



# **U.S. ATLAS Tier 2 Computing Center**

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**HIPCAT Meeting, UTA**

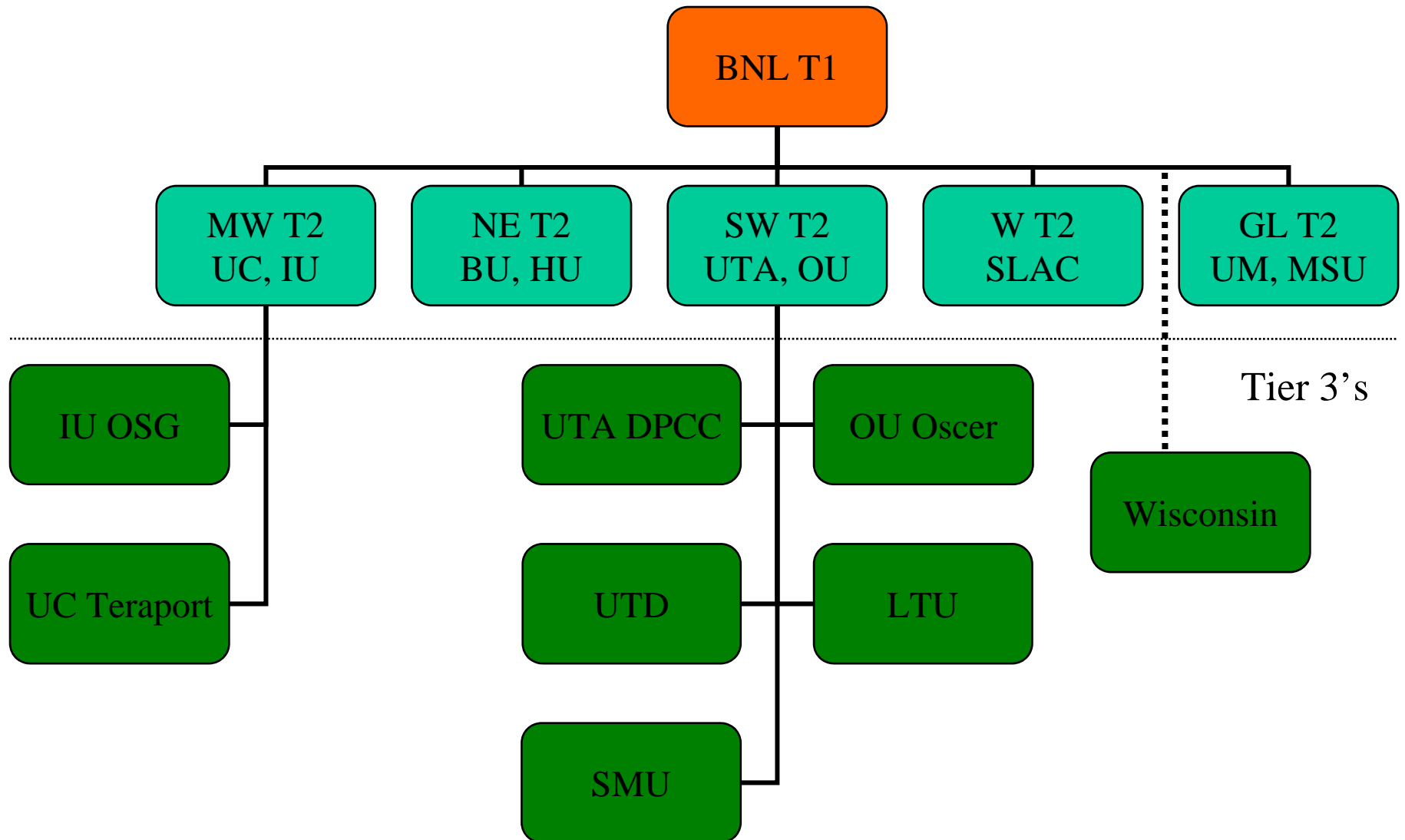
**February 29, 2008**

# Overview



- ❑ Large Hadron Collider (LHC) at CERN
  - ❑ International project involving >50 countries started in 1993
  - ❑ Explore fundamental laws of physics – origin of mass, time, symmetries...
- ❑ LHC computing
  - ❑ Organized internationally through MoU's with WLCG (supports four VO's currently – ATLAS, CMS, LHCb and ALICE)
  - ❑ Organized hierarchically in Tiers – CERN Tier 0, 10 Tier 1's, 30 Tier 2's ++
  - ❑ U.S. effort organized through OSG, which includes other non-LHC VO's
  - ❑ U.S. effort funded by DoE and NSF
- ❑ USATLAS organization
  - ❑ Managed by US ATLAS organization and jointly reviewed by DoE-NSF
