# WORK ON CLUSTER HYBRILIT

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# Web site: heterogeneous cluster HybriLIT

### Website hybrilit.jinr.ru

#### About | Resources | Users | Support

ENG | PYC



#### Heterogeneous cluster "HybriLIT"

"HybriLIT" heterogeneous cluster is a computation component of a multifunctional center for data storage, processing and analysis of the Laboratory of information technologies JNR; and it is intended for performing computations with the use of parallel programming technologies. Heterogeneous structure of computational nodes allows developing parallel applications for the solution of a wide range of mathematical resource-intensive tasks using the whole capacity of multicore component and computation accelerators: Nvidia graphic processors and Intel Xeon Phi coprocessors.

#### Hardware



Cluster includes computational nodes with graphical processors of NVIDIA Tesla K40 and NVIDIA Tesla K20x, Intel Xeon Phi7120 and Intel Xeon Phi5110P coprocessors...

#### Software



Software for adjustment, profiling and development of parallel applications, and Fortran, C/C++ are installed on the cluster.

#### Tutorial



Tutorials on MPI, OpneMP, OpenCL, CUDA are held on the basis of the heterogeneous cluster HybriLIT.

JINR, Joliot-Curie 6, 141980 Dubna Moscow region, Russia

# Registration at HybriLIT

### Registration is available at **hybrilit.jinr.ru** in the following section:

### Users $\rightarrow$ Registration

#### • For registration of JINR employees:

It is necessary to fill <u>registration form</u>, print it, sign it and carry it to the room № 216, LIT.

#### • For registration of users from external organizations:

- 1. It is necessary to send an official letter addressed to Matveev V.. the director of JINR.
- 2. After the approval, it is necessary to fill <u>registration form</u> to the users specified in the letter.
- 3. Then it should be signed, scanned and sent to the following e-mail address: <u>hybrilit@jinr.ru</u>.

# Registration at HybriLIT

#### Registration form for JINR employees

#### Registration

*Full name	
*Laboratory	Select laboratory
*Phone number	
*E-mail address	
*Funding source	Select funding source
Project from the funding source	
*Login (latin)	
*Name of the scientific project	
*Summary of the scientific project	

# Registration form for users from external organizations

#### Registration

*Full name	
*Organization	
*Phone number	
*E-mail address	
Collaboration with JINR	
Funding source	Select funding source
Project from the funding recourse	
*Login (latin)	
*Name of the scientific project	
*Summary of the scientific project	

\*Choose resource categories which are planned to be used

CPU	
GPU	
Intel coprocessor	ſ

\*Choose resource categories which are planned to be used

CPU GPU Intel coprocessor

## Services available for HybriLIT users

Services:

Web site: hybrilit.jinr.ru

A service for account management Free IPA

Project Management Service (pm.jinr.ru). Project: HybriLIT user support <a href="https://pm.jinr.ru/projects/hybrilit-user-support">https://pm.jinr.ru/projects/hybrilit-user-support</a>

Indico service for organization of events, conferences, etc. indico-hybrilit.jinr.ru

External services:

Development of documentation Publican

A system for versions' control GIT

# **Project Management Service**

🕝 💿 🔻 🄼 https://pm.jinr.ru/projects/hybrilit-user-support		💌 🔒 😔 🗶 輝 Live Search 🖉
Файл Правка Вид Избранное Сервис Справка 🛛 🗙 🎭 Convert 🝷 🔂 Select		
🖕 Избранное 🛛 Обзор - HybriLIT user support - JINR Project Manage		
Домашняя страница Моя страница Проекты Помощь		Вошли как aleksand Моя учётная запись Выйти
Hybril IT user support	Поиск:	HybriLIT user support
Обзор Действия Задачи Новая задача Диаграмма Ганта Календарь Обзор	Новости Документы Wiki Файлы Настройки	Затраченное время
• helpdesk-sender-email: hybrilit@jinr.ru	🝰 Участники	② 2.00 часов
<ul> <li>Вид: 0 открыто / 0</li> <li>Support: 0 открыто / 2</li> </ul>	Manager: Oksana Streltsova, Дмитрий Подгайный, Мартин Валя, Петр Зрелов Developer: Evgeny Aleksandrov, Дмитрий Беляков, Михаил Матвеев Reporter: Anton Trunin	Затраченное время   Подробности   Отчёт
<ul> <li>Ошибка: 0 открыто / 0</li> <li>Улучшение: 0 открыто / 0</li> <li>Поддержка: 0 открыто / 0</li> </ul>		
Просмотреть все задачи   Календарь   Диаграмма Ганта		





