SUPER KAMIOKANDE
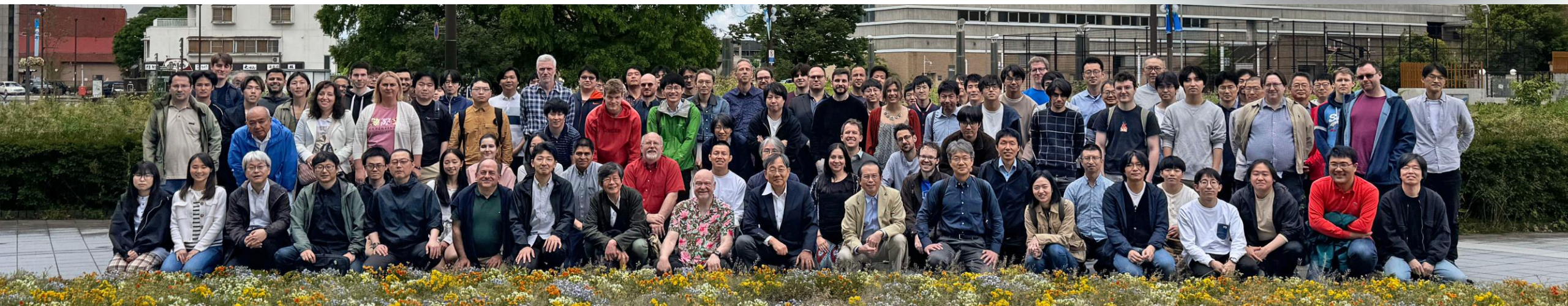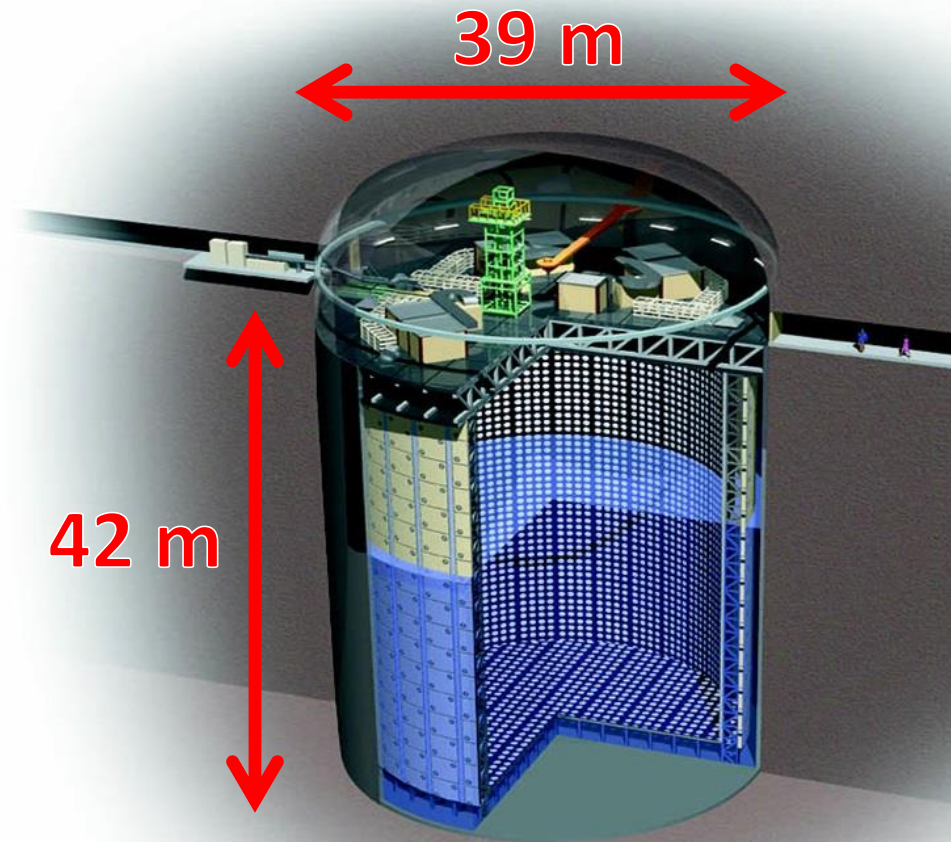
Lorenzo PERISSE
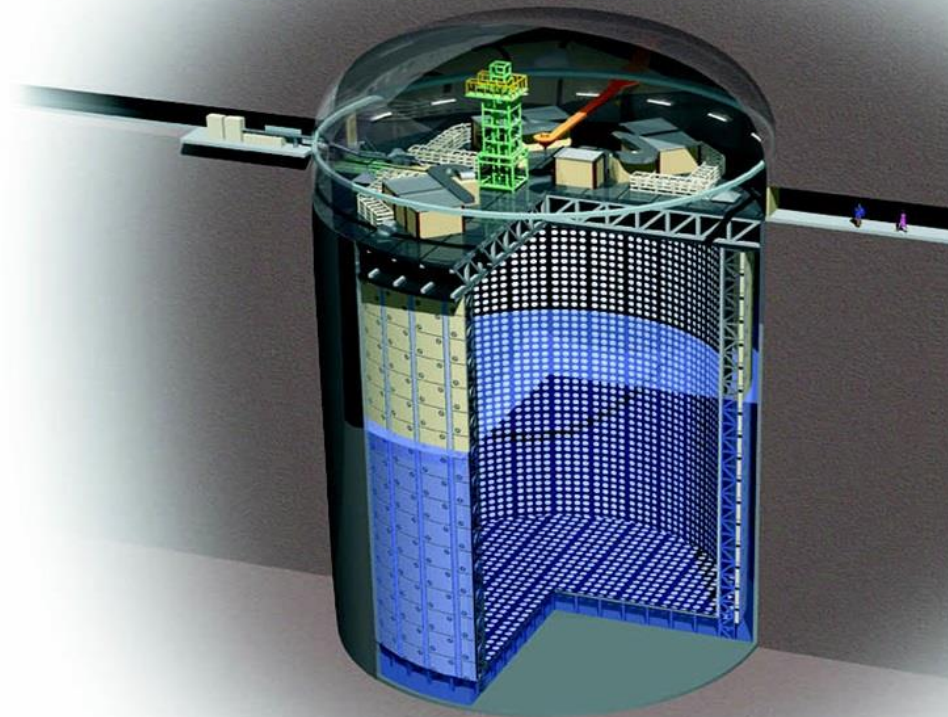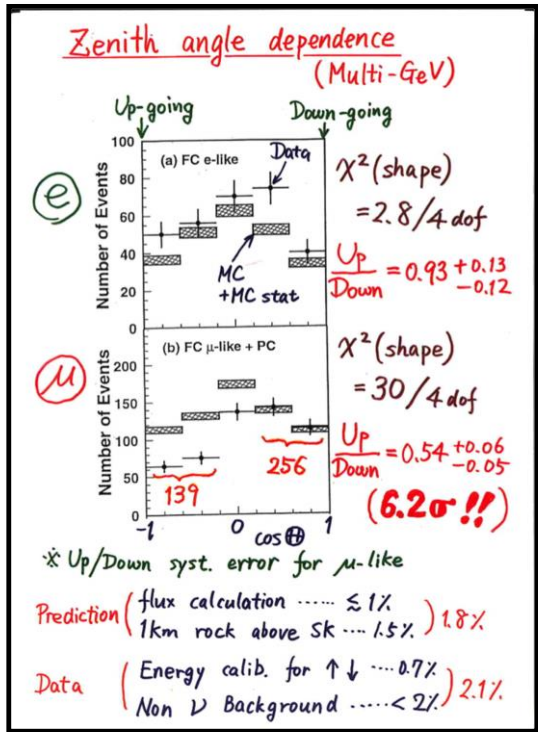
SK in brief