  - ❑ BNL Tier 1. five Tier 2's, many Tier 3's
- ❑ Software systems for production
  - ❑ VDT stack supported by OSG
  - ❑ ATLAS stack - Panda (including pathena) and DQ2 (including FTS)

# Site Hierarchy for U.S. Production



# Operations



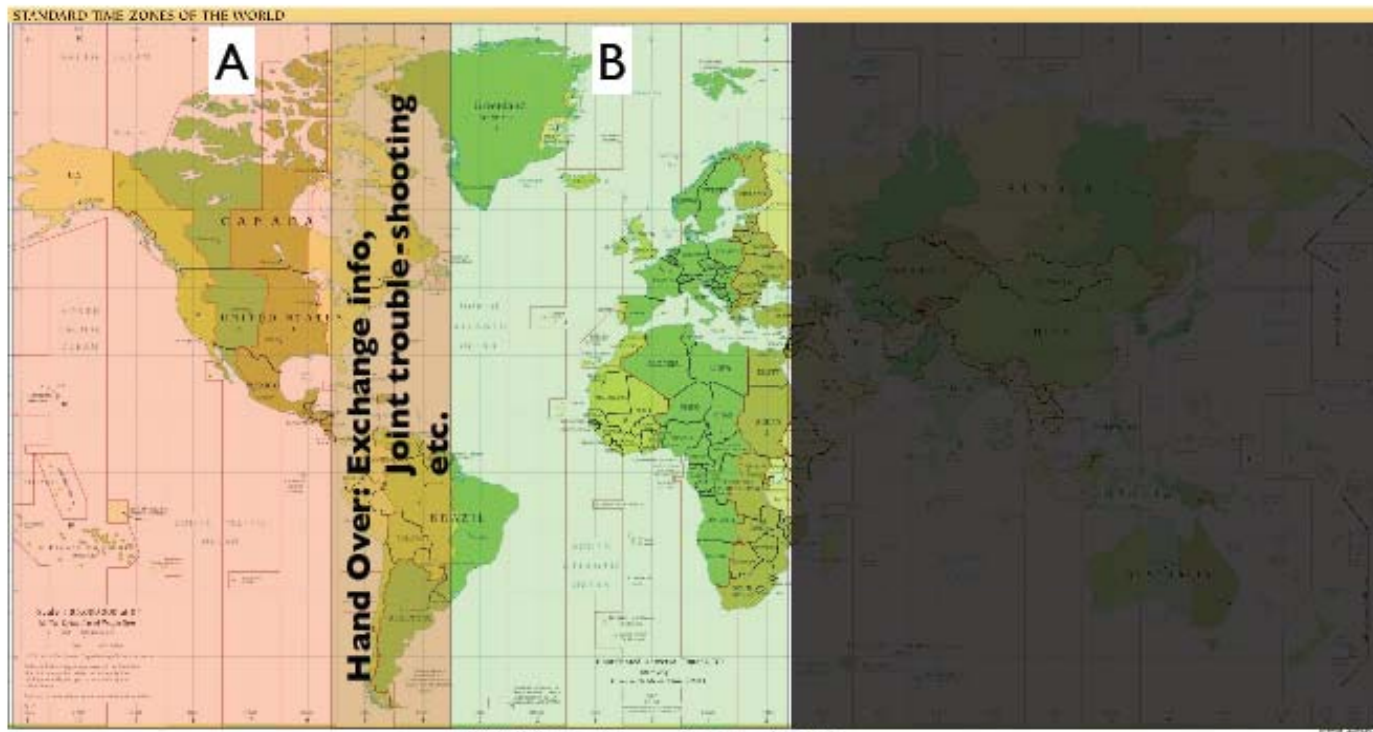
- ❑ LHC data arriving in 2008
- ❑ ATLAS computing system already operational for MC data production, user analysis, throughput tests...
  - ❑ Most systems already at 20-50% scale
  - ❑ Supporting ~2000 users
  - ❑ Support staff worldwide ~300 people (approximately 1/3<sup>rd</sup> in US)
  - ❑ Approximately 30K CPU's available worldwide
  - ❑ Approximately 4PB of storage worldwide
  - ❑ Worldwide operations in place to monitor and provide QoS
- ❑ US ATLAS scale
  - ❑ Currently providing ~10k CPU hours per day for central production, 2k CPU hours for users, 2PB of storage

