Neutrino physics with dark matter detectors

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based on work done in collaboration with
Carlos Argüelles, Roni Harnik, Pedro Machado

Outline

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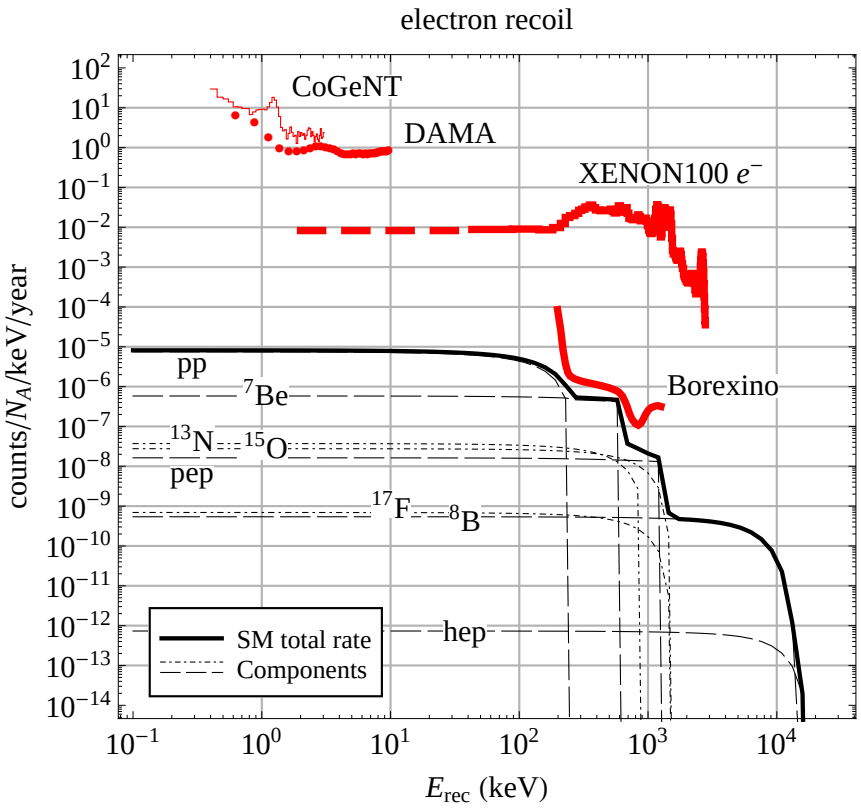
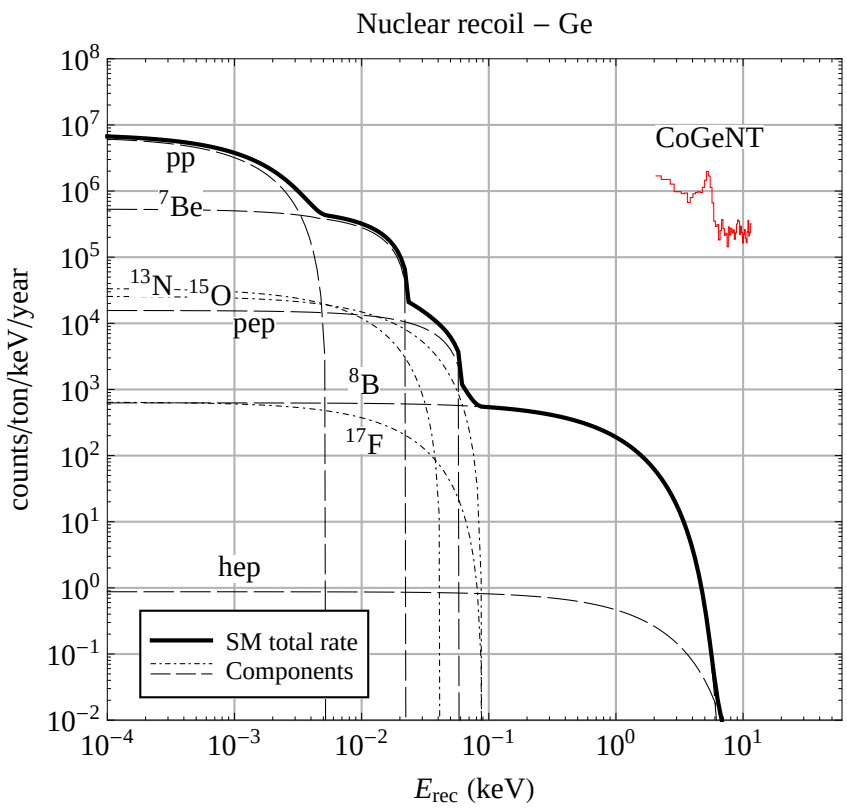
Neutrinos and direct dark matter detection

