CPU budget for the next years

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- luminosity
- time per event
- available CPU in the farm

Introduction

Demands to CPU power of level3:

- need luminosity L projections
- need expected time per event T for given luminosity
- need expected L2 accept rate R
- combined figure P_{need}:

$$P_{need} = L \cdot T \cdot R$$

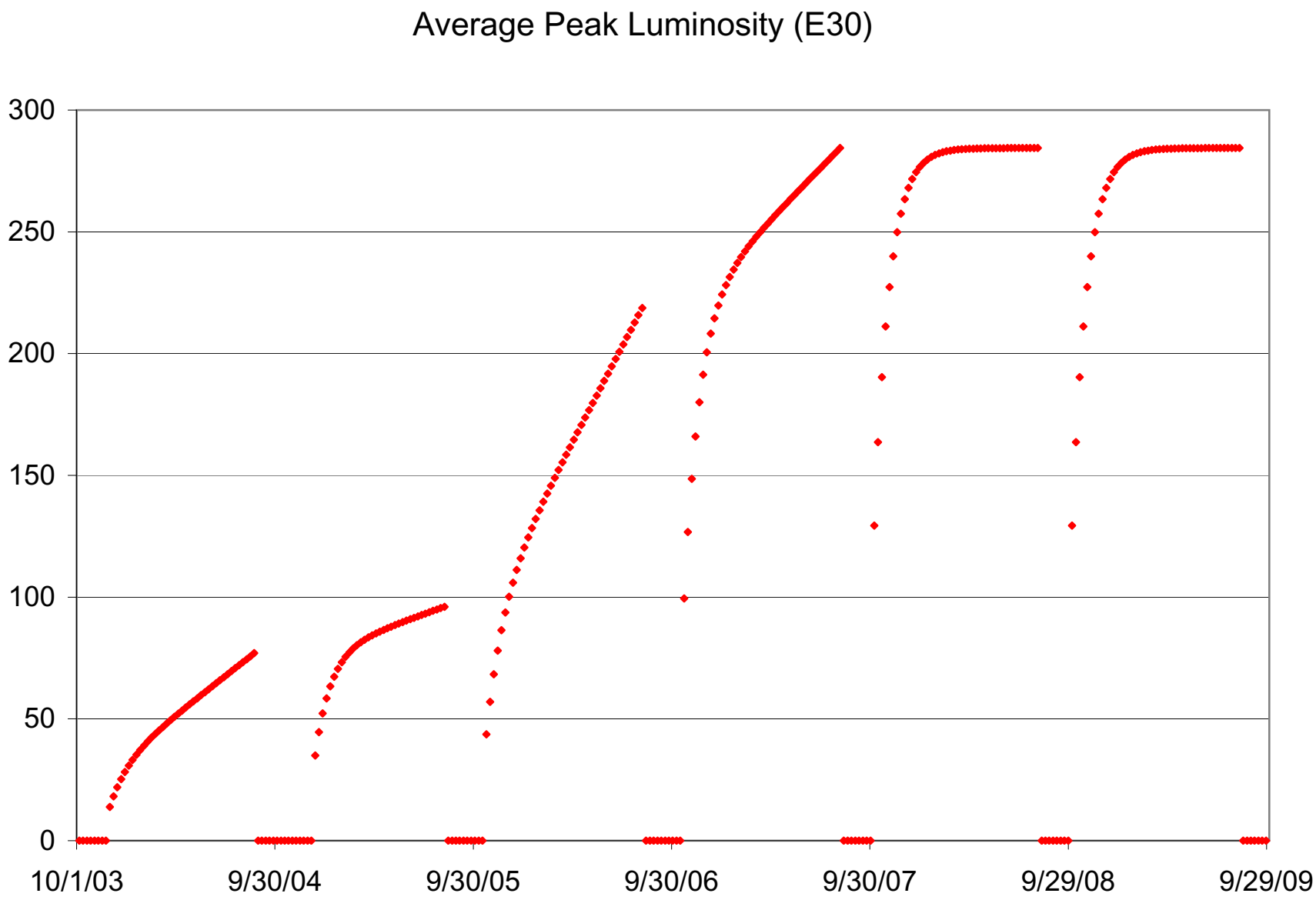
CPU power of the farm:

- need expected CPU/processor growth with time to get speed S
- need expected schedule of purchases to get N_{cpu}
- combined figure P_{get}:

$$P_{get} = S \cdot N_{cpu}$$

Can we achieve $P_{need} > P_{get}$?

