

Designing All Sky Camera for the AMISR

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- Programming
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High Altitude Observatory (HAO)



Outline

- The AMISR Facility
- The Fabry Perot Interferometer
- All Sky Camera :The Hardware
- All Sky Camera: The Software Components



The Big Mission : AMISR

- Advanced Modular Incoherent Scatter Radar (AMISR) is a mobile radar facility that will be used by scientists to study rapidly changing upper atmosphere and space weather.
- It is a 44 million dollar project funded by NSF and designed by SRI to be set up partly at Alaska and partly at Resolute Bay, Canada.
- The All Sky Camera is part of this mission

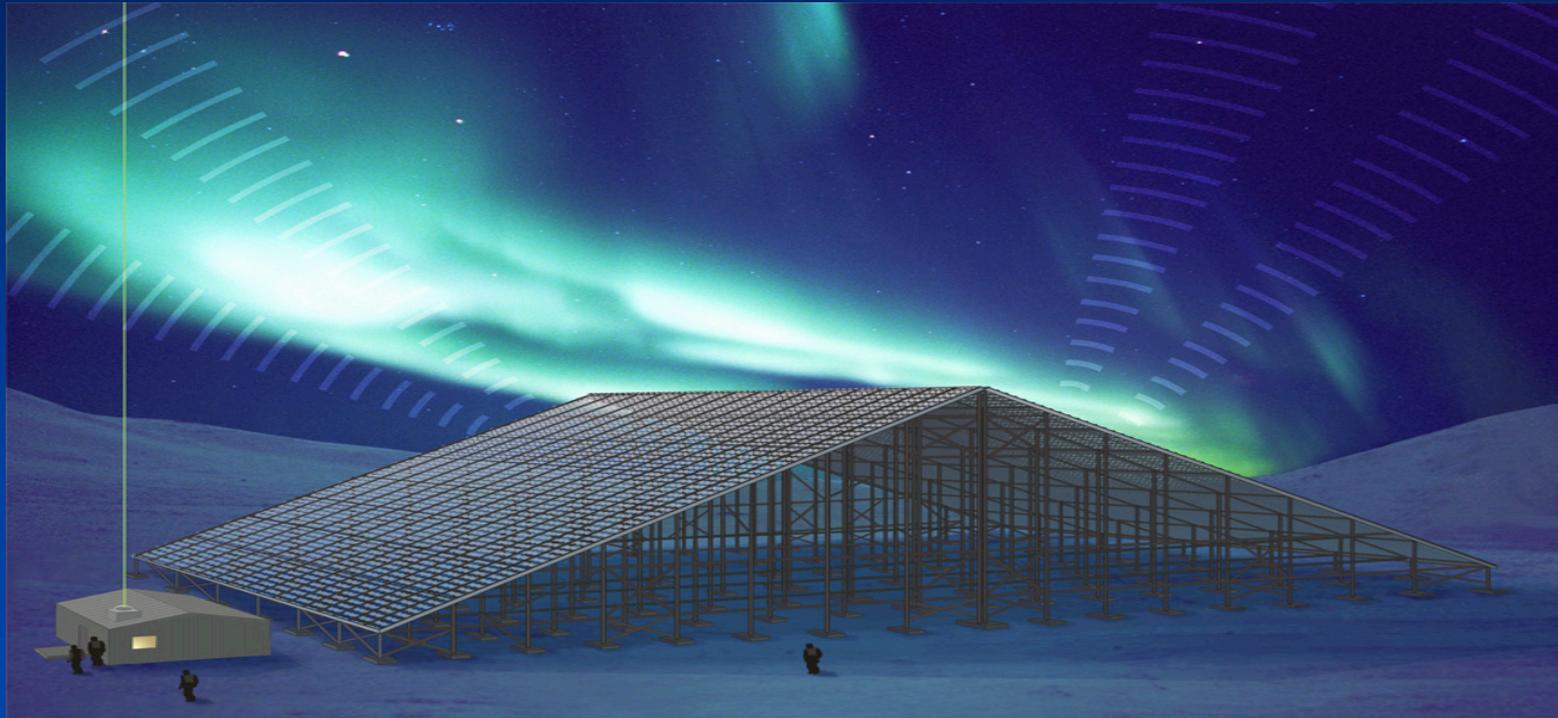


Specialties of the AMISR

- Its modular configuration will allow it to be disassembled and moved across the globe to study space weather.
