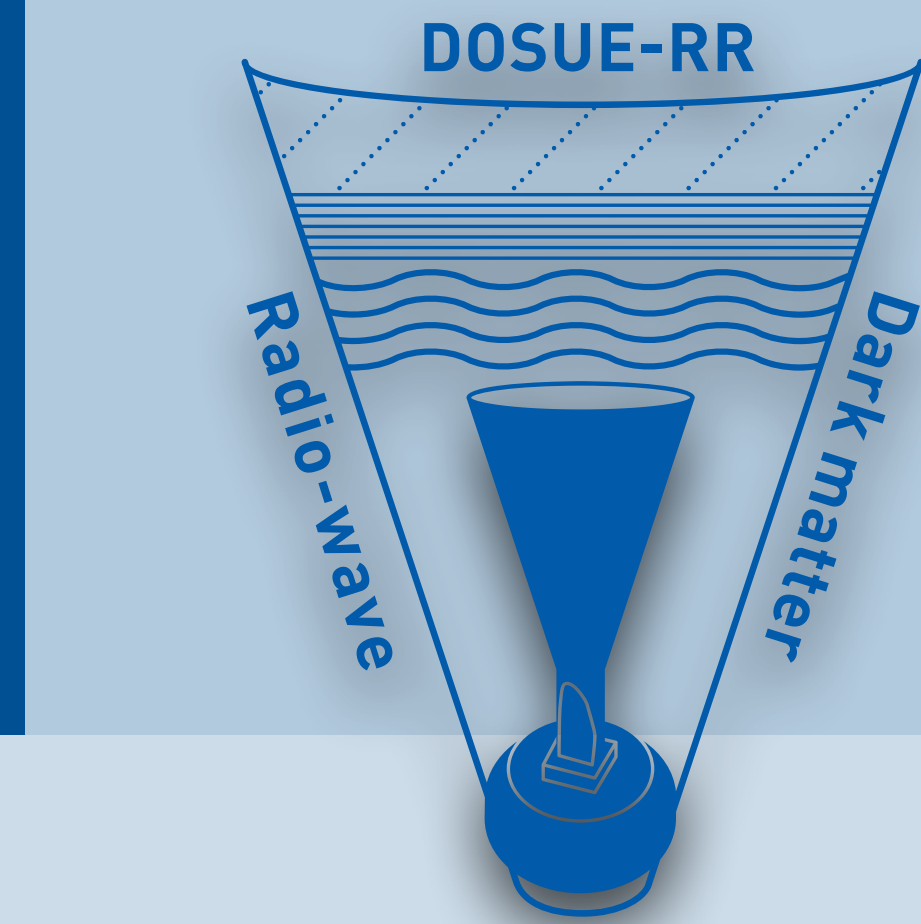


“DOSUE - RR”—Searching for Wavy Dark Matter Using Millimeter-Wave Receivers

