

# UČEŠĆE SRPSKIH NAUČNIKA U CERN-U

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**Nov 28, 2009**



# OVERVIEW

- ATLAS DETECTOR
- LHC DATA
- ESCIENCE - A SCIENTIFIC RENAISSANCE
- TECHNOLOGY PUSH
- THE GRID VISION
- **GRID PROJECTS RELEVANT FOR SERBIA**
  - EGEE PROGRAMME
  - SEE-GRID PROGRAMME
  - AEGIS PROGRAMME
- **SERBIAN GRID RESOURCES - AEGIS**  
**EINFRASTRUCTURE**
- CONCLUSIONS

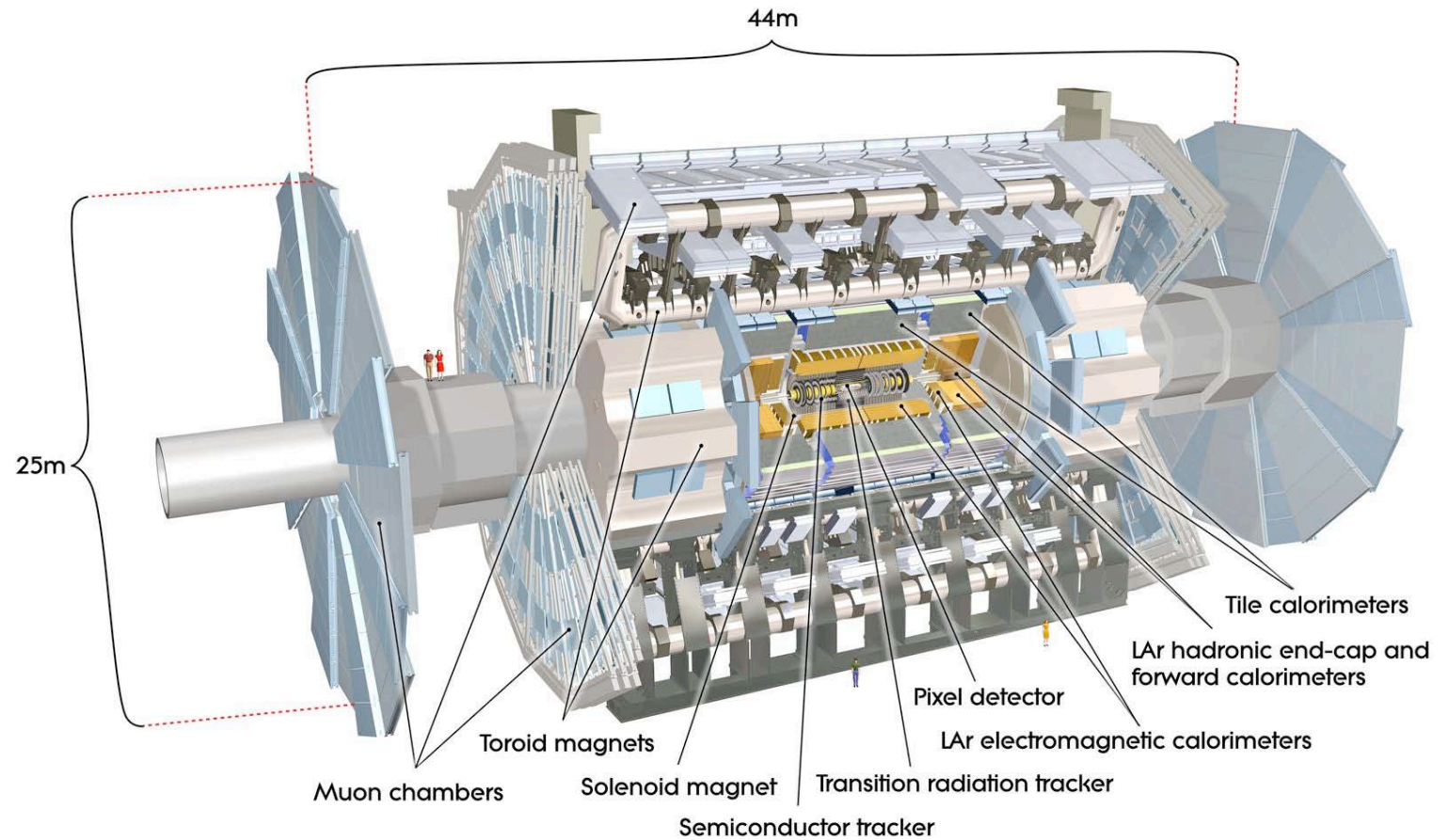


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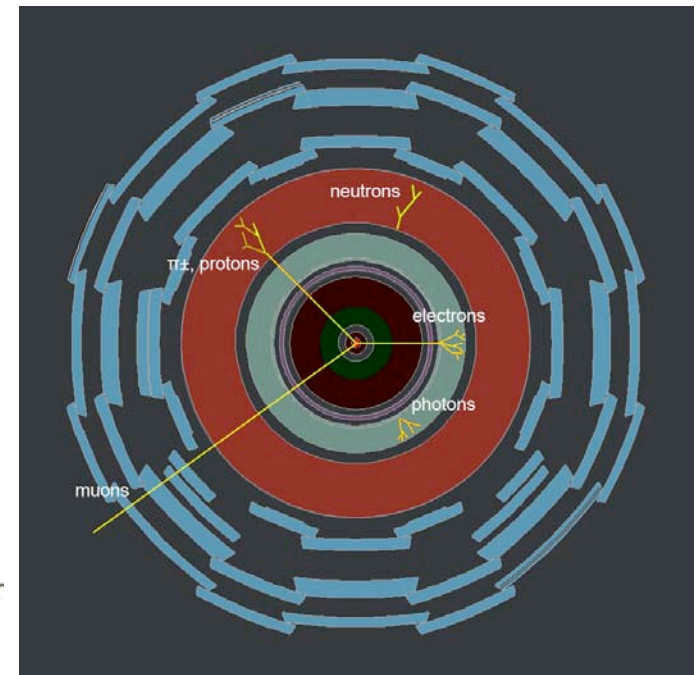
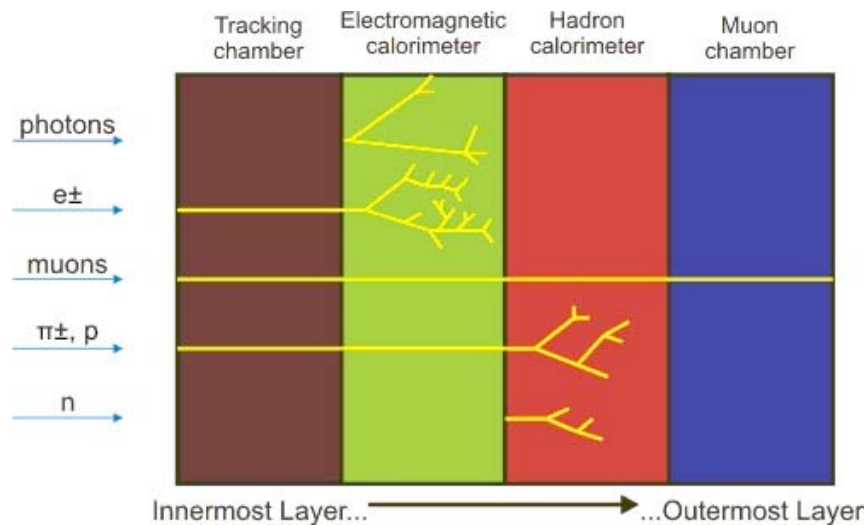
# ATLAS DETEKTOR [1/2]

## ■ A TOROIDAL LHC APPARATUS



# ATLAS DETEKTOR [2/2]

- THE ATLAS DETECTOR CONSISTS OF SEVERAL COMPONENTS
- DIFFERENT PARTICLES INTERACTING IN DIFFERENT LAYERS





# LHC PODACI

- 4 EKSPERIMENTA (ATLAS, ALICE, CMS, LHCb)
- 40 MILIONA SUDARA PO SEKUNDI
