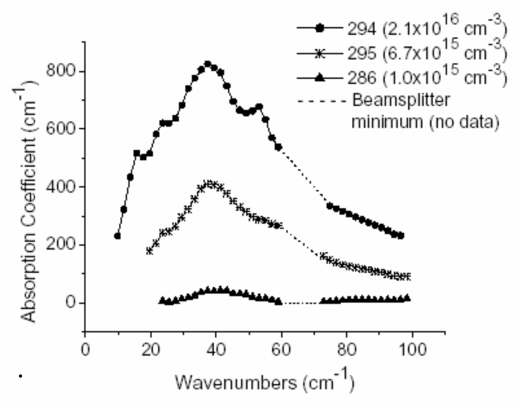
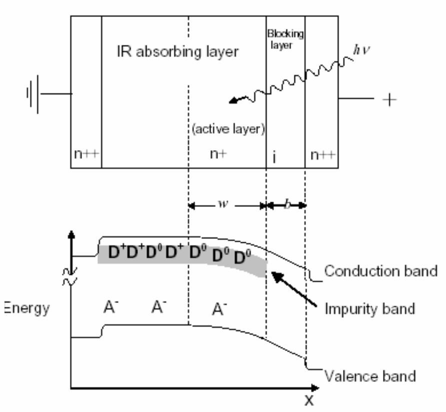
GaAs BIB detector development

A **GaAs BIB detector development program for far infrared astronomy** was started three years ago as a common effort of four institutions: MPE (Germany), UC Berkeley, LBNL and NPS Monterey (USA). Our actual research program is supported by a NASA grant # NNG04GB82G.

Rationale for a n-GaAs BIB (Blocked Impurity Conduction Band) Detector Array:

- GaAs has the shallowest stable dopant (e.g., Te: 5.7 meV) of any well-explored semiconductor.
- Extension of the photoconductive cut-off wavelength to 330 µm (30 cm^{-1}) with GaAs BIB devices is expected (cut-off wavelength limit of stressed Ge:Ga photoconductors is 210µm)
- Manufacture of planar structured detector arrays at an affordable price seems feasible.
- Complexity advantage of photoconductors over bolometers: Operation at 1.6 K avoids the more demanding ^3He cooling technique required for 0.3K or $^3He/^4He$ for 0.1K bolometers.
- GaAs BIB detectors should get rid of g-r noise characteristic of bulk GaAs photoconductors.

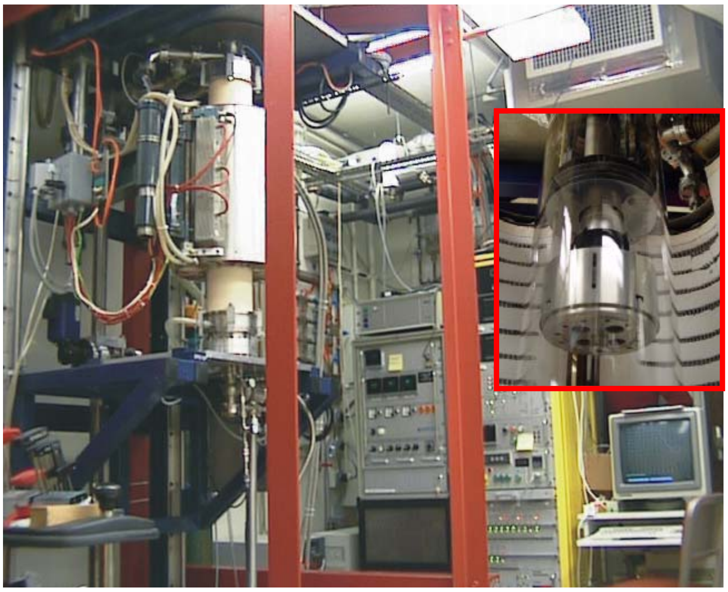




Experimental work is assisted by theoretical modeling. GaAs BIB modeling predicts that 4x10^{15} cm^{-3} majority doping improves the FIR absorption by a factor 100 w.r.t. bulk devices even for a 10 µm thick layer.

Experiment status:

GaAs layers are grown using the Liquid Phase Epitaxy process. A centrifuge system with magnetic bearings was set up at UCB and is operational for 3 years. Growth parameters could be optimized meanwhile and replacement of the graphite crucible with a small sapphire crucible leads to a significant reduction of unwanted donors (impurity concentration is now few 10^{12} cm^{-3}). Controlled doping of n-GaAs (e.g. with Te) is proven. The reproducibility of the growth processes will be the next goal. Then, manufacture of a BIB detector pilot sample is within reach.



Reference:

Reichertz L.A., Beeman J.W., Cardozo B.L., Haegel N.M., Haller E.E., Jakob G., Katterloher R., SPIE Vol 5543

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