- 11 129 PMTs

- 50 000 tons

- 1000 m overburden

- +200 researchers (>10 in French group)

39 m

42 m

SK in brief
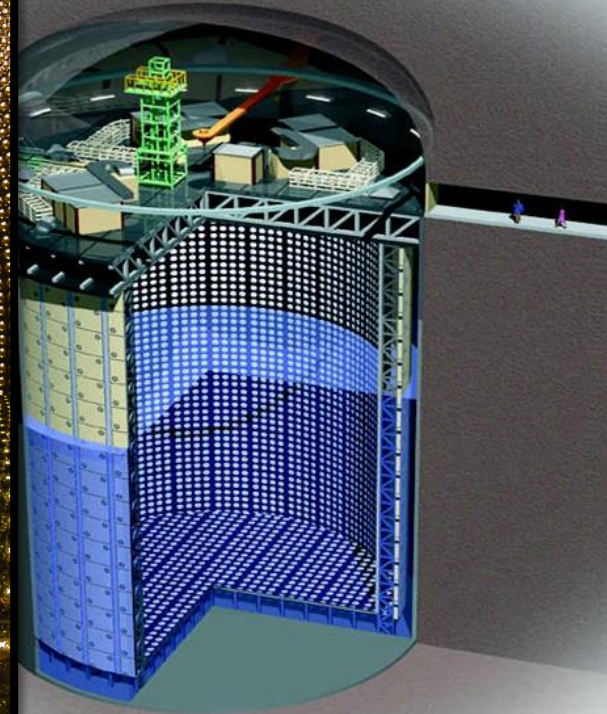

Zenith angle dependence (Multi-GeV)

