

# CSN2



M. Duranti (Perugia), F. Di Pierro (Torino)- 5/9/2022



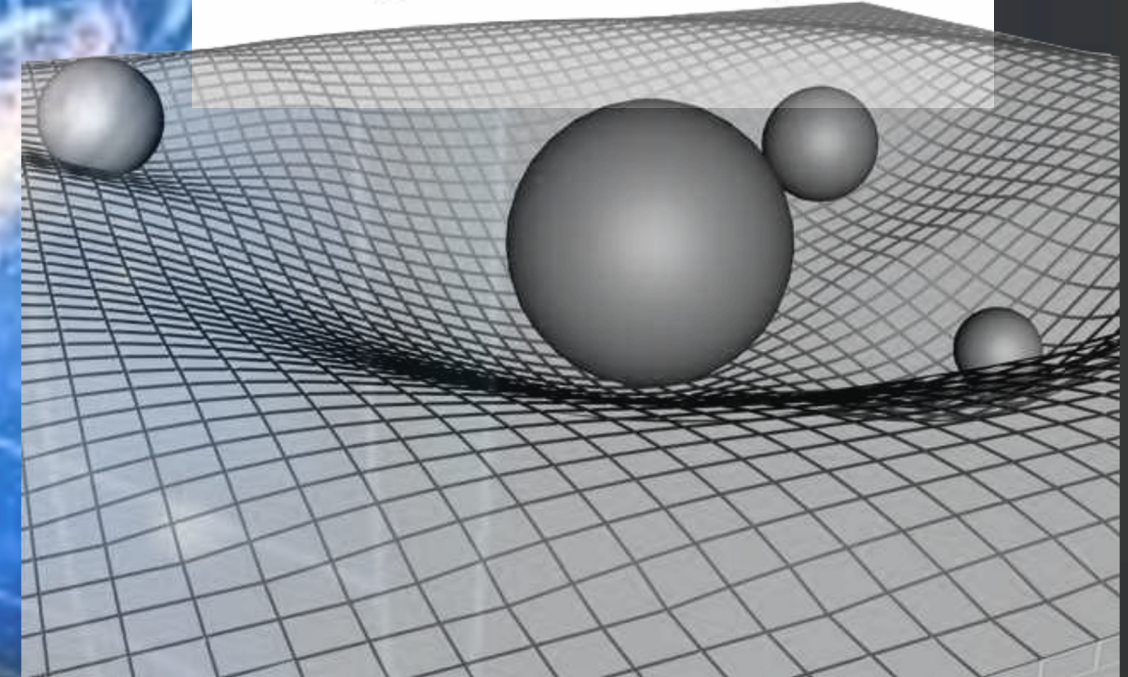
# astroparticles



**CSN2**  
Fisica delle  
Astroparticelle

**GR**

$$R_{\mu\nu} - \frac{1}{2}R g_{\mu\nu} + \Lambda g_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$$



$$\mathcal{L}_{SM} = -\frac{1}{4}F_{\mu\nu}F^{\mu\nu} - g_s f^{abc} \partial_\mu \psi_a^\dagger \partial_\nu \psi_b - \frac{1}{2}g_s^2 f^{abc} f^{ade} \psi_a^\dagger \psi_b \psi_c^\dagger \psi_d - \partial_\mu W_\nu^a \partial^\mu W^{\nu a} - M^2 W_\mu^a W^{\mu a} - \frac{1}{2} \partial_\mu Z_\nu^\alpha \partial^\mu Z^{\nu\alpha} - \frac{1}{2} M_Z^2 Z_\mu^\alpha Z^{\mu\alpha} - \frac{1}{2} \partial_\mu A_\nu \partial^\mu A^\nu - igc_w (\partial_\mu W_\nu^a - W_\nu^a \partial_\mu) W^{\mu a} - W_\nu^a W_\mu^a - Z_\nu^\alpha (W_\mu^a \partial^\mu W_\nu^a - W_\nu^a \partial^\mu W_\mu^a) + Z_\nu^\alpha (W_\mu^a \partial^\mu W_\nu^a - W_\nu^a \partial^\mu W_\mu^a) - ig_s (\partial_\mu A_\nu - W_\nu^a \partial^\mu W_\mu^a - A_\nu (W_\mu^a \partial^\mu W_\nu^a - W_\nu^a \partial^\mu W_\mu^a) + A_\nu (W_\mu^a \partial^\mu W_\nu^a - W_\nu^a \partial^\mu W_\mu^a)) - \frac{1}{2} g^2 W_\mu^a W_\nu^a W_\mu^a W_\nu^a + \frac{1}{2} g^2 W_\mu^a W_\nu^a W_\mu^a W_\nu^a + g^2 f^{abc} f^{ade} Z_\nu^\alpha Z_\mu^\alpha W_\nu^a W_\mu^a - Z_\nu^\alpha Z_\mu^\alpha W_\nu^a W_\mu^a + g^2 f^{abc} f^{ade} (A_\nu W_\mu^a W_\nu^a - A_\nu W_\mu^a W_\nu^a) + g^2 f^{abc} f^{ade} (A_\nu W_\mu^a W_\nu^a - W_\nu^a W_\mu^a A_\nu) - 2A_\nu Z_\nu^\alpha W_\mu^a W_\nu^a - \frac{1}{2} \partial_\mu H \partial^\mu H - 2M^2 \alpha H^2 - \partial_\mu \phi^\dagger \partial^\mu \phi - \frac{1}{2} \partial_\mu \phi^\dagger \partial^\mu \phi - \lambda_\phi (\frac{2M^2}{\Lambda^2} H + \frac{1}{\Lambda^2} H^2 + \phi^\dagger \phi + 2\phi^\dagger \phi^2) + \frac{2M^4}{\Lambda^4} \alpha_\Lambda - \frac{1}{2} g^2 \alpha_\Lambda (H^4 + (\phi^\dagger \phi)^4 + 4(\phi^\dagger \phi)^2 \phi^2 + 4H^2 \phi^\dagger \phi + 2(\phi^\dagger \phi)^2 H^2) - g W_\mu^+ W_\nu^- H - \frac{1}{2} g^2 Z_\nu^\alpha Z_\mu^\alpha H - \frac{1}{2} ig (W_\mu^+ (\partial^\nu \partial_\nu \phi - \phi \partial_\nu \partial_\nu) - W_\nu^- (\partial^\mu \partial_\mu \phi^\dagger - \phi^\dagger \partial_\mu \partial_\mu)) + \frac{1}{2} g (W_\mu^+ (H \partial_\nu \phi - \phi \partial_\nu H) + W_\nu^- (H \partial_\mu \phi^\dagger - \phi^\dagger \partial_\mu H)) + \frac{1}{2} g^2 (Z_\nu^\alpha (H \partial_\nu \phi - \phi \partial_\nu H) + M (\frac{1}{\Lambda^2} Z_\nu^\alpha \partial_\nu \phi + W_\mu^+ \partial_\mu \phi - W_\nu^- \partial_\nu \phi) - ig_s^2 M Z_\nu^\alpha (W_\mu^+ \phi^\dagger - W_\nu^- \phi) + ig_s M A_\nu (W_\mu^+ \phi - W_\nu^- \phi) - ig (\frac{1}{\Lambda^2} Z_\nu^\alpha \partial_\nu \phi + W_\mu^+ \partial_\mu \phi - W_\nu^- \partial_\nu \phi) + ig_s M A_\nu (\phi^\dagger \partial_\nu \phi - \phi \partial_\nu \phi) - \frac{1}{2} g^2 W_\mu^+ W_\nu^- (H^2 + (\phi^\dagger \phi)^2 + 2\phi^\dagger \phi) - \frac{1}{2} g^2 \frac{1}{\Lambda^2} Z_\nu^\alpha Z_\mu^\alpha (H^2 + (\phi^\dagger \phi)^2 + 2(2s_w^2 - 1)^2 \phi^\dagger \phi) - \frac{1}{2} g^2 \frac{1}{\Lambda^2} Z_\nu^\alpha \partial_\nu (W_\mu^+ \phi + W_\nu^- \phi) - \frac{1}{2} g^2 \frac{1}{\Lambda^2} Z_\nu^\alpha Z_\mu^\alpha H (W_\mu^+ \phi - W_\nu^- \phi) + \frac{1}{2} g^2 s_w A_\nu \partial_\nu (W_\mu^+ \phi + W_\nu^- \phi) + \frac{1}{2} g^2 s_w A_\nu H (W_\mu^+ \phi - W_\nu^- \phi) - g^2 \frac{1}{\Lambda^2} (2c_w^2 - 1) Z_\nu^\alpha \partial_\nu \phi - g^2 s_w A_\nu \partial_\nu \phi + \frac{1}{2} ig_s \lambda_\phi^2 (g^2 \gamma^i \gamma^j) g_\mu^\mu - e^2 (\gamma \partial + m_e) \bar{\psi} - e^2 (\gamma \partial + m_e) \psi - \bar{\psi} (\gamma \partial + m_e) \psi - \frac{1}{2} (m_e^2 \psi^\dagger \psi + m_e^2 \bar{\psi} \bar{\psi}) + ig_s A_\mu (-e^2 \gamma^\mu \psi) + \frac{1}{2} (d_1^2 \psi^\dagger d_1) + \frac{1}{2} Z_\nu^\alpha ((\psi^\dagger \gamma^\nu (1 + \gamma^5) \psi) + (\bar{\psi} \gamma^\nu (1 - \gamma^5) \bar{\psi})) + (d_2^2 \gamma^\nu (1 - \gamma^5) \psi) + (d_3^2 \gamma^\nu (1 + \gamma^5) \bar{\psi})) + \frac{1}{2} m_\nu^2 W_\mu^+ (\psi^\dagger \gamma^\mu (1 + \gamma^5) \psi) + (d_4^2 C_\nu^{\mu\alpha} \gamma^\mu (1 + \gamma^5) \psi) + \frac{1}{2} m_\nu^2 W_\mu^- (\bar{\psi} \gamma^\mu (1 + \gamma^5) \bar{\psi}) + (d_5^2 C_\nu^{\mu\alpha} \gamma^\mu (1 + \gamma^5) \bar{\psi}) + \frac{1}{2} m_\nu^2 \psi^\dagger (-m_\nu^2 (\psi^\dagger \gamma^\mu \psi_\mu (1 - \gamma^5) \psi) + m_\nu^2 (\bar{\psi} \gamma^\mu \bar{\psi}_\mu (1 + \gamma^5) \bar{\psi})) + \frac{1}{2} m_\nu^2 \psi^\dagger (m_\nu^2 (\psi^\dagger \gamma^\mu \psi_\mu (1 + \gamma^5) \psi) - m_\nu^2 (\bar{\psi} \gamma^\mu \bar{\psi}_\mu (1 - \gamma^5) \bar{\psi})) - \frac{1}{2} m_\nu^2 H (\psi^\dagger \psi) + \frac{1}{2} m_\nu^2 \bar{\psi} (\bar{\psi} \psi) - \frac{1}{2} m_\nu^2 \psi^\dagger (\psi^\dagger \psi) - \frac{1}{2} m_\nu^2 \bar{\psi} (\bar{\psi} \bar{\psi}) + \frac{1}{2} m_\nu^2 M_\nu^2 (1 - \gamma_5) \psi_\nu - \frac{1}{2} m_\nu^2 M_\nu^2 (1 - \gamma_5) \bar{\psi}_\nu + \frac{1}{2} m_\nu^2 \psi^\dagger (-m_\nu^2 (\psi^\dagger C_\nu X - (1 - \gamma^5) \psi) + m_\nu^2 (d_1^2 C_\nu (1 + \gamma^5) \psi) + \frac{1}{2} m_\nu^2 \psi^\dagger (m_\nu^2 (d_1^2 C_\nu^* (1 + \gamma^5) \psi) - m_\nu^2 (d_2^2 C_\nu^* (1 - \gamma^5) \psi) - \frac{1}{2} m_\nu^2 H (\psi^\dagger \psi) - \frac{1}{2} m_\nu^2 H (\bar{\psi} \bar{\psi})) + \frac{1}{2} m_\nu^2 \psi^\dagger (\psi^\dagger \gamma^\mu \psi) - \frac{1}{2} m_\nu^2 \bar{\psi} (\bar{\psi} \gamma^\mu \bar{\psi}) + G^{\mu\nu} G^{\mu\nu} + g_s f^{abc} \partial_\mu C^a \partial_\nu C^b - X^\dagger (\partial^2 - M^2) X + X^\dagger (\partial^2 - M^2) X + X^\dagger (\partial^2 - \frac{M^2}{2}) X + Y \partial^2 Y + igc_w Z_\nu^\alpha (\partial_\mu X^\dagger X^\mu - \partial_\mu X^\dagger X^\mu) + igc_w W_\mu^+ (\partial_\nu Y X^\dagger - \partial_\nu X^\dagger Y) + igc_w W_\mu^- (\partial_\nu X^\dagger X^\mu - \partial_\nu X^\dagger X^\mu) + igc_w W_\mu^+ (\partial_\nu X^\dagger X^\mu - \partial_\nu X^\dagger X^\mu) + igc_w Z_\nu^\alpha (\partial_\mu X^\dagger X^\mu - \partial_\mu X^\dagger X^\mu) + igc_w A_\nu (\partial_\mu X^\dagger X^\mu - \partial_\mu X^\dagger X^\mu) - \frac{1}{2} g M (X^\dagger X^\dagger + X^\dagger X^\dagger - H + \frac{1}{2} X^\dagger X^\dagger H) + \frac{1}{2} g M (X^\dagger X^\dagger \phi^\dagger - X^\dagger X^\dagger \phi) + \frac{1}{2} ig M (X^\dagger X^\dagger \phi^\dagger - X^\dagger X^\dagger \phi) + ig M s_w (X^\dagger X^\dagger \phi^\dagger - X^\dagger X^\dagger \phi) + \frac{1}{2} ig M (X^\dagger X^\dagger \phi^\dagger - X^\dagger X^\dagger \phi)$$

