# W6

# Near earth space and beyond

# – eyes on the sky –

## Key Notes


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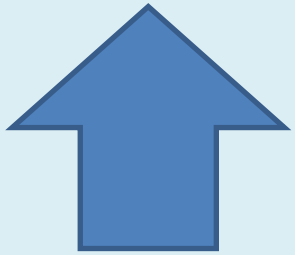
# The 1st SCAR Antarctic and Southern Ocean Science Horizon Scan - Final List of Questions -

## NEAR-EARTH SPACE AND BEYOND - EYES ON THE SKY

**69.** What happened in the first second after the Universe began?

**70.** What is the nature of the dark Universe and how is it affecting us?



Deep Universe / Cosmology

# The 1st SCAR Antarctic and Southern Ocean Science Horizon Scan - Final List of Questions -

# NEAR-EARTH SPACE AND BEYOND - EYES ON THE SKY

## Near Earth Space

**71.** What are the differences in the inter-hemispheric conjugacy between the ionosphere and that in the lower, middle and upper atmospheres, and what causes those differences?

**72.** How does space weather influence the polar ionosphere and what are the wider implications for the global atmosphere? *(Cross-cuts "Antarctic Atmosphere")*

**73.** How do the generation, propagation, variability and climatology of atmospheric waves affect atmospheric processes over Antarctica and the Southern Ocean? *(Cross-cuts "Antarctic Atmosphere")*


# Astronomy & Astrophysics from Antarctica (AAA)

The objectives of ***Astronomy & Astrophysics from Antarctica*** are to coordinate astronomical activities in Antarctica in a way that ensures the best possible outcomes from international investment in Antarctic astronomy, and maximizes the opportunities for productive interaction with other disciplines.

AAA aims to deliver:

- Quantitative assessments of the **potential of each Antarctic plateau** station to contribute to astronomy,
- Advances in the understanding of **Antarctic meteorology**, as it applies to astronomical observations,
- Improved **coordination with atmospheric and ionospheric researchers**,
- Papers in peer-reviewed journals,
- Properly **archived** data sets of **site-testing data**.


# Astronomy & Astrophysics from Antarctica (AAA)

Working Group A: Site testing, validation and data archiving.
The SCAR AAA site testing database is now online.

Working Group B: Arctic site testing.

Working Group C: Science goals.

• **Optical and Infrared Astronomy** • First Light in the Universe • Stellar Populations • The Galaxy and Galactic Ecology • Exo-planets • **Terahertz and Sub-millimetre Astronomy** • Formation of Molecular Clouds • Origins of Stellar Mass • Galactic Star Formation Rate • Interstellar Medium of the Magellanic Clouds • Templates for high-redshift galactic emission • **Cosmic Microwave Background Radiation** • Small-scale temperature anisotropies • **B-mode Polarization** • Neutrinos • Astrophysical Sources of Neutrinos • **Cosmic Rays** • Extension to lower energy Neutrinos • Cosmogenic Neutrinos • Dark Matter • **Solar Astronomy** • Corona-Chromosphere interface • Magnetic fields, MHD or Alfvén waves

Working Group D: Major new facilities.


# Astronomy & Astrophysics from Antarctica (AAA)

## Past AAA Planning Group meetings

**Friday 7 August 2009**
Centro de Convencoes SulAmerica, Rio de Janeiro, Brazil.

**Monday 11 May 2009**
Grand Hotel Villa Tuscolana, Frascati, Italy.

## Past Scientific Research Program meetings

**7 - 10 August 2015**
Third Workshop AAA2015, Volcano, Hawaii

**26 August 2014**
SkyCity Conference centre, Auckland, New Zealand.

**24 - 26 July 2013**
Second Workshop AAA2013, Siena, Italy

**14 July 2012**
Hilton Hotel, Portland, Oregon, USA.

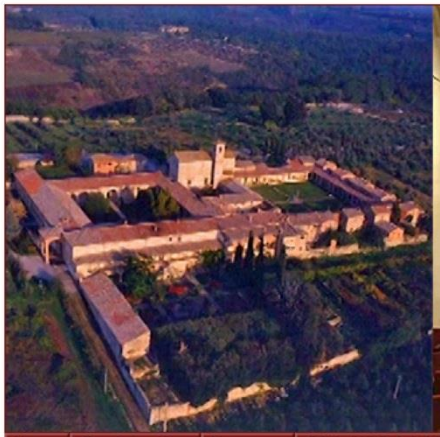
**29 June - 1 July 2011**
AAA Kick-off meeting, Taronga Zoo, Sydney

**1 August 2010**
Hotel Panamericano Buenos Aires, Buenos Aires, Argentina.

# Astronomy & Astrophysics from Antarctica (AAA)

## Second Workshop of the SCAR AAA: 24-26 July 2013, Certosa di Pontignano, Siena





Astronomy and Astrophysics from Antarctica (AAA)

**AAA2013**

**Second workshop of the SCAR AAA Scientific Research Program**

24 - 26 July 2013
Certosa di Pontignano
Siena, Italy.



**Rationale**

Astronomy & Astrophysics from Antarctica became a Scientific Research Program of SCAR in 2010. Broadly stated, its objectives are to coordinate astronomical activities in Antarctica in a way that ensures the best possible outcomes from international investment in Antarctic astronomy, and to maximize the opportunities for productive interaction with other disciplines. This meeting aims to bring together the key players in Antarctic astronomy, to further develop the work begun in 2011 at the "Taronga Zoo" meeting in Sydney, Australia.

**Note**: PDF versions of all the presentations are now available here. Some photos from the meeting are available here.

This is a SCAR Scientific Program meeting with additional funding generously provided by the Italian Programma Nazionale di Ricerche in Antartide, and logistic support from the University of Rome and the University of Siena.

# ARENA

A European Network for Astrophysics in Antarctica

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A European Network for Astrophysics in Antarctica

## ARENA

### *Antarctic Research, a European Network for Astrophysics*

**A project of the *Research Infrastructures* of the European Commission FP6**

**(RICA-026150)**

ARENA is a European networking activity aimed at fostering optical,infrared and (sub)millimetre-wave astronomy in Antarctica, and primarily at Dome C CONCORDIA on the Antarctic Plateau.

It has been approved by the European Commission for a period of 4 years (2006-2009) as a Coordination Action of the Research Infrastructures Programme.

It involves 22 research laboratories, institutes and industrial partners in 7 European countries (Belgium, France, Germany, Italy, Portugal, Spain, and UK) and Australia.

**ARENA Leaflet**
*English Version*
*French version*
*Italian Version*

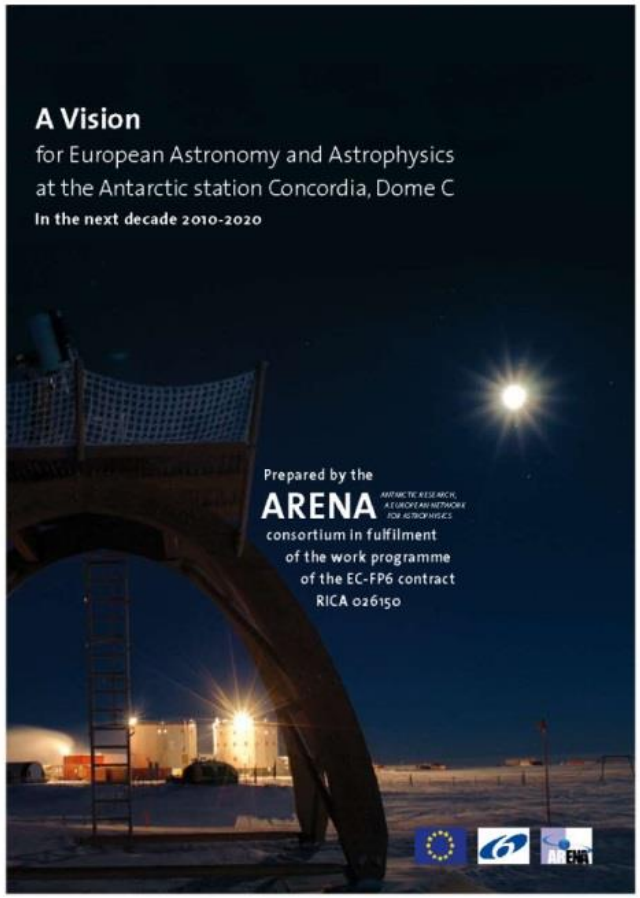
**The ARENA "Roadmap"**

The ARENA consortium has released the final version of its ***"Vision for European Astronomy and Astrophysics at the Antarctic station Concordia, Dome C in the next decade 2010-2020"*** (January 26, 2010).

- **Press release (EN)**
- **Communiqué de Presse (FR)**

**Proceedings of the ARENA Conferences (published by EDP EAS Series):**

- **ARENA1 (Roscoff, 2006), vol. 25**
- **ARENA2 (Potsdam, 2007), vol. 33**
- **ARENA3 (Frascati, 2009), vol. 40**