Luminosity schedule, curtesy Rob Rose



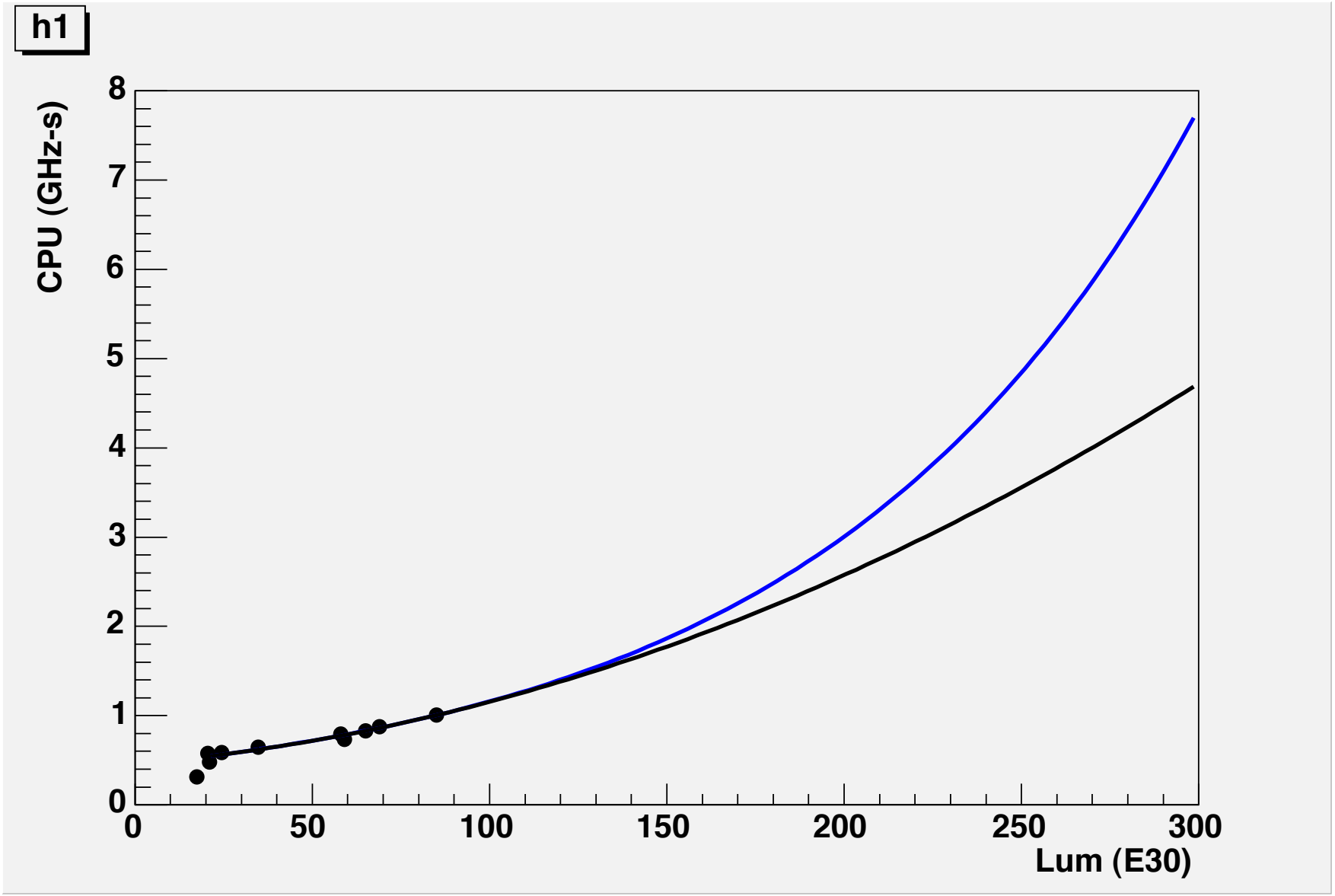
Luminosity schedule, II

Read off the graph on the previous slide:

