U.S. CMS Software and Computing
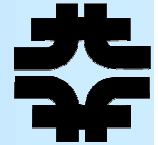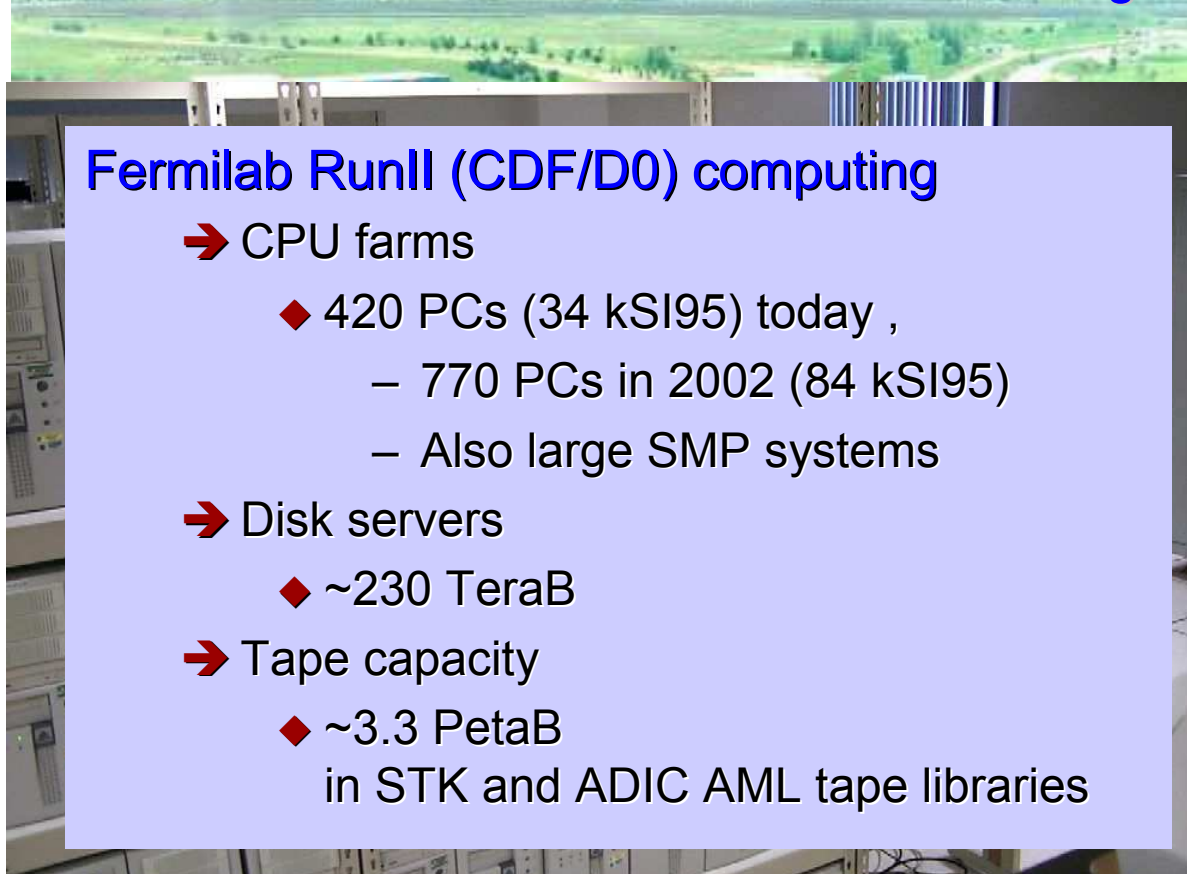
A DOE/NSF sponsored program
   to develop and build "User Facilities" for CMS in the U.S.

