CEPC computing resources

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Basis for estimation

- Accelerator TDR
- Online trigger rate estimation
- MC simulation statistics

Operation mode		ZH	Z	W^+W^-	$t\bar{t}$
$\sqrt{s}$ [GeV]		~240	~91	~160	~360
Run Time [years]		10	2	1	5
30 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**5.0**	**115**	**16**	**0.5**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	13	60	4.2	0.65
	Event yields [2 IPs]	2.6×10^{6}	2.5×10^{12}	1.3×10^{8}	4×10^{5}
50 MW	L / IP [$\times 10^{34}$ cm^{-2}s^{-1}]	**8.3**	**192**	**26.7**	**0.8**
	$\int L\,dt$ [ab^{-1}, 2 IPs]	21.6	100	6.9	1
	Event yields [2 IPs]	4.3×10^{6}	4.1×10^{12}	2.1×10^{8}	6×10^{5}

CEPC accelerator TDR (Xiv:2312.14363)

Raw data rate and volume in Higgs mode

- Energy: 240GeV
- Trigger rate: 1kHz
- Online event data size: ~300kB
- DAQ rate: 0.3GB/s
- Running time: 3600 hours
- Data volume per year （1IP）:
  - 0.3GB/s*3600h=3.7PB/year

Table 12.5: Trigger rate estimation table for different run conditions.

Condition	Higgs	Z(10MW)	Z(50MW)	W	$t\bar{t}$
Luminosity $(10^{34}/cm^2/s)$	8.3	38	192	26.7	0.8
Bunch space (ns)	346.2	69.3	23.1	253.8	4523.1
Bunch crossing rate (MHz)	1.34	12	39.4	6.5	0.18
Raw data rate (Tbyte/s)	0.4	3.6	11.82	1.95	0.048
Physical event rate (kHz)	0.087	15.3	76.6	0.1	0.002
L1 triger rate (kHz)	13	120	400	65	2
DAQ readout rate (Gbyte/s)	26	240	800	130	4
High level trigger rate (kHz)	1	25	100	6	1
DAQ storage rate (Gbyte/s)	0.3	7.5	30.0	1.8	0.3

MC data size and volume for Higgs mode

- MC event data size: 1MB
- Full MC simulation events per year: ~$2*10^9$ (MC: Data = 10 ： 1)
- Data volume per year: $2*10^9$ *1MB=~2PB (~1 IP, 1year)

2IP, 10years

Sample set	Cross section	MC Yield(10yrs)	Ratio
240GeV Higgs	200 fb	4*10^6	100:1
240GeV 4fermion	20pb	4*10^8	10:1
240GeV 2fermion(not bhabha)	55pb	11*10^8	10:1
240 bhabha	1000pb	200*10^8	1:1

Raw data rate and volume in Z mode

- 91GeV energy (50MW)
- Trigger rate: 100kHz
- event data size: ~675kB
- Storge rate: 67.5GB/s
- Data volume per year:
  - 67.5GB/s*3600h=834PB/year
- 亮度减少一半，~400PB/year

Table 12.5: Trigger rate estimation table for different run conditions.

Condition	Higgs	Z(10MW)	Z(50MW)	W	$t\bar{t}$
Luminosity $(10^{34}/cm^2/s)$	8.3	38	192 92	26.7	0.8
Bunch space (ns)	346.2	69.3	23.1	253.8	4523.1
Bunch crossing rate (MHz)	1.34	12	39.4	6.5	0.18
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High level trigger rate (kHz)	1	25	100	6	1
DAQ storage rate (Gbyte/s)	0.3	7.5	30.0 67.5	1.8	0.3

MC data size and volume for Z mode

- MC event data size: 1MB
- Full MC simulation events each year: $1*10^{12}$ (Z 1:1)
- Data volume (per year): $1*10^{12}$ *1MB=1EB (1IP, 1year)
- 亮度少一半，0.5EB，$0.5*10^{12}$

2IP, 2years

Sample set	Cross section	MC Yield(10yrs)	Ratio
240GeV Higgs	200 fb	4*10^6	100:1
240GeV 4fermion	20pb	4*10^8	10:1
240GeV 2fermion(not bhabha)	55pb	11*10^8	10:1
240 bhabha	1000pb	200*10^8	1:1
91.2 Zpole		4*10^12	1:1

