

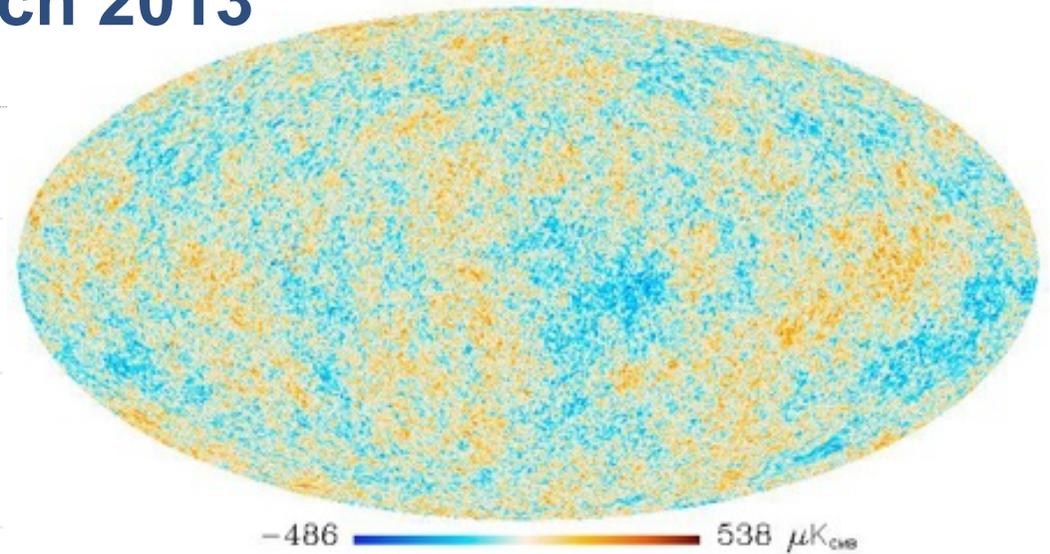
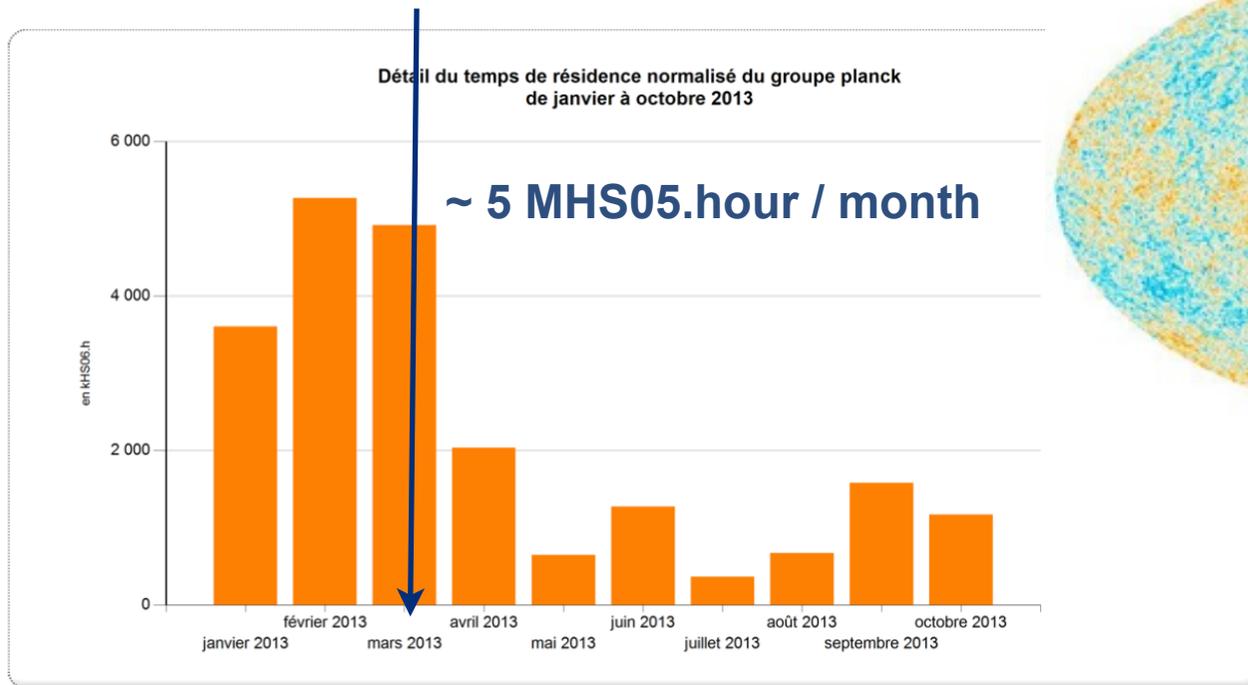
# Astroparticles at CC-IN2P3