SK in brief

1996	ATM ν	Solar ν	2001	2005	2008	DAQ	2018	2020	0.01% Gd	2022	0.03% Gd	Today
Super-Kamiokande				SK-II	SK-III	SK-IV	Tank SK-V		SK-VI		SK-VII	

SK in brief
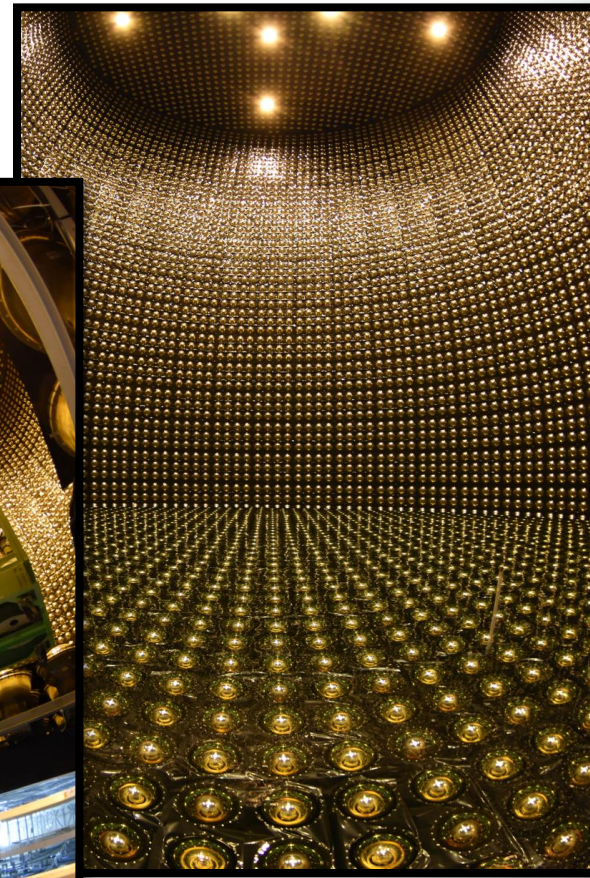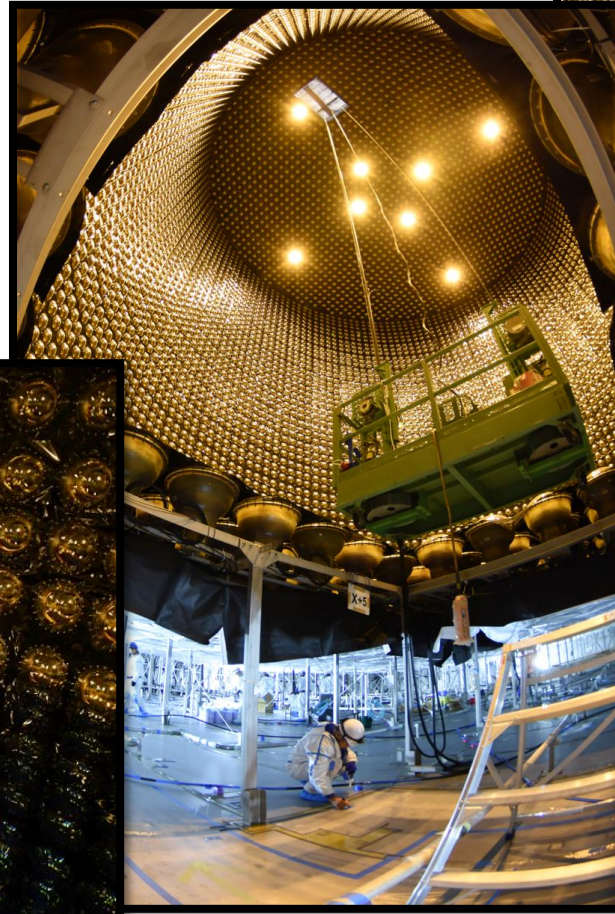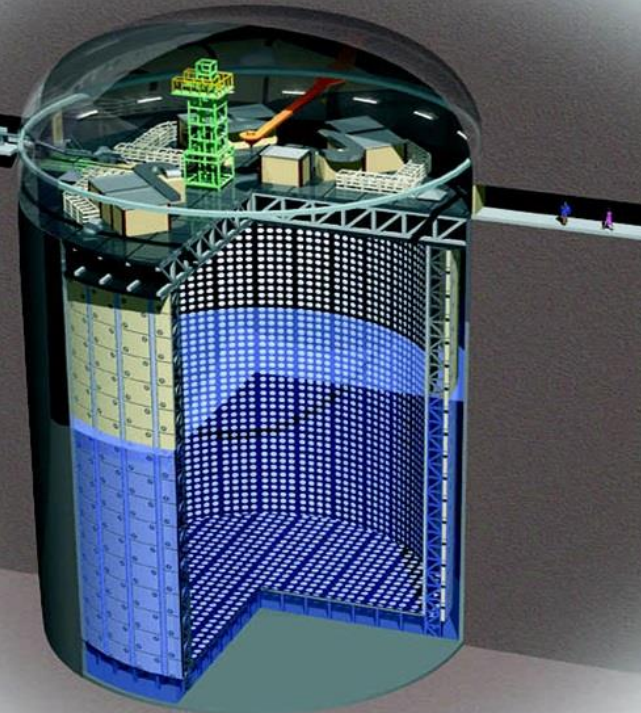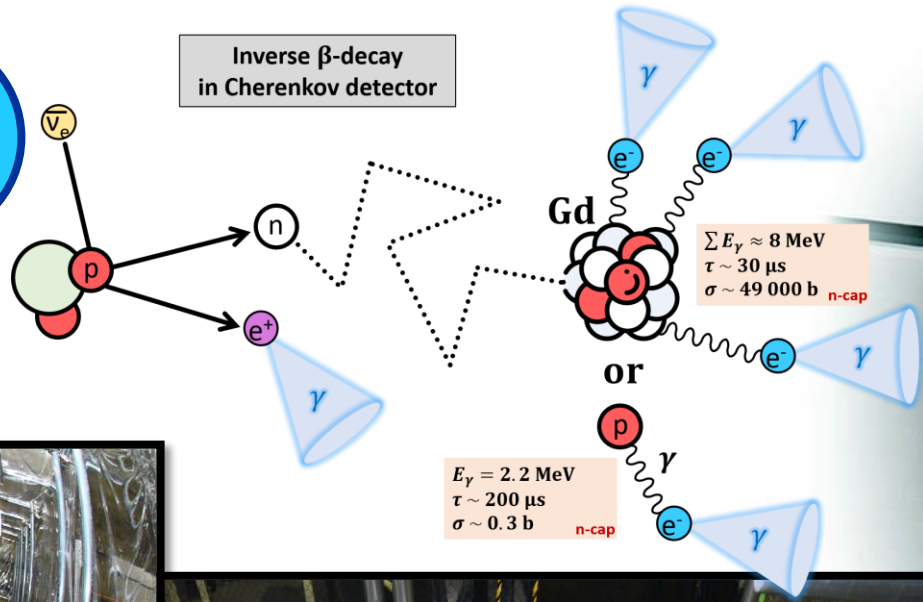
Inverse β-decay in Cherenkov detector