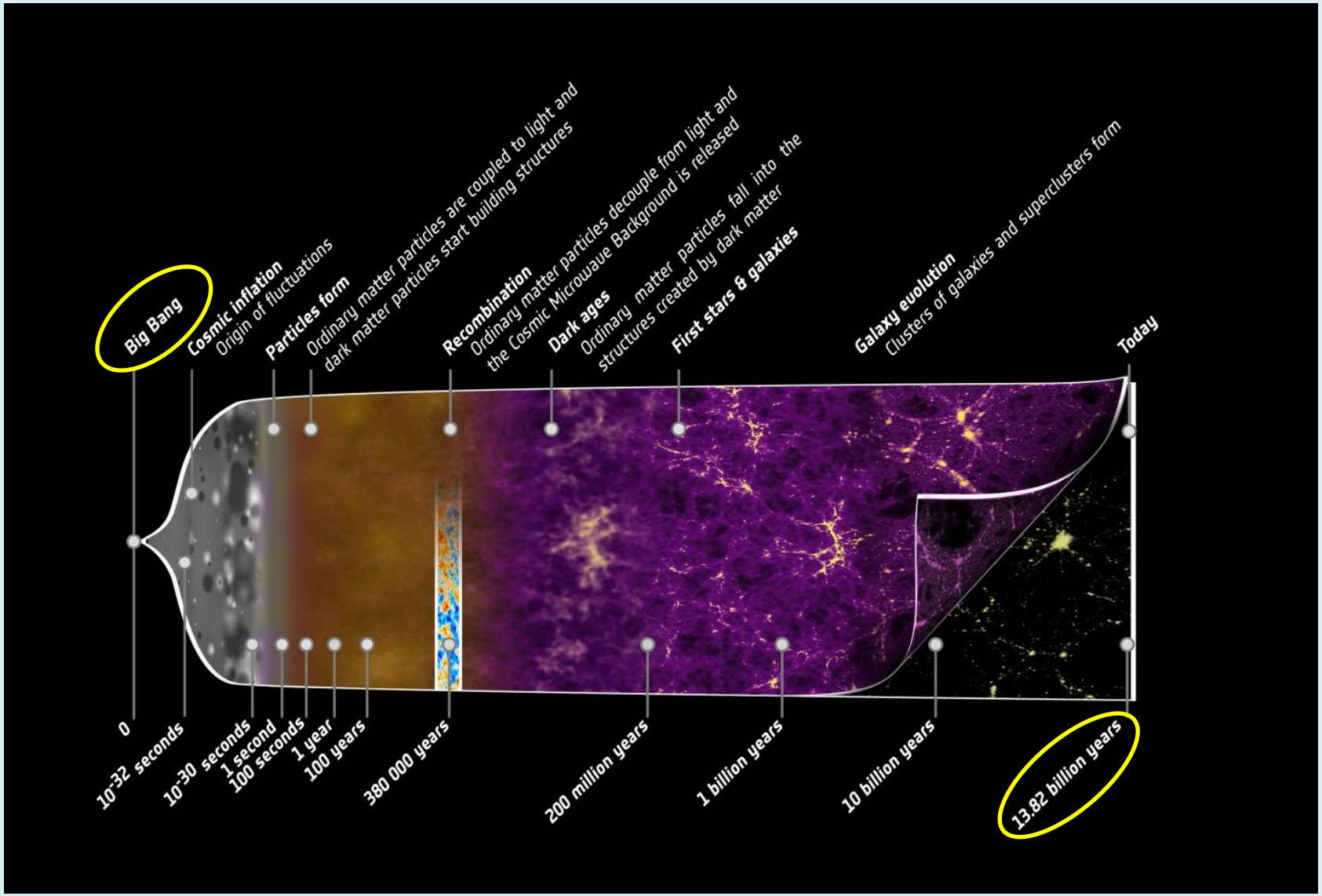

**Executive Summary (only)**

# ARENA

## Instrumentation for Astronomy proposed for Concordia

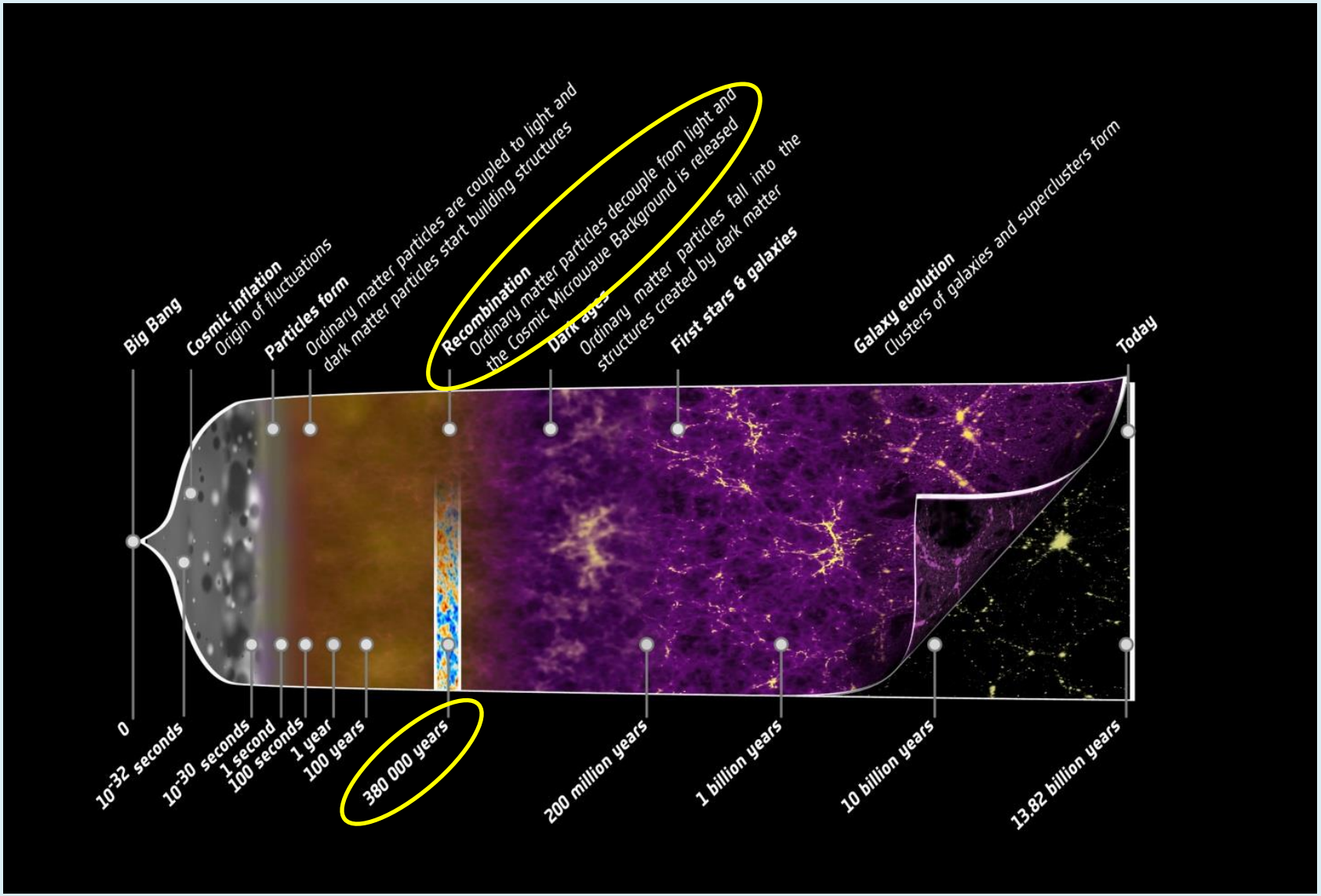
# Evolution of the Universe

**Looking far away we look back in time from now to Big Bang: 13.8 billion years !!!**



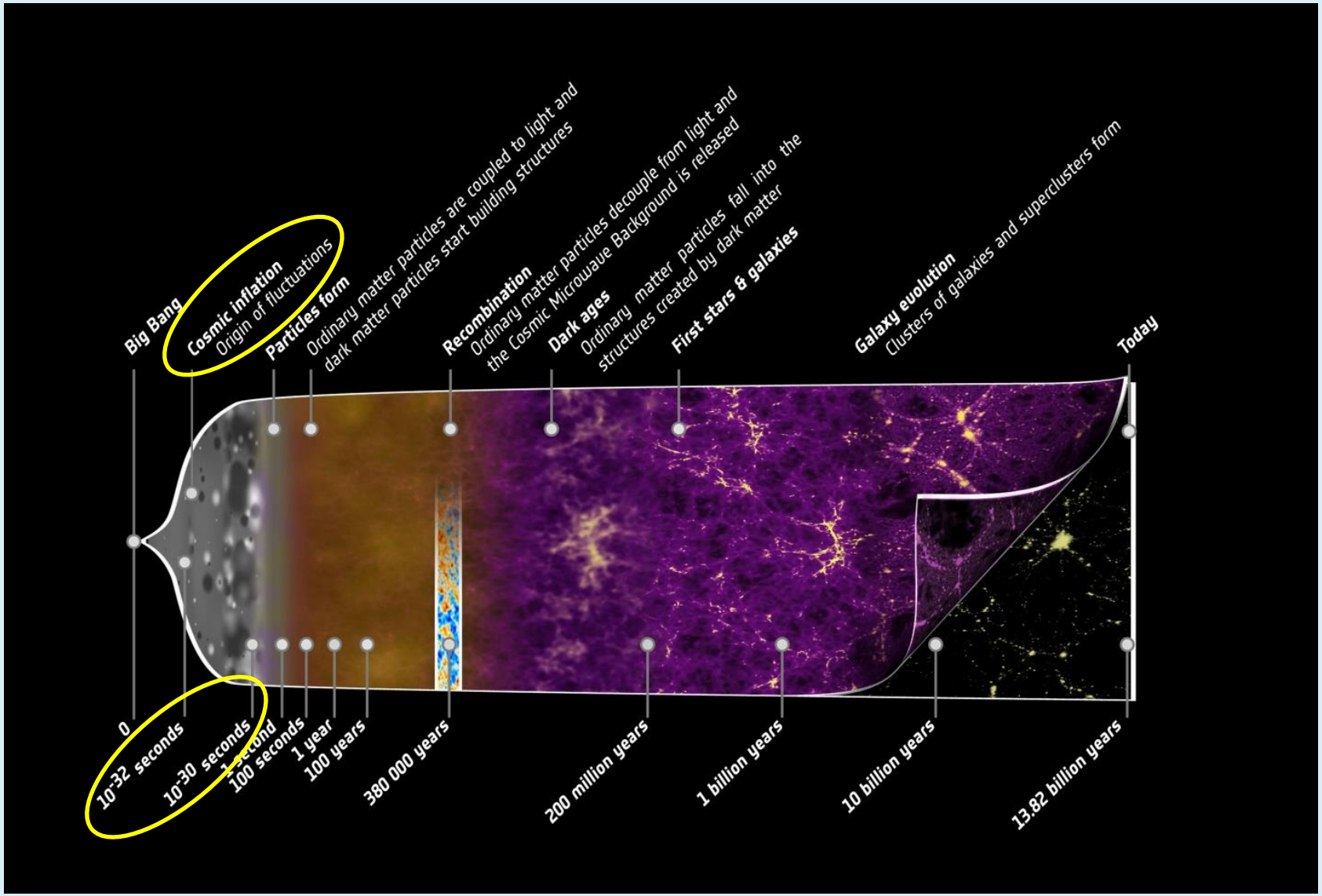
# Evolution of the Universe

**We can access directly the universe up to 380 kyr after Big Bang: Cosmic Microwave Background.**



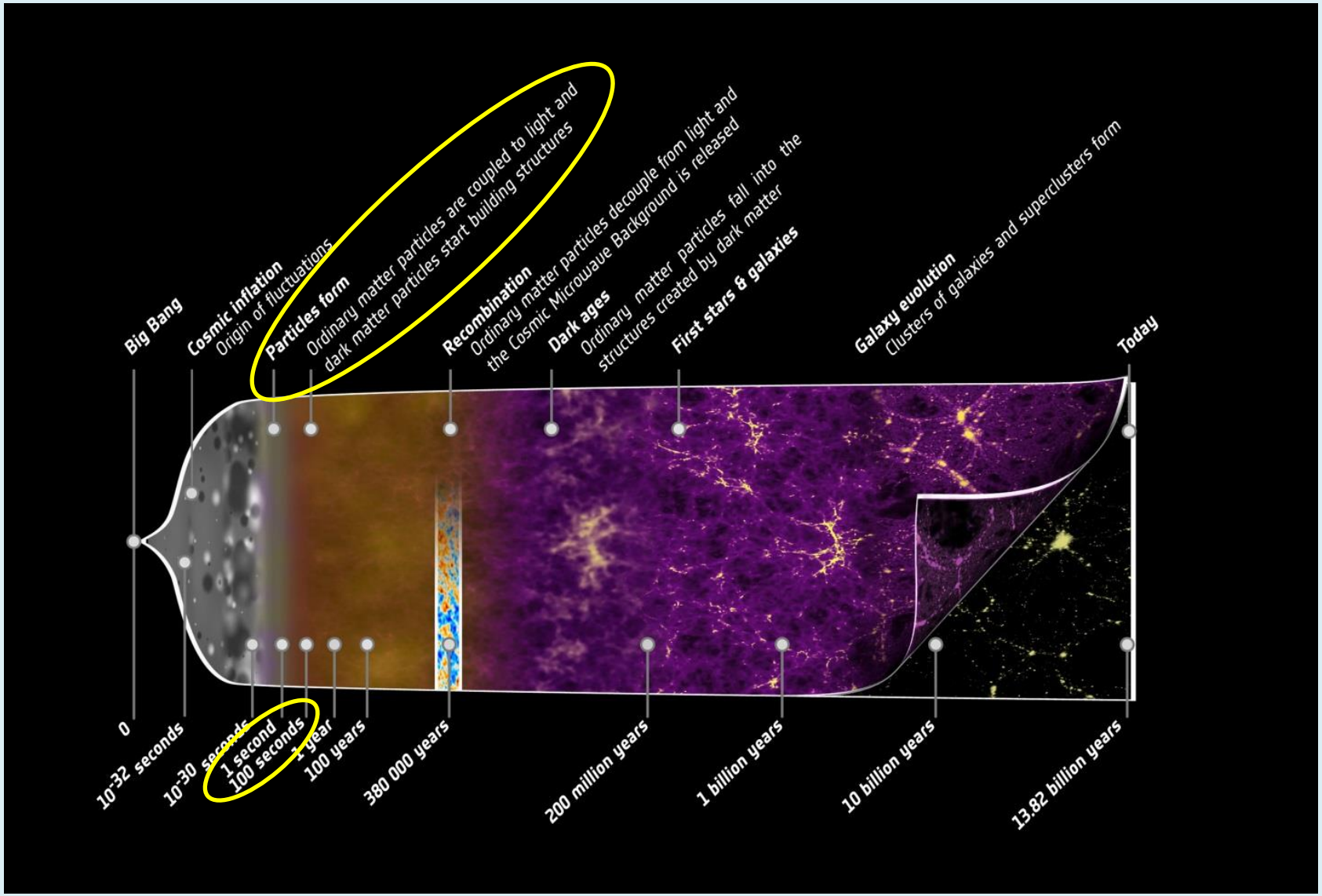
# Evolution of the Universe

**Cosmic Inflation: an early ($10^{-30}$ s) exponential expansion of the Universe originating density fluctuations and the flatness of the Universe.**



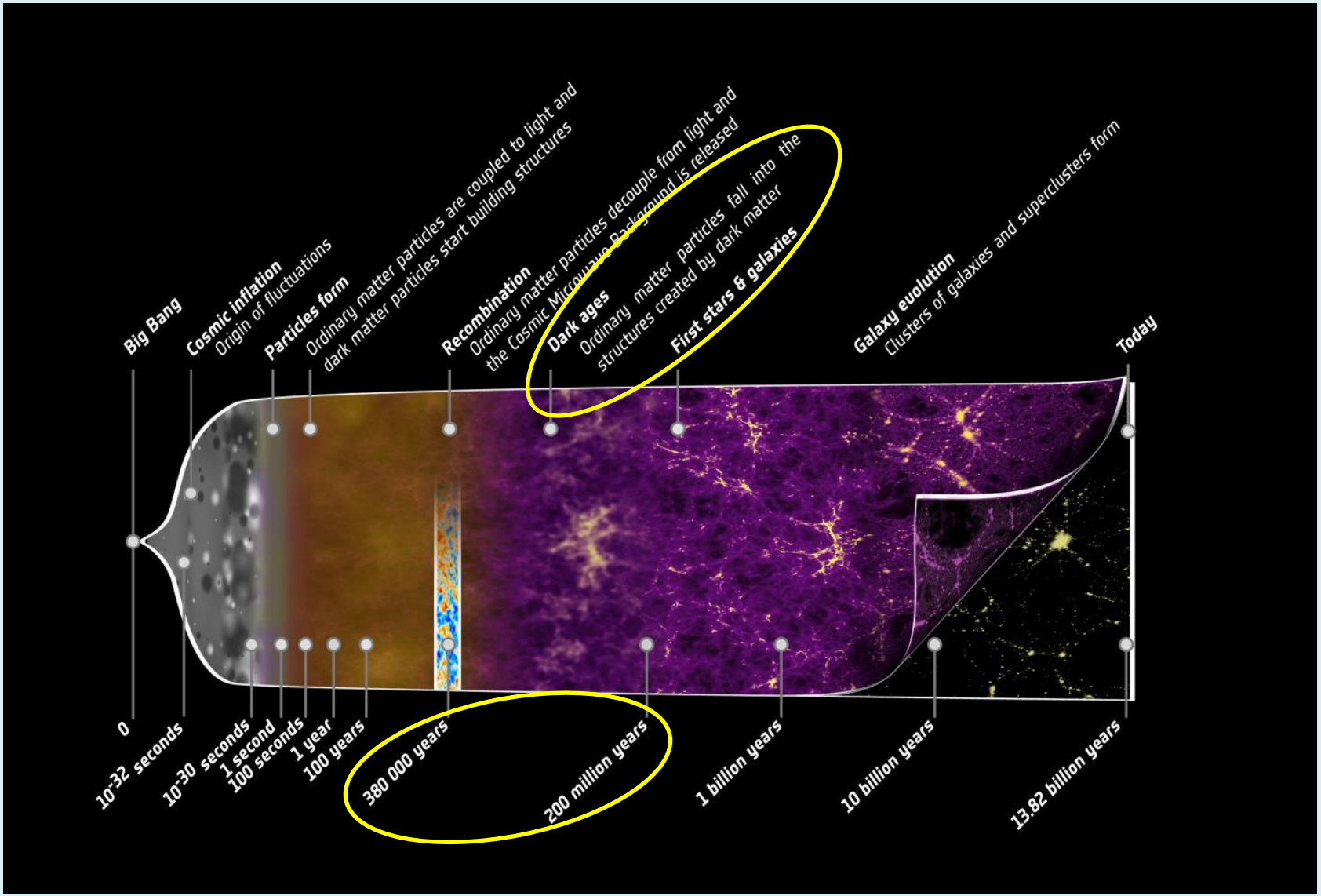
# Evolution of the Universe

**Particles formation: ordinary and dark matter form in ~ few minutes from Big Bang.**



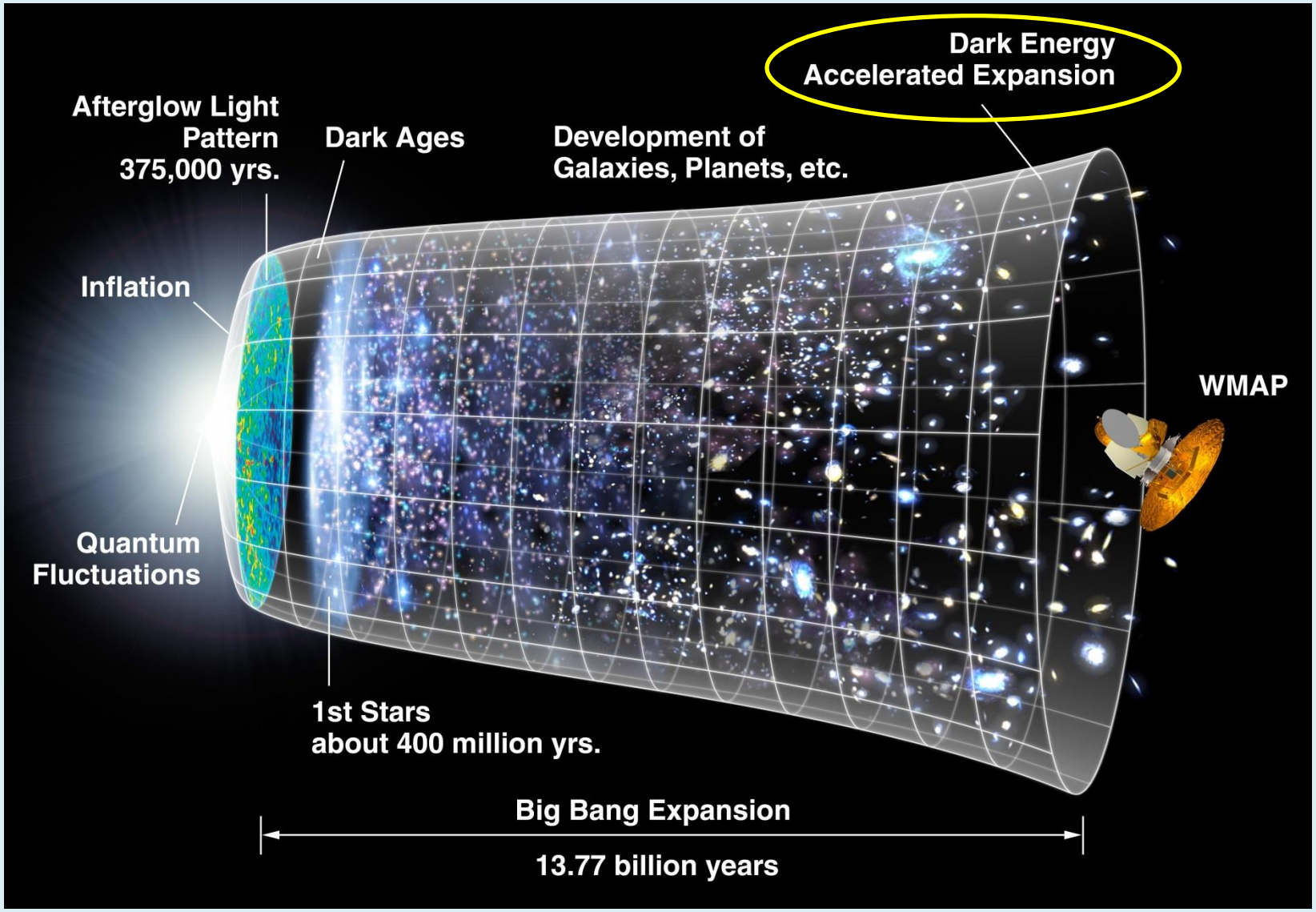
# Evolution of the Universe

**Dark Age: time interval when structures formation occurred before first stars shine (0.4-200 Myr).**



# Evolution of the Universe

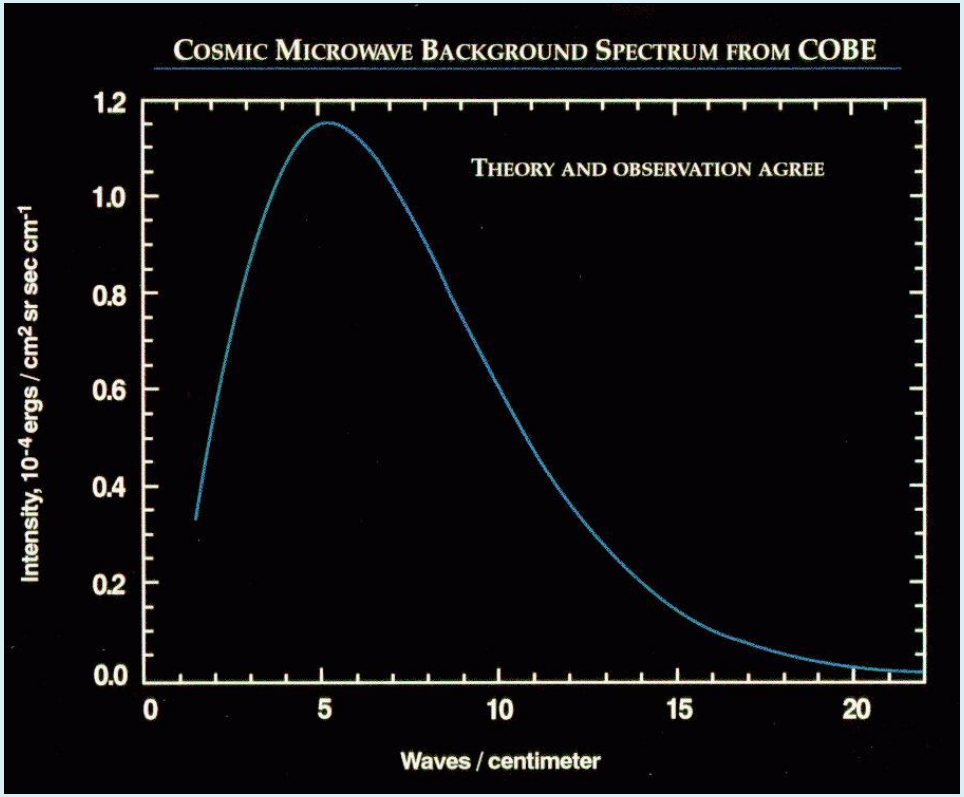
**Dark Energy**: responsible for the current accelerating expansion of the Universe.

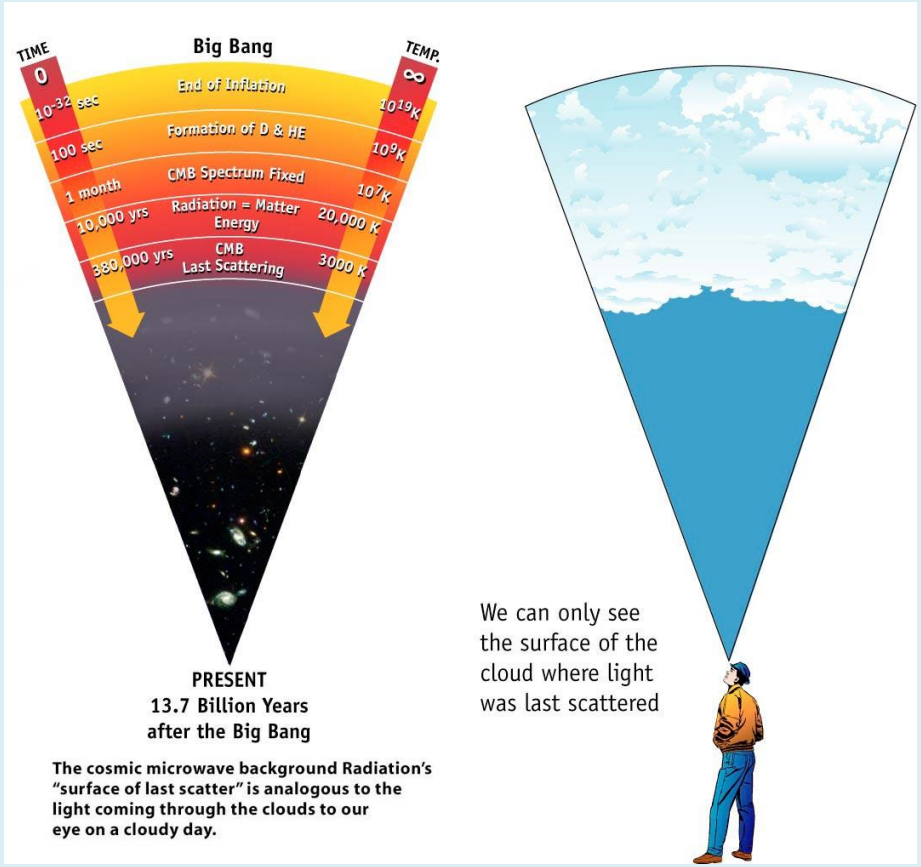


# Cosmic Microwave Background

**The earliest radiation we can observe:**

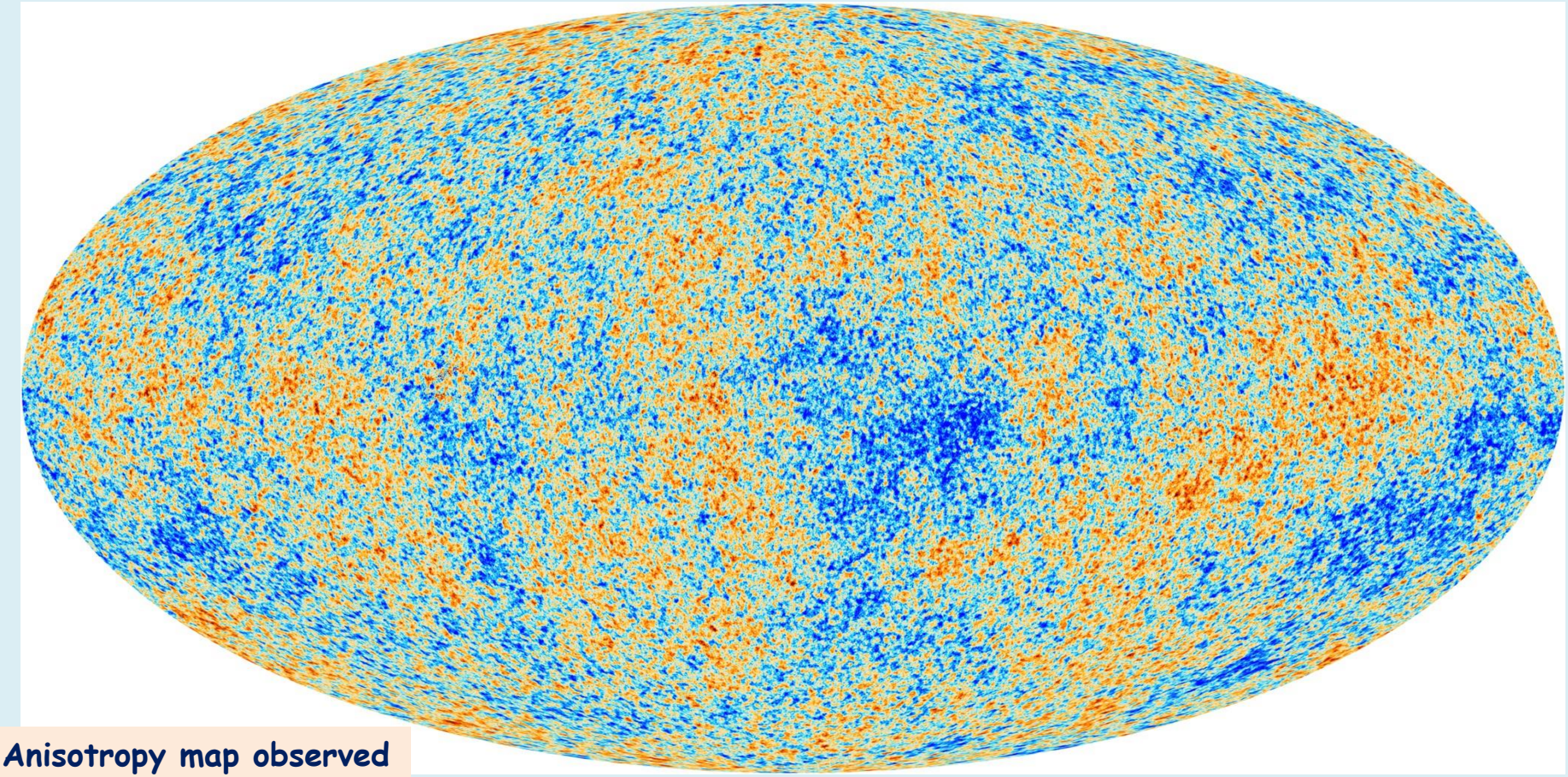
- **Was emitted 380.000 year after Big Bang, when atoms recombined and Universe became transparent**
- **Spectral distribution is a Black Body**



# Cosmic Microwave Background

- CMB is isotropic, fluctuations are $10^{-5}$ times the average temperature.
- Anisotropies are related to structures formation and to primordial density fluctuations, generated by Cosmic Inflation.
- CMB is isotropic at large scale, as expected if Universe experienced a Cosmic Inflation.