Rachid Lemrani, June 11th, 2014

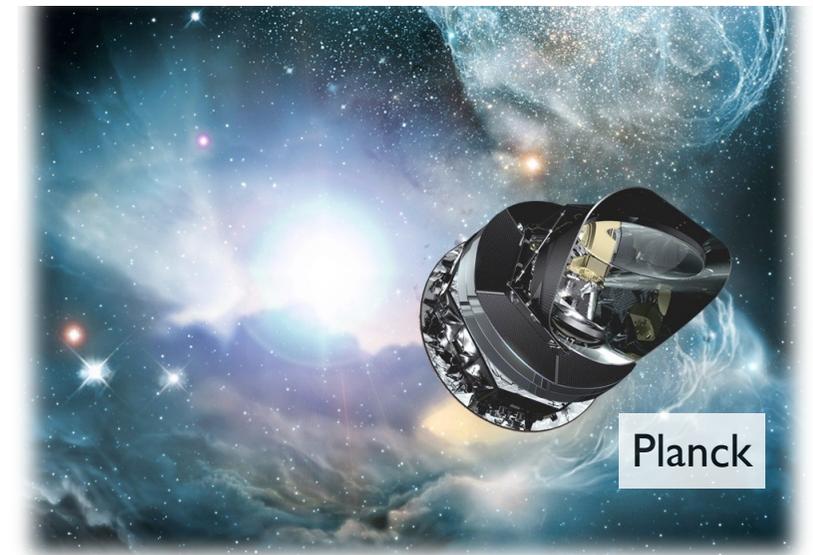
		running	soon	later
<b>Astroparticles</b> Extreme energies Origin Composition Anti-matter Dark Matter Gravity	<b>Gamma</b>	HESS-II FERMI		<b>CTA</b>
	<b>Neutrino</b>	ANTARES		<b>KM3NET</b>
	<b>Cosmic rays</b>	AUGER AMS02		<b>JEM-EUSO</b>
	<b>Gravitational Waves</b>	VIRGO	Adv VIRGO	ET
<b>Cosmology</b> Dark Matter Dark Energy Parameters	Dark Matter SuperNovae,WL,... CMB	EDELWEISS SNLS / SNF PLANCK		<b>EURECA</b> <b>LSST / EUCLID</b>
<b>Neutrinos : Majorana/Mass                      Mixing</b>	$\nu$ -less double $\beta$ Decay Neutrino Oscillation	NEMO OPERA D-CHOOZ T2K		<b>SuperNEMO</b>
<b>Proton decay</b>				<b>LAGUNA</b>

**Most computing intensive in the future : CTA, LSST, Euclid**

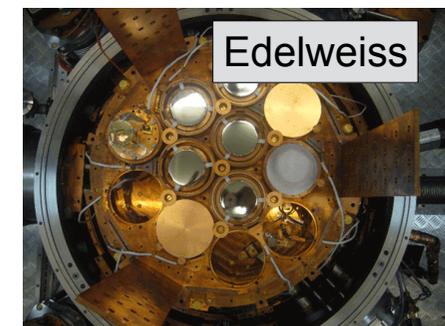
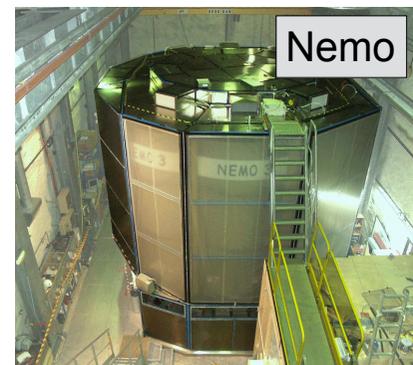
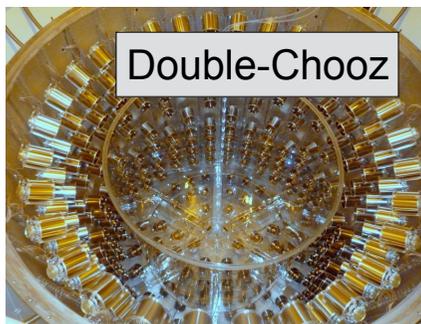
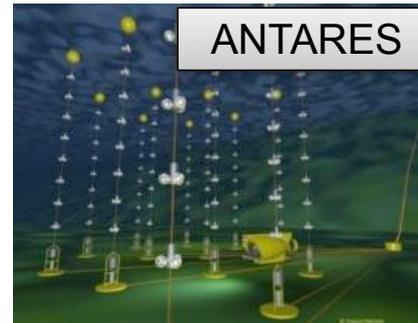
## Planck publication : 21st march 2013



