

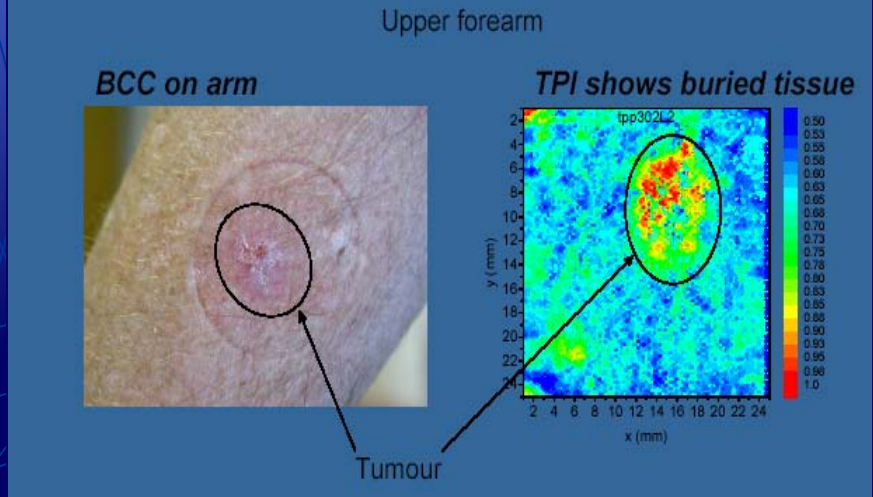
Passive Terahertz Heterodyne Imager Technology for Biomedical Applications

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- **Problem statement:** Improved healthcare at reduced cost is a critical national priority. Improved electromagnetic imaging can improve the effectiveness of diagnostics, therapies, and clinical trials. Terahertz imaging promises to be a potent new tool for diagnosis of biological tissues.

- MRI and THz images provide qualitatively different and complementary information.
- In general, THz bio-imaging capabilities do not exist today.
- Some niche applications were developed based on the time-domain spectroscopic (TDS) technique (*TeraView Inc.*)

In vivo TPI™ images of basal cell carcinoma recorded with TPI scan



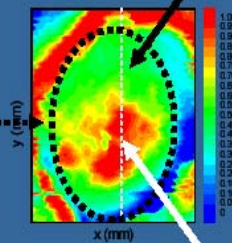
Ex vivo TPI™ images of basal cell carcinoma recorded with TPI scan

Visible picture of patient forehead with suspect lesion



Where is the lesion?

TPI image



Uniform low absorption (green) by healthy tissue

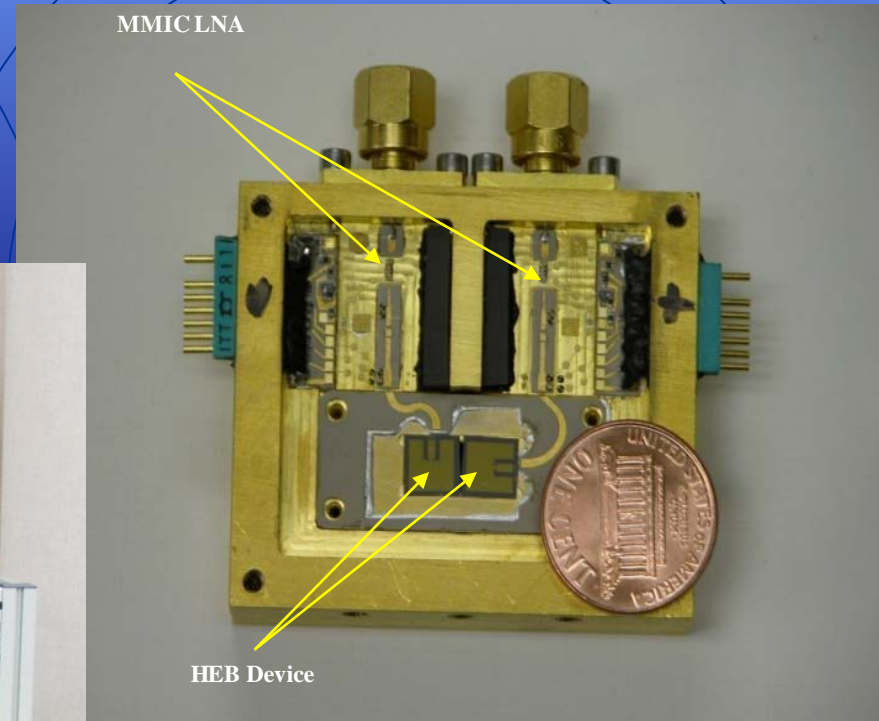
Large 'hot spots' show huge, invisible tumour under surface of skin

- **Goal:** develop new terahertz non-invasive and non-destructive imaging capability with high sensitivity and high spatial-resolution for accessing surface and sub-surface signatures of biological systems.

We are developing a new family of detectors, known as hot electron bolometers (HEB), that already demonstrated superior sensitivity and spectral resolution at terahertz frequencies when compared with other detector technologies.

Heterodyne detection summary:

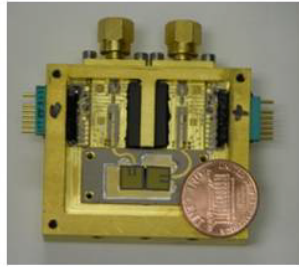
- HEB heterodyne detectors (mixers) are made of superconductors.
- Lowest noise temperature and the highest spectral resolution.
- Well-suited for focal plane arrays (FPAs).



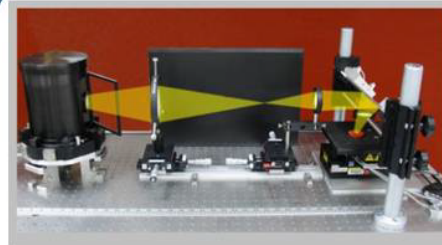
Mobile compact integrated system:

- New 4 K Stirling-type pulse-tube cryocooler.
- Quasi-optical system.
- Well-suited for automated operation.

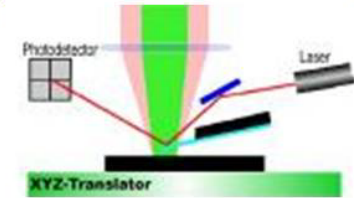
Commercial Applications



New focal plan arrays for THz imagers with diffraction-limited spatial resolution.

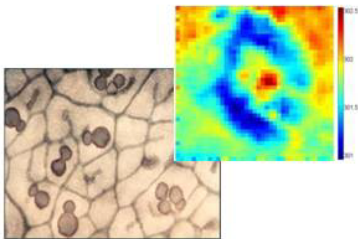


Versatile detector systems for passive THz imaging.



THz apertureless near-field scanning optical microscope (ANSOM) techniques for sub micron spatial resolution.

In Vivo applications down to the cellular level.



Biological THz Passive Imaging

- Cancer detection.***
- Tissue identification, disease and disease state identification.***
- Inspecting wounds through bandaging.***
- Skin hydration and elasticity.***
- Imaging in dentistry.***
- Biochip analysis of DNA and proteins.***

- **For further information contact:**

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- **More technical information in the poster ...**