$\sum E_\gamma \approx 8$ MeV
$\tau \sim 30$ μs
$\sigma \sim 49\,000$ b n-cap

$E_\gamma = 2.2$ MeV
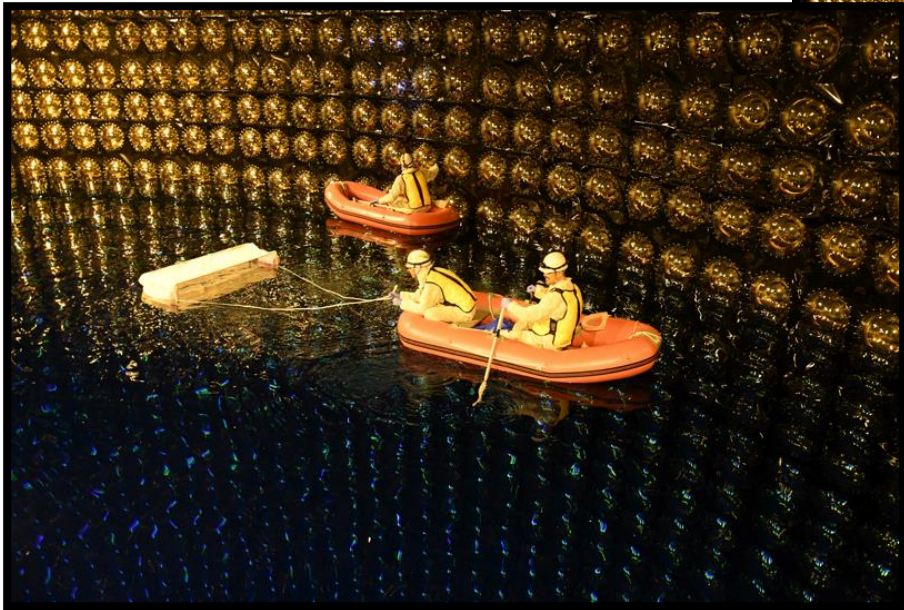$\tau \sim 200$ μs
$\sigma \sim 0.3$ b n-cap