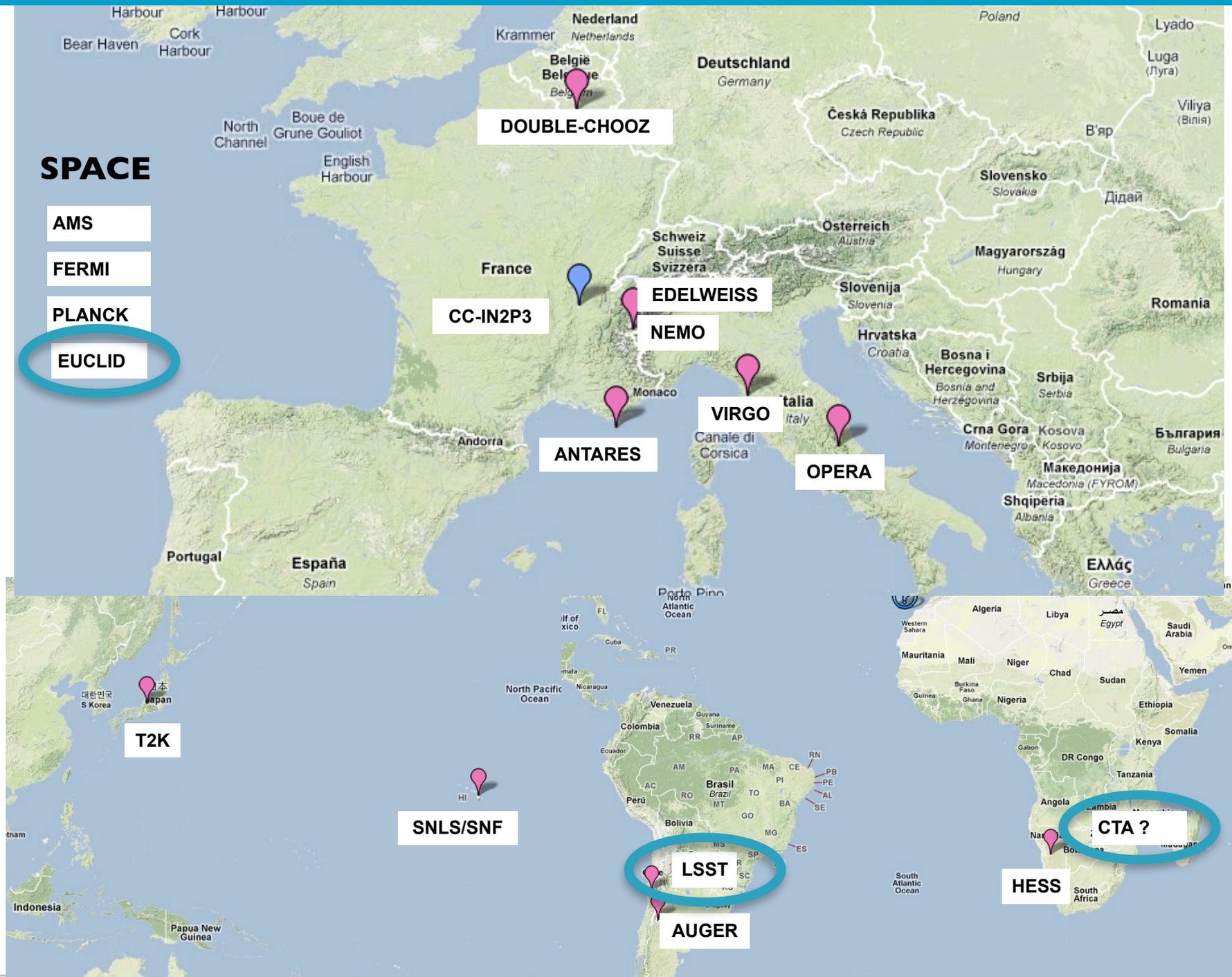
**- CC-IN2P3 provided increased amount of computing before the publication**



# Astroparticle experiments at CC-IN2P3



# Astroparticle experiments at CC-IN2P3



- **Events : gammas, neutrinos, cosmic rays**
- **1D signals : gravitational waves, CMB**
- **2D Images : Supernovae**
- **run conditions : calibration, monitoring**

- **Mass storage on tapes (HPSS) : large files**
- **Data analysis on Semi-Permanent Storage (GPFS) : SuperNovae, Planck ...**
- **Disks : gravitational waves, ...**
- **Shared files on AFS : programs, ...**
- **Databases : run conditions, parameters**

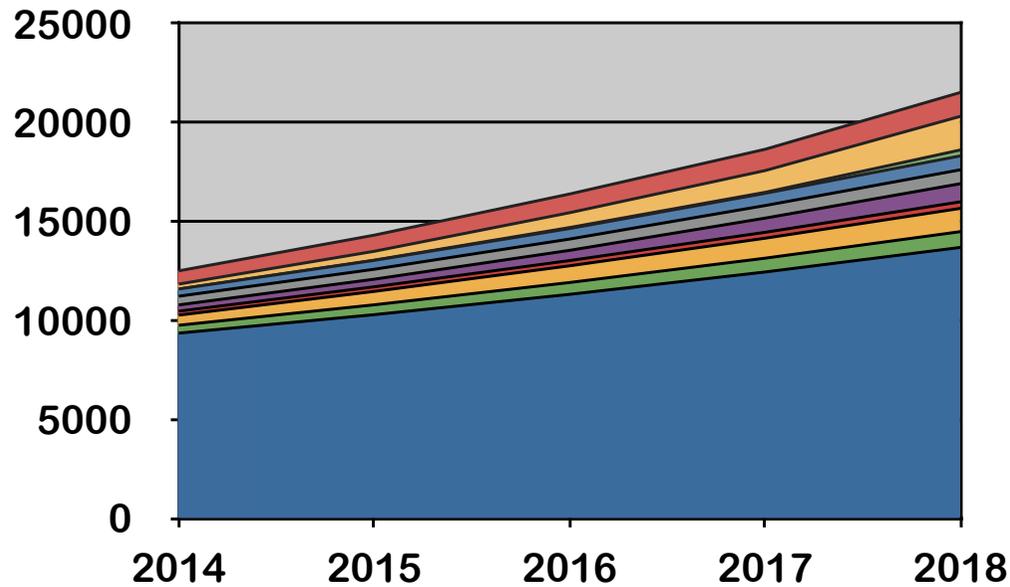
- **Management with IRODS** : data transfer, heterogeneous support : cartridges, disks, databases. Unix like commands to copy, list, search for files in a simple arborescence
- **Access with XROOTD** : well adapted to root files (other formats also possible) interfaced at CC-IN2P3 with HPSS

- **Parallel processing MPI : CMB**
- **Signal processing : GW, CMB (1D → 2D maps)**
- **Images processing: Supernovae**
- **Events processing: reconstruction, analyses, ...**
- **Monte-Carlo simulations :**
  - **Atmospheric showers (auger, cta)**
  - **Propagation of light in the sea (antares)**
  - **Backgrounds for rare events detection (edelweiss, supernemo)**
  - ...
- **Interactive : programs tuning before mass computing**

