

Introduction

In order to validate the ozone data from ground-based Brewer instruments and satellite-based instruments measuring ozone, a series of balloon-based experiments will be conducted. The SPS (SunPhotoSpectrometer) will be flown on board the PARABLE (Payload for Remote sounding of the Atmosphere using Balloon Limb Experiments) training program. In order to achieve fine sun tracking for spectrometer based instruments onboard balloon experiments or satellite missions a new pointing system is being designed and built.

PARABLE will act as a balloon platform flying at 35-40km to conduct measurements of trace gases and aerosols using solar occultation and limb measurements.

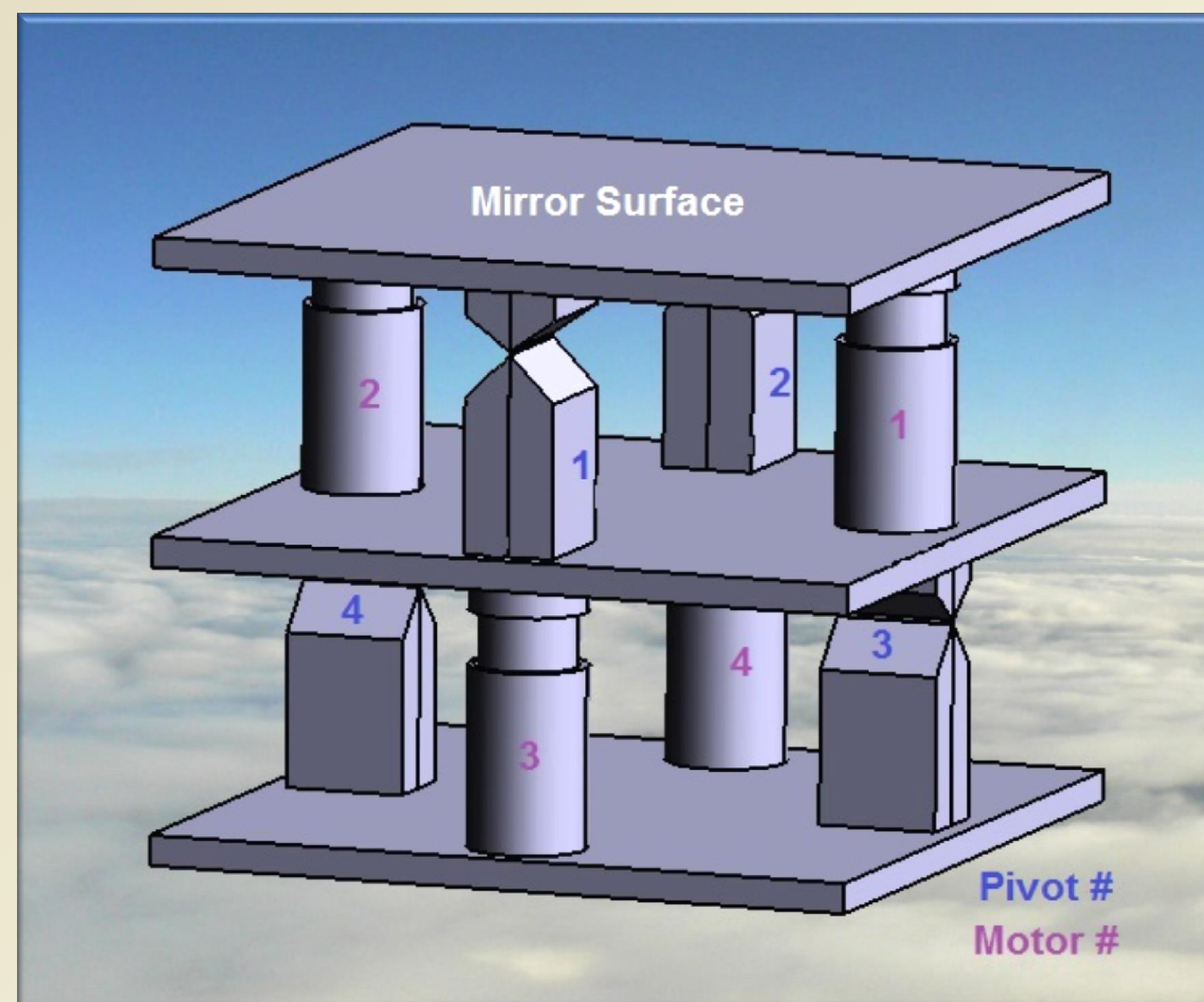
The pointing system acts as fine tuning for the sun tracking platform on which SPS will be flying on. This sun tracker could be a solar tracking satellite or a solar tracking balloon gondola. In order to add an extra 5-10% accuracy to the tracker, an additional pointing system is designed for the SPS on board the gondola.



