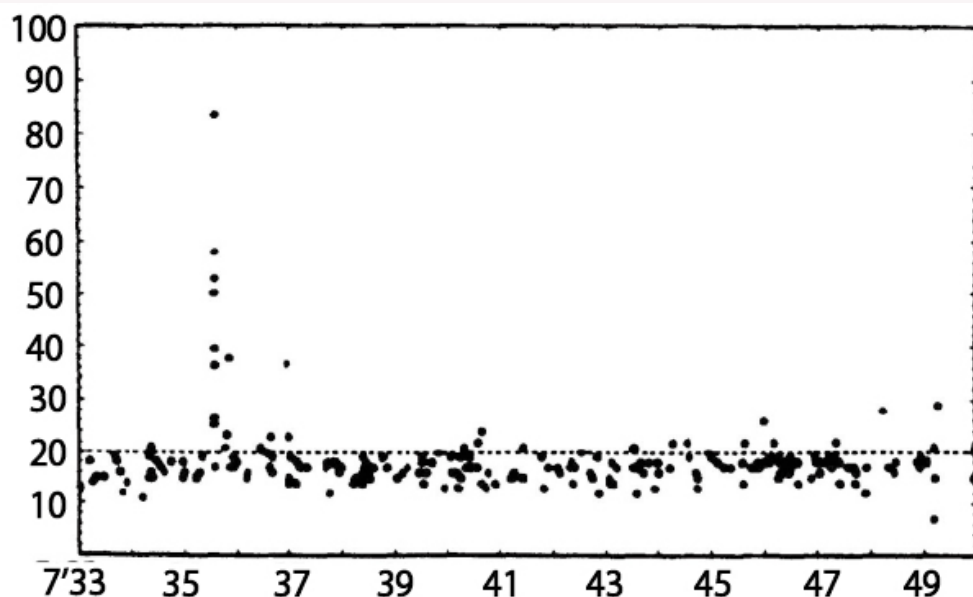
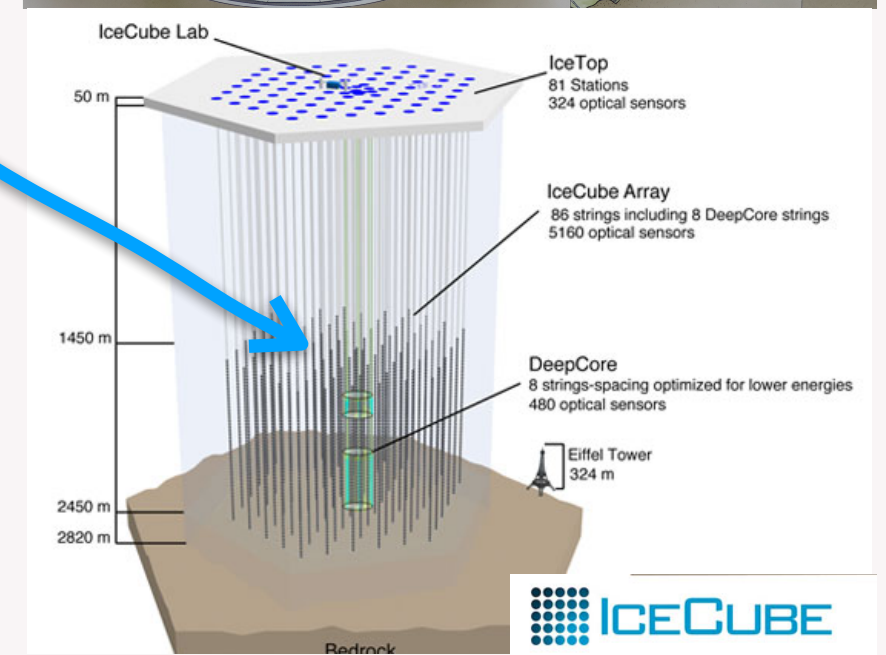
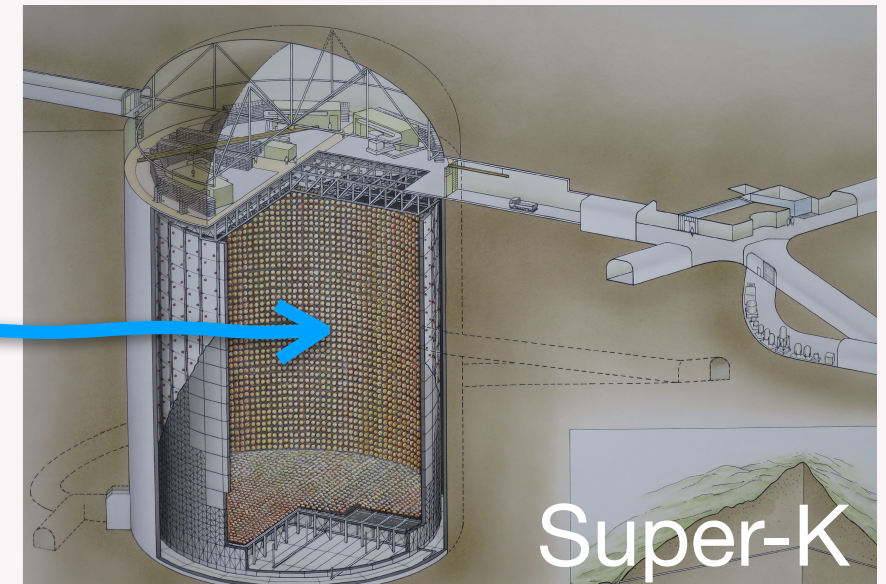


Corrections of charged current neutrino reaction rates and its effects on PNS cooling



Ken'ichi Sugiura (Waseda Univ.) Collaborators: K., Nakazato (Kyushu Univ.)
S., Yamada (Waseda Univ.)