- Solar and atmospheric neutrinos are a well-known background to future direct dark matter searches

see also Gütlein et al. arXiv:1003.5530





Neutrinos and direct dark matter detection

- Solar and atmospheric neutrinos are a well-known background to future direct dark matter searches

see also Gütlein et al. arXiv:1003.5530

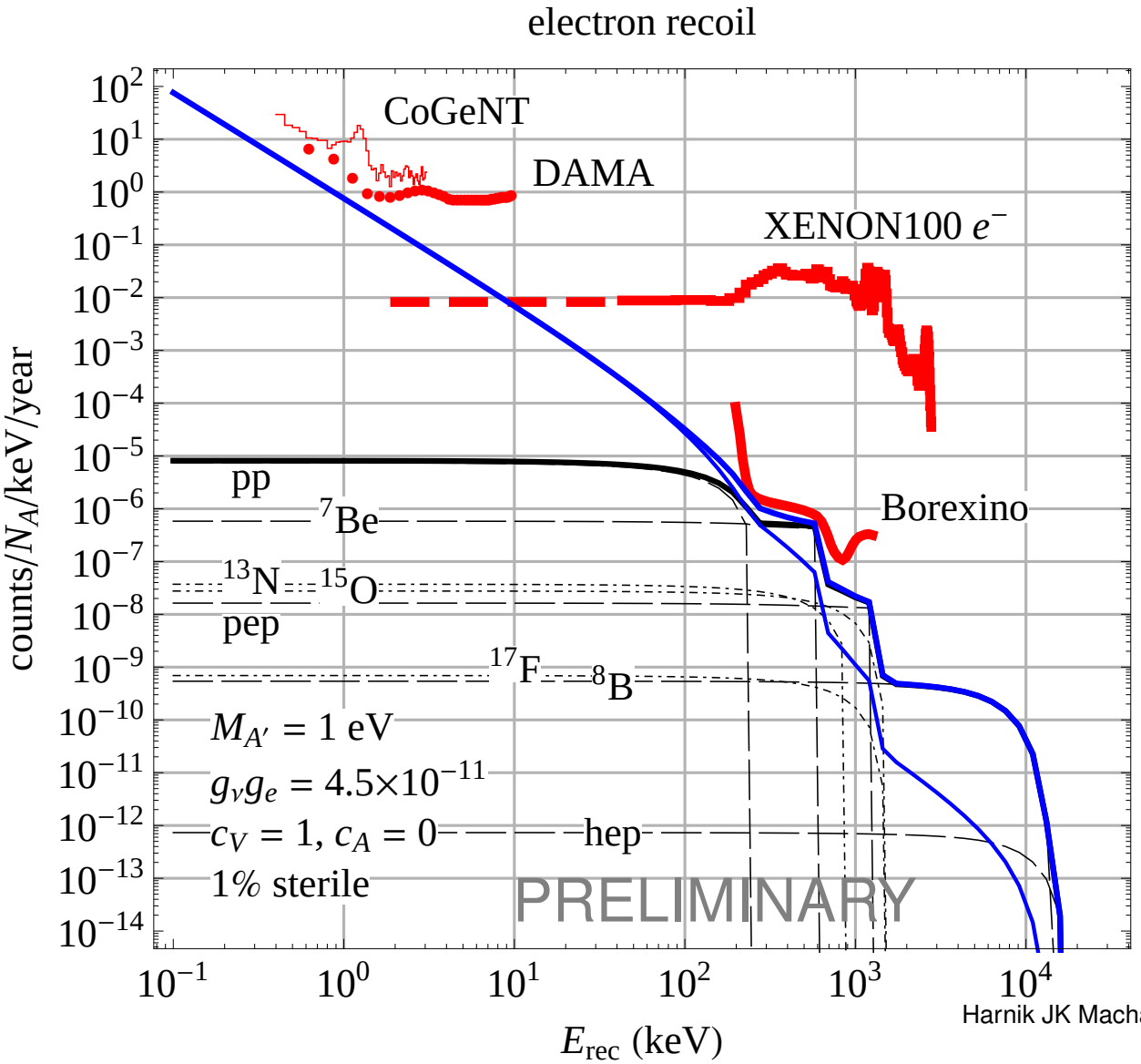
- If low-E neutrino interactions are enhanced by new physics (here: a dark photon A', kinetically mixed with the photon + an optional sterile neutrino ν_s), this BG can be enhanced
  $\longrightarrow$ Possible explanation of DM anomalies?

