Preface: Radon is one of the major background sources in low energy neutrino experiments. Accordingly it is essential to suppress radon events in future large-scale xenon detectors aiming for neutrino-less double beta decay and pp solar neutrino measurements. Although the removal of radon from air using adsorption on activated charcoal is well established, because its chemical properties are similar to those of radon this technique cannot be used with xenon; Xenon itself adsorbs to charcoal and thereby deteriorates its radon absorption efficacy. So we propose a new radon removal method.

1. Xe-based neutrino detector - beyond dark matter search

- solar neutrino spectra in Xe
- $^{136}$Xe 2νββ spectrum

To observe ppν (to achieve BG=10⁻⁶ counts/keV/day/kg), Rn must be reduced 1/100 and continuously removed.

2. Resonant ionization of Rn

- A laser is used to promote radon atoms to an electronically excited state via resonant single- or multiple-photon absorption and these excited Rn atoms are then ionized by the introduction of another photon.

Rn Resonant ionization scheme

- Excitation cross section
  $\sigma = g_γ g_\gamma \chi^2 \lambda_\gamma A_{21}/(8\gamma^2 \times \pi \Delta\nu)$
  $\Delta\nu$: Laser linewidth[Hz]
  $A_{21}$: Einstein coefficient[s⁻¹]

In case of Rn $g_\gamma = g_\gamma \times 2\hbar = 3$

- Selectively ionized Rn impurities can be removed with an applied electric field.

A possible system for 1/100 reduction

3. Development of Lasers

- 4 wave-mixing for making 178.6nm or 145.2nm
- Wavelength transformation in Kr gas cell

How to make input wavelength

- 355nm: Continuum® Nd:YAG Laser

Results measured by oscilloscope

- 178.6nm
- 145.2nm

- $\approx 100\mu J/pulse$ is almost achieved.

4. Test: Kr removal from Ar

- Kr can be resonantly ionized via 212.6nm $^2S_{1/2}$

The setup

- 10ppm Kr in Ar w/ 5mJ/pulse laser

Resonant ionization of Kr and its electric “sweep” were confirmed.

Conclusion: A system for removing Rn from Xe has been developed. In this study, the feasibility of this method was demonstrated by removing Kr from Ar. Since the necessary laser has already been developed, tests of Rn removal from Xe will begin soon.