Total data volume

- Higgs mode
  - 3.7PB (Real) + 2PB (MC) =~5.7PB
- Z mode
  - 400PB + 500PB = ~900PB

CPU time and resources estimated for Higgs

Higgs mode	CPU time (CPU Seconds/event)	Iteration	Event number	Total CPU time (CPU hours)
MC (sim+rec)	60	2	$2*10^9$	$6.7 * 10^7$
Data	10	2	$13*10^9$	$7.2 * 10^7$

- Higgs Mode
  - Total CPU time: ~$14*10^7$ CPU hours (~ 320 KHS06 years)*
  - ~20,000 CPU cores needed, supposed 80% CPU utilization

* 1 CPU core = 20 HS06

CPU time and resources estimated for Z

Z mode	CPU time (CPU Seconds/event)	Iteration	Event number	Total CPU time (CPU hours)
MC (sim+rec)	**60**	**2**	**$0.5*10^{12}$**	**$16 * 10^{9}$**
Data	**12**	**2**	**$0.65*10^{12}$**	**$4 * 10^{9}$**

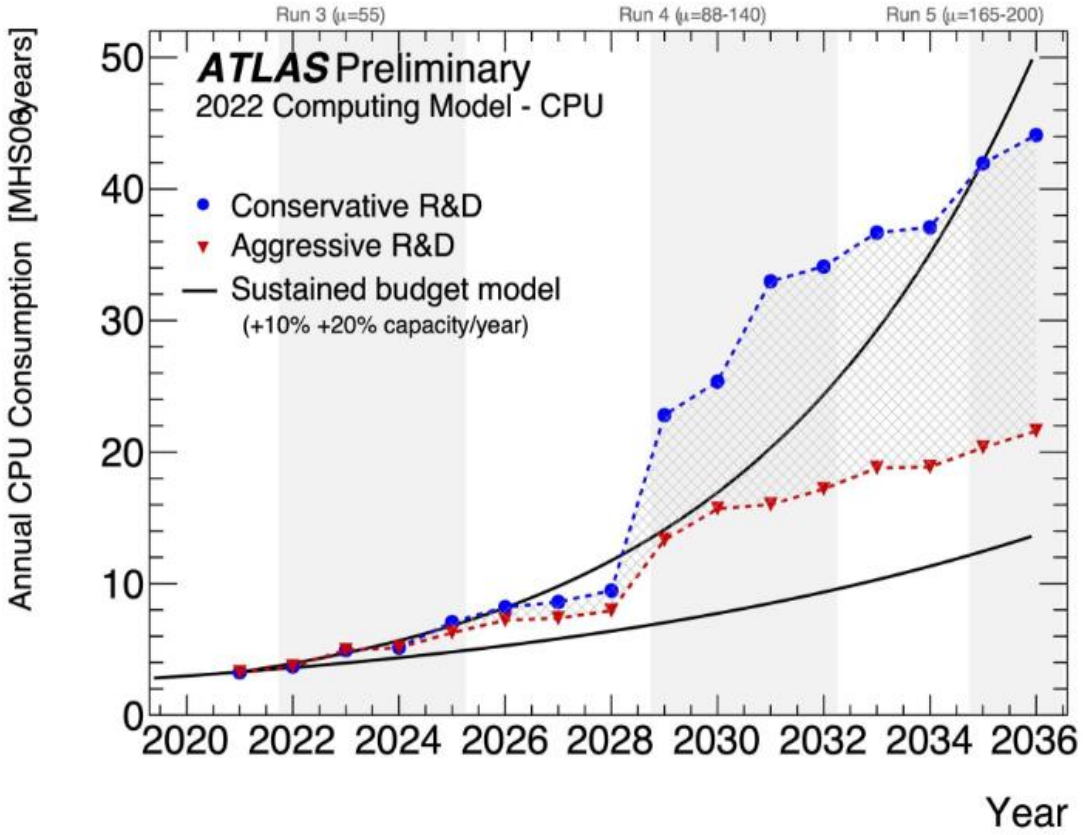
Z mode (>100 times Higgs mode)

