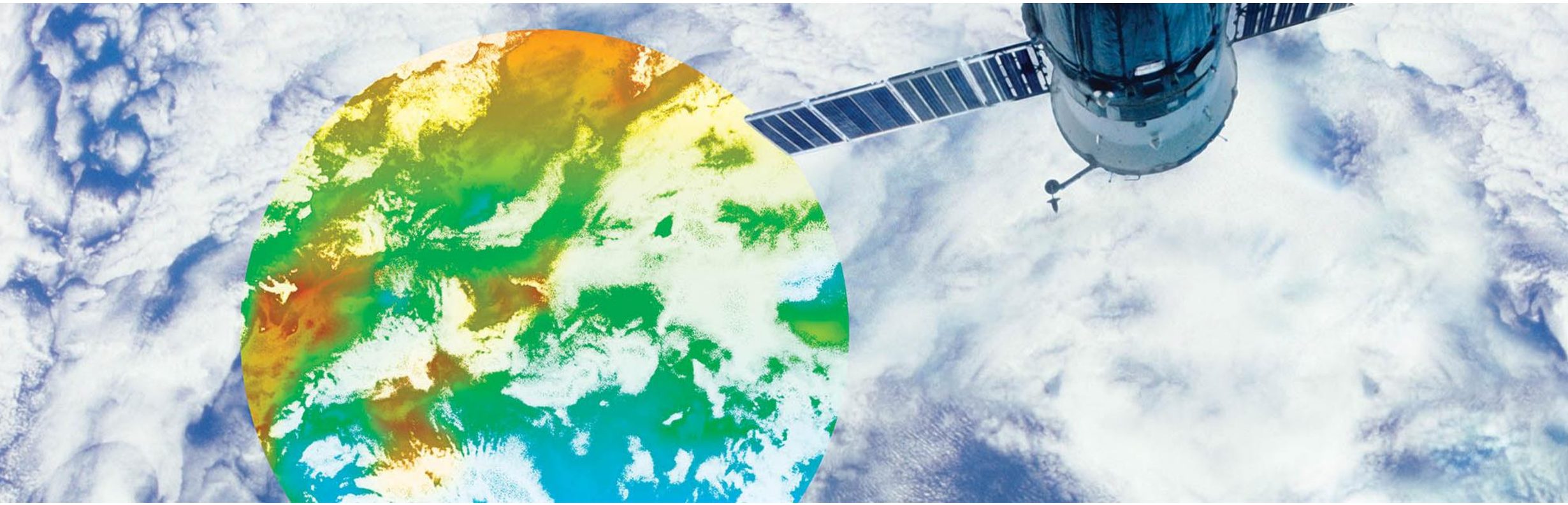


Working with / within an Optical System Integrator in Astronomy Projects

Frederic Grandmont

NTCO AGM, Victoria, Dec. 15th 2017

From an Astronomy Degree to a Career in Industry

- From my years of Ph.D in astronomy, those who left to industry would be viewed as drop-out or joining the dark side of working for evil capitalist…
- Yet 1 teacher will graduate ~15 Ph.D. student in his career… (more at M. Sc.) and will free only one researcher position upon retirement.
  Have to acknowledge that academic employment ratio are unfavorable!
- A career in industry is just as fun and rewarding!
  (albeith less scientifically… unless you get lucky. Think Penzias & Wilson)
- You will keep learning all your career and feel you contribute to the global effort to bring humanity into the future.
- You run high chance of enlarging your horizon to other field of science which do cool stuff too! (ex. solving the global warming problem!)

Working in Industry; a Competitive Environment

- We sell goods or services to customers… PRICE MATTERS! (even more so when customers could do your job!) The focus on cost reduction & increased efficiency is being felt in all we do.
  - Competitive bidding process is a constant reminder.
  - All hours are tracked in time sheet (down to 0.25 units). Must find 40 every week!
  - non-chargeable ones makes the labour rate go up…spend wisely!
- In spite of the above, industry always appear more expensive… why is that?
  - This perception appears from organizations which global operating expenses are partly covered “elsewhere” (ex. student cost to a project do not amortize the university building and administrative staff)
- Yet some fundamental difference remains:
  - Profit margin: We want 10% interest on our RRSP (made of cie stocks)
  - Sales: We have to go after future work… (ex. travelling to NTCO meeting)
  - All operating charges need to be reflected in what we sale (labour rates have little to do with employee’s pay). Accountant’s job is to make sure that flowdown reflects usage within the cie.
- Permanent job… WHAT?

