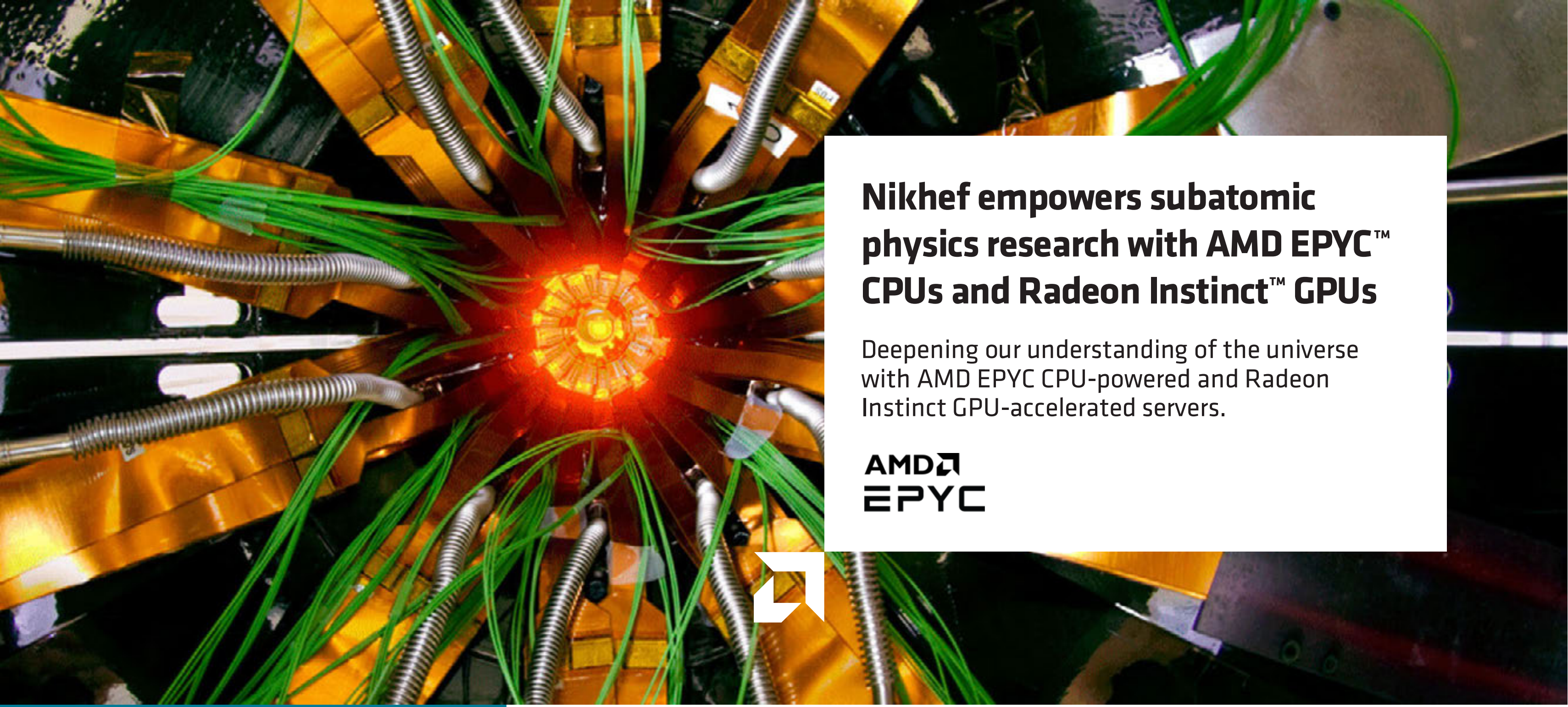

Nikhef empowers subatomic physics research with AMD EPYC™ CPUs and Radeon Instinct™ GPUs

Deepening our understanding of the universe with AMD EPYC CPU-powered and Radeon Instinct GPU-accelerated servers.

AMD EPYC

CUSTOMER

Nikhef

INDUSTRY

Subatomic Physics

CHALLENGES

Increasing data throughput with higher I/O and memory bandwidth

SOLUTION

Deploy AMD EPYC™ 7502P and 7702P CPUS, and AMD Radeon Instinct™ MI50 GPUs

RESULTS

Faster processing and the ability to harness GPU-accelerated machine learning to cope with rapidly expanding experimental data volume

AMD TECHNOLOGY AT A GLANCE

AMD EPYC 7502P processors with 32 cores
AMD EPYC 7702P processors with 64 cores
AMD Radeon Instinct MI50 GPUs

TECHNOLOGY PARTNER

Lenovo

Many of the latest scientific discoveries are as much about the computing power used to analyze experimental data as they are about the theories behind them. At the forefront of delivering the processing capabilities for subatomic physics research is Nikhef, the Dutch National Institute concentrating on this area. Nikhef has provided computing that has helped with the discoveries of gravitational waves in 2016, the Higgs Boson, and the fundamental physics in between, including confirmation that many of the heavy elements in the universe are produced in neutron star mergers.