- POSLE FILTRIRANJA 100 SUDARA OD INTERESA PO SEKUNDI
- DIGITIZACIJA 1 MB PODATAKA PO SUDARU
- 0.1 GB PO SEKUNDI
- 10PB PO GODINI
- 20 MILIONA CD-OVA PO GODINI

1 EB (EXABYTE)	SVETSKA GODIŠNJA PRODUKCIJA INFORMACIJA
1 PB (PETABYTE)	GODIŠNJA PRODUKCIJA LHC EKSPERIMENTA
1 TB (TERABYTE)	SVETSKA GODIŠNJA PRODUKCIJA KNJIGA
1 GB (GIGABYTE)	DVD FILM
1 MB (MEGABYTE)	DIGITALNA FOTOGRAFIJA



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# LHC OBRADA PODATAKA [1/2]

- GENERISANJE DOGADJAJA – GENERISANJE ČESTICA I NJIHOVIH KINEMATIČKIH OSOBINA
- SIMULACIJA DOGADJAJA – POMOĆU TEORIJE I KARAKTERISTIKA DETEKTORA  
IZRAČUNAVANJE ODGOVORA DETEKTORA
- REKONSTRUKCIJA DOGADJAJA –  
TRANSFORMACIJA SIGNALA DETEKTORA U  
FIZIČKE VELIČINE (ENERGIJU, NELEKTRISANJE  
ČESTICA, ...)
- ANALIZA DOGADJAJA – NALAŽENJE SUDARA  
SLIČNIH OSOBINA I KORIŠĆENJE  
KOMPLEKSNIH ALGORITAMA ZA  
EKSTRAHOVANJE FIZIKE