Working in Industry can be Fun!

- Working on big & challenging projects
- Patent great ideas and solve customer's problem.
- Part of multi-disciplinary high efficiency team.
- Retribution based on performance keeps motivation high (important efficiency metric)
- Ability to layoff has some advantages…

ABB: An Optical System Integrator

Where do we fit in the Astronomy Grand Scheme

- ABB is not a component level supplier but a multi-disciplinary system integrator with a focus on optical instrumentation.

- ABB offering often overlaps with that of university labs and national Research Center.

- We are more expensive in most cases compared to internal rates. So when to call us?
  - Modern astronomy instrument are expensive, large, heavy, complex and takes years to assemble. Scope is not within the reach of every astronomy department.
  - These project typically required sizeable chunk of government money (a.k.a. tax payers). The question of economic impact of these investment matters to governments. The “what comes after”: job sustainability & creation, reusability of infrastructure, economic growth. Industry tends to be in a good position to spin the innovation wheel through their constant contract search and reuse of newly acquired expertise to create more business .
  - We have the structure an team expertise to take on these challenge. (Note that a NFIRAOS-level system is pushing it a bit!). Where we know less, we are eager to learn more.

Internships; Why we like them

- Industry is also looking to hire the brightest of their field. Grades don't tell everything…
- Internships are ideal to evaluate candidate fit to the industrial environment and motivation to pursue (loosing an employee after 2 years is seen as a failed hiring)
- Help accelerate future employee ramp-up upon hiring (less impact on the labour rates)
- Can help reduce our project cost if working on customer deliverables!!
- Candidates motivation toward a possible career path in industry is key for internship success.

Ongoing Astronomy Related Projects

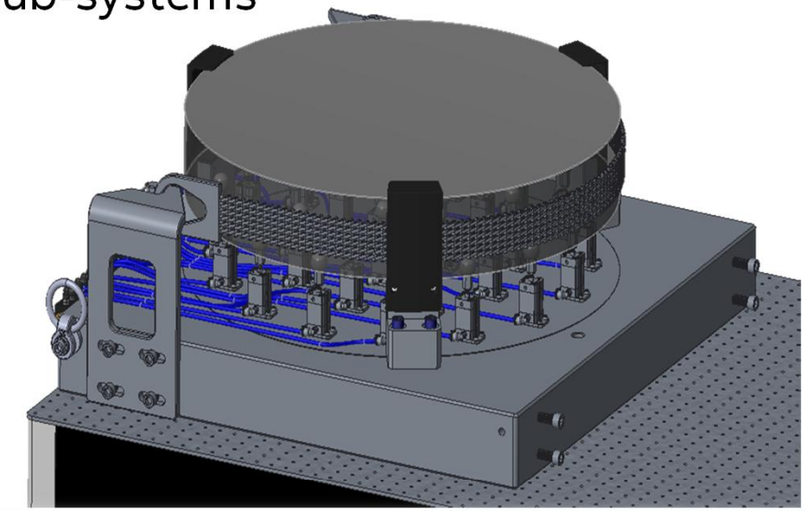
This is only a sample… more going on in earth observation!