"The Institute performs blue-sky research to learn more about the nature of the universe and the building blocks of matter," explains Roel Aaij, Scientific Staff Member at Nikhef. "The fundamental goal of this institute is to find the big universal box of building blocks everything is made from," adds Tristan Suerink, IT Architect at Nikhef. The more computing power that the Institute can throw at this quest, the more that can be discovered. This led the team to AMD EPYC™ processors and Radeon Instinct™ GPUs, which delivered the performance Nikhef's workloads required and the solution price that aligned with their budget.

"We were able to be the worldwide number one in a few public projects like Rosetta@home and Worldwide Community Grid with the AMD EPYC cluster."

Roel Aaij, Scientific Staff Member, Nikhef

Data-hungry science

Nikhef is involved in many different experiments, but all of them require a considerable level of computing power. "About 100 scientific staff work at Nikhef," explains Aaij. "These staff usually work on one (or sometimes more than one) of the experiments Nikhef is involved in.

Three of those experiments are at CERN: the ATLAS, LHCb, and ALICE experiments. There are several astroparticle physics experiments. One is the Pierre Auger experiment, covering several thousand square kilometers of Pampa in Argentina. The area is equipped with detectors to search for air showers caused by extremely high-energy particles that arrive from the universe. Then there is the neutrino-physics experiment KM3NeT, and dark-matter research with the XENON experiment. Finally, there is a large gravitational waves physics group that is a member of the LIGO-Virgo experiment collaboration."

If there's one thing all these experiments have in common, it's the increasing amounts of data that the experiments produce. "The scientists always want more data," says Suerink. "I think there are few experimental physics papers that do not end with 'we need more data.' And in this field of physics, to get more data you build a more sensitive experiment." In the case of the Large Hadron Collider (LHC) at CERN, the leap in data produced will be particularly huge.

"In about five years the LHC will increase the number of collisions detected by about a factor of 10," says Aaij. "This means that the experiments will start producing a similarly increasing amount of data. If we look at the growth of storage space and compute capacity over time, then we do not expect to even get close to a factor 10 in increase of performance for a flat budget. We need to deal with that, because we need to process the data. Otherwise, we can't do science with it." This is where AMD EPYC processors and GPU acceleration have offered the best solutions to satiate the hunger for growing data processing ability.

The benefits of single-socket CPUs

“In 2012 we discovered that if we took a dual-socket server and removed the second CPU, the jobs running on the first socket would individually go faster,” says Suerink. “It gave us a 20 percent difference, so we asked for single-socket systems.” When 1st Gen AMD EPYC™ processors arrived, their strong single-socket performance immediately seemed ideal. “Around Christmas 2017, we tested a beta EPYC ‘Naples’ system. It was completely different to how the Intel systems were working. We were able to get a lot more throughput out of it. We have a lot of I/O in our workloads, so a CPU that's good in I/O and has a lot of bandwidth, a lot of PCI Express® lanes, a lot of memory channels, is better than having a CPU that's running at a very high clock but that is not very good for I/O.” After this, Nikhef acquired around 100 systems with single-socket 1st Gen AMD EPYC processors.

“If you compare AMD ‘Rome’ with an Intel Skylake system, you'll see a very big difference in the amount of throughput that it can get with our workloads.”

Tristan Suerink, IT Architect, Nikhef

When 2nd Gen AMD EPYC processors arrived they promised even better single-socket performance, and still more benefits. Nikhef was starting to use GPUs to enable their Machine Learning algorithms, so the support for PCI Express® 4 was a major advantage. Nikhef moved to Lenovo’s ThinkSystem SR655 platform. “The Lenovo system was the only one that was completely PCI Express Gen 4 and built in a flexible way, so that you could fit in three GPUs, eight different cards, a lot of things we need,” says Suerink. Alongside its 1st Gen AMD EPYC CPU-based servers, Nikhef now has around 70 systems with 2nd Gen processors – nine based on the 32-core 7502P and the rest using 64-core 7702P CPUs. The extra performance available was considerable, which Nikhef illustrated using the CERN HEP-SPEC benchmark.