Gd$_2$(SO$_4$)$_3$ powder

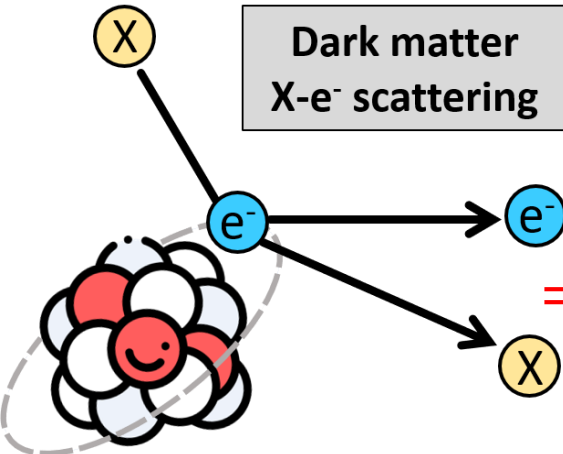| 1996	ATM ν Solar ν	2001	2005	2008	DAQ	2018	2020	0.01% Gd	2022	0.03% Gd	Today
Super-Kamiokande			SK-II	SK-III	SK-IV		Tank	SK-V	SK-VI		SK-VII

SK physics reach

Baryon number violation

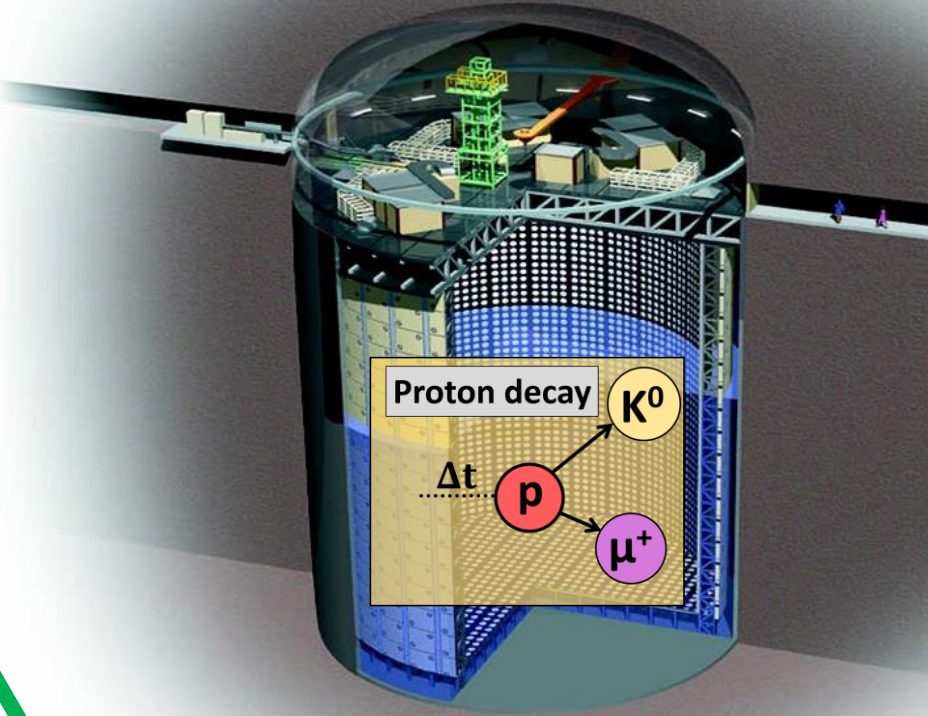⇒ **World's most stringent limit on $n \to \bar{n}$ oscillation**

PRD 103, 012008 (2021)

Proton decay

Dark matter X-e⁻ scattering

Gd improv. BG reject.

⇒ **World's most stringent limit on $p \to \mu^+ K^0$ decay**

PRD 106, 072003 (2022)

⇒ **World's most stringent limit on cosmic-ray boosted DM**

PRL 130, 031802 (2023)

