

Prospectives du LPSC – 1&2 juin 2015

Astroparticules - Cosmologie - Neutrinos

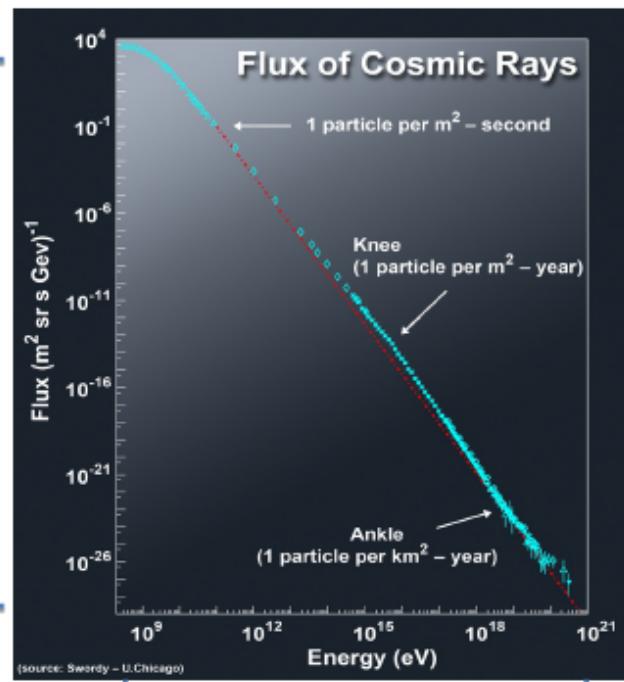
3 thèmes :

- Quels enjeux scientifiques pour le rayonnement cosmique ?
-> *Devenir du rayonnement cosmique au LPSC ?*
- Futur de la cosmologie au laboratoire et complémentarité entre les expériences
- Réflexions sur le futur des neutrinos et de la détection directe de matière noire

Multi-messengers: spectra and anisotropies

Two categories

- Neutral species (astronomy)
 - ✓ Gamma-rays
 - ✓ Neutrinos
- Charged cosmic rays (fluxes, anisotropy)
 - ✓ Leptons
 - ✓ Nuclei



