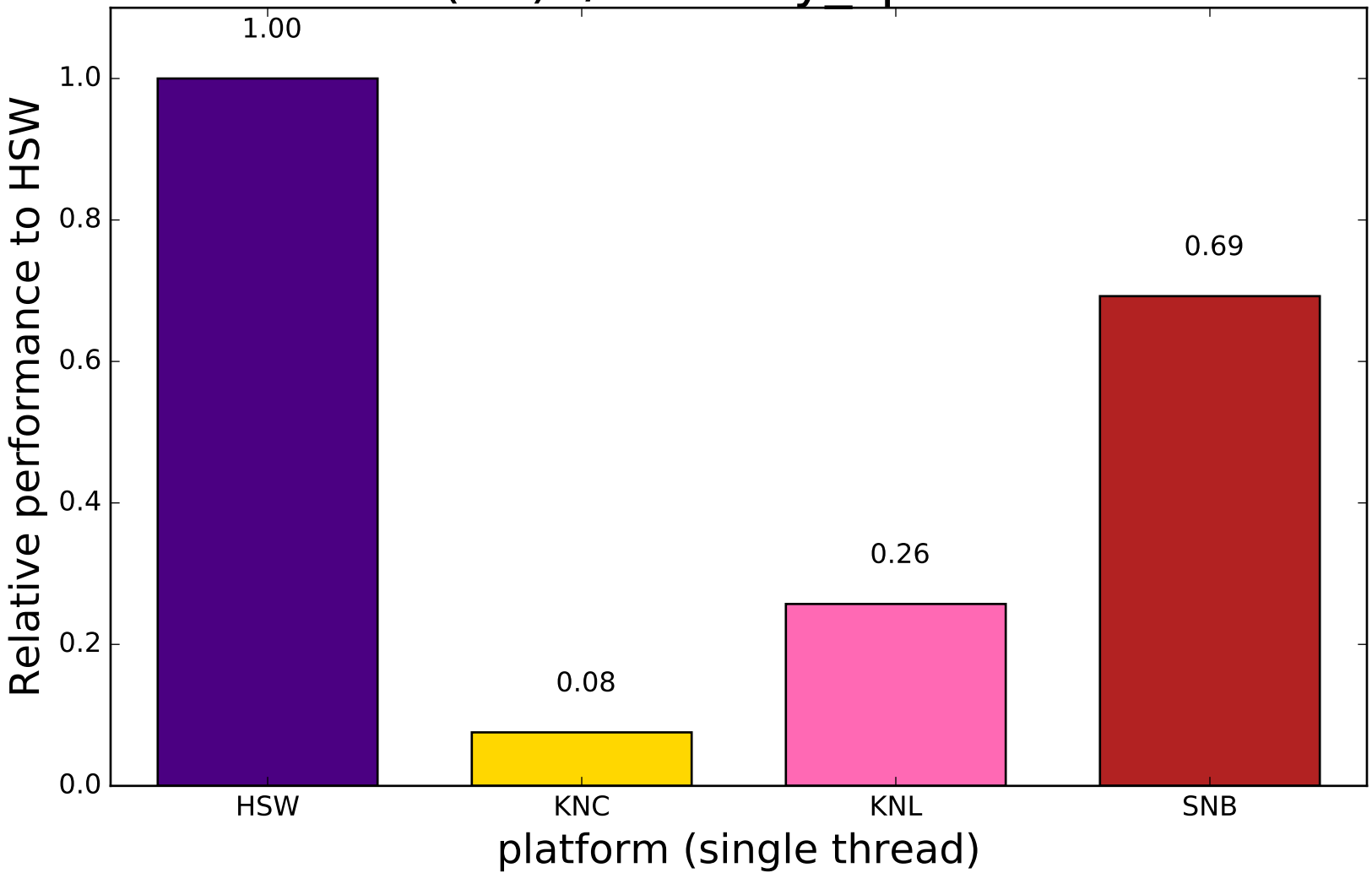

(33) ./port/rrtmg_sw_vrtqdr
Relative performance to HSW
platform (single thread)
1.00
0.06
0.30
0.82
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