➔ ~$67M equipment, operations, salaries until 2007
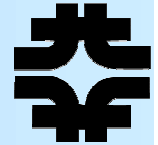
Fermilab is host-lab for U.S. CMS Research Program

Fermilab RunII (CDF/D0) computing

➔ CPU farms

◆ 420 PCs (34 kSI95) today ,

– 770 PCs in 2002 (84 kSI95)

– Also large SMP systems

➔ Disk servers

◆ ~230 TeraB

➔ Tape capacity

◆ ~3.3 PetaB
   in STK and ADIC AML tape libraries

Tier-1 center at Fermilab + 5

➔ Mission is to deliver "Us

➔ 14 CP on project (includ

➔ Fermilab hosts Tier-1 c

◆ for Tier-2 centers

◆ "user community", e

◆ physics analysis ce

Project Milestones and Sch

➔ Prototyping, testbeds, F

◆ R&D systems, fund

– Used for "5% data challenge" ➪ release Software and Computing TDR

◆ Prototype T1/T2 systems, funded in FY2004

– for "20% data challenge" ➪ end "Phase 1", RC TDR, start deployment

➔ Deployment: 2005-2007, 30%, 30%, 40% costs

◆ Fully Functional Tier-1/2 funded in FY2005 through FY2007

– for LHC pilot and physics runs ➪ start Physics Program

➔ Maintenance and Operations: 2007 on

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5 Tier-2 centers in the U.S.

➔ Together will provide same CPU/Disk as Tier-1

"involvement of collaboration" in S&C

➔ Prototyping and test-bed effort going on now

⬇ I.Fisk's talk

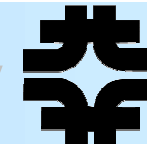**Universities will "bid" to host Tier-2 center**

➔ taking advantage of existing resources

➔ deliver more than they're funded

NSF program for "empowering Universities"

➔ Proposal to the NSF submitted Nov 2001

5% DC: Tier-1 +Tier-2 R&D Systems

20% DC: Prototype Systems

Fully Functional Full Capacity Tier-1/2 Facilities

Fiscal Year	2002	2003	2004	2005	2006	2007
Simulation CPU (Si95)	2,000	3,000	4,000	7,200	28,800	72,000
Analysis CPU (Si95)	750	2,100	4,000	8,000	32,000	80,000
Server CPU (Si95)	50	140	270	1,500	6,000	15,000
Disk (TB)	16	31	46	65	260	650

**Total Resources U.S. CMS
Tier-1 and all Tier-2**

CPU	(Si95)	310,000
Disk	(TB)	1,400

Prototypes AND [obscured]

California [obscured]
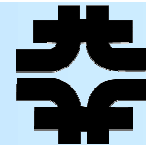
Caltech

Fermilab Tier-1 Prototype

40 Duals
Storage Serv[obscured]
GE switches [obscured]

Pr[obscured]
4[obscured]
3[obscured]
ta[obscured]
Us[obscured]
1[obscured]
R&[obscured]
16 nodes
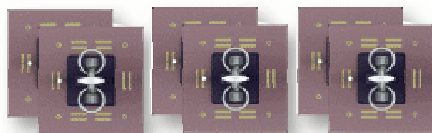
University of Florida