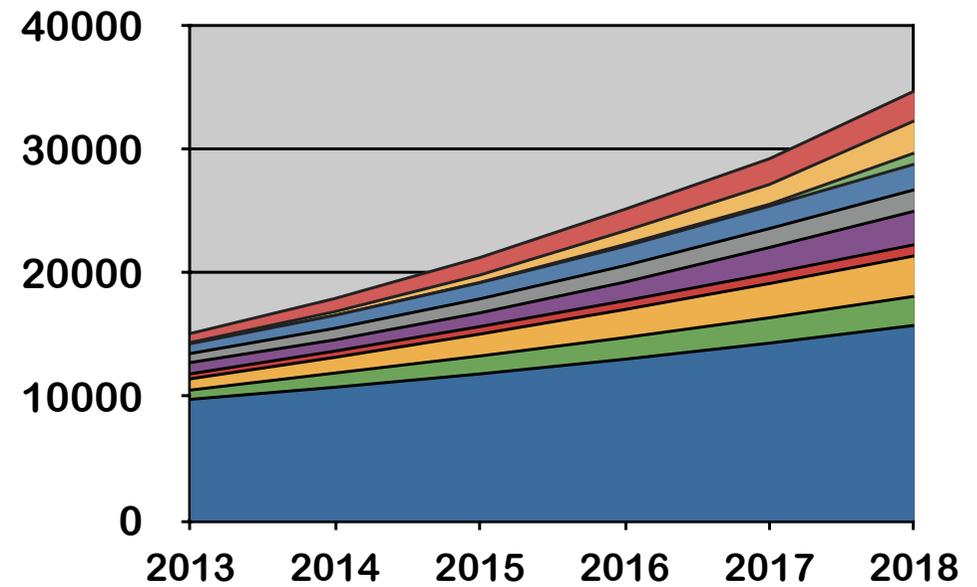
# Future

## Increase expected by experiments

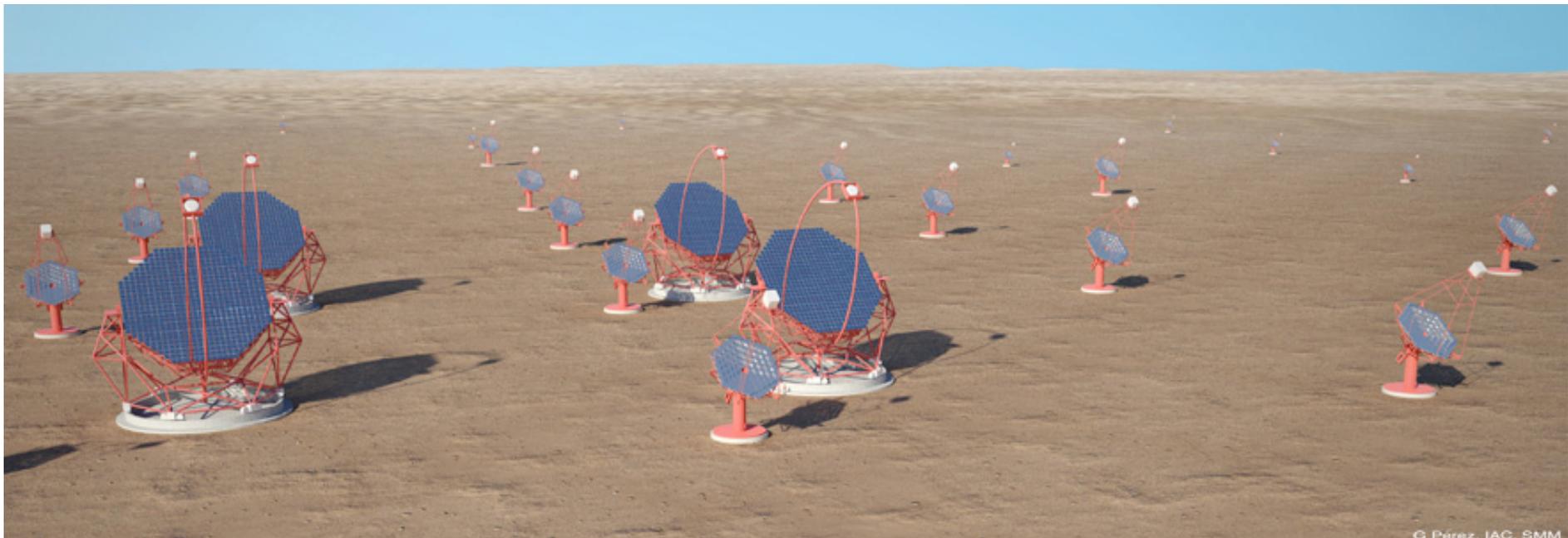
### Cumulated Disk TB



### Cumulated Tape TB



- 2016 to 2020 ??? deployment of the array
  - > Increasing data flow



- From 2020 : of order 1 to 10 PB/year

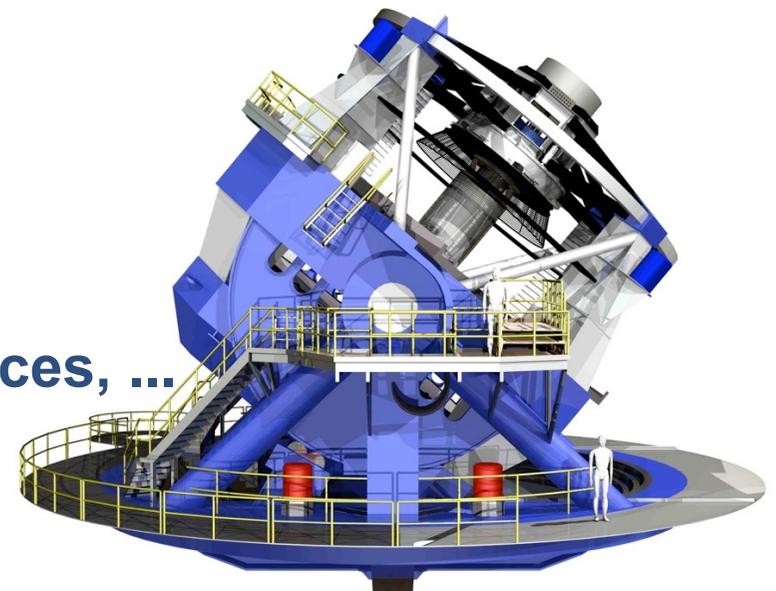
- Telescope ready for system Integration and testing : **July 4 2019**
- Camera ready : **May 15, 2020**
- Commissioning phase will be **24-36 months**
  - 6 months minimum with the Commissioning camera
  - 18 months with camera for I&T and science verification

