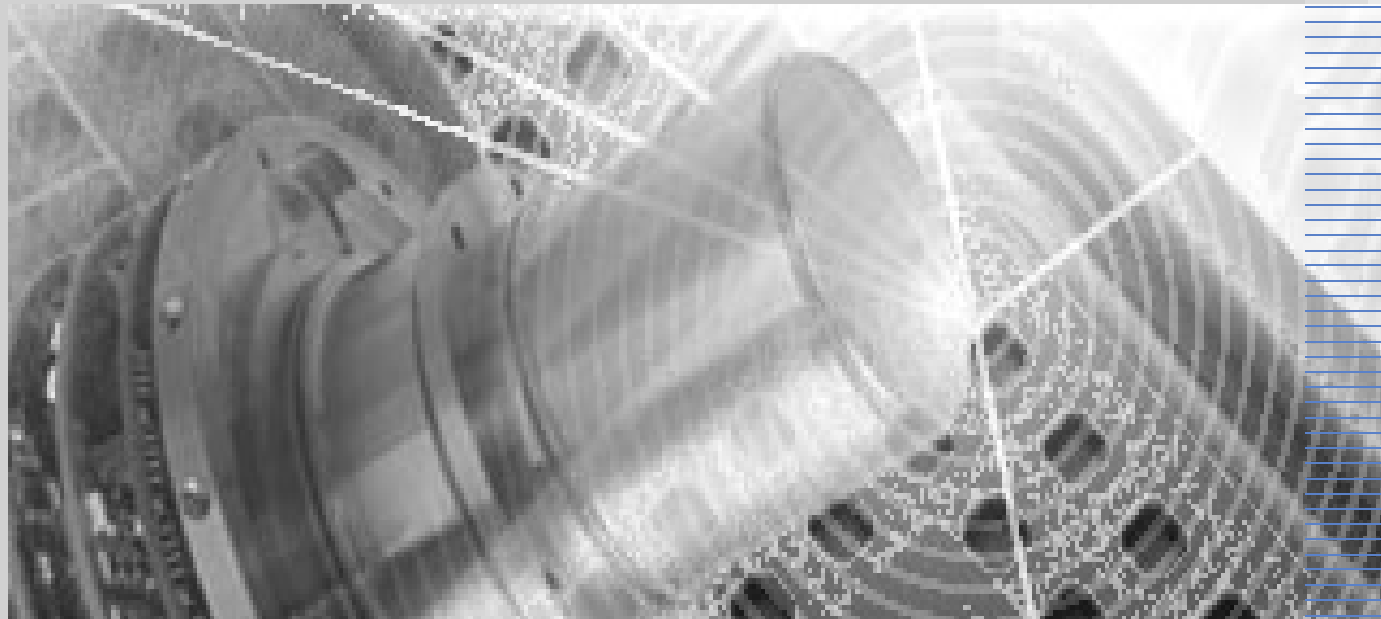


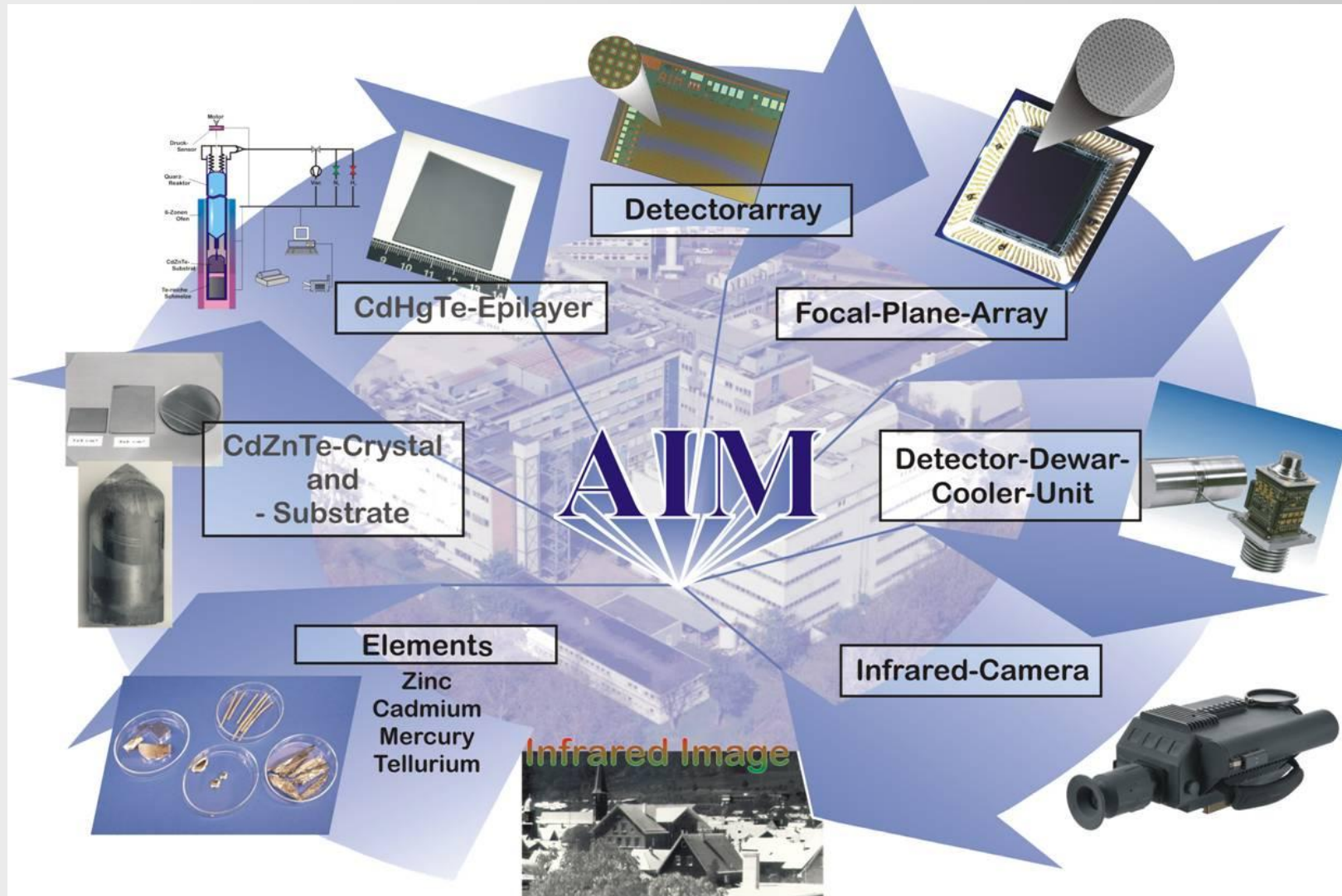
AIM INFRAROT-MODULE GmbH

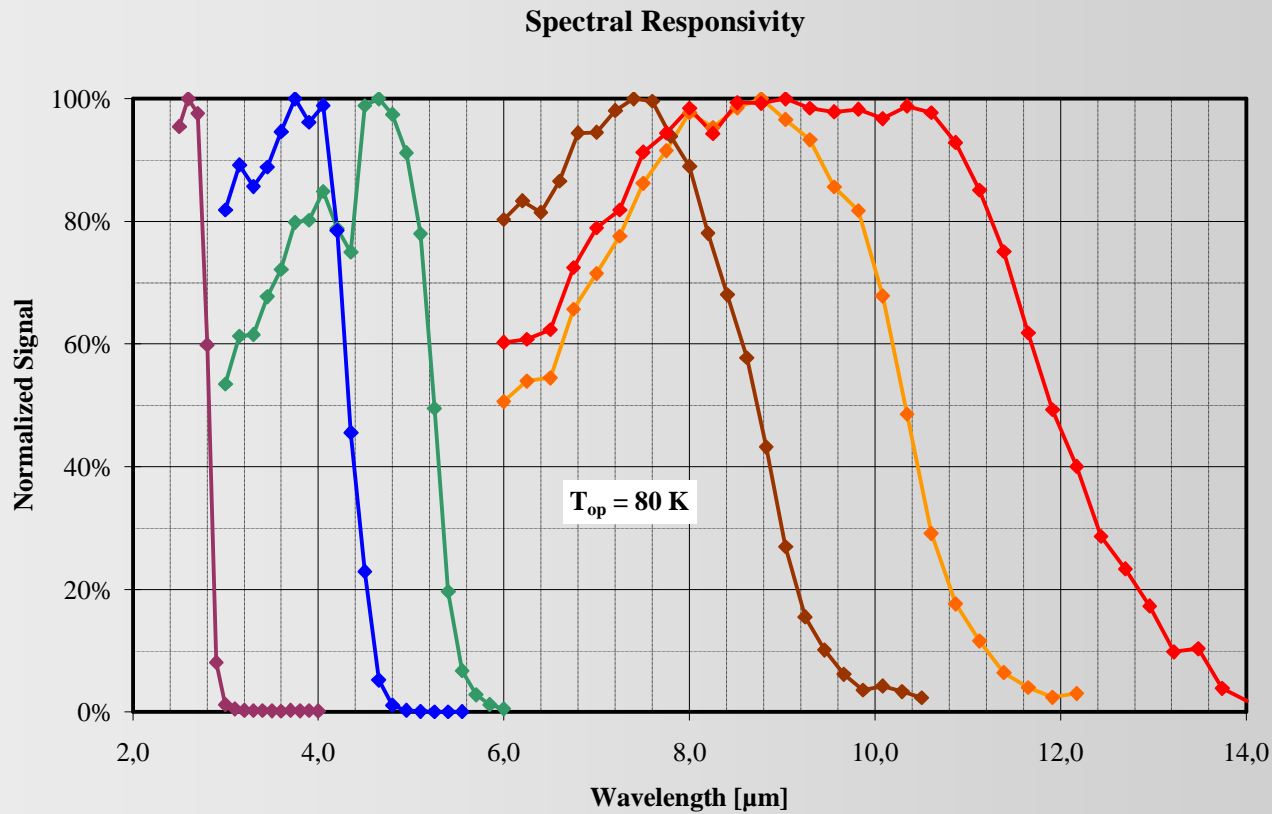