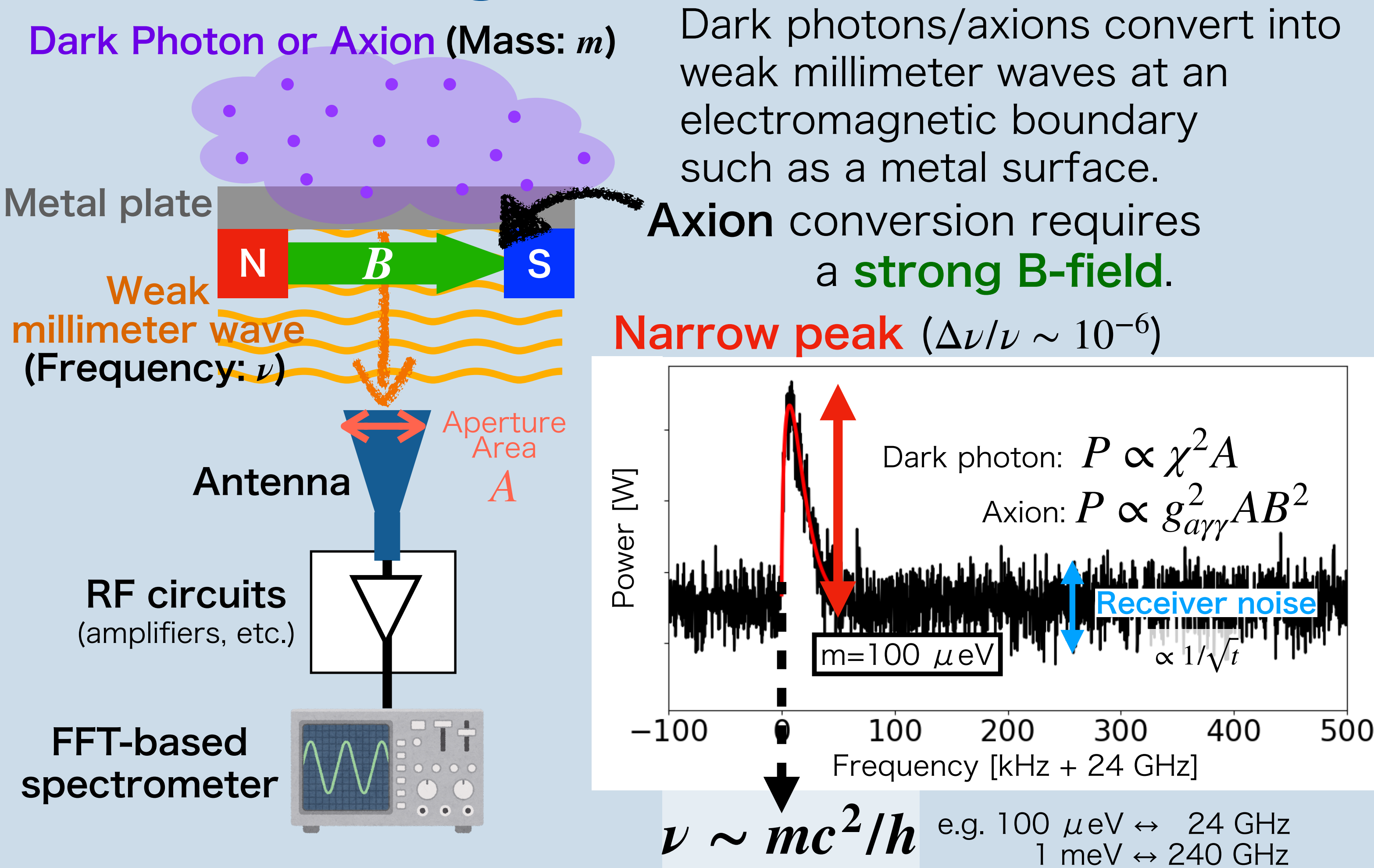
Shunsuke Adachi (Okayama University) for the DOSUE-RR Collaboration