12 orders of magnitude

“Low” energy: Galactic Cosmic Rays

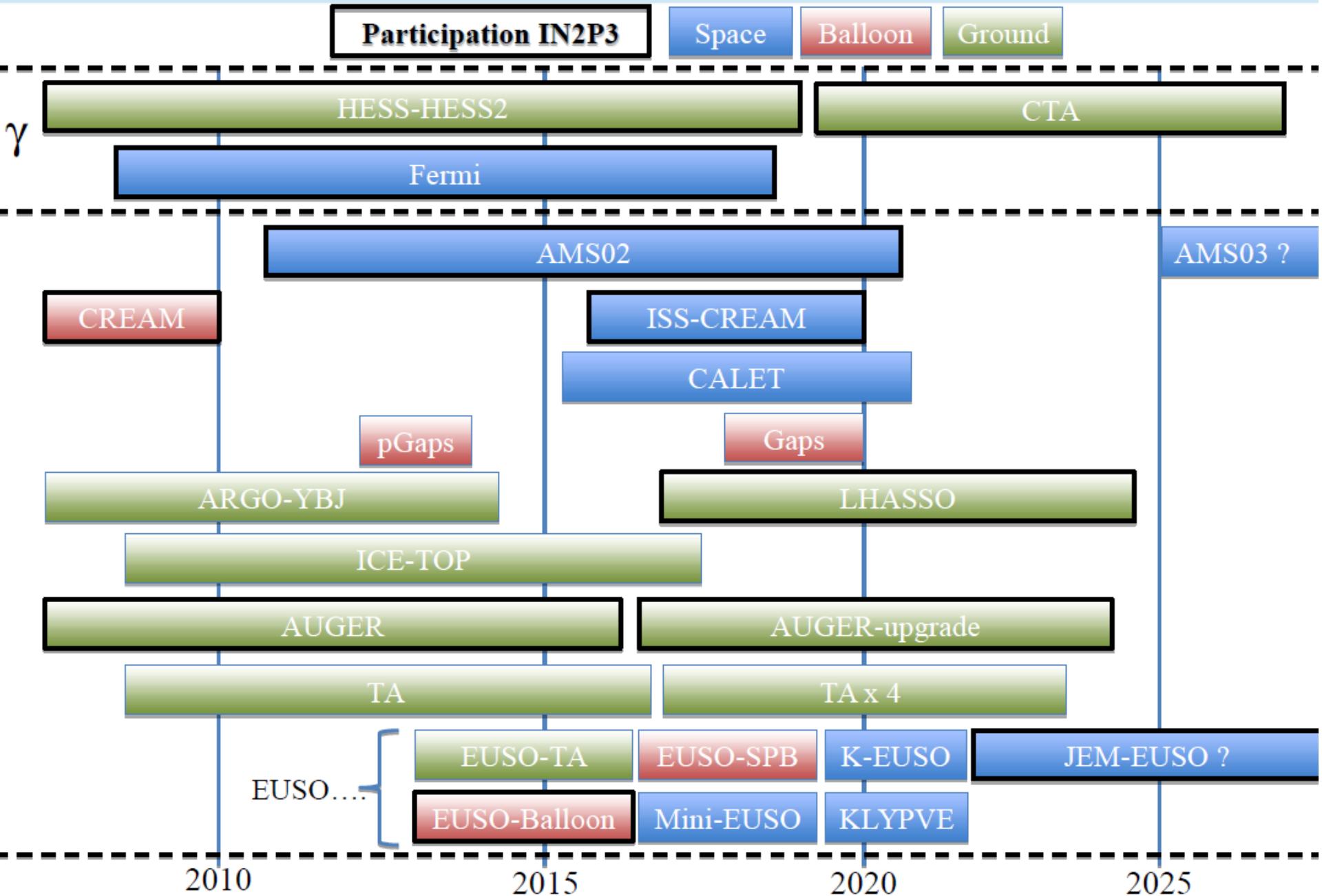
- Astrophysics questions (spectra, abundances)
 - ✓ What are the sources?
 - ✓ Transport in the Galaxy?
 - ✓ Solar modulation (time dependence)?
- Dark matter indirect detection best “targets”
 - ✓ Antiprotons and antideuterons fluxes
 - ✓ Dwarf spheroidal galaxies for γ -rays

Ultra-High Energy Cosmic Rays

- Astrophysics questions (spectra, abundances)
 - ✓ What are the sources?
 - ✓ GZK cutoff?
 - ✓ Transport in extragalactic B?
- New physics?
 - ✓ UHE interactions
 - ✓ Constraints on Lorentz Invariance Violation

→ Multi-messenger approaches
→ Multi-wavelength observations

Present and future experiments (γ and charged CRs)



Conclusions and perspectives

Galactic cosmic rays

- exciting new data now (AMS-02)
 - possible target of opportunity for higher energy (ISS-CREAM)
- AMS data exploitation now, but less interesting after → move to LSST

Ultra-high energy cosmic rays

- Auger upgrade status still under discussion
 - EUSO (and its avatars) status still unclear
- Ongoing discussions