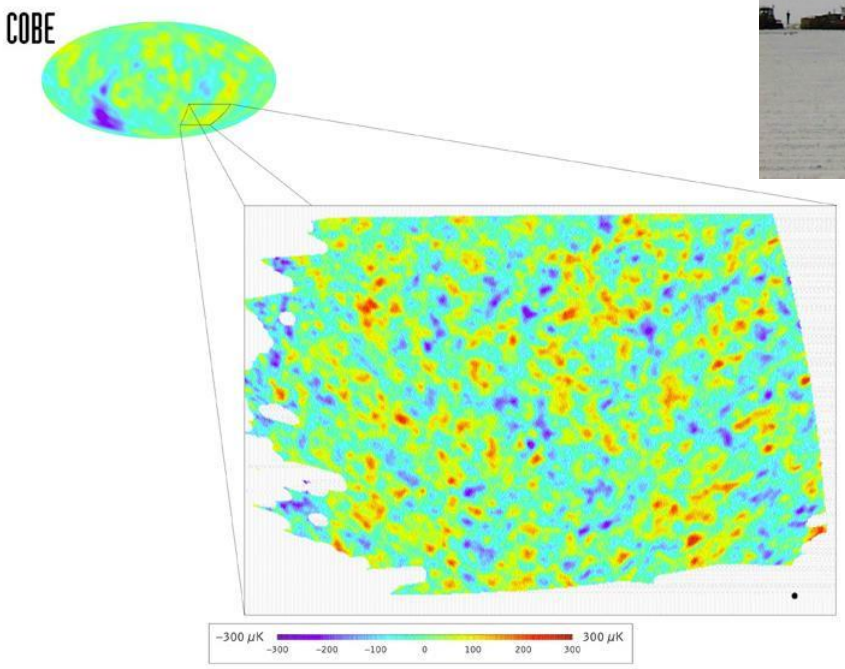


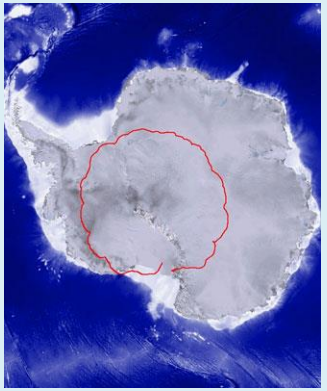
Anisotropy map observed by Planck. ESA credits.

# CMB: BOOMERanG

- Long duration Balloon flight from McMurdo
- Two flights: 1998 and 2003
- Mapped a small clean region in intensity and polarization

BOOMERanG ready to be launched.

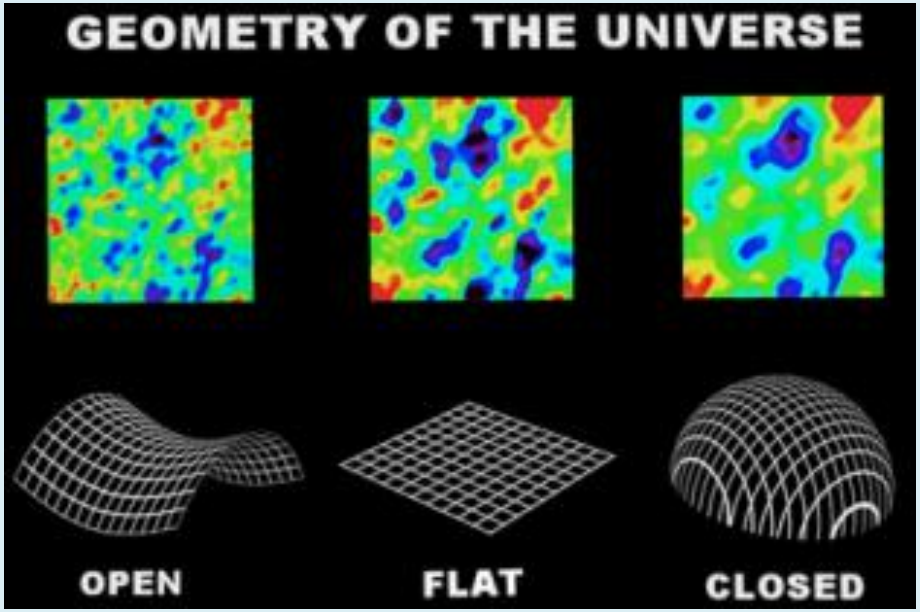


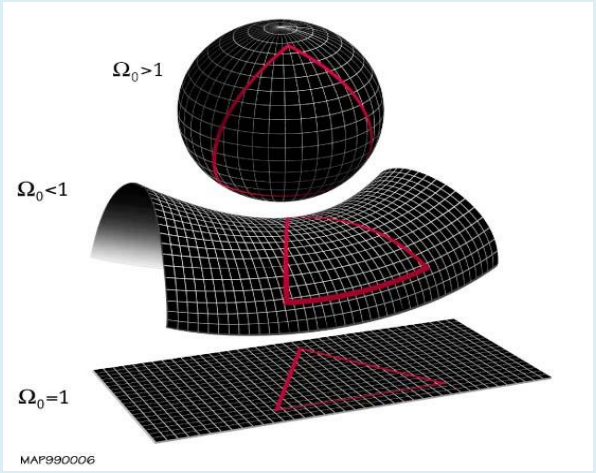



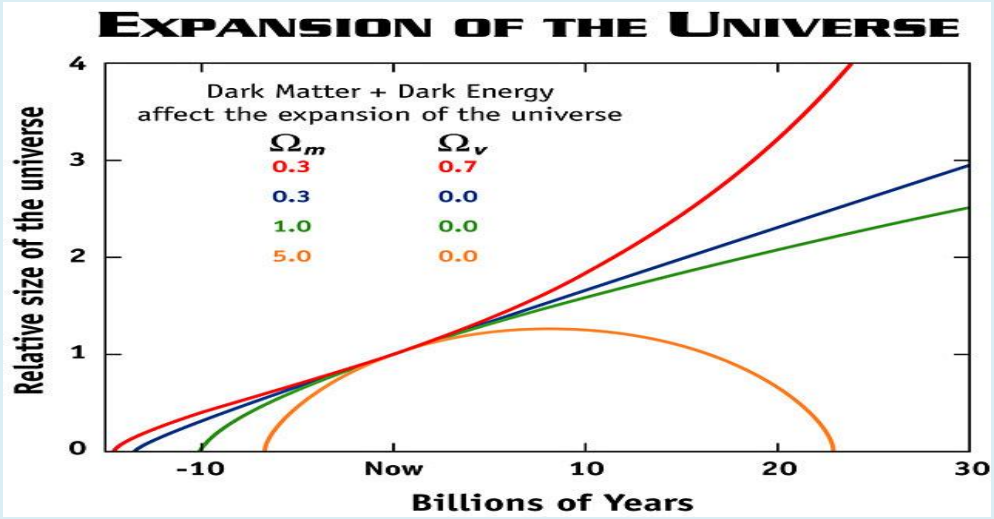
Antarctic balloon flights trajectory.

# CMB: BOOMERanG

- Accurate measurement of the first acoustic peak. Then:
- Set the overall density of the Universe: $\Omega_0 = 1$. Then:
- Set the geometry of the Universe: Euclidean or Flat.

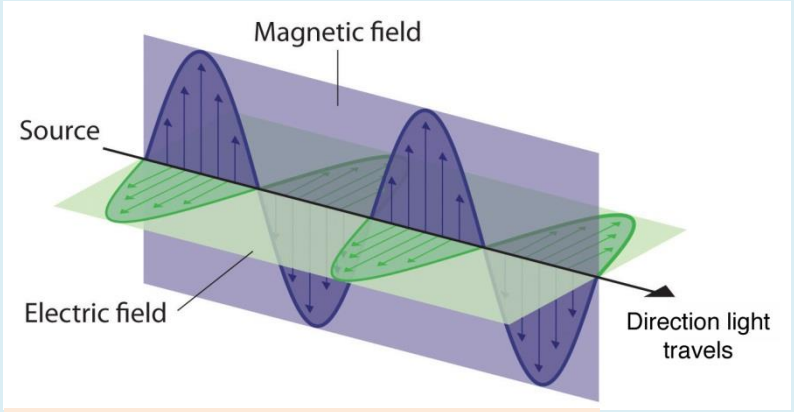


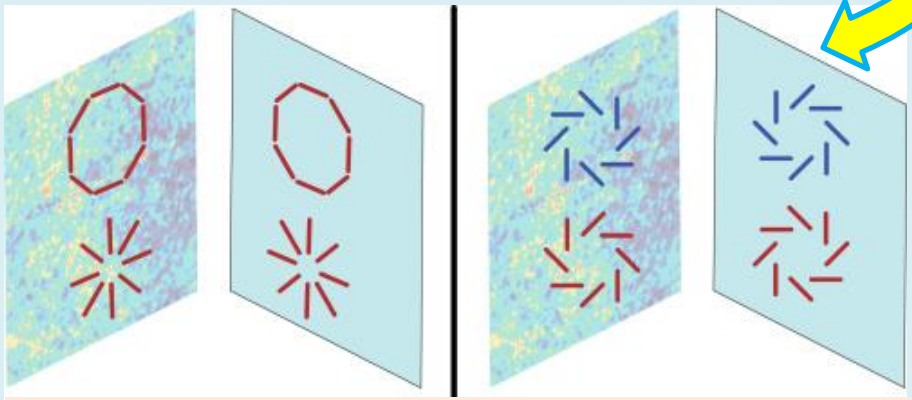



# Inflation and CMB B-modes

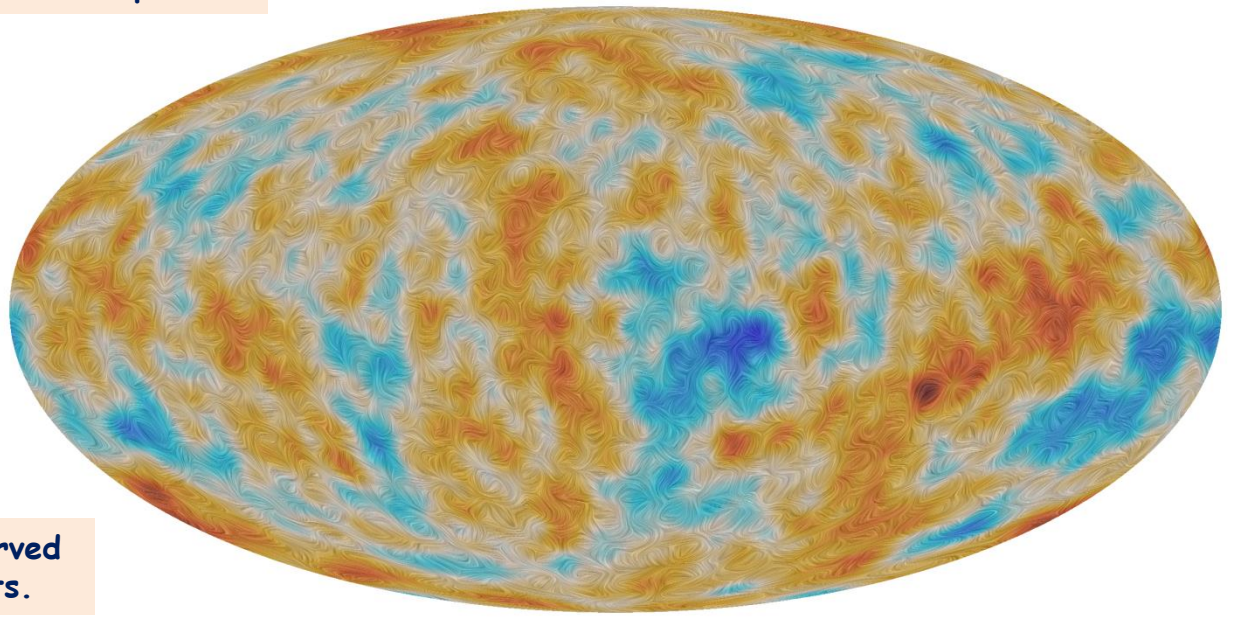
**Cosmic Inflation ($10^{-32}$-$10^{-30}$s) released Gravitational Waves, which can be detected by means of the patterns on CMB polarization: the B-modes.**




Electromagnetic wave: Electric and Magnetic fields polarization planes.

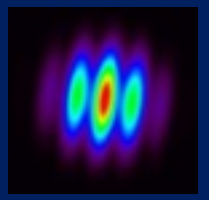


Polarization patterns: E-modes (left), B-modes (right).

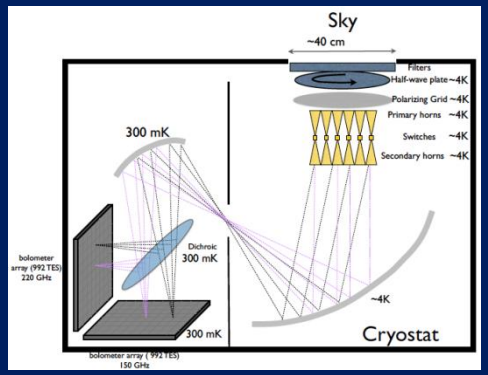


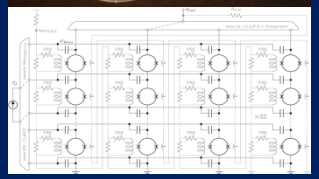
Polarization map observed by Planck. ESA credits.

# QUBIC: Q and U Bolometric Interferometer for Cosmology

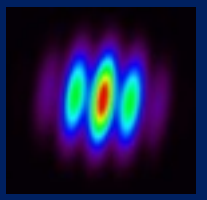


- QUBIC is a Bolometric Interferometer combining the sensitivity of bolometers and the systematic control of interferometers (QUBIC collaboration, APP 2011)
- QUBIC will take measurements from the best site on earth: Concordia Station
- QUBIC will map 1.5% of the cleanest sky down to r=0.02
- QUBIC is made of a dry cryostat + 400 horns + optical combiner + 2000 TES TDM
- QUBIC first module will be installed on 2017, 5 more modules next



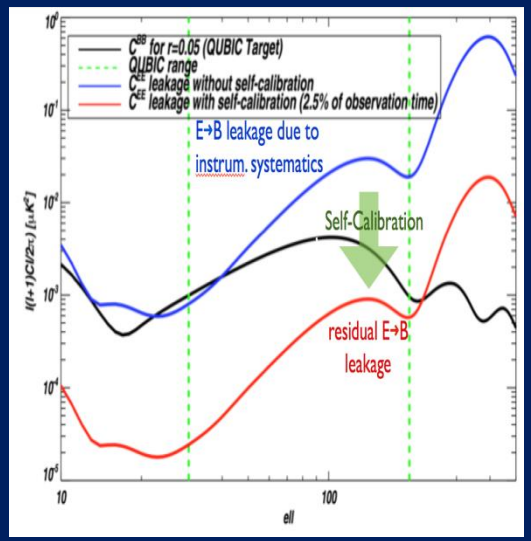



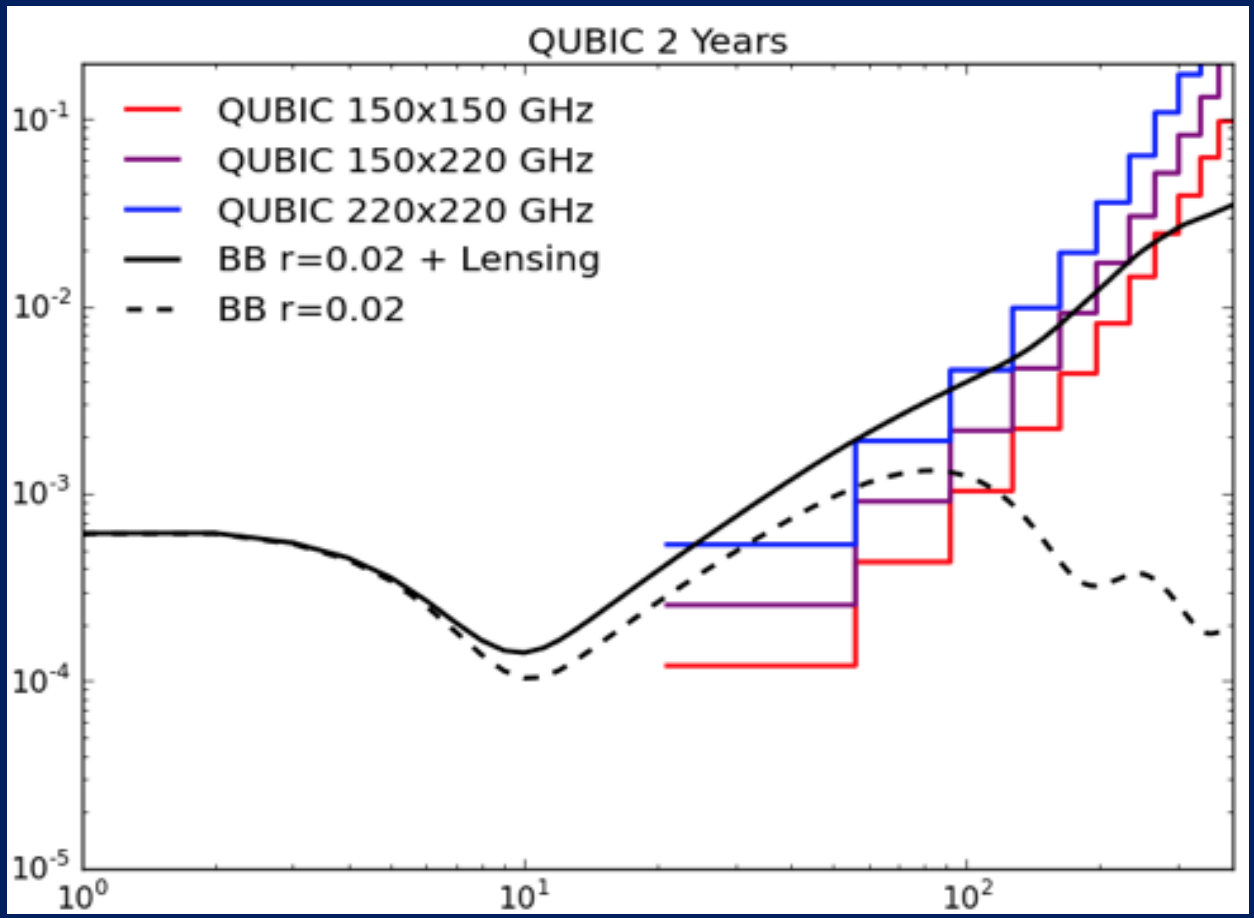
# QUBIC forecast



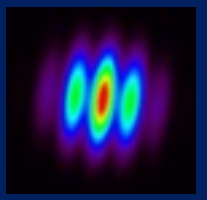
- Accurate knowledge of your instrument and departure from idealities is key for BI→ self calibration can do it