**Λ-CDM**

**Quarks**

u up	c charm	t top
d down	s strange	b bottom

**Forces**

Z Z boson	γ photon
W W boson	g gluon

H  
Higgs boson

e electron	μ muon	τ tau
ν <sub>e</sub> electron neutrino	ν <sub>μ</sub> muon neutrino	ν <sub>τ</sub> tau neutrino

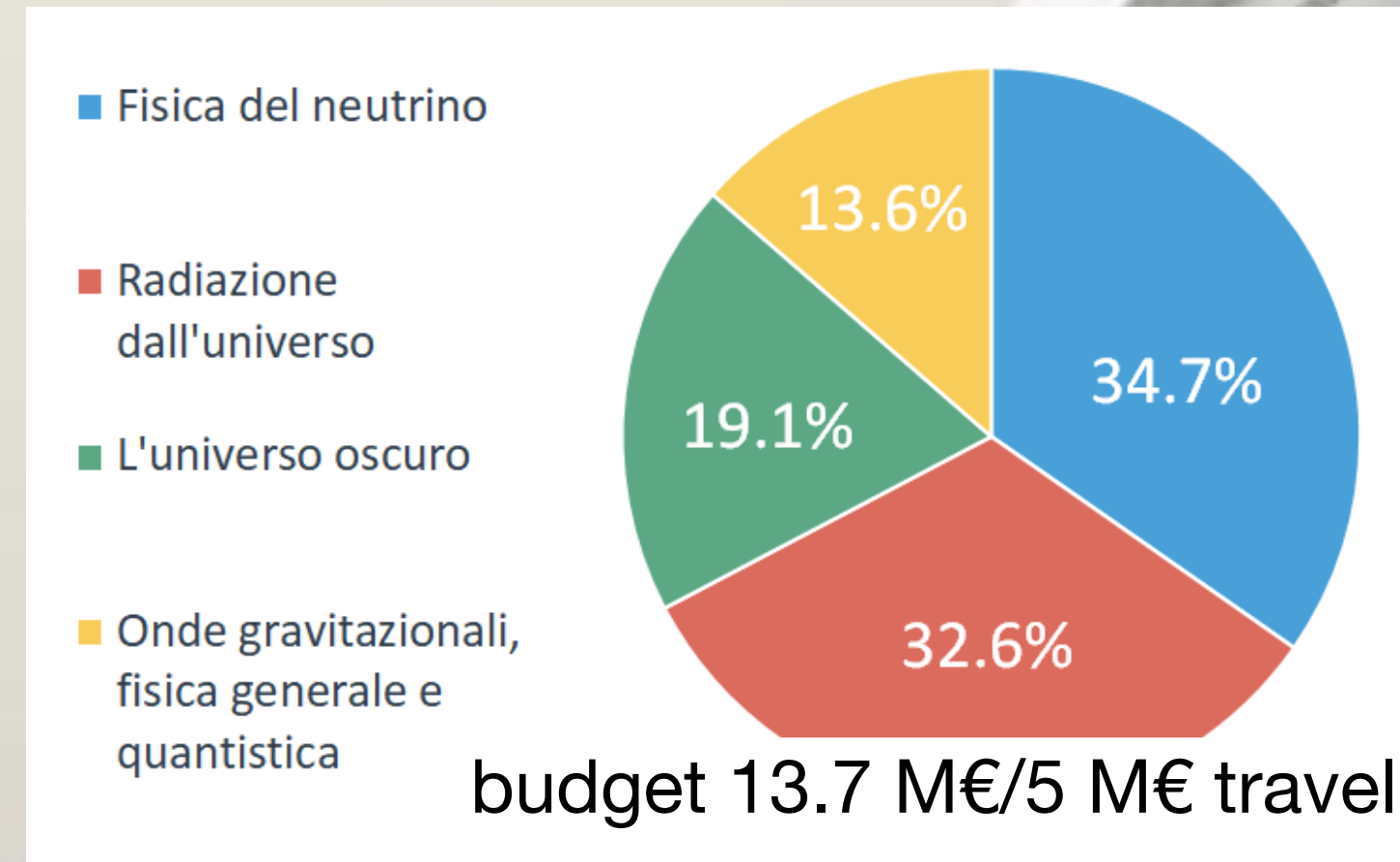
**Leptons**

**SM**



# astroparticle pillars in CSN2

the “observables”



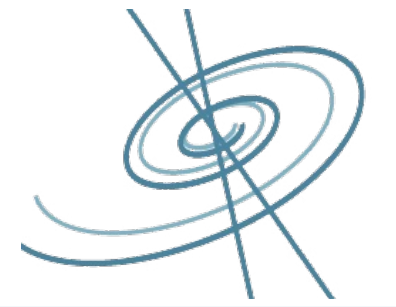
Neutrino physics

radiation  
from universe

the dark universe

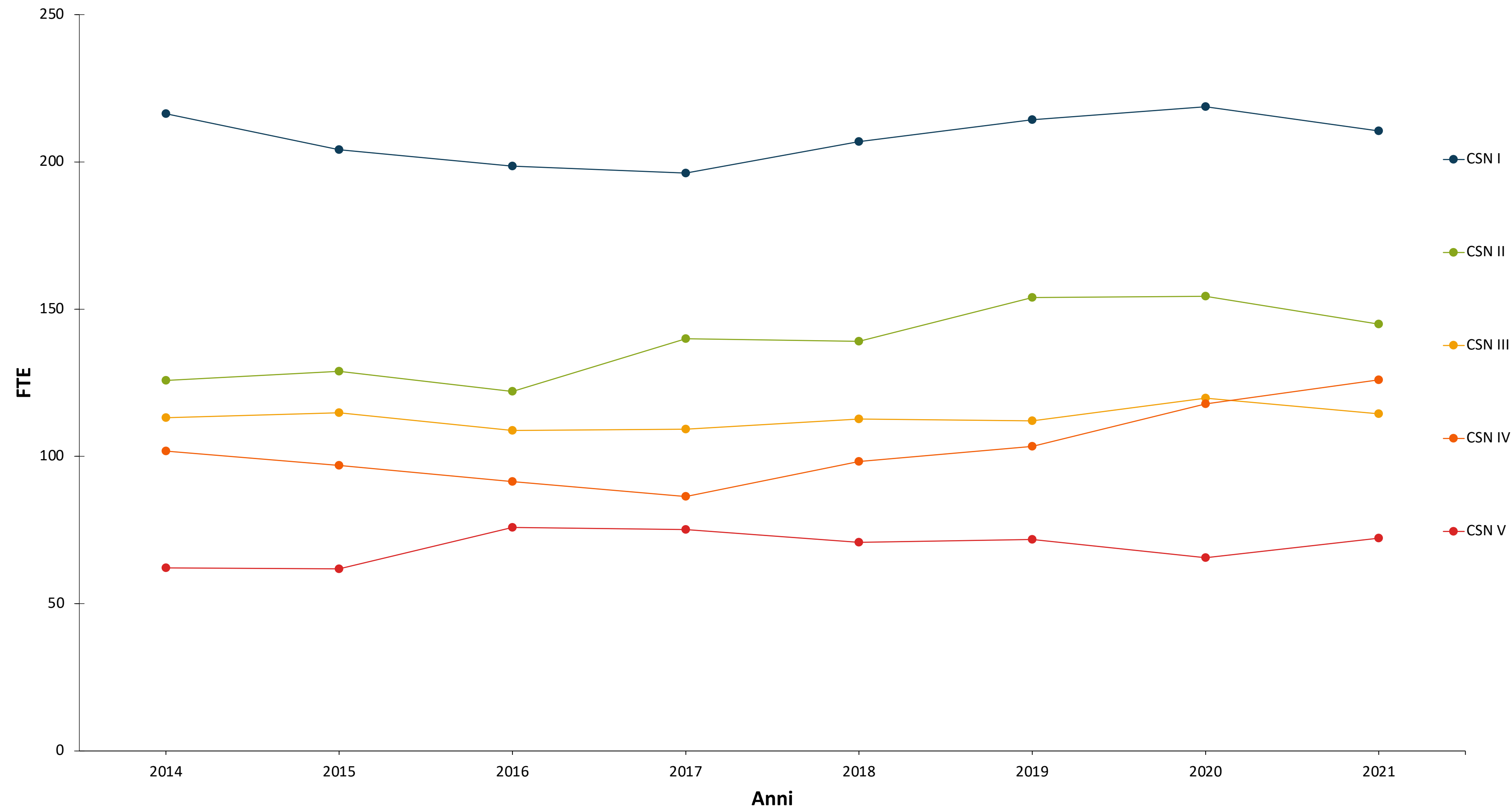
Gravitational Waves, general  
and quantum physics