# LHC OBRADA PODATAKA [1/2]

- ZA POTUPNU SIMULACIJU JEDNOG SUDARA (DOGADJAJA) U ATLAS DETEKTORU POTREBNO JE ~ 15 MIN. NA DANAŠNJIM PROCESORIMA
- ZA DOBRU ANALIZU JEDNOG KANALA POTREBNO JE U PROCEKU 100 000 DOGADJAJA
- ZA POTPUNU SIMULACIJU SAMO JEDNOG KANALA POTREBNO JE U PROCEKU 3 GODINE PROCESORSKOG VREMENA
- ANALIZA PODATAKA NA LHC ZAHTEVA KOMPIJUTERSKU SNAGU EKVIVALENTNU 100 000 DANAŠNJIH PC PROCESORA

KOMPJUTERSKA SNAGA CERN-A

VIŠE OD 1000 DVOPROCESORSKIH PC-JA

VIŠE OD 1 PB PROSTORA NA DISKOVIMA I TRAKAMA

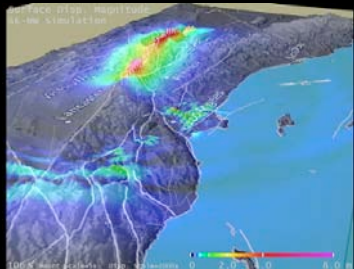
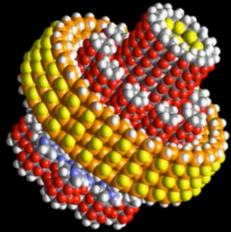
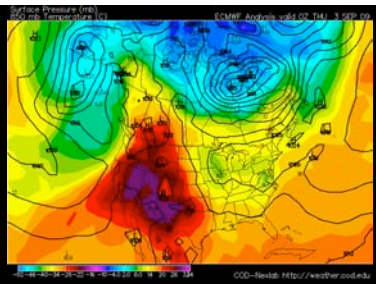


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# ESCIENCE

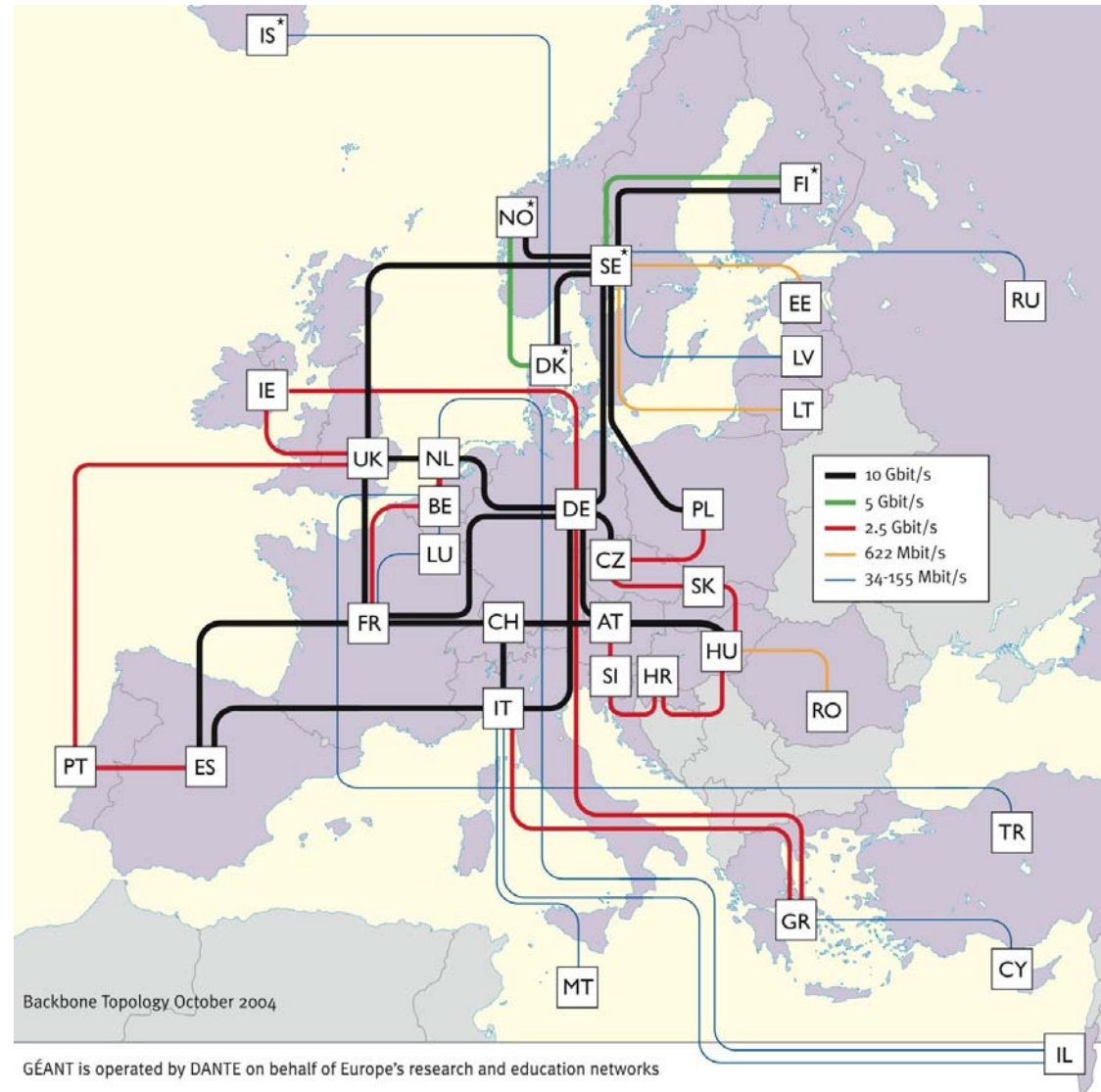
- SCIENCE IS BECOMING INCREASINGLY DIGITAL, NEEDS TO DEAL WITH INCREASING AMOUNTS OF DATA AND COMPUTATIONAL NEEDS
- SIMULATIONS GET EVER MORE DETAILED
  - NANOTECHNOLOGY – DESIGN OF NEW MATERIALS FROM THE MOLECULAR SCALE
  - MODELING AND PREDICTING COMPLEX SYSTEMS (WEATHER FORECASTING, RIVER FLOODS, EARTHQUAKE)
  - DECODING THE HUMAN GENOME
- EXPERIMENTAL SCIENCE USES EVER MORE SOPHISTICATED SENSORS TO MAKE PRECISE MEASUREMENTS
  - NEED HIGH STATISTICS
  - HUGE AMOUNTS OF DATA
  - SERVES USER COMMUNITIES AROUND THE WORLD
- DIFFERENT GROUPS COLLABORATE