# ADC Shifts – February 2008



Full ADC operations and Round-the-clock shifts

Phase I: 2 Shifters on Duty (+Trainees) - 14h coverage <sup>2x8h</sup>



ADC Operations Shifts

ATLAS Tier-1 Jamboree 6th December 2007

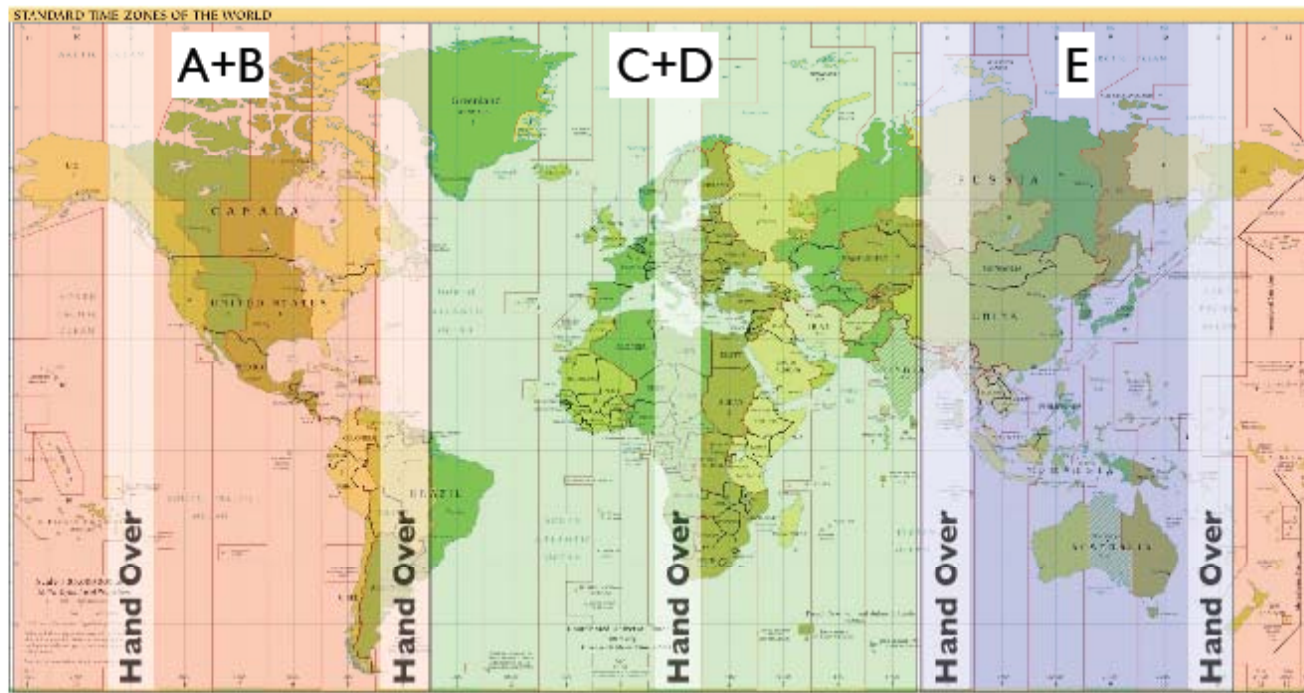
Xavier Espinal

# ADC Shifts – Data Taking Mode



Full ADC operations and Round-the-clock shifts

Phase III: 5 Shifters on Duty (+ Trainees) - 24h coverage<sup>6x6h</sup>



ADC Operations Shifts

ATLAS Tier-1 Jamboree 6th December 2007

Xavier Espinal

# UTA Involvement



- ❑ Leads SouthWest Tier 2 center (UTA, OU, Langston)
- ❑ Leads development of Panda software system
  - ❑ Support centrally managed production
  - ❑ Regional production
  - ❑ User analysis
  - ❑ Selected in 2007 for all ATLAS production
- ❑ Organize regional participation in ATLAS
  - ❑ Support Tier 3 sites
  - ❑ Regional users
- ❑ Physics analysis