# 4 pillars of CSN II experiments



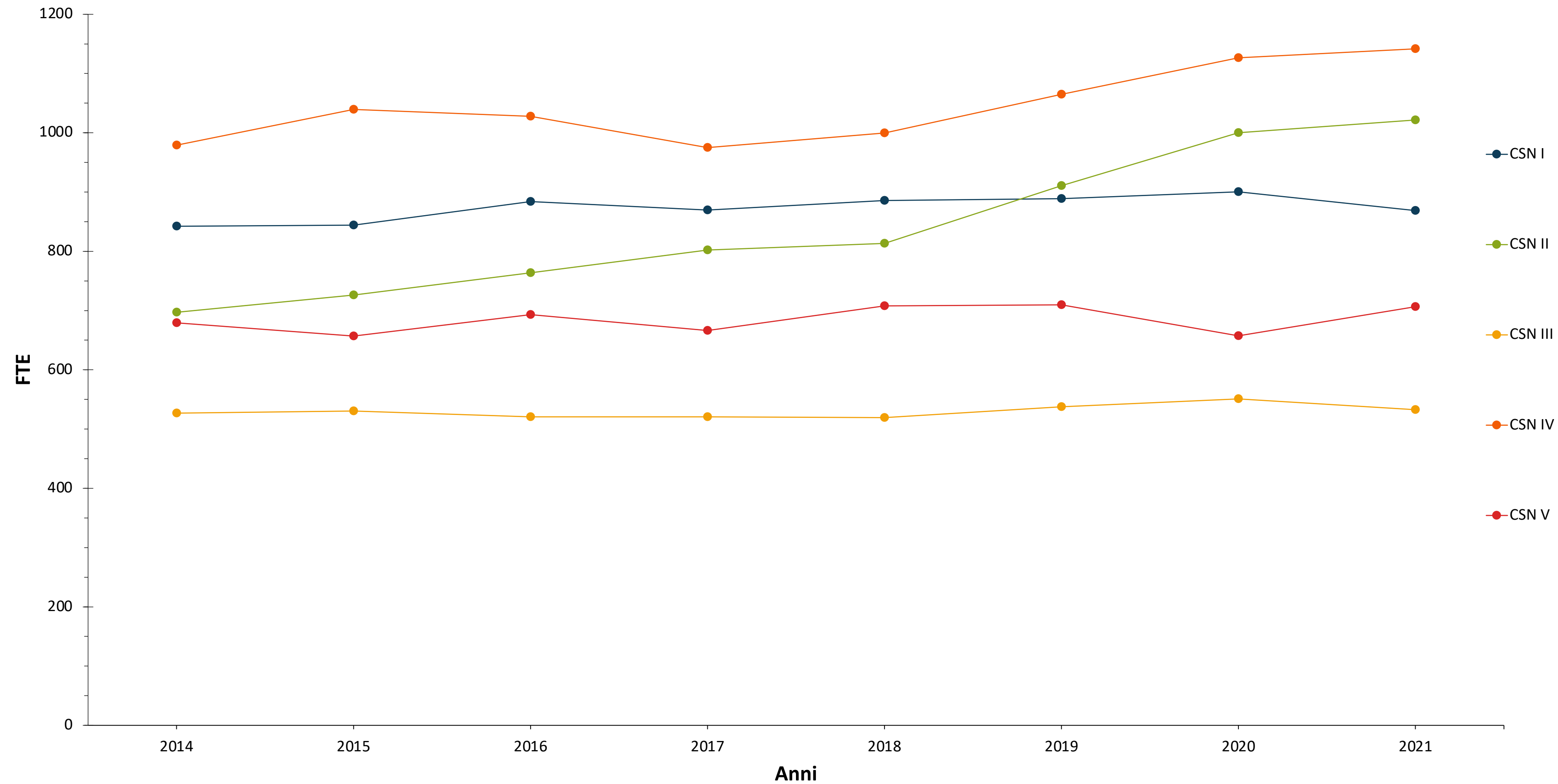
NEUTRINO PHYSICS	RADIATION FROM UNIVERSE	THE DARK UNIVERSE	GRAVITATIONAL WAVES, GENERAL AND QUANTUM PHYSICS
BOREX	AMS	COSINUS	ARCHIMEDES
CUORE	AUGER	CYGNO/INITIUN (ERC)	ET_ITALIA
CUPID	CTA	CRESST	FISH
ENUBET (ERC)	FERMI	DAMA	GINGER
GERDA	GAPS	DARKSIDE	GRAFIQO
HOLMES	HERD/DAMPE	EUCLID	LIMADOU
ICARUS	IXPE	MOSCAB	LISA
LVD	KM3	NEWS	MEGANTE (ERC)
JUNO	LITEBIRD	QUAX	MOONLIGHT-2
Nu@FNAL	LSPE	SABRE	SATOR_G
NUCLEUS	QBIC	XENON	SUPREMO
PTOLEMY	SPB2		VIRGO
T2K	XRO		VMB-CERN
TRISTAN	SWG0		
Hyper-Kamiokande			

# FTE dei dipendenti INFN per CSN



	CSN I	CSN II	CSN III	CSN IV	CSN V
2020	219	154	120	118	66
2021	211	145	114	126	72

# FTE totali



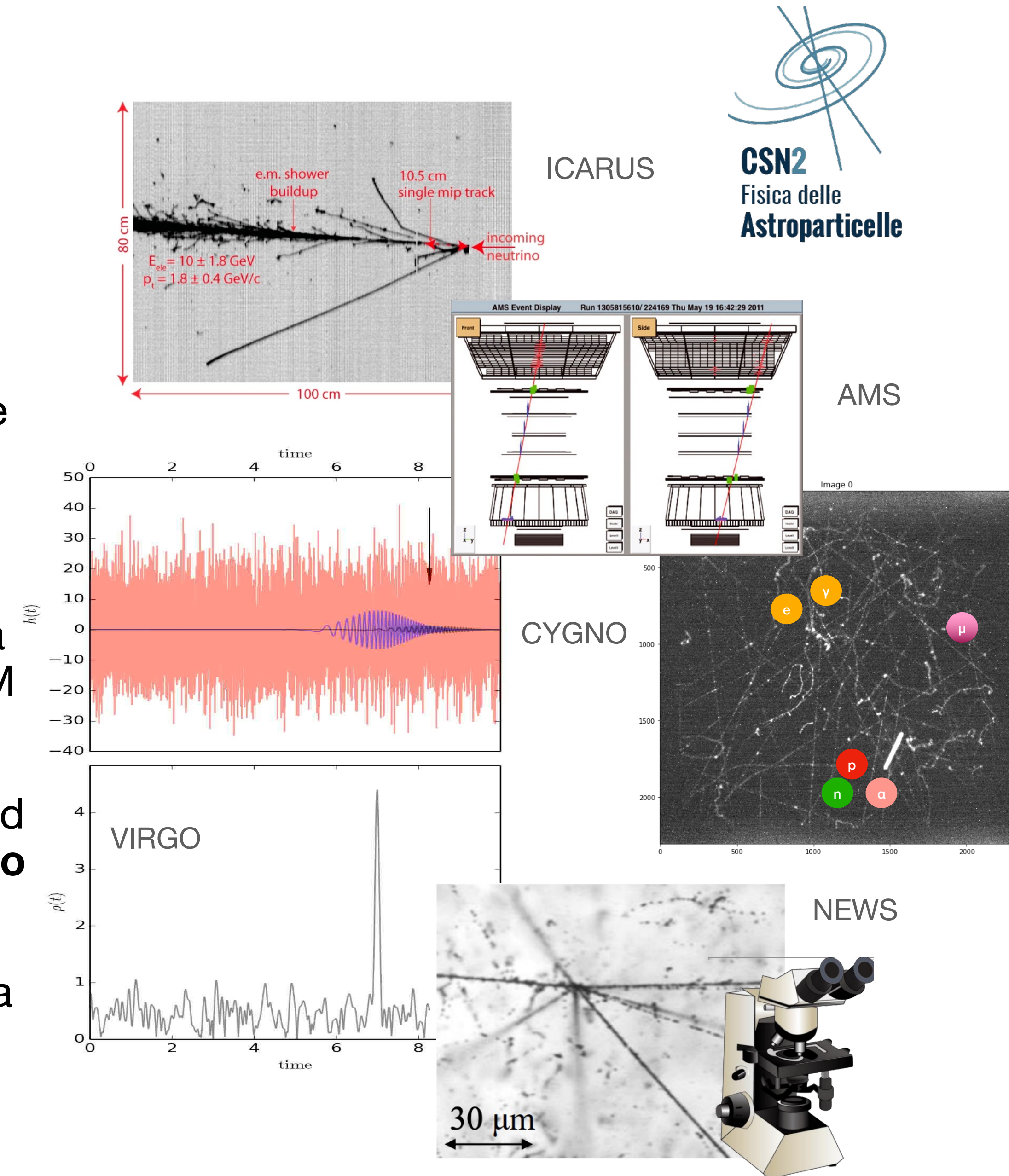
	CSN I	CSN II	CSN III	CSN IV	CSN V
2020	900	1000	551	1127	658
2021	869	1022	533	1142	706



# astroparticle DAQ

## personal view...

- **triggered:** a logic (hw or sw) requirements enable data collection: **a trigger acquire one event**, signal candidate are selected (eg: cosmic ray detectors, space experiments, neutrino experiments)
- **post triggered:** a logic (hw or sw) requirements enable to acquire many information: **a trigger acquire many events**, a post processing is needed to extract the signal/noise (eg: DM experiments)
- **continuous streaming:** continues time series post processed to extract data, an **elaborated post processing is needed to extract events** (eg: double beta, GW experiments)
- **post processed:** the **detector it self “store” data** and a complex procedure extract events (eg: nuclear emulsion)



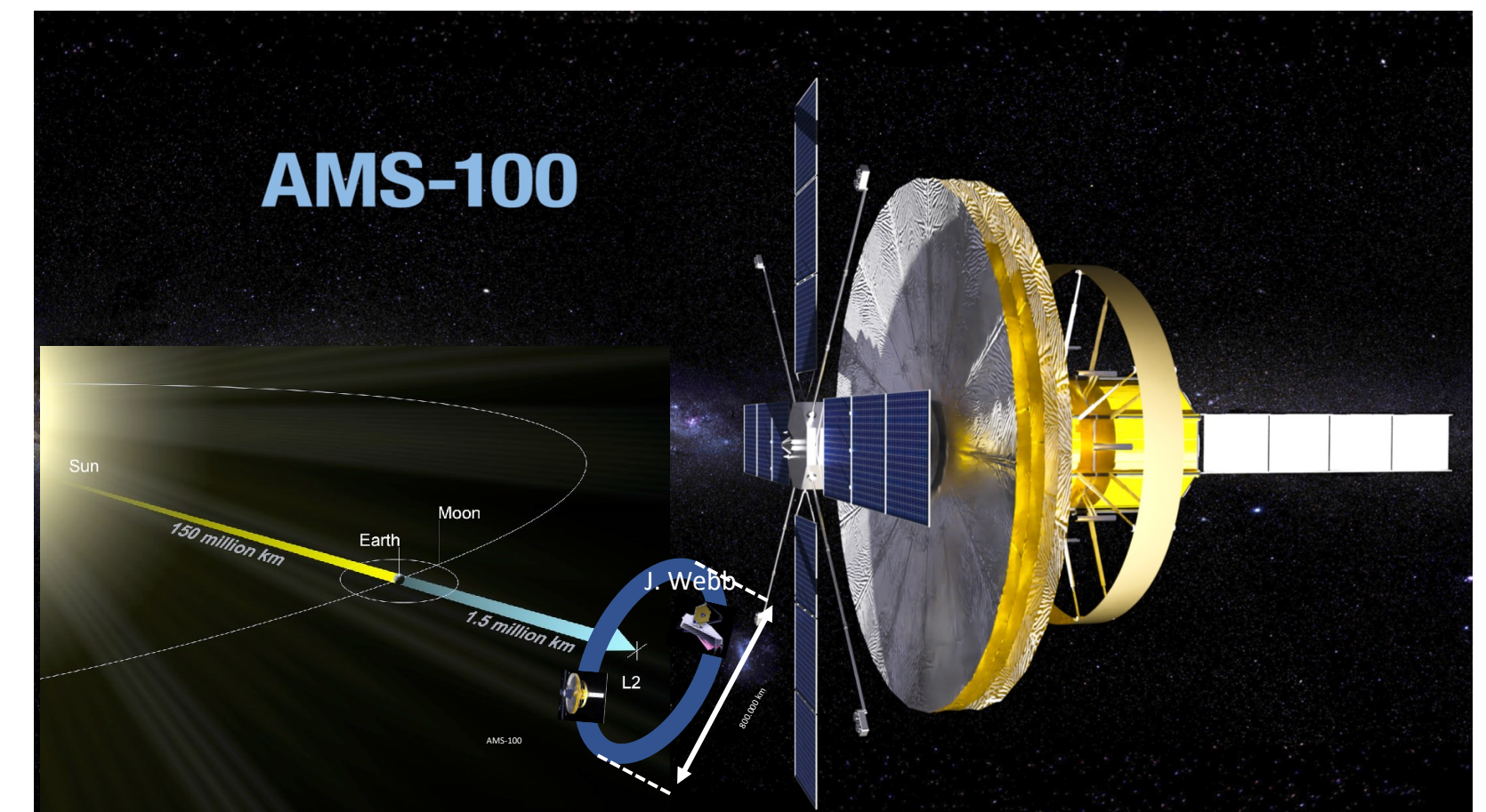


# astroparticle data ...

## personal view...

- **unique** and **unrepeatable** data (ex. cosmic events)  
constraint on uptime/dead-time
- data could be acquired in difficult and **extreme conditions** (ex. space, under water ice, etc) conditioning the possibility of interventions and changes in the setup
- **templates** and **montecarlo** are needed not only to evaluates systematic but also to identify “candidates” of events. (ex OG, cosmic ray shower, etc) with large request of computing resources
- for many experiment data need to often to be **re-calibrated** and **reconstructed** many times whit discontinuity and peak in the usage of computing resources