## CC-IN2P3 :

- **half of Data Release Production** (other half by NCSA / Urbana Illinois)
- **will host all the processed data**

## Challenges :

- data volume 100s PB in 2030 ?
- analysis type : images
- scale gap wrt SNLS / SN Factory
- Huge database : 10s PB of objects, sources, ...



## **DC-2013 : First major DC involving both CC-IN2P3 and NCSA**

**Using DATA from SDSS : SDSS DR7 survey in Stripe 82 :**

**~5 TB for CC-IN2P3: 298 runs and nearly 4 million images in 5 passbands**

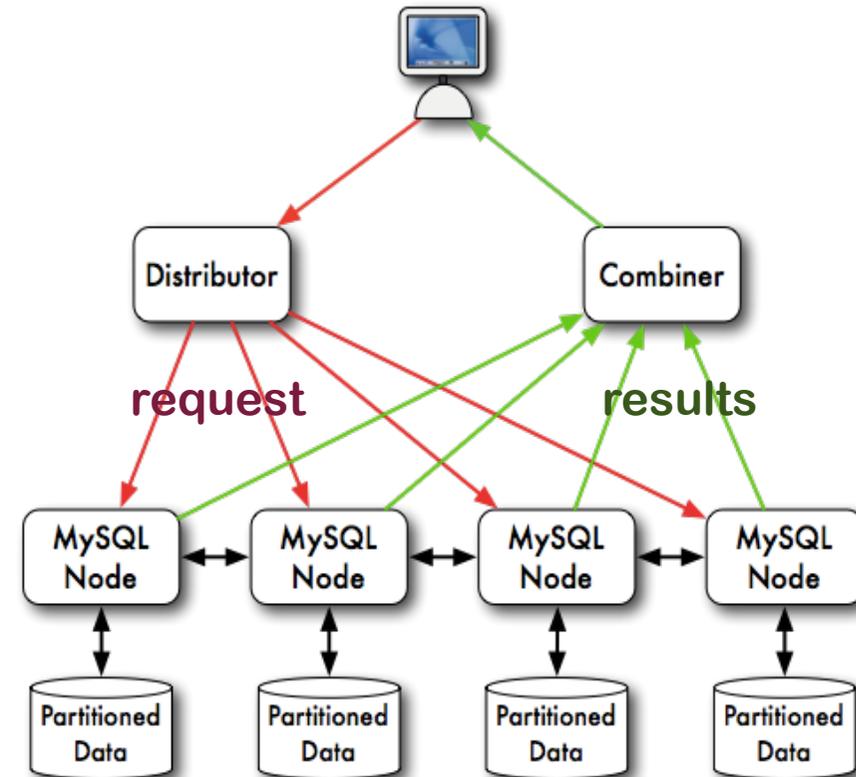
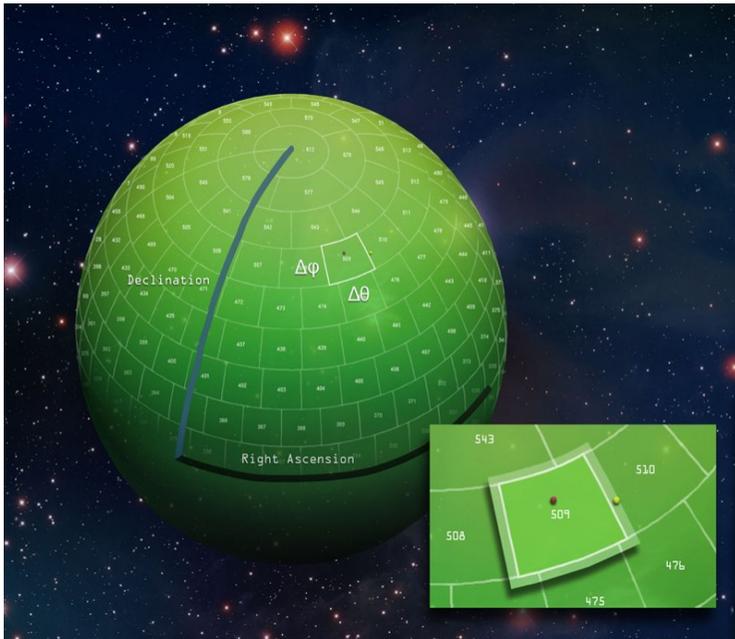
### **CC-IN2P3 :**