LPSC

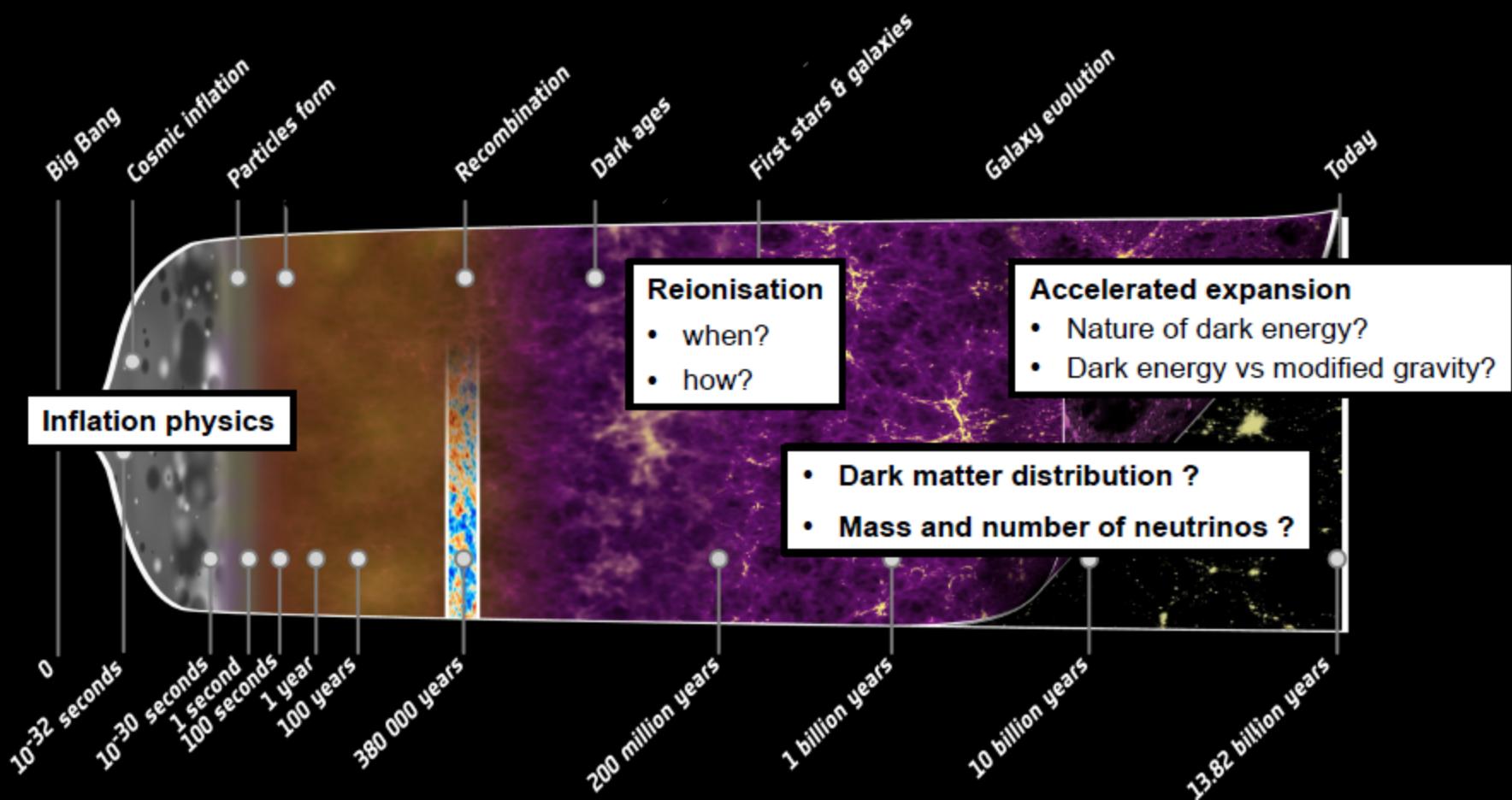
γ -rays

- CTA is the future instrument, post-Fermi experiments more uncertain
 - Possible local synergies (IPAG and LAPP)
- Not considered at LPSC so far, but synergy between LSST/CTA could exist
(new objects discovered with LSST could be CTA targets)

Neutrinos

- A new interesting window is opening (ICECUBE)
- *KM3 a tardé à démontrer une stratégie optimale et commune au niveau européen.
La détermination de la hiérarchie de masse des neutrinos [...] pourrait constituer
une réorientation et une convergence renforcée du projet*
[From prospectives IN2P3/Irfu 2013-2022]