- Each face functions independently and can be therefore deployed in 3 separate locations at the same time
- Its remote operation and electronic beam steering will let researchers remotely operate and position the radar beam



A Conceptual Drawing



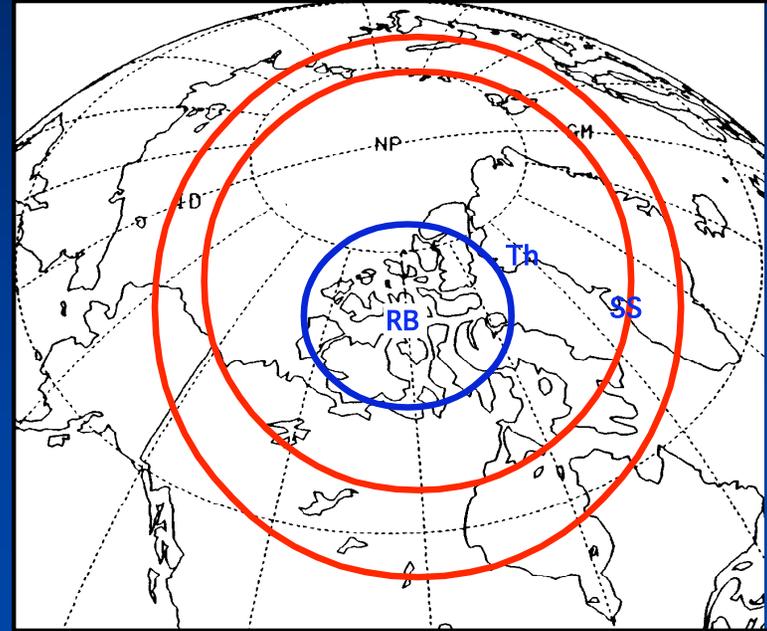
These are two faces of the AMISR. Each face functions independently and each comprises of 128 building block like panels over a 30x30 meter roughly square surface

Why at Resolute Bay ?

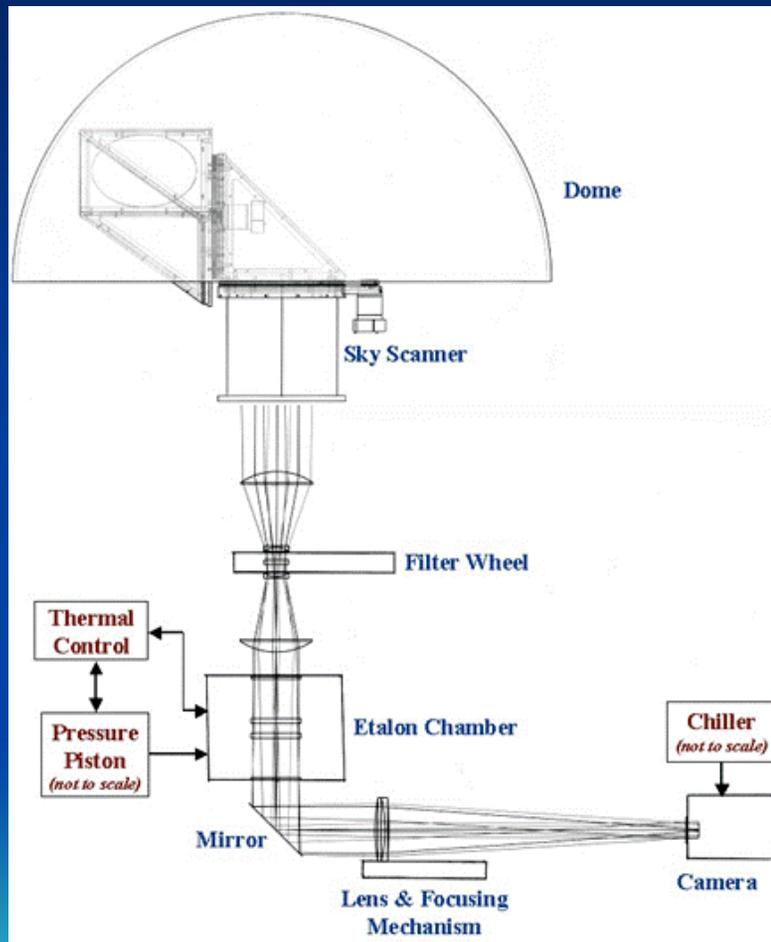
1. It is located deep inside the polar cap where there are regular airline flights
2. It is the location of the polar cap observatory designed by SRI
3. Being at the polar cap you can observe aurora and interactions between space weather events and the ionosphere



