We have developed a sub-Doppler resolution spectrometer. A difference frequency generation source, which consists of a pump source of a Nd:YAG laser, a signal source of an extended-cavity laser diode, and a waveguide-type PPLN, covers from 87 to 93 THz (2900 to 3100 cm⁻¹). An enhanced-cavity absorption cell remarkably improves the sensitivity of Lamb dips. An optical frequency comb controls the central frequency of the source with an uncertainty of a few kilohertz. Because the idler frequency is swept based on absolute frequency through the comb, recorded spectra can be repeatedly accumulated without any frequency drift. We have applied the spectrometer to resolve the hyperfine structure of the fundamental band of HCl with a spectral resolution of about 250 kHz.

To reduce the transit-time broadening, a novel enhanced-cavity absorption cell coupled with an idler wave of 1.9-mm beam radius at the beam waist has been introduced. The A₁-A₂ splitting of the ν₁ and ν₄ bands of CH₃D is resolved for a few tens low-J transitions with the Lamb-dip linewidth of 60 to 100 kHz.

Very recently, the source linewidth has reduced to 3 kHz using a linewidth transfer technique from the Nd:YAG laser to the extended-cavity laser diode through a novel optical frequency comb with a fast servo control. When methane sample is cooled with liquid-nitrogen, and the beam radius is expanded to 3 mm, the observed Lamb dip is 20 kHz wide without any enhanced-cavity absorption cell.