INFRARED DETECTOR Modules for SPACE APPLICATIONS

Potentials for TET-2

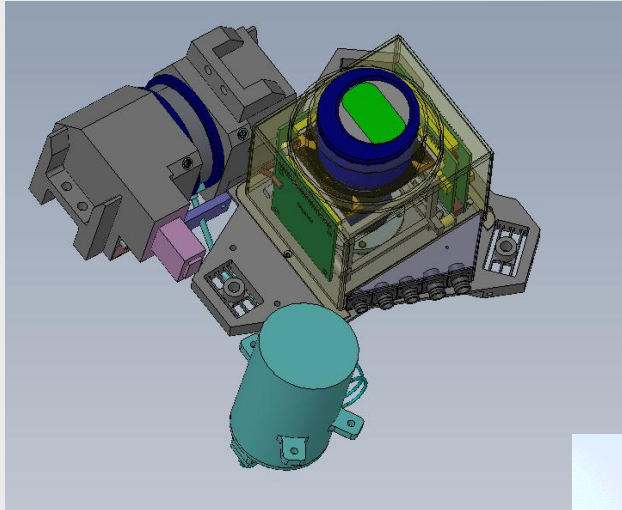
2nd TET Customer Day, KAYSER-THREDE, July 6th 2010



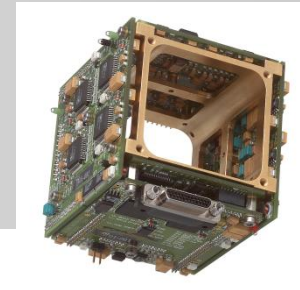


**Spectrum of AIM-pv-MCT-Infrared Detectors Detector Operation Temperature = 80 K
with present DLR funded Programme: Extension to UV/VIS/SWIR**