Resolute Bay



Fabry Perot Interferometer



Major Components

Sky scanner

Filters & filter wheel

Etalon & chamber

Thermal & pressure control

Focusing lens

Detector

Computer system

Etalon coating reflectivity 80%

Etalon gap 2 cm

Back-illuminated CCD with

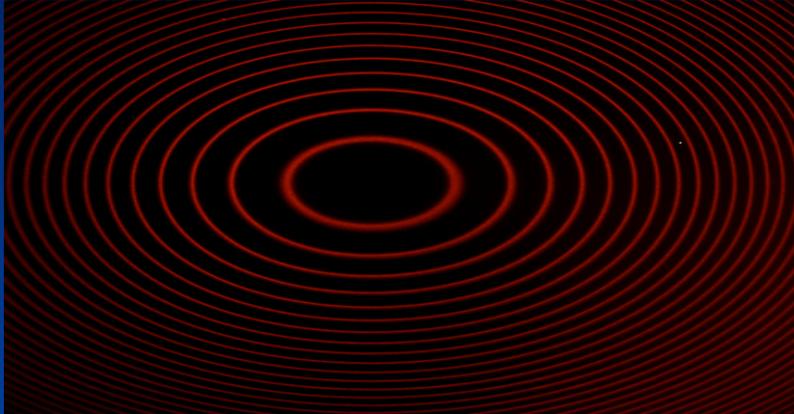
1024x1024 pixels

CCD temperature -55 C

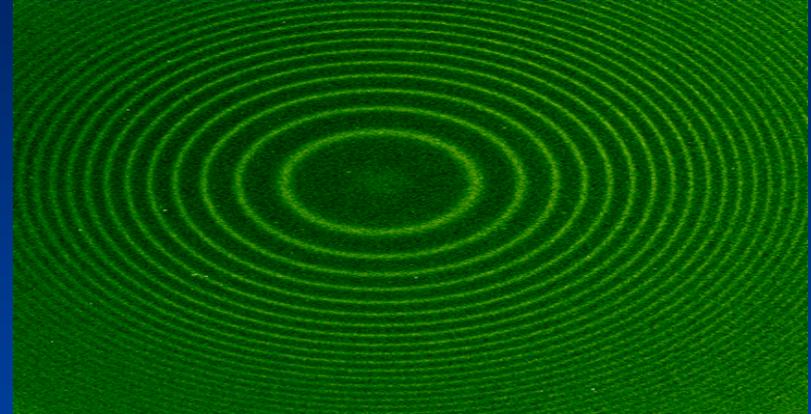
CCD readout noise 4 electrons

Filter wheel position 8