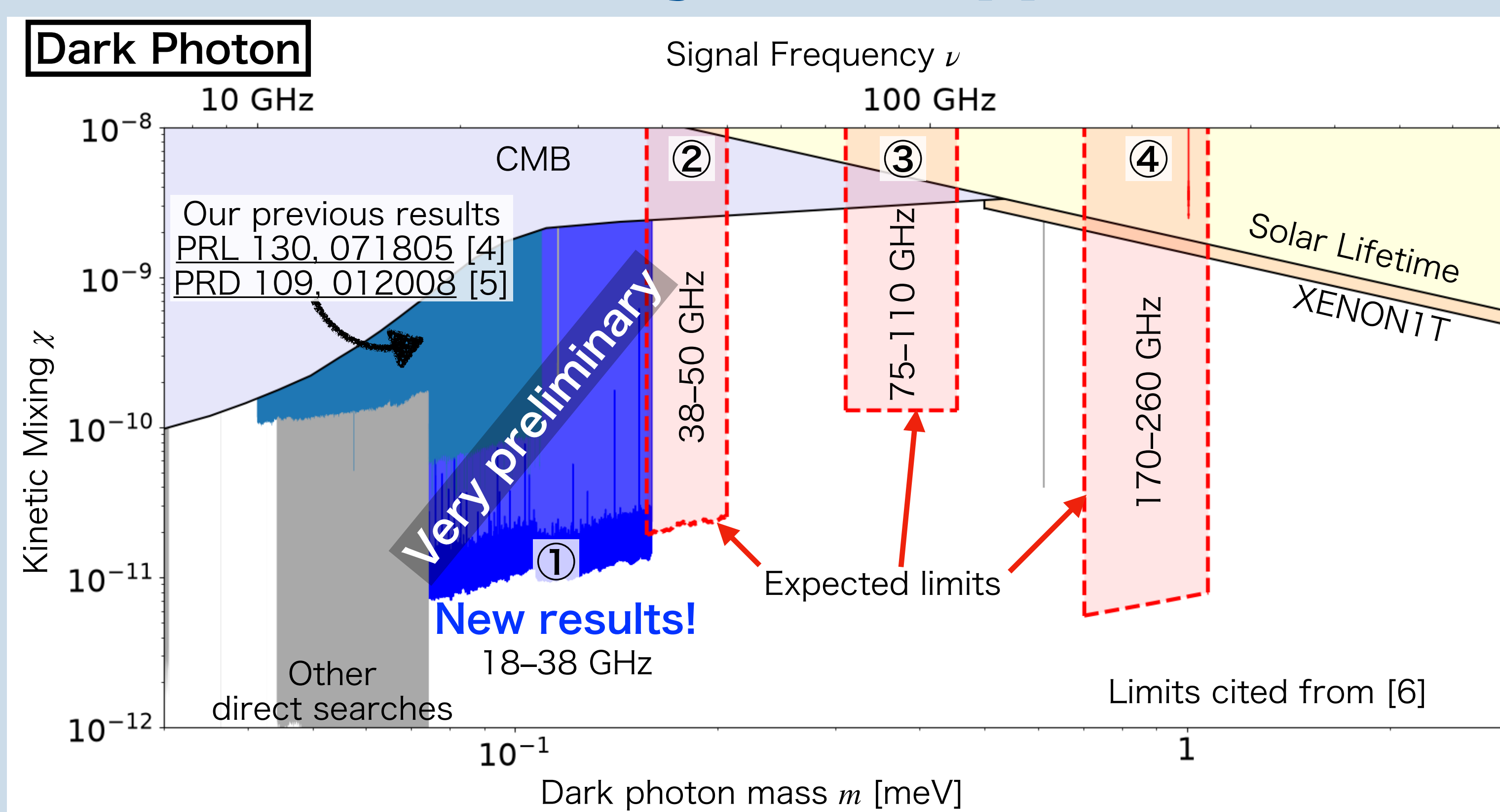
Dark Photon / Axion (+Axion-Like Particles, ALPs)

- Both are ultra-light (μeV – meV) dark matter candidates and interact weakly with the electromagnetic field.
 - Dark photon: kinetic mixing χ / Axion: coupling constant $g_{a\gamma\gamma}$
- Dark photons are motivated by the high-scale inflation[1] or string theory models[2], and axions by the strong CP problem[3].
- Generally, the photons from the interaction have a frequency corresponding to the dark matter mass: $h\nu \sim mc^2 \rightarrow \text{GHz–THz}$.
- DOSUE-RR is aiming to detect the photons from dark photons or axions (including ALPs) using millimeter-wave receivers covering 10–300 GHz.

