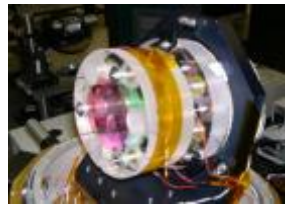
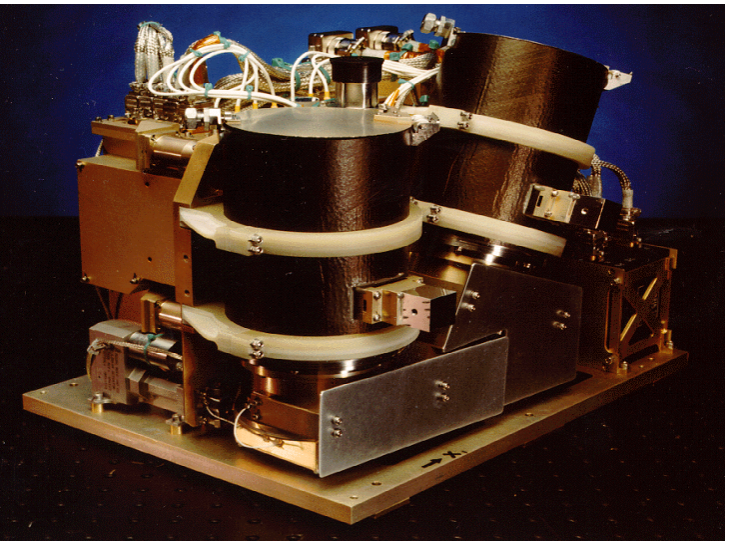
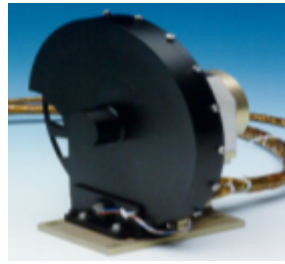
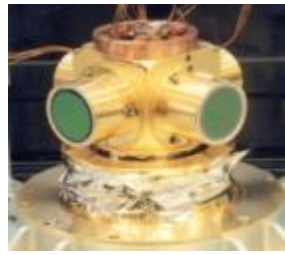