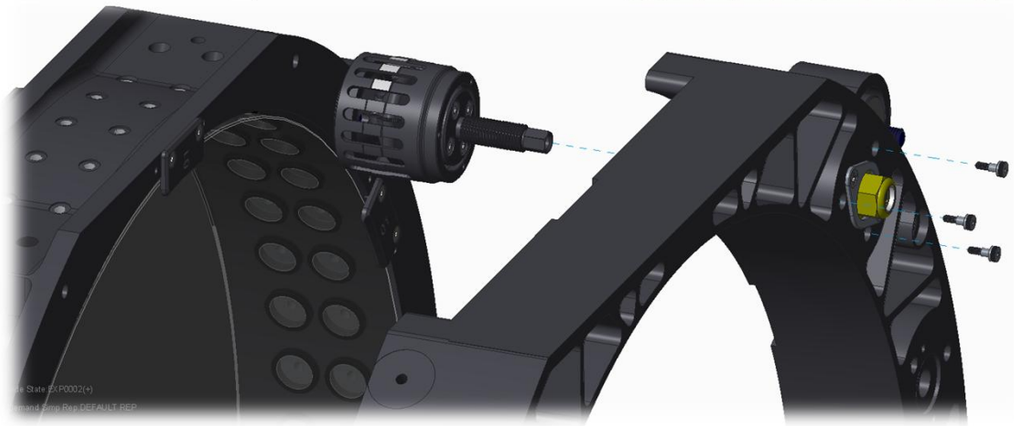
TMT NFIRAOS - OAP

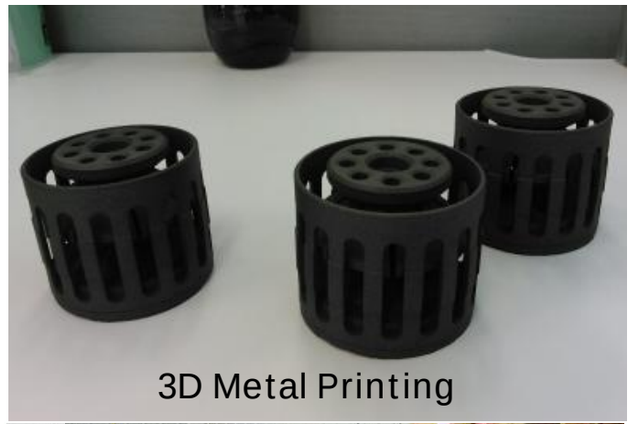
ABB is responsible for critical NFIRAOS sub-systems

Challenge :

- Support a 65cm optics without deformation in a tip-tilt-focus mount at -30°C
- Some mounted from the front, some from the back, some vertical, some at 45º
- Strict mass, and mount-unmount position repeatability requirements