Detection Using a Millimeter-Wave Receiver



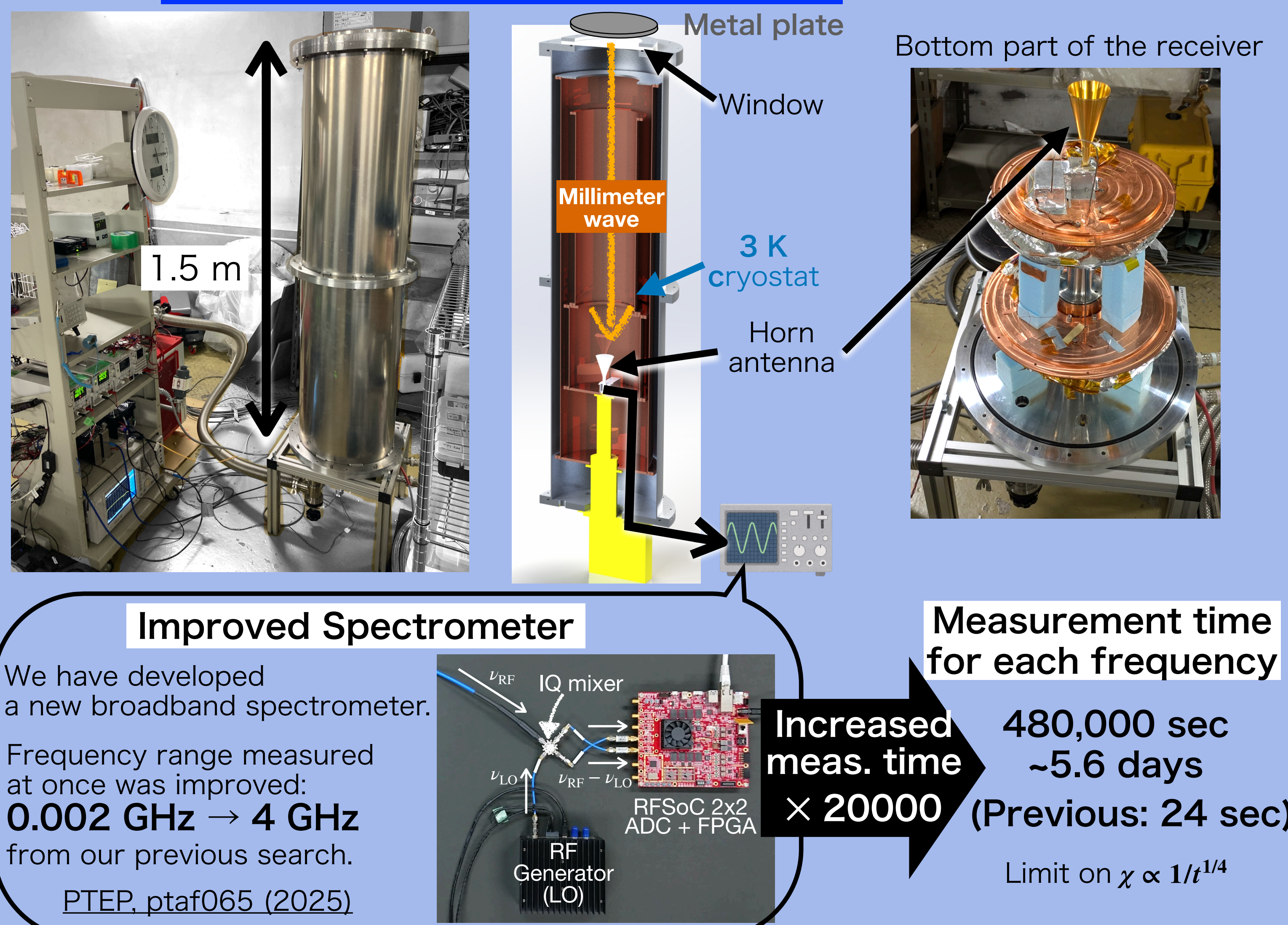
DOSUE-RR: Band-by-Band Approach



- ② 38–50 GHz Retrofit the ① receiver for a new band
- ③ 75–110 GHz Develop a receiver in a new cryostat
- ④ 170–260 GHz Develop a new receiver with an “SIS mixer”