SK physics reach

Gd allows $\nu/\bar{\nu}$ split

SK I–V expanded FV
— Data fit
-- MC expectation
Inverted
Normal

$\Delta\chi^2$

δ_{CP}
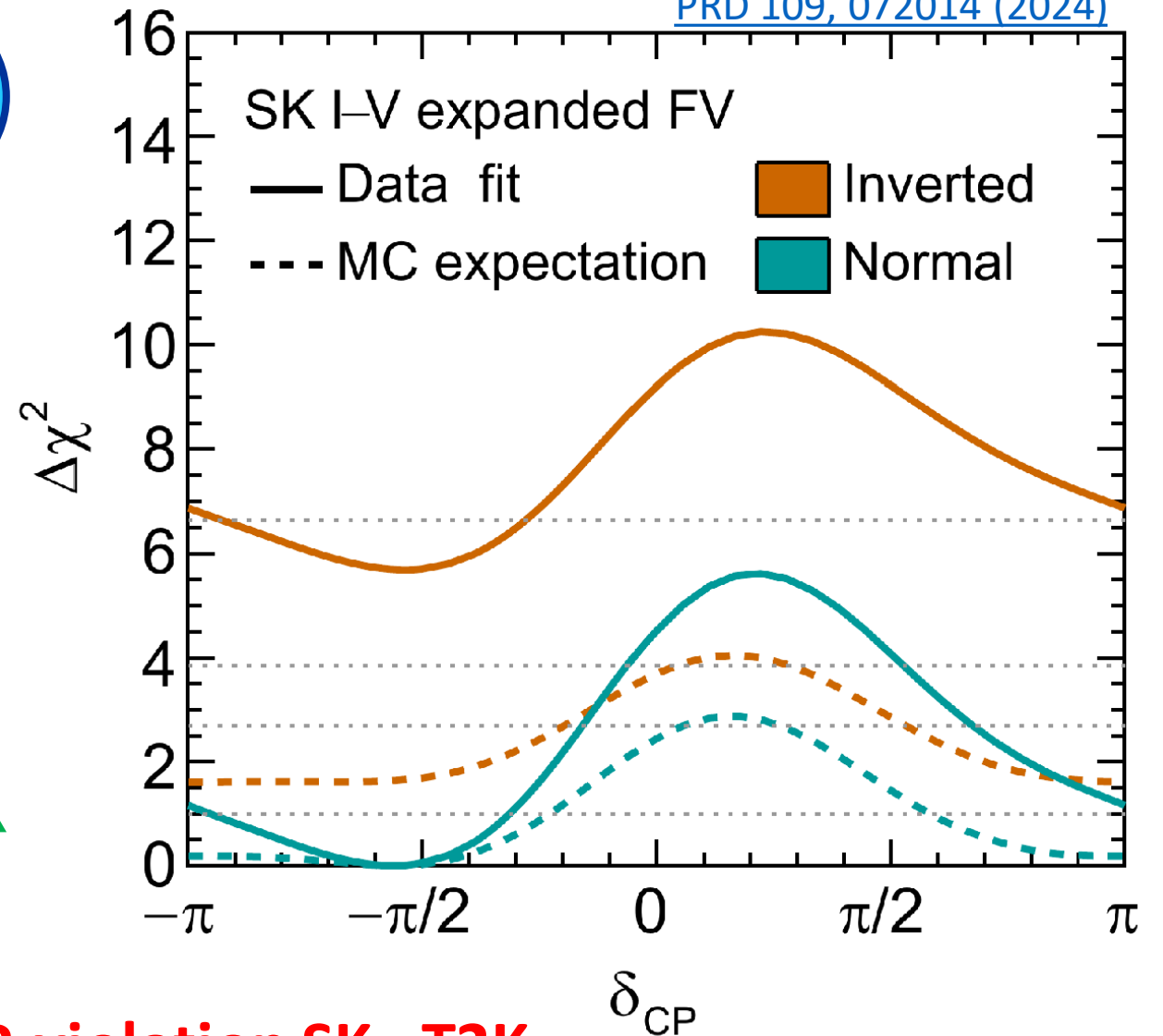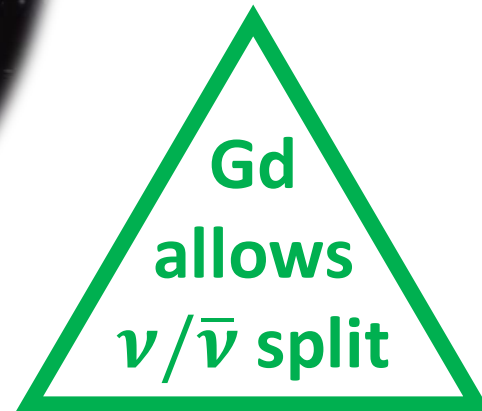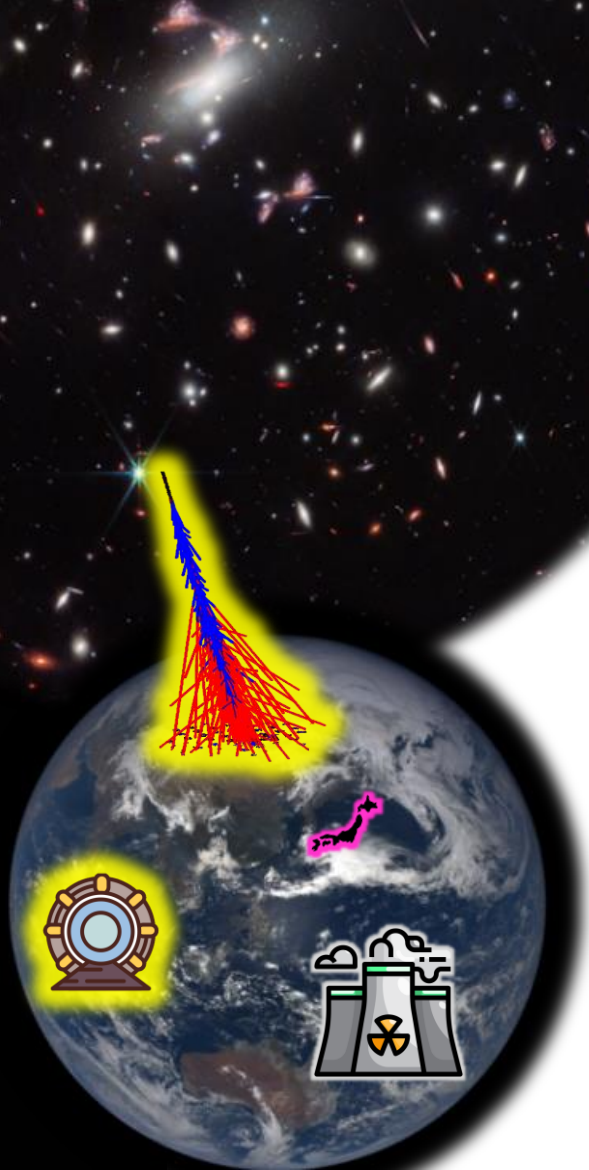
⇒ **CP-violation SK∼T2K**