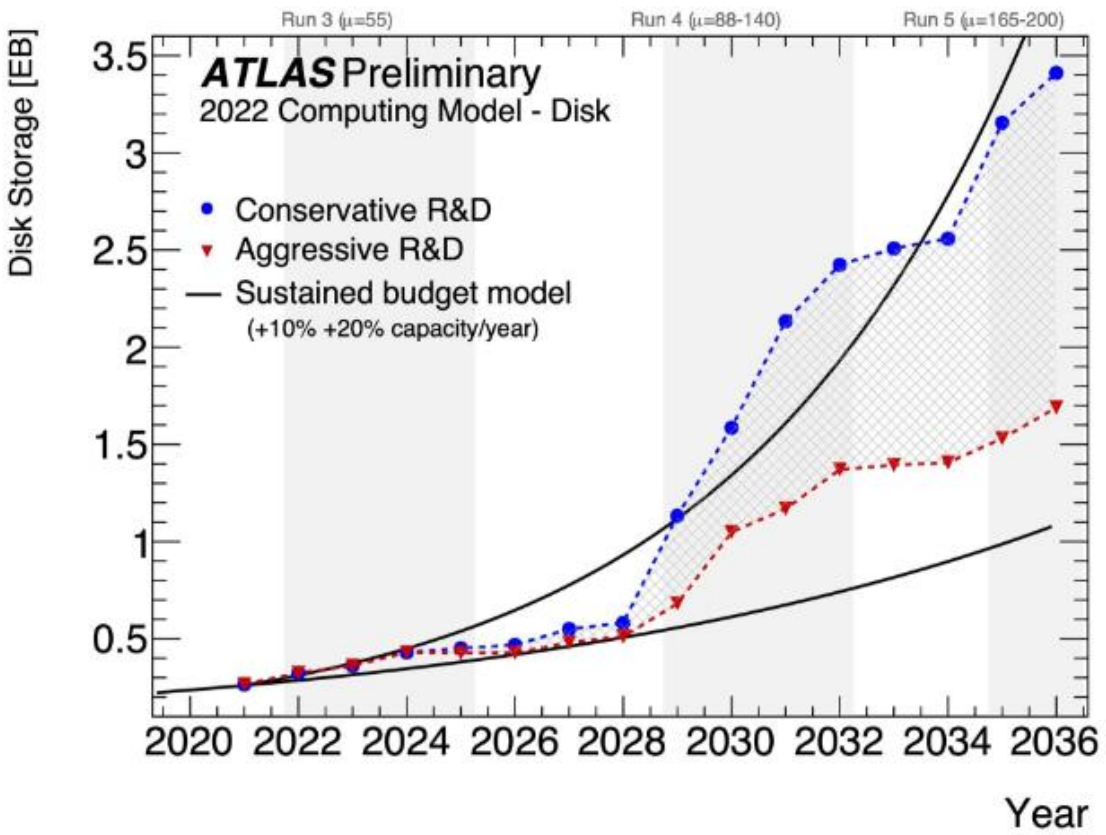
- Total CPU time: ~ $20*10^{9}$ CPU hours (~40 MHS06 years)
- ~2,200,000 CPU cores needed

- Backup

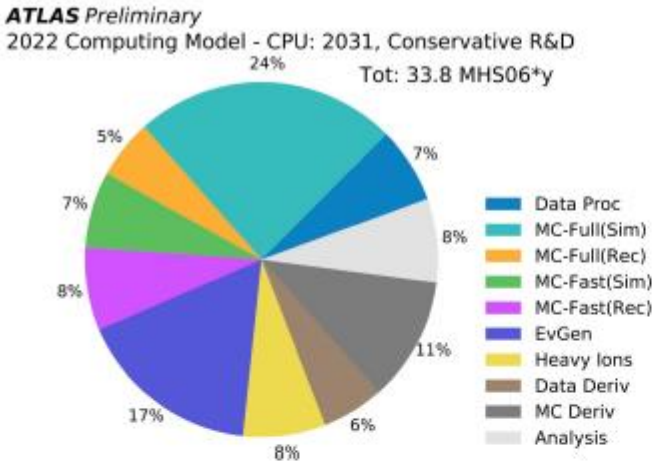
ATLAS in HL-LHC

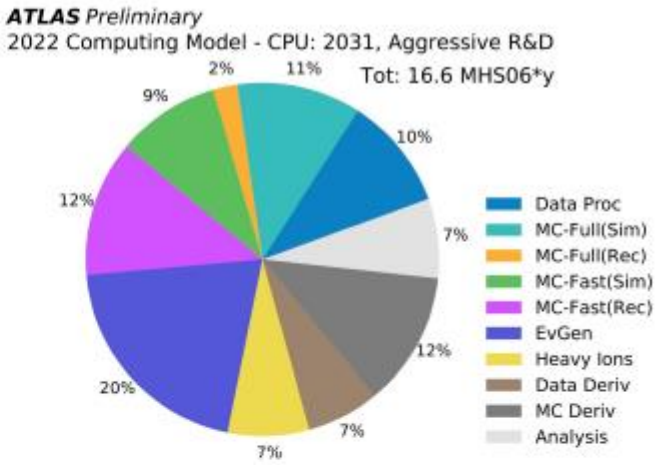
Disk storage: 0.5EB/year
Resource: 10MHS06year