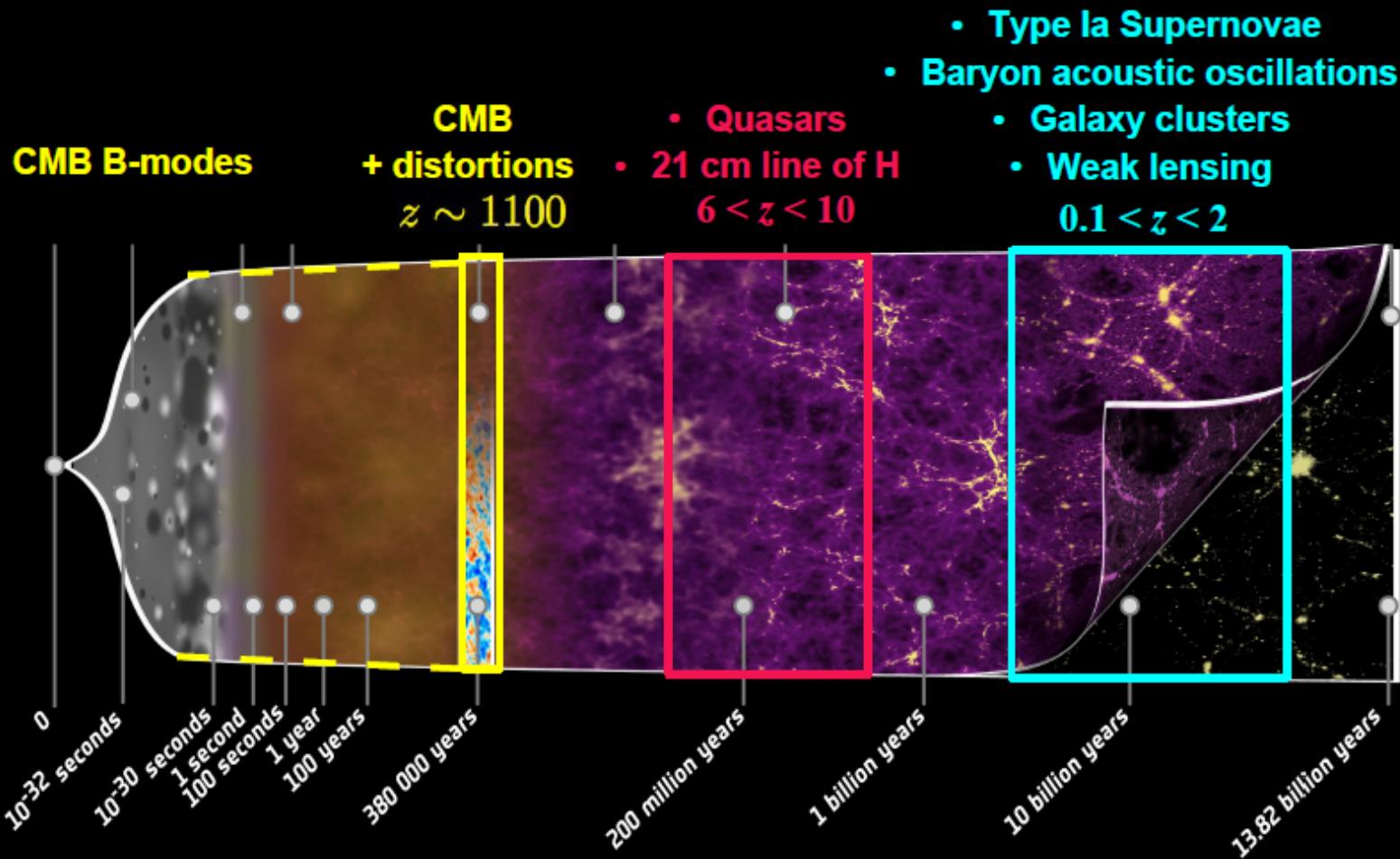
History of the Universe: open questions



History of the Universe: what probes?

