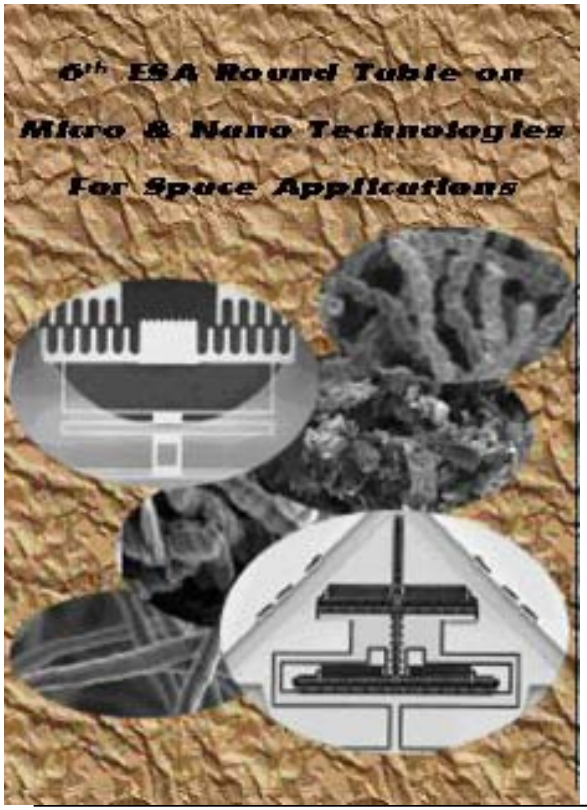
6th ESA Micro & Nano Technologies Round Table
ESTEC, Noordwijk, The Netherlands
8-12 October 2007



WELCOME
&
INTRODUCTION

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Head of Mechanical Engineering Department

6th ESA MNT Round Table
Welcome to ESTEC

European Space & Research Technology Center: ESTEC

Principal tasks

- **Studies, preparation and management of ESA space programmes: science, applications, human spaceflight and future exploration**
- **Technical support to ESA project teams, incl. preparation and coordination of ESA space technology R&D programme**
- **Product assurance and safety responsibility for ESA space programmes**
- **Management of ESTEC Test Centre and coordination with other test centres in Europe**

