DEPARTMENT OF RADIO ELECTRONICS

BRNO UNIVERSITY OF TECHNOLOGY
FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION

Sub-millimetre wave antennas

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Content

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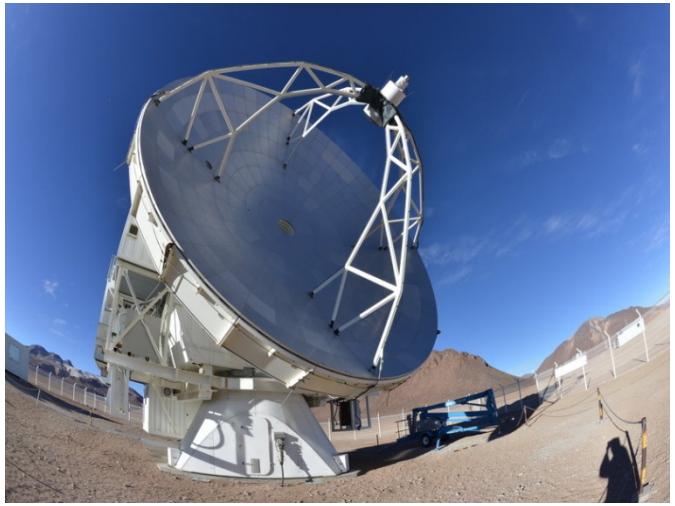
- Application areas of sub-millimetre waves
- Sub-millimetre system – antennas, detectors, emitters
- Different antenna types
- From single element to array of antennas
- Future aspects & Conclusion



source: www.apex-telescope.org

Application areas of sub-millimetre waves

DREL
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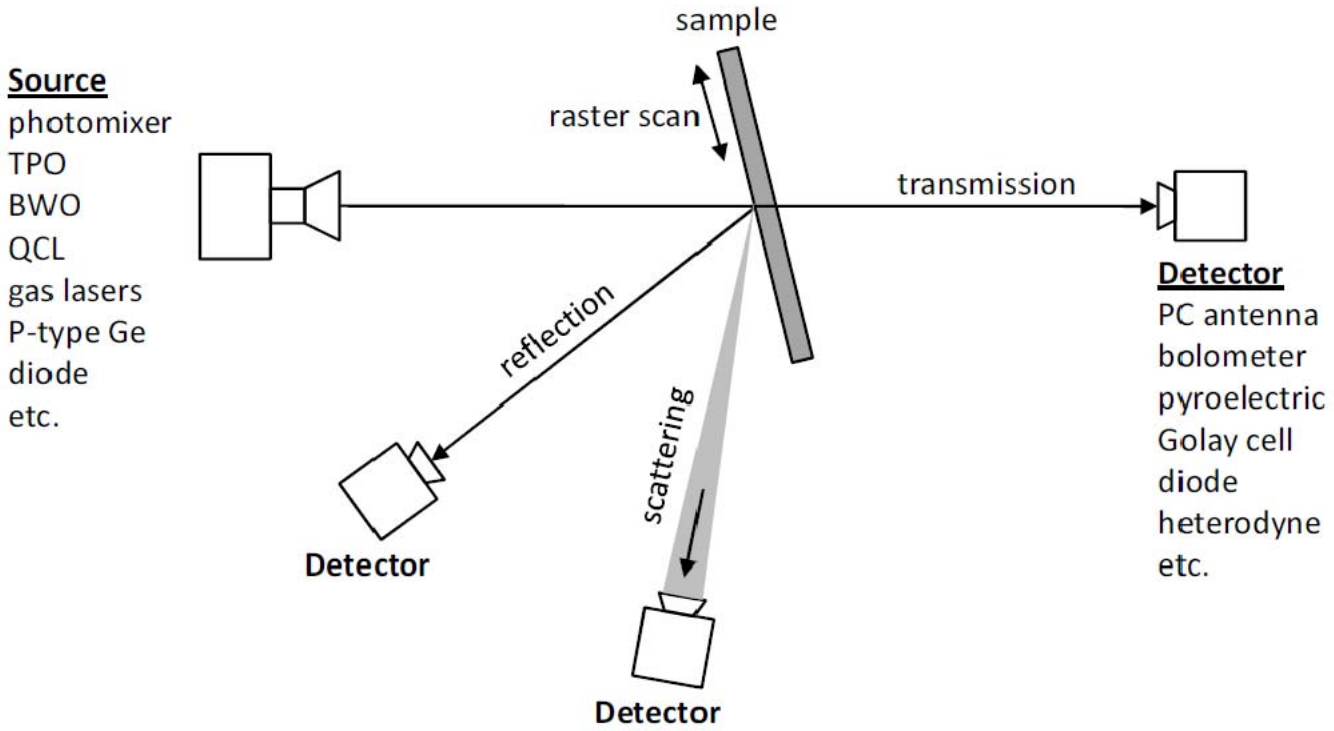
- Science
- Defence and Security
- Medicine
- Broadband communications etc…

Sub-millimetre wave antennas

source: www.nrao.edu

Example of Sub-millimetre system



source: Yun-Shik Lee. *Principles of Terahertz Science and Technology.* Springer, 2009

Antenna elements for sub-mm wavelengths

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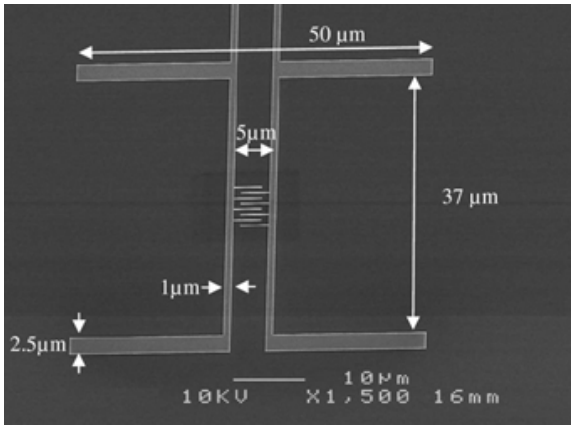
- Dipoles, Slots, Lens antennas, Reflector antennas, Horn antennas, Wide-band antennas etc.