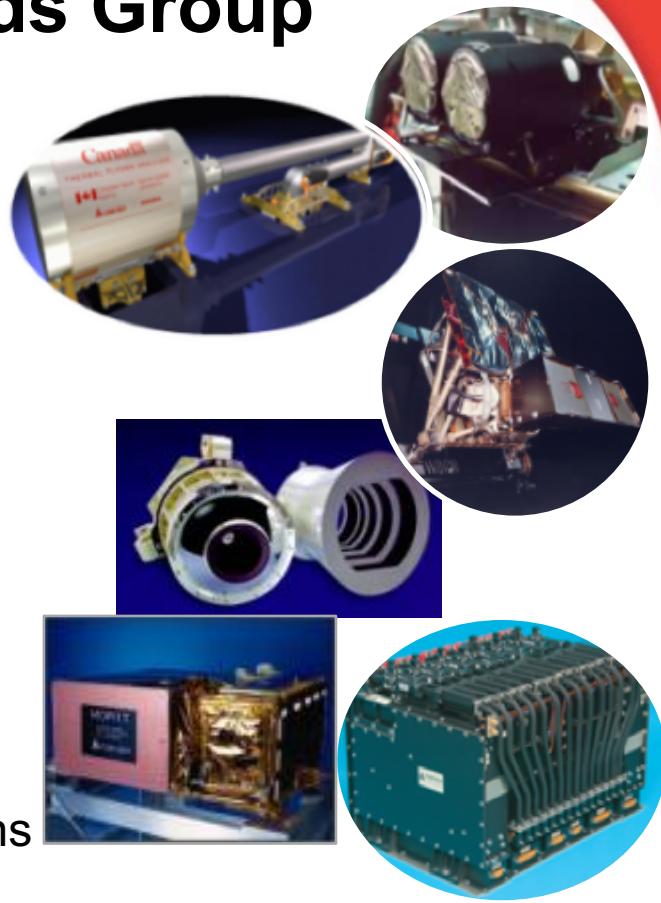
Dec. 14th 2017
University of Victoria

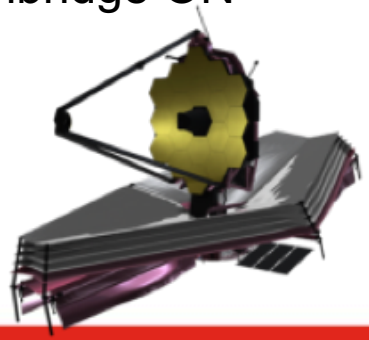
HONEYWELL AEROSPACE OVERVIEW
NSERC NTCO CREATE PROGRAM

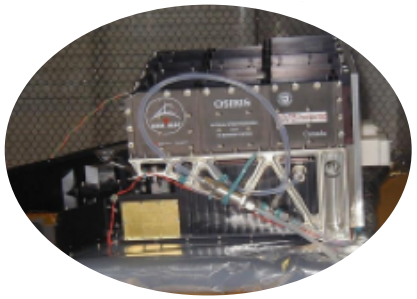
Honeywell

Missions, Instruments & Payloads Group

- Ottawa-based Group History
  - Space Division of Ottawa based CAL Corporation
    - founded in 1974
  - Early 1990's: CAL was acquired by EMS Technologies
  - 1999: EMS acquired Spar Aerospace Montreal
  - 2006: the group was bought by COM DEV Canada Ltd.
  - 2010: COM DEV purchased Routes AstroEngineering.
  - Honeywell bought COM DEV in Feb. 2015
  - Integrated into the Honeywell Aerospace organization
    - A $14B/yr business based in Phoenix AZ
- Current Day
  - A team of ~40 scientists, engineers and technicians
  - Based in Ottawa and Cambridge ON
  - Currently hiring!







Canada's space science instrument provider for 30 years

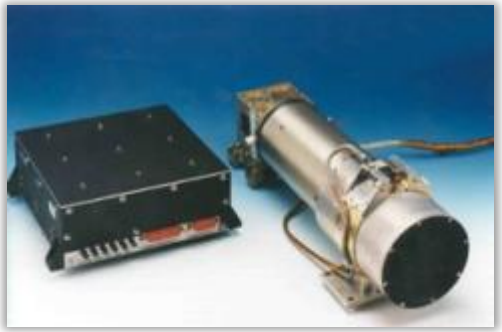
Optical and Science Instruments

- Fine Guidance Sensors
- Astronomical Imagers
- Imaging Spectrometers
- UV Imagers
- Space Weather Instruments

Sapphire Optical Payload

JWST Fine Guidance Sensor

SWARM Electric Fields Instrument



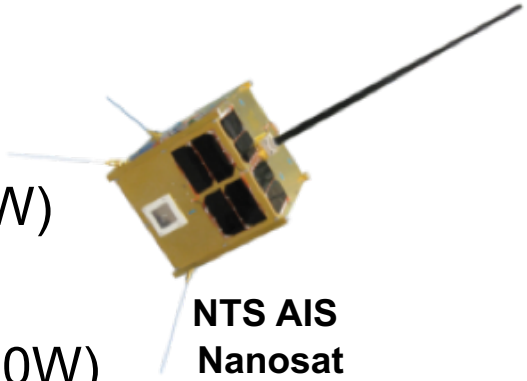
Freja Cold Plasma Analyzer

- Capabilities
  - Detector characterization
  - Image processing
  - Read-out electronics
  - Contamination control
  - Optical and lens design
  - Opto-mechanical design
  - Cryogenic AIT