# UTA T2 Resources



## ❑ Dedicated Resources

### ❑ UTA\_SWT2

- 320 cores - 2GB/core Xeon EM64T (3.2GHz)
- Several Headnodes
- 20TB/16TB in IBRIX/DDN

### ❑ UTA\_CPB (name is TBD)

- 200 Cores – 2GB/core Opteron 2216
- 3 head nodes
- 75TB/65TB in Dell 10xMD1000+8xDell PE1950

## ❑ UTA\_DPCC

- ❑ 64 Xeon 2.4GHz + 100 Xeon 2.66GHz-1GB/core
- ❑ Atlas usage ~80 Cores
- ❑ Nominally 45TB in 10 ASA Raid systems
  - Realistically using 9TB



# OU/Langston Resources



Horst Severini

November 30, 2007

OCHEP BWT2 Status

## OCHEP Tier 2 Hardware

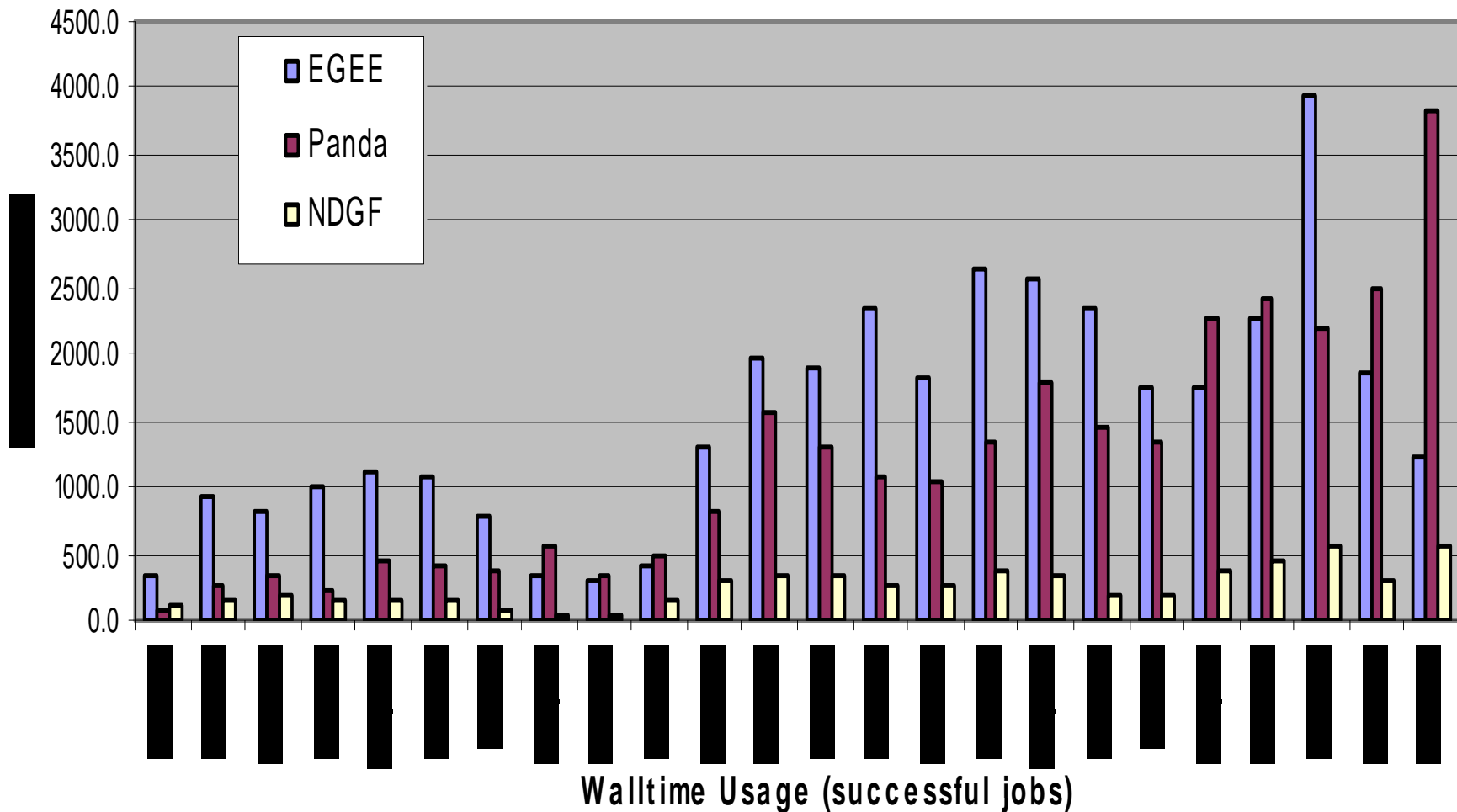
- 61 Node (260 Core) 2.33/3.2 GHz Xeon-64
- 10 Support Nodes (5 head, 5 storage) 2.33/3.2 GHz Xeon-64
- 2 GB RAM per Core
- 16 TB of usable DDN/IBRIX3 storage (24 TB raw)
- ROCKS 4.1 (RHEL4 64 bit)
- OSG 0.8.0, DQ2 0.4.1 remotely from UTA
- tier2-01: head node
- tier2-02: storage node (gsiftp)
- Monitoring: Ganglia, MonALISA, cron scripts
- FY08: \$60k available: 48 additional Cores, 20 additional TB