- *1 millions CPU hours (HS06)*
- *40 000 jobs*
- *Up to 700 batch slots*
- *One dedicated interactive VM for debug, file transfer, ...*
- *Tests of job submission using DIRAC (on z filter)*
- *Up to 100 TB on sps (GPFS) / 20 million files*
- *Data transfers using IRODS : 100 TB*
- *MySQL server for produced catalog of objects*

**Very challenging with only 5 TB of Raw data**

Developped by SLAC & Caltech, contributions by LPC/IN2P3 Clermont  
Will host 34 PB with 9000 billions entries

## Overlapping partitions of the sky



## CC-IN2P3 : Test of QSERV platform with 310 nodes (in 2013)

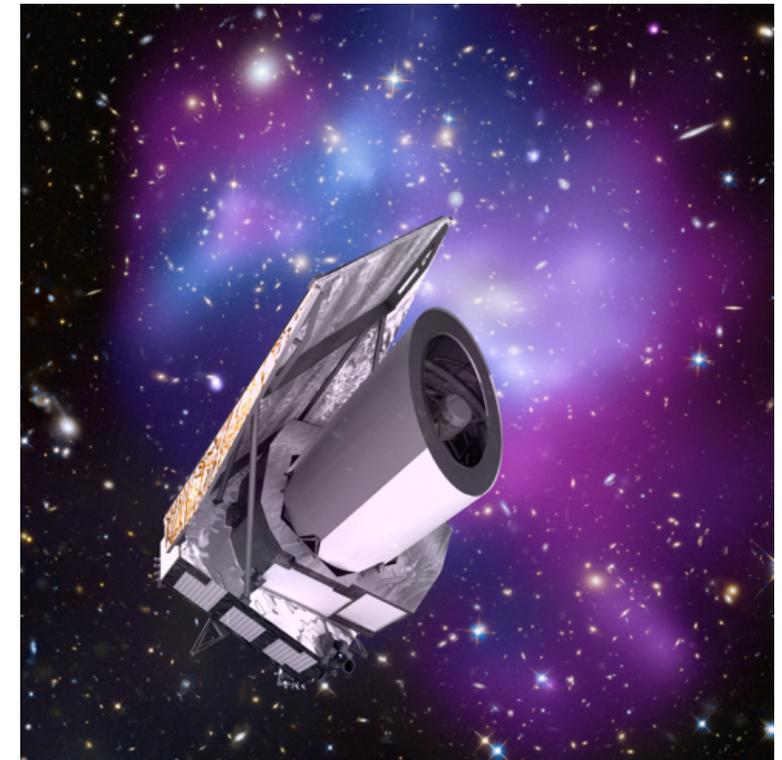
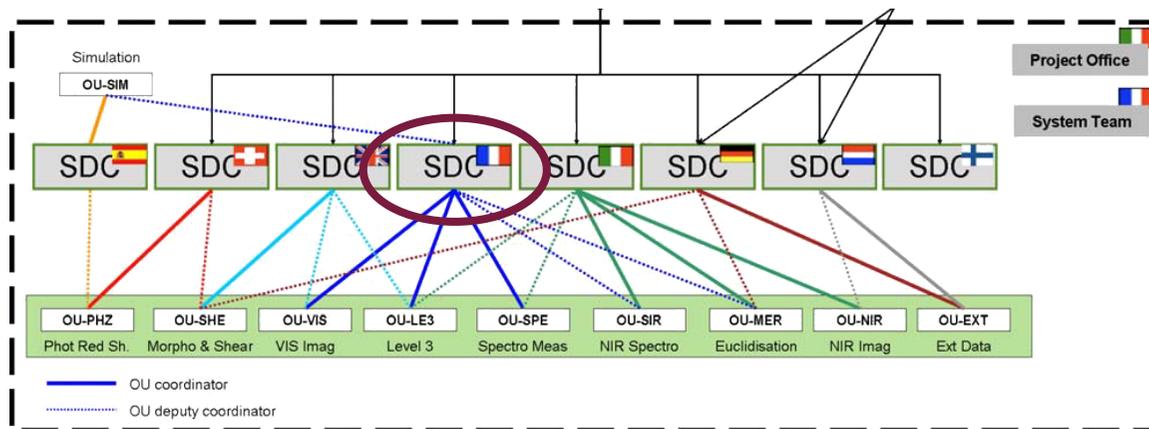
Very usefull uncovering unexpected issues : QSERV didn't scale with more than 250 nodes

## ■ Space mission 7 years, **launch in 2020**

- Dark Energy / Dark Matter, Gravity, Large Scale Structures

## ■ 2026 : ~ total 150 PB ?

## ■ 8 Science Data Centers



## ■ CC-IN2P3 : 30 % of total Processing and Storage

## Virgo shutdown

Advanced Virgo : **starting end 2015 ?**

**800 TB / year at CC-IN2P3 from 2019 ?**

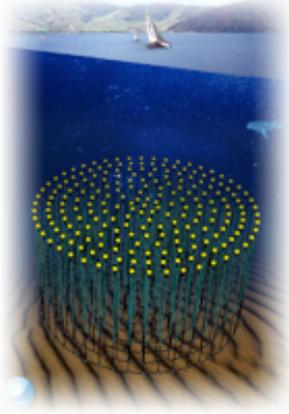
- **Computing : mainly at CC-IN2P3 and CNAF**
- **Preparation for computing model for adv. virgo :**