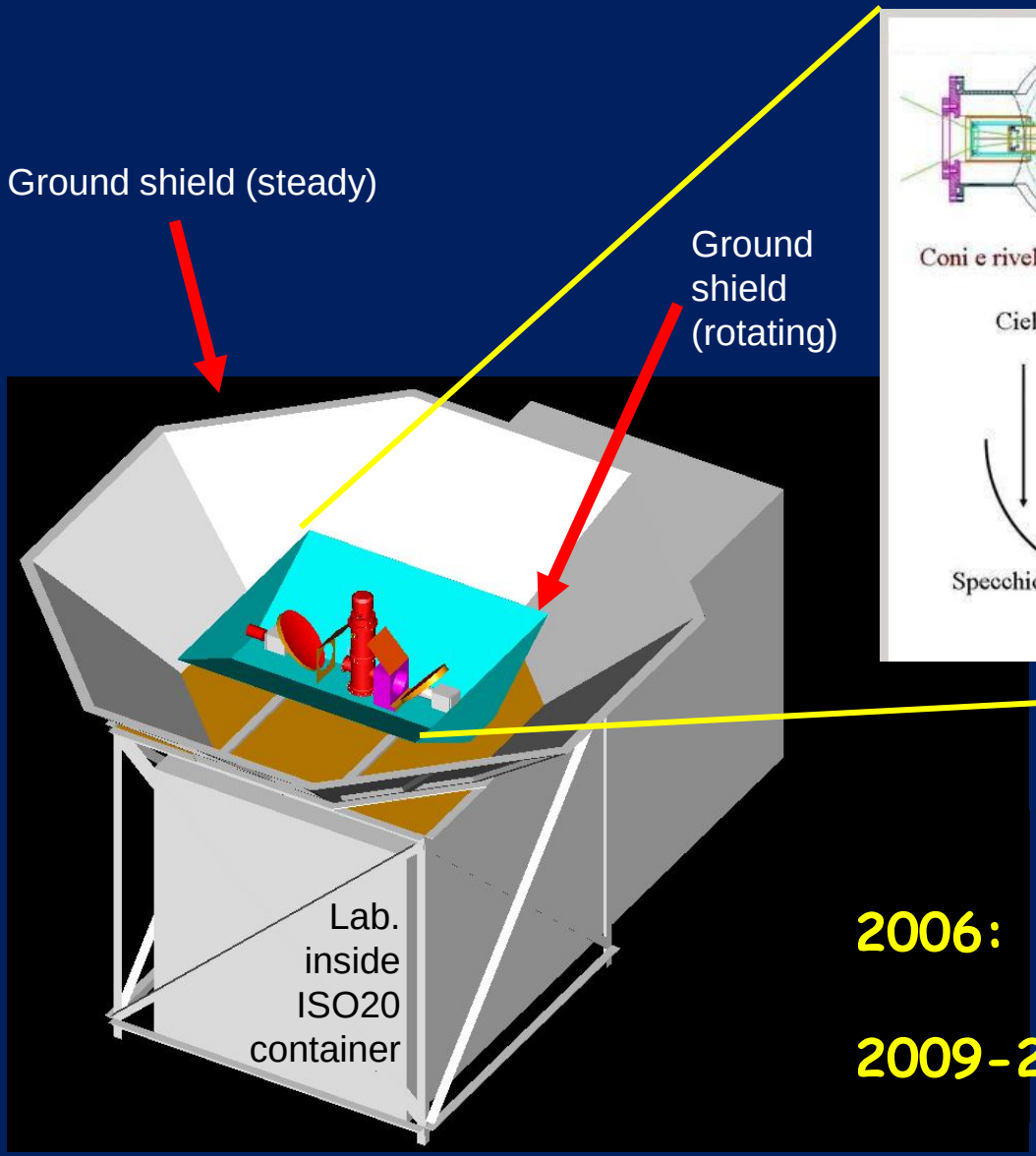
- Overall forecast predict a final sensitivity of r=0.02

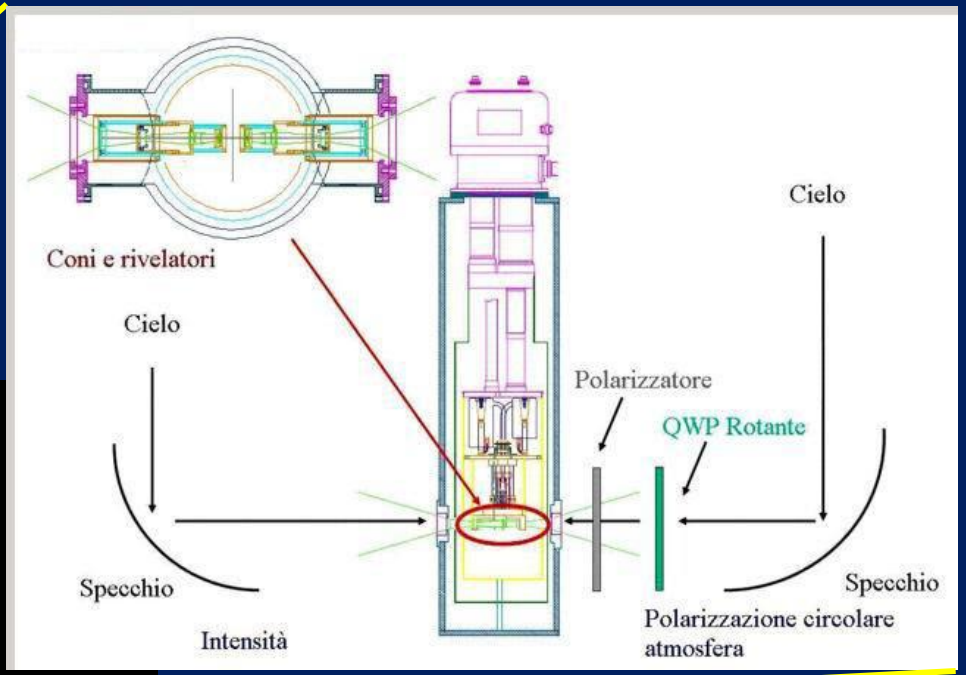


# BRAIN-pathfinder instrument



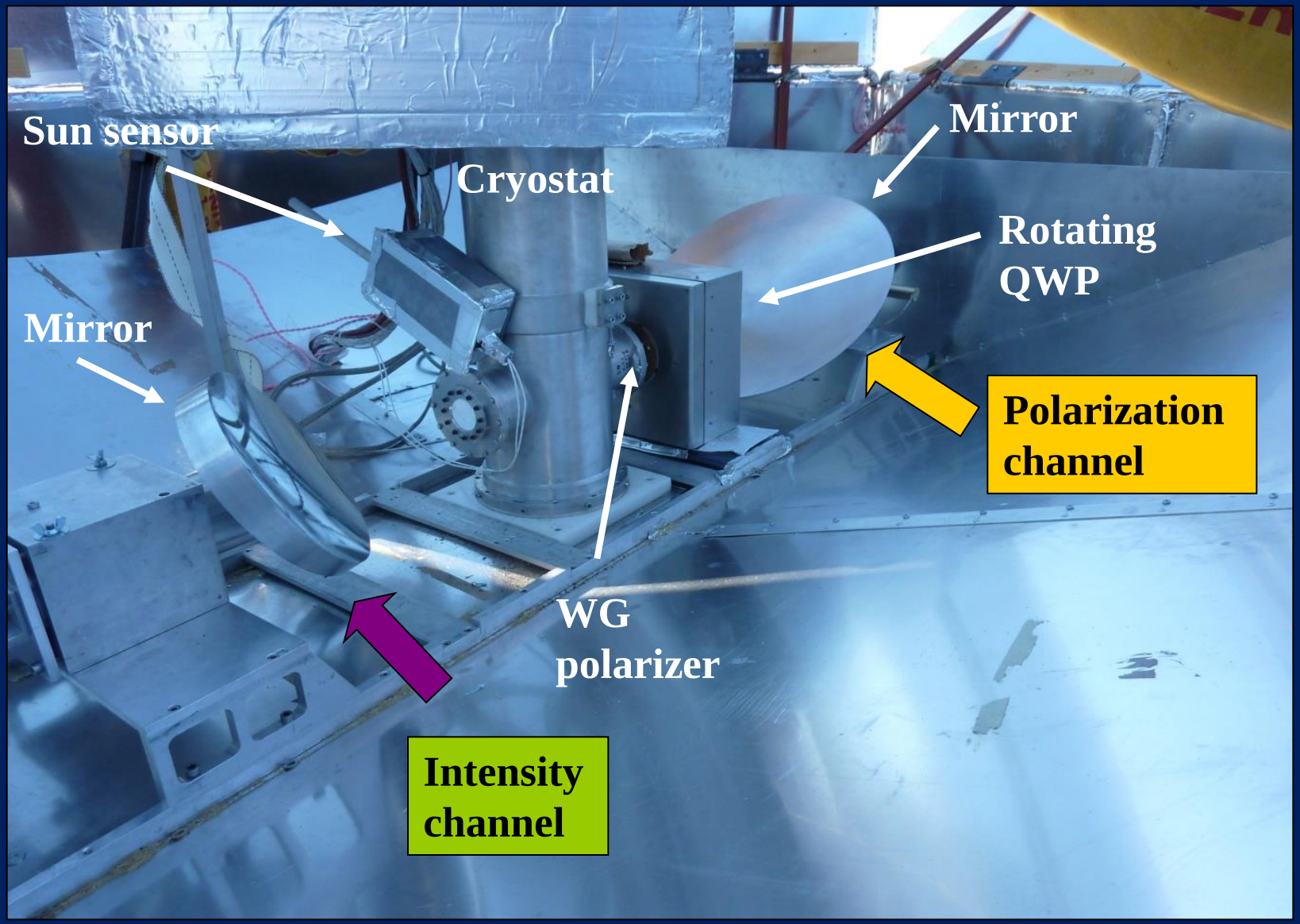



**2006: Installation and First Light**

**2009-2010: Observation Campaign**

# BRAIN-pathfinder instrument



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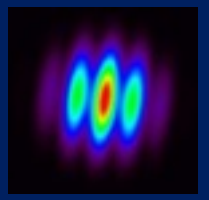
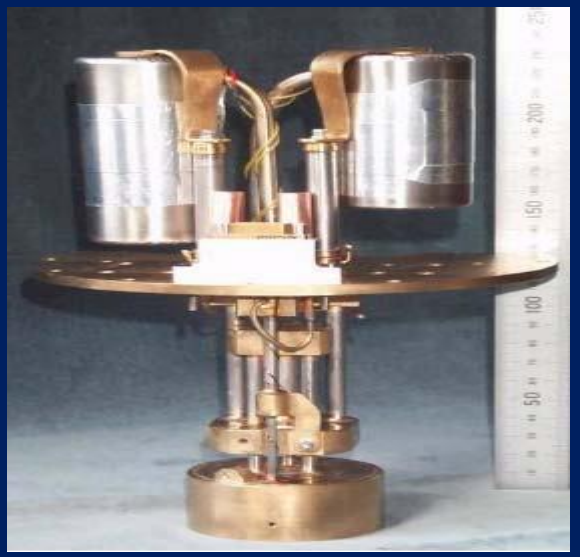
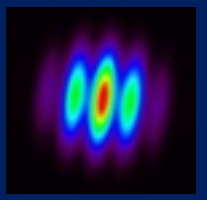


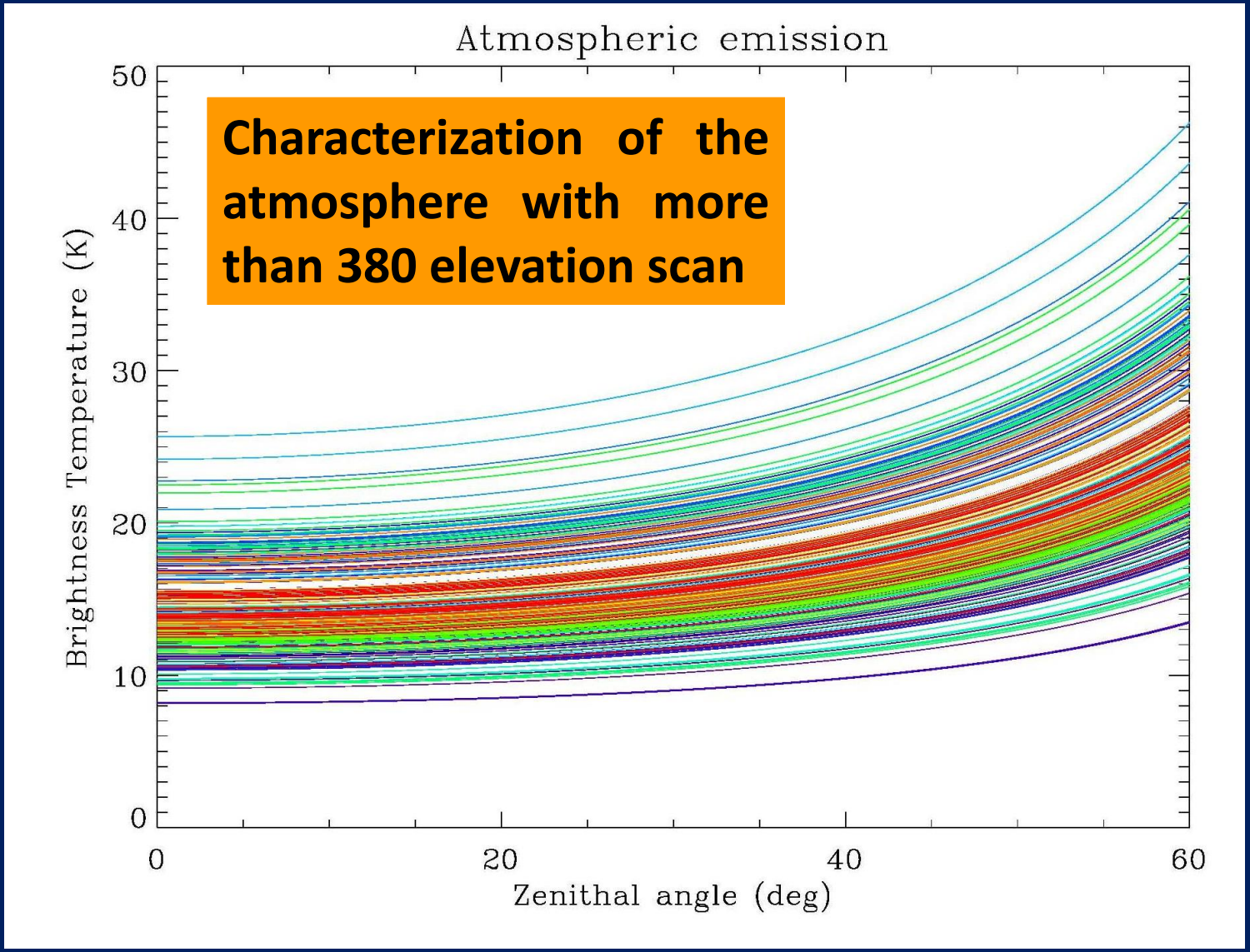
Technological development:

- Pulse Tube dry cryostat with He7 fridge: first time in Antarctica
- He7 fridge → 0.3K
- Outside hardware certified to -80°
- HW, FW and SW for remotization/automatization
- As pathfinder BRAIN did its job: successful hardware test!



# BRAIN-Sky dip: brightness temp.





# CASPER

PI M. De Petris [1]

1 *Department of Physics – "Sapienza" University - Rome – Italy*
2 *Department of Physics – "Bicocca" University – Milan - Italy,*
3 *Institute of Atmospheric Sciences and Climate, CNR - Bologna - Italy.*

*+ international collabs*
1. *Consejo superior de Investigaciones Científicas – Madrid - Spain,*
2. *Astroparticule et Cosmologie, Université Denis Diderot-Paris 7, Parigi - France*
3. *Dept. of Physics and Astronomy - University College London - UK*

A low-resolution spectrometer devoted to measurements of atmospheric emission in the spectral region between 180 microns and 3 mm (3÷55 cm-1 or 90-450 GHz) to support the next installation at Dome C of QUBIC, an international collaboration to observe CMB polarization (B modes).
Already operated at DC in January 2015

Main components:
- ✓ 62-cm reflective telescope
- ✓ Martin-Puplett Interferometer
- ✓ Wet cryostat with 300 mK detectors
- ✓ altazimuthal mount

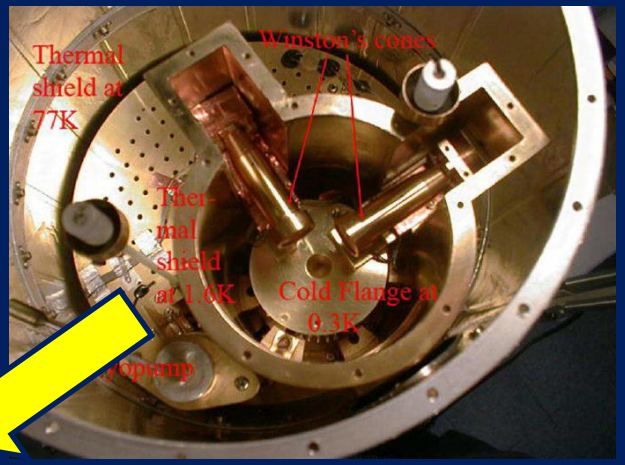
# CASPER

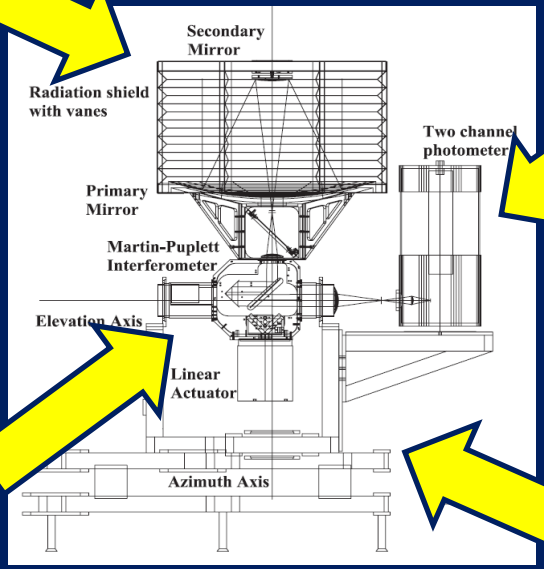
## 62-cm reflective telescope

f/3.5 Pressman-Camichel config. / telescope shield with vanes / subreflector support in styrodur

## Wet cryostat with 300 mK detectors

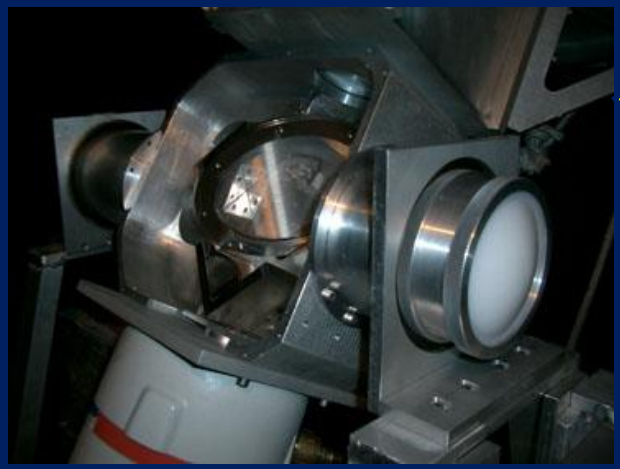
liquid nitrogen and helium tanks and a He3 fridge to cool down to 290 mK two Ge-bolometers




## Martin-Puplett Interferometer

3 different kinds of phase modulations



## Altazimuthal mount

with a CCD camera as star-tracker



Refs

De Petris M., et al. Monthly Notices of the Royal Astronomical Society, 425, 222–230 (2012)

http://oberon.roma1.infn.it/marco/MDP_webpage/indexCASPER.html

# CASPER

Targets:

- Spectra at zenith position and along skydips to infer atmosphere opacity in mm/sub-mm spectral region;

- Atmosphere emission and its variability in selected photometric bands;