Pospelov arXiv:1103.3261

- Idea: Strong A'-mediated ν_s–SM interactions at low E

Sterile neutrinos and direct dark matter detection

- Can potentially explain CoGeNT excess through ν_s–e^- scattering



Harnik JK Machado (work in progress)

Sterile neutrinos and direct dark matter detection

- Can potentially explain CoGeNT excess through ν_s–e^- scattering
- With some tuning of oscillation parameters, models like this can also lead to annual modulation.

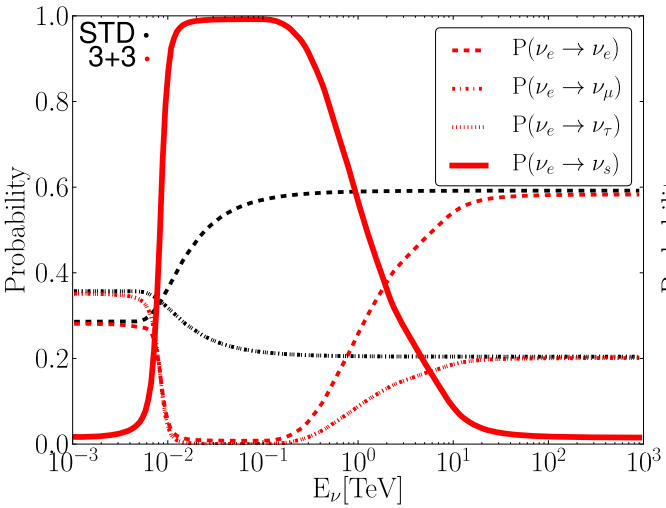
Outline

Sterile neutrinos and DM annihilation in the Sun

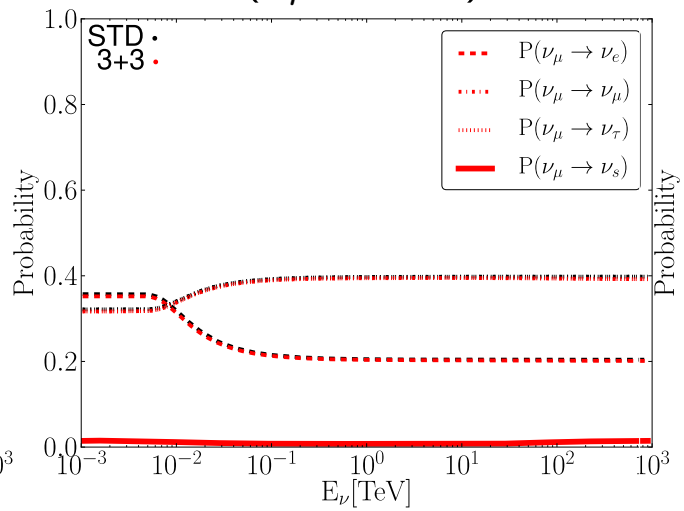
- IceCube and Super-Kamiokande limits on neutrinos from dark matter annihilation in the Sun depend crucially on oscillation physics.
- If sterile neutrinos exist, new MSW resonances can lead to strong conversion of active neutrinos into sterile neutrinos in the Sun