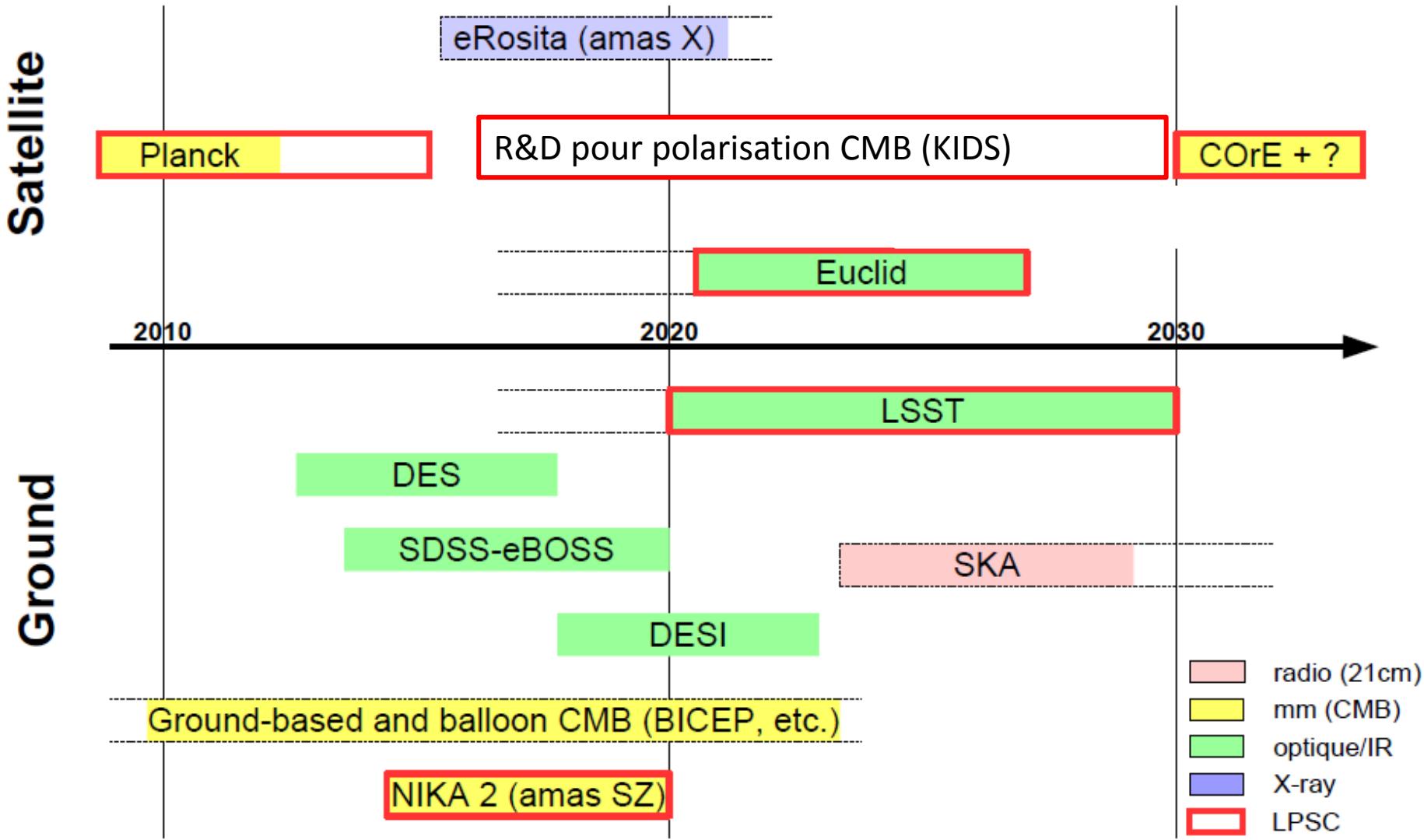
Different observables probe different epochs

Flat universe, 69% dark energy, 26% dark matter, 5% baryons



Observational cosmology: what projects ?