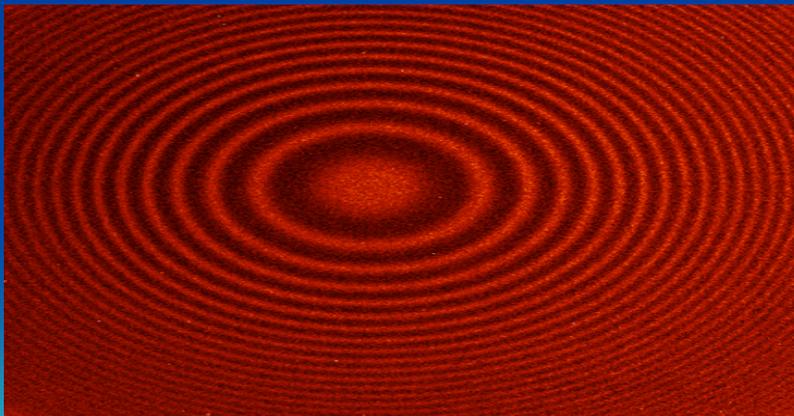
Some FPI Fringes



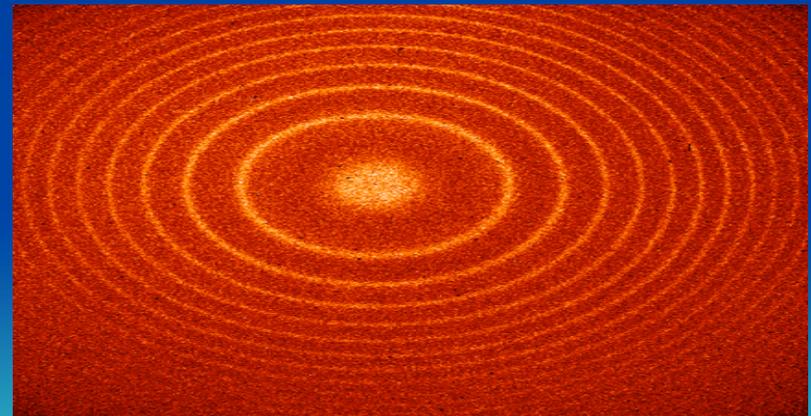
Laser



5577



8920



6300

The Actual Instrument

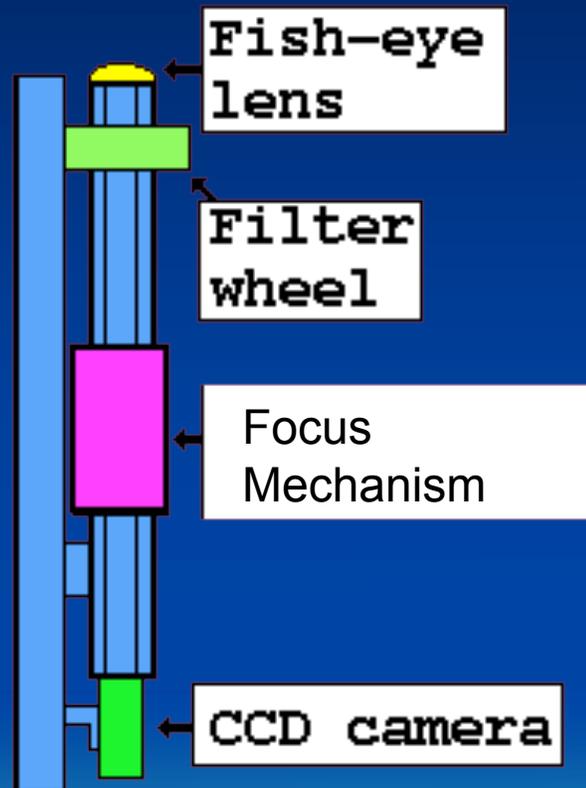


Why is All Sky Important for AMISR ?

- It is the “ Eye” for the AMISR.
- It will take images of the upper atmosphere and will determine aurora and gravity waves.
- It will give the scientist sitting in a remote place the information to where to point the radar beam.