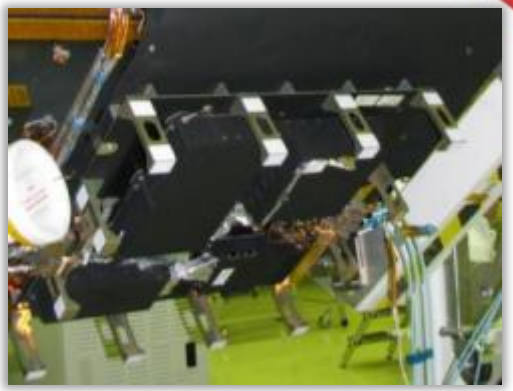
Systems Engineering ensures it all works together

Missions

- Nanosats (~10 kg, ~10W)
- Hosted Payloads
- Microsats (~100kg, ~100W)
  - M3MSat: ship tracking & low rate data relay launched in June 2016

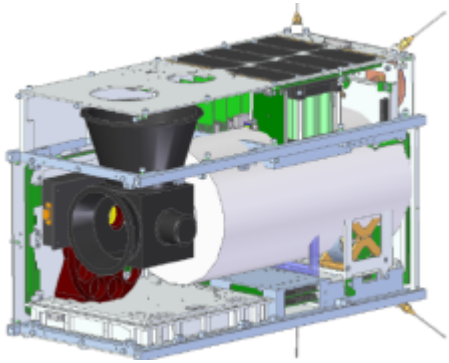


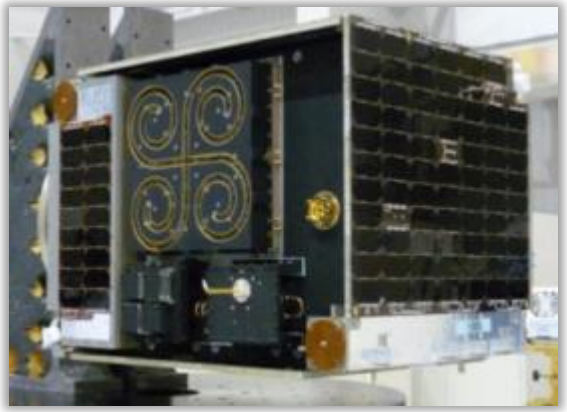
NTS AIS Nanosat



EV8 Hosted AIS Payload

TICFIRE Nanosat





M3MSat Microsatellite

EV-1 Microsatellite Launch

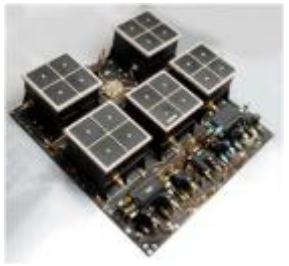
Current & Recent Studies

- Thin Ice Cloud monitoring in the arctic
- Wildfire monitoring using micro-bolometer sensors
- Hyperspectral environmental monitoring
- Quantum Key Distribution
- Optical communications
- RF geo-location

M3MSat has provided mission prime experience

Communications Payload Product Group

- 80% of the world's communications satellites use our equipment
  - > 750 satellites to date
- Extensive production facilities employing advanced lean manufacturing
- Space electro-mechanical switches, filters, multiplexers and microwave components

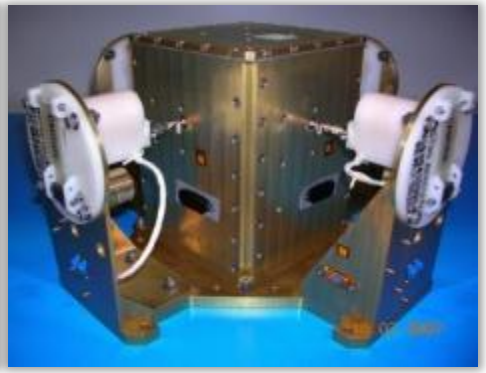


World Leader in Volume Production for Space

RF Products and Systems

- TT&C Transponders
- Search and Rescue Repeaters
- AIS Receivers
- RF Science Instruments
- mm-Wave Subsystems