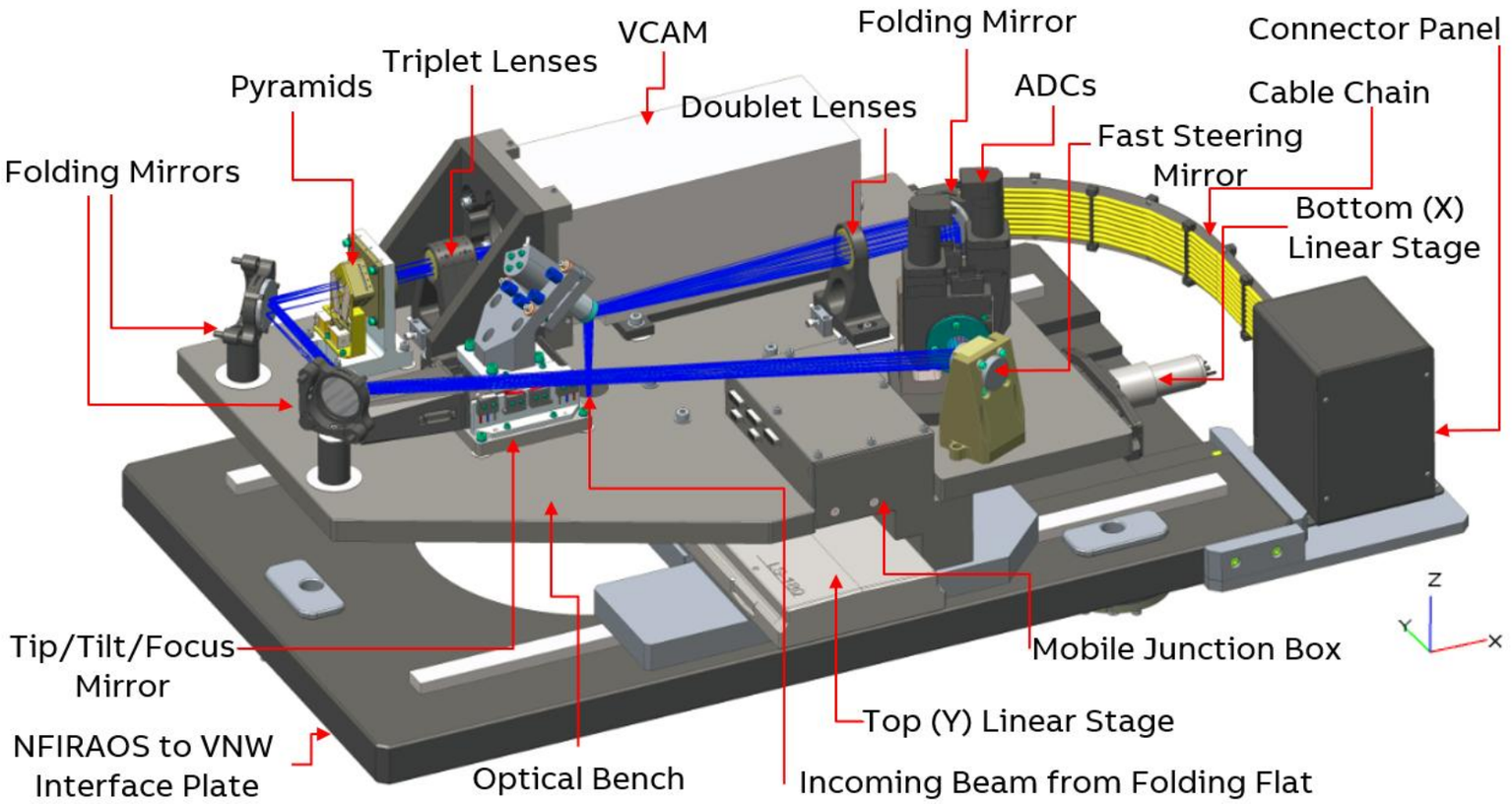


3D Metal Printing

TMT NFIRAOS - VNW

Challenge :

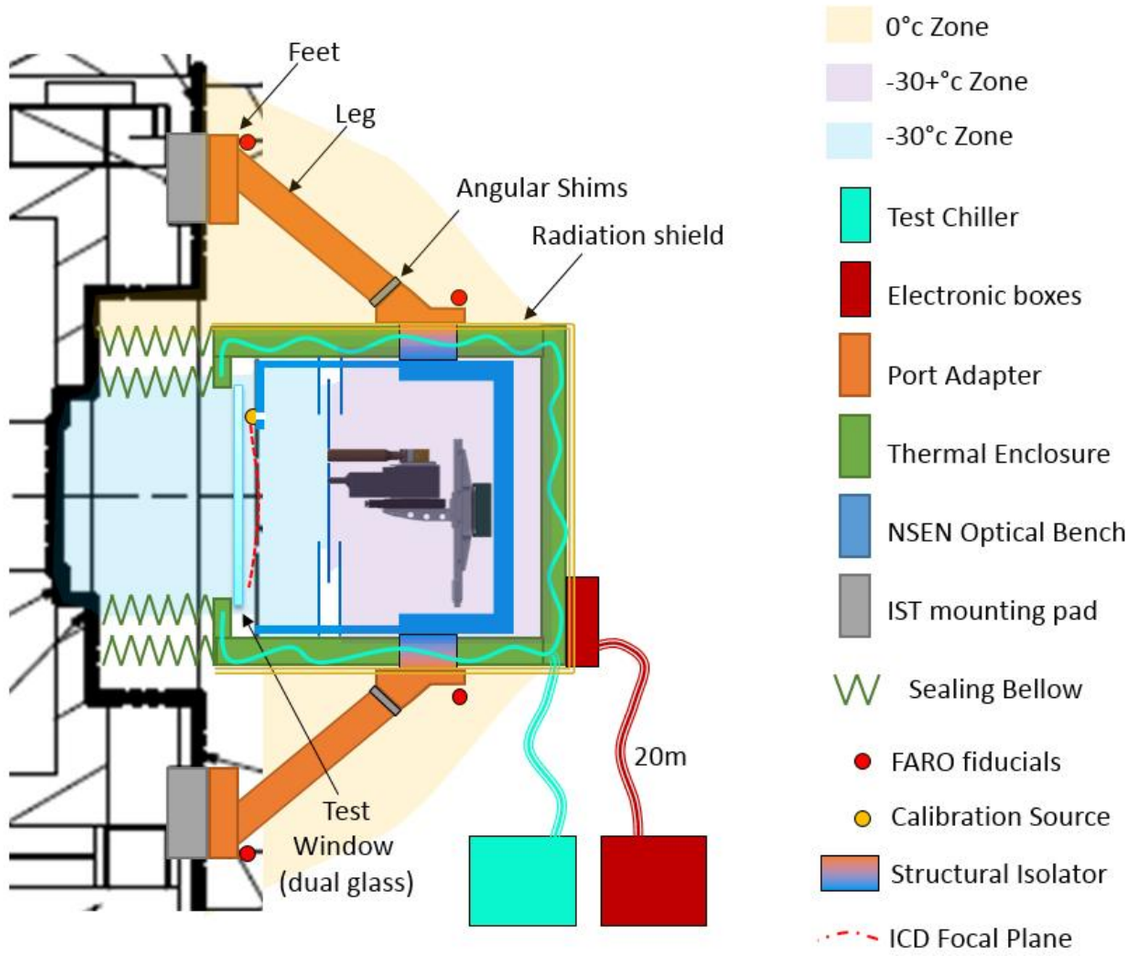
- Implement the pyramid wavefront sensor optical bench.
- Understand/challenge design constraints
- Provide all desired functionalities
  (lots of high precision mechanisms @ -30! Coupled to tight optical tolerances)