⇒ **Normal Ordering preferred at ∼2σ**

SK physics reach

$$\Phi_{DSNB}(E_\nu) = \int R_{SN}(z) \times F(E_\nu[1+z]) \times \frac{c\,dz}{H_0\sqrt{\Omega_M(1+z)^3 + \Omega_\Lambda}}$$

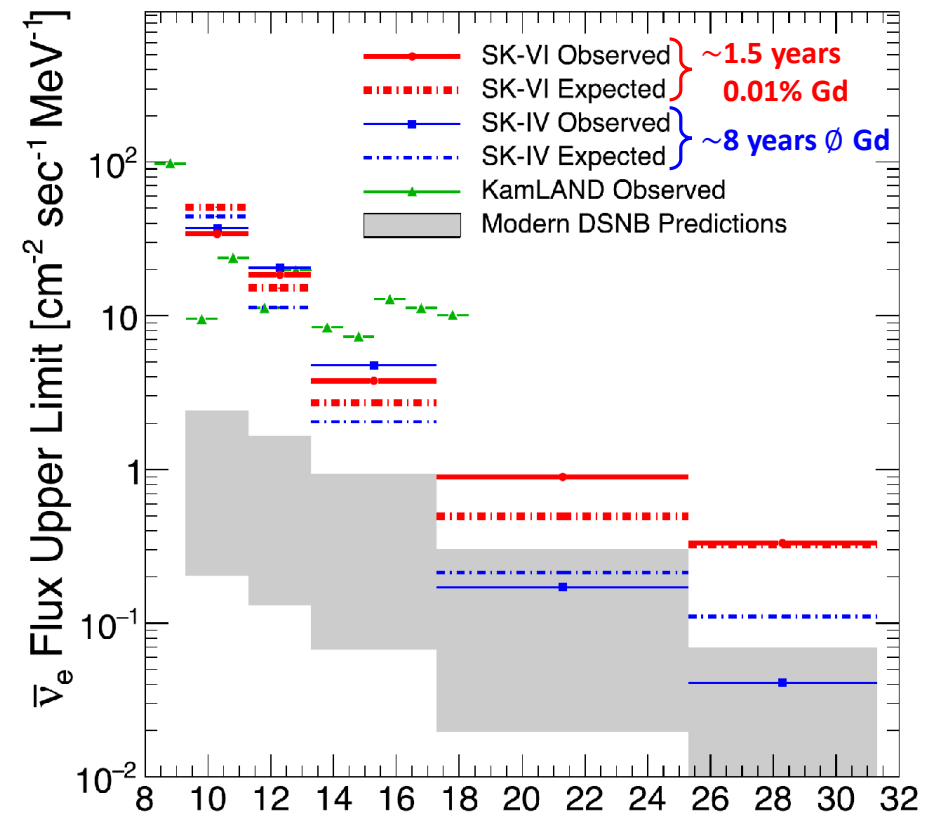**Supernova formation rate**   **Neutrinos emitted per supernova**   **Universe expension**