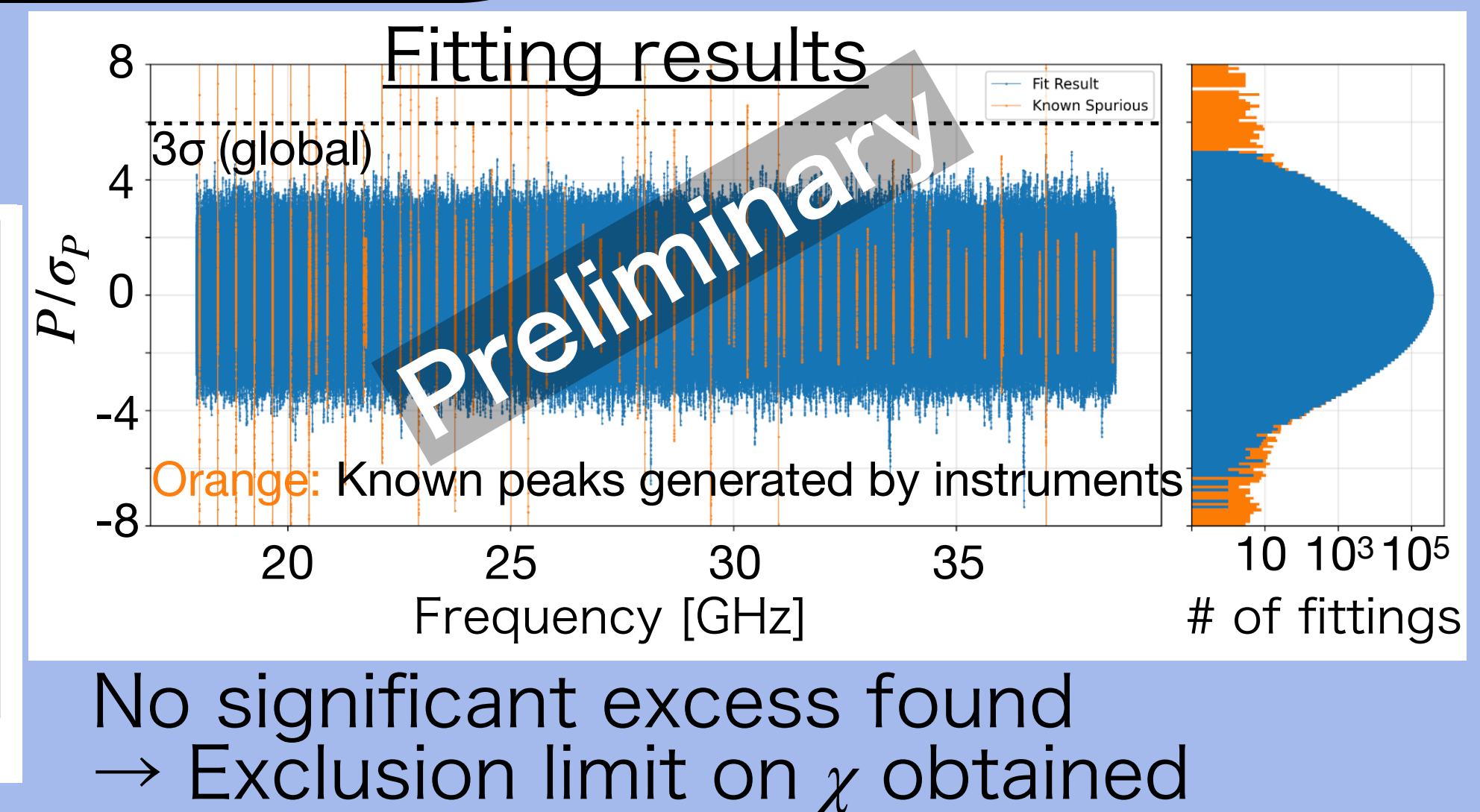
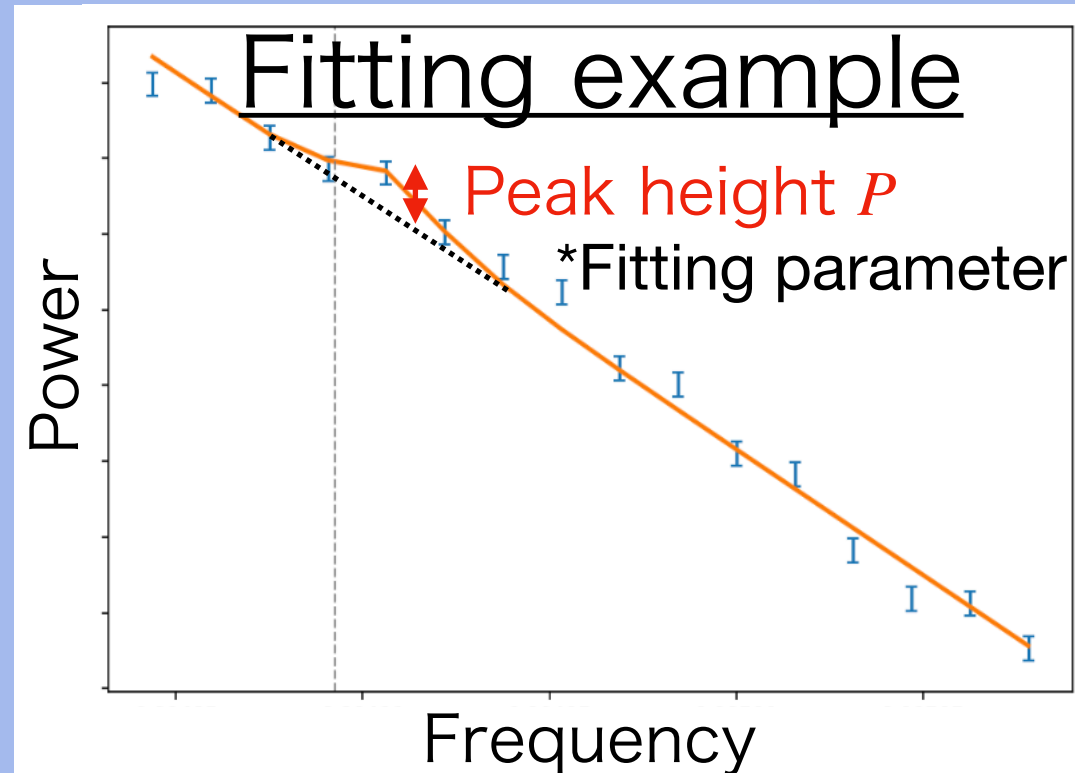
Status of Each Receiver