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ATLAS Tier2/Tier3 Workshop, SLAC

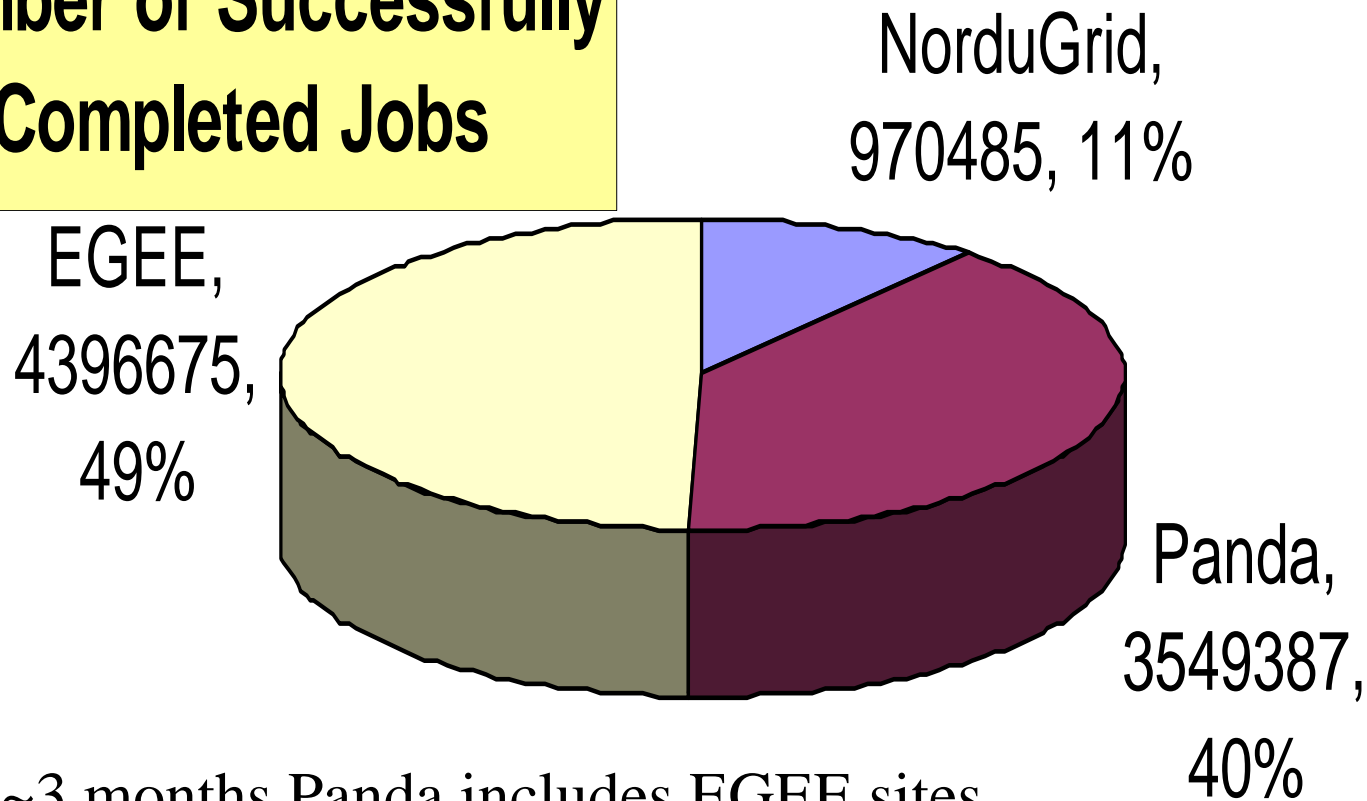
# ATLAS Central Production Resource Usage