GPS III Search and Rescue Repeater



ePOP RRI Digital Radio Receiver

Earthcare 94 GHz Transmit/Receive Subsystem

M3MSat AIS and LDR Payloads

<u>Capabilities</u>

- RF / Analog design
- Digital design
- Firmware development
- RF Payload architecture design

RF Capability Applied to Custom Systems

Honeywell Interest in NTCO

- Text from the NTCO CREATE proposal:

"……this is a field that attracts students with a strong background in math, problem solving, and specific interests in physical sciences and/or engineering. During their degrees, they then have opportunities to develop higher-level skills in critical thinking, scientific writing and communication, theoretical modeling, and data analysis."

- We plan to involve the NTCO interns in our current development projects, ideally one in the planning stages and one currently in the testing phase.

- Corporate wide, Honeywell's objective with its internship program is to hire 70% of all interns.

Beyond the Standard Engineering Disciplines

- Systems Engineer
  - Radiometry – is there enough signal and not too much noise?
  - Multi- disciplinary – communicate with any engineering discipline.
  - Managing requirements & the customer!
- Optical Engineer
  - Geometric ray-tracing
  - Wavefront propagation
- Electro-optical engineer
  - Detector / semiconductor physics
- Electromagnetic Interference & Compatibility
  - Modeling and Testing – it is an art!
- Radiation Analyst
  - Importing FEM structural models and “ray tracing” to simulate high energy particle trajectories.
- Straylight Analyst
  - Non-sequential ray tracing, particulate scattering
- Contamination Analyst
  - Particle fallout, volatile deposition
- Quality Assurance Engineer / Manager
  - Needs good knowledge of all disciplines and excellent critical thinking abilities

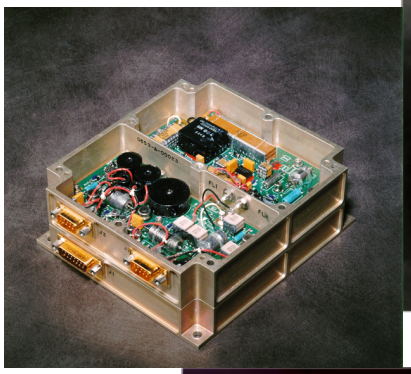
A Career in Industry

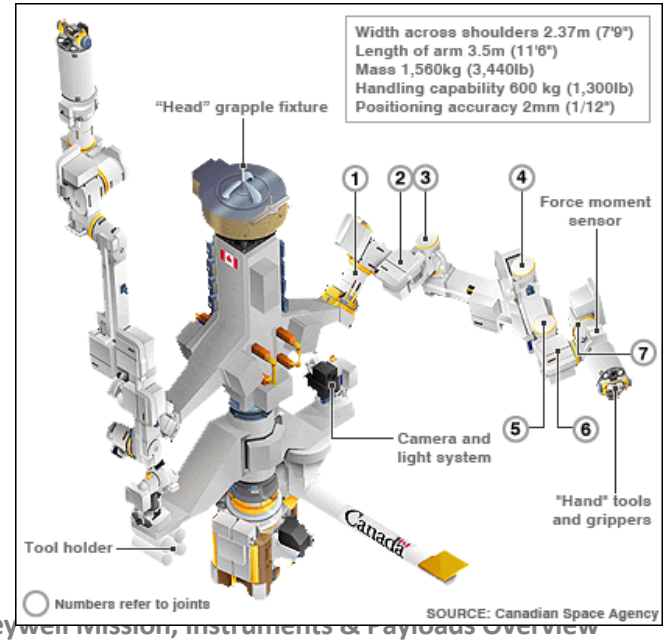
- Work with a rapidly expanding technology, one with the potential for lots of applications.
- Emphasize your ability to complete projects and get results (ie. proposal deadlines, finish before the funding runs out).
- Ability to analyze complex data sets, especially in non standard ways, ability to plan and execute the handing of “big data” sets.
- Software coding abilities. Large scientific models are often developed more efficiently than software industry standards.
- Ability to organize, manage and contribute to, multi-disciplinary teams.
- Project systems engineering – keeping one’s eye on what is important to achieve a successful experiment (project outcome).
- Ability to “speak science” and thus liaise effectively with the academic community.