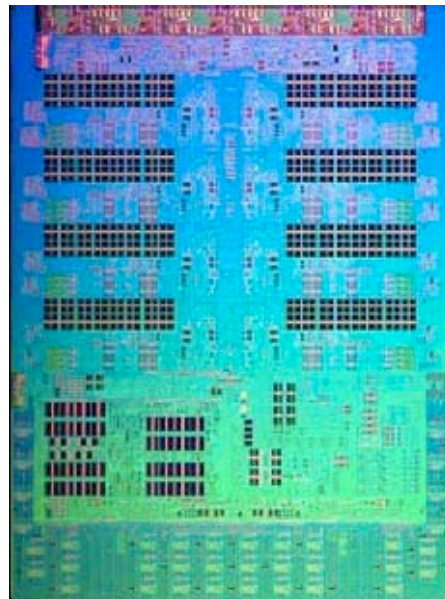
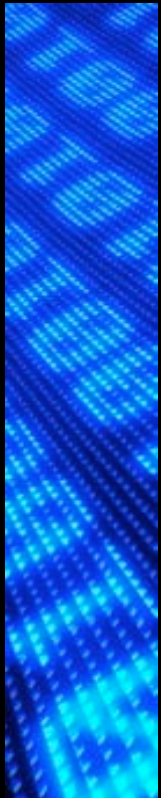
# TECHNOLOGY PUSH (1/2)

## ■ HIGH PERFORMANCE NETWORKS



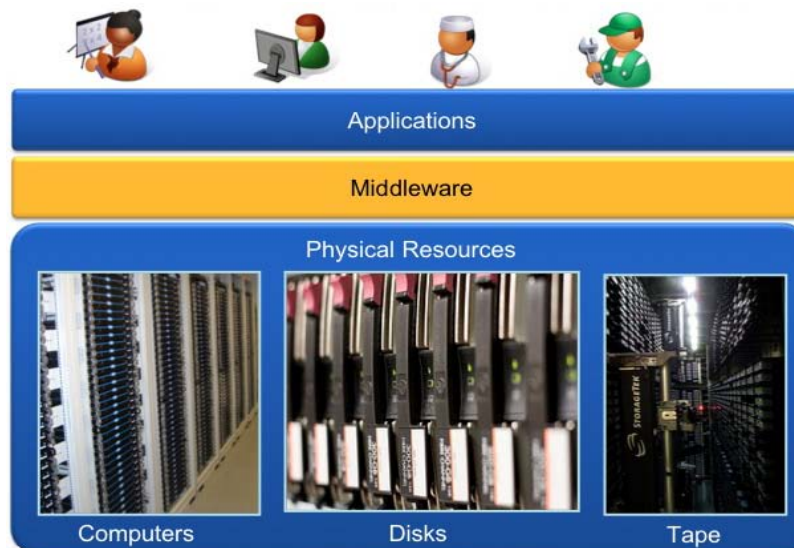
# TECHNOLOGY PUSH (2/2)