① 18–38 GHz receiver



Peak search results

Peaks were searched for by fittings at each frequency.



② 38–50 GHz receiver

The band ① receiver has been retrofitted for band ②.

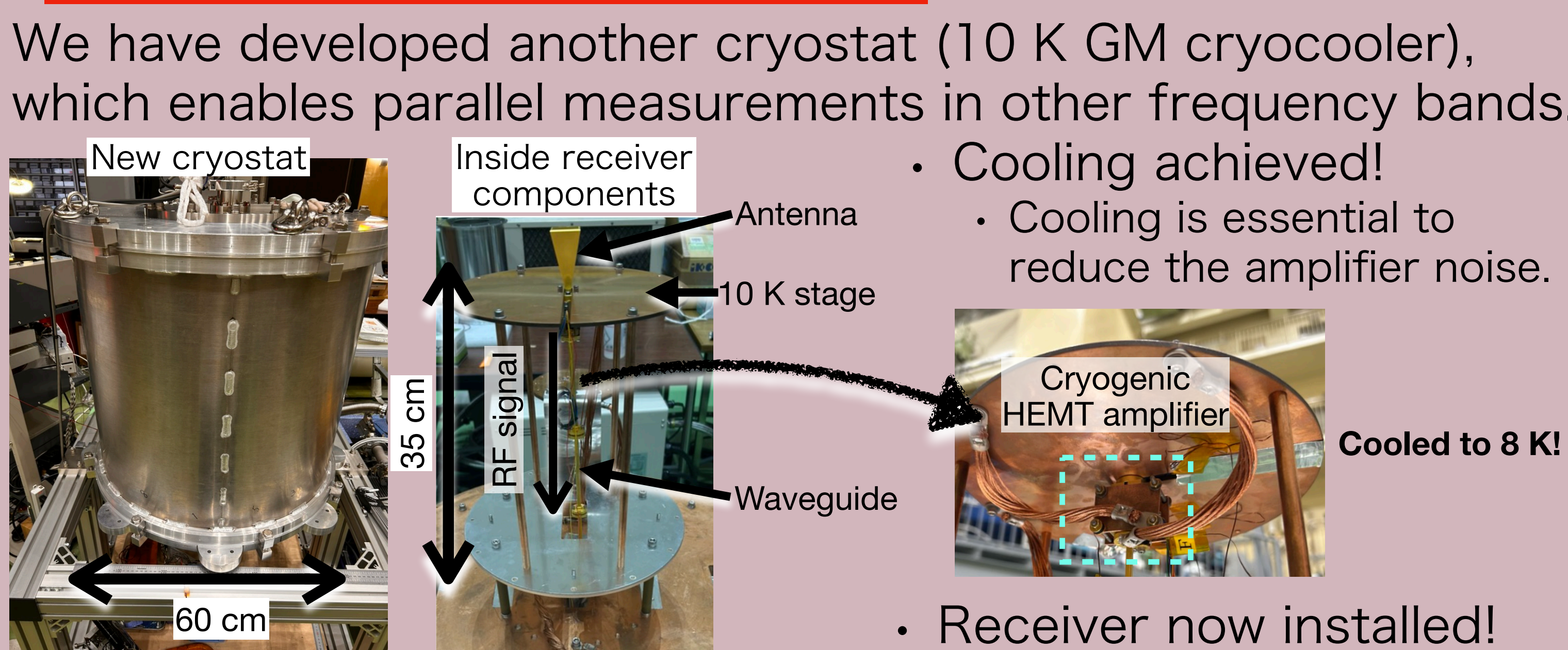
The expected limit shown in the band-by-band plot was derived from the preliminary receiver noise evaluation, which is still ongoing.