Heritage Charts

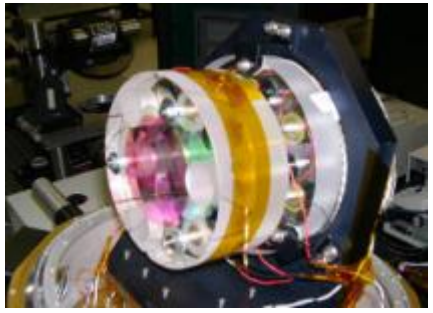
International Space Station Heritage

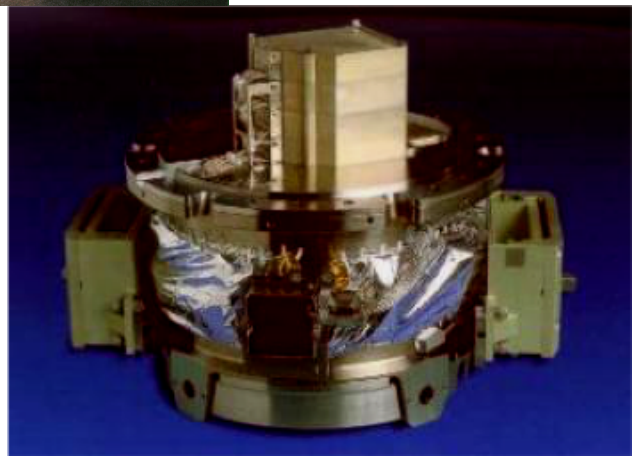
- Supplied critical force moment sensors to the Space Station Remote Manipulator System (SSRMS) and the Special Purpose Dextrous Manipulator (Dextre)
  - gives manipulator robots a sense of ‘touch’
  - Capacitive displacement sensors
- Canadian mobile base system electronics
  - remote power control modules
  - buffer amplifier



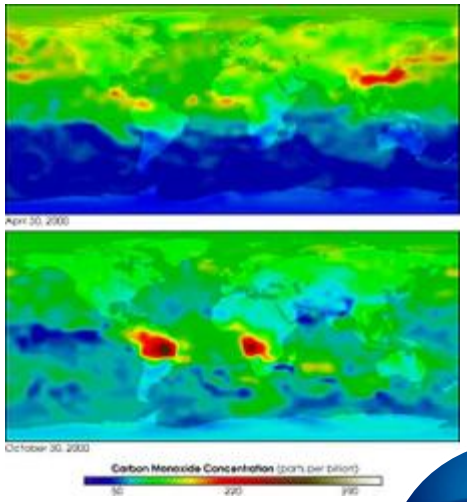


Capacitive Displacements Sensors also used in Fabry- Perot Etalons





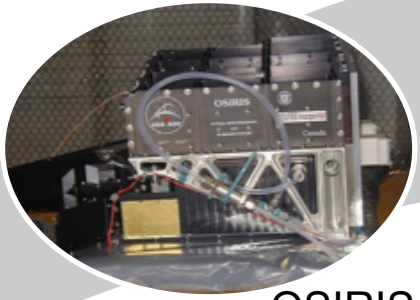
Atmospheric Instruments



Global map of CO (MOPITT)