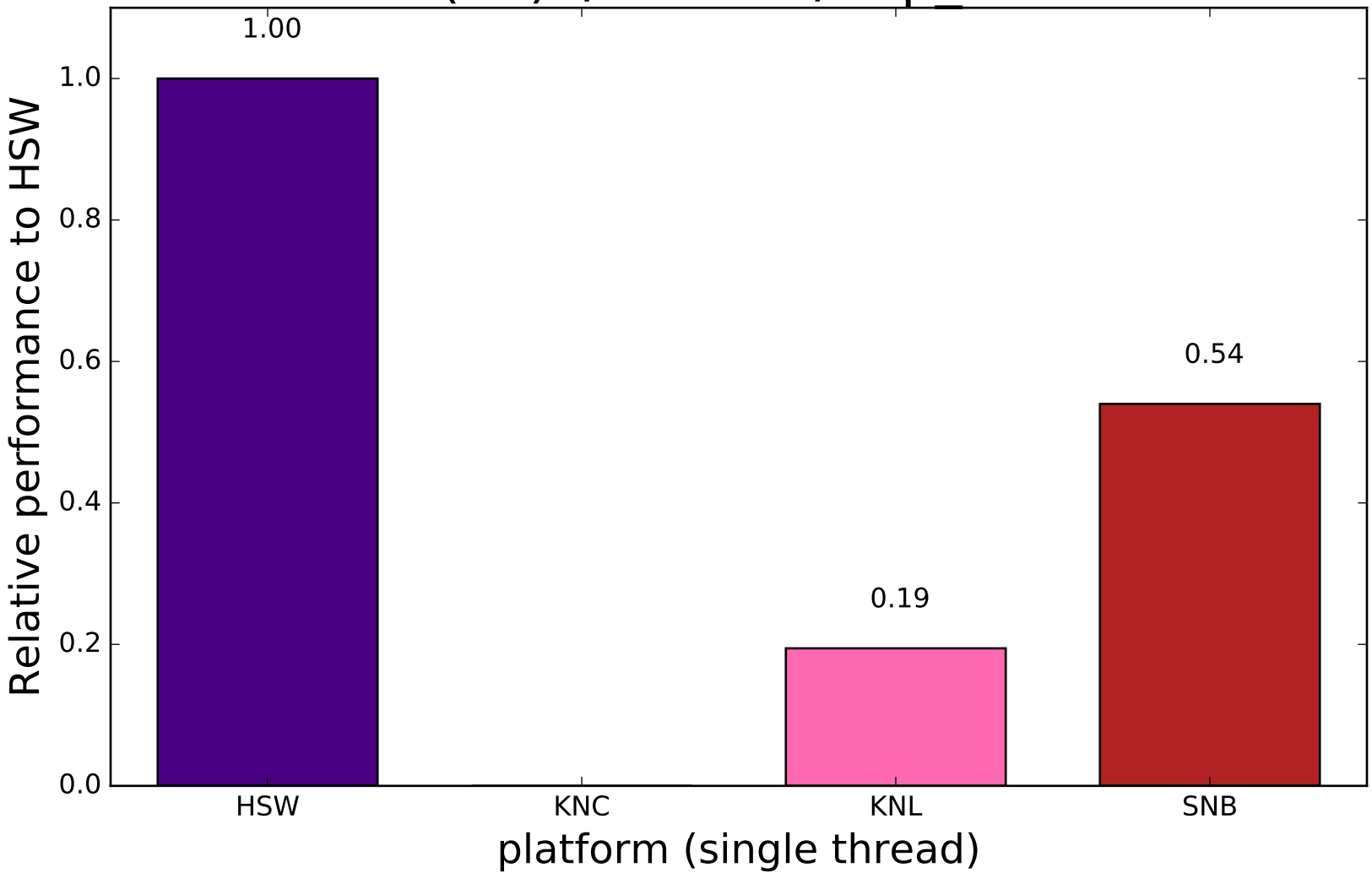

(34) ./preq_hydrostatic
Relative performance to HSW
1.2
1.0
0.8
0.6
0.4
0.2
0.0
1.00
0.09
0.61
1.15
HSW
KNC
KNL
SNB
platform (single thread)

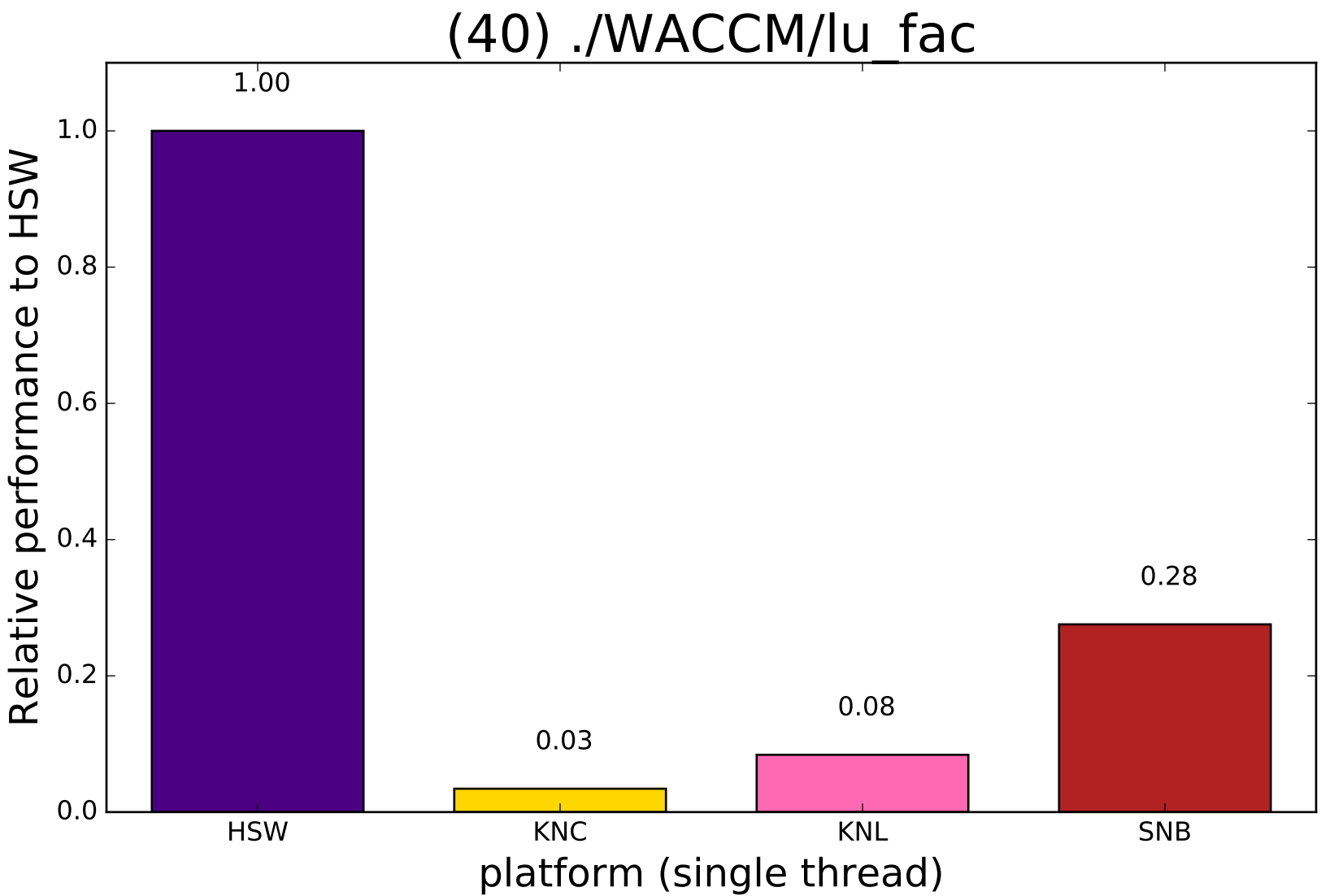

(35) ./preq_omega_ps
Relative performance to HSW
platform (single thread)
1.00
0.07
0.52
0.67
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB


(36) ./remap_q_ppm
Relative performance to HSW
1.0
0.8
0.6
0.4
0.2
0.0
1.00
0.08
0.25
0.97
HSW
KNC
KNL
SNB
platform (single thread)

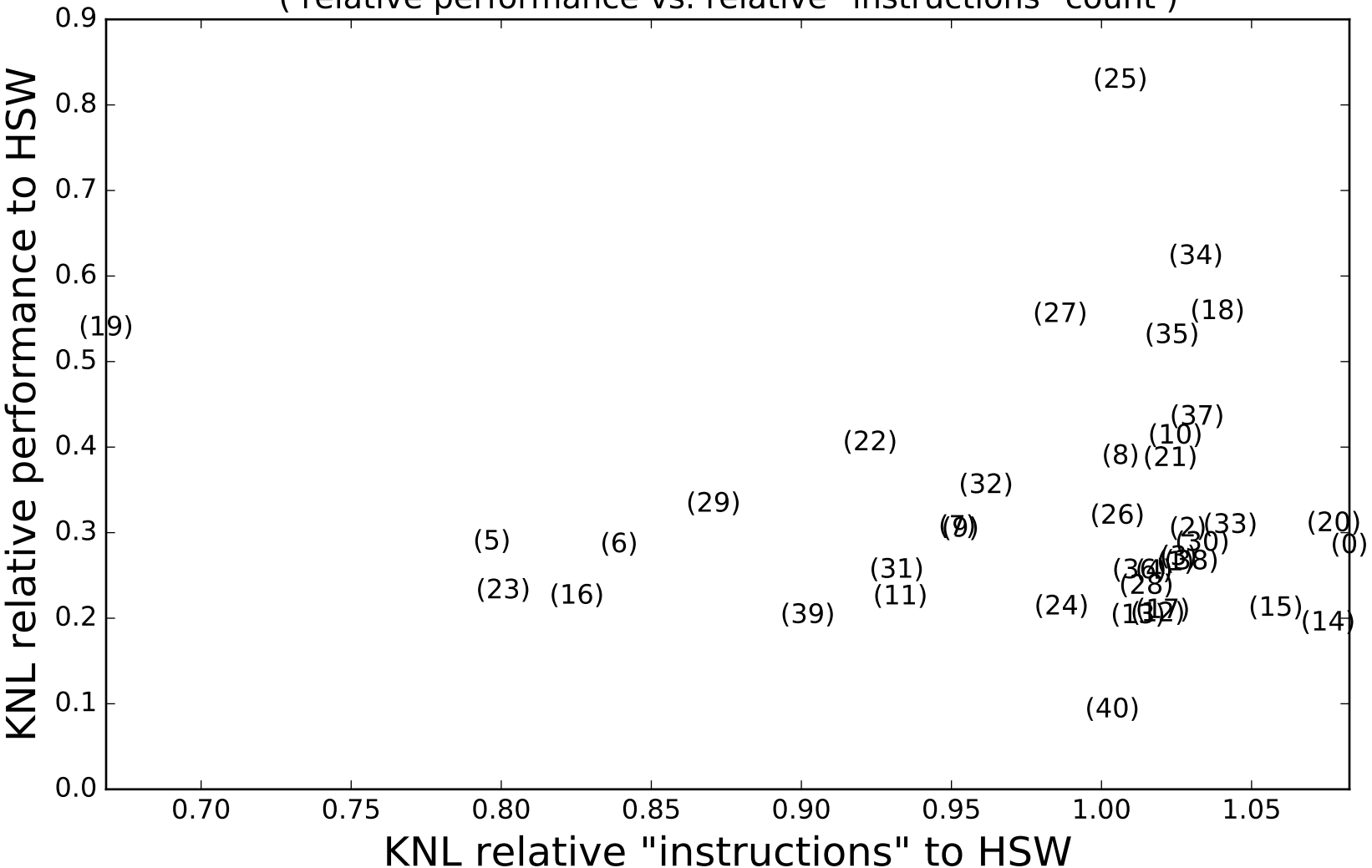

(37) ./vlaplace_sphere_wk
Relative performance to HSW
platform (single thread)
1.00
0.11
0.43
0.74
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