**challenges : type/amount of computing (GPU),  
heterogeneous clusters**

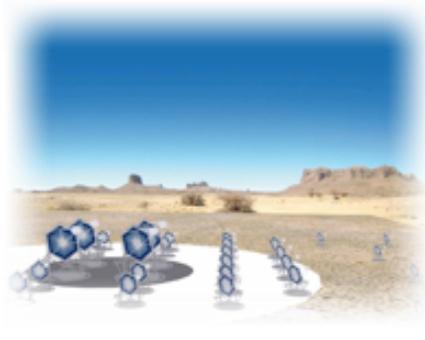


# Prospects

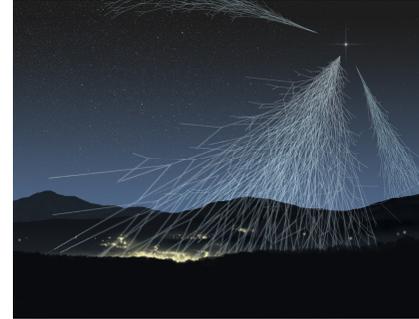
KM3NET  
high energy neutrinos



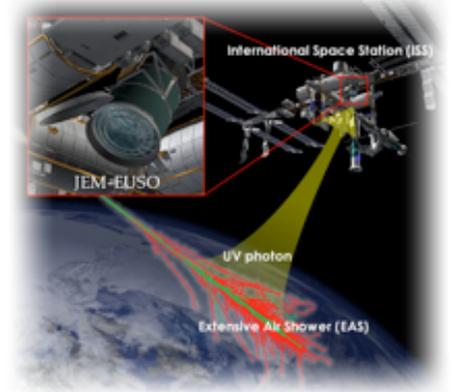
CTA : gamma rays



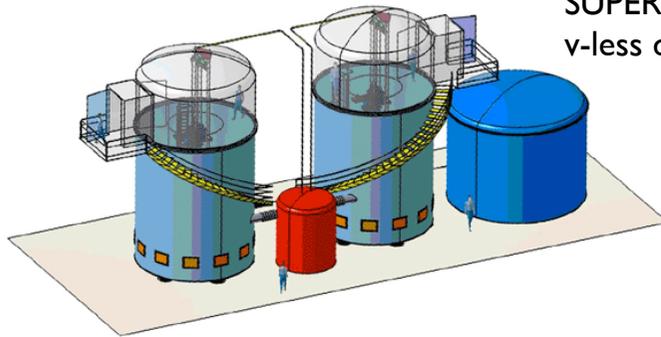
AUGER upgrade/extension



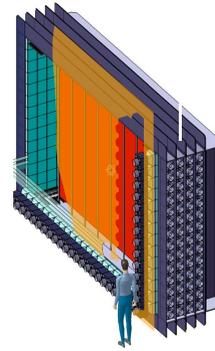
JEM-EUSO : extreme energies



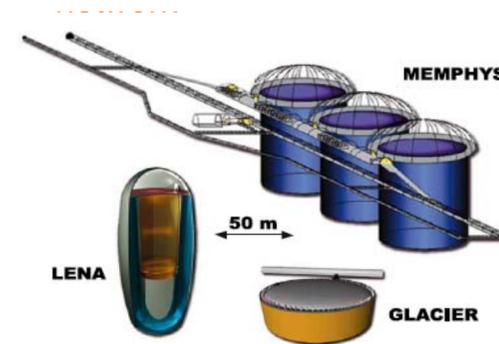
EURECA : Dark Matter



SUPERNEMO  
v-less double beta decay



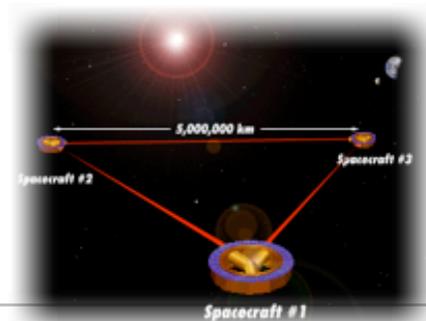
LAGUNA proton decay, neutrino



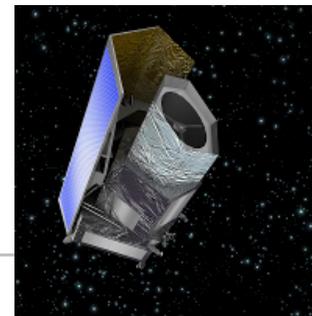
advIRGO /ET Gravitational waves



LISA gravitational waves



Euclid,  
dark energy

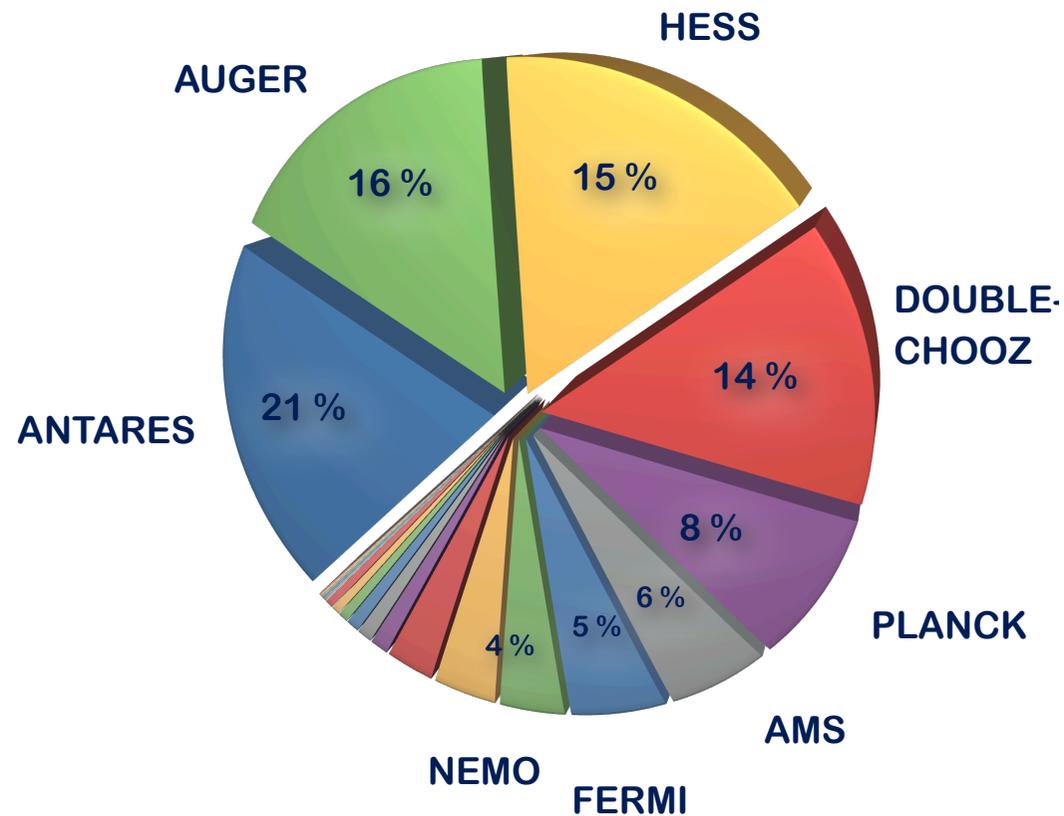


LSST, Chile  