2010 – 2030



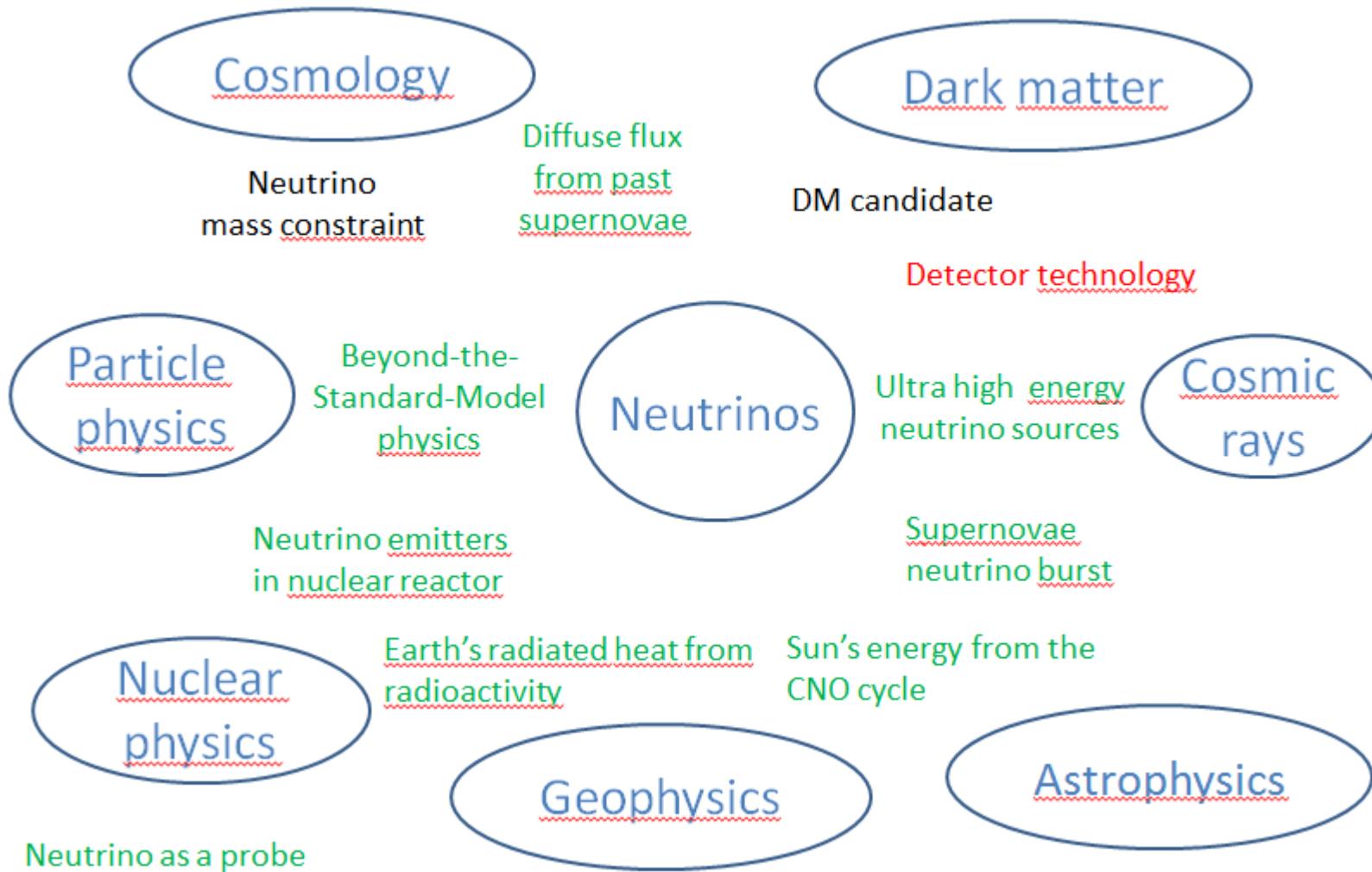
Conclusions

- **Planck/NIKA group**
 - CMB – instrumentation (2016 -):
 - development detectors (KIDs), ground and/or balloon-borne tests
→ “services techniques” strongly implicated + synergy LPSC/Néel/IPAG
 - Science:
 - NIKA2 (2016 – 2021): large program for SZ clusters, analysis pipeline, instrumental upgrade
 - Euclid (2021)– detector characterization (2016 – 2020), cluster studies, CMB cross-correlation
- **LSST group**
 - Instrumentation: CCOB, filter loader (delivery 2016, 2017, 2018) → “services techniques”
 - Computing (starting 2015)
 - LSST pipeline validation on existing public data (CFHTLS,...)
 - Science
 - Photometric redshift (necessary to **all** cosmological probes)
 - Baryon acoustic oscillations (complete analysis pipeline)
 - Weak lensing? Cluster?