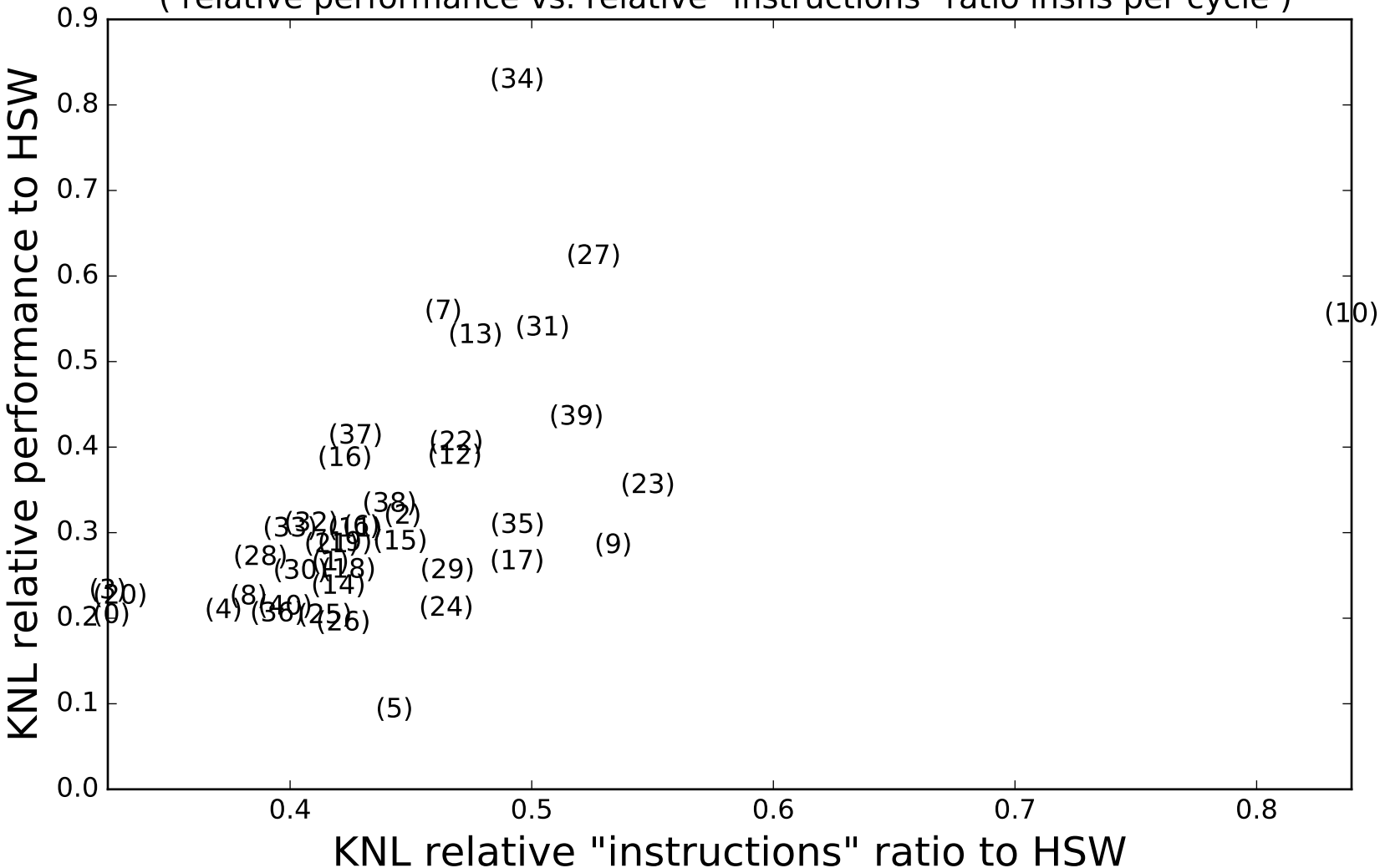

(38) ./vorticity_sphere
Relative performance to HSW
1.00
0.08
0.26
0.69
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

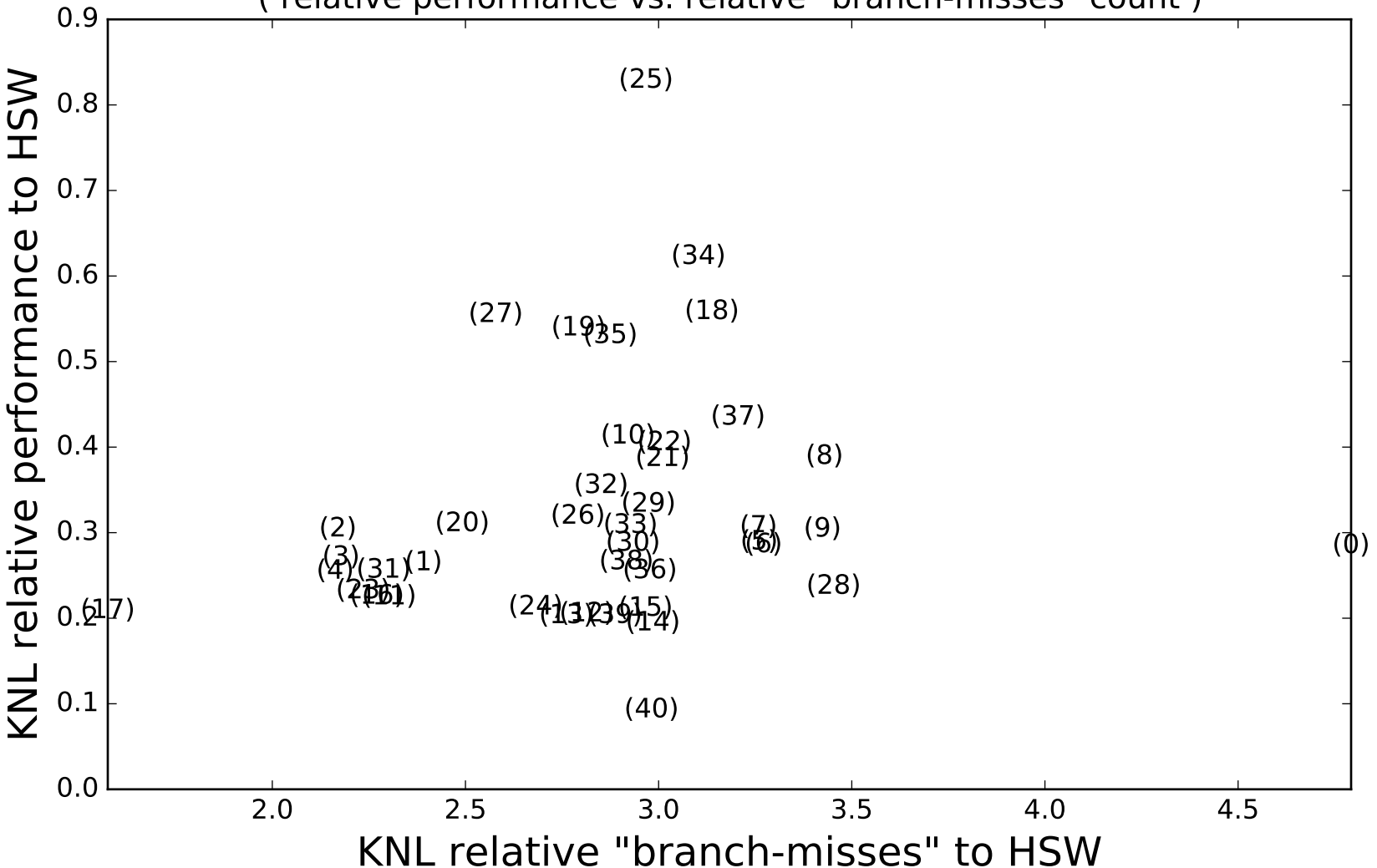

(39) ./WACCM/imp_sol
Relative performance to HSW
1.00
0.54
0.19
0.0
0.2
0.4
0.6
0.8
1.0
HSW
KNC
KNL
SNB
platform (single thread)