- HIGHER PERFORMANCE AT REDUCED COST
  - MULTI CORE ARCHITECTURES
- PETAFLOPS MACHINES
  - USA: ROADRUNNER, JAGUAR (1 PF 2008);
  - EUROPE: JUGENE (1 PF 2009)  
PRACE (3-5 1PF MACHINES 2010)
  - JAPAN: KEISOKU (10PF 2011/12)



# THE GRID VISION

- RESEARCHERS PERFORM THEIR ACTIVITIES REGARDLESS GEOGRAPHICAL LOCATION, INTERACT WITH COLLEAGUES, SHARE AND ACCESS DATA
- THE GRID: NETWORKED DATA PROCESSING CENTRES AND MIDDLEWARE SOFTWARE AS THE “GLUE” OF RESOURCES
- SCIENTIFIC INSTRUMENTS AND EXPERIMENTS PROVIDE HUGE AMOUNT OF DATA





# WHAT IS THE GRID?

- THE WORLD WIDE WEB PROVIDES SEAMLESS ACCESS TO INFORMATION THAT IS STORED IN MANY MILLIONS OF DIFFERENT GEOGRAPHICAL LOCATIONS
- IN CONTRAST, THE GRID IS A NEW COMPUTING INFRASTRUCTURE WHICH PROVIDES SEAMLESS ACCESS TO COMPUTING POWER AND DATA DISTRIBUTED OVER THE GLOBE
- THE NAME GRID IS CHOSEN BY ANALOGY WITH THE ELECTRIC POWER GRID: PLUG-IN TO COMPUTING POWER WITHOUT WORRYING WHERE IT COMES FROM, LIKE A TOASTER



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## GRID PROJECTS RELEVANT FOR SERBIA – EGEE [1/3]