TMT NFIRAOS - NSEN

Challenge :

- NSEN is NFIRAOS's ultimate performance checker
- Find ways to validate imaging quality and NFIRAOS optical interface before mounting the new instrument.
- Should provide confidence that NFIRAOS is not the problem when troubleshooting future issues with instruments...



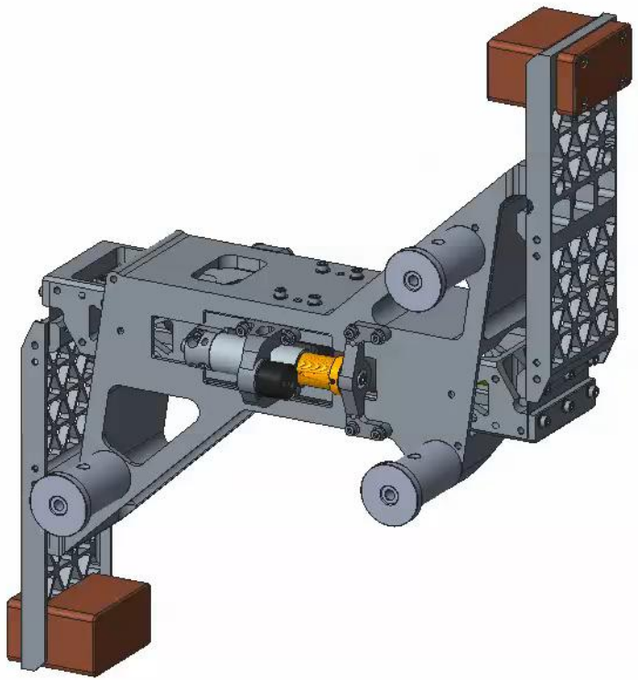
SPICA – Imaging Spectrometer Scan Mechanism

Challenge :

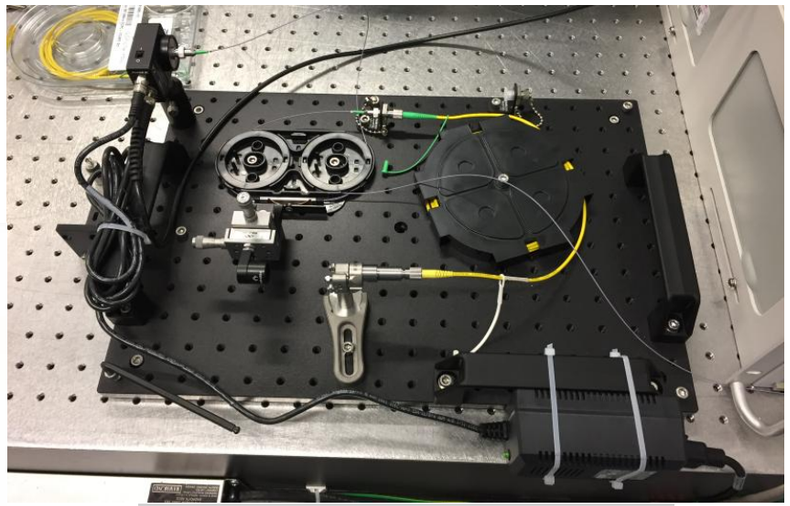
- Move mirror over 6 cm at constant speed or in a stepped fashion with 15 nm RMS precision/stability using a laser metrology system running at kHz refresh rate.