Employment

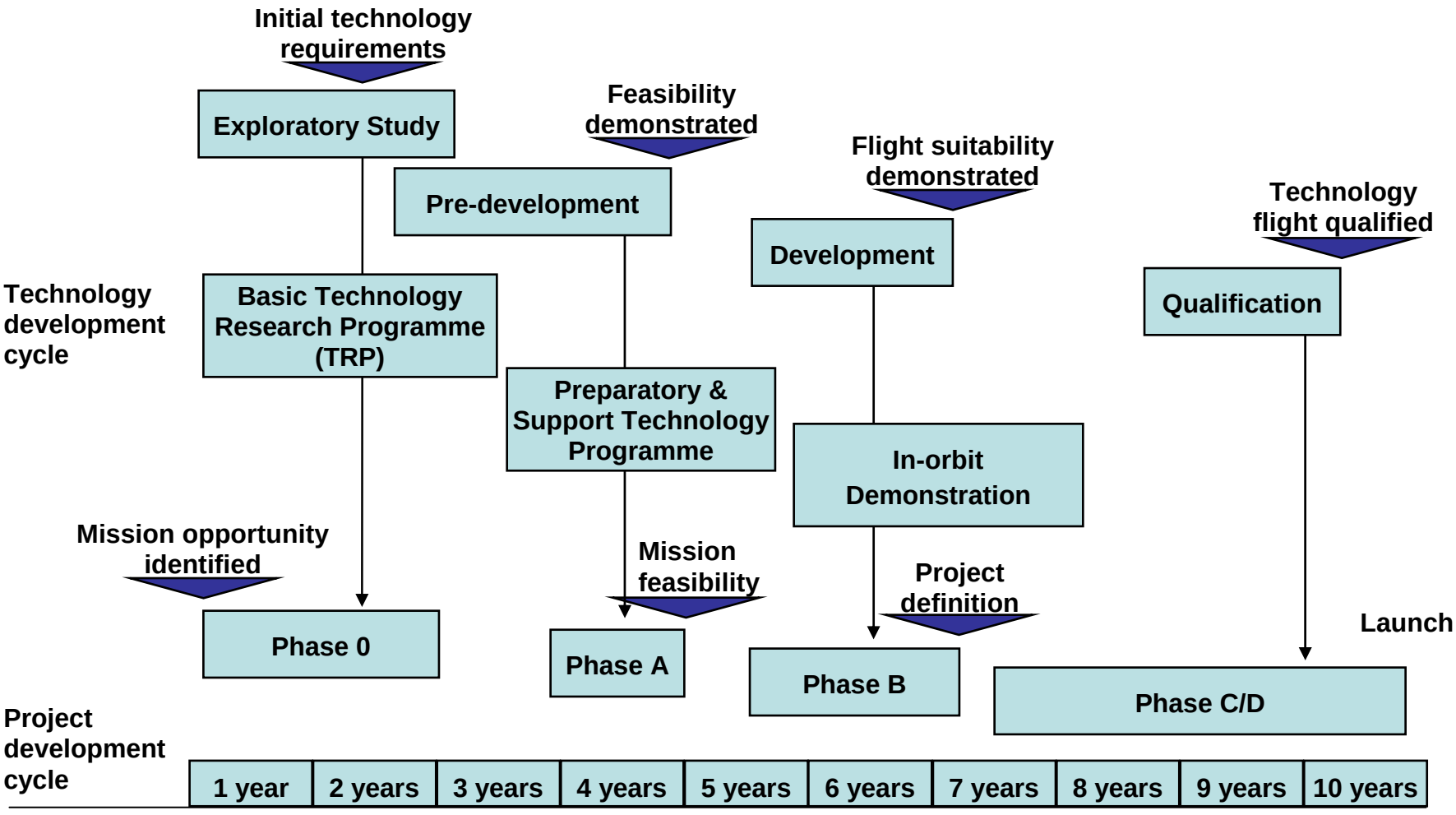
- **Appr. 2200 persons (of which 1074 as international ESA staff)**