The All Sky Camera



The Components of the Instrument

1. Fish Eye Lens
2. Filter Wheel
3. Focus Mechanism
4. Andor CCD Camera

The Actual Instrument



Specialty of This All Sky Camera

- It has a focus mechanism unlike the previous one which it is replacing
- The focus mechanism enables the All Sky to focus all wavelengths and we don't have to compromise in terms of range of wavelengths. (Focal length is dependent on wavelength of radiation incident on it)
- Will also give sharper and brighter images



Aurora Images

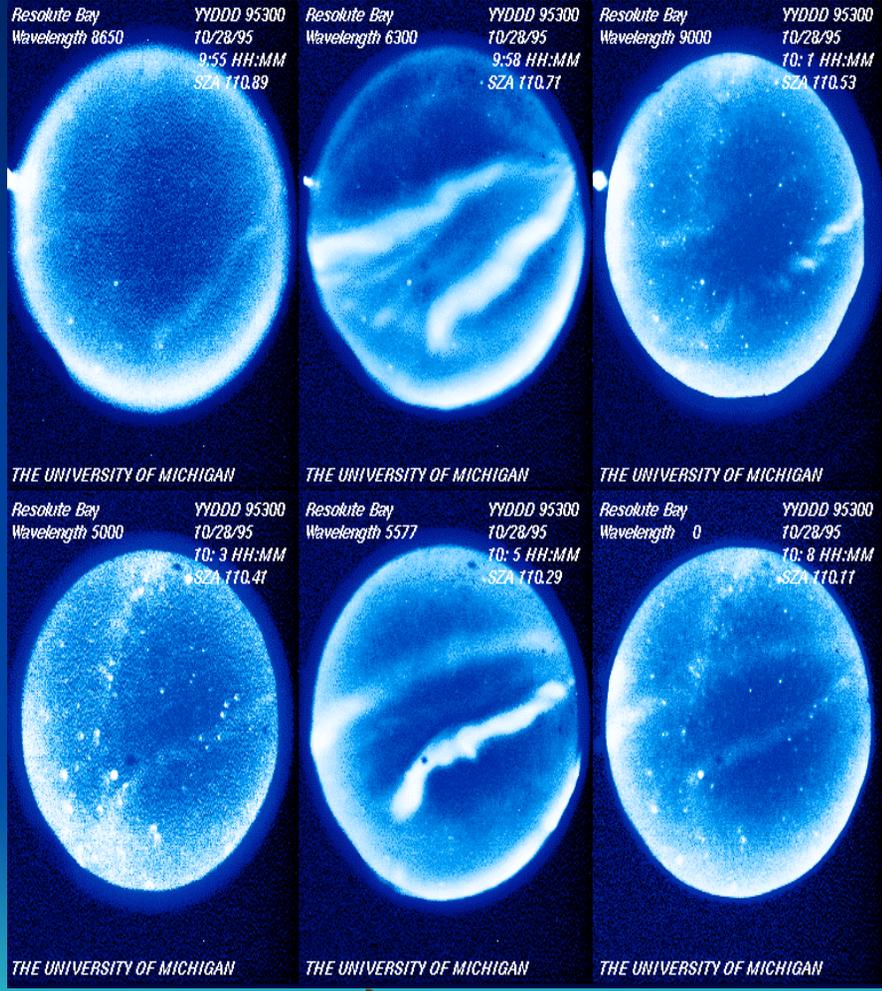
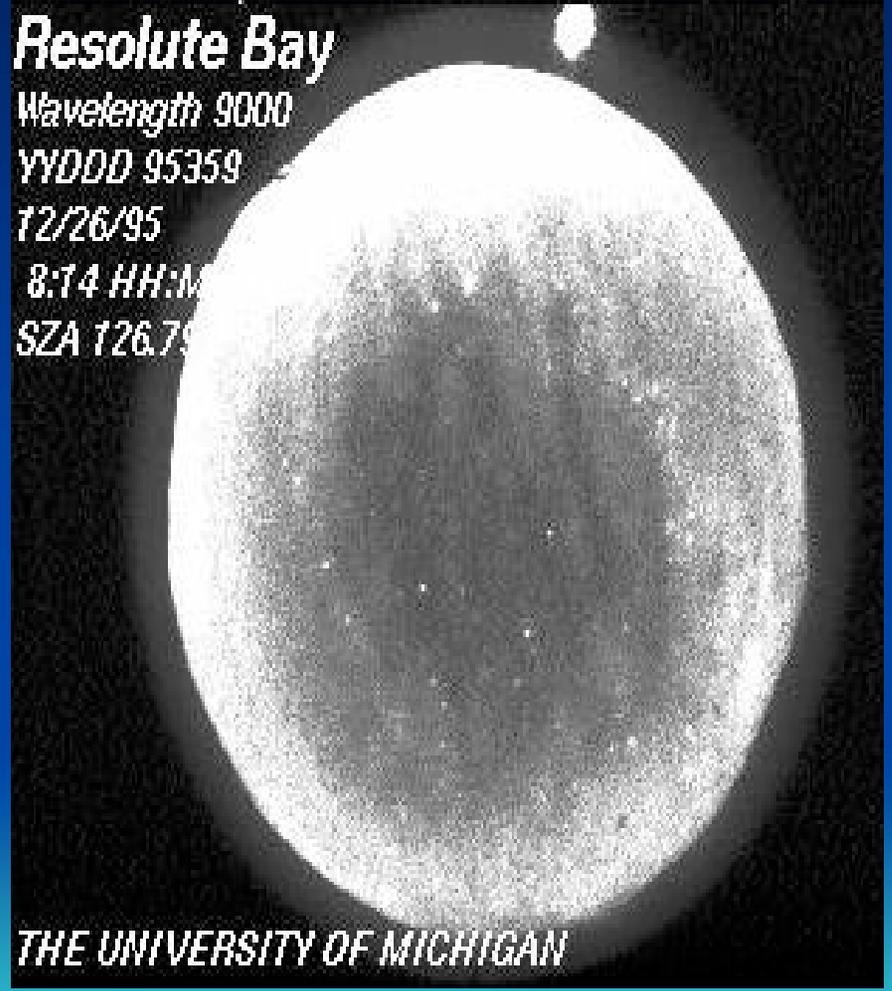