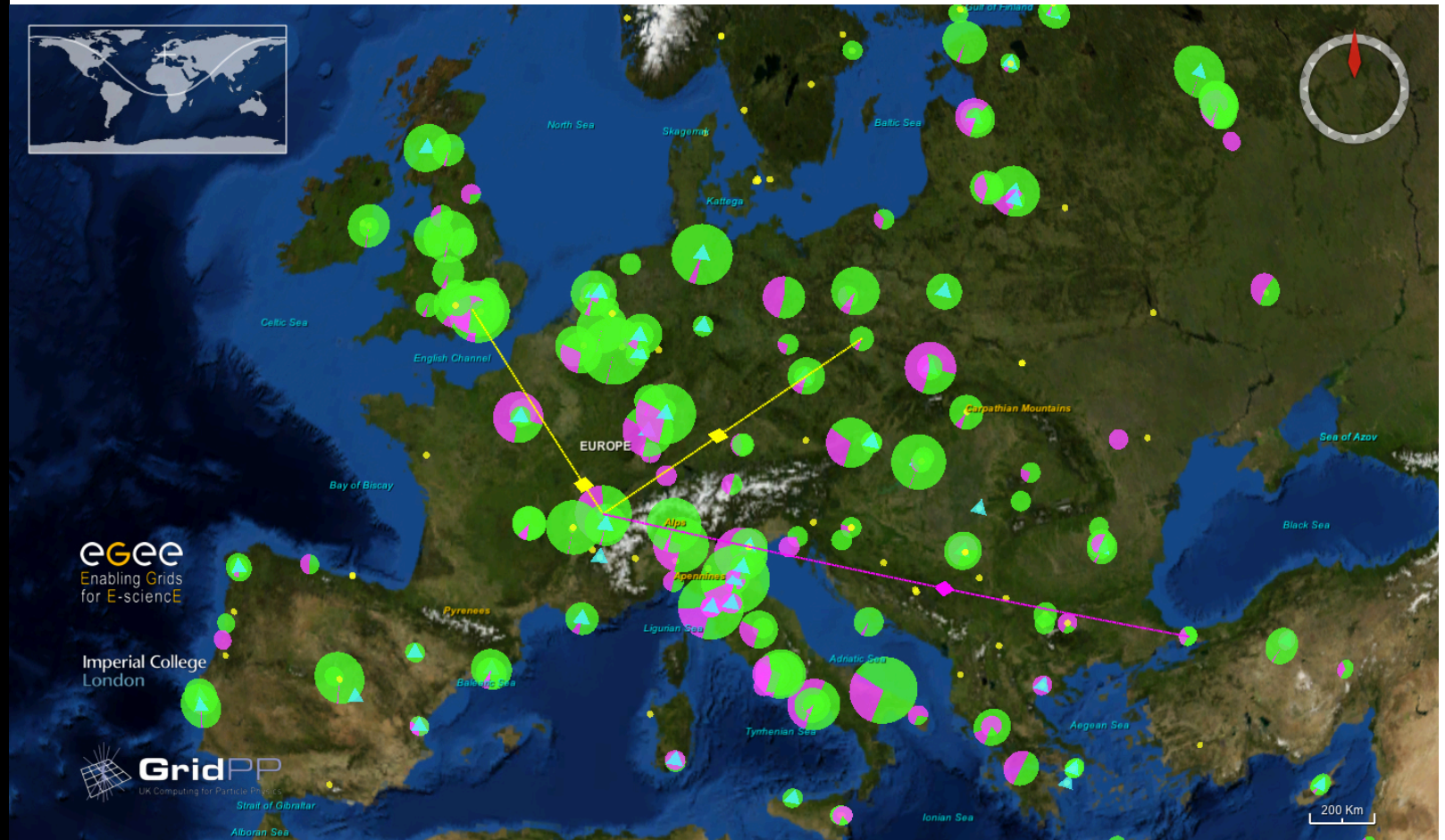
- EUROPE'S LEADING GRID COMPUTING PROJECT, PROVIDING A COMPUTING SUPPORT INFRASTRUCTURE FOR OVER 10 000 RESEARCHERS WORLD-WIDE, FROM FIELDS AS DIVERSE AS HIGH ENERGY PHYSICS, EARTH AND LIFE SCIENCES
- EGEE OBJECTIVES
  - BRINGS TOGETHER EXPERTS FROM MORE THAN 50 COUNTRIES WITH THE COMMON AIM OF BUILDING ON RECENT ADVANCES IN GRID TECHNOLOGY AND DEVELOPING A SERVICE GRID INFRASTRUCTURE
  - THE MAIN FOCUS TO PREPARE THE MIGRATION OF THE EXISTING PRODUCTION EUROPEAN GRID FROM A PROJECT-BASED MODEL TO A SUSTAINABLE FEDERATED INFRASTRUCTURE BASED ON NATIONAL GRID INITIATIVES

# GRID PROJECTS RELEVANT FOR SERBIA – EGEE [2/3]

## ■ EGEE RESULTS

- ABOUT 290 SITES ACROSS 55 COUNTRIES
- MORE THAN 144 000 CPU AVAILABLE
- MORE THAN 60 PETABYTES OF STORAGE
- REGULAR WORKLOADS OF 330K JOBS/DAY
- MASSIVE DATA TRANSFERS ~1.5 GB/s
- REAL TIME MONITORING
- USER SUPPORT: SINGLE ACCESS POINT FOR SUPPORT, KNOWLEDGEABLE EXPERTS, RESPONSIVE SUPPORT
- MORE THAN 15 APPLICATION DOMAINS

# GRID PROJECTS RELEVANT FOR SERBIA – EGEE [3/3]





# GRID PROJECTS RELEVANT FOR SERBIA – SEE-GRID [1/2]

## ■ SEE-GRID

- THE SEE-GRID THROUGH ITS TWO PHASES HAS ESTABLISHED A STRONG REGIONAL HUMAN NETWORK IN THE AREA OF SCIENTIFIC COMPUTING, HAS SET UP A POWERFUL REGIONAL GRID INFRASTRUCTURE, AND ATTRACTED A NUMBER OF APPLICATIONS FROM DIVERSE FIELDS FROM COUNTRIES THROUGHOUT THE SOUTH-EAST EUROPE
- CURRENT PHASE OF SEE-GRID PROGRAMME, SEE-GRID-SCI INVOLVES THREE STRATEGIC INTERNATIONAL SCIENTIFIC COMMUNITIES:
  - SEISMOLOGY
  - METEOROLOGY
  - ENVIRONMENTAL PROTECTION)