Area

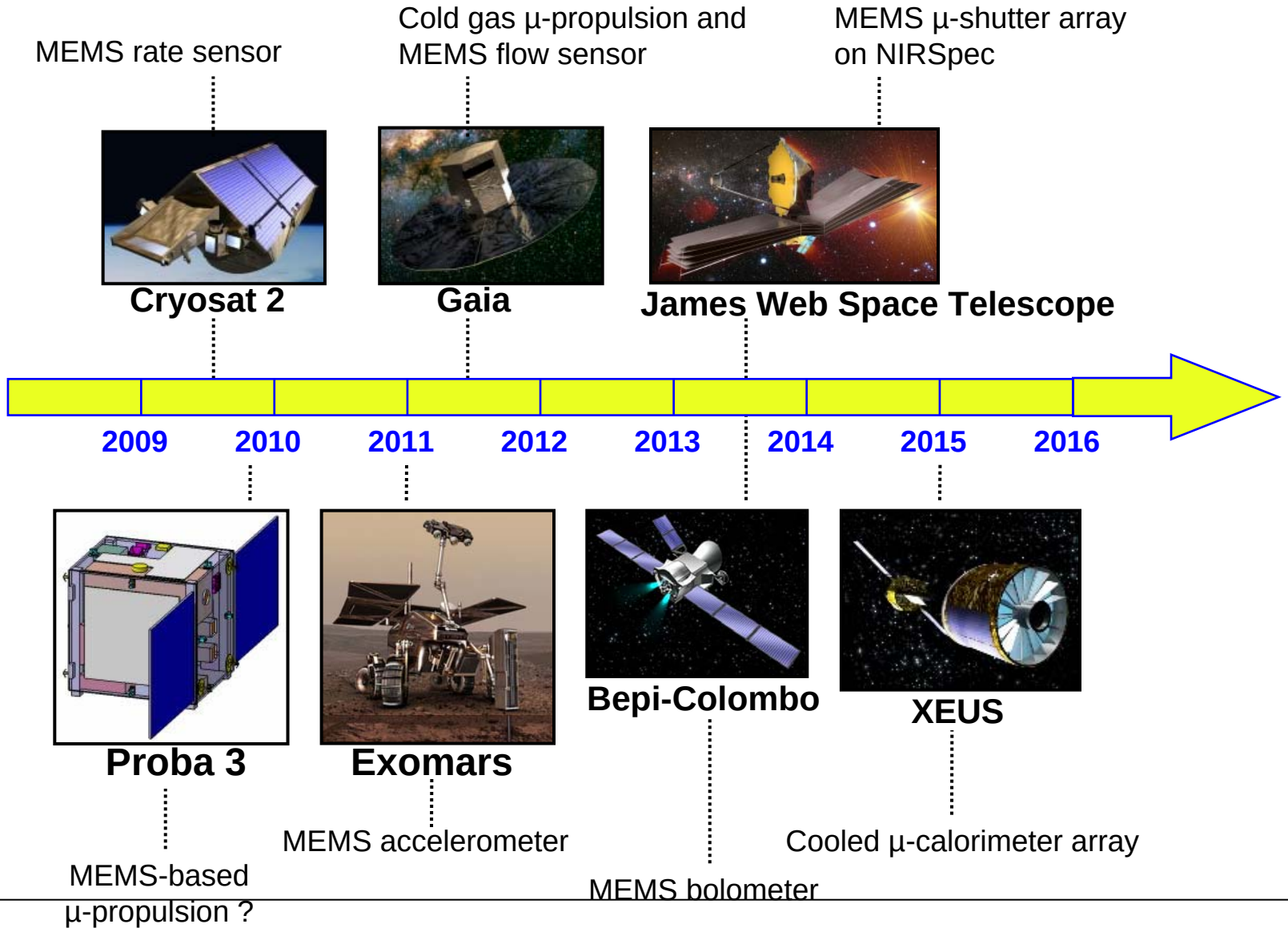
- **40 hectares, 106.000 square metres of buildings and parking area**
- **Future expansion area: 4,5 ha**

MNT & ESA Missions

Technology Development
Project phasing relationship



ESA Missions Timeline



MNT Demonstrators on CRYOSAT 2

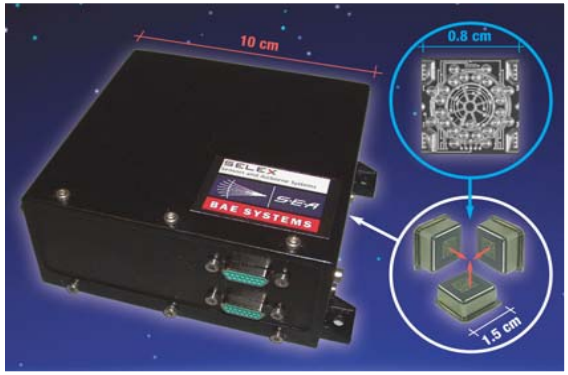
MEMS rate sensor from BAe and SEA

Will fly as transparent (non flight critical) passenger for:

- **Attitude propagation, rate determination and failure detection**
- **Launch information: the MEMS-gyro will be switched on during launch**

Advantages of MEMS for inertial sensors

- **Low mass and small foot print**
- **No bearings, or moving items that wear out**
- **Low Power Consumption**
- **Solid state (more reliable that mechanical)**
- **Low Sensitivity to vibration & shock**
- **Low recurring costs**



MNT Space Projects: XEUS
(X-Ray Evolving Universe Spectrometer)

X-Ray spectrometry can be performed with a micro-calorimeter array, which senses the heat pulses generated by X-ray photons when they are absorbed.