an example of future/futuristic challenge



Weight:	40 t
Thin coil Solenoid :	BL2=15 Tm2
Acceptance:	100 m2sr
MDR:	100 TV
Calorimeter:	70 X0, 4λ
Power Consumption:	15 kW
Incoming Particle Rate:	2 MHz
Number Readout Channels:	8 Million
Mission Flight Time:	10 years

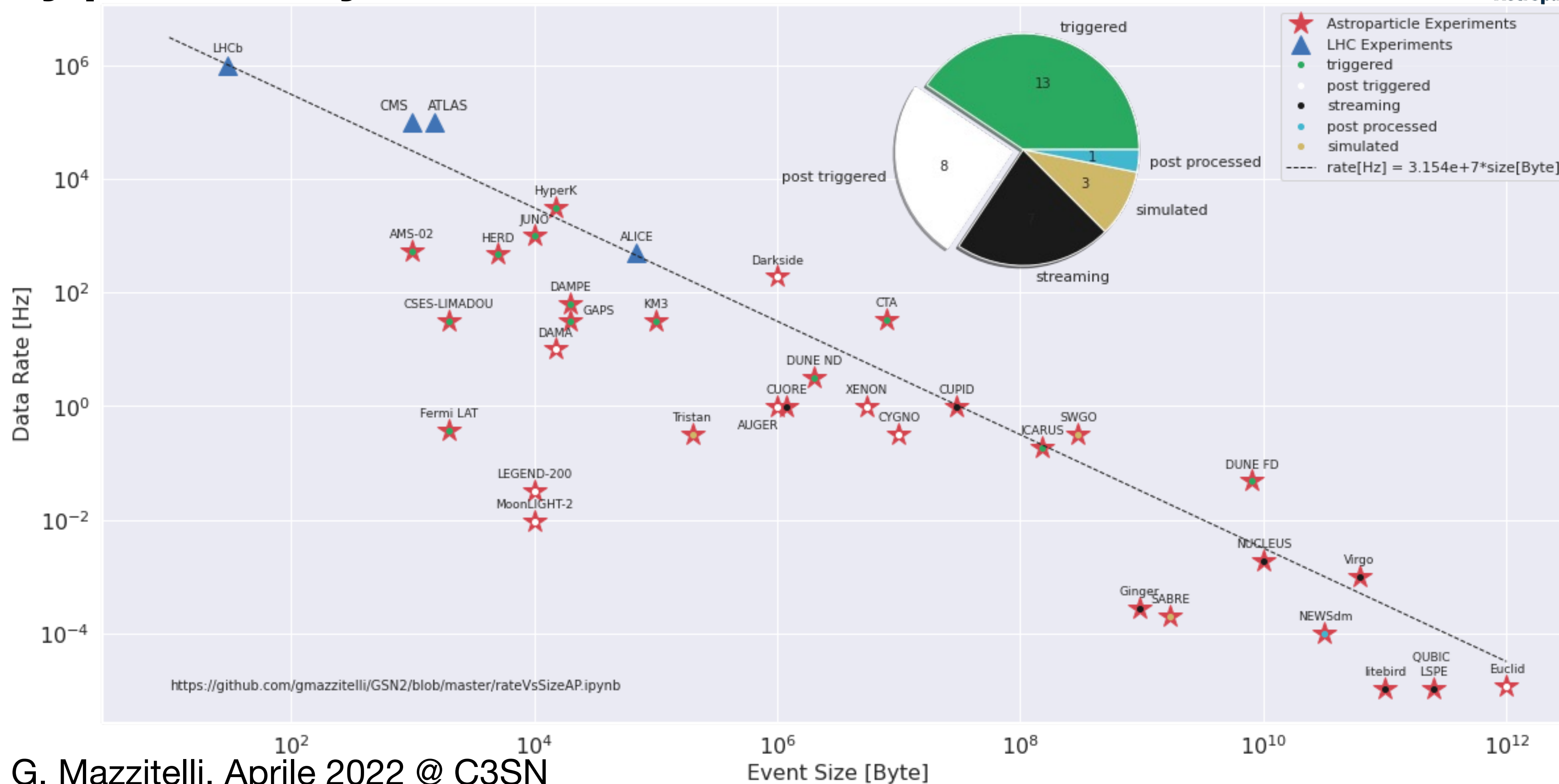


# astroparticle experiments throughput

very preliminary



CSN2  
Fisica delle  
Astroparticelle



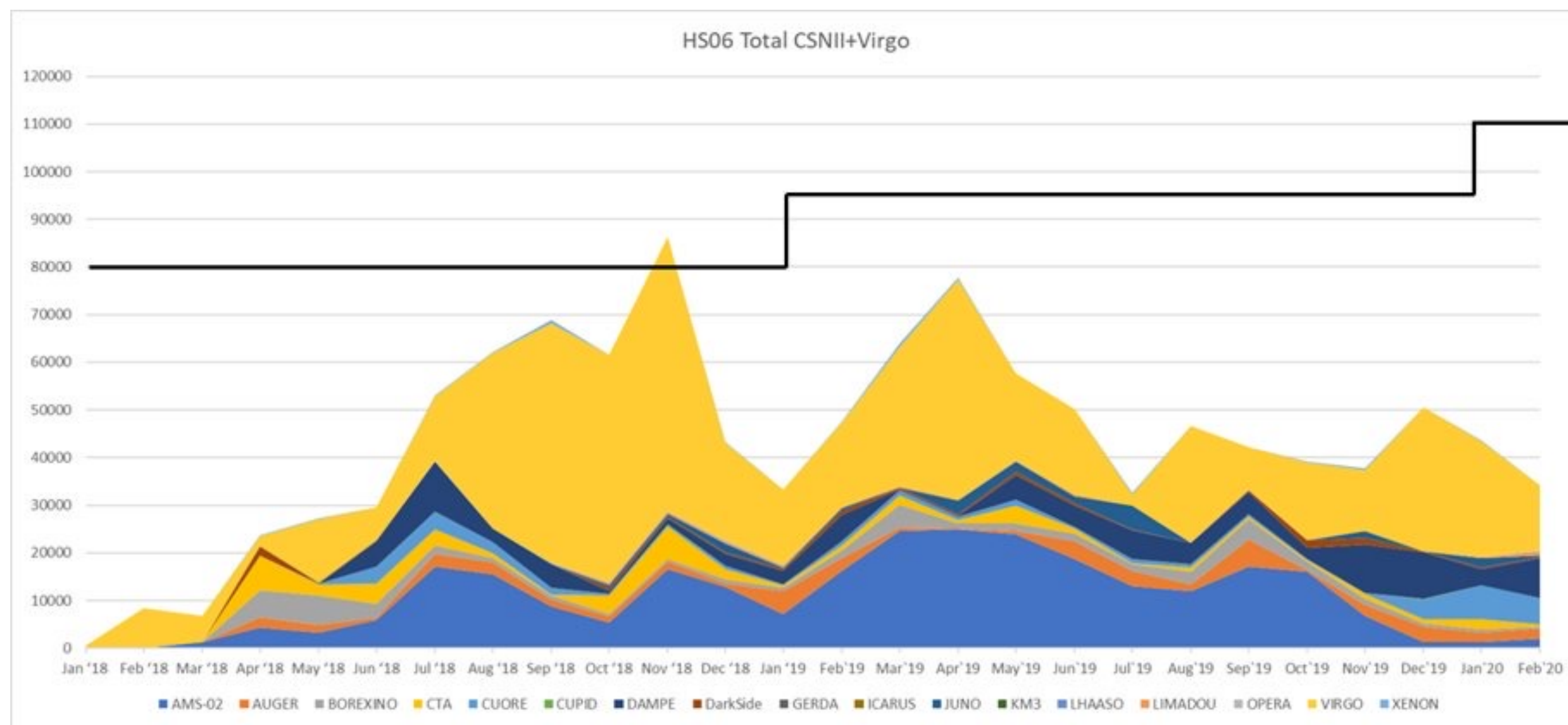


# il calcolo in CSN2

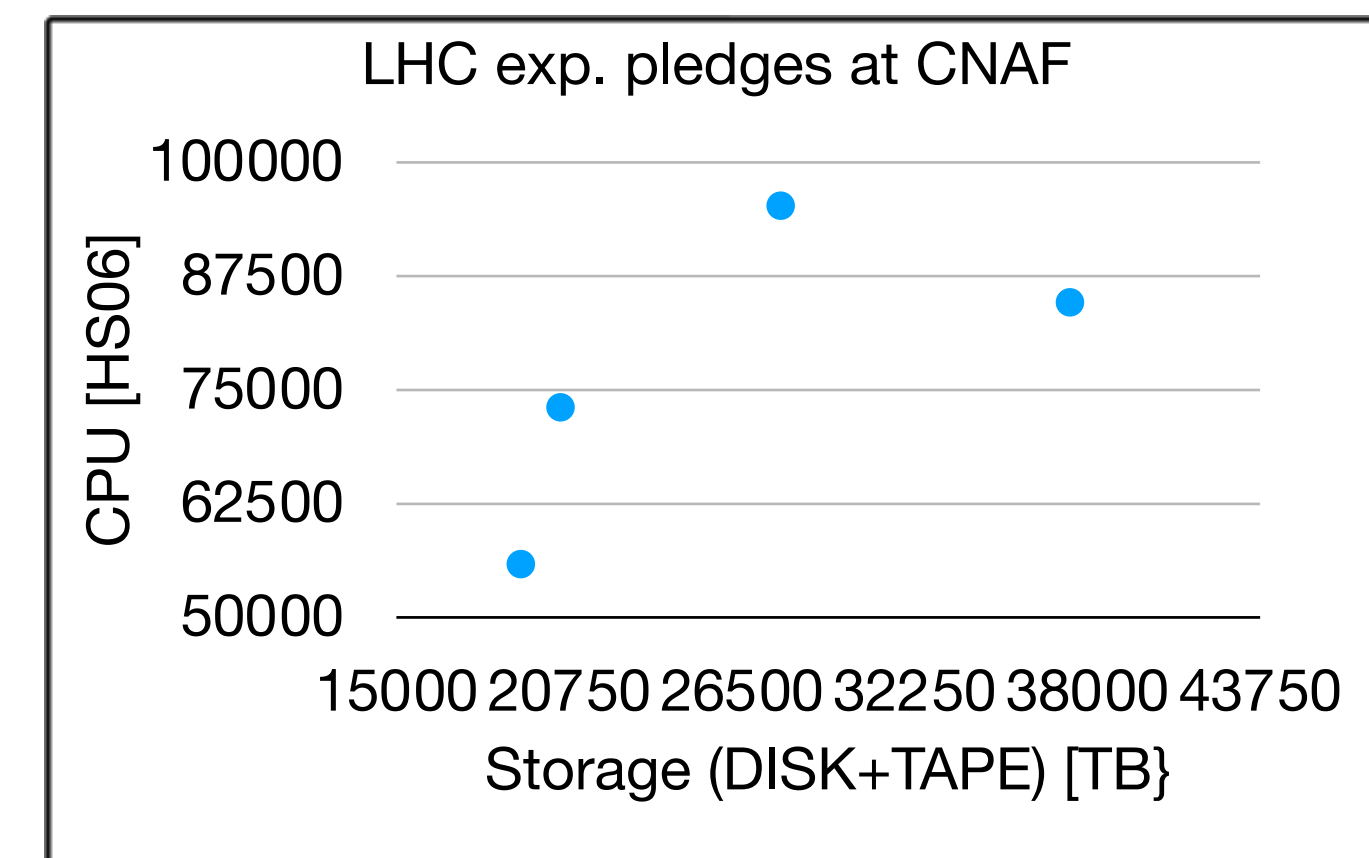
la CSN2 ospita 50 sigle composte da **0(5 → 500) FTE**