dark energy



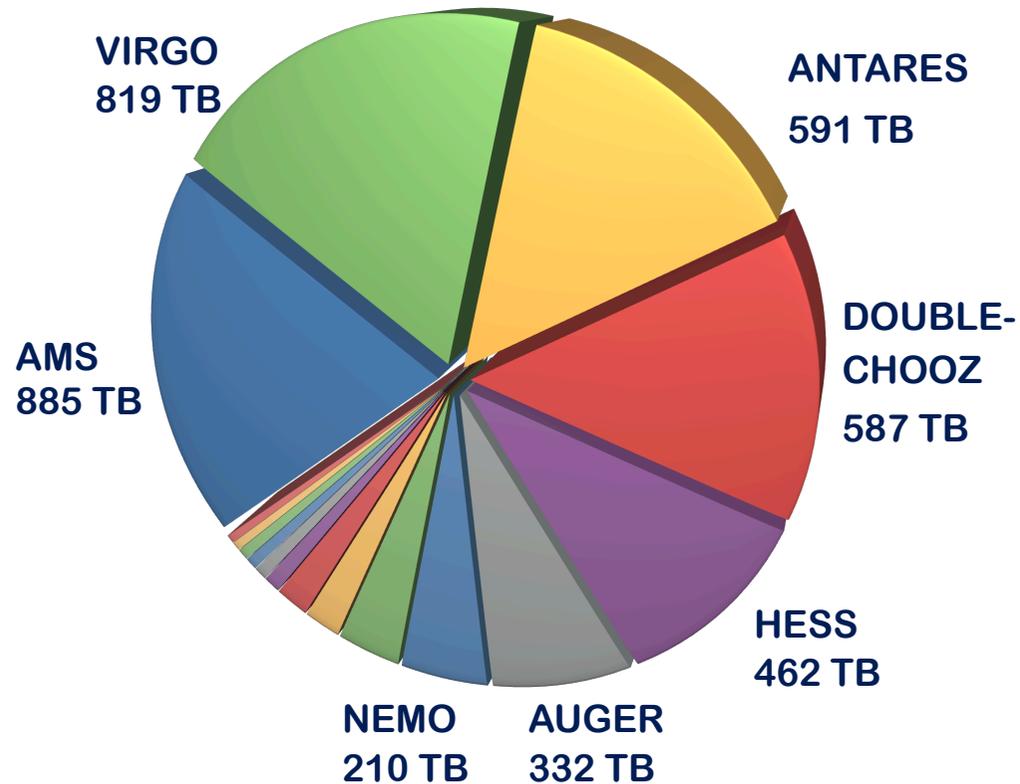
# Backup Slides

	2012 [HS06 Hrs]
antares	22 637 176
pauger	17 549 325
hess	17 074 751
dchooz	14 902 802
planck	9 255 537
ams	6 246 575
glast	6 051 319
nemo	4 179 202
km3net	4 037 867
virgo	3 079 917
t2k	1 175 106
nusol	965 334
snovae	831 608
trend	642 864
lsst	536 866
cta	536 303
xmm	247 230
integral	163 779
sdss	117 093
opera	105 090
nucifer	89 243
jemeuso	62 015
baoradio	7 686
edelweis	5 588
Total	110 253 047



## - Tapes (HPSS)

	Mass Storage (TB)
ams	885
virgo	819
antares	591
dchooz	587
hess	462
pauger	332
nemo	210
snovae	153
baoradio	88
cta	81
km3net	40
edelweis	31
t2k	29
sdss	27
planck	21
trend	20



- High performance disks (GPFS) : PLANCK : ~ 150TB  
 SNLS : ~ 140 TB  
 SNF : ~ 65TB