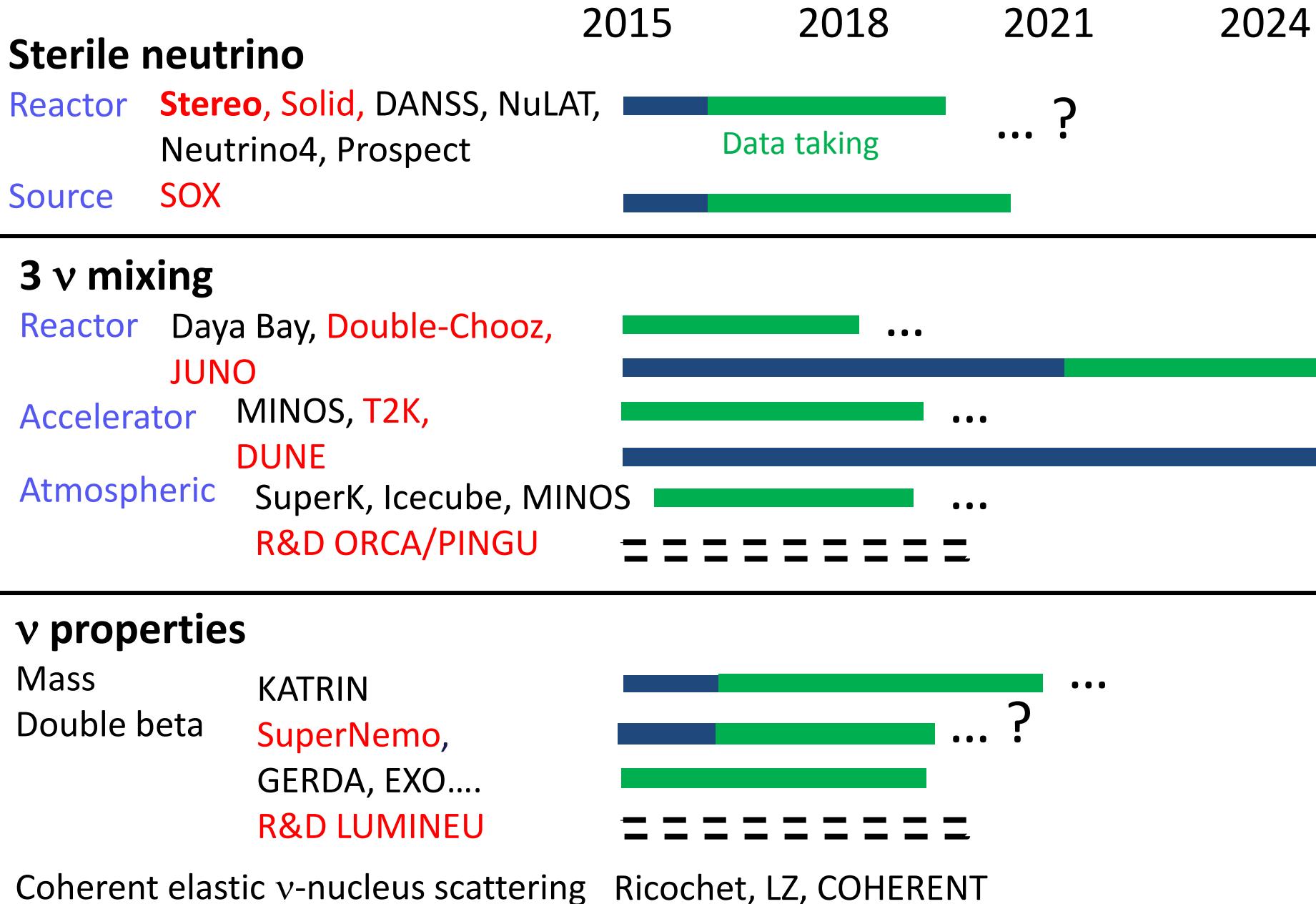
Ongoing discussion to develop common expertise between the two groups

Neutrino: open questions

Nature ? Absolute scale mass ? Mass hierarchy ? CP violation ?
Sterile neutrino ?



