# Project HiCIBaS

## High-Contrast Imaging Balloon System


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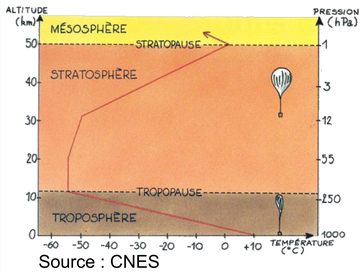
(Names arranged in alphabetical order)


## Mission Goals

- Develop and test a new type of Low-Order WaveFront Sensor (LOWFS)
- Develop and test a sub-milli-arcsecond-level pointing system
- Gather data on and study high-altitude wavefront instabilities and errors
- Test optical components (DM, Coronagraph) for future high contrast imaging missions
- Fly the technology in space-like conditions

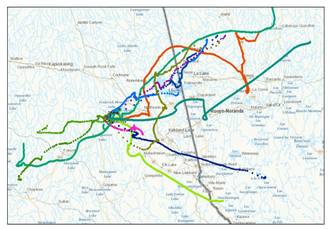
## General Mission Information




Source : CNES

### Environmental Conditions

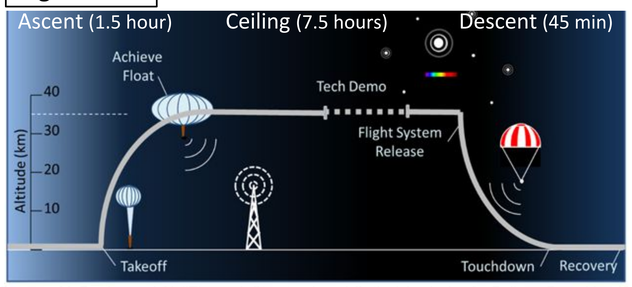
Temperature: down to -60°C
Pressure: down to 0.5 kPa
Humidity: up to 100%



### Possible Balloon Trajectories

Launch Location: Timmins
Stratospheric Balloon Base (Ontario)
Target Launch Date: September 2018

### Flight Profile




Source : M. Borden and Al. ''Thermal, Structural, and Optical Analysis of a Balloon-Based Imaging System,'' Publications of the Astronomical Society of the Pacific, Volume 129, Number 973, (2017)

## Milestones

**April 2016 : Grant start**

**December**
Conceptual design review

**2017**

**June-July**
Kickoff meeting with scientific teams (Payloads portfolio)

**August**
Prelimary Design Review (PDR)

**2018**

**January**
Configuration of Payloads on gondola + Mission profile

**April**
Submission of the payload backup file

**March**
Final Design Review (FDR)

**May**
Launch capability review

**May**
Integration, Assembly and Test Review (IAT)

**July**
Final review with CSA

**August**
Flight Preparation at Timmins

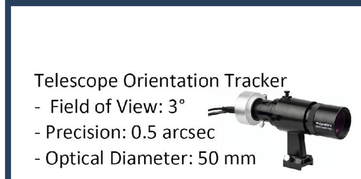
**SEPTEMBER 2018**
**Stratospheric Balloon Launch**

**October**
Data Analysis

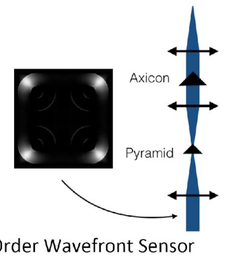
**March**
Post flight Review

**END**

## Technology




Telescope Orientation Tracker
- Field of View: 3°
- Precision: 0.5 arcsec
- Optical Diameter: 50 mm




Low-Order Wavefront Sensor
- Milliarcsecond sensitivity
- Maximum 20 arcsecond tip/tilt error
- 250 Hz refresh rate

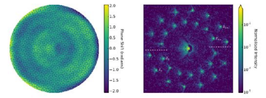
Light Detection and Imaging
- EM Gain: 1-5000
- Quantum Efficiency: > 90%
- Dark current: 0.0002 ē/pixel/s
- Clock-induced charges: 0.001 ē/pixel/s

Light Collection
- 14'' Schmidt-Cassegrain (f/11)
- Light-Gathering Power Relative to the Human Eye: 2581x

Telescope and Light Stream Orientation
- Equipped with gyrometer for pointing efficiency
- Precision: 0.3 arcsec

Wavefront Correction
- Inscribed Aperture: 3.5 mm
- 37 Piston-Tip-Tilt Segments
- Open-Loop Flat Surface
Figure: < 20 nm rms

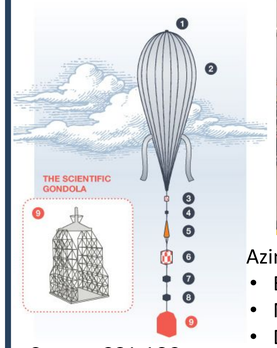
Coronagraphic imaging and focal-plane wavefront sensing of PSF [1]
- No invasive modification of the science PSF
- Does not require Fourier transforms
- Display holographic PFS copies



Pupil-plane phase  Focal-plane PSF

[1] M. J. Wilby and Al. "The coronagraphic Modal Wavefront Sensor: a hybrid focal-plane sensor for the high-contrast imaging of circumstellar environments", A&A 597, A112 (2017)

## Carmen-2 Pointing Gondola




Source : CSA-ASC

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Azimuth Orientation Control
- Empty Structure Weight: 335 kg
- Max. Launch Weight: 1170 kg
- Dimensions (L x W x H) : 2106 x 1846 x 2822 (mm³)

## STRATOS, CSA Balloon Program

This program gives academic and industrial projects a way to perform scientific experiments at stratospheric altitudes using balloon flights. This provides a way for small teams to test new equipments and novel experiments in near space conditions.

## Flight and Fieldwork for the advancement of Science and Technology (FAST)


This work is supported by the FAST program, granted by the Canadian Space Agency. This program gives an opportunity to train highly qualified personnel by supporting projects involving students and young researchers.


*Shaping light one ray at a time*