  Silicon lens with dual slot antenna/spiral antenna etc.

- Challenges: high attenuaton of the transmittion lines, poor coupling efficiencies (antenna-detector / antenna-source), fabrication tolerances



source: www3.mpifrbonn.mpg.de/div/submmtech/

source: www.spaceoffice.nl

Silicon lens antennas

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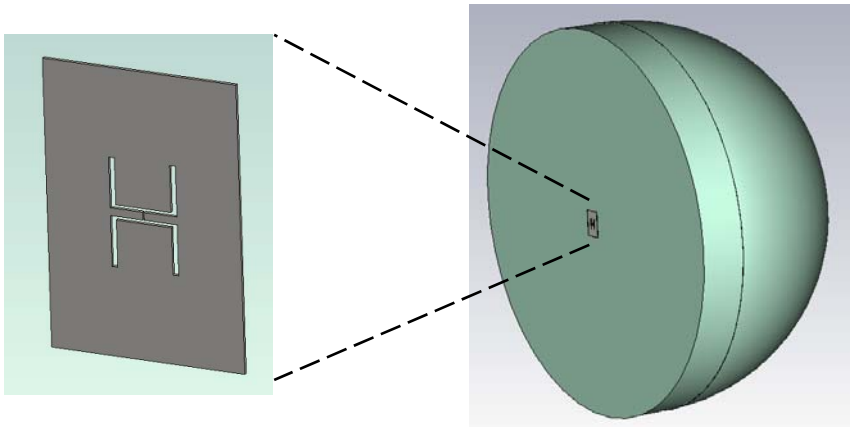
\+ Possibility to buid a complete front-end system on the same wafer (antenna, mixer, MMICs)

Suppression of surface waves, medium directivity, fair RF bandwidth, unidirectional radiation pattern

\- Fabrication costs



From single element to array of antennas

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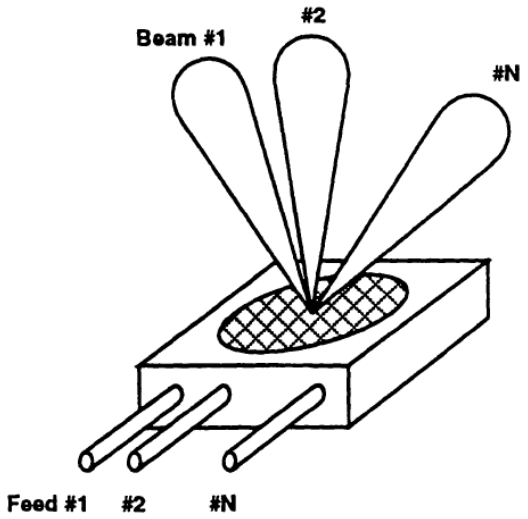
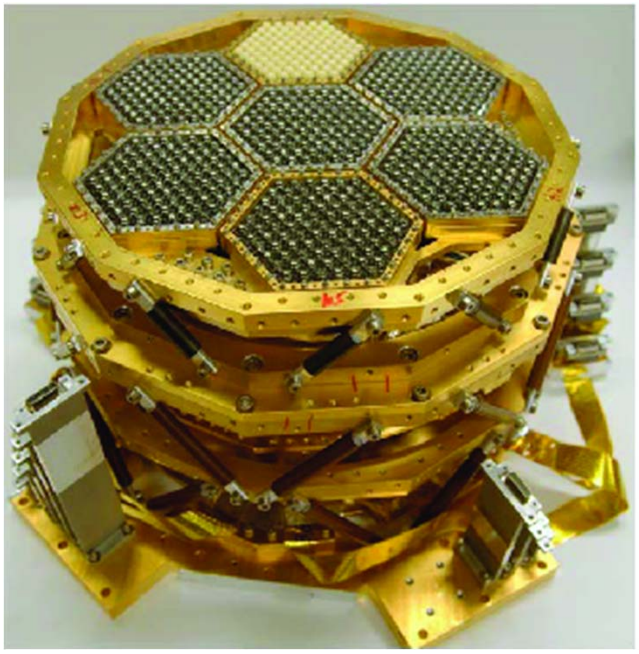
- Phased arrays – radiation pattern can be synthesized,
  – multibeam operation possible
- Focal plane arrays – corrugated horns, Vivaldi antennas etc.

  Johansson, J. F., "Fundamental Limits for Focal-Plane Array Efficiency", *Astronomical Society of the Pacific Conference Series, Volume 75. Multi-Feed Systems for Radio Telescopes*, pp. 34-41, May 16-18, 1994.
- Interferometric arrays – in radio astronomy (ALMA)

Focal plane array



source: Johansson, J. F., “Fundamental Limits for Focal-Plane Array Efficiency“



Arnold K. et. al. The bolometric focal plane array of the POLARBEAR CMB experiment. *Proc.SPIE Int.Soc.Opt.Eng*. 8452 84521D, September 24, 2012.

Conclusion

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- Importance of sub-mm wave technologies
- Single element and array antennas
- Multibeam possibilities of phased and focal plane arrays

- Future research – cost reduction (completly planar topologies)

  – performace enhancement (metamaterials and new materials utilization - e.g. graphene)

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Thank you for your attention!

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