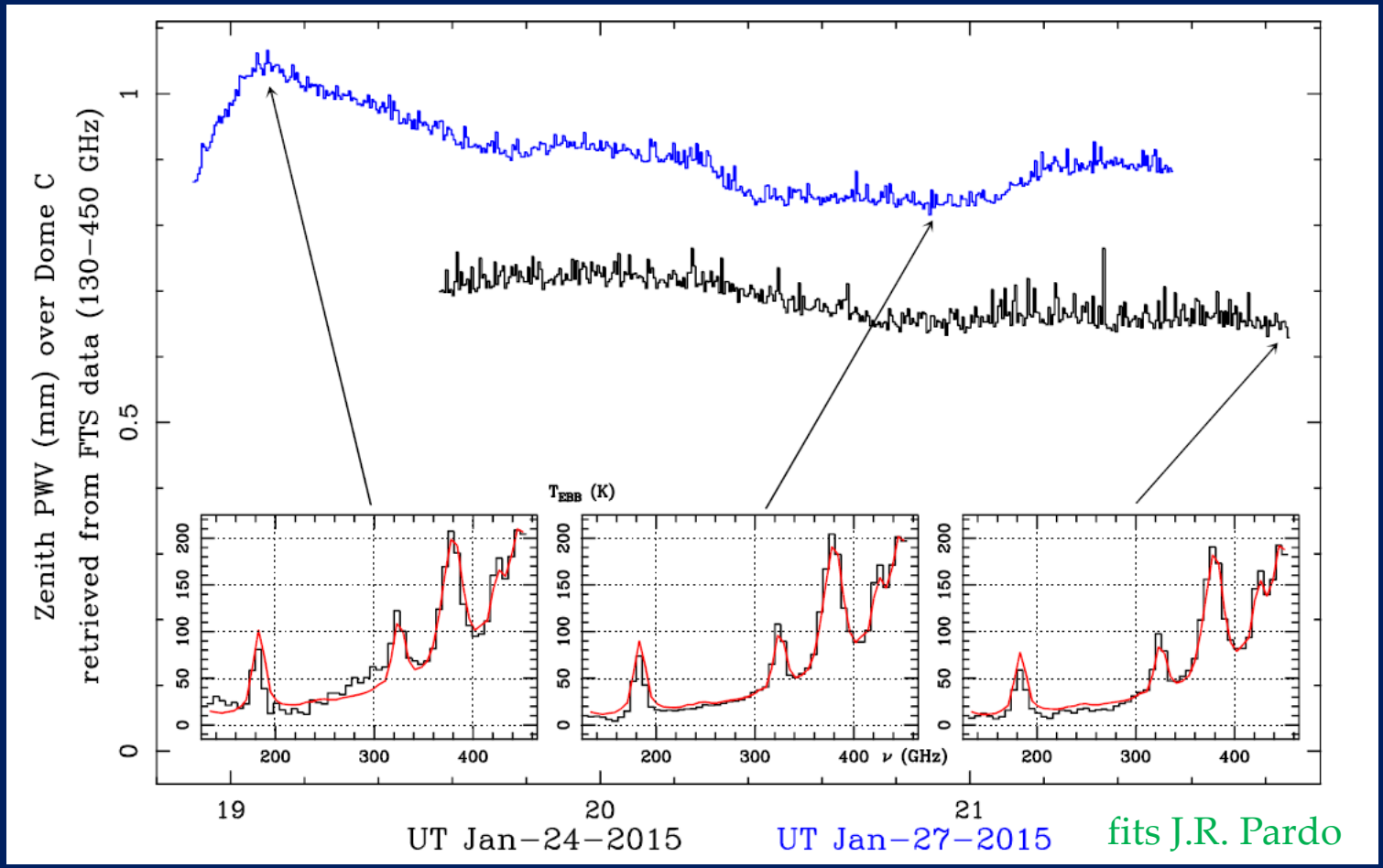
- Results comparison with others complementary and already operating instruments at DC (RAFIR-PAD, HAMSTRAD, radiosoundings,..);

- Spectra with polarization capabilities to investigate mm-polarised emission from cirri (Ice crystal clouds), celestial sources and ice emission.

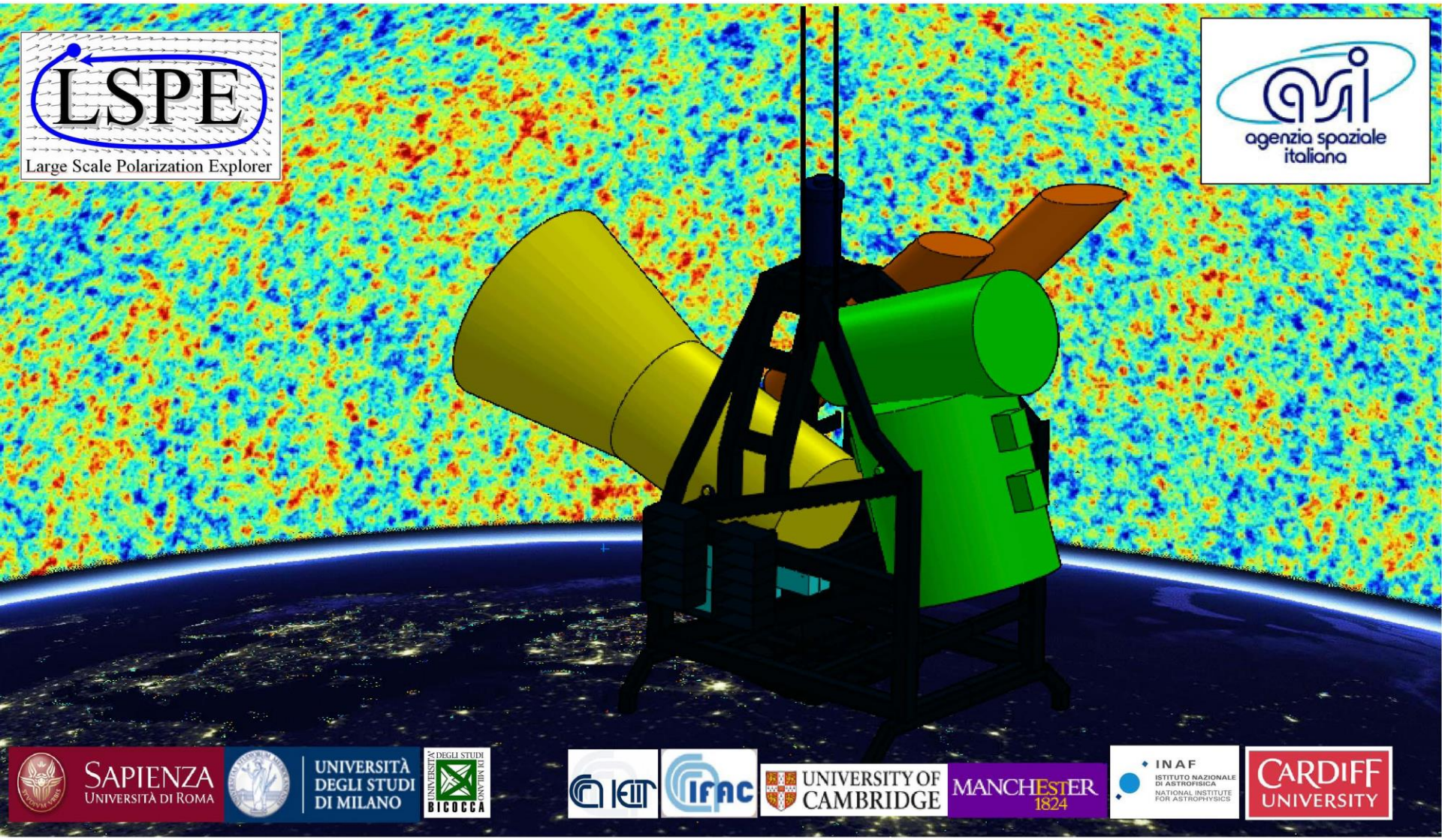
All the expected goals support the preparation and the observations of instruments to explore the sky at mm bands, such as QUBIC project.

# CASPER – pwv

Fit with ATM code to infer pwv content along time



# LSPE – Large Scale Polarization Explorer

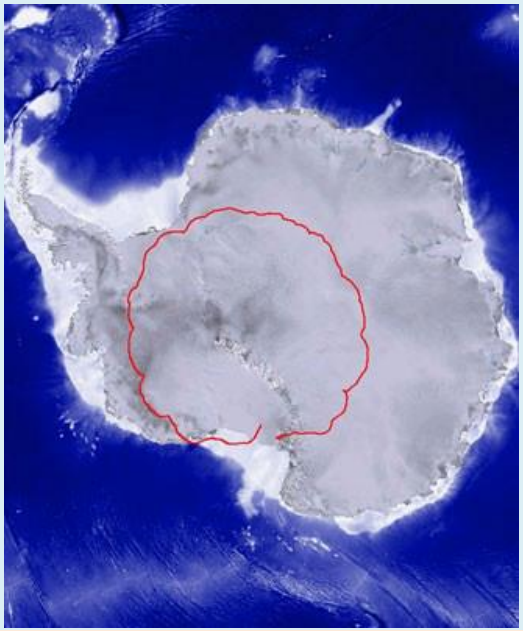


# Stratospheric Balloons

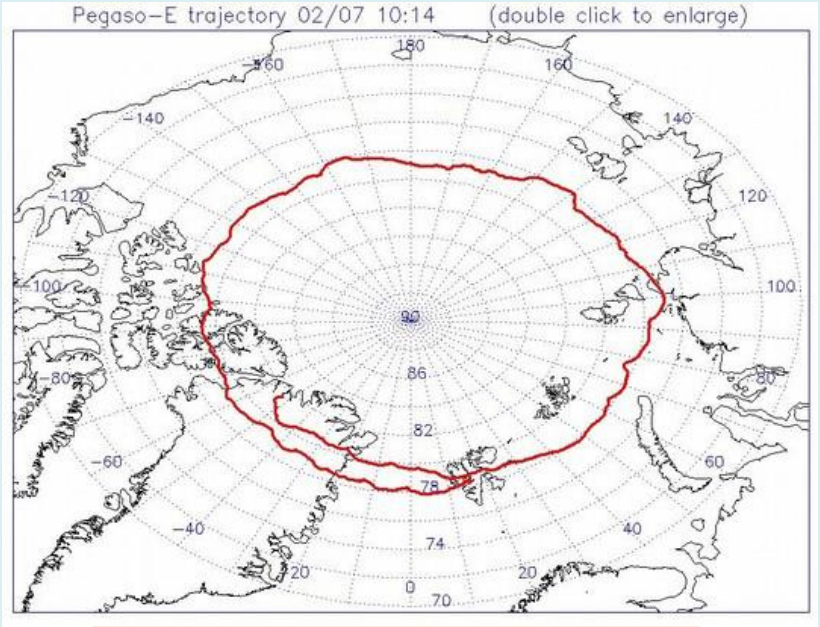
A way to avoid atmospheric emission:

- **LSPE**: to observe CMB primordial B-modes
- **OLIMPO**: to observe CMB on galaxy clusters

Both are Arctic long duration balloon experiments, with a possibility to fly from Antarctica (McMurdo).



Antarctic balloon flights trajectory.




Arctic balloon flights trajectory.

# Equivalent mid-latitude performances of Antarctic telescopes

**S/N improvement:** $(100)^{1/2} \times (30/20) = 15$
**Telescope equivalent aperture: ~ 4 times larger**

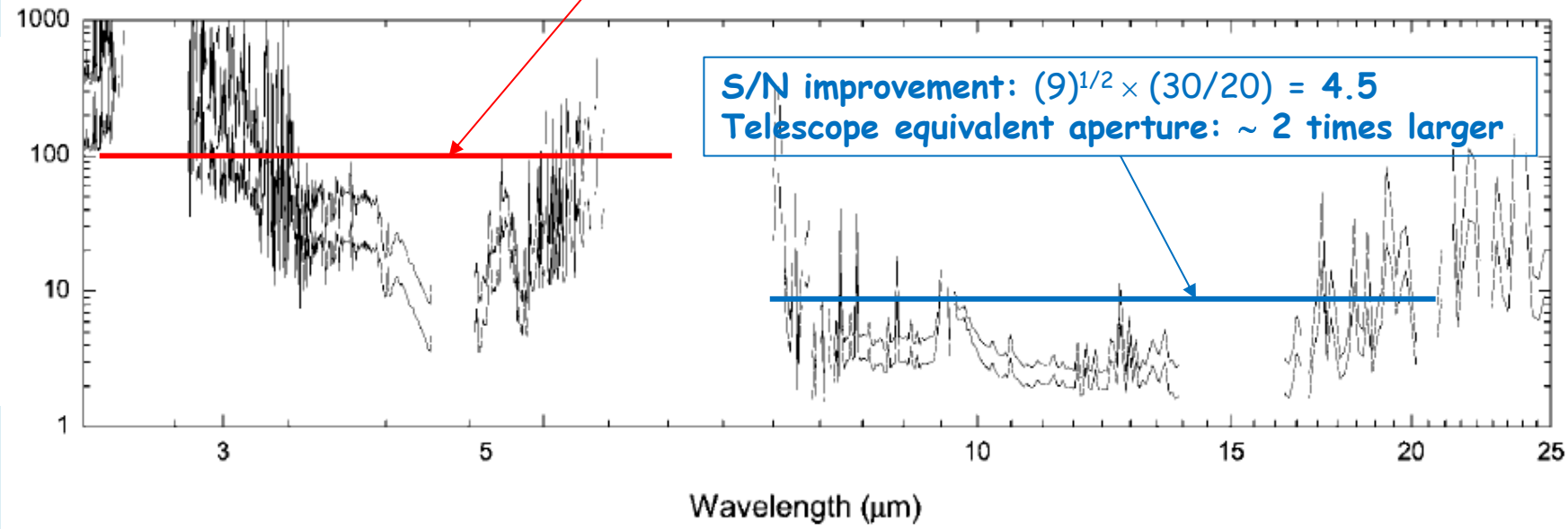



FIG. 9.—Ratio of point-source integration times for a 30 m Mauna Kea telescope with a 20 m Antarctic telescope. Each telescope is diffraction limited. In each panel, both Dome C (*lower curve*) and Dome A (*upper curve*) sites are considered. Values are only shown for wavelengths at which the Mauna Kea transmission is greater than 10%.

(J.S. Lawrence, 2004, PASP, 116, 482)

# A sample of science case for Infrared Astronomy from Antarctica

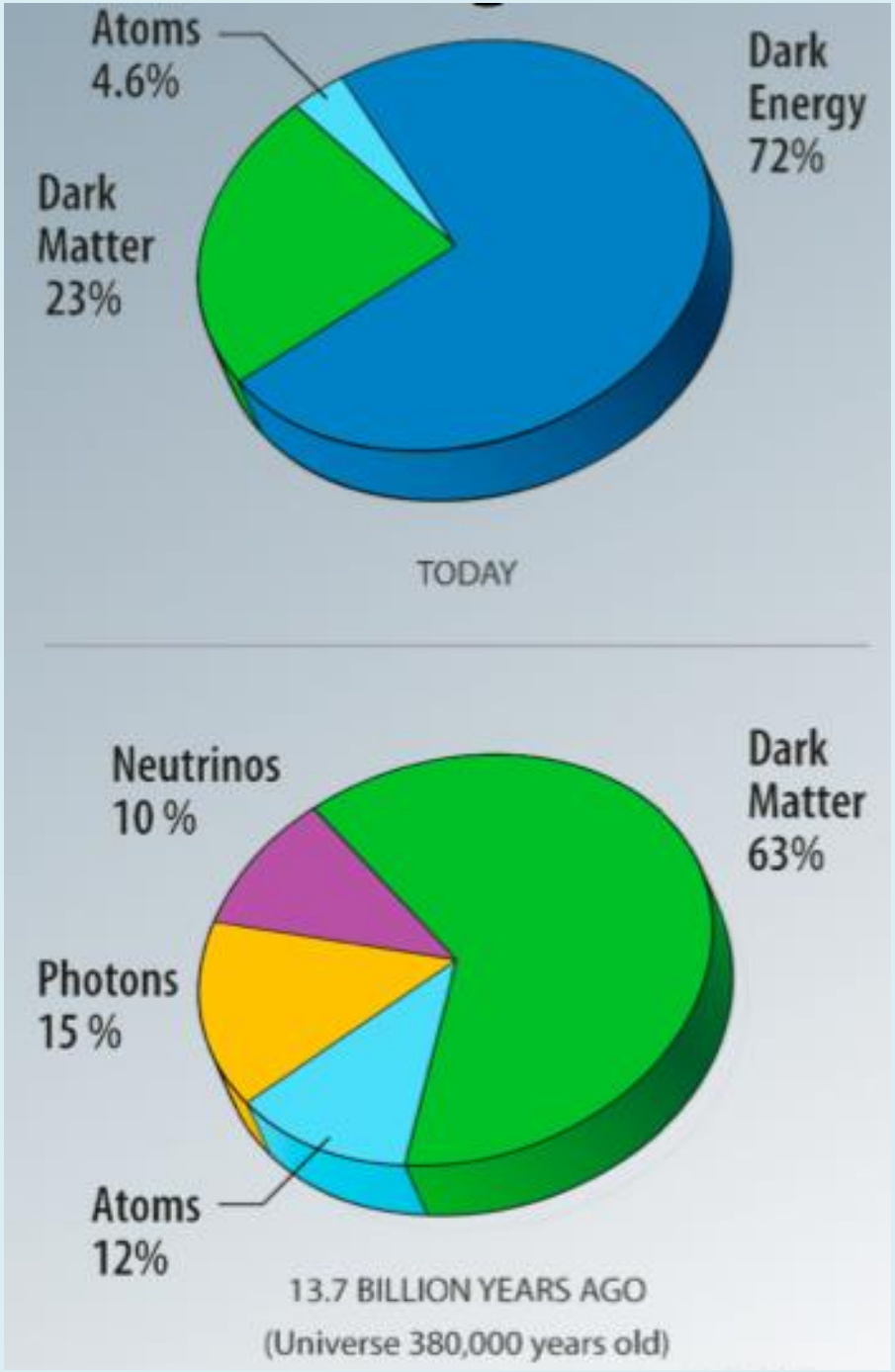
- **AGB stars** in the Milky Way, in LMCs and nearby galaxies
- **Star Formation Regions** in the Milky Way and nearby galaxies
- **Red SuperGiants** in the Milky Way and nearby galaxies
- **Obscured Supernovae**
- **Supernova Remnants**
- **Solar System Bodies**
- **Extinction** in our and in nearby galaxies
- **Stellar Variability** (P-L RR Lyrae in L & M)
- Brown dwarfs (**exoplanets?**)
- 2 – 28 μm site testing

# The Dark Universe

- **Dark Matter**
- **Dark Energy**

But also …

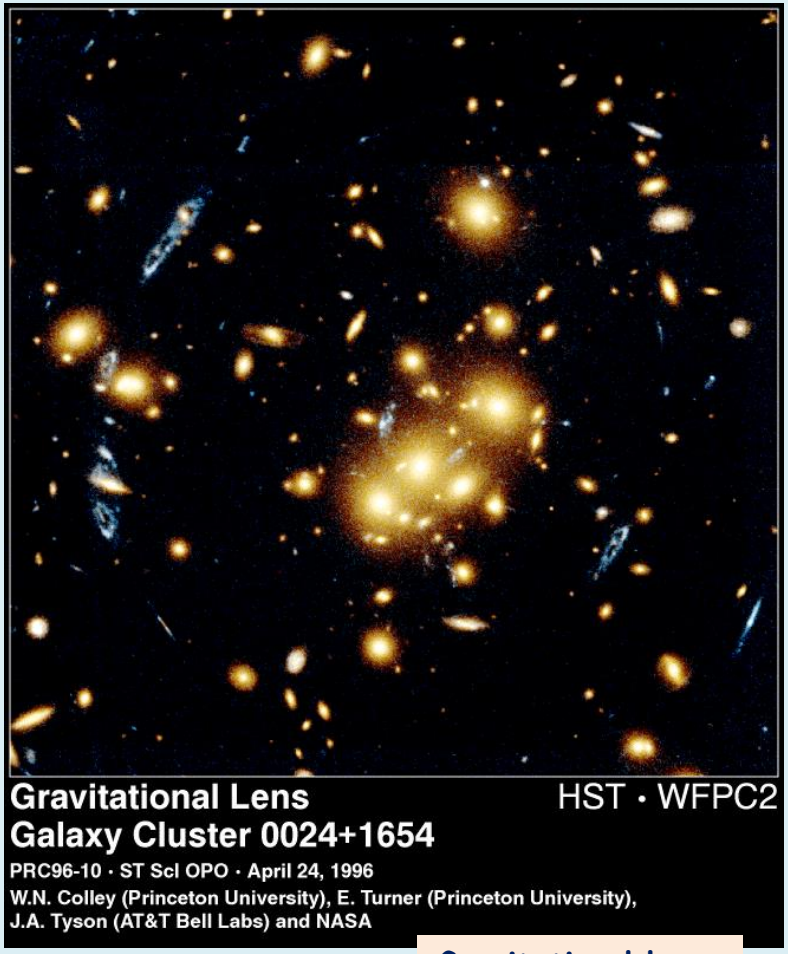
- **Dark Age** (formation of first structures)
- **Dark Objects** (exoplanets)