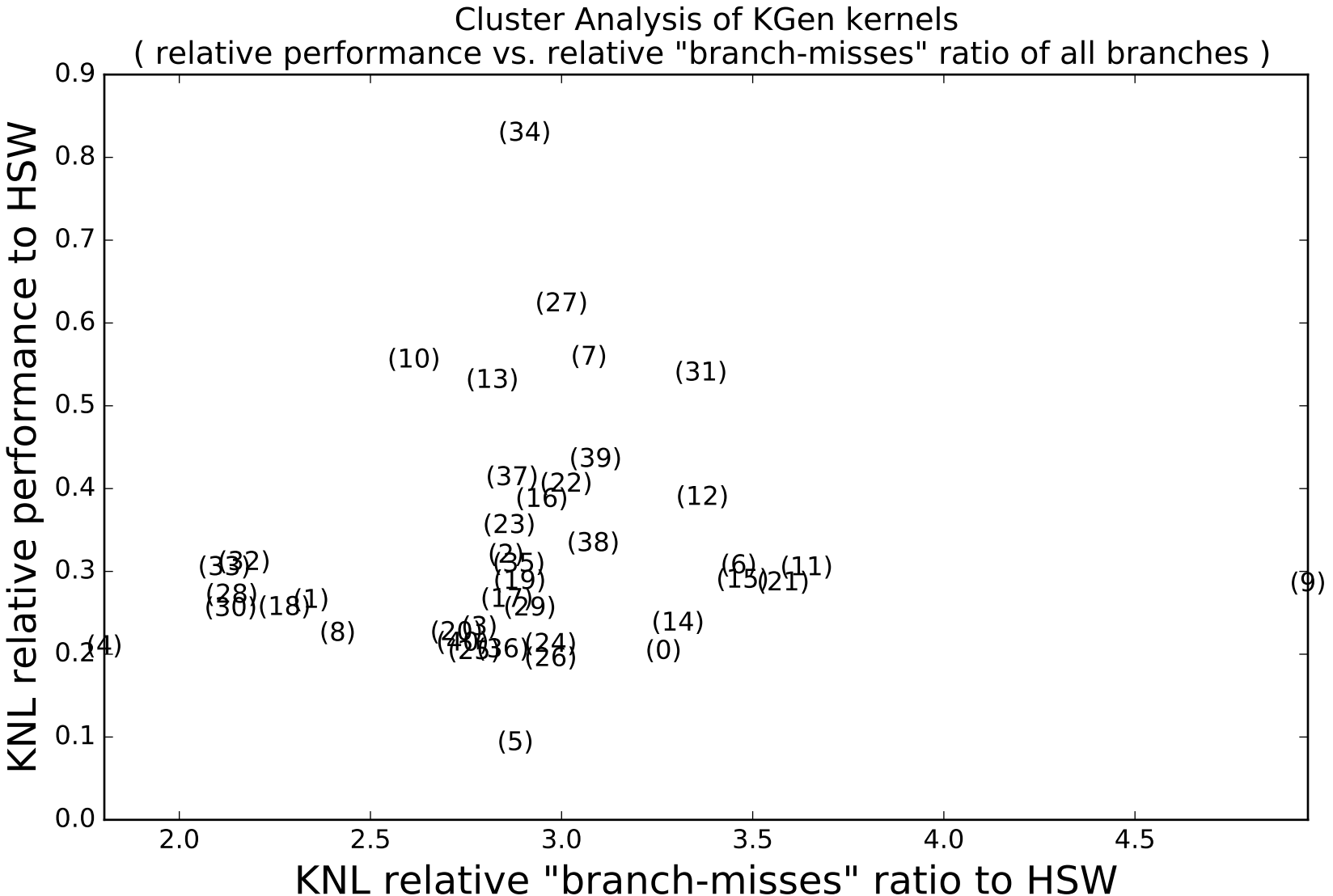

(40) ./WACCM/lu_fac
Relative performance to HSW
platform (single thread)
1.00
0.03
0.08
0.28
HSW
KNC
KNL
SNB
0.0
0.2
0.4
0.6
0.8
1.0