# CSC Production – Job Breakdown



**Number of Successfully Completed Jobs**



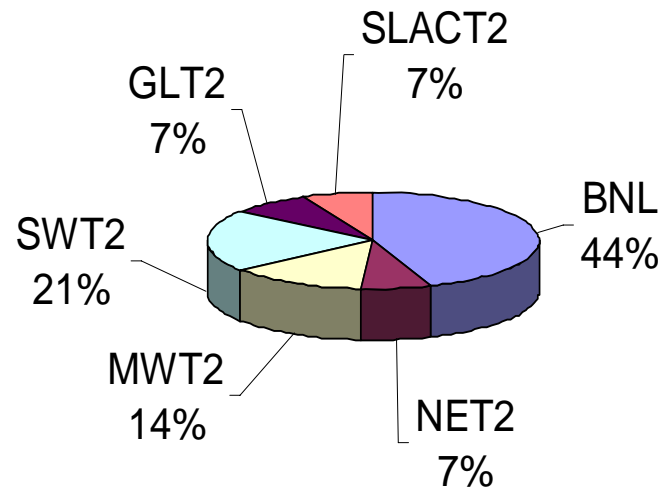
For past ~3 months Panda includes EGEE sites

Total Waltime usage (successful jobs): 6,000 CPU years, since 2006!

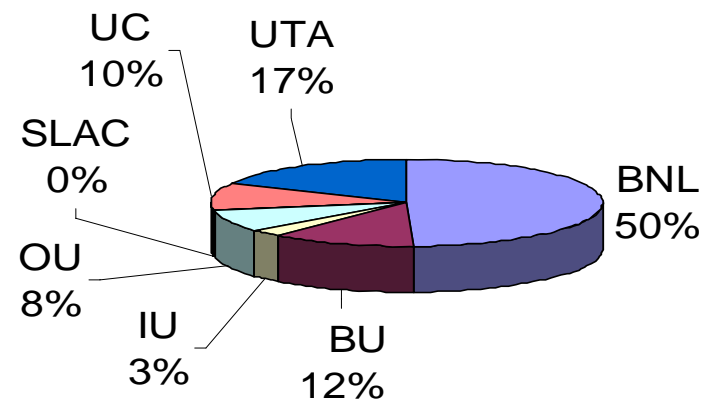
# U.S. ATLAS Production Tier 1 and Tier 2s