# Dark Matter

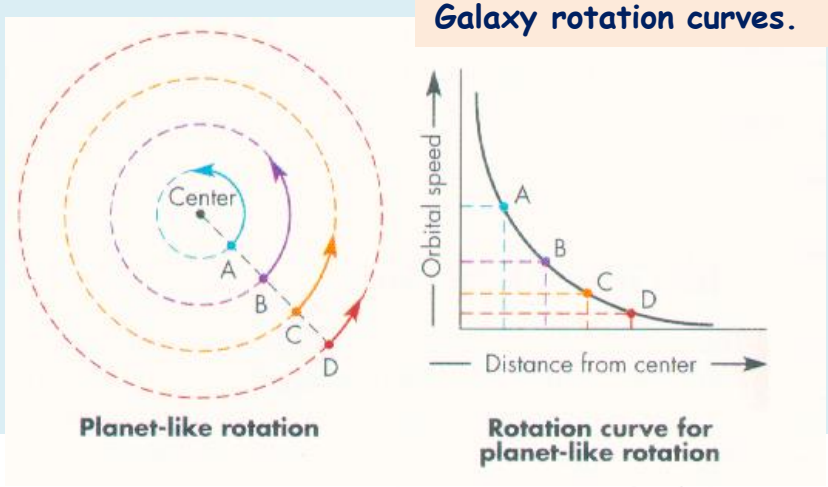
**Evidences of Dark Matter:**

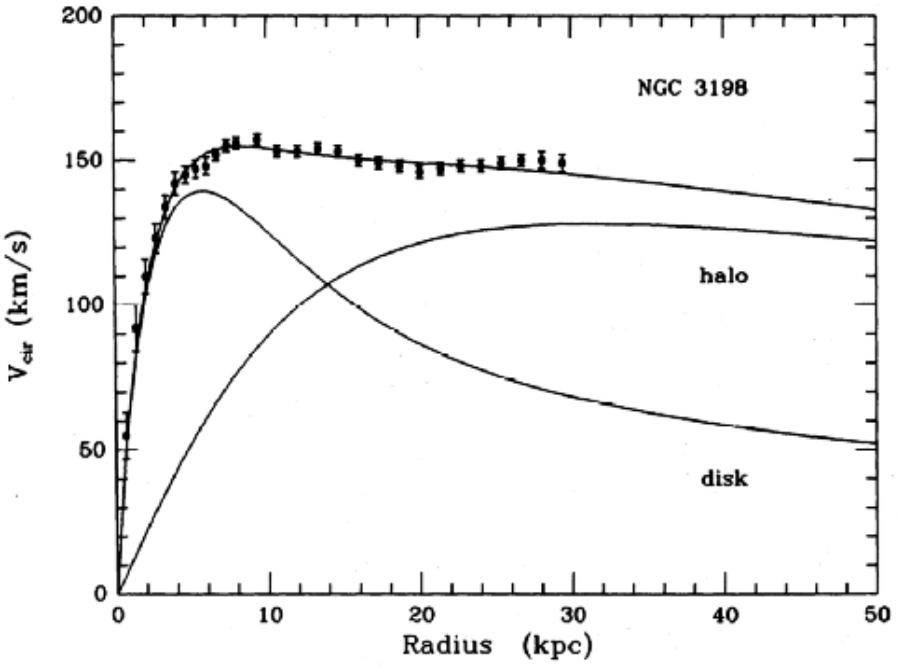
- CMB
- Dynamic systems
- Gravitational lensing




Gravitational lens.

Galaxy rotation curves.

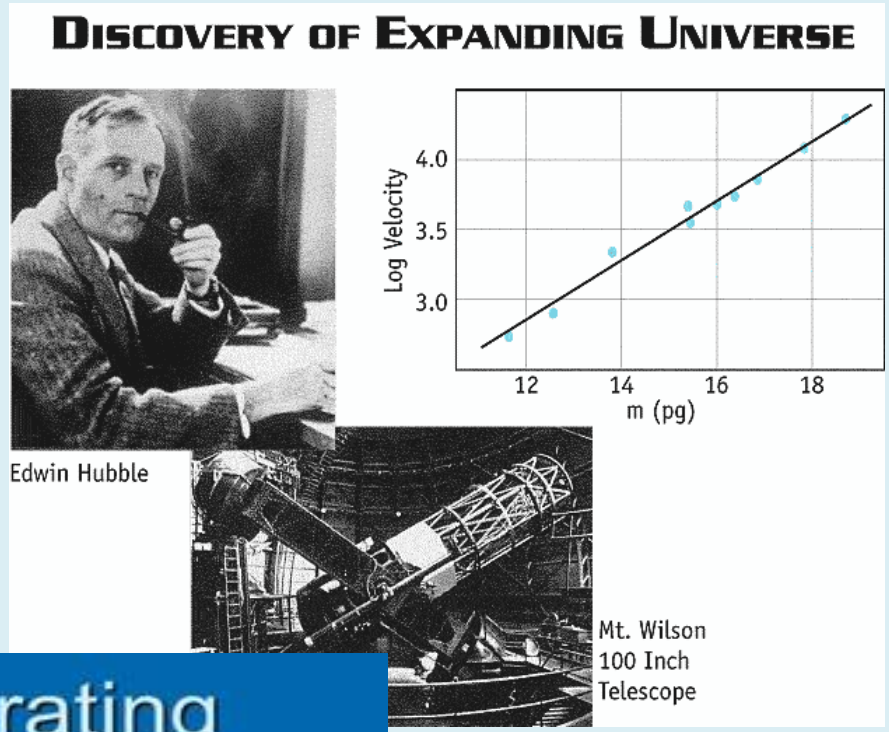


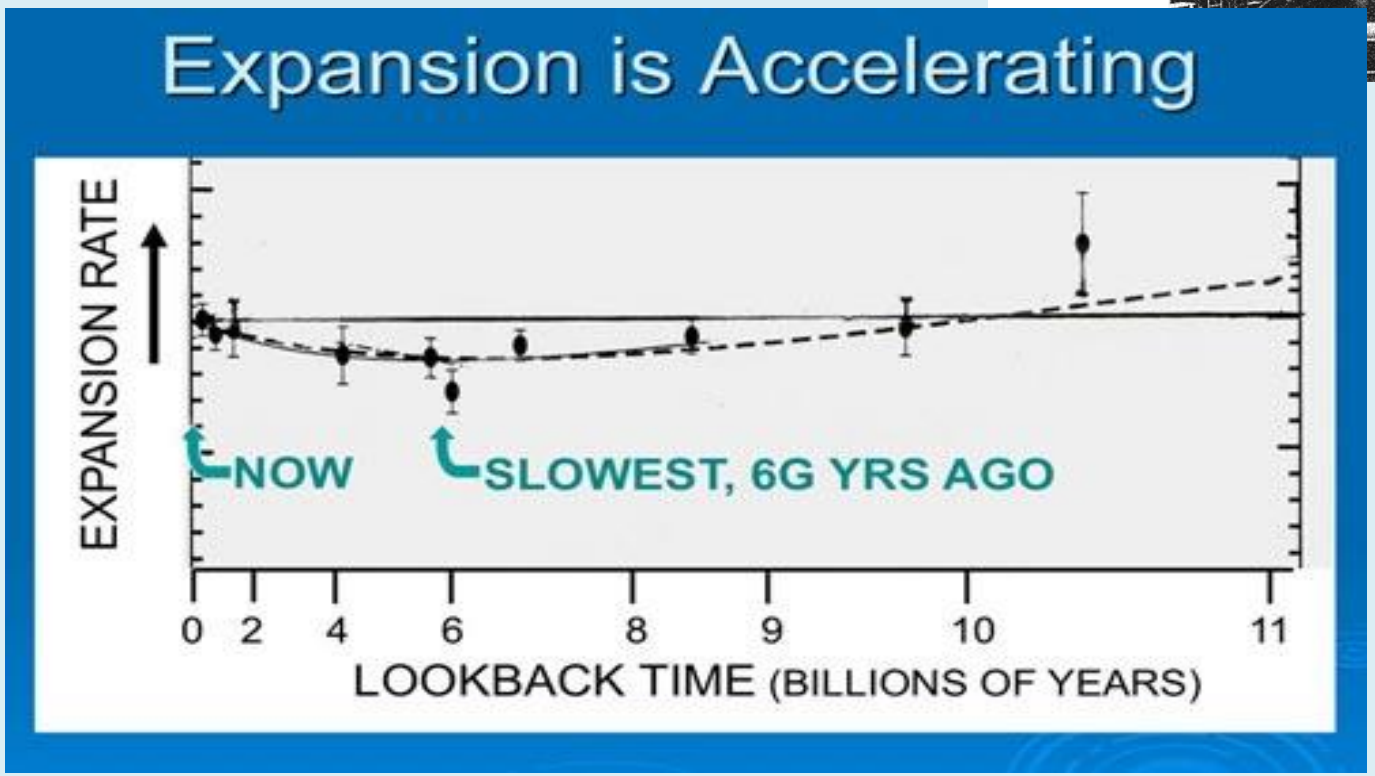



# Dark Energy

**Evidences of Dark Energy:**

- **Accelerating expansion of the Universe from distant SNs**



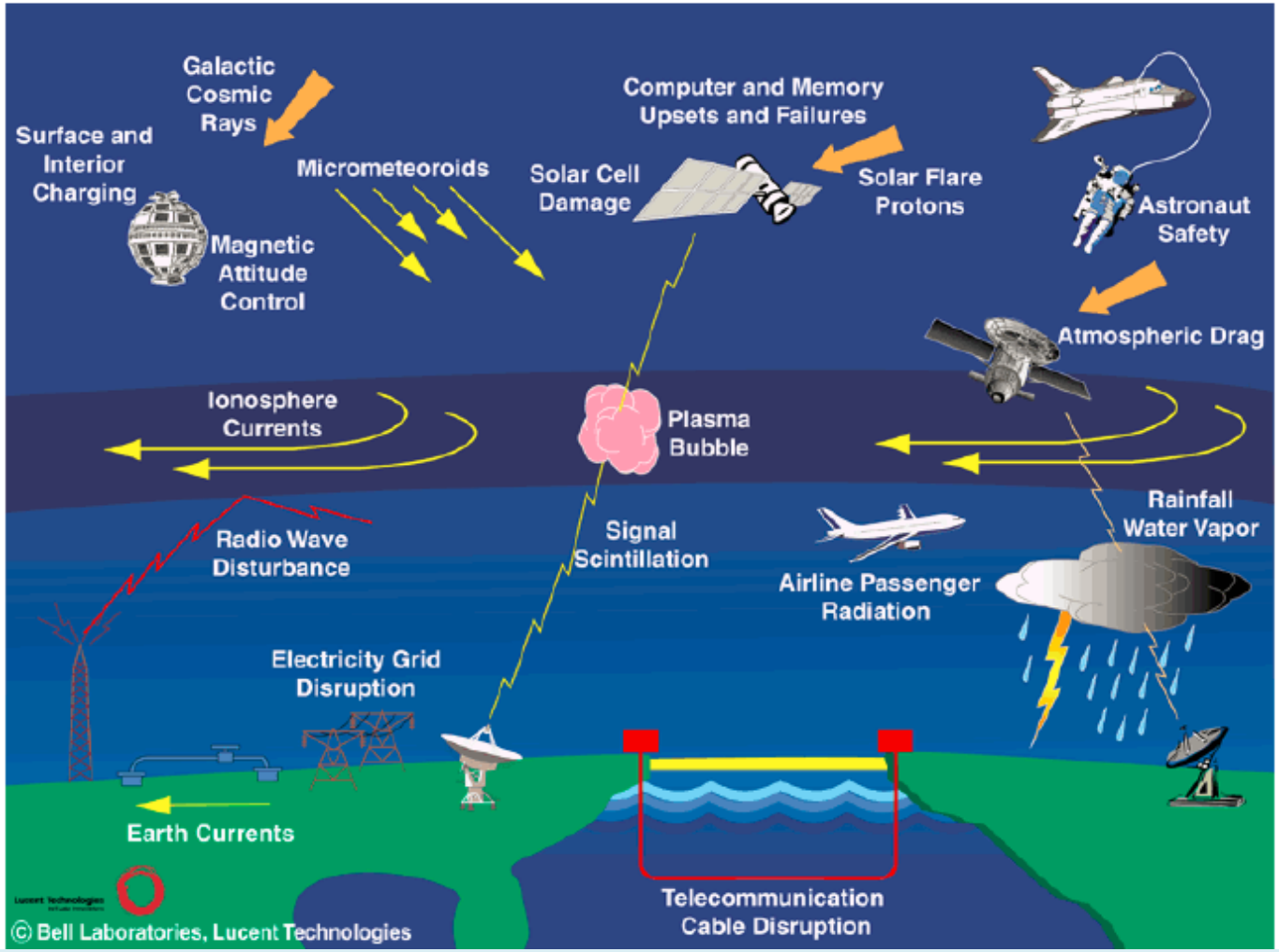

**Discovery of expanding Universe.**

**Discovery of accelerating expansion of Universe.**

# Relazioni Sole - Terra dall'Antartide

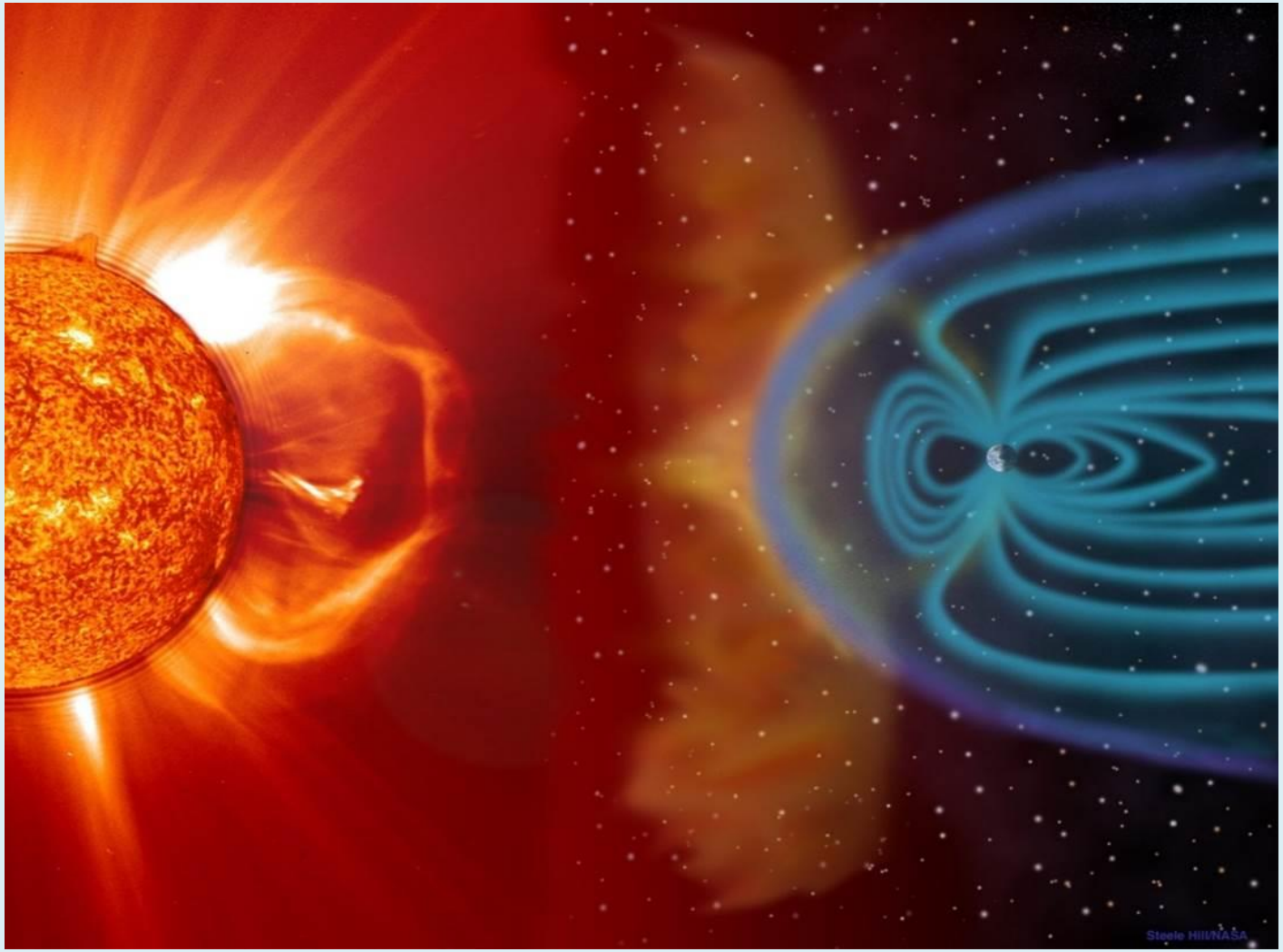
**Space weather → ionosfera → atmosfera → effetti pratici**

*Question #72.* How does space weather influence the polar ionosphere and what are the wider implications for the global atmosphere?



# Relazioni Sole - Terra dall'Antartide

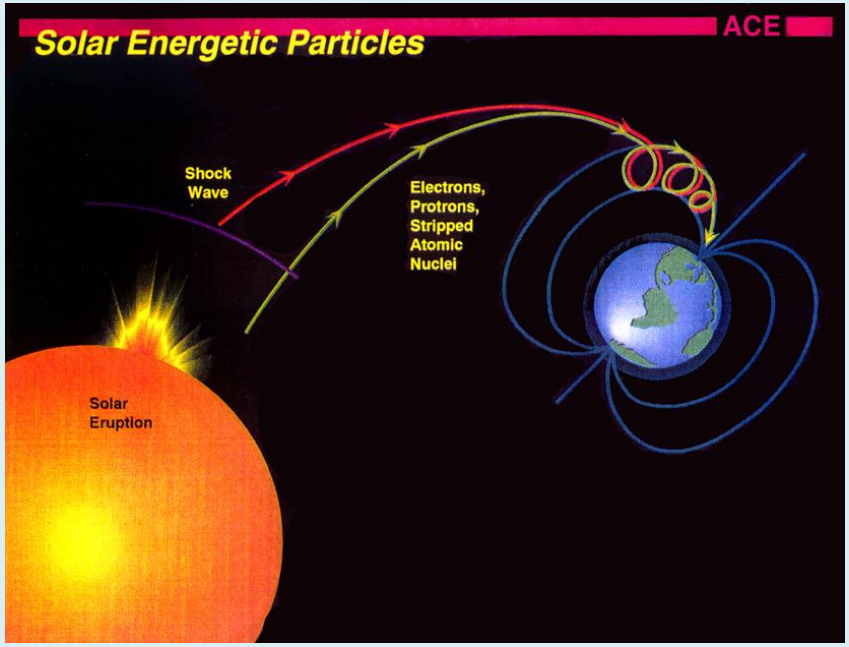
**Il vento solare trasferisce continuamente energia** alla magnetosfera attraverso processi di fisica del plasma che avvengono alla magnetopausa.