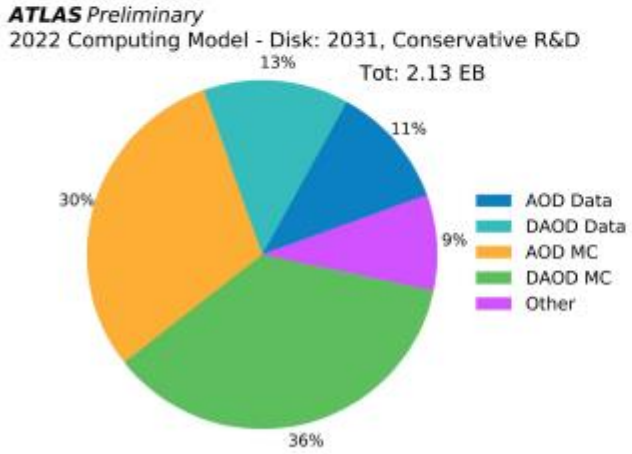


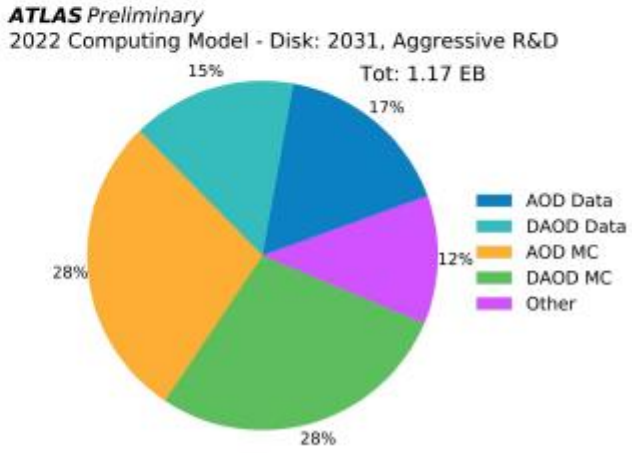


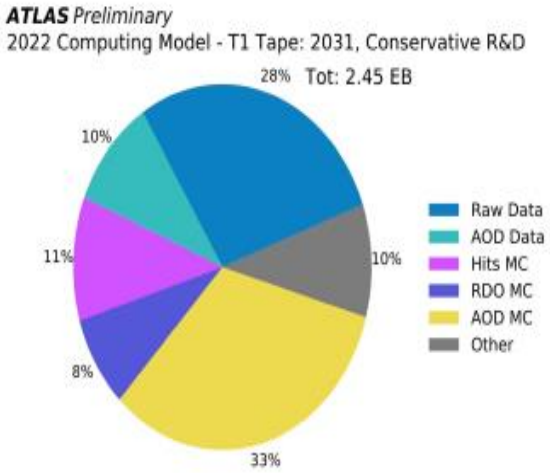
Atlas Run4

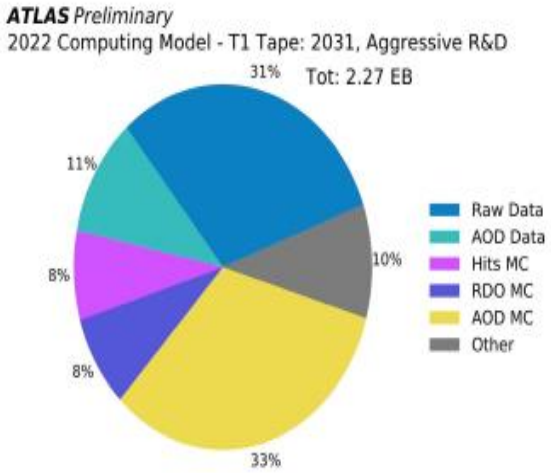












Altas Raw: 230PB
Disk storage: 2.1EB
Resource: 34MHS06year