Oscillation probabilities

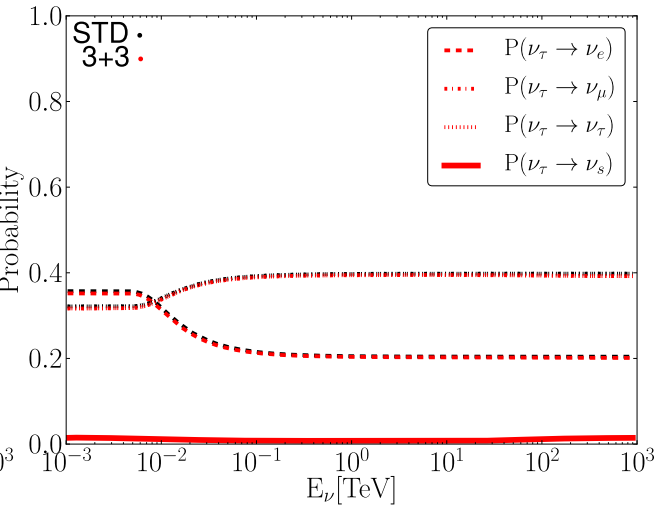
$P(\nu_e \to \nu X)$



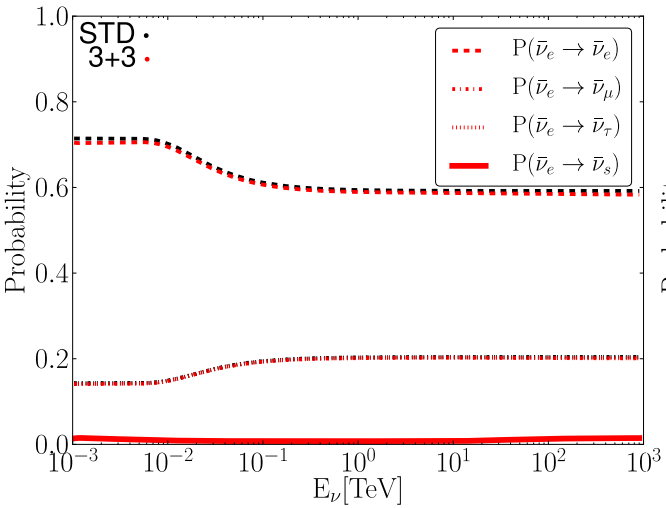
$P(\nu_\mu \to \nu X)$



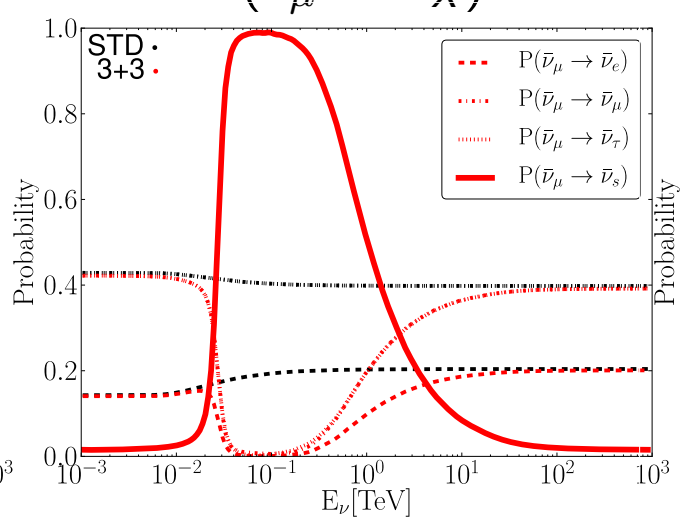
$P(\nu_\tau \to \nu X)$



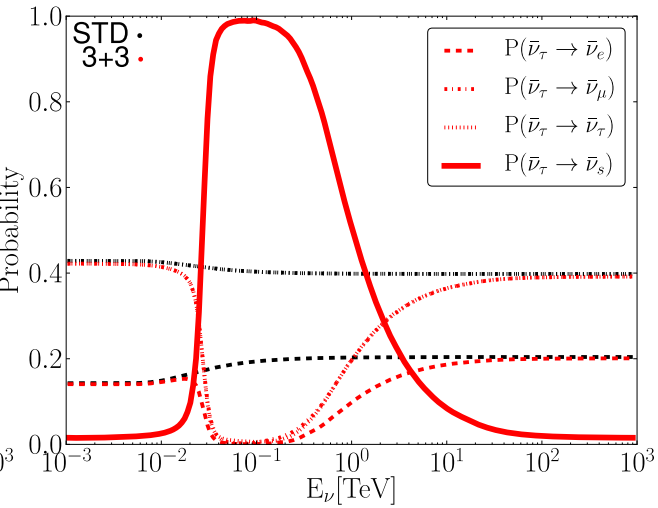
$P(\bar{\nu}_e \to \bar{\nu} X)$



$P(\bar{\nu}_\mu \to \bar{\nu} X)$



$P(\bar{\nu}_\tau \to \bar{\nu} X)$



Thick red lines = active–sterile oscillations

Carlos Argüelles JK, work in progress

Sterile neutrinos and DM annihilation in the Sun

- IceCube limits can be strongly affected by existence of sterile neutrinos.
- If capture cross section and annihilation channels are know (e.g. from direct detection, LHC), neutrinos from DM annihilation are tool to study oscillation physics.