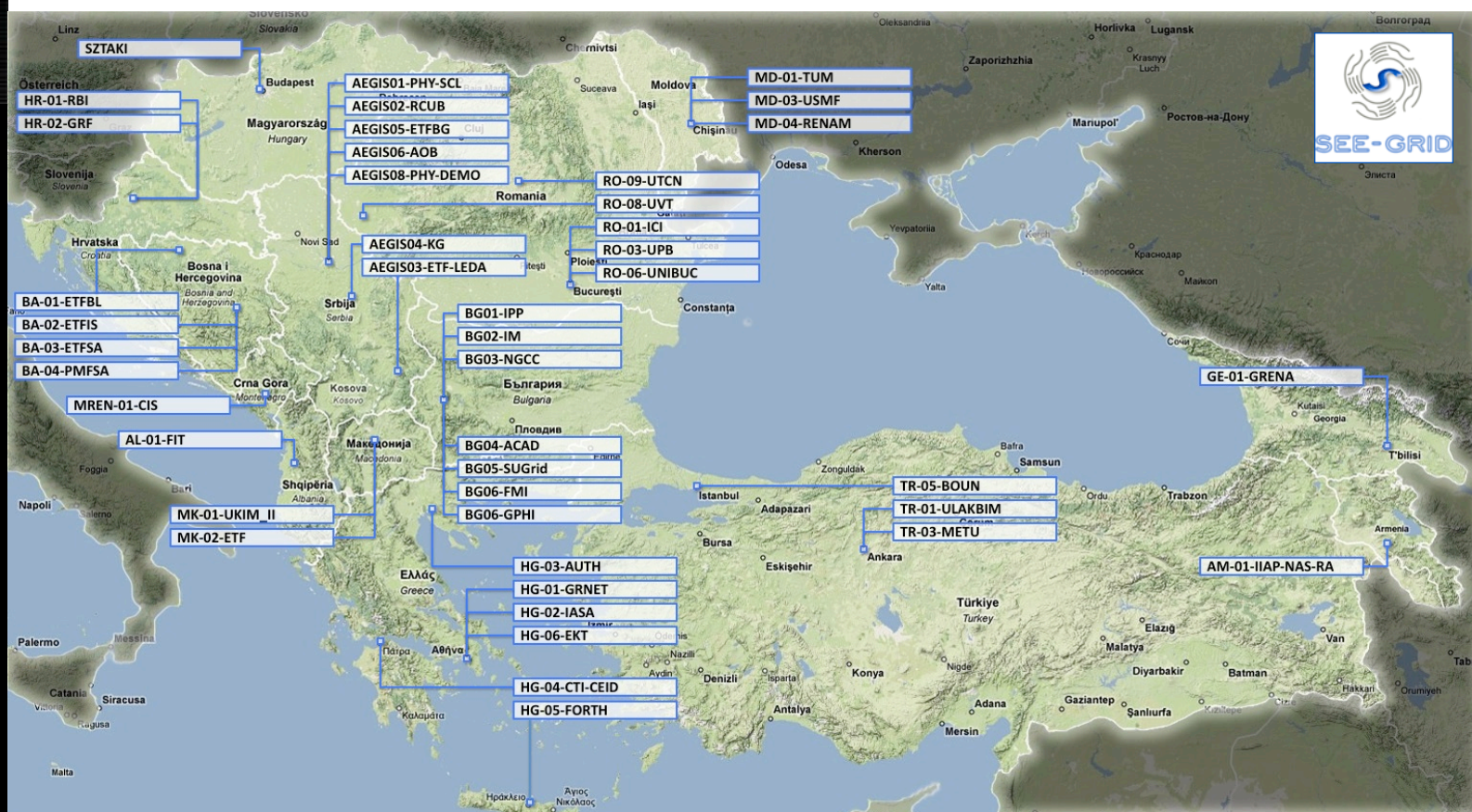




# GRID PROJECTS RELEVANT FOR SERBIA – SEE-GRID [2/2]

## ■ SEE-GRID INFRASTRUCTURE

- ABOUT 35 SITES ACROSS 15 COUNTRIES
- MORE THAN 2 000 CPU AVAILABLE
- MORE THAN 400 TERABYTES OF STORAGE





**AEGIS**

# **GRID PROJECTS RELEVANT FOR SERBIA – AEGIS [1/2]**

- **ACADEMIC AND EDUCATIONAL GRID INITIATIVE OF SERBIA WAS ESTABLISHED IN 2005 TO COORDINATE EFFORTS ON DEVELOPING ACADEMIC AND EDUCATIONAL HIGH PERFORMANCE COMPUTING FACILITIES IN SERBIA**
  