### CSC Production - Jobs finished in 2007



### Jobs Finished in 2006

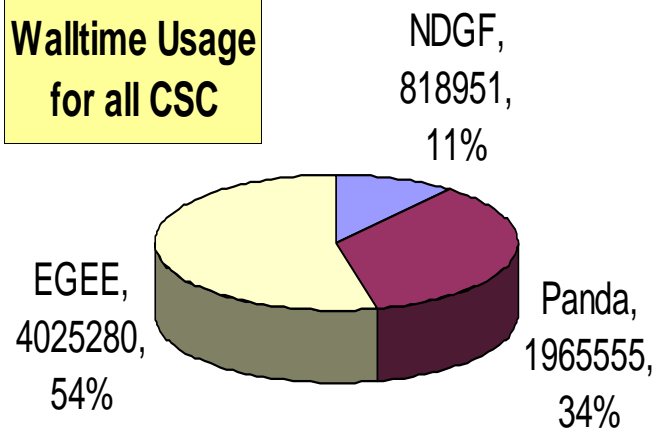


# Panda Production Statistics

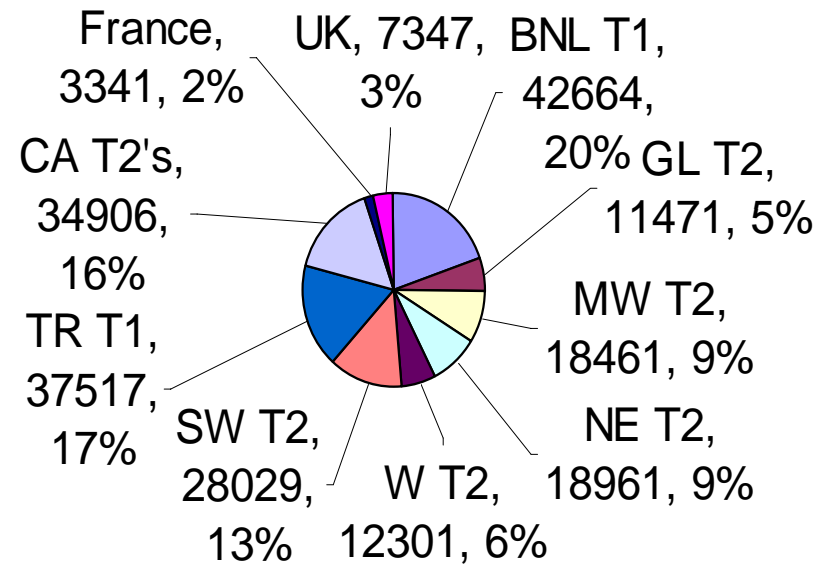


**CSC= Computing System Commissioning**

**Walltime Usage  
for all CSC**

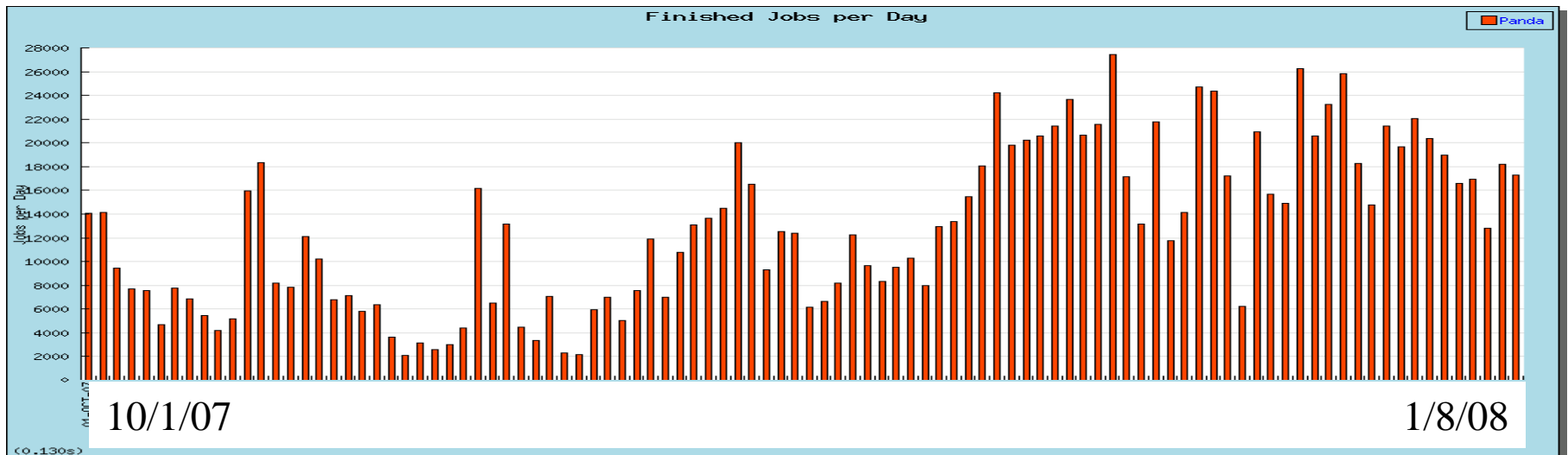
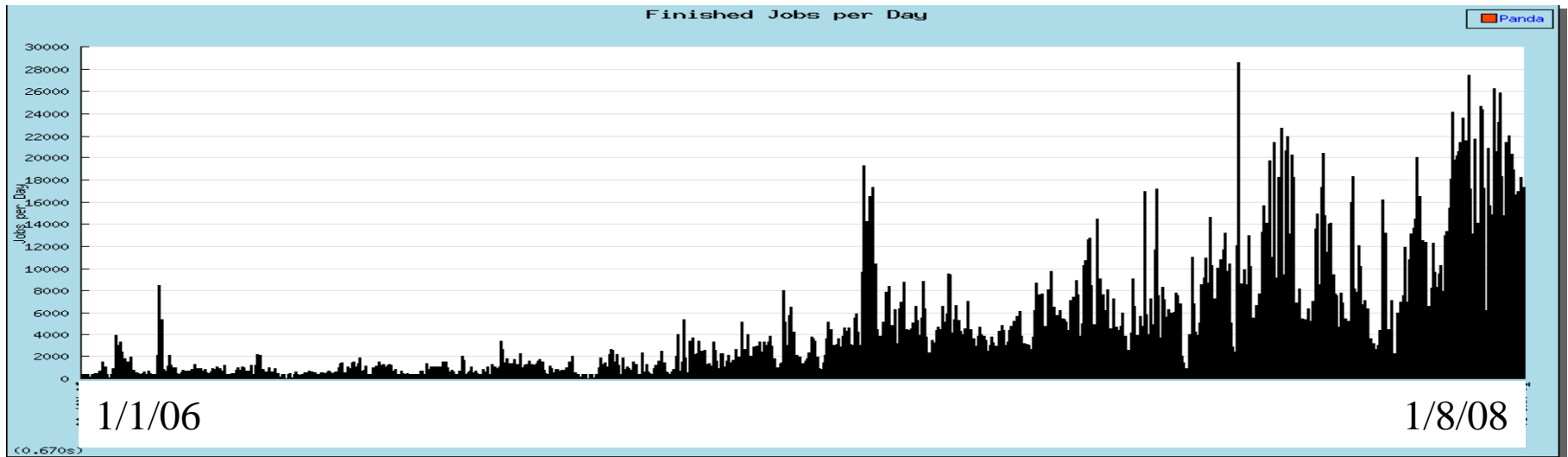


**Panda Walltime Days  
Sep.-Nov., 2007**



Plots till November 2007

# Panda Central Production



# US ATLAS Projections (WLCG Pledged)



		2007	2008	2009	2010	2011
Northeast T2	<i>CPU (kSI2k)</i>	384	685	1,049	1,592	1,988
	<i>Disk (TB)</i>	103	244	445	727	1,024
Great Lakes T2	<i>CPU (kSI2k)</i>	581	985	1,408	1,670	2,032
	<i>Disk (TB)</i>	155	322	542	709	914
Midwest T2	<i>CPU (kSI2k)</i>	826	1,112	978	1,282	1,785
	<i>Disk (TB)</i>	213	282	358	382	512
SLAC T2	<i>CPU (kSI2k)</i>	550	820	1,202	1,191	1,685
	<i>Disk (TB)</i>	228	482	794	1,034	1,482
Southwest T2	<i>CPU (kSI2k)</i>	998	1,388	1,734	1,988	2,514
	<i>Disk (TB)</i>	143	256	328	650	1,103
<b>TOTAL US Tier 2's</b>						
	<i>CPU (kSI2k)</i>	3,348	4,947	6,367	7,681	9,982
	<i>Disk (TB)</i>	842	1,587	2,467	3,482	5,015

BNL Tier1	2007	2008	2009	2010	2011
<b>CPU (kSI2K)</b>	2560	4844	7337	12765	18193
<b>Disk (Tbytes)</b>	1100	3136	5822	11637	16509
<b>Tape (Tbytes)</b>	603	1715	3277	6286	9820

# Conclusion



- ❑ LHC provides unprecedented opportunity and challenge for distributed high performance computing
- ❑ SouthWest Tier 2 center playing a central role
- ❑ Physics data will arrive this year
- ❑ Looking forward to fundamental discoveries of physics