See also the poster by M. Hirose

Summary

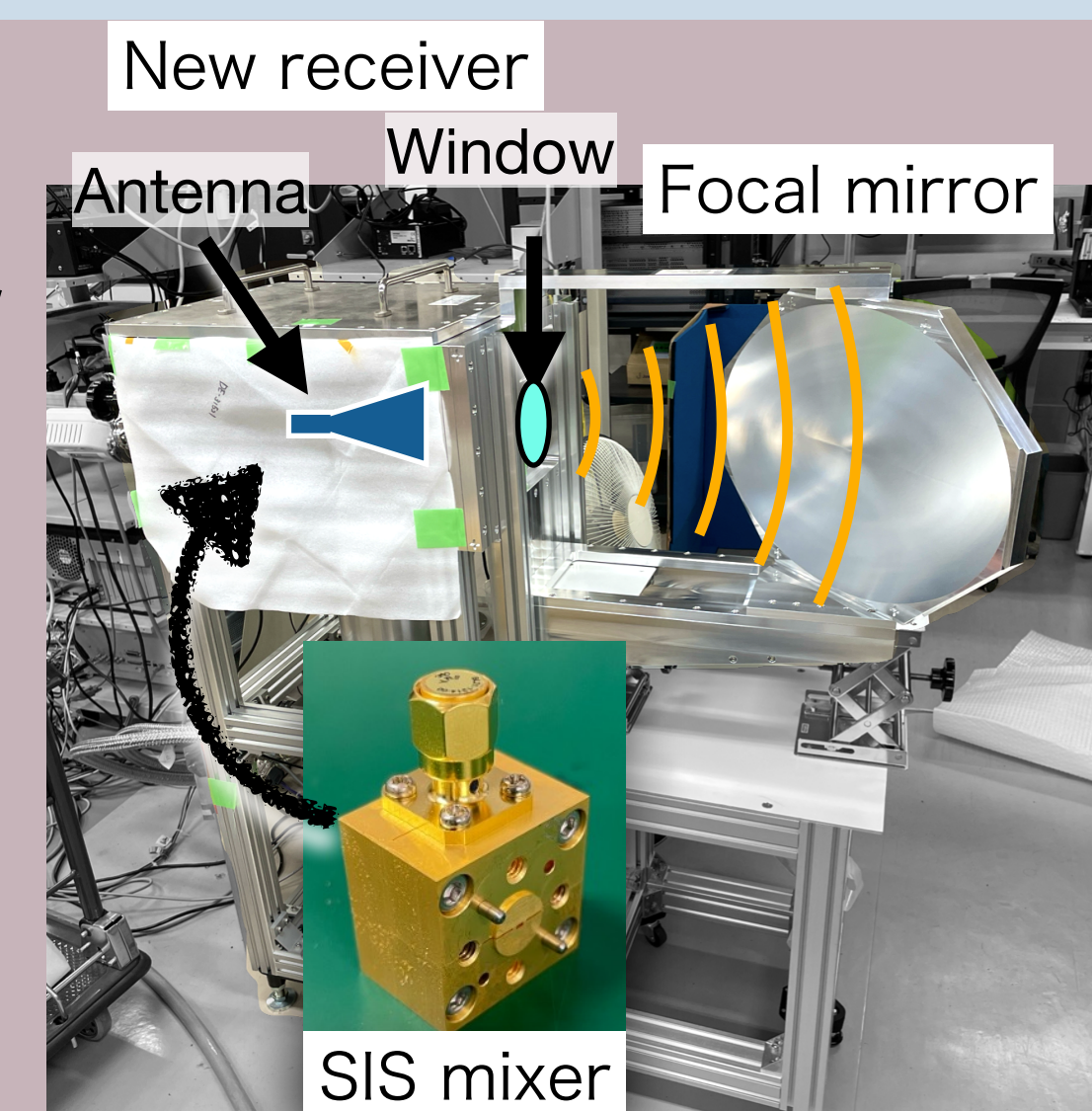
- New preliminary limit on dark photon dark matter at 18–38 GHz, using a new broadband spectrometer.
- Millimeter-wave receivers for 38–50, 75–110, and 170–260 GHz under development to extend the mass range.
- Axion search with the 8 T superconducting magnet at NIFS in preparation; test run planned for October 2026.