- **ONE OF THE MAJOR AEGIS TASKS**
  - **DISSEMINATION AND TRAINING ACTIVITIES ORGANIZATION**
  
  - **HELP TO SERBIAN RESEARCH COMMUNITIES IN DEVELOPING AND PRODUCTION USE OF APPLICATIONS**



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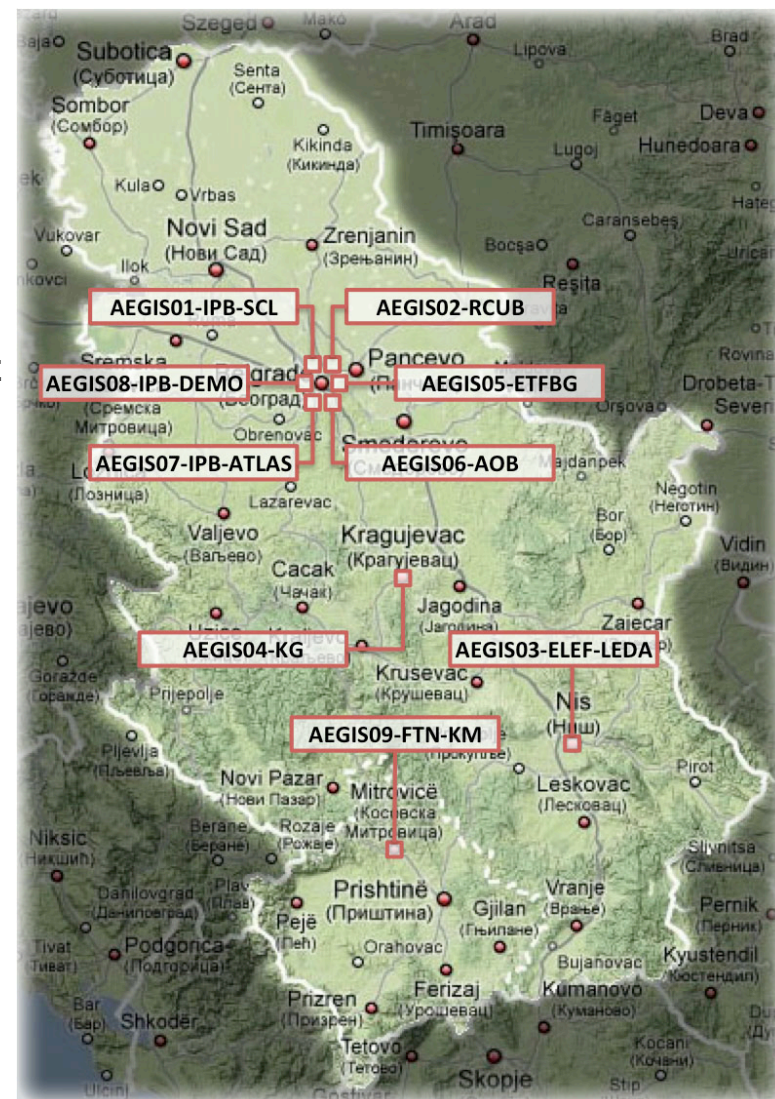


**AEGIS**

# GRID PROJECTS RELEVANT FOR SERBIA – AEGIS [2/2]

## ■ AEGIS INFRASTRUCTURE

- 9 SITES
- MORE THAN 1 000 CPUS
- MORE THAN 30 TERABYTES
- NATIONAL SOFTWARE AND MIDDLEWARE REPOSITORIES
- NATIONAL GRID CORE SERVICES
- NATIONAL VO
- NATIONAL MONITORING
- NATIONAL USER PORTAL
- NATIONAL HELPDESK



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# CONCLUSIONS [1/2]

- SERBIA HAS LONG-STANDING STRONG PARTICIPATION IN EUROPEAN GRID PROJECTS AND HAS ESTABLISHED A RELIABLE AND EXTENSIVE NATIONAL GRID INFRASTRUCTURE
- SERBIAN GRID INFRASTRUCTURE PROVIDES MORE THAN 1000 CPUS AND 30 TB OF DATA STORAGE TO ALL USER COMMUNITIES THROUGH A DISTRIBUTED SET OF GRID SITES HOSTED BY MAJOR RESEARCH INSTITUTES AND UNIVERSITIES
- SERBIAN GRID INFRASTRUCTURE IS FULLY UTILIZED BY A NUMBER OF SCIENTIFIC HIGH-PERFORMANCE APPLICATIONS, DEVELOPED SERBIAN RESEARCHERS AND ADAPTED FOR OPTIMAL USE ON THE GRID



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## CONCLUSIONS [2/2]

- SERBIAN GRID INFRASTRUCTURE ALSO STIMULATED FURTHER COLLABORATION OF SERBIAN AND EUROPEAN RESEARCHERS, AND HELPED IN BRINGING THE ISSUE OF PROVIDING SUPPORT FOR RESEARCH INFRASTRUCTURE TO THE AGENDA OF SERBIAN POLICY MAKERS
- SERBIAN NGI ACTIVELY PARTICIPATES AND WORKS WITH OTHER NGIS ON ESTABLISHING A SUSTAINABLE EUROPEAN GRID INITIATIVE