- Forgot to mention…
  - has to work at 4K!!
  - Cannot generate any heat (friction…)
  - No magnetic disturbance
  - Insensitive to spacecraft vibration

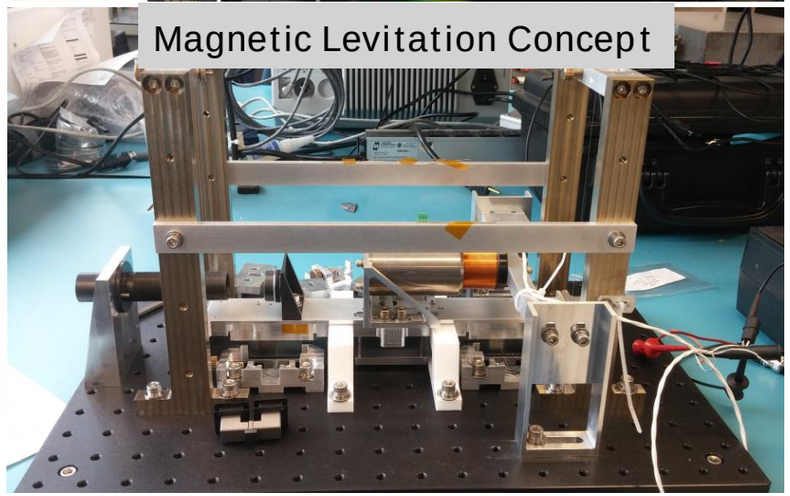
Flex Blade Concept



Single Fiber Laser Metrology Sensor



Magnetic Levitation Concept

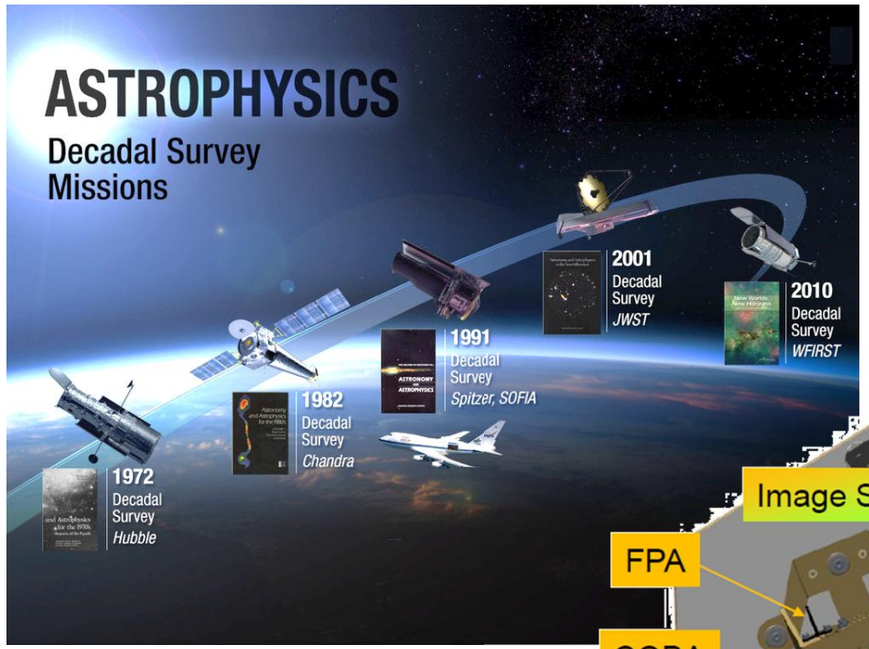


WFIRST - Imaging Spectrometer for NASA's Next Flagship Space Telescope

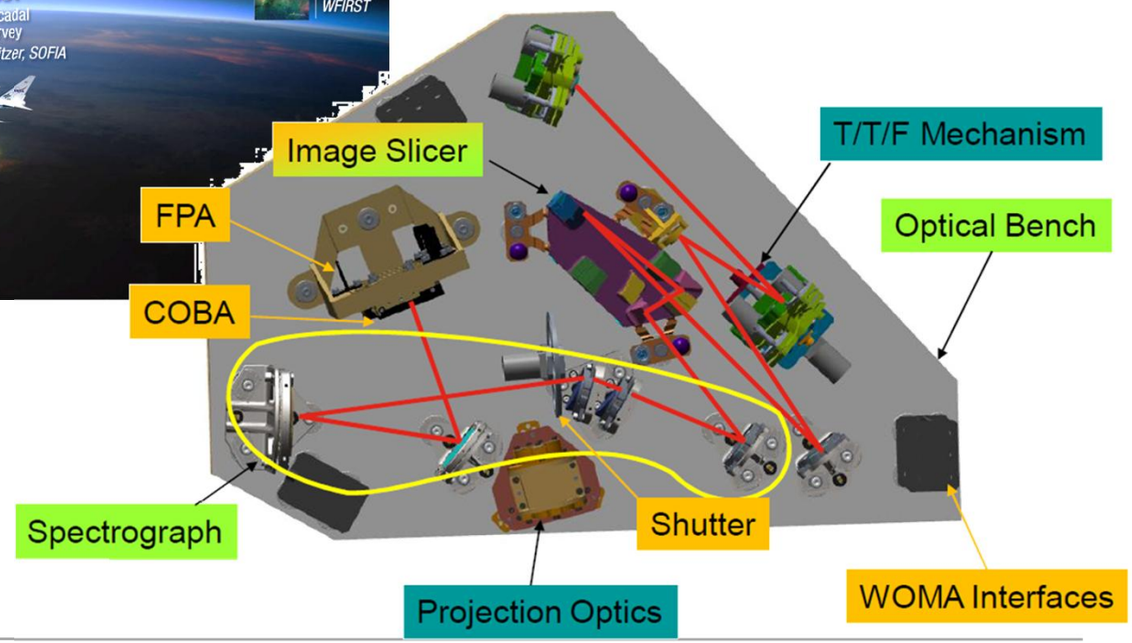
Can it get any cooler that that?

Challenge :

- Port an image slicer IFU design to space. More precise than that of JWST optical quality wise!
- Respect all NASA/CSA quality assurance rules (there are lots to follow!)
- Convince the CND gov that we can do it for a reasonable & predictable price!!



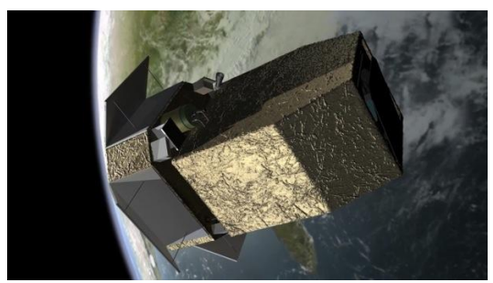
Honeywell



And More…

CASTOR

- Future Canadian Space Telescope
- Responsible for optical train behind telescope