iVD gL

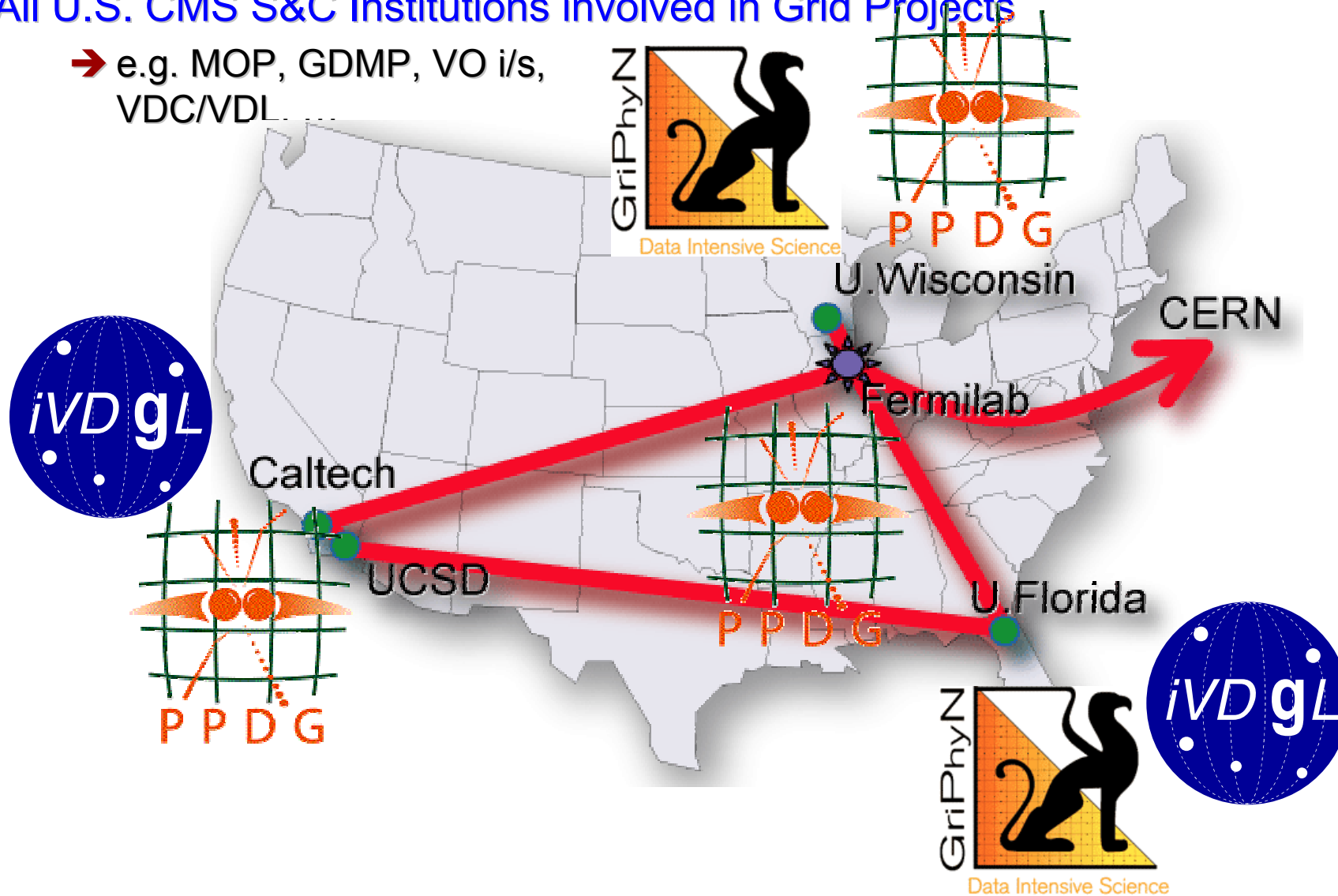2nd U.S. CMS prototype Tier-2
72 CPU nodes
76GB disk each
Raid 660GB

All U.S. CMS S&C Institutions involved in Grid Projects

➔ e.g. MOP, GDMP, VO i/s, VDC/VDL. ...

GriPhyN
Data Intensive Science

P P D G

U.Wisconsin

CERN

iVD gL

Caltech

Fermilab

UCSD

P P D G

U.Florida

P P D G

GriPhyN
Data Intensive Science

iVD gL
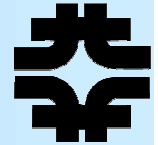
CMS Grid Integration and Deployment on U.S. CMS Test Bed

Data Challenges and ProductionRuns on Tier-1/2 Prototype Systems

"Spring Production 2002"
↘ **Physics, Trigger, Detector studies**

➔ Produce several x 10^6 events fully simulated including pile-up fully reconstructed