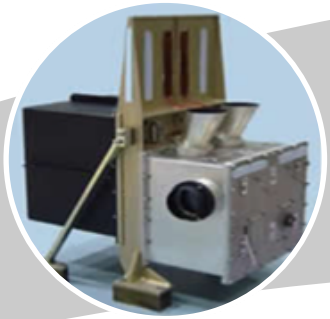
MOPITT on TERRA Operational 1999-

WINDII on UARS 1991-2005

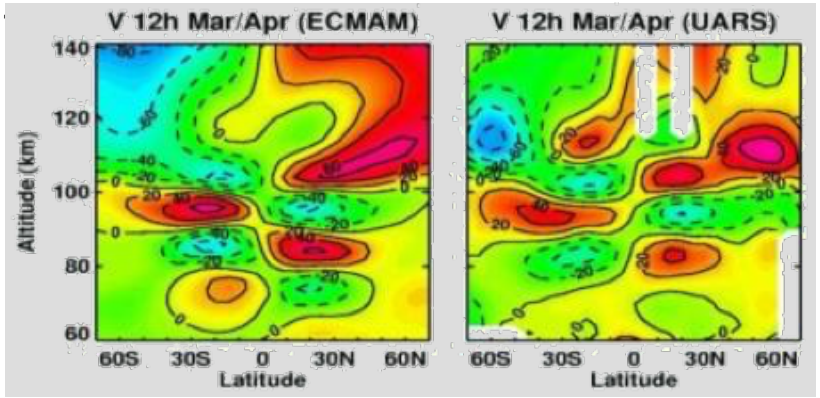


OSIRIS on ODIN

Operational 200

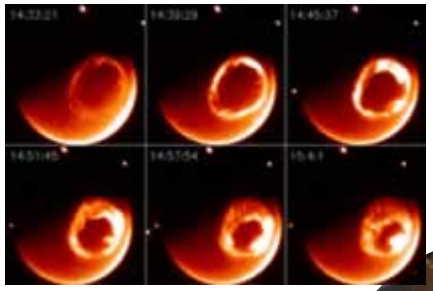


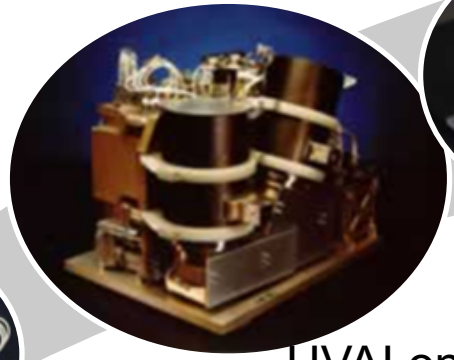
MAESTRO on SciSat Operational 2002-

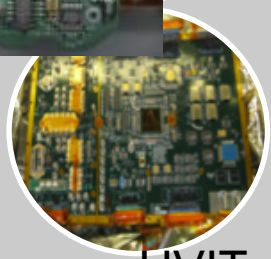


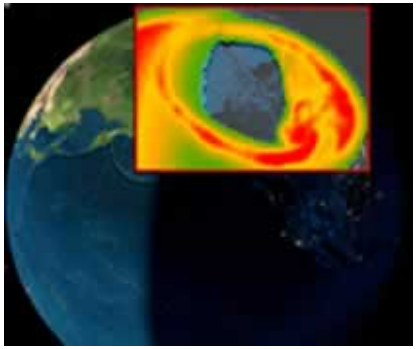
Wind field in Thermosphere, (model & WINDII data)

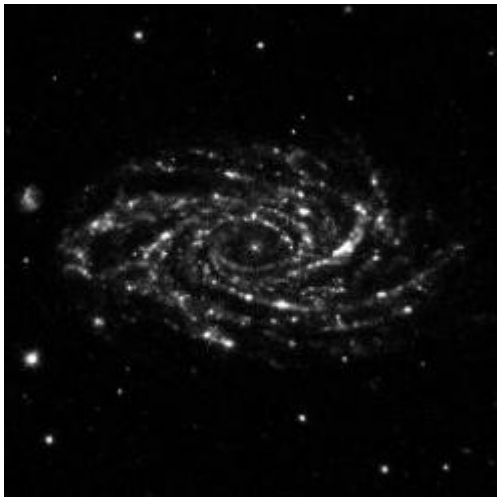
Ultraviolet Imagers











WIC optics on IMAGE 2000-?