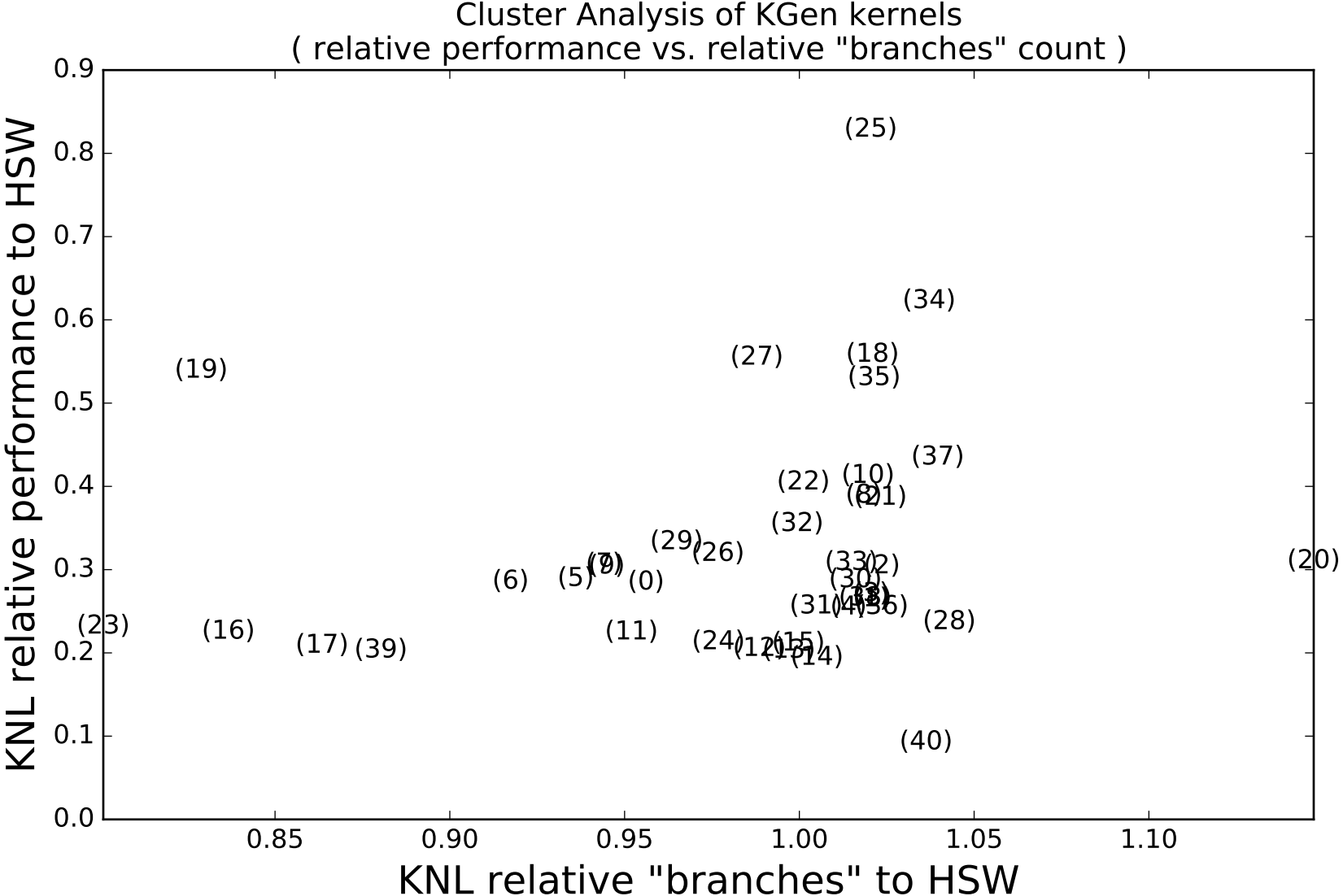
Cluster Analysis with Linux "perf stat" H/W counters

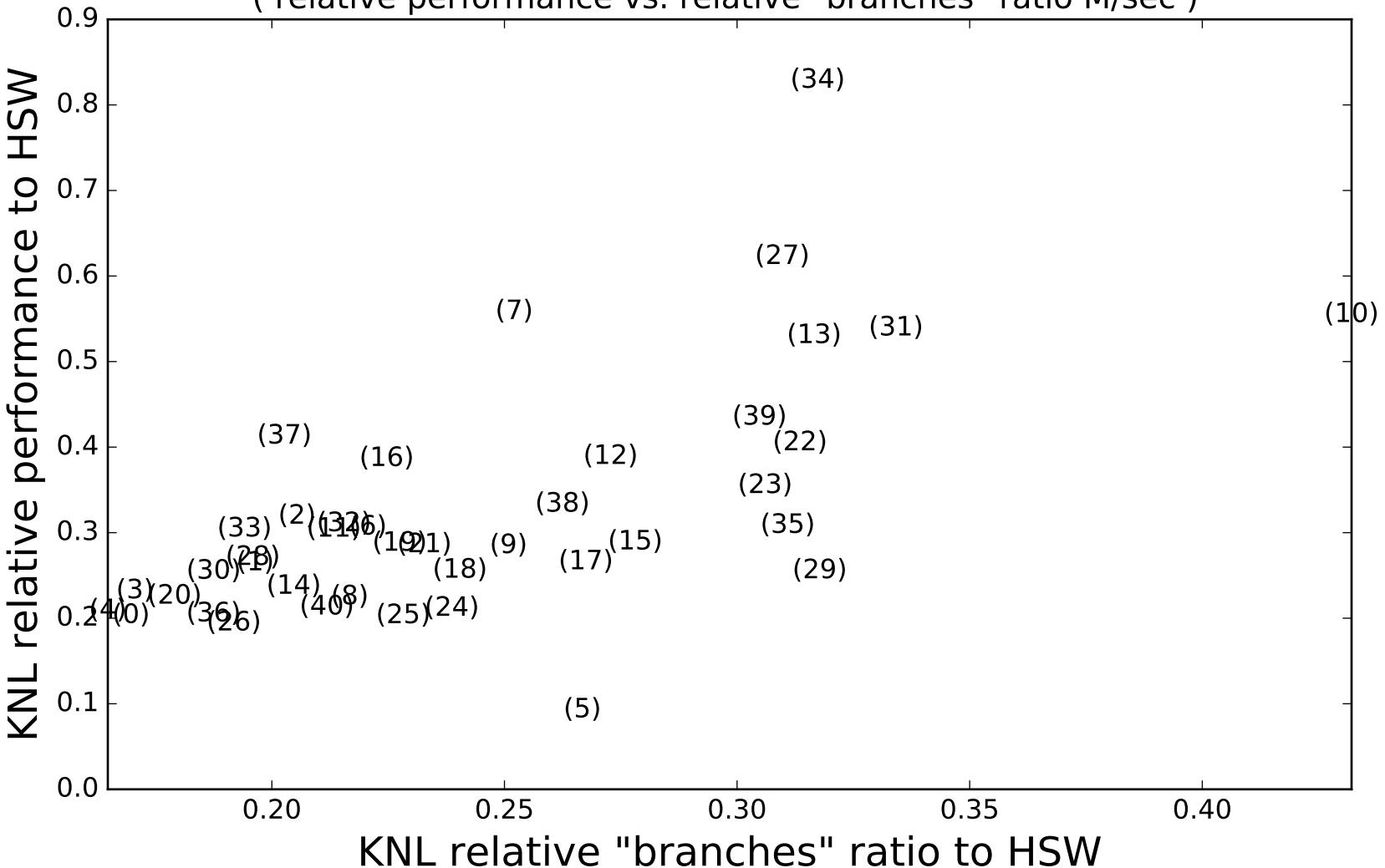

Cluster Analysis of KGen kernels
(relative performance vs. relative "instructions" count)
KNL relative performance to HSW
KNL relative "instructions" to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.70
0.75
0.80
0.85
0.90
0.95
1.00
1.05
(25)
(34)
(27)
(18)
(19)
(35)
(37)
(10)
(22)
(8)
(21)
(32)
(29)
(26)
(2)
(33)
(20)
(5)
(6)
(30)
(0)
(31)
(28)
(23)
(16)
(11)
(39)
(24)
(15)
(14)
(40)