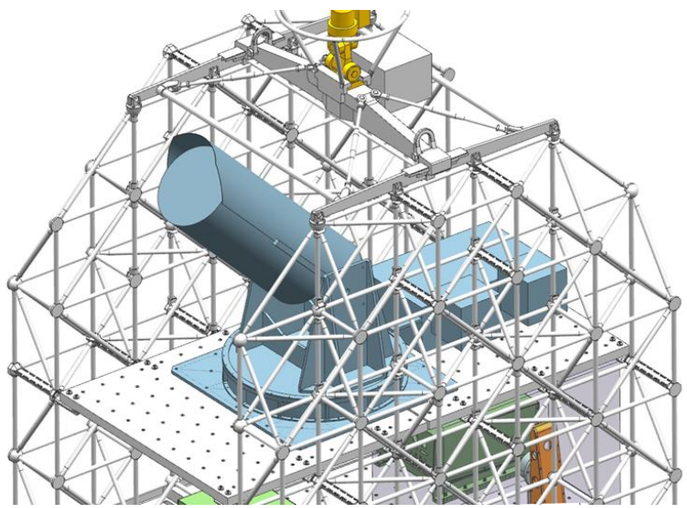


Honeywell

ABB

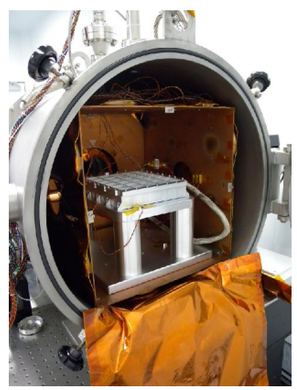
HICIBAS

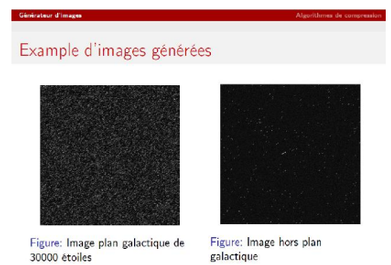
- Co-instigator of project
- Free Engineering Support J



Orbital Debris Imaging

- Sensor for orbital debris tracking
- Capture and encode light streak within high sensitvity camera.





ABB

nuvu cameras

UNIVERSITÉ LAVAL

Some Notable Past Astronomy Projects

SITELLE @ CFTH

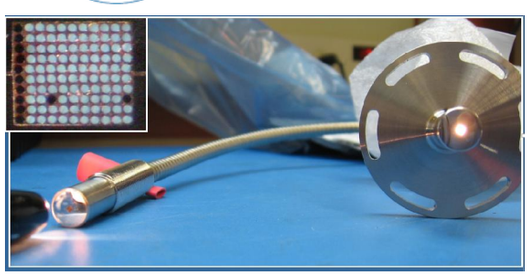
- First visible Imaging FTS operational on a large ground telescope
- FOV, spectral range & transmission larger than MUSE!

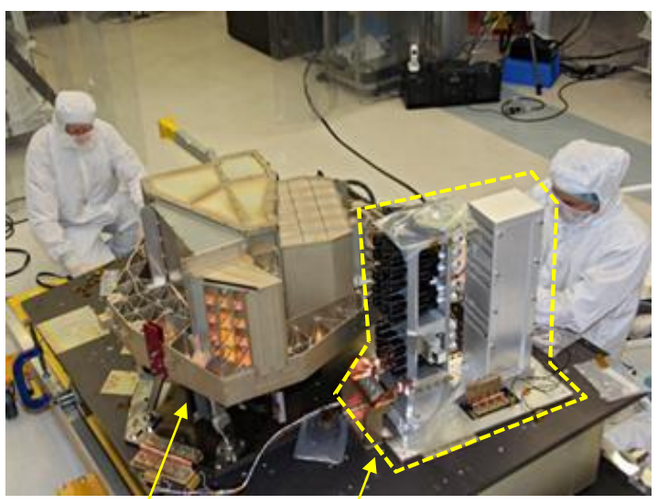
JWST OGSE

- ABB delivered the FGS-NIRISS starfield simulator
- Helped FTO develop its first imaging fiber bundle…

Honeywell

FTO FiberTech Optica





JWST FGS

ABB OGSE: JWST Star Field Simulator

ABB Measurement & Analytics, Quebec

Keeping an eye on the air we breathe…

From ground platforms

- Online multi-gas sensing for smokestack emission monitoring
- MobileGuard for portable trace gas sensing

Through drone and plane based instruments

- Embedding multispectral & hyperspectral imaging over various spectral range (UV to LWIR)

Up to high altitude plane and balloon based

- Research experiment
- Space hardware demonstration

Into space missions

- ABB spectroscopic engines powers critical earth observation missions of leading agencies from the US, Europe, Japan & Canada.

Conclusion

- While graduate studies tend to align student on scientific career, the basin cannot hold all graduate and must also promote career in industry which is what NTCO is all about.
- Career in industry should be viewed positively by students. Competition positively influence motivation for many.
- It is not about making more money. Somewhat similar to public sector unless you jump the fence into management!
- Working on large astronomy projects present challenge in every aspects regardless at which level you work. They are all equally important to the discovery.
- ABB is happy to partner in NTCO and hopes to find opportunities for student internships.

www.abb.com/spacedefense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