# μ-Spec: A High Performance Compact Spectrometer for Submillimeter Astronomy

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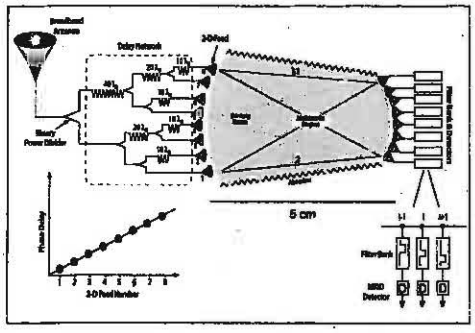
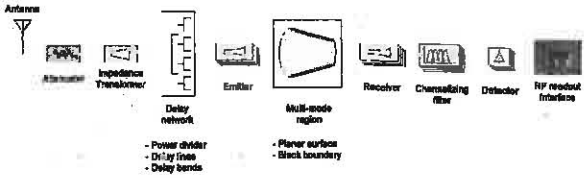
## μ-Spec: Revolutionary Instrument on a Chip

μ-Spec – an analog of a grating spectrometer, reduced in size by many orders of magnitude through the use of superconducting transmission lines on low loss single crystal Si dielectric.

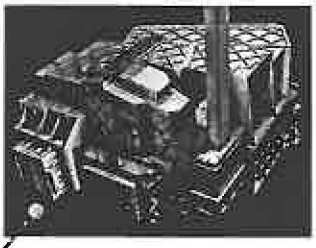


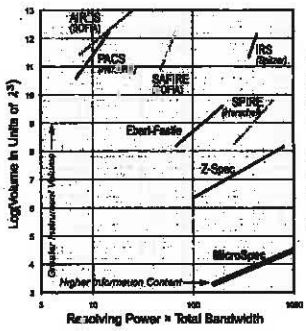

- μ-Spec is the first fully integrated high performance spectrometer system covering 250 – 700 μm in wavelength.
- The detectors are deeply imbedded in microstrip circuitry, allowing extensive filtering and excellent isolation from thermal backgrounds.
- μ-Spec can couple to large two dimensional arrays of detectors in a very small volume – built on a 4-inch Si wafer.
- Transmission line optics can be highly corrected to provide diffraction limited imaging of the spectrum.
- System integration risk is lowered with fully integrated spectrometer.

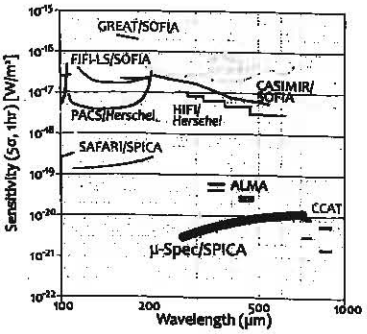
## μ-Spec sensitivity - limited only by the statistics of the input photons

The Herschel PACS instrument, a moderate resolution far infrared spectrometer.

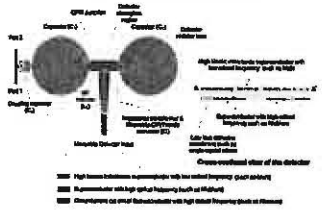


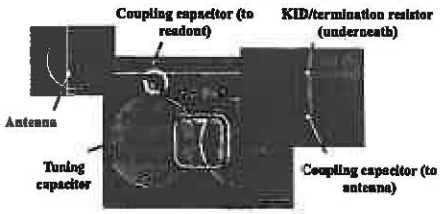
μ-Spec, a submillimeter spectrometer with greater capability, approximately to scale.



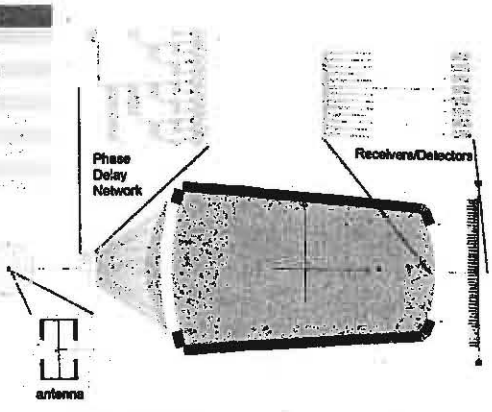

## Low Noise Equivalent Power Microwave Kinetic Detector






## Low Resolution Spectrometer Demonstration

| | |
|---|---|
| Minimum frequency | 450 GHz |
| Maximum frequency | 650 GHz |
| Maximum wavelength in $\theta_1$ | $\lambda_1$ = 195 μm |
| Minimum wavelength in $\theta_1$ | $\lambda_2$ = 135 μm |
| Antenna spacing or array pitch | p = 179 μm |
| Design order of the grating | M = 1 |
| Number of emitters | $N_e$ = 65 |
| Number of receivers | $N_r$ = 47 |
| Resolving power | R = 65 |
| Multimode radius | R = 1.25 cm |




- μ-Spec will be a strong competitor for a wide range of current and future missions, such as the Early Universe Spectroscopic Explorer and SPICA.
- μ-Spec will also significantly enhance the capability of the future mission concepts, such as SAFIR, SPIRIT, and SPECS.