# Installed software

- Scientific Linux 6.5. Version of core: 2.6.32—431.11.2
- gcc compiler:
  - version 4.4.7
  - version 3.4.6 (has name gcc34)
- Fortran:
  - f77
  - f95
  - gfortran

# Installed software

- mpi:
  - Openmpi version 1.6.5
  - Openmpi version 1.8.1
  - compat-openmpi
  - MVAPICH
  - MVAPICH2
- cuda:
  - CUDA Toolkit v5.5
  - CUDA Toolkit v6
- Intel Cluster Studio XE 2013
- jdk-1.7.0\_60
- jdk-1.8.0

# Cuda toolkit

- nvcc CUDA C/C++ compiler;
- Nsight integrated development environment is the ultimate development platform for heterogeneous computing. Work with powerful debugging and profiling tools that enable you to fully optimize the performance of the CPU and GPU;
- Visual Profiler is a cross-platform performance profiling tool that delivers developers vital feedback for optimizing CUDA C/C++ applications;
- CUDA-GDB delivers a seamless debugging experience that allows you to debug both the CPU and GPU portions of your application simultaneously;
- CUDA-Memcheck detects these errors in your GPU code and allows you to locate them quickly;
- CUDA Libraries set of GPU-Accelerated Libraries.

# Intel Cluster Studio XE 2013

- Intel C and C++ Compilers C/C++ compilers;
- Intel Fortran Compiler Fortran compilers;
- Intel MPI Library focuses on making applications perform better on Intel<sup>®</sup> architecture-based clusters—implementing the high performance MPI Version 3.0 specification on multiple fabrics;
- Intel Math Kernel Library (MKL) includes a wealth of math processing routines to accelerate application performance and reduce development time;
- Intel Integrated Performance Primitives is an extensive library of software functions for media and data processing;
- Intel Inspector XE is an easy to use memory and threading error debugger for C, C++, C# and Fortran applications;
- Intel Threading Building Blocks is a widely used, award-winning C and C++ library for creating high performance, scalable parallel applications;
- Intel Trace Analyzer and Collector is a graphical tool for understanding MPI application behavior, quickly finding bottlenecks, improving correctness, and achieving high performance for parallel cluster applications based on Intel architecture;
- Other tools and libraries from Intel

# Start work

### Use **Putty** for Windows or terminal for Linux (only ssh)

Category:			
Session	Basic options for your PuTTY set	]	
Logging	Specify the destination you want to connect to		
	Host Name (or IP address)	Port	
Bell	159.93.36.230	22	
Features	Connection type:		
⊡ · Window	🔘 Raw 🛛 Telnet 🔘 Rlogin 💿 SSH	🔘 Serial	
- Appearance Rehaviour	Load, save or delete a stored session		
	Saved Sessions		
Selection	159.93.36.230		or hydra.jinr.ru
Colours	159.93.36.230	Load	
Proxy		Save	
Telnet		Delete	
··· Rlogin			
····· Senai	Close window on exit:		
	Always Never Only on cl	ean exit	
About	Open	Cancel	]

# Software peculiarities for work on the cluster HYBRILIT

Use of EOS for data storage:

The project started in 2010 at CERN

> There are still some mistakes(symbolic references do not work, file attributes are

lost while copying a file (Executive file becomes a non-executive))

➢It is possible to monitor the server remotely

The use of package of modules;

The use of Simple Linux Utility for Resource Management (SLURM) for task distribution.

### EOS:

- Home dir (cd): /eos/hybrilit.jinr.ru/user/a/aleksand
- Materials for the tutorial: /eos/hybrilit.jinr.ru/scratch/Tutorial\_MPAMCS2014/
- To copy to the home directory: cp –r /eos/hybrilit.jinr.ru/scratch/Tutorial\_MPAMCS2014/

# **Modules** package

Modules package is meant to provide dynamic changes of parameters of user's environment (changes the PATH, etc.).

Main commands:

- module avail list of available modules;
- module list list of loaded modules;
- module add/load MODE load module MODE;
- module rm MODE unload module MODE.

sinfo-gives information about all existing partitions;

srun [-p *partition*] *command* – runs a task in interactive mode (max 5 min), where *partition* is one of the existing partitions (automatically interactive), and *command* is the execution command;

sbatch [-p partition] pathScript – puts a task on the queue, where partition is
one of the existing partitions (automatically interactive); and pathScript is
the path to a file with the script;

An example of script file outputting the host name :

#!/bin/bash
hostname

squeue [-u username] – gives information about executing tasks and the queue, where username is the login of a user;

scancel jobId – means task's cancellation, where jobId is a task's id.



### Documentation available on following address: <u>http://vm147.jinr.ru/doc/en/</u>

# Thank you for attention!