■ INTEGRATED DETECTOR DEWAR COOLER ASSEMBLIES



Example:
EnMAP 1024x256-SWIR



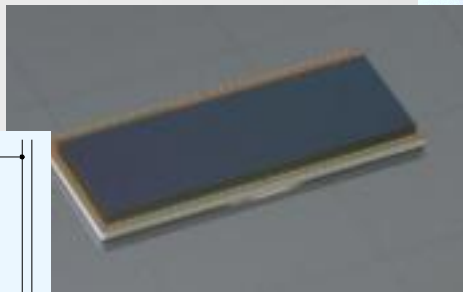
Electronics



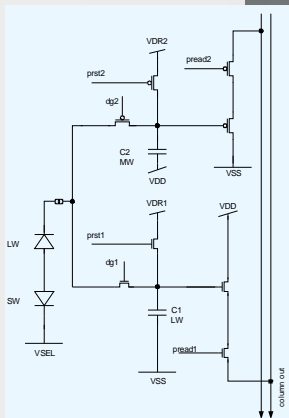
Cryo-Coolers



Dewar Assembly



Focal Plane Array Sensors

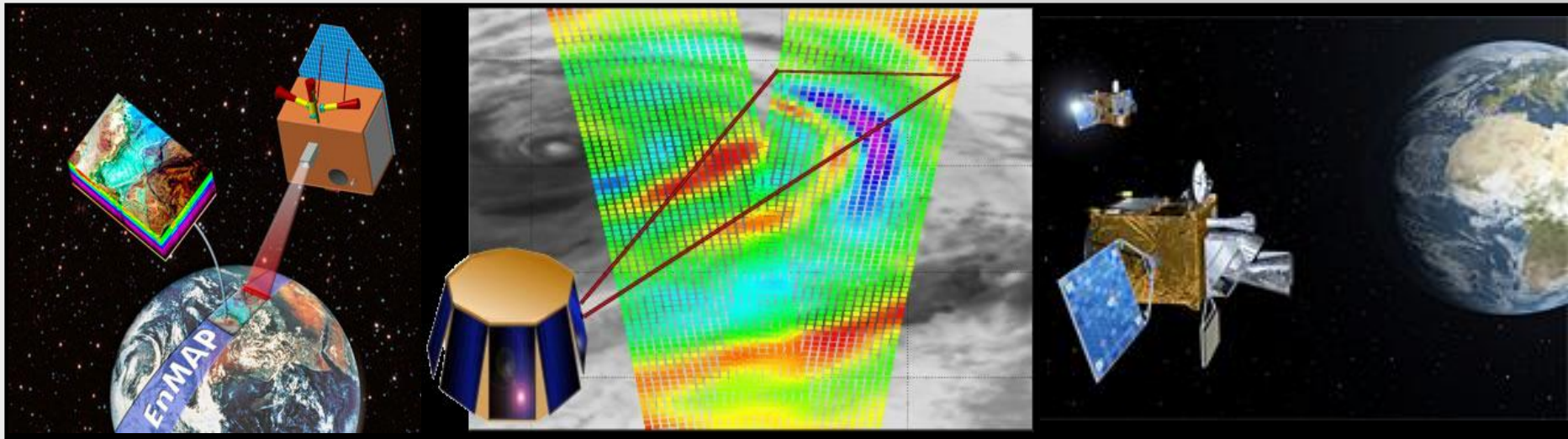


ROIC design

All technologies available in house:

- optimized interfaces
- approved processes
- best performance
- easy system integration

■ AIM INFRARED DETECTORS for SPACE PROGRAMS



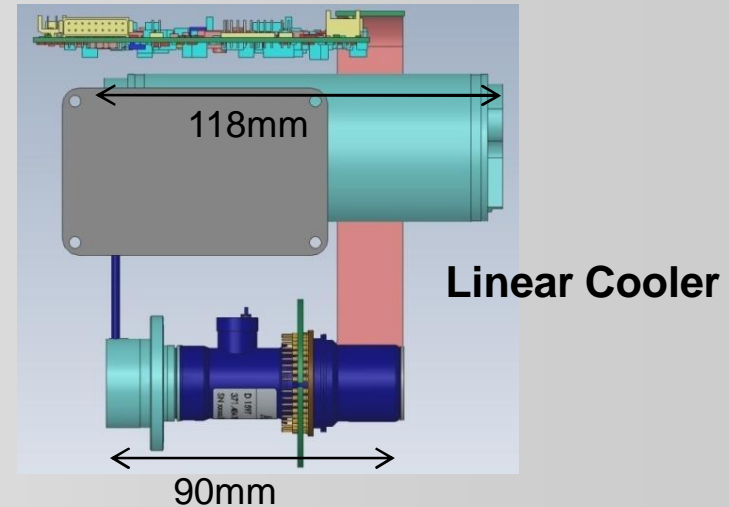
- Strategic Market Segment for AIM: IR-Modules for Space Applications

- Examples of present and future DLR / ESA Programmes:

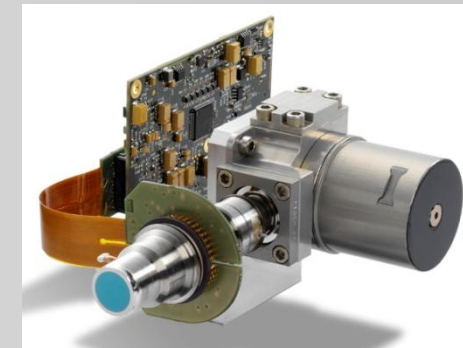
- EnMAP	Earth observation,	$0.9 \mu\text{m} < \lambda < 2.5 \mu\text{m}$	DLR
- Gloria	Climate research,	$7 \mu\text{m} < \lambda < 13 \mu\text{m}$	DLR
- MetImage	Weather observation,	$1 \mu\text{m} < \lambda < 13 \mu\text{m}$	DLR
- Meteosat 3 rd Gen	Operational satellite program	$1 \mu\text{m} < \lambda < 15 \mu\text{m}$	ESA / EUMETSAT
- Sentinel 3	GMES, operational program	$1 \mu\text{m} < \lambda < 15 \mu\text{m}$	ESA / EU
- KompSAT 3A	Korean Multi Purpose Satellite	$3 \mu\text{m} < \lambda < 5 \mu\text{m}$	KARI, Korea

■ OPTION-1: 640x512-MWIR- or LWIR-MCT-IDDCA

- Compact dewar configuration
- Low power consumption
- Low noise and vibration output
- MWIR and LWIR, high MTTF
- Needed adaptations for space application:
 - Cooler (TBC), cooler electronics
 - Frontend electronics



Typical performance	MWIR	LWIR
Spectral range	3.4 μ m – 5.2 μ m	7.5 μ m – 9.1 μ m
SX095 Linear Cooler	30W	35W
Operating temperature	95K	67K
Integration time	5ms	180 μ s
NETD@300K	23mK	35 mK



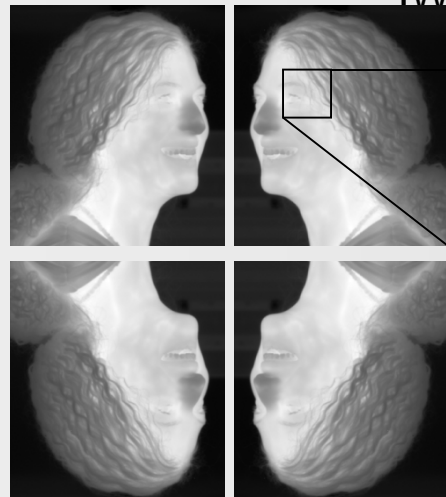
Rotary Cooler

■ OPTION-1: 640x512-MWIR- or LWIR-MCT-IDDCA

ROIC features 640x512, 15 μ m

- 0.35 μ m Si CMOS read-out integrated circuit
- 2 or 4 video outputs
- Two modes of operation: ,integrate then read' (ITR) and ,integrate while read' (IWR)
- Charge handling capacities: ITR: ~ 6 Mio e⁻; IWR: ~ 5 Mio e⁻
- Max. pixel rate 10MHz/ per output channel
- Full frame rates (640x512):
 - 50Hz operation (2 outputs) ITR: 1.4ms (max. tint)
 - IWR: 17.7ms (max. tint)
 - 4 outputs) ITR: 0.4ms (max. tint)
 - IWR: 9.5ms (max. tint)