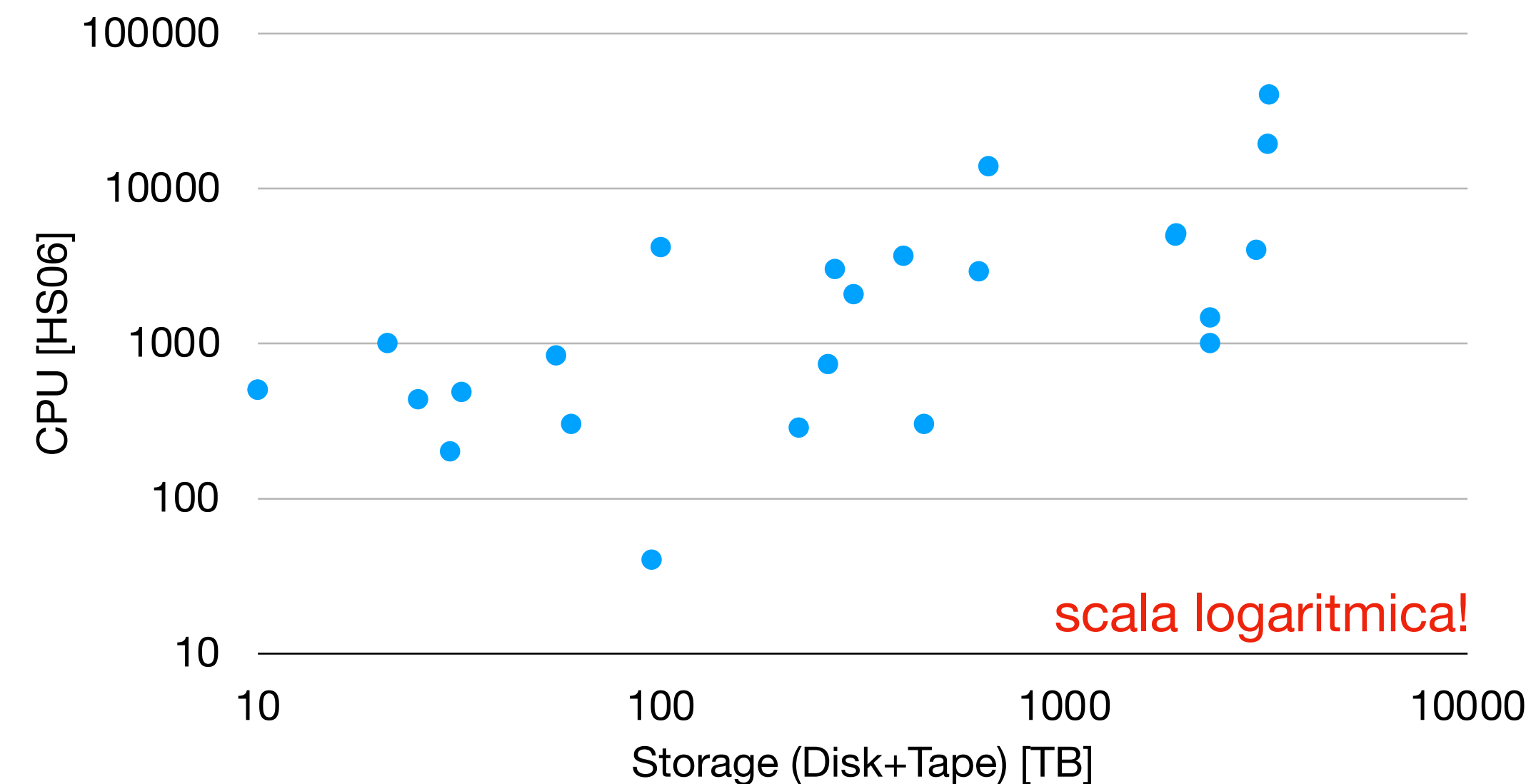
2020 data



l'analisi di utilizzo delle pledge allocate su esperimenti di CNS2 dimostra **inefficienza e discontinuità** oltre che una **eterogeneità** notevole delle richieste.



CSN2 pledges at CNAF (2020)



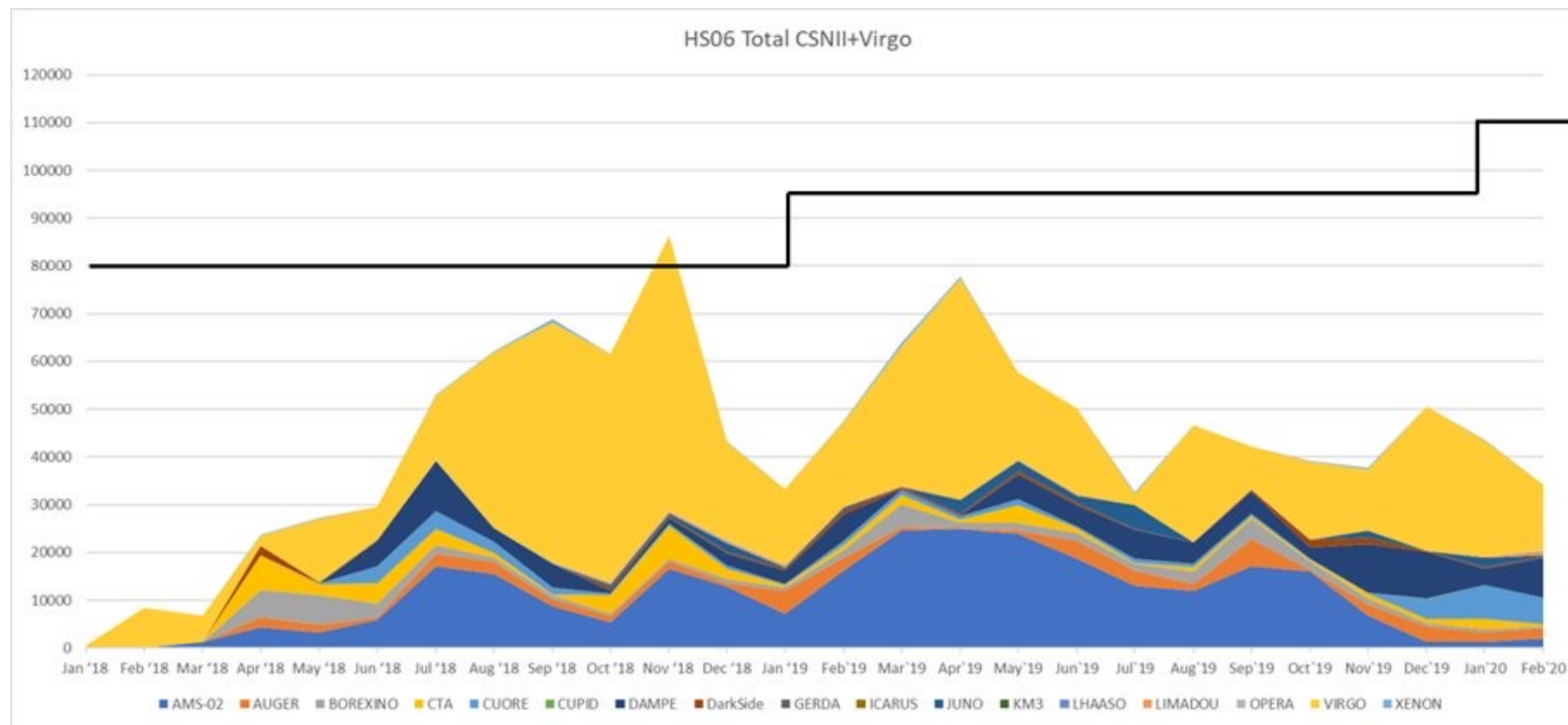


# il calcolo in CSN2: Tier 1

la CSN2 ospita 50 sigle composte da 0(5 → 500) FTE



2020 data



l'analisi di utilizzo delle pledge allocate su esperimenti di CNS2 dimostra **inefficienza** e **discontinuità** oltre che una **eterogeneità** notevole delle richieste.

il pater di utilizzo non solo è chiaro e inevitabile ma è anche in qualche modo prevedibile:

- 50 "piccoli" fanno peggio di 1 "grande")
- le sigle di CSN2 **non** utilizzano le risorse (i.e. CNAF-Tier1) come un Tier1 di una rete di computing complessa → analisi dati + Tier1 (in alcuni casi) di una rete di 1, 2 o 3 Tier1...



# richieste 2022



	<u>CPU (kHS06)</u>	<u>Disk (TB-N)</u>	<u>Tape (TB)</u>	<u>Costi (k€)</u>
AMS2	2	200	100	
AUGER	0,8	100	50	
BOREXINO		11		
CTA		200	100	
CYGNO	0,25	20	20	
CUORE		50		
DARKSIDE			100	
DAMPE	5	150		
ENUBET	0,5		5	
GAPS	0,3	10		
GERDA		10	10	
HERD	4	100		
JUNO	6,5	480	400	
KM3	2,2			
LIMADOU	1,2	80	4	
LITEBIRD		50	200	
NEWS		60	40	
NU_AT_FNAL	3	500	25	
NUCLEUS	1			
SPB2_MiniEUSO	0,2	10		
XENON		100	500	
Totale	26,95	2131	1552	
Totale effettivo	21,56	2131	1552	
Costi	216	256	18	489

Per il 2022 le richieste di CSN2 (al netto dei rimpiazzi) sono state di:

- CPU: 21.5 (+ 10) kHS06
- Disco: 2131 (+ 50) TB
- Tape: 1552 (+ 500) TB

Che corrispondono, coi fattori 2021, a:

- CPU: 216 (+ 100) k€
- Disco: 256 (+ 5) k€
- Tape: 18 (+ 6) k€

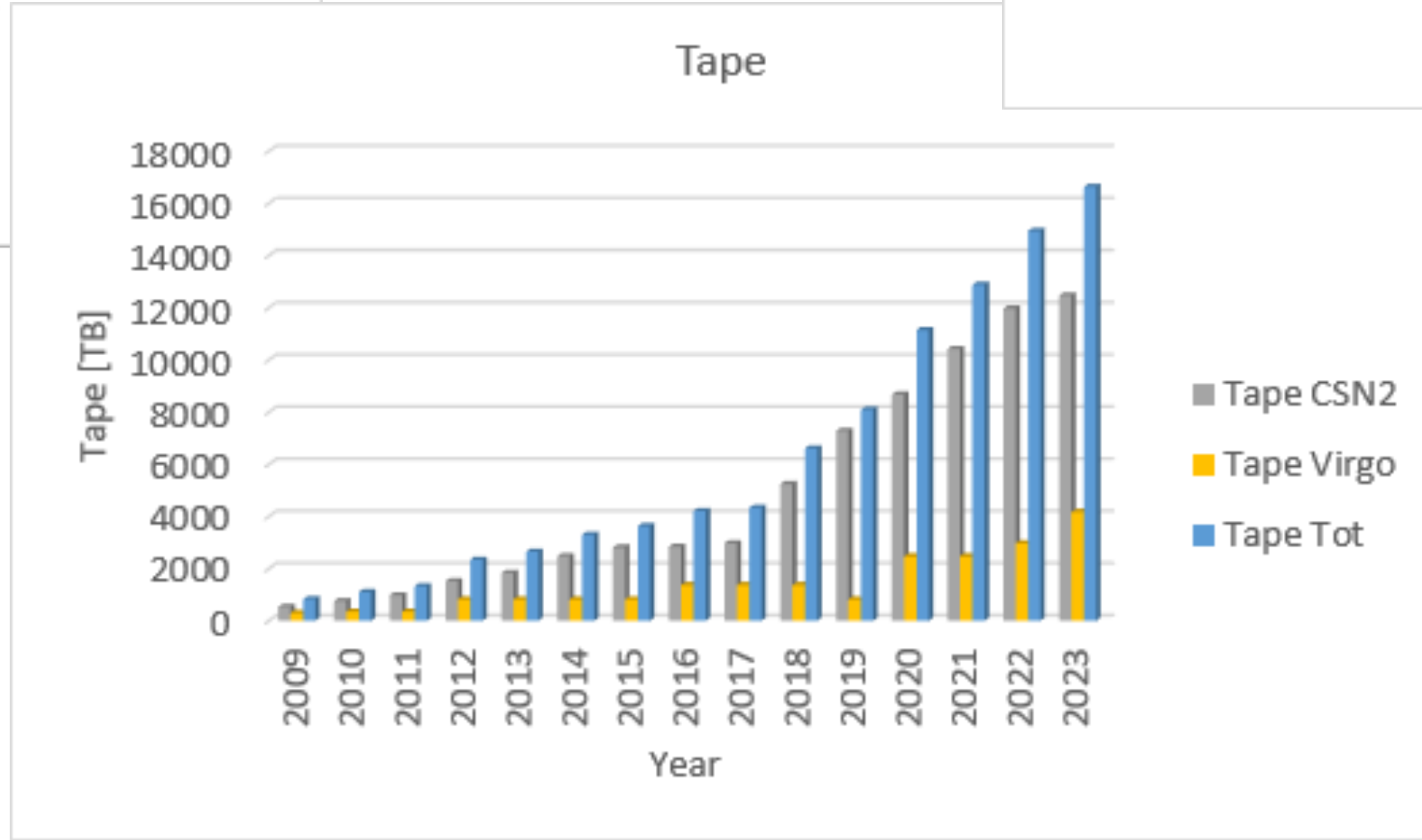
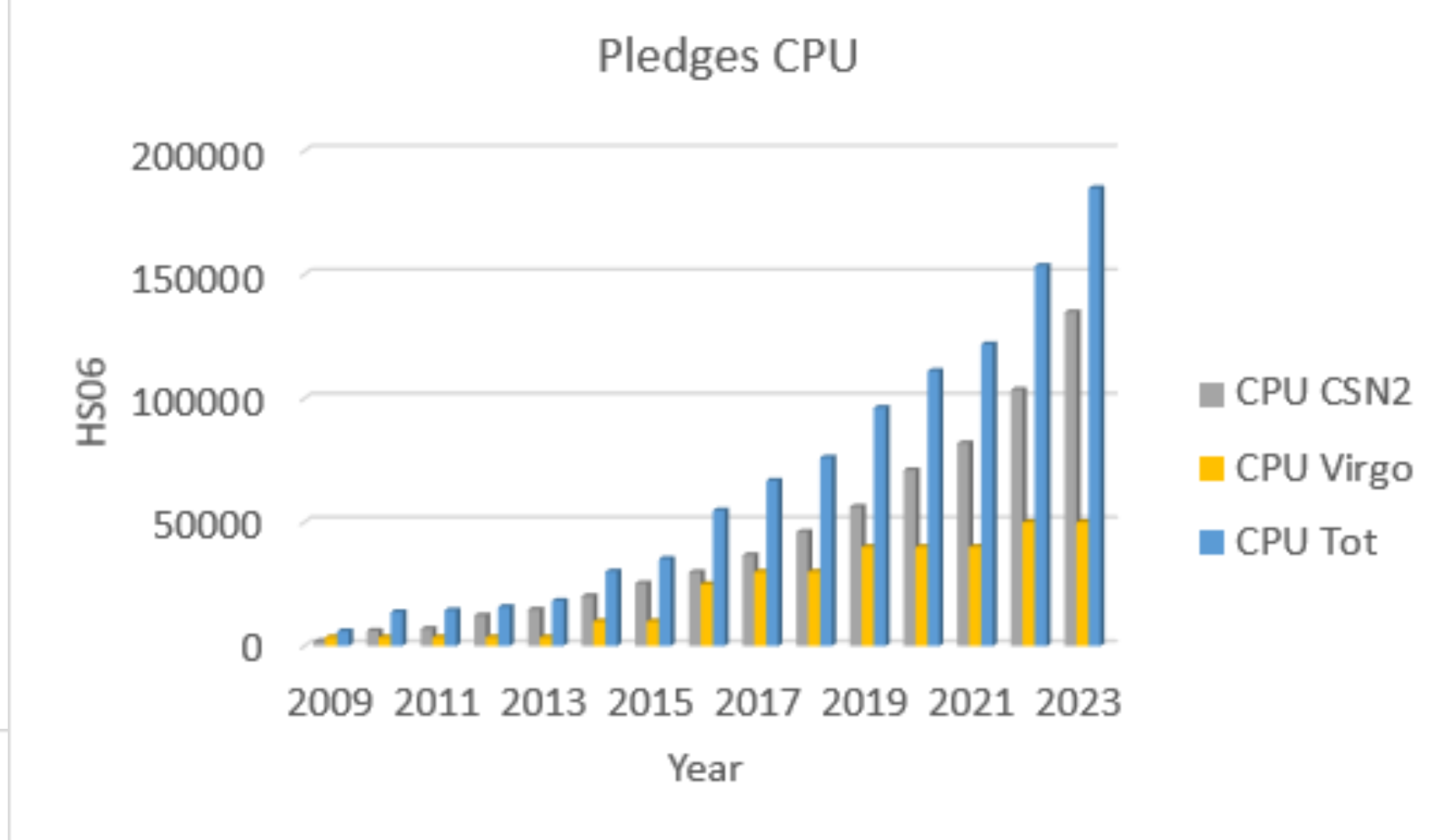
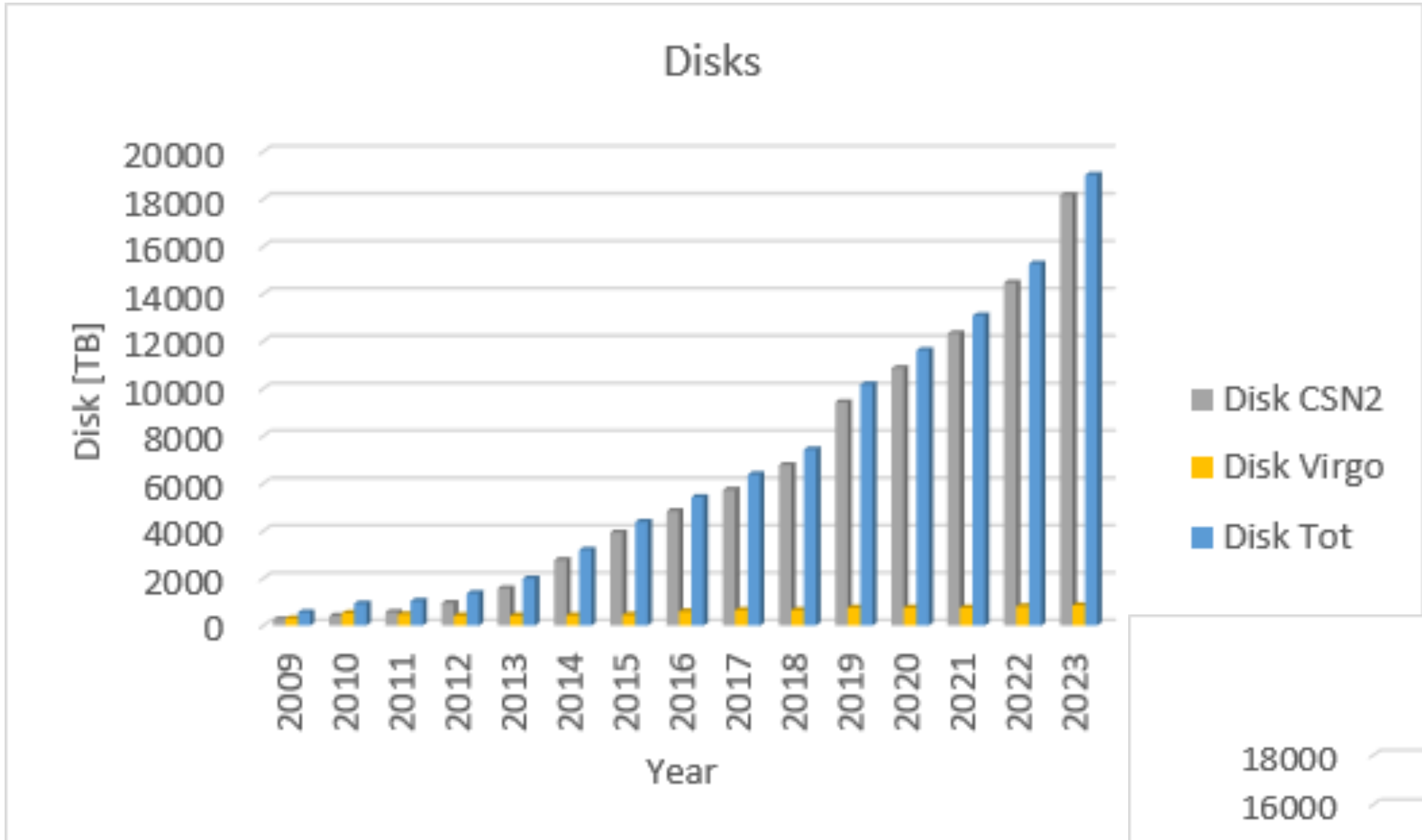
Questa relazione non contiene la valutazione delle risorse necessarie a Virgo (CPU=10kHS06, Disk=50 TB-N e Tape:500 TB) il cui calcolo è attualmente trattato direttamente dal CNAF con il consorzio EGO e non è soggetto a questo referaggio.