Image of a Gravity Wave



My Goal: Design the Software

1. To integrate all these devices under one Graphical User Interface (GUI)
2. To write the software for controlling the CCD Camera separately
3. To write the software for controlling the filter wheel separately
4. To write the software for controlling the focus mechanism
5. To write the software to enable the All Sky Camera to run scripts
6. To write the code to save the images in memory as fits file along with relevant information

The Camera Code

The software enables the camera to:

1. Initialize the camera , get the detector size, start the cooler, set the temperature
2. Set the exposure time
3. Take an exposure and bin the image before reading out
4. To shut down the camera



The Filter Wheel Code

- It enables the filter wheel to :
 1. Initialize the filter wheel
 2. Set the filter wheel to a particular slot
 3. Give information about which slot presently the filter wheel is in
 4. Advance the filter wheel by one slot at a time.



The Focus Mechanism

The software enables the Focus Mechanism to:

1. Home the focus and start the Motor
2. Get the current position
3. Take the focus to a desired location
4. Test communications
5. Stop the motor.



The Code for Scripts

- It enables the All Sky to :
 1. Load a Script
 2. Check the Script
 3. Check if the sun is out and then run a script
 4. Run the script for whole day and stop at night and again start the next morning
 5. Make the All Sky Camera wait for a particular local time and then start taking pictures.



Code to Save Data

- The Code does the following :
 1. Creates a directory with the current date and saves the images as fits files
 2. For each image taken it saves its following information:
 1. Date and Time (including seconds)
 2. Exposure time of the camera
 3. Filter Wheel and Focus Position



Results and Accomplishment

We do now have a working All Sky Camera with a complete software ready to be taken and installed at Resolute Bay, Canada !!!