Neutrino events observed in Kamiokande detectors
from supernova SN 1987 A. ©ICRR, The University of Tokyo.

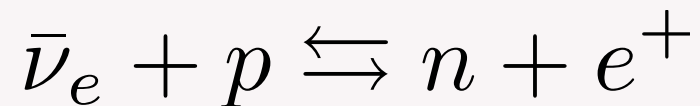
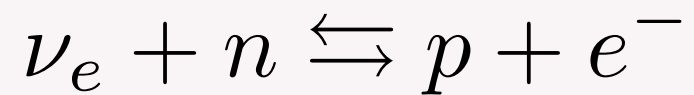
- ✓ The next generation neutrino detectors can observe the galactic SN neutrinos for ~100s
→ Long term evolution of PNS cooling gives the new window to property of hot dense matter

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- Absorption and emission of electron (anti-) neutrino



- Reaction is well described by Fermi interaction

$$\mathcal{L} = \frac{G_F}{\sqrt{2}} \cos \theta_c l_\mu j_{cc}^\mu$$

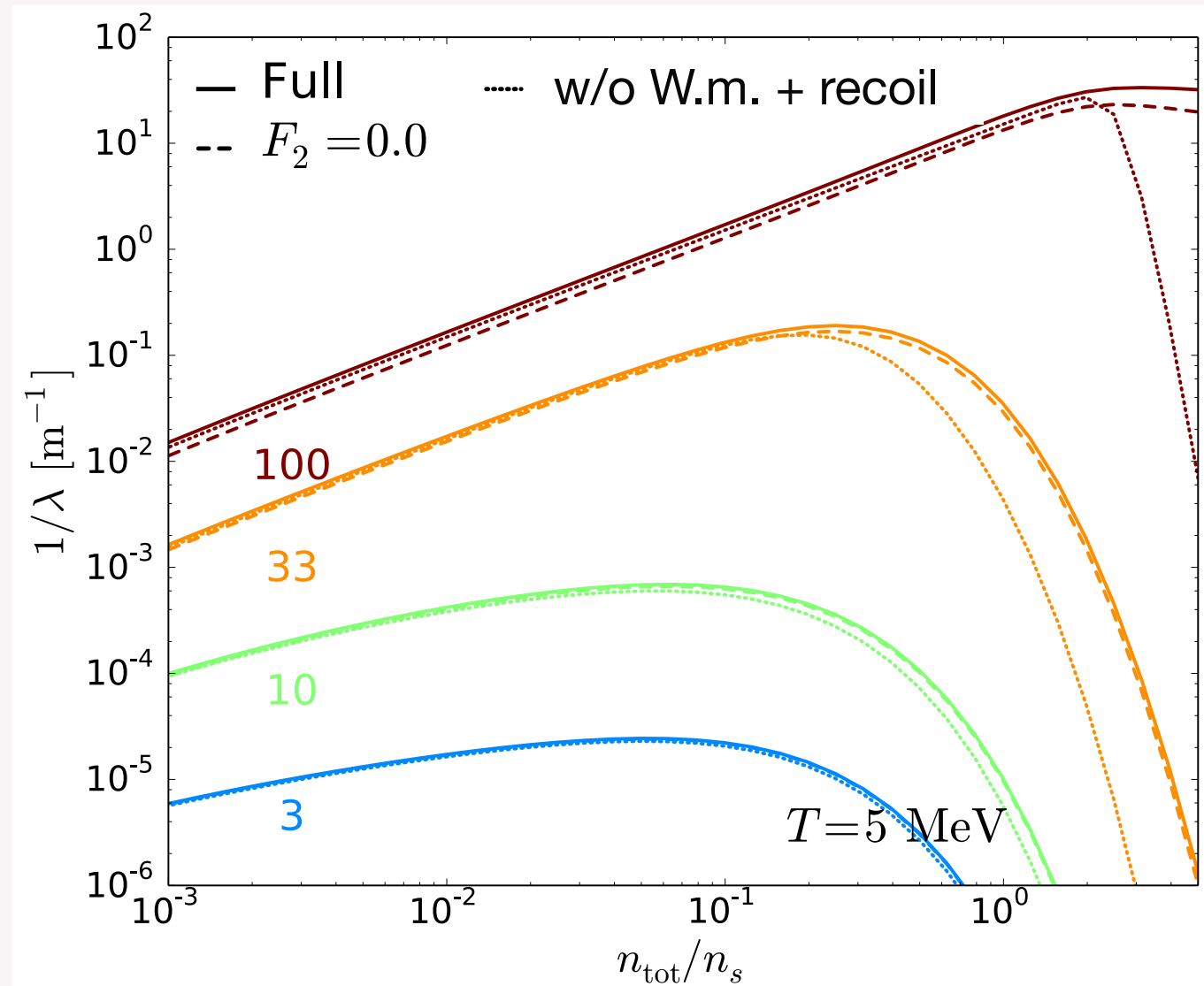
$$l_\mu = \bar{l} \gamma_\mu (1 - \gamma_5) \nu$$

$$j_{cc}^\mu = \bar{\Psi}_p \left(\gamma^\mu (g_V - g_A \gamma_5) + F_2 \frac{i\sigma^{\mu\alpha} q_\alpha}{2M} \right) \Psi_n$$

Weak magnetism

$$\text{nucleon recoil: } \vec{q} = \vec{p}_p - \vec{p}_n$$

Electron neutrino cross section



Nucleon recoil and weak magnetism corrections make neutrino mean free path short

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- ✓ Long-term PNS cooling calculation
- Quasi-static evolution of PNS cooling
- We calculated 2 models with and w/o weak magnetism and nucleon recoil

Nucleon recoil and weak magnetism corrections make neutrino mean energy lower, especially in early phase.