Independent inversion of x,y readout scandirection

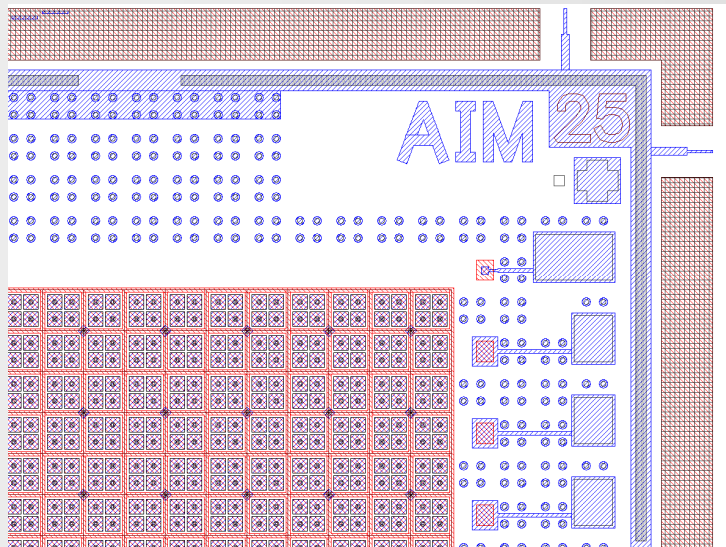


Subframe windowing in steps of 4 pixel horizontal, 1 pixel vertical

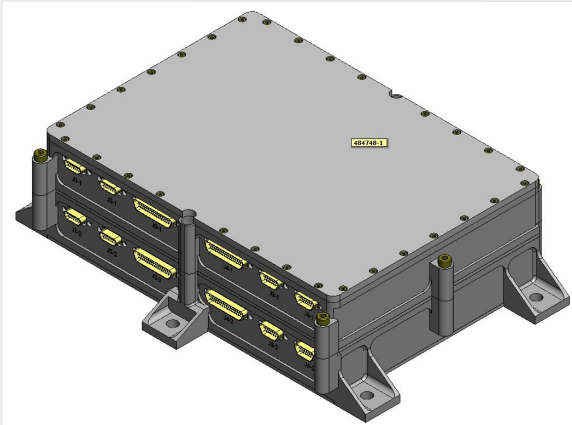
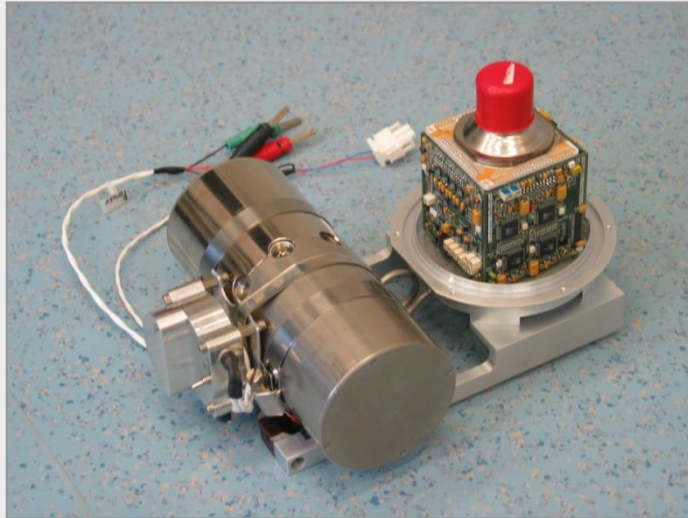
Design and Test of a VLWIR-MCT-IDDCA Test Vehicle for FFT-Applications

- Starting point: Results from ESTEC Contract for the development of VLWIR MCT pv-material wrt dark currents and homogeneity ⇒
 - Reduction in dark current by a factor of 10,
 - Design, manufacture of a ROIC for high photon background,
 - Characterization of corresponding FPA test vehicles

- Proposed FPA Test Vehicle:



Parameter	FPA-Features
Operating Temperature T_{op}	55K
Cut-Off Wavelength at T_{op}	14.4 μ m
Spectral Range	8 μ m-15 μ m (TBD)
Array Configuration	128x128
Number of Subpixels per Pixel	2x2
Number of Active (Sub-) Pixels	1, 2, 3 or 4 per Pixel
Pixel Size	(80x80) μ m ²
Anti-Debiasing Technique	Ö
Guard Rings	Ö
Operating Mode	IWR
Number of Video Outputs	2x2 analog
Frame Rate	1k frames/s
Integration Time t_{yp} .	~250 μ s
Charge Handling Capacitance	140 Me ⁻
ROIC Input Stage	BDI
Pixel Select / Deselect	Ö
Anti-Blooming Function	Ö
Gain Switch (high ↔ low)	Ö



Development Tasks

- Design and manufacture of VLWIR-FPA:
 - ROIC and
 - PV-Array
- Use of existing Dewar Housing, consisting of:
 - Pulsetube-Coldfinger (as part of dewar),
 - Dewar,
 - Adaptation of Cold Shield and
 - Vacuum Cover with Entrance Window
- Use of existing SF400 Cooler, consisting of:
 - Pulsetube-Coldfinger,
 - Flexure-Bearing Compressor, 4W
 - Buffer Volume and
 - Cooler-Control-Electronics
- Detector-Control-Electronics, consisting of:
 - Proximity Electronics and
 - Front-End-Electronics