UVIT camera on Astrosat 2015-

UVAI on Interball 1996-97

UVI on Freja 1992-1996

UVI on Viking 1986-87

UVIT image of NGC2336

Ion Optics Instruments

Suprathermal and Energetic Ion Mass Spectrometer (SMS) 1989-2015 Akebono

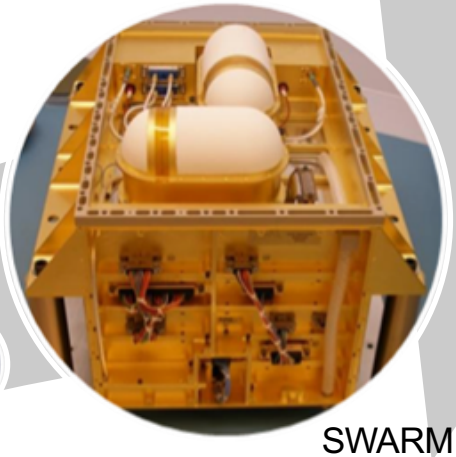
Cold Plasma Analyzer (CPA)

1992-1996 Freja

Thermal Plasma Analyzer (TPA) on Nozomi

1998-

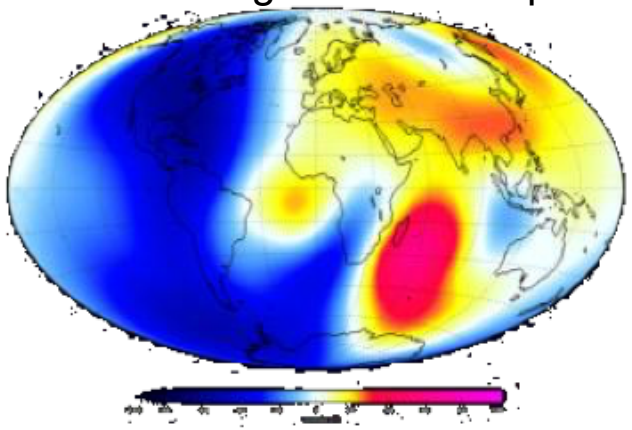
Failed Mars Orbit Insertion



SWARM Canadian Electric Field Instrument (x3)

Operational 2013-

SWARM Magnetic field map



Star Field Imagers and Guidance Sensors

Jason-1

Formosat-2

CALTRAC™ star tracker on

Jason-1 (2001-2013)

Mission success

Genesis-1 (2001-4)

Mission success

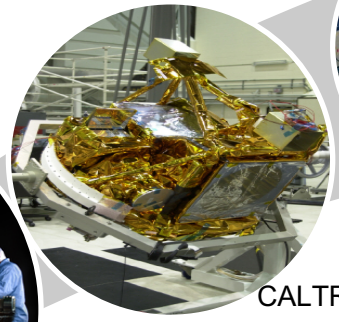
Formosat-2 (2004)