③ 75–110 GHz receiver



④ 170–260 GHz receiver

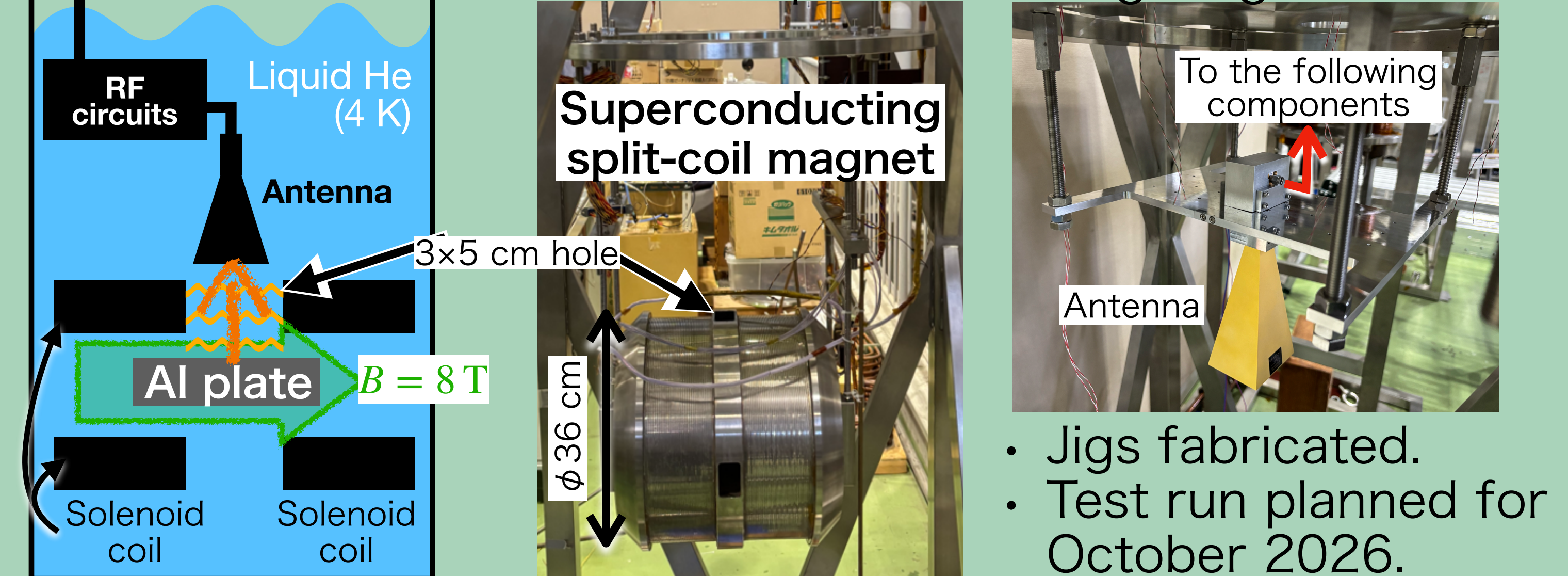
- We are also developing a new receiver using a superconducting **SIS mixer** to access frequencies **above 100 GHz**.
- It down-converts the signal to lower frequencies with low noise.
- A **focal mirror** is also being introduced to improve the sensitivity.



①' Axion Search

Mainly a **technology demonstration** (no stringent limit expected)

- We are installing the ① receiver components in the 8 T superconducting magnet at NIFS.



NIFS: National Institute for Fusion Science (Toki, Gifu)