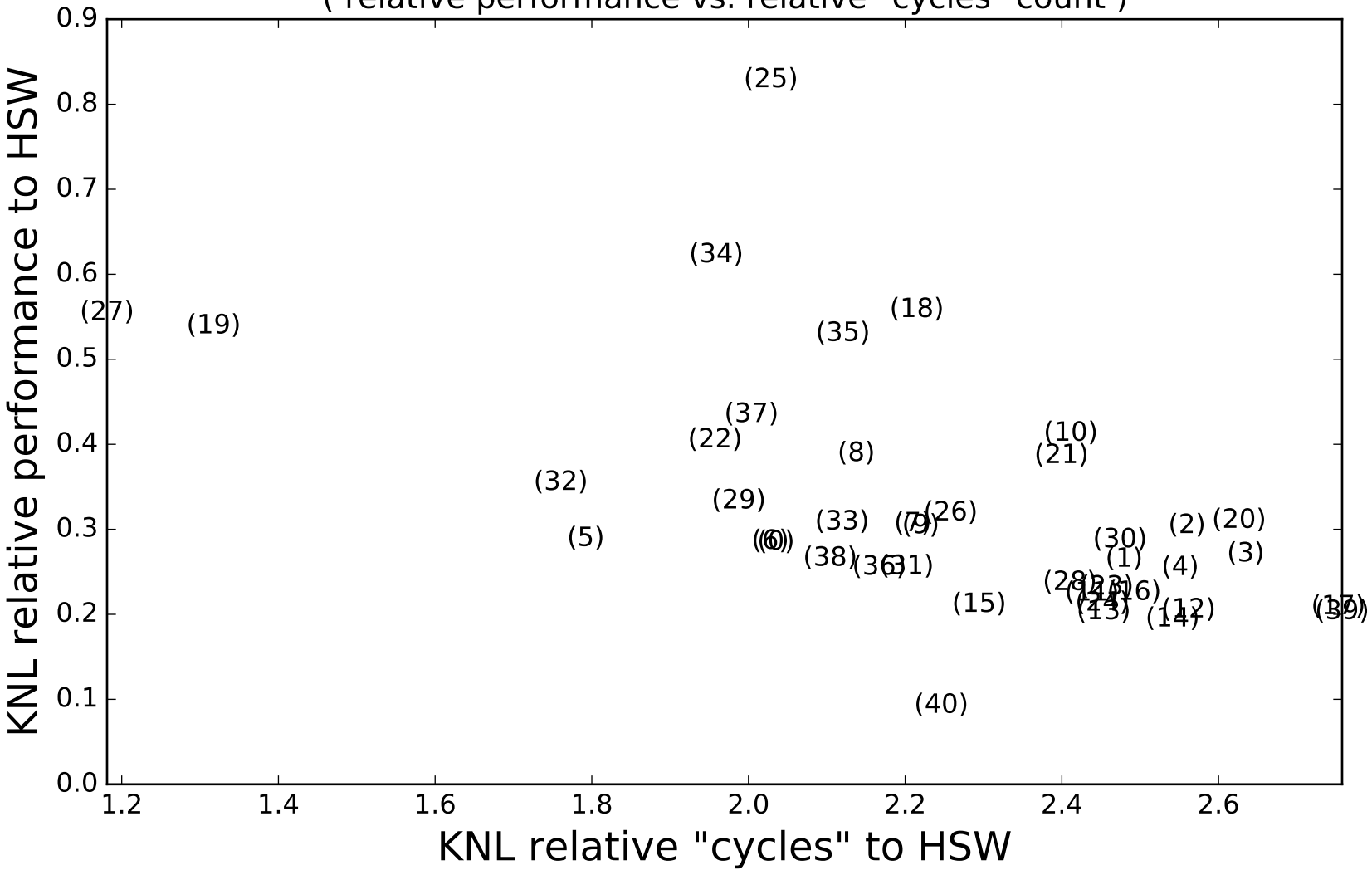

Cluster Analysis of KGen kernels
(relative performance vs. relative "instructions" ratio insns per cycle)
KNL relative performance to HSW
KNL relative "instructions" ratio to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.4
0.5
0.6
0.7
0.8
(34)
(27)
(7)
(13)
(31)
(10)
(39)
(37)
(22)
(16)
(12)
(23)
(38)
(35)
(9)
(28)
(17)
(29)
(24)
(5)

