

Masashi Omiya (Co-PI, ABC/NAOJ), Hajime Inaba (PI, AIST), Wako Aoki (NAOJ), Tomonori Usuda (NAOJ), Sho Okubo (AIST), Ken Kashiwagi (AIST), Akito Tajitsu (NAOJ), Eiji Kembe (NAOJ), Jun Nishikawa (NAOJ/SOKENDAI/ABC), Akira Arai (NAOJ), Yuki Moritani (NAOJ/SOKENDAI), Hideyuki Izumiura (NAOJ/SOKENDAI), Bun'ei Sato (Science Tokyo), Toru Misawa (Shinshuu Univ.)

An astrocomb for HDS "**HDS comb**" is a laser frequency comb designed for HDS wavelength calibration, and currently under construction. The comb produces many comb-like emission lines with precise wavelengths of a mode spacing ~ 30 GHz in three wavelength bands (350 nm - 420 nm, 450 nm - 560 nm, 660 nm - 900 nm). We are also constructing a Fiber Feed Module (FFM) to deliver stellar and HDS comb lights from the Opt. Nasmyth focus to the slit of the spectrograph via optical fibers. The FFM is mounted on AG/SH flange on Optical Nasmyth side. It is equipped with a system for changing observation modes, light injection systems, a fiber and scrambler system, and a light output system for ingesting the lights on the slit. We plan to install the HDS comb and the FFM on the Subaru telescope in FY2025, followed by engineering observations.

- * Search for and detect (Earth-like) planets around stars
 - * By using the Doppler method with very precise RV measurements
 - * RV precision and stability of **<10cm/s** are required to detect Earth-like planets in the habitable zone around solar-type stars.
 - * **Optical** astrocomb is needed for RV monitors of solar-type stars.
- * Direct measurements of accelerated expansion of the universe
 - * ~10cm/s precision and stability levels are required for a long period.

“HDS comb” = Astrocomb for HDS

Overall picture of FFM

The diagram illustrates the layout of the FFM system. Key components and their connections are labeled:

- Three Optical fiber**: Connects the input section to the HDS room.
- Scrambler**: Located in the HDS room, connected to the optical fibers.
- HDS room**: The central area containing the scrambler and the HDS flange.
- Input section**: Contains the **Optical Nasmyth Focus**.
- Output section**: Contains the **Slit of HDS**.
- AG/SH flange on Optical Nasmyth Focus**: A component at the input section.
- Gap between HDS room and AG/SH flange**: The distance between the HDS room and the input section.
- HDS Room Roof**: A photograph showing the interior of the HDS room.
- Slit of HDS**: A photograph showing the output section.

Arrows indicate the flow of light and the physical layout of the system.

Subplate system with input ports

Pinhole mirror and fiber injection lens for object light into a fiber

CCD camera for pin-hole viewer for object light

Pinhole mirror and fiber injection lens for comb light into a fiber

CCD camera for pin-hole viewer for comb light

Imaging lens for pin-hole viewer

Filter wheel for pin-hole viewer

Collimator lens for pin-hole viewer

Pinhole mirror and fiber injection lens for sky light into a fiber

Prism for optical comb light into the sky fiber

Input light switching stage

Circular Mask for light axis adjustment

Pupil monitor insertion stage

Pupil monitor system

Circular Mask for light axis adjustment

1st Beam splitter for optical comb light

2nd Beam splitter for optical comb light

Shutter for optical comb light

Optical fiber for optical comb light to HDS

Optical fiber for optical comb light from a light generator

Collimator lens for optical comb light

Filter wheel for optical comb light

Motorized linear stage for mode change
シフト光軸
OSMS33-300(X)

252

78 300 118 104

78 108 104

Iodine cell

Free port for expansion

本系導入用
光路折り曲げスライダ
Pick up mirror to the fiber port

光線直進用スペース

コードヤセル設置スペース

視野回転機構
手保護スペース

Passing through HDS slit

Technology transfer to comb manufacturer from AIST team : **2021-2022**
 Production of comb equipment : **2021-2025**
 FFM fabrication (Now) : **until End of 2025**
 Installation on Subaru Telescope : **February-March 2026 (planned)**
 Engineering observation start : **S26B-**
 Science observation (open-use) : **S27B-**

simulation)