KATANA: Koolstof (Carbon) Atom Tomography with Advanced Nanotechnology for Astronomy

Abstract
KATANA is a new spectrometer camera specialized for a [CII] line emitter search at redshift of higher than 3. Using the extremely bright [CII] line as a tracer of high-redshift, dust-obscured star-forming galaxies, KATANA can reveal ~100 times more galaxies ever found.

KATANA is based on the technologies of NbTiN Integrated Superconducting Spectrometer (ISS) and Microwave Kinetic Inductance Detector (MKID) that have been developed by the SRON/TU Delft collaboration. We have calculated the sensitivity of KATANA on several telescopes (ASTE, APEX, LMT, IRAM30m, and JCMT). The results show a great potential of KATANA to cut a new window open for studying dust-obscured formation of massive galaxies.

Conceptual Design
Combine technologies of:
- Lens-antenna coupled MKID camera from AMKID [1]
- Broadband spectrometer from DESHIMA [2]
- Optimize (and limit) observing bands to maximize N_{DSSG} and mapping speed

Focal plane configuration
- 270, 340 GHz
- 340, 400 GHz

Expected Number of Dusty Star-Forming Galaxies (DSFGs) discovered by KATANA

KATANA can directly discover dusty star-forming galaxies in the early Universe, and pinpoint their positions and age (redshift) at once.

KATANA will be able to reveal dust-obscured star-formation in massive galaxies in the early Universe with an unprecedented completeness.

Conclusion
We propose a new imaging spectrometer, KATANA, for high-redshift [CII] line emitter search.

Technologies for KATANA are available at SRON/TU Delft.

The mapping speed calculation and following prediction show the great potential of KATANA: it can detect ~100 times more DSFGs, including less bright galaxies that are hard to detect with conventional continuum cameras due to their confusion limit.

KATANA will be a game-changer for the research field of dust-obscured formation of massive galaxies.

Sensitivity Calculation
Calculate mapping speed of KATANA for five telescopes:
- ASTE: 10 m dish, 4800 m alt., Ω3.9 = 37 um
- APEX: 12 m dish, 6100 m alt., Ω3.9 = 17 um
- LMT: 50 m dish, 4640 m alt., Ω3.9 = 60 um
- IRAM30m: 30 m dish, 2850 m alt., Ω3.9 = 66 um
- JCMT: 15 m dish, 4092 m alt., Ω3.9 = 24 um

Expected Number of Dusty Star-Forming Galaxies (DSFG) discovered by KATANA

KATANA can cover [CII] line emitter search.

Those bright in far-IR continuum are expected to be rare: just a tip of the iceberg.

KATANA will be able to reveal dust-obscured star-formation in massive galaxies in the early Universe with an unprecedented completeness.

References
3. E. Cooke et al., 2016, Astronomical Journal, 861, 100