➔ Status as of last week: 600GB produced

➔ Large assignment to U.S. CMS
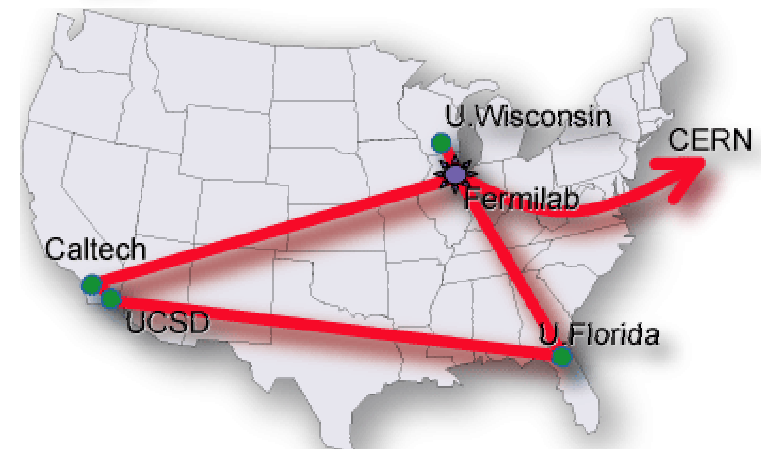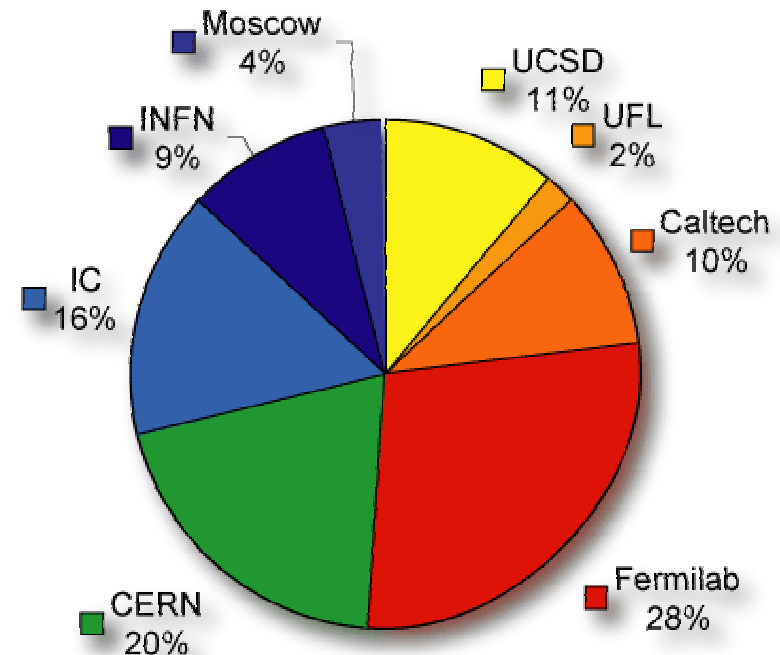
CMS Produced Data in 2001

Simulated Events TOTAL = 8.4 M	
Caltech	2.50 M
FNAL	1.65 M
Bristol/RAL	1.27 M
CERN	1.10 M
INFN	0.76 M
Moscow	0.43 M
IN2P3	0.31 M
Helsinki	0.13 M
Wisconsin	0.07 M
UCSD	0.06 M
UFL	0.05 M

TYPICAL EVENT SIZES

Simulated
- 1 CMSIM event = 1 OOHit event = 1.4 MB

Reconstructed
- 1 "10^{33}" event = 1.2 MB
- 1 "2×10^{33}" event = 1.6 MB
- 1 "10^{34}" event = 5.6 MB

OBJECTIVITY DATA TOTAL = 29 TB	
CERN	14 TB
FNAL	12 TB
Caltech	0.60 TB
Moscow	0.45 TB
INFN	0.40 TB
Bristol/RAL	0.22 TB
UCSD	0.20 TB
IN2P3	0.10 TB
Wisconsin	0.05 TB
Helsinki	-
UFL	0.08 TB

Conclusion
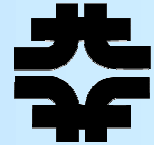
Tier-1 center at Fermilab and 5 Tier-2 centers at U.S. Universities
    Fermilab and U.S. Universities

Prototypes and test-beds are operational now
    R&D and test-bed efforts are very important

Make use of Fermilab Run II experience
    evolve Fermilab into major Grid node

Prototype facilities are sizeable
        already play a major role for CMS user community
        production efforts for physics studies and upcoming data challenges
        user support, software distribution, hosting data samples

We should work closely with the LCG Project to build LHC computing