Fra gli esperimenti della CSN2 crescono le richieste per l'utilizzo di risorse HPC (EUCI ID, I SPE



# evoluzione del computing in CSN2

## pledge CPU/Disks/Tape





# richieste 2023 - CPU

<https://docs.google.com/spreadsheets/d/1BfDR4rm53fy2JgDhUPABDqZRdiwaXaKL3TWIMrCGIg8/edit#gid=1956810176>

SIGLA	Pledge 2022 CPU [HS06]	Incremento [HS06]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>148759</b>	<b>31298</b>	<b>21,04%</b>	<b>469,47</b>
Virgo	50000	0	0,00%	0
AMS-02	23800	4000	16,81%	60
DAMPE	22300	5000	22,42%	75
JUNO	10300	8850	85,92%	132,75
HERD	6110	0	0,00%	0
CTA	5296	0	0,00%	0
Darkside	4917	0	0,00%	0
ICARUS	4000	0	0,00%	0
CUORE	3940	0	0,00%	0
AUGER	3833	800	20,87%	12
DUNE (nu_at_fnal)	3000	0	0,00%	0
KM3NeT	2500	500	20,00%	7,5
Borexino	2000	-400	-20,00%	-6
LIMADOU	1947	200	10,27%	3
XENON	1250	0	0,00%	0
GAPS	1133	300	26,48%	4,5
NUCLEUS	1000	0	0,00%	0
Fermi	833	0	0,00%	0
Tristan	600	600	100,00%	9
Euclid	0	0	0,00%	0
HyperK	0	10838	0,00%	162,57
SWG0	0	210	0,00%	3,15
ET	0	100	0,00%	1,5
QUBIC	0	300	0,00%	4,5
LiteBIRD	0	0	0,00%	0
QUAX	0	0	0,00%	0
Cygn0				

SIGLA	Pledge 2022 CPU [HS06]	Incremento [HS06]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>148759</b>	<b>31298</b>	<b>21,04%</b>	<b>469,47</b>
HyperK	0	10838	0,00%	162,57
JUNO	10300	8850	85,92%	132,75
DAMPE	22300	5000	22,42%	75
AMS-02	23800	4000	16,81%	60
AUGER	3833	800	20,87%	12
Tristan	600	600	100,00%	9
KM3NeT	2500	500	20,00%	7,5
GAPS	1133	300	26,48%	4,5
QUBIC	0	300	0,00%	4,5
SWG0	0	210	0,00%	3,15
LIMADOU	1947	200	10,27%	3
ET	0	100	0,00%	1,5
Virgo	50000	0	0,00%	0
HERD	6110	0	0,00%	0
CTA	5296	0	0,00%	0
Darkside	4917	0	0,00%	0
ICARUS	4000	0	0,00%	0
CUORE	3940	0	0,00%	0
DUNE (nu_at_fnal)	3000	0	0,00%	0
XENON	1250	0	0,00%	0
NUCLEUS	1000	0	0,00%	0
Fermi	833	0	0,00%	0
Euclid	0	0	0,00%	0
LiteBIRD	0	0	0,00%	0
QUAX	0	0	0,00%	0
Borexino	2000	-400	-20,00%	-6
Cygn0				

Per il 2023 le richieste di CSN2 (al netto dei rimpiazzati) sono di:

- CPU: 31.3 kHS06
  - +20% rispetto al pledge
  - 63% dell'incremento concentrato in due esperimenti
  - ~ uguali a quelle 2022

Che corrispondono, coi fattori 2022, a:

- CPU: 469.5 k€
  - +150% rispetto al 2022



# richieste 2023 - disco

<https://docs.google.com/spreadsheets/d/1BfDR4rm53fy2JgDhUPABDqZRdiwaXaKL3TWIMrCGIlg8/edit#gid=1956810176>



SIGLA	Pledge 2022 DISK [TB]	Incremento [TB]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>14656</b>	<b>4557</b>	<b>31,09%</b>	<b>637,98</b>
AMS-02	2600	200	7,69%	28
Darkside	2290	50	2,18%	7
CTA	1700	100	5,88%	14
JUNO	1100	2000	181,82%	280
ICARUS	1000	300	30,00%	42
Euclid	1000	450	45,00%	63
AUGER	900	100	11,11%	14
Virgo	806	50	6,20%	7
DAMPE	700	100	14,29%	14
DUNE (nu_at_fnal)	510	0	0,00%	0
CUORE	450	300	66,67%	42
XENON	400	100	25,00%	14
Borexino	350	10	2,86%	1,4
HERD	300	0	0,00%	0
KM3NeT	200	200	100,00%	28
LIMADOU	140	40	28,57%	5,6
GAPS	50	30	60,00%	4,2
LiteBIRD	50	0	0,00%	0
Tristan	40	0	0,00%	0
Fermi	40	0	0,00%	0
NUCLEUS	20	160	800,00%	22,4
QUBIC	10	15	150,00%	2,1
HyperK	0	152	0,00%	21,28
SWGGO	0	150	0,00%	21
ET	0	50	0,00%	7
QUAX	0	0	0,00%	0
Cygn				

SIGLA	Pledge 2022 DISK [TB]	Incremento [TB]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>14656</b>	<b>4557</b>	<b>31,09%</b>	<b>637,98</b>
JUNO	1100	2000	181,82%	280
Euclid	1000	450	45,00%	63
ICARUS	1000	300	30,00%	42
CUORE	450	300	66,67%	42
AMS-02	2600	200	7,69%	28
KM3NeT	200	200	100,00%	28
NUCLEUS	20	160	800,00%	22,4
HyperK	0	152	0,00%	21,28
SWGGO	0	150	0,00%	21
CTA	1700	100	5,88%	14
AUGER	900	100	11,11%	14
DAMPE	700	100	14,29%	14
XENON	400	100	25,00%	14
Darkside	2290	50	2,18%	7
Virgo	806	50	6,20%	7
ET	0	50	0,00%	7
LIMADOU	140	40	28,57%	5,6
GAPS	50	30	60,00%	4,2
QUBIC	10	15	150,00%	2,1
Borexino	350	10	2,86%	1,4
DUNE (nu_at_fnal)	510	0	0,00%	0
HERD	300	0	0,00%	0
LiteBIRD	50	0	0,00%	0
Tristan	40	0	0,00%	0
Fermi	40	0	0,00%	0
QUAX	0	0	0,00%	0
Cygn				

Per il 2023 le richieste di CSN2 (al netto dei rimpiazzati) sono di:

- disco: 4.5 PB
- +30% rispetto al pledge
- ~ 50% dell'incremento concentrato in un esperimento
- doppie rispetto a quelle 2022

Che corrispondono, coi fattori 2022, a:

- disco: 638 k€
- ~ +150% rispetto al 2022



# richieste 2023 - tape

<https://docs.google.com/spreadsheets/d/1BfDR4rm53fy2JgDhUPABDqZRdiwaXaKL3TWIMrCGI8/edit#gid=1956810176>



SIGLA	Pledge 2022 TAPE [TB]	Incremento [TB]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>14502</b>	<b>4664</b>	<b>32,16%</b>	<b>46,64</b>
XENON	3500	0	0,00%	0
Virgo	2968	1200	40,43%	12
ICARUS	2000	1000	50,00%	10
Darkside	1870	50	2,67%	0,5
AMS-02	1200	350	29,17%	3,5
Euclid	1000	0	0,00%	0
JUNO	500	500	100,00%	5
CTA	500	200	40,00%	2
KM3NeT	250	50	20,00%	0,5
AUGER	200	100	50,00%	1
DAMPE	200	0	0,00%	0
LiteBIRD	200	0	0,00%	0
Borexino	56	24	42,86%	0,24
DUNE (nu_at_fnal)	35	475	1357,14%	4,75
Fermi	15	0	0,00%	0
LIMADOU	8	2	25,00%	0,02
CUORE	0	0	0,00%	0
NUCLEUS	0	83	0,00%	0,83
HyperK	0	605	0,00%	6,05
SWG0	0	0	0,00%	0
ET	0	0	0,00%	0
GAPS	0	0	0,00%	0
QUBIC	0	25	0,00%	0,25
HERD	0	0	0,00%	0
Tristan	0	0	0,00%	0
QUAX	0	0	0,00%	0
Cygno				

SIGLA	Pledge 2022 TAPE [TB]	Incremento [TB]	Incremento %	Costo incremento k€
<b>TOTALE</b>	<b>14502</b>	<b>4664</b>	<b>32,16%</b>	<b>46,64</b>
Virgo	2968	1200	40,43%	12
ICARUS	2000	1000	50,00%	10
HyperK	0	605	0,00%	6,05
JUNO	500	500	100,00%	5
DUNE (nu_at_fnal)	35	475	1357,14%	4,75
AMS-02	1200	350	29,17%	3,5
CTA	500	200	40,00%	2
AUGER	200	100	50,00%	1
NUCLEUS	0	83	0,00%	0,83
Darkside	1870	50	2,67%	0,5
KM3NeT	250	50	20,00%	0,5
QUBIC	0	25	0,00%	0,25
Borexino	56	24	42,86%	0,24
LIMADOU	8	2	25,00%	0,02
XENON	3500	0	0,00%	0
Euclid	1000	0	0,00%	0
DAMPE	200	0	0,00%	0
LiteBIRD	200	0	0,00%	0
Fermi	15	0	0,00%	0
CUORE	0	0	0,00%	0
SWG0	0	0	0,00%	0
ET	0	0	0,00%	0
GAPS	0	0	0,00%	0
HERD	0	0	0,00%	0
Tristan	0	0	0,00%	0
QUAX	0	0	0,00%	0
Cygno				

Per il 2023 le richieste di CSN2 (al netto dei rimpiazzati) sono di:

- tape: 4.5 PB
  - +30% rispetto al pledge
  - ~ 50% dell'incremento concentrato in due esperimenti
- doppie rispetto a quelle 2022

Che corrispondono, coi fattori 2022, a:

- tape: 47 k€
  - ~ +150% rispetto al 2022



# HPC

Descrivere eventuali richieste di HPC (se sì, quantità e motivazione)

Testo risposta lunga

- Nel form di raccolta richieste di giugno abbiamo anche raccolto le prospettive di uso di risorse HPC
- Non sono state "tradotte" in richieste economiche
- Richieste molto eterogenee
- Profilo temporale previsto: non definito (1), concentrato in 3-4 mesi flessibili (2), uniforme (3)

Sigla	Richiesta
EUCLID	25 M cores x hours
Auger	43000 GPUs x hours
ET	Ideally 5000 cores for 2-4 months, with as many GPUs as possible
DUNE	Al momento sono disponibili < 192G su una macchina con due slot assegnati. Si richiede un raddoppio effettivo della memoria host disponibile complessivamente.
LiteBIRD	2 M cores x hours
LSPE	0.9 M cores x hours

# Cloud



Sezione 2 di 3

INFN Cloud

La CSN2 intende favorire il passaggio alla piattaforma INFN-Cloud, ad esempio per gli esperimenti che hanno un livello di richieste di calcolo moderato e non continuativo. Questa sezione raccoglie informazioni utili a comprendere il livello di predisposizione degli esperimenti.

Descrivere eventuali richieste specifiche su INFN-Cloud (Quantità e motivazione).