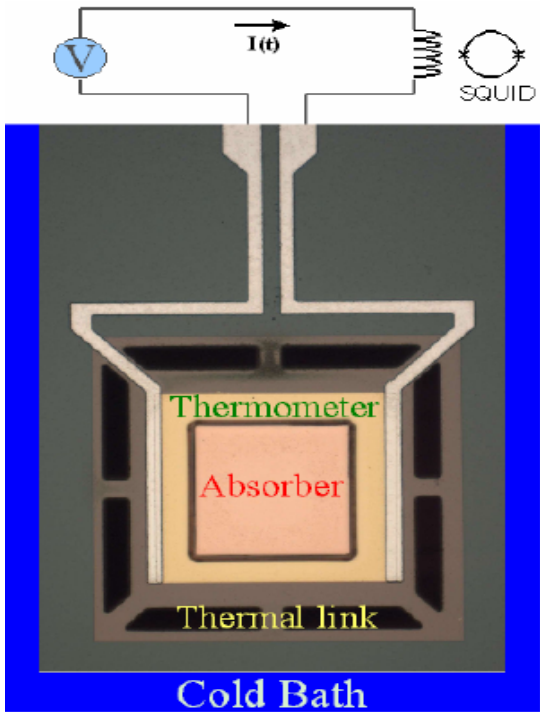
Cooled µ-calorimeters for X-Ray detection:

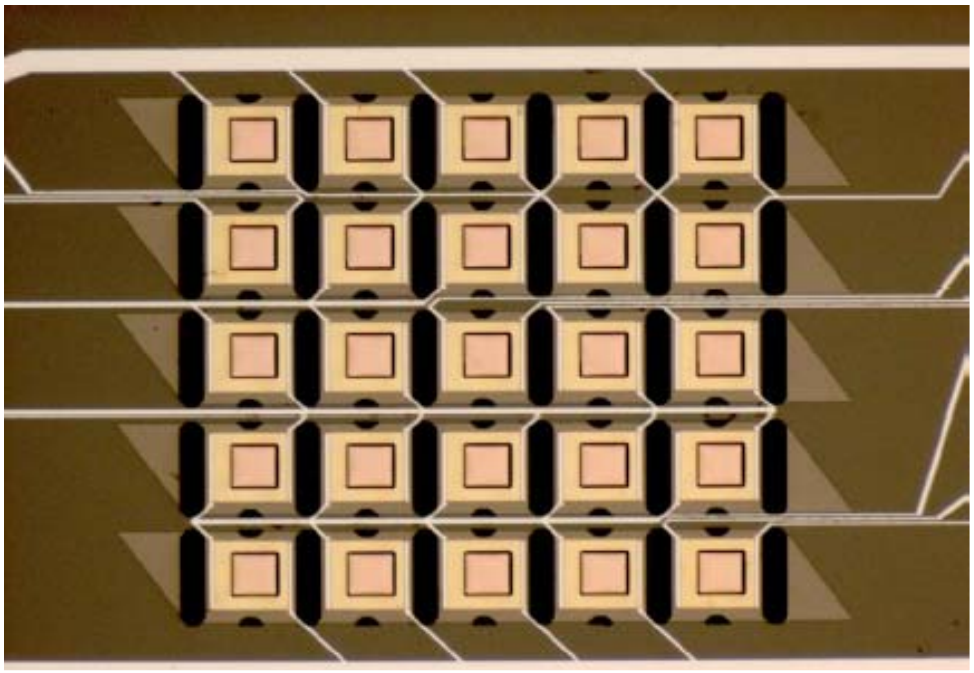
MEMS enable small thermal capacitance, thermally isolated from substrate:

- Best energy resolution and X-ray absorption efficiency:
  - A good plasma analysis spectrometer requires 2 to 3 eV resolution
  - At 6 keV MEMS allow a resolution of 2.4 eV whereas for STJs (Superconducting Tunnel Junction) european competitors it is 16 eV!
- Multiplexing based on SQUID (Superconducting Quantum Interference Device):
  - Reduces the distance to the detector, the wiring and the heat of the body.
  - For STJs competitors, each sensor has traditional amplification, which requires tremendous wiring.