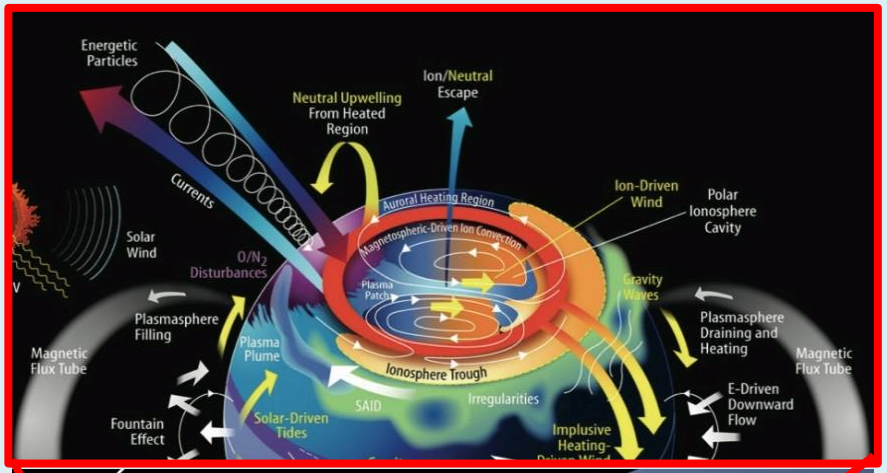


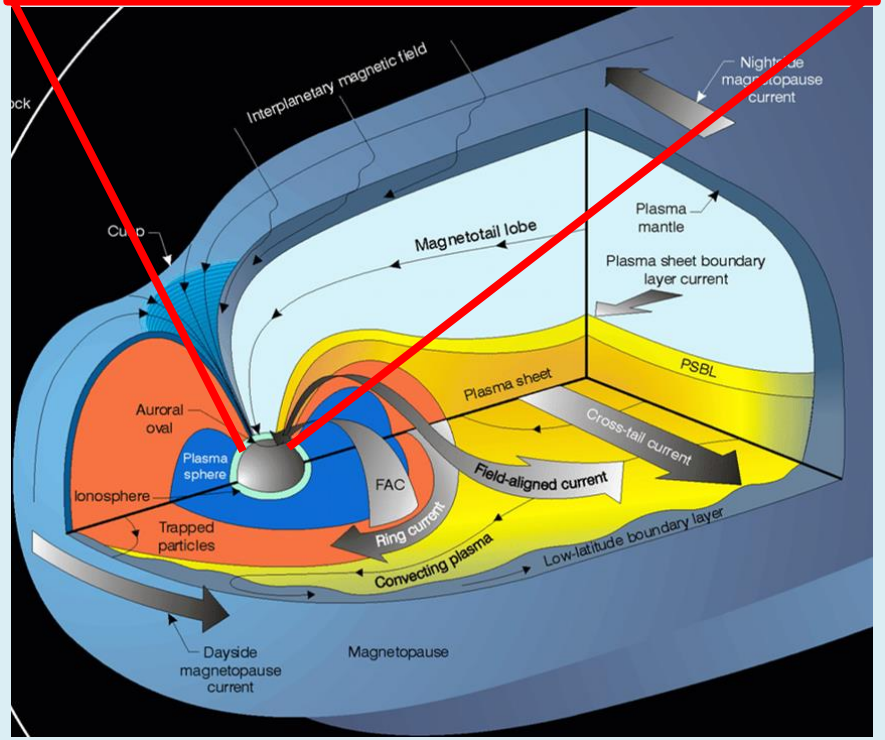
# Relazioni Sole - Terra dall'Antartide

Tale interazione influisce sulla ionosfera di alta latitudine, direttamente accoppiata alla magnetosfera esterna ed al vento solare per l'alta conduttività elettrica lungo il campo magnetico.

Tali processi sono molto intensi in occasione delle **sotto-tempeste**, quando l'energia fornita dal vento solare ed immagazzinata nella coda geomagnetica viene rilasciata verso la magnetosfera interna e la ionosfera.



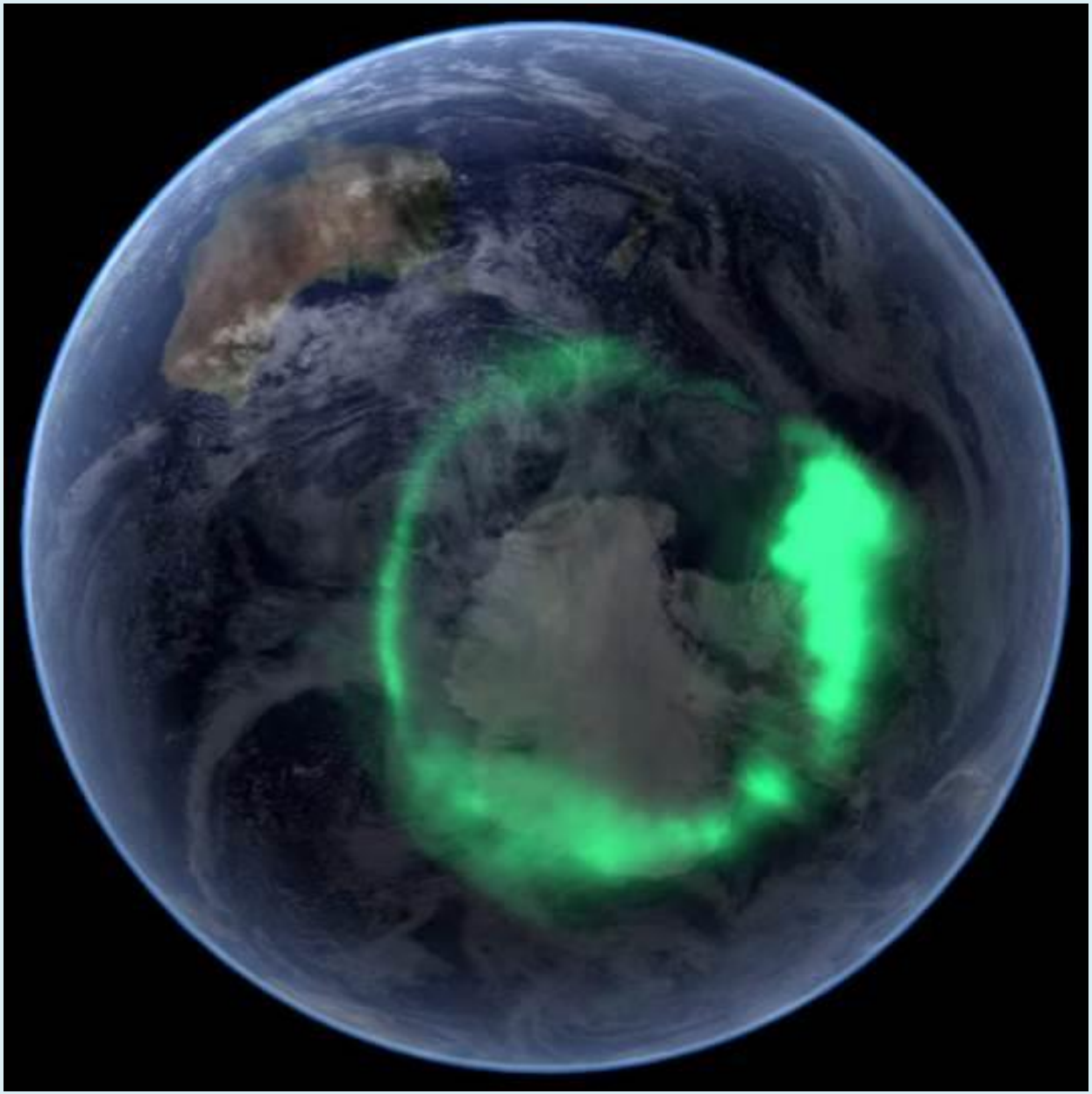



# Relazioni Sole - Terra dall'Antartide

Tali fenomeni sono accompagnati dalle **aurore** e da **perturbazioni** che possono influenzare i sistemi tecnologici fino a danneggiare satelliti in orbita e linee elettriche di potenza al suolo e ad interrompere le comunicazioni terra-terra e spazio-terra.

Quindi, la dinamica del sistema magnetosfera-ionosfera è considerata di grande rilievo per possibili applicazioni pratiche in relazione con la Meteorologia Spaziale.

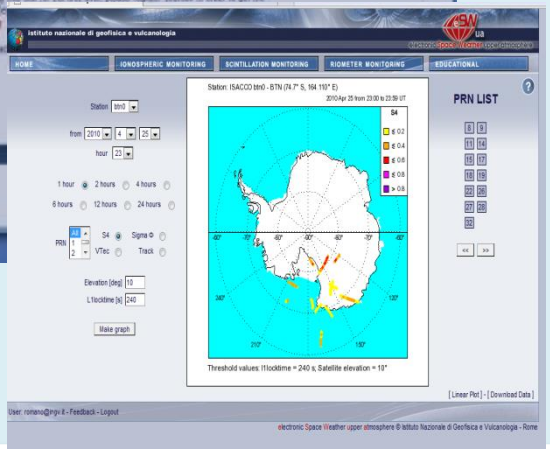


# Relazioni Sole - Terra dall'Antartide

La strumentazione a terra comprende:

- **Reti di osservatori magnetici**
- **reti di radar ionosferici**
- **reti di all-sky camera per le osservazioni aurorali**
- **ionosonde**
- **ricevitori GPS/GNSS ..**

# Upper atmosphere physics observations
# PNRA projects since 1990

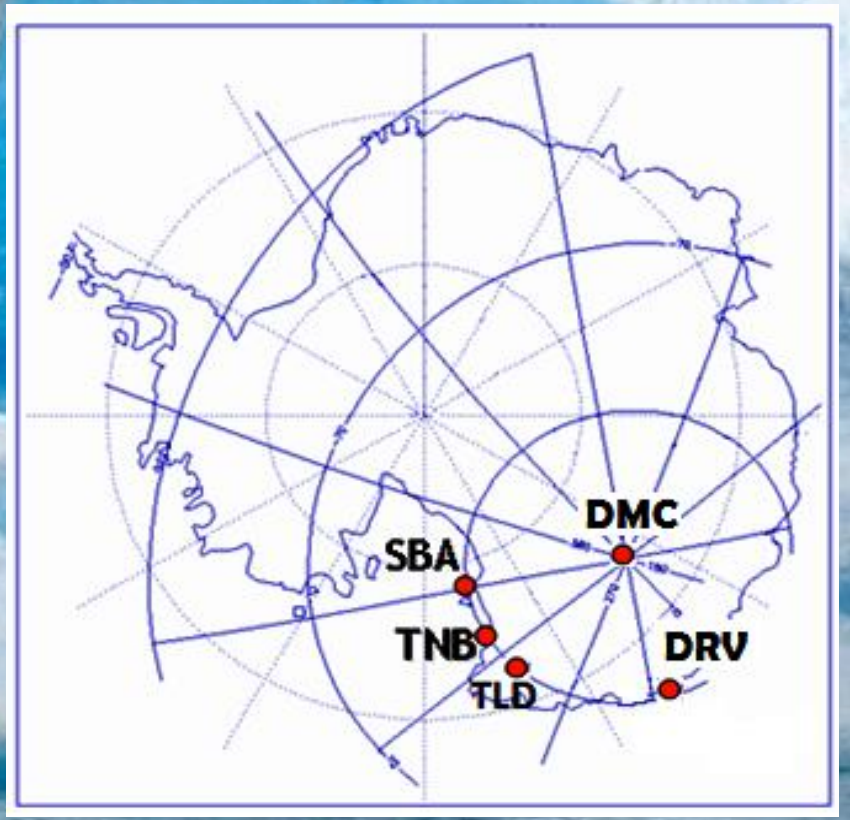

Data are accessible at the *electronic Space Weather upper atmosphere* website **eSWua**

www.eSWua.ingv.it

# Osservatori geomagnetici

**L'Italia gestisce in Antartide due osservatori geomagnetici: uno a Stazione Mario Zucchelli (Baia Terra Nova, TNB, dal 1987), uno a Concordia (DomeC, DMC, dal 2005, in collaborazione con la Francia).** La serie di dati raccolti nei due osservatori è ormai molto lunga e quindi costituisce un prezioso dataset per lo studio della dinamica del campo geomagnetico su varie scale temporali (variazione secolare, variazione diurna, pulsazioni).

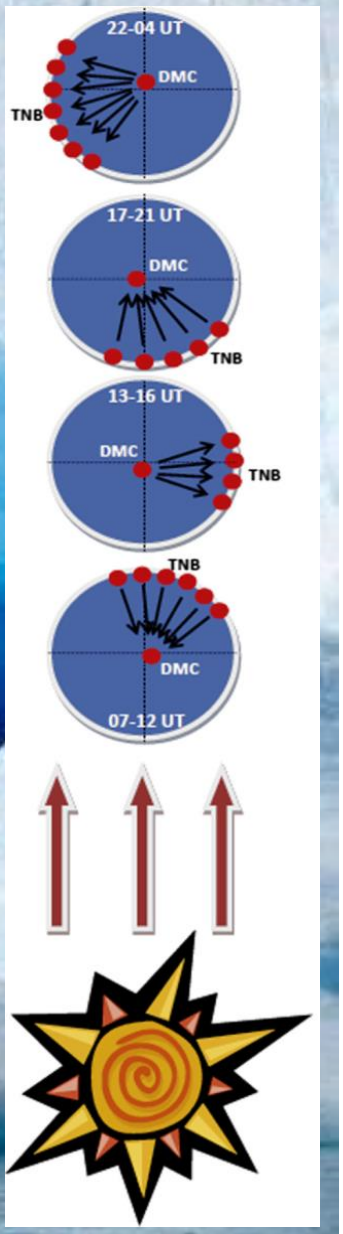
TNB, DMC e le altre stazioni lungo il parallelo geomagn. 80°S:
Dumont D'Urville (DRV; Francia)
Scott Base (SBA; Nuova Zelanda)
TalosDome (TLD; temporanea; Italia)
Le linee tratteggiate e continue mostrano rispettivamente il sistema di coordinate geografico e geomagnetico corretto.



# Osservatori geomagnetici

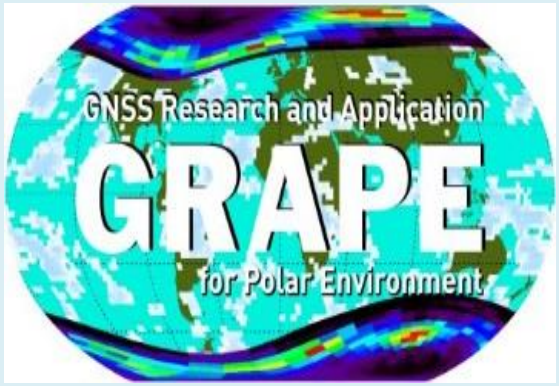
I dati di TNB, che con DRV e SBA costituisce una rete longitudinale lungo il parallelo geomagnetico 80°S, sono ideali per lo studio della propagazione longitudinale delle variazioni del campo di origine esterna, nell'ambito dello Space Weather.
Il confronto con DMC, in prossimità del polo geomagnetico, permette invece di studiare la propagazione latitudinale.

**La direzione di propagazione è indicata dalla differenza di fase tra segnali coerenti (ritardo).**




**Analisi della propagazione delle pulsazioni di bassa frequenza tra TNB e DMC:**
**-dalla regione di mezzogiorno e mezzanotte dell'ovale verso il polo**
**- dal polo verso le regioni alba/tramonto dell'ovale.**

**Meccanismi di generazione legati al flusso del vento solare (instabilità Kelvin-Helmholtz), fenomeni nella coda (sottotempeste) e nella calotta polare.**




# "GNSS Research and Application for Polar Environment" (GRAPE)

## *A joint SSG PS and GS Expert Group*

*Coordinator: Giorgiana De Franceschi,*
***giorgiana.defranceschi@ingv.it***
Istituto Nazionale di Geofisica e Vulcanologia

## GRAPE main objectives:

- Create and maintain distributed **networks** of specialized **GPS/GNSS** Ionospheric Scintillation and TEC Monitors

- Identify and quantify mechanisms that cause **scintillation** and control **interhemispheric** differences, asymmetries and commonalities

- Develop **ionospheric** scintillation climatology, tracking and mitigation **models** to improve prediction capabilities of **space weather**.

- Retrieve **tropospheric PWV** for input to **weather forecast** models and to develop **regional PWV climatology** for atmospheric sensing in remote areas.

# GRAPE 2012-2015 RESULTS

- WEB www.grape.scar.org,
- Outreaches
- Publications (full list at www.grape.scar.org) > 20 papers

  - Grape, Solar Terrestrial Physics in an operational environment- **Special Issue Annals of Geophysics Vol. 56, No2 (2013)** DOI:10.4401/ag-6366 , Ed G. De Franceschi, M. Candidi,
  - Papers on *JGR, JASTP, Ann. Geophys., Space Weather, Adv. in Space Res., Radio Sci., etc.*

- Conferences, Meetings, Workshops
  - IPY 2012 Conference (Montreal, Canada)
  - XXXII SCAR OSC 2012 (Portland, Oregon - USA): GRAPE Oral Session, Grape Satellite Meeting
  - XXXIII SCAR OSC 2014 (Auckland, New Zealand): GRAPE Oral and Poster Session, GRAPE Satellite Meeting
  - DemoGRAPE project (PNRA): KoM , Rome, Italy, 9-10 October 2014
  - URSI AT RASC 2015 (Gran Canaria, Spain): GRAPE Oral session 19 May 2015
  - **GRAPE session is scheduled at SCAR OSC 2016 in Malaysia**

- DemoGRAPE funded PNRA project (2014-2016) involving Italy, South Africa and Brazil

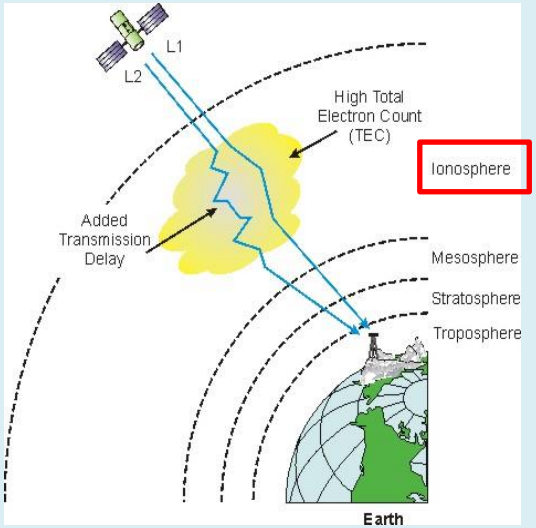
# DemoGRAPE (Demonstrator for GRAPE)

DemoGRAPE is a 2 years project: May 2014-May 2016.

It is funded by the Italian Ministry for University and Research in the frame of the Italian National Program for Antarctic Research.

## Main Objective

The project will realize a demonstrator, DemoGRAPE, to provide on selected case studies an empirical assessment of the delay and of the corruption induced by the ionosphere on satellite signals in the Antarctic regions. The scope is to develop a prototype of a service addressed to the scientific and technological communities that relies on GNSS for their investigations and applications. DemoGRAPE will experiment the use of Cloud computing to create an innovative technological tool.
The initiative was born into GRAPE (GNSS Research and Application for Polar Environment), SCAR Expert Group.




## Participants

INGV (Coordinator, Italy), Politecnico di Torino (Italy), ISMB (Italy)
INPE-CRAAM (Brazil), SANSA (South Africa)
SpacEarth Technology (INGV spin-off)

WWW.DEMOGRAPE.NET

# Sun Earth Relationships and Antarctica
# SERAnt

We propose to establish an **Action Group within SSG/PS** to determine the Terms of Reference for an Expert Group on solar terrestrial physics, with the following objectives:

- Identify the science to be addressed, and the groups worldwide that are already active in research in the field
- Formulate a proposal for its structure and composition
- Analyse the interaction with GRAPE EG and avoid duplication, while promoting sinergy
- Bridge over gap between ICESTAR, closed at Auckland, and future EG to be formed in Kuala Lumpur

Proposed members:

-Dr. Maurizio Candidi, Chair
-Dr. Allan Weatherwax, Chair of past ICESTAR EG
-Dr Annika Seppala, SCAR representative in SCOSTEP Bureau
-Dr. Giorgiana DeFranceschi, Chair of GRAPE EG

Requested budget for 2015 and 2016: US$ 1500 per year to support limited travel, and participation in SCAR XXXIV

# Super Dual Auroral Radar Network

I radar ionosferici SuperDARN formano una rete internazionale dedicata allo studio del sistema ionosfera-magnetosfera, nell'ambito della fisica del plasma e delle relazioni Sole - Terra (Space Weather).