■ OPTION-3: LONG LIFE CRYO-COOLERS

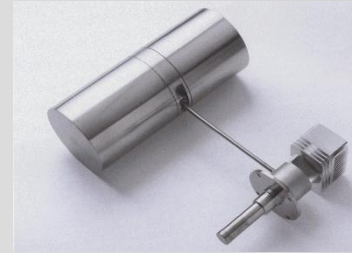
- Focusing on highest lifetime for 24/7 and space applications



SF100
Flexure Bearing



SF070
Flexure Bearing



SF400
Flexure Bearing



Pulse-Tube
Cooler

- Common design features: Flexure Bearing Suspension on both ends of driving mechanisms, Moving Magnets, coil outside helium vessel

- 13 mm Stirling coldfinger
- 2 W cooling power
- Diam. 60.45mm
- length < 120 mm
- weight < 1.7 kg
- MTTF > 20000 h

- Production start 2006
- > 100 units build, 5 per month

- 6mm, 8mm Stirling coldfinger
- 0.7 W cooling power
- Diam. 44.4 mm
- length < 115 mm
- weight < 1.0 kg
- MTTF > 20000 h

- Production start 2009

- 13mm Stirling coldfinger
- 2.5 W cooling power
- Diam. < 75 mm
- length < 162 mm
- weight < 2.8 kg
- MTTF > 20000 h

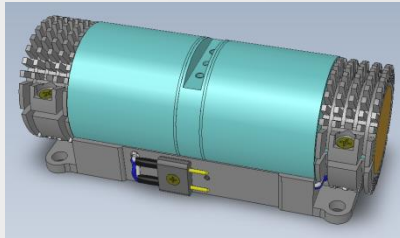
- Production start 2010 (space programs)

- Pulse Tube coldfinger no moving parts
- 1.5W cooling power
- Diam. < 75 mm
- length < 162 mm
- weight < 3 kg
- MTTF > 50000 h

- Production start 2009 (space programs)

■ OPTION-3: LONG LIFE CRYO-COOLERS, 3rd Gen

- Focusing on highest specific performance and high reliability



**SX040
Cryocooler**

- 6 mm Stirling coldfinger
- 0.4 W cooling power
- Diam. 36 mm
- length 99 mm
- weight < 0.65 kg
- MTTF > 20000 h
- In development
- production start 2011

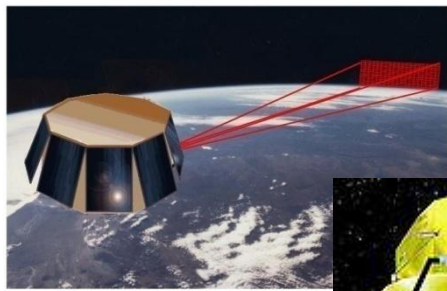
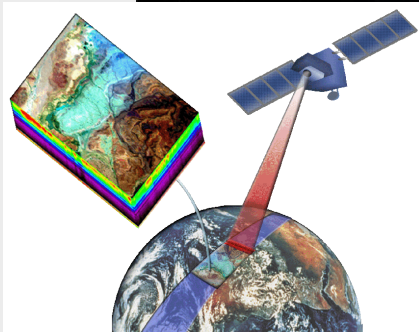


**SX095
Cryocooler**

- 6 mm and 9mm Stirling coldfinger
- > 1.3 W cooling power
- Diam. 44.45 mm
- length < 115 mm
- weight < 1 kg
- MTTF > 15000 h
- In development
- production start 2011

■ AIM INFRARED-SENSORS for SPACE APPLICATIONS

AIM



§ Weather Observation, Weather Forecast, Meteosat 3rd Generation: MTG

§ Earth Observation: EnMAP

- Geology, Soil Conditions and Properties
- Agriculture
- Observation of Vulcanos
- Archeology

§ Climate Research: GLORIA

- Atmospheric Observations
- Greenhouse Gases („Ozon Hole“)

§ Global Monitoring of Earth and Security, GMES: Sentinel-3

§ Scientific Applications: BEIRUS (UV-SWIR)