PCI Express 4-enhanced GPU performance

Nikhef has also opted for AMD when choosing GPU acceleration for its servers, selecting Radeon Instinct™ MI50 cards. “One of the reasons that we went for AMD Radeon GPUs is we like the fact that they're open source,” says Suerink. “The whole suite is completely open source, using the HIP API. They are also very attractively priced. The number of FLOPS that we do per terabyte is quite low. The PCI Express 4.0 support of the latest AMD EPYC processors and Radeon graphics allows for fast data throughput between system memory and GPU. Compared to NVIDIA’s V100 GPUs, the AMD Radeon MI50s were delivering 14TFLOPs instead of 15TFLOPS,but for half the price.”

Nikhef’s new servers aren’t just being used for physics experiments, however. Lenovo was installing the servers just as the global pandemic hit, so Nikhef offered its newfound processing power for Coronavirus research. “We were able to be the worldwide number one in a few public projects like Rosetta@home and Worldwide Community Grid with the AMD EPYC cluster,” says Aaij. “There are also some projects working on experimental hadron therapy for cancer treatment, and Project MinE, which is ALS research.” Suerink adds: “This cluster is also part of the Dutch National e-Infrastructure, the goal of which is that every scientist can get easy access to a lot of compute power, data, storage, and networking.”

AMD EPYC CPUs tick all the boxes for Nikhef, delivering PCI Express 4, high core density and memory bandwidth that is allied with an extremely competitive price-performance ratio. But it’s the single-socket capability that puts AMD EPYC CPUs above the competition. “If you look at the amount of cores you can get per CPU, the benchmark results you get, and the storage and memory you can put around one CPU, why should I buy a dual-socket system anymore?” says Suerink. “Dual-socket systems are a thing of the past. If you compare AMD ‘Rome' with an Intel Skylake system, you'll see a very big difference in the amount of throughput that it can get with our workloads. If a colleague asks whether they should consider AMD EPYC processors, I say ‘Why didn’t you buy them earlier?”

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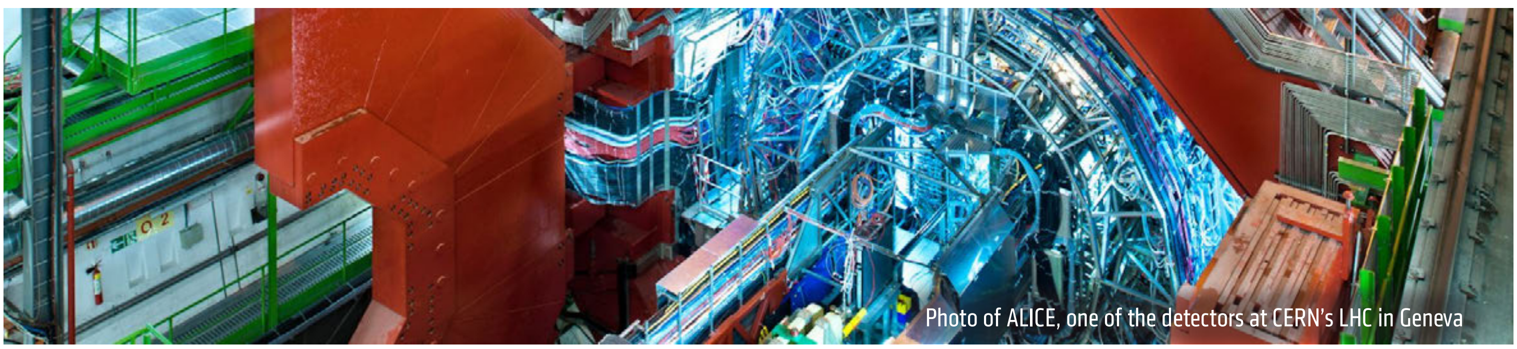

Photo of ALICE, one of the detectors at CERN’s LHC in Geneva

About Nikhef

Nikhef is the Dutch National Institute for Subatomic Physics. The institute performs research into the elementary building blocks of our Universe, their mutual forces and the structure of space and time. A large part of Nikhef’s research takes place at the Large Hadron Collider at CERN. Nikhef is also active in astroparticle physics, where interactions of high-energy cosmic particles are observed, for example in the atmosphere or in sea water. Research into gravitational waves and the existence of dark matter is of key importance as well. For more information, visit nikhef.nl.

About AMD

For 50 years, AMD has driven innovation in high-performance computing, graphics, and visualization technologies–the building blocks for gaming, immersive platforms, and the data center. Hundreds of millions of consumers, leading Fortune 500 businesses, and cutting-edge scientific research facilities around the world rely on AMD technology daily to improve how they live, work, and play. AMD employees around the world are focused on building great products that push the boundaries of what is possible. For more information about how AMD is enabling today and inspiring tomorrow, visit amd.com/EPYC.