- SN energy = 99% ν
- Local SN very rare
- DSNB constant
- Constrains on star formation

⇒ **World's best limit for DSNB search**

ApJL 951 L27 (2023)

SK physics reach

$$\Phi_{DSNB}(E_\nu) = \int R_{SN}(z) \times F(E_\nu[1+z]) \times \frac{c\,dz}{H_0\sqrt{\Omega_M(1+z)^3 + \Omega_\Lambda}}$$
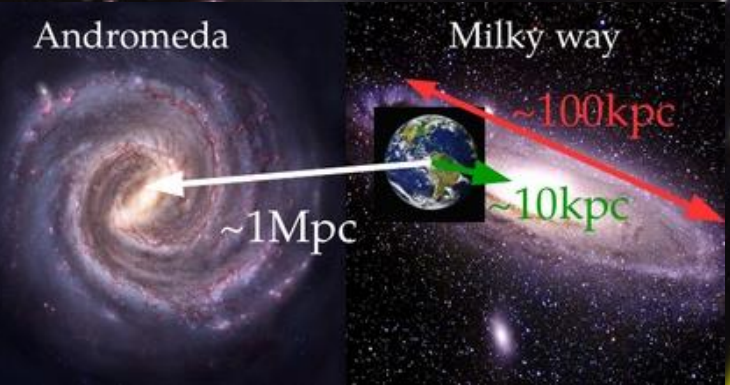
Supernova formation rate   **Neutrinos emitted per supernova**   **Universe expension**

- SN energy = 99% ν
- Local SN very rare
- DSNB constant
- Constrains on star formation
- HK sensitive to Andromeda SN
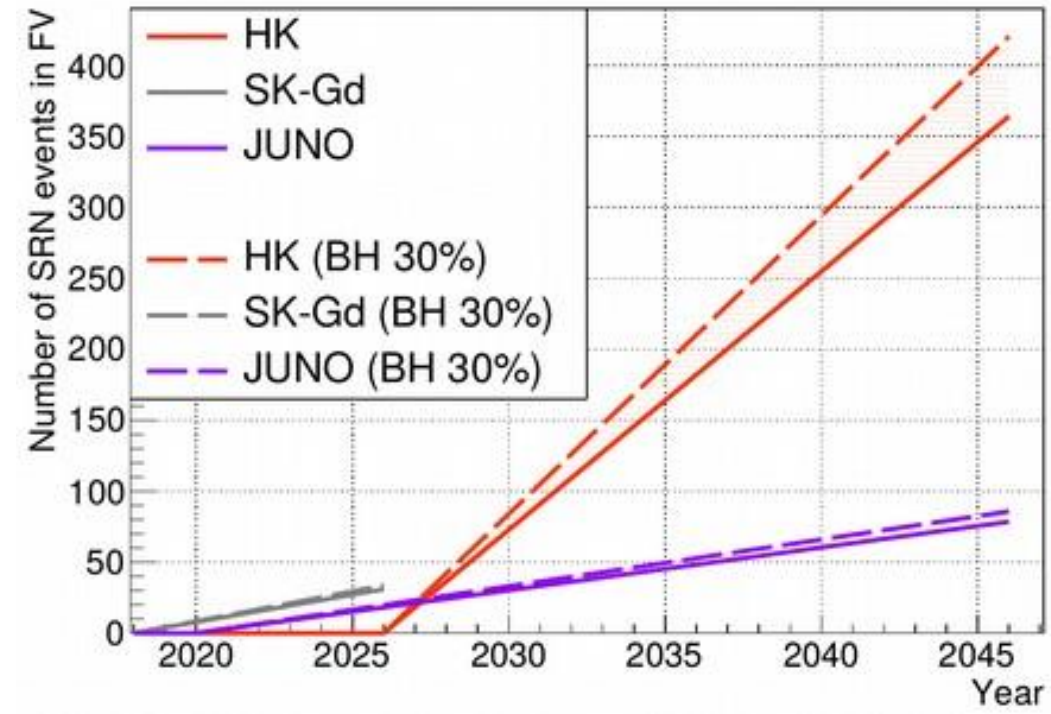- DSNB spectrum measured by HK
- Low energy → probe older star

⇒ **SK-Gd & HK are <u>the</u> pioneer experiments**

Thank you very much !

Lorenzo PERISSE

IL∧NCE