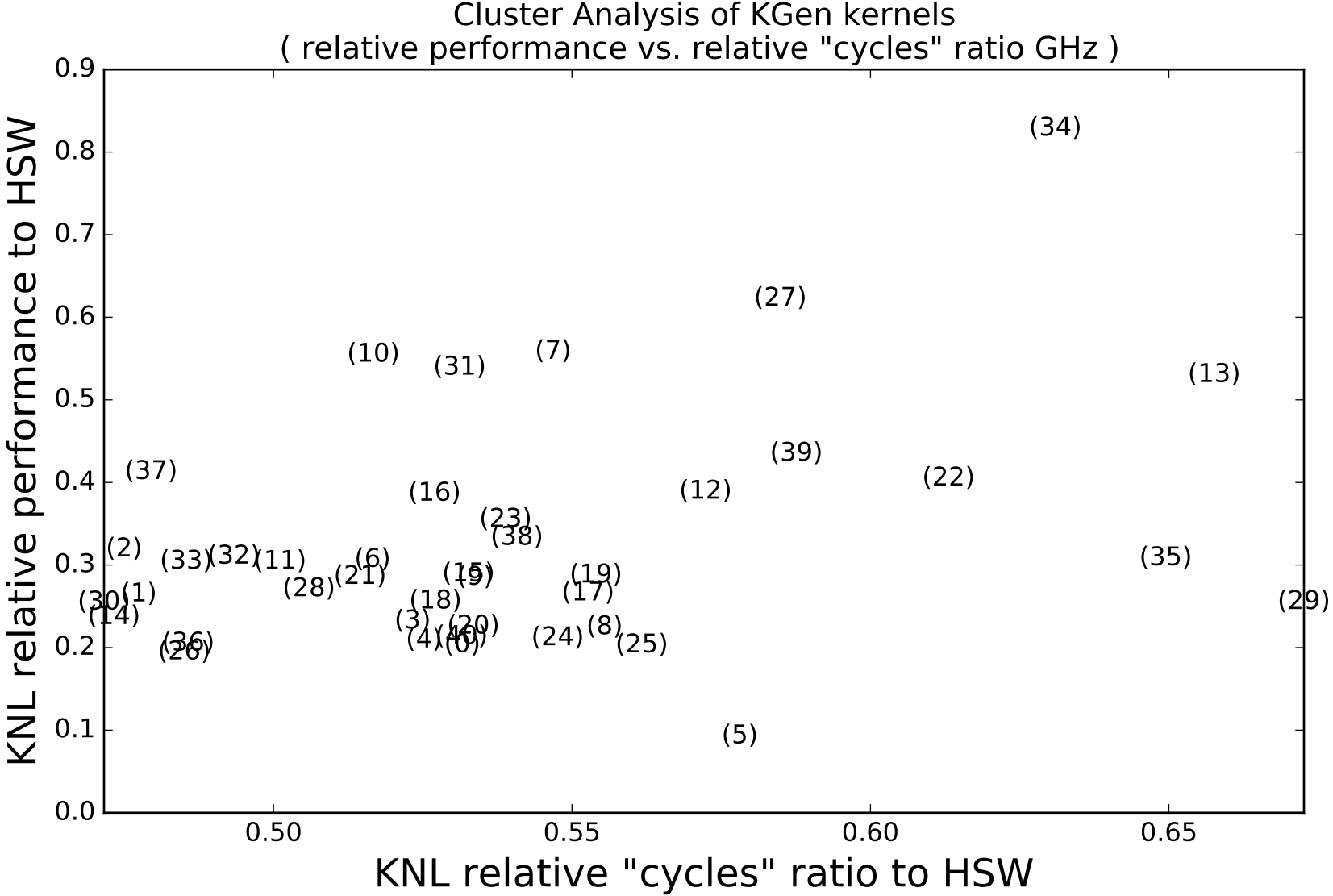

Cluster Analysis of KGen kernels
(relative performance vs. relative "branch-misses" count)
KNL relative performance to HSW
KNL relative "branch-misses" to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
2.0
2.5
3.0
3.5
4.0
4.5
(25)
(34)
(27)
(18)
(19)
(35)
(37)
(10)
(22)
(21)
(8)
(32)
(29)
(26)
(20)
(33)
(7)
(9)
(2)
(30)
(0)
(3)
(1)
(38)
(36)
(28)
(31)
(17)
(24)
(15)
(14)
(40)


Cluster Analysis of KGen kernels
(relative performance vs. relative "branch-misses" ratio of all branches)
KNL relative performance to HSW
KNL relative "branch-misses" ratio to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
2.0
2.5
3.0
3.5
4.0
4.5
(34)
(27)
(10)
(7)
(31)
(13)
(39)
(37)
(22)
(16)
(12)
(23)
(38)
(2)
(32)
(33)
(35)
(6)
(11)
(19)
(15)
(21)
(9)
(28)
(1)
(17)
(30)
(18)
(29)
(14)
(8)
(3)
(24)
(4)
(36)
(0)
(26)
(5)


Cluster Analysis of KGen kernels
(relative performance vs. relative "branches" count)
KNL relative performance to HSW
KNL relative "branches" to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.85
0.90
0.95
1.00
1.05
1.10
(25)
(34)
(27)
(18)
(19)
(35)
(37)
(22)
(10)
(32)
(29)
(26)
(33)
(20)
(6)
(5)
(0)
(30)
(31)
(28)
(23)
(16)
(17)
(39)
(11)
(24)
(15)
(14)
(40)


Cluster Analysis of KGen kernels
(relative performance vs. relative "branches" ratio M/sec)
KNL relative performance to HSW
KNL relative "branches" ratio to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.20
0.25
0.30
0.35
0.40
(34)
(27)
(7)
(13)
(31)
(10)
(39)
(37)
(22)
(16)
(12)
(23)
(38)
(2)
(33)
(35)
(9)
(15)
(17)
(18)
(29)
(14)
(8)
(40)
(25)
(24)
(20)
(36)
(26)
(5)


Cluster Analysis of KGen kernels
(relative performance vs. relative "cycles" count)
KNL relative performance to HSW
KNL relative "cycles" to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
(25)
(34)
(27)
(19)
(18)
(35)
(37)
(22)
(10)
(8)
(21)
(32)
(29)
(26)
(33)
(2)
(20)
(5)
(30)
(3)
(38)
(1)
(4)
(15)
(40)


Cluster Analysis of KGen kernels
(relative performance vs. relative "cycles" ratio GHz)
KNL relative performance to HSW
KNL relative "cycles" ratio to HSW
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.50
0.55
0.60
0.65
(0)
(1)
(2)
(3)
(4)
(5)
(6)
(7)
(8)
(9)
(10)
(11)
(12)
(13)
(14)
(15)
(16)
(17)
(18)
(19)
(20)
(21)
(22)
(23)
(24)
(25)
(26)
(27)
(28)
(29)
(30)
(31)
(32)
(33)
(34)
(35)
(36)
(37)
(38)
(39)