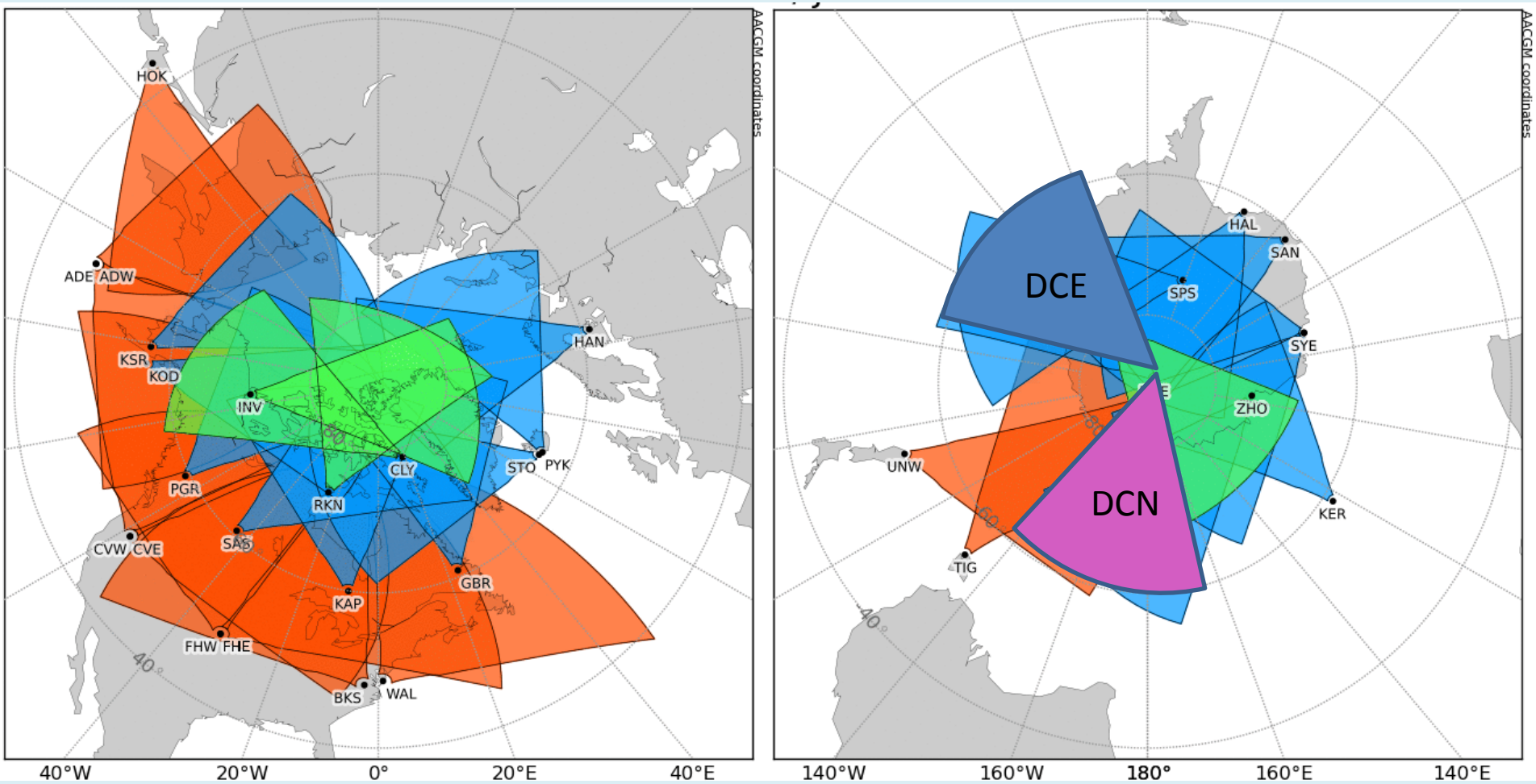
I radar sono localizzati nella zona aurorale e subaurorale in entrambi gli emisferi. La copertura è totale nell'emisfero settentrionale, mentre nell'emisfero meridionale verrà completata grazie i radar DCE e DCN presso la base italo-francese di Concordia.

Le nazioni, oltre all'Italia, che attualmente contribuiscono a SuperDARN sono: l'Australia, il Canada, la Cina, la Francia, il Giappone, l'Inghilterra, gli Stati Uniti e il Sud Africa.

Tutte le informazioni su SuperDARN possono essere trovate sul sito del *College of Engeneering* del *Virginia Polytechnic Institute and State University*:

**http://vt.superdarn.org**

# Super Dual Auroral Radar Network – copertura




Dome C East – installato durante la campagna 2012-2013 nell'ambito di una collaborazione IPEV-PNRA
Dome C North – da installare durante la campagna 2017-2018

# Super Dual Auroral Radar Network – tematiche di investigazione

Struttura e dinamica della convezione ionosferica

(global - meso - small scale)

Coniugazione inter-emisferica dei fenomeni ionosferici.

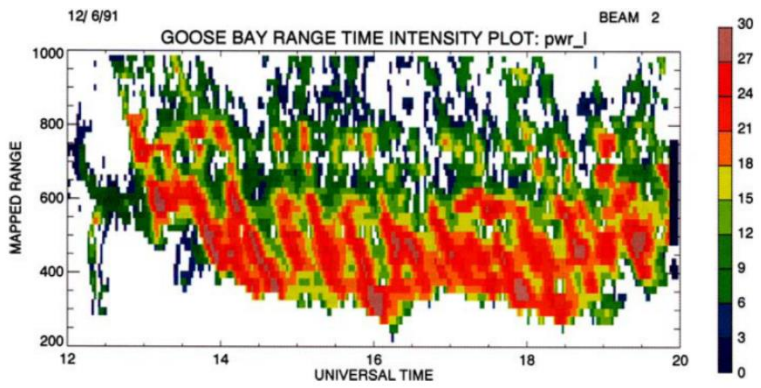
Convezione associata alle *substorm*.

Fisica delle irregolarità ionosferiche associate alle strutture di plasma alle alte latitudini (e. g. patches).

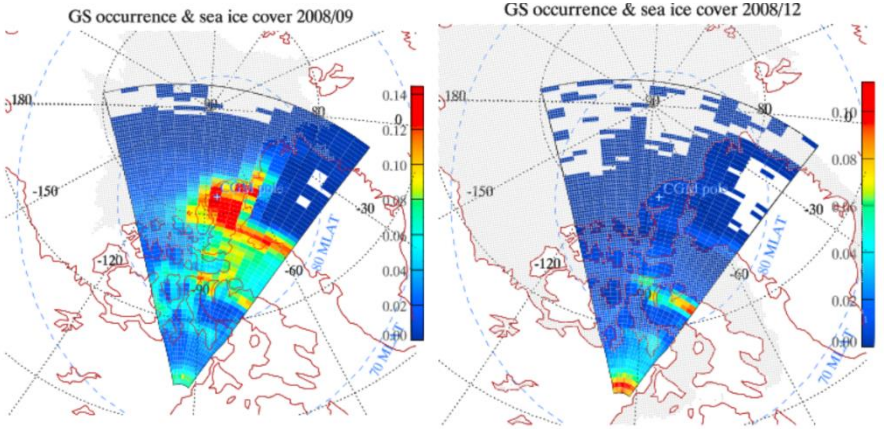
Onde elettromagnetiche: MHD, ULF, Magnetic Field Line Resonances.

Atmosfera: e.g. onde di gravità.

Rilevazione della rugosità della superficie terrestre - copertura dei ghiacci




Le onde di gravità sono visibili come fluttuazioni nell'intensità del segnale retrodiffuso da terra (Bristow et al. 1994)




La distribuzione spaziale del segnale retrodiffuso dipende dalle proprietà di riflessione della superfice terrestre: oceano, distese di ghiacci montagne (Ponomarenko et al. 2010)

# The SuperDARN radars @ Concordia

In the framework of a French – Italian collaboration, it has been funded the construction of two new SuperDARN radars: Dome C East (DCE) and Dome C North (DCN).

The DCE radar has been successfully installed by personnel from INAF-IAPS, LPCE2-CNRS and CNR-DTA, with the help of the University of Saskatchewan and the logistic of Concordia, during the 2012-2013 Antarctic campaign and it is now operated by INAF-IAPS (PI E. Amata).

The mechanics of DCN is already at Dome C and the installation of the radar is planned for the 2016-2017 Antarctic campaign.

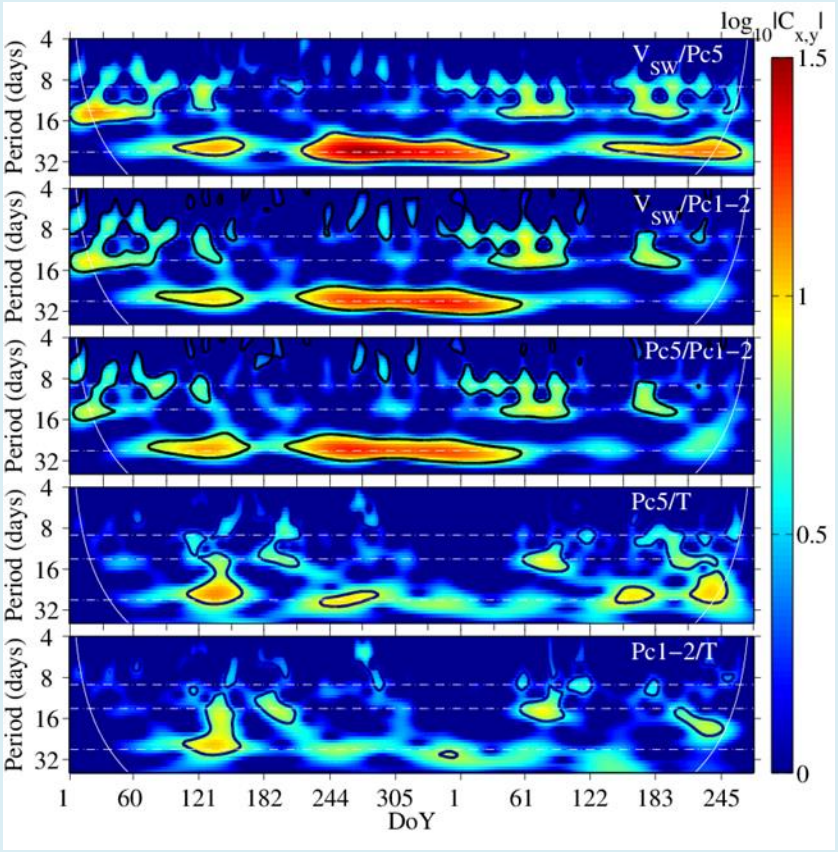
The construction of the radars has been supported by **PNRA**, **INAF** and **CNR** from the Italian side, and by **IPEV** and **INSU** from the French side.


# L'attività geomagnetica e la variabilità della temperatura superficiale dell'aria a latitudini polari

P. Francia, M. Regi, M. De Lauretis

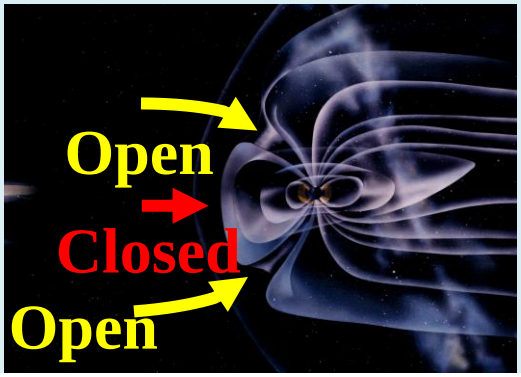
*Dipartimento di Scienze Fisiche e Chimiche – Università dell'Aquila*

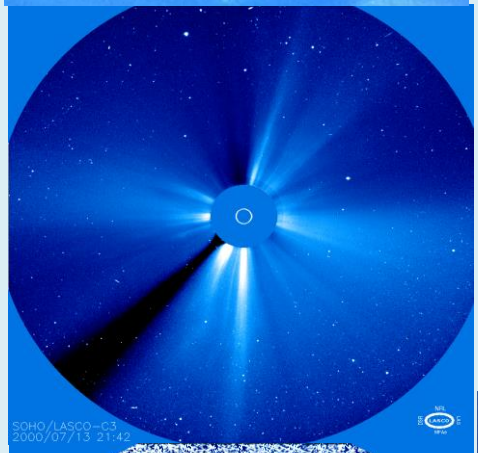
Si studia la connessione tra **disturbi del campo geomagnetico generati dal vento solare ed effetti atmosferici**.
Sono state usate misure magnetiche e di temperatura superficiale a Baia di Terranova, durante gli anni 2007-2008, caratterizzati da attività geomagnetica generata da fasci di vento solare ricorrenti. E' stata osservata una buona correlazione tra temperatura e fluttuazioni geomagnetiche (onde Pc5 e Pc1-2) ai periodi di ricorrenza dei fasci di vento solare, cioè a ~27, 13.5, e 9 giorni (ultimi 2 pannelli in basso), simile a quella che c'è, come previsto, tra la velocità del vento solare e l'attività geomagnetica (primi 3 pannelli dall'alto).

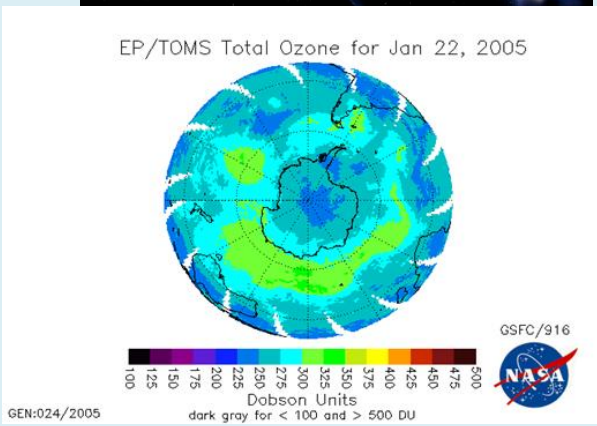


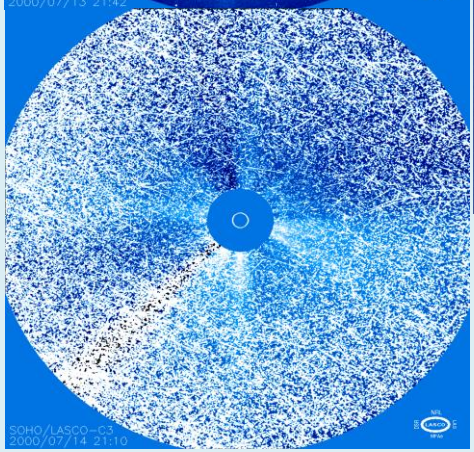
# High energy particle effects in the polar regions

- Damages to spacecraft operations and electronics
- Ionization of the Earth's atmosphere (ozone depletion, radio communication, clouds, lightning)
- Climate
- Human health hazard (radiation dose)

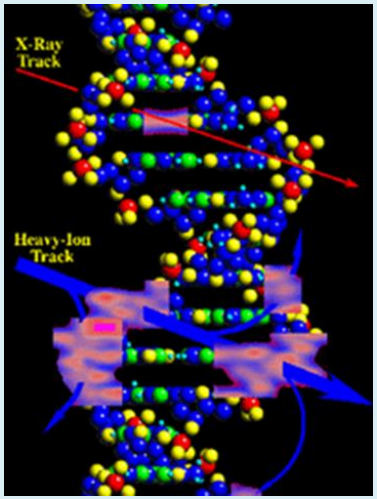


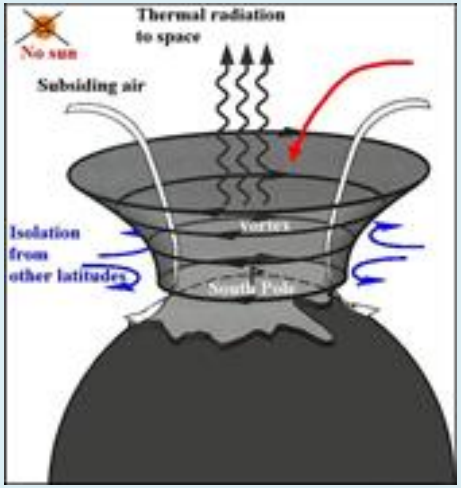







# Session W6

- **Francesco Piacentini** : *LSPE - Large Scale Polarization Explorer e i palloni stratosferici da zone polari* (8 minuti)
- **Elia Battistelli** : *QUBIC: un interferometro bolometrico per misure di modi B della polarizzazione della CMB* (8 minuti)
- **Mauro Dolci** : *L'Antartide come sito ideale per l'Astronomia nell'infrarosso* (8 minuti)
- **Marco De Petris** : *CASPER: emissione atmosferica nel submillimetrico a Dome-C e site testing* (8 minuti)
- **Mario Zannoni / Aniello Mennella** : *Sviluppi tecnologici per LSPE e QUBIC* (5+5 minuti)
- **Silvano Fineschi** : *Il Sole dall'Antartide: relazioni Sole-Terra e space weather* (8 minuti)
- **Vincenzo Romano** : *Le "open question" ionosferiche dello SCAR: l' "Expert Group" GRAPE (GNSS Research and Application for Polar Environment) ed il contributo italiano* (15 minuti)
- **Maurizio Candidi** : *L' "Action Group" SERAnt (Sun-Earth Relationships and Antarctica)* (5 minuti)
- **Federica Marcucci** : *Le misure della rete di radar ionosferici SuperDARN nel contesto delle Relazioni Sole Terra* (10 minuti)
- **Domenico Di Mauro** : *Misure e analisi dei dati geomagnetici raccolti in Antartide: una finestra privilegiata per indagare l'interno e l'esterno del nostro pianeta* (10 minuti)
- **Patrizia Francia** : *L'attività geomagnetica e la variabilità della temperatura superficiale dell'aria a latitudini polari* (10 minuti)
- **Monica Laurenza** : *Effetti delle particelle energetiche nelle regioni polari* (5 minuti)

# Commenti e questioni aperte in Astrofisica

- L'astrofisica offre la possibilità di utilizzare **Concordia** anche e soprattutto nei mesi invernali;
- Per fare scienza di frontiera servono grandi progetti, come QUBIC, ma è richiesto anche uno **sviluppo tecnico/logistico** in parallelo allo sviluppo della strumentazione;
- Per fare scienza di frontiera nel vicino e medio **IR** serve un telescopio di classe **8m**;
- Occorre definire una strategia per utilizzare al meglio le facilities attualmente installate, coinvolgendo il più possibile la comunità scientifica: **call for ideas?**

# Esigenze tecnologiche W6 per le osservazioni permanenti

- **Connettività dati** delle stazioni antartiche che sia robusta e continua, con banda adeguata (in particolare per MZS)
- **Continuità nella fornitura di energia** anche durante l'inverno (MZS)
- Possibilità di **controllo remoto** della strumentazione dall'Italia
- Definizione di uno **standard duraturo** per le procedure di **trasmissione** automatica dei dati dalle basi antartiche e l'Italia
- Definizione di una **architettura di infrastruttura dati** e metadati a supporto dei PdR
- Definizione di standard e **strategie sulla gestione dei dati** in accordo con lo SCADM
- **Sostegno a progetti specifici** per lo sviluppo di infrastrutture di gestione dati a carattere innovativo ed internazionale.

# Altre proposte della comunità scientifica

- **Solar Coronagraphy from Antarctica.** Coronal Magnetic Field Measurements Optical/IR at Dome-C. ESCAPE: Extreme Solar Coronagraphy Antarctic Program Experiment

- **High energy particle effects in the polar regions - SEP-induced effects on the polar atmosphere - Environmental radiation dosimetry in Antarctica**

Entrambi questi aspetti integrano l'attività già in programma.