Neutrino experiments: global picture



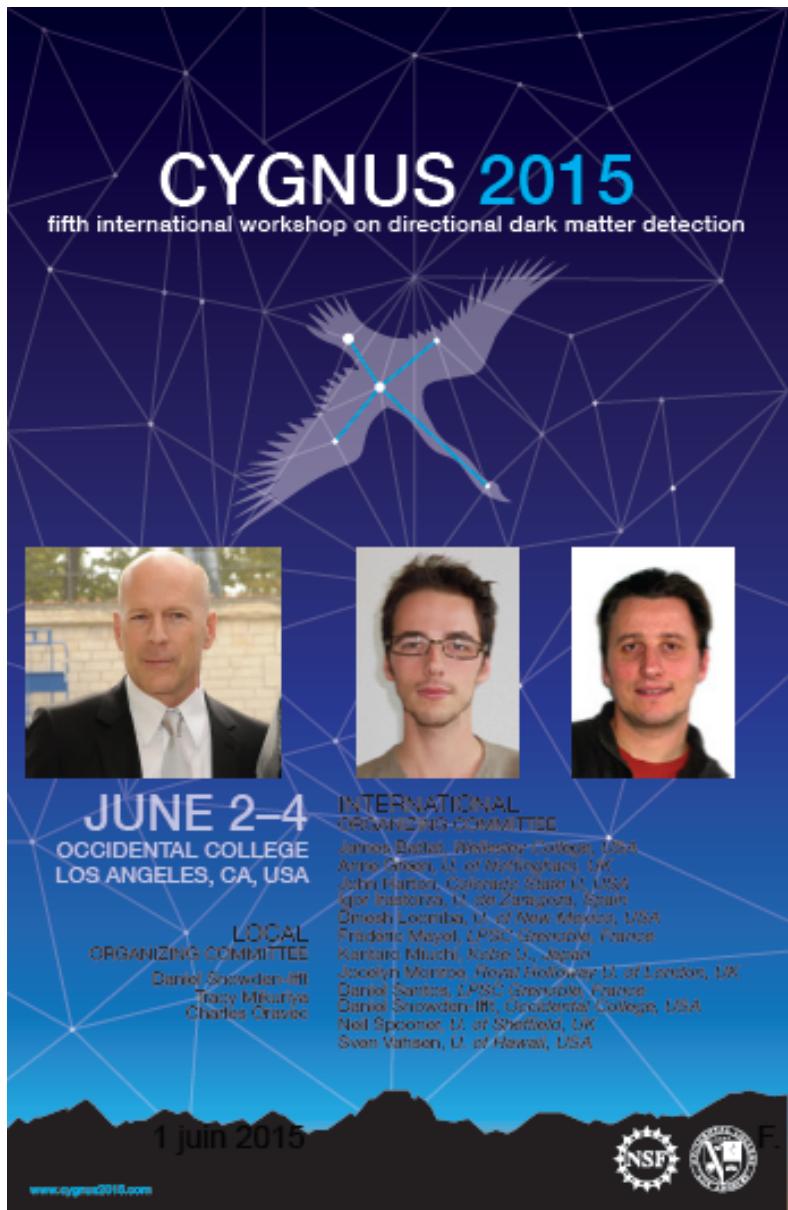
Conclusions

- Still a lot of open questions in the neutrino field.
- A lot of connections with other fields.
- For the future, identified french contributions concern mainly $3\bar{\nu}$ mixing experiments (JUNO, DUNE).
- The LPSC group will work on Stereo at least until 2018 and later in case of positive signal.

First priority for the next year, make Stereo running.

Implications for the future to be defined

Détection directe de matière noire



← **Introduction aux Prospectives 7/7**
LPSC 2015-2020

MIMAC :

- Installation du module actuel au CJPL
- Installation et test du module bi-chambre 35 x35 x 26 cm au LSM
- Construction, test et opération du détecteur 1m³ au LSM
- Construction et test du détecteur 5m³ au CJPL

NEWS :

- Calibration + Mesure du facteur de Quenching + système de circulation du gaz (LPSC)
- Construction, installation et prise de données à SNOLAB