MNT Space Projects: XEUS (X-Ray Evolving Universe Spectrometer)

Design and Fabrication: SRON and MESA^{+}, The Netherlands



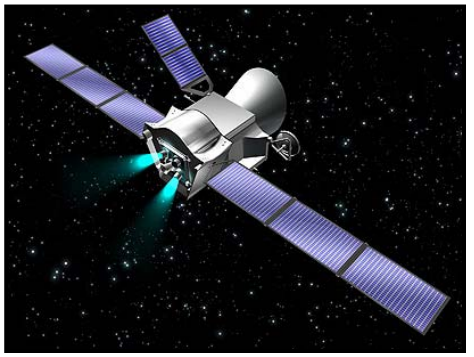


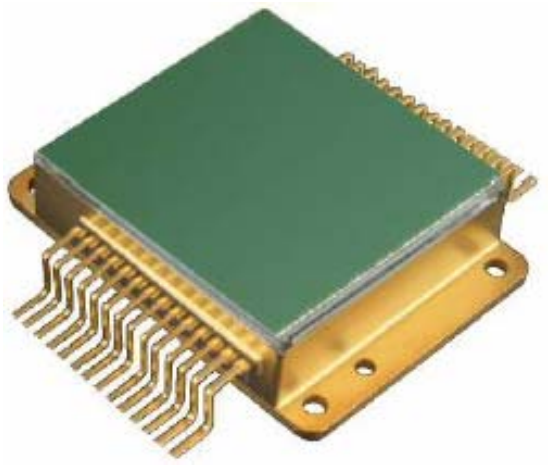
Flight horizon 2018-2022, currently TRL 4: Component and/or breadboard validation in relevant environment to be achieved by 2010

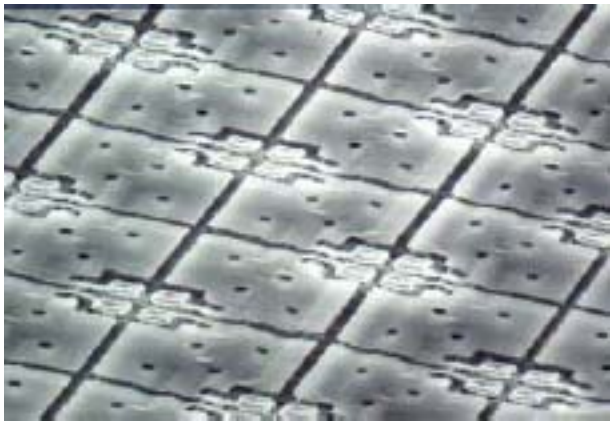
MNT Space Projects: Bepi Colombo

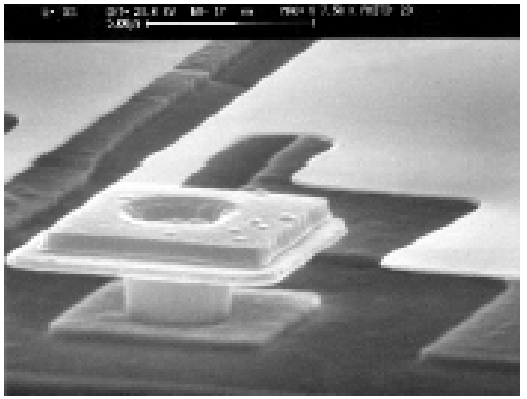
MEMS uncooled infra-red imagers using MEMS bolometers from ULIS:

- MEMS enables wide band detection (6-60eV initially)
- MEMS offer pitch smaller than 25 µm
- MEMS enable larger arrays