- but, we seems to be ahead now, hence the "fudged" column
- luminosity is measured in 1e30

	official graph	fudged
Now	80	120
Jul 2005	95	130
Jan 2006	135	140
Jul 2006	220	220
Jan 2007	240	240
Jul 2007	280	280

CPU per event from Gilles



CPU per event, II

Read off the graph on the previous slide:

- two predictions: plynomial and exponential model
- units: GHz-s, time to process an event on a 1 GHz CPU

	CPU per event, GHz-s
Now	1.4-1.4
Jul 2005	1.5-1.5
Jan 2006	1.6-1.7
Jul 2006	2.9-3.6
Jan 2007	3.4-4.4
Jul 2007	4.2-6.5

Event rates

For now, assume the baseline EVB specs:

- 400 Hz max rate until the end of 2005
- 1 kHz rate from Jan 2006 and on
- caveat: there is some talking of 1.3 kHz rates

Required CPU power

Combine all inputs from the previous slides:

- P_{need} is calculated in THz
- rate is in Hz and CPU/event is in GHz-s

	CPU per event	event rate	P_{need}
Now	1.4-1.4	400	0.6
Jul 2005	1.5-1.5	400	0.6
Jan 2006	1.6-1.7	1000	1.6-1.7
Jul 2006	2.9-3.6	1000	2.9-3.6
Jan 2007	3.4-4.4	1000	3.4-4.4
Jul 2007	4.2-6.5	1000	4.2-6.5

CPU power projections

What goes into computations:

- processor speed
  - assume x2 processor speed every 18 month
  - difficult to predict!
    - possible non-smooth growth
    - possible serious cooling problems
- purchase schedule
  - assume 128 new nodes in 2005, 64 in 2006 and 64 in 2007
  - may change depending on our needs and available budget
- farm size
  - baseline 192 nodes in 6 racks
  - cycle out the oldest nodes with each purchase
  - fallback option: expand to 256 in 8 racks

CPU power projections, II

Approximate schedule for L3 farm composition/power:

order date	full integration	farm composition	P_{get}
Jul 2004	Nov 2004	64 nodes $\times$ 2 CPU $\times$ 2.0 GHz 64 nodes $\times$ 2 CPU $\times$ 2.6 GHz 64 nodes $\times$ 2 CPU $\times$ 3.2 GHz	1.0 THz
Jul 2005	Nov 2005	64 nodes $\times$ 2 CPU $\times$ 2.6 GHz 64 nodes $\times$ 2 CPU $\times$ 3.2 GHz 64 nodes $\times$ 2 CPU $\times$ 5.1 GHz	1.4 THz
Dec 2005	Apr 2006	64 nodes $\times$ 2 CPU $\times$ 3.2 GHz 64 nodes $\times$ 2 CPU $\times$ 5.1 GHz 64 nodes $\times$ 2 CPU $\times$ 6.2 GHz	1.9 THz
Aug 2006	Dec 2006	64 nodes $\times$ 2 CPU $\times$ 5.1 GHz 64 nodes $\times$ 2 CPU $\times$ 6.2 GHz 64 nodes $\times$ 2 CPU $\times$ 8.4 GHz	2.5 THz
Apr 2007	Aug 2007	64 nodes $\times$ 2 CPU $\times$ 6.2 GHz 64 nodes $\times$ 2 CPU $\times$ 8.4 GHz 64 nodes $\times$ 2 CPU $\times$ 13.3 GHz	3.6 THz

Conclusions

	P_{need}	P_{get}
Now	0.6	1.0
Jul 2005	0.6	1.0
Jan 2006	1.6-1.7	1.4
Jul 2006	2.9-3.6	1.9
Jan 2007	3.4-4.4	2.5
Jul 2007	4.2-6.5	3.6

Conclusions

- ok until the end of this year
- may need to expand to 256 nodes in Jan 2006
- may need to buy more or faster nodes in Jul 2006 and on
- reduce per-event time?