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From Big Bang to Big Data: ASTRON and IBM Collaborate to Explore Origins of the Universe

- Partners to research the exascale computer systems that are needed for what will become the world's largest radio telescope
- Initial 32.9 million EURO, five-year collaboration will materialize in Drenthe, the Netherlands at the newly established ASTRON & IBM Center for Exascale Technology
- Computer system will be targeted to read, analyze and store one exabyte of raw data per day, two times the entire daily traffic on the World Wide Web

Drenthe, the Netherlands and Zurich, Switzerland, April 2, 2012: ASTRON, the Netherlands Institute for Radio Astronomy and IBM (NYSE: IBM) today announced an initial 32.9 million EURO, five-year collaboration to research extremely fast, but low-power exascale computer systems targeted for the international Square Kilometre Array (SKA). The SKA is an international project to build the world's largest and most sensitive radio telescope. Scientists estimate that the processing power required to operate the telescope will be equal to several millions of today's fastest computers.

ASTRON is one of the leading scientific partners in the international project that is developing the SKA. Upon completion in 2024, the telescope will be used to explore evolving galaxies, dark matter and even the very origins of the universe—dating back more than 13 billion years.

Flickr Photos: http://www.flickr.com/photos/ibm_research_zurich/sets/72157629212636619/

YouTube Video: http://youtu.be/dvSnPhxe-8U

The next generation of large scientific instruments, of which the SKA is a key example, requires a high-performance computing architecture and data transfer links with a capacity that far exceeds current state-of-the-art technology.

To solve this unprecedented challenge, ASTRON and IBM scientists in the Netherlands and Switzerland have launched an initial five-year collaboration called DOME, named for the protective cover on telescopes and the famous Swiss mountain.

DOME will investigate emerging technologies for large-scale and efficient exascale computing, data transport and storage processes, and streaming analytics that will be required to read, store and analyze all the raw data that will be collected daily.* Scientists from both organizations will collaborate at the newly established ASTRON & IBM Center for Exascale Technology in Drenthe, the Netherlands.

Ton Engbersen, IBM Research – Zurich explains, “If you take the current global daily Internet traffic and multiply it by two**, you are in the range of the data set that the Square Kilometre Array radio telescope will be collecting every day. This is Big Data Analytics to the extreme. With DOME we will embark on one of the most data-intensive science projects ever planned, which will eventually have much broader applications beyond radio astronomy research.”

Only by basing the overall design on architectures that are beyond the current state-of-the-art will it be possible to handle the vast amounts of data produced by the millions of antenna systems of the SKA. Specifically, scientists at ASTRON and IBM will investigate advanced accelerators and 3D stacked chips for more energy-efficient computing. They will also research novel optical interconnect technologies and nanophotonics to optimize large data transfers, as well as high-performance storage systems based on next-generation tape systems and novel phase-change memory technologies.

“Large research infrastructures like the SKA require extremely powerful computer systems to process all the data. The only acceptable way to build and operate these systems is to dramatically reduce their power consumption. DOME gives us unique opportunities to try out new approaches in Green Supercomputing. This will be beneficial for society at large as well,” said Marco de Vos, Managing Director of ASTRON.

To help determine a fundamental design based on realistic parameters, scientists will use advanced and proven methodologies developed by IBM Research – Zurich to model and optimize the architectures of large-scale infrastructures. The basis for this optimization will be an analysis of the existing system for the low-frequency array (LOFAR), designed and built by ASTRON. LOFAR also serves as a so-called “pathfinder telescope” for the larger SKA because it demonstrates pivotal SKA technology.

The DOME collaboration is realized with financial support of the Dutch Ministry of Economic Affairs, Agriculture and Innovation (EL&I) and from the Province of Drenthe.

Introducing the SKA

Headquartered in Manchester in the UK, the SKA Organization is leading the international project to design and build the SKA, the world’s largest radio telescope.

This extremely powerful survey telescope will have millions of antennas to collect radio signals, forming a collection area equivalent to one square kilometre but spanning a huge surface area—over 3000 km wide or approximately the width of the continental United States. The SKA will be 50 times more sensitive than any former radio device and more than 10,000 times faster than today’s instruments.

The SKA is expected to produce a few Exabytes of data per day for a single beam per one square kilometer. After processing this data the expectation is that per year between 300 and 1500 Petabytes of data need to be stored. In comparison, the approximately 15 Petabytes*** produced by the large hadron collider at CERN per

year of operation is approximately 10 to 100 times less than the envisioned capacity of SKA.

A History of Collaboration

IBM has collaborated previously with ASTRON on the design, engineering and manufacturing of customized, high-performance, low-power analogue and mixed signal processing chips for a SKA prototype system. Furthermore, the two organizations worked together on implementing IBM's Blue Gene® supercomputer, currently being used to gather and analyze information from ASTRON's low-frequency array (LOFAR) "software telescope" network located in the northern region of the Netherlands.

Plans for the location of the SKA are still to be finalized, with a decision expected in 2012. Australia and South Africa are the two remaining options, where it would be possible to install the millions of antennas required for receiving the very weak signals from the universe.

** To put in perspective the one exabyte that the SKA is expected to generate daily: approx. 18 exabytes represents the limit of what is addressable with today's 64-bit computer architectures (it is exactly 18.4467441 × 10E19)*

*** Based on 19,707 petabytes per month (2011), http://en.wikipedia.org/wiki/Internet_traffic*

****Source: http://user.web.cern.ch/public/en/LHC/Computing-en.html*

About ASTRON

ASTRON is the Netherlands Institute for Radio Astronomy. Its mission is to make discoveries in radio astronomy happen, via the development of novel and innovative technologies, the operation of world-class radio astronomy facilities, and the pursuit of fundamental astronomical research. See also: www.astron.nl.

About IBM:

For more information visit www.research.ibm.com

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