Testo risposta lunga

- Richieste "Cloud" raccolte e inserite nei Preventivi 2023
- Sono state inserite anche 130 TB (120 QUAX + 10 CYGNO) di "tape", che però vanno considerati su Tier-1

SIGLA	CPU [HS06]	DISK [TB]
AMS-02	200	
SWGGO	40	
Auger	80	
HERD	1000	100
Fermi	1100	
QUAX	100	130
CYGNO	160	10
<b>TOTALE</b>	2680 (40 ke)	240 (33.5 ke)



# richieste 2023 - rimpiazzi

<https://docs.google.com/spreadsheets/d/1BfDR4rm53fy2JgDhUPABDqZRdiwaXaKL3TWIMrCGIg8/edit#gid=1956810176>



<b>Gran Totale:</b>	148759	74866	1.111k€	14656	12642	1.770k€	14502	4664	47k€	3.003k€
<b>Rimpiazzi Virgo</b>		17028	255k€		792	111k€				
<b>Rimpiazzi CSN2-Virgo</b>		25740	386k€		7293	1.021k€				
<b>SIGLA</b>	<b>Pledge 2022</b>	<b>Incremento</b>	<b>Costo incremento</b>	<b>Pledge 2022</b>	<b>Incremento</b>	<b>Costo incremento</b>	<b>Pledge 2022</b>	<b>Incremento</b>	<b>Costo incremento</b>	
#req	<b>CPU [HS06]</b>	<b>[HS06]</b>	<b>k€</b>	<b>DISK [TB]</b>	<b>[TB]</b>	<b>k€</b>	<b>TAPE [TB]</b>	<b>[TB]</b>	<b>k€</b>	
<b>TOTALE</b>	<b>148759</b>	<b>31298</b>	<b>469,47</b>	<b>14656</b>	<b>4557</b>	<b>637,98</b>	<b>14502</b>	<b>4664</b>	<b>46,64</b>	

Per il 2023 le richieste di CSN2 (al netto dei rimpiazzi) sono di:

- CPU: 469.5 k€
- disco: 638 k€
- tape 47 k€
- (cloud 73k€)

→ ~ 1 M€ (doppio rispetto a 2021)

Per il 2023 le richieste di rimpiazzi CNAF "imputate" a CSN2 (+Virgo) sono di:

- CPU: 640 k€
- disco: 1130 k€

→ ~ 1.8 M€ (~ x10 a 2021)

→ ~ 3 M€ (~ x4 a 2021)

# Conclusioni



- il panorama del Computing Model e delle risorse necessarie per gli esperimenti di astroparticle appare **vasto e differenziato**;
- la tipologia di alcuni esperimenti di astroparticle richiede l'utilizzo delle risorse di calcolo **in modo discontinuo e con picchi limitati** nel tempo che, attraverso una infrastruttura flessibile, possono essere ottimizzate;
- le richieste 2023 sono, economicamente, molto più alte di quelle 2022 ma:
  - 2/3 sono dovute ai rimpiazzi
  - grossa parte dell'incremento è dovuto all'aumento dei costi



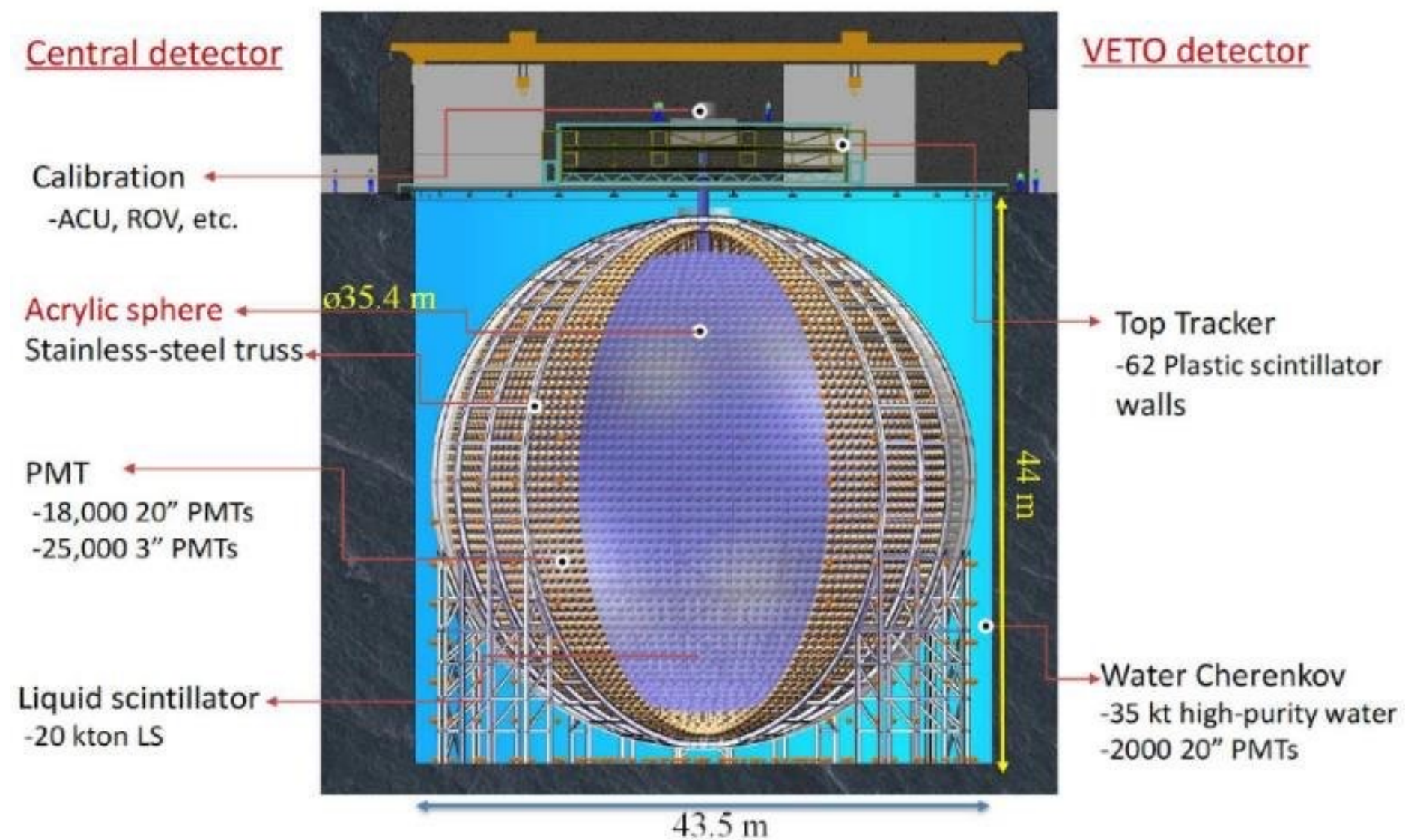
# BACKUP





# JUNO

## Jiangmen Underground Neutrino Observatory

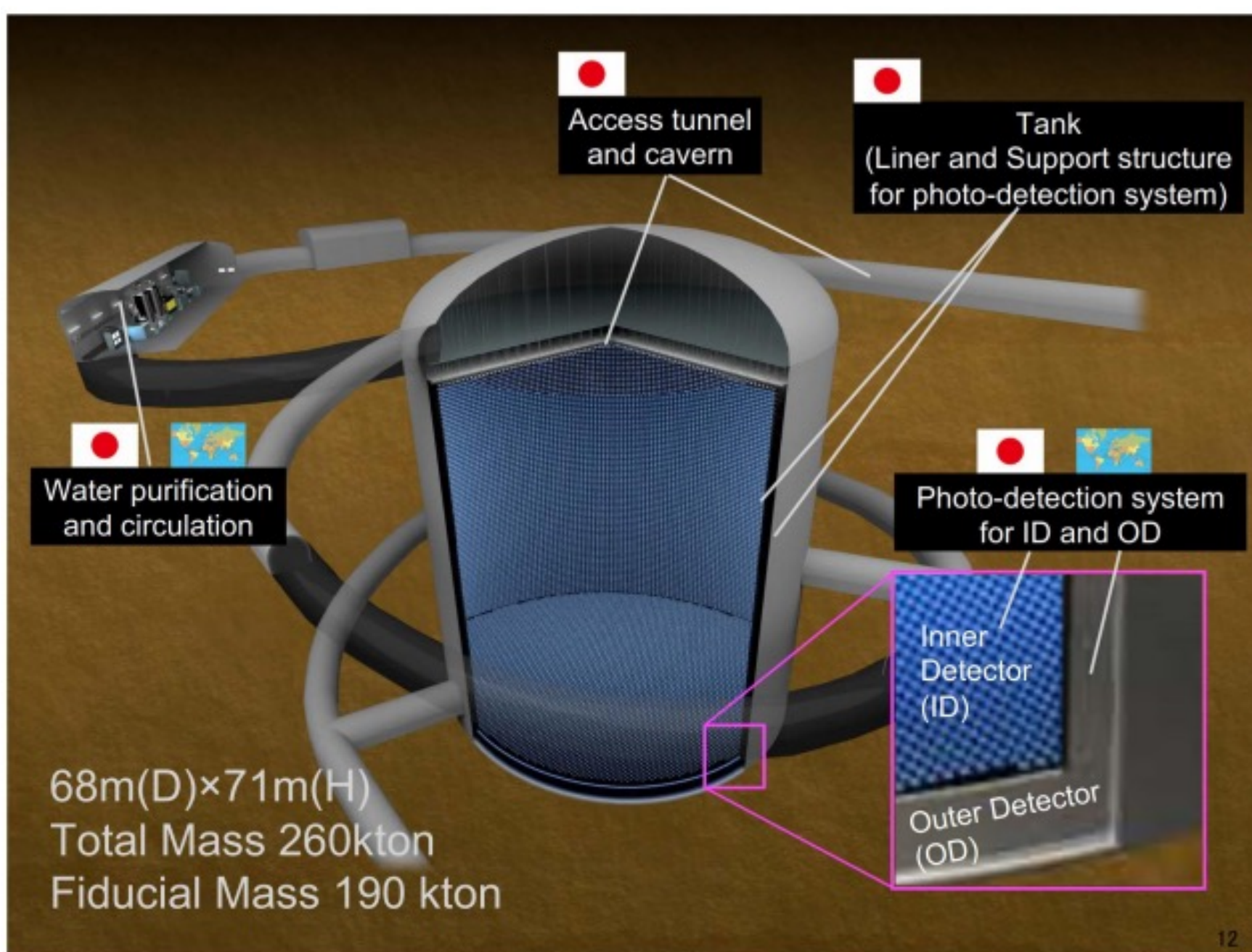


- JUNO è in commissioning
- Alla fine del 2023 è prevista una prima presa dati
- Dal 2024 inizia la presa dati scientifica

	2023	2024	2025	2026	2027
TAPE [PB]	0.5	1.0	4.0	7.0	10
DISK [PB]	1.0	3.0	6.0	6.0	6.0
CPU [kHS06]	10	20	20	20	20

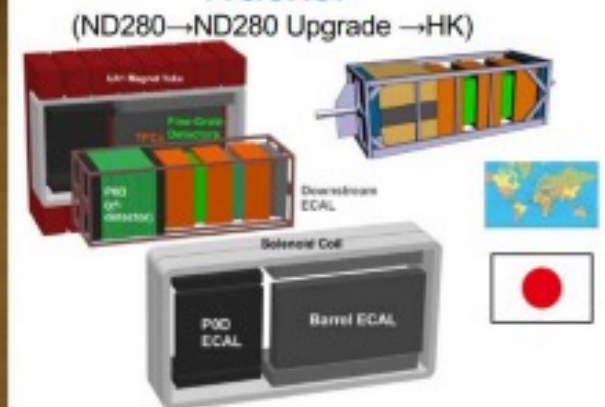


# Hyper-Kamiokande

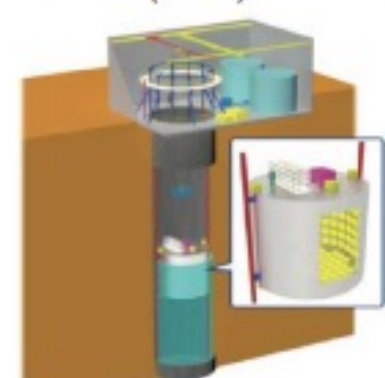


## Neutrino Beam


### Off-axis Magnetized Tracker (ND280→ND280 Upgrade →HK)



### Off-axis spanning intermediate water Cherenkov detector (IWCD)



Item	Quantity	Cost/year (k€)
CPU	11 kHS06	110
Tape storage	600 TB	7
Disk storage	150 TB	18
<b>Total</b>		<b>135</b>

 25% delle necessità di calcolo della collaborazione fino al 2027

Test al CNAF completati con successo

Richiesta per il 2023 sottomessa

Richiesta 2022 accolta al CNAF in corso d'anno

- HK installation starts 11/2025
- Operations start Q3/2027