Still operational

FUSE Fine Error Sensor

1999-2007

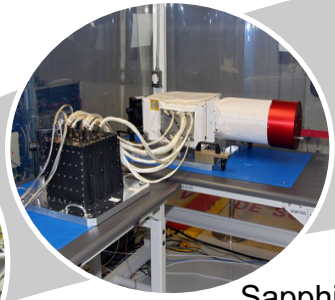
Mission success



CALTRAC™ on SciSat

Launched 2002

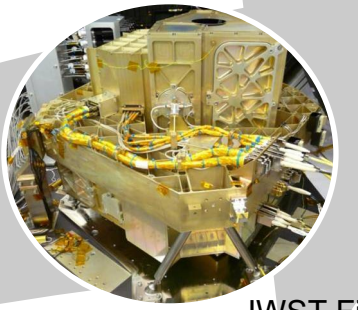
Still operational



Sapphire surveillance instrument

Launched 2013

Still operational



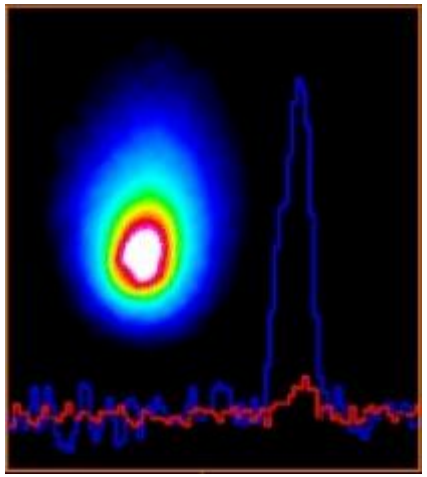
JWST Fine Guidance Sensor/ Near Infrared Imager and Slitless Spectrograph

Delivered 2013

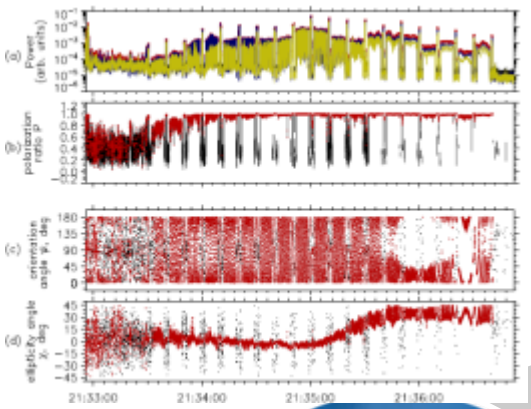
Integration and Test

OISL front end tracking head (patented centroiding algorithm)

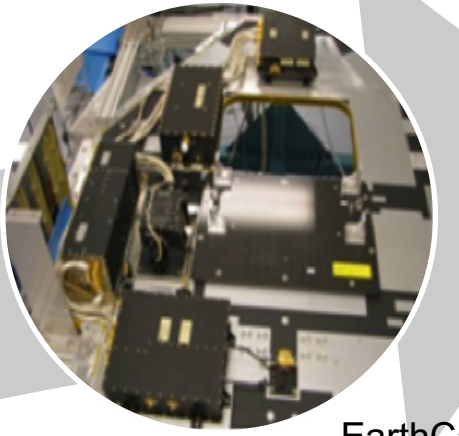
RF/Radar Instruments



HIFI Comet 103P/Hartley 2

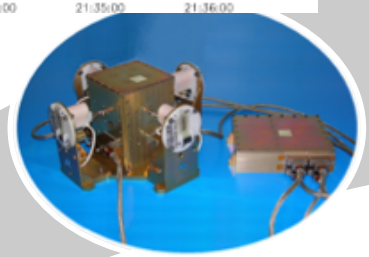


ePOP RRI HF ionosphere transmission power & polarization



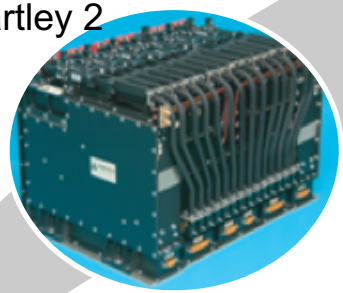
EarthCare Cloud Profiling Radar

Delivered 2013 to JAXA



ePOP Radio Receiver Instrument, MGF, and FAI, CASCADE mass memory unit

2013- on CSA CASSIOPE mission



Herschel HIFI 26-35 GHz local oscillator

2009-2013

successful mission

Cloudsat RF receiver

2006-

Still operational

CloudSat Cross-section of Hurricane Cloud