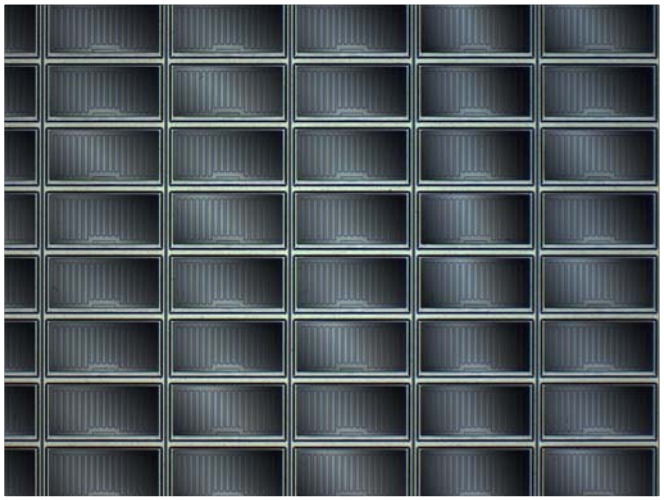
MNT Space Projects: JWST (James Webb Space Telescope)

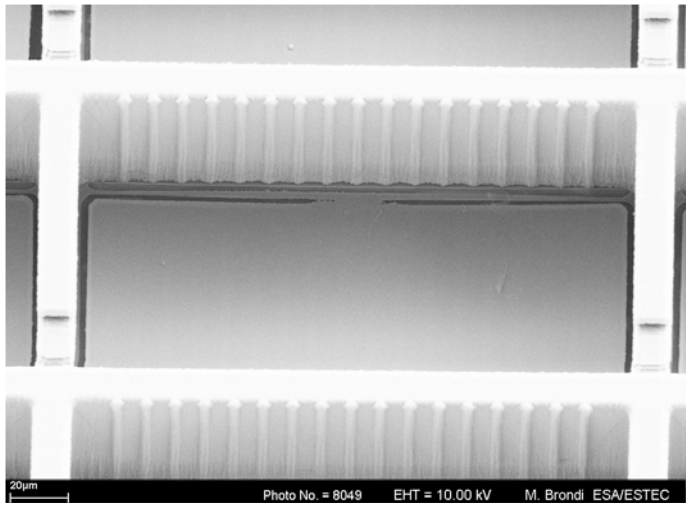
NIR-Spec: Multi-image Near InfraRed Spectrometer

- **ESA/NASA Cooperation**
- **Will use MEMS micro-shutters**
- **Capable of 100 images observations at one time**
  - **Significant improvement on the current technology capability (only one object at a time)**
  - **Increased efficiencies of operation**
- **171 X 365 shutters arrays, 4 arrays, all individually addressable and programmable**
  - **Extremely flexible**
  - **Tiny shutters that can be opened in the pattern of objects hence targeting objects of interest.**

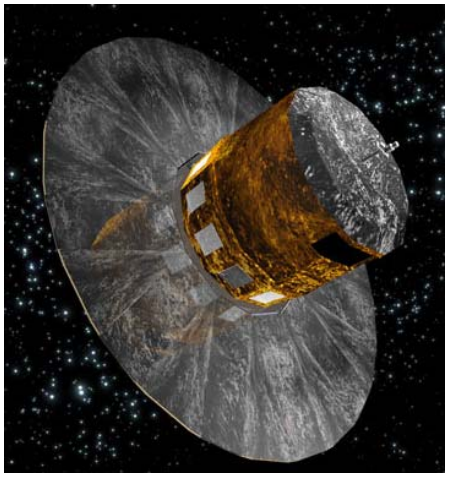
MNT Space Projects: JWST (James Webb Space Telescope)

Micro-shutters manufactured by NASA/GSFC:





MNT Space Projects: GAIA

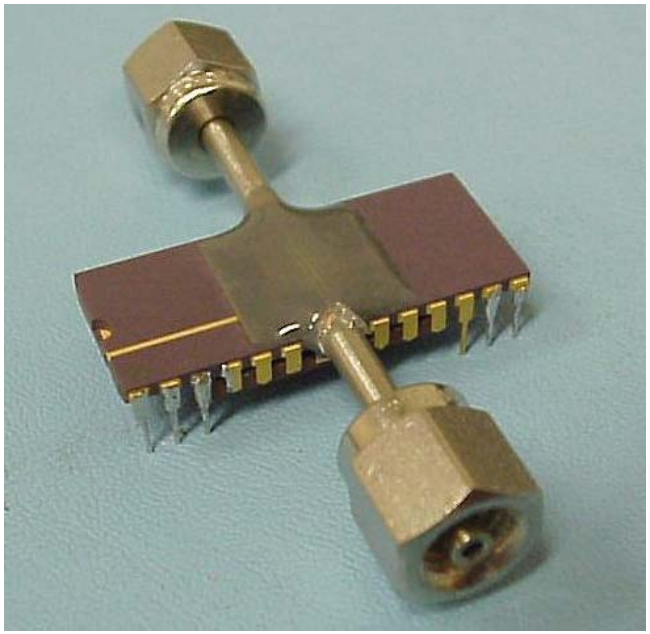


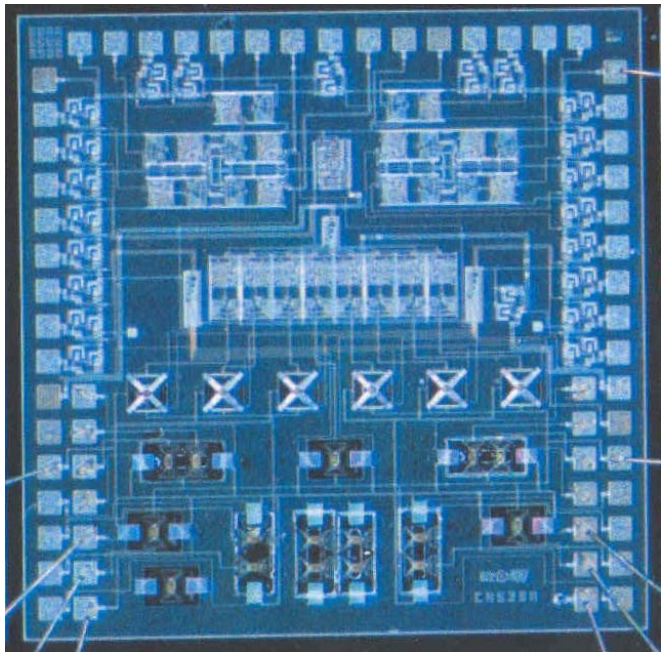
GAIA:

- Replacement for HIPARCOS spacecraft
  - In 1993: HIPARCOS Astrometric Accuracy: 1-10 milliarcs
  - GAAI in 2011 : 20 **µ**arcs
- Will use MEMS flow sensor
- Very accurate pointing required => order of µN thrust is mandatory
- µN thrust only available with cold gas micro propulsion
  - Need for very accurate (1 µN) and fast time response (10 Hz) flow sensor
- MEMS is the only solution available today

MNT Space Projects: GAIA

MEMS Flow Sensor, AAS Florencia, Italy





The 6th ESA MNT Round Table

- **1st Round Table in March 1995**
- **2nd Round Table in October 1997**
- **3rd Round Table in May 2000**
- **4th Round Table in May 2003**
- **5th Round Tablein October 2005**

➢ ***6th ESA MNR Round Table 8-12 October 2007:***

- **More than 100 Abstracts submitted (70 in 2005)**
- **18 countries participating (Netherlands, Switzerland, France, Denmark, Italy, Spain, Germany, Portugal, UK, China, USA, Belgium, Sweden, Greece, Norway, Finland, Austria, Canada) (16 in 2005)**
- **4 complete days, 15 sessions including two complete session for Nano-Technologies (3 days and 11 sessions, 1 for nano in 2005)**

Wrap up

- **Micro-Nano Technology holds great promise and is now base-lined for Missions as critical equipment**

- **This forum is key on the road to achieve qualified and validated micro-nano technology solutions for space**

- **The next five days also provide a unique opportunity to all participants to exchange ideas, data, services, products, start collaborations**

- **On behalf ESA a warm welcome to all participants and wish you all a very fruitful exchange of experiences in this Round Table**