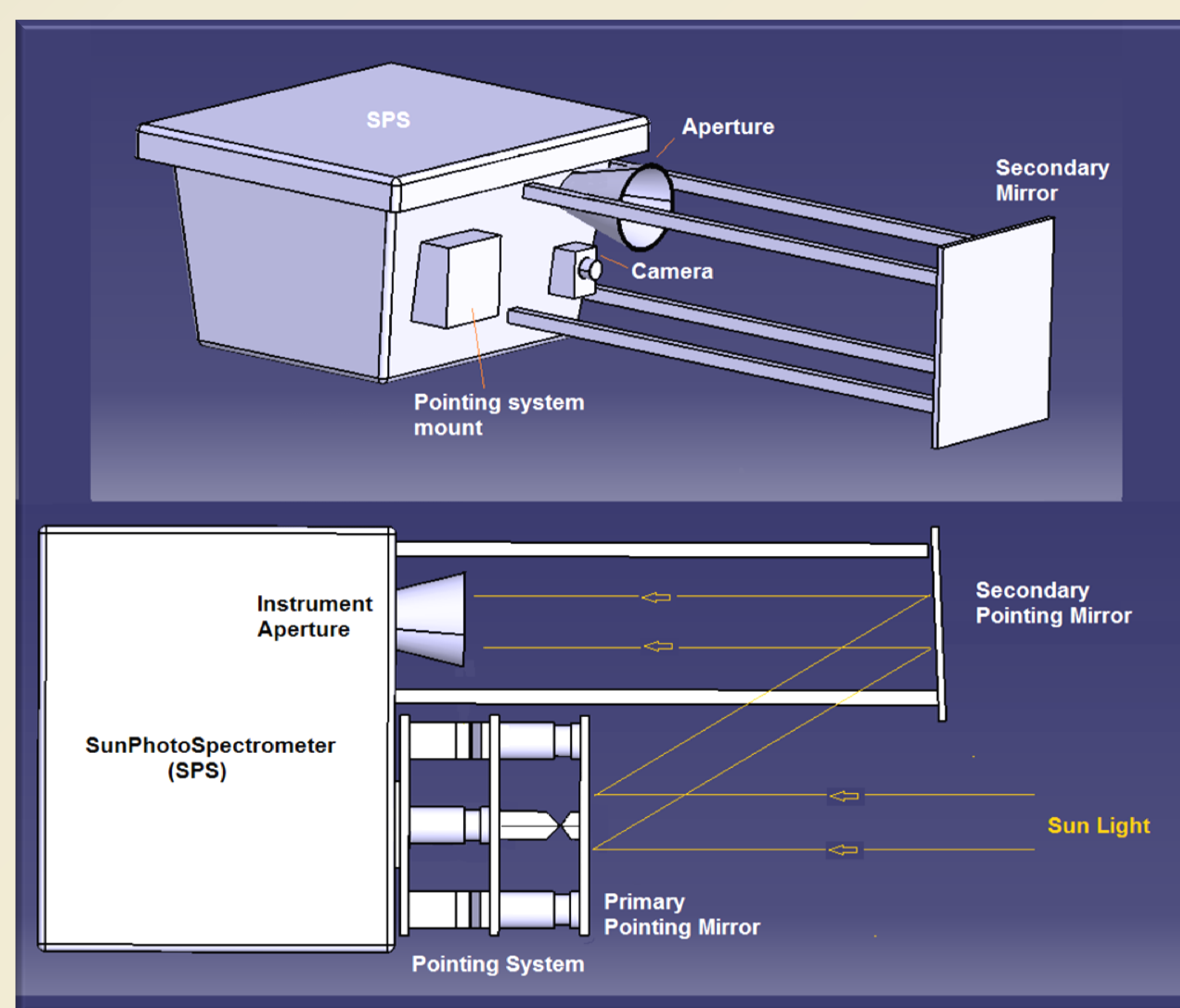
SPS (right) and MAESTRO (left) mounted on a sun-tracker at PEARL station in Eureka, Canada



MANTRA mission launch in 2002 similar to the PARABLE mission balloon.



Mechanical design of the pointing system.



Mounting the pointing system on SPS.

Assembly

The pointing system will be mounted on the instrument and an additional mirror will guide the sun beam into the instrument aperture.

A small camera will be placed in proximity of the instrument aperture and will act as the feedback to the software controlling the pointing system.

Hardware Design

The requirements for such a pointing system are:

- $\pm 2.5^\circ$ to $\pm 5.0^\circ$ travel range angle
- 10Hz frequency
- Small and light weight
- Simple and space qualified
- Based on a two axis tilt mirror concept
- Comprised of three panels, four voice coil motors and four pivot points or hinges.
- Maximum travel range angle: $\pm 2.5^\circ$ and including the reflection the ability to track over $\pm 5.0^\circ$.
- Material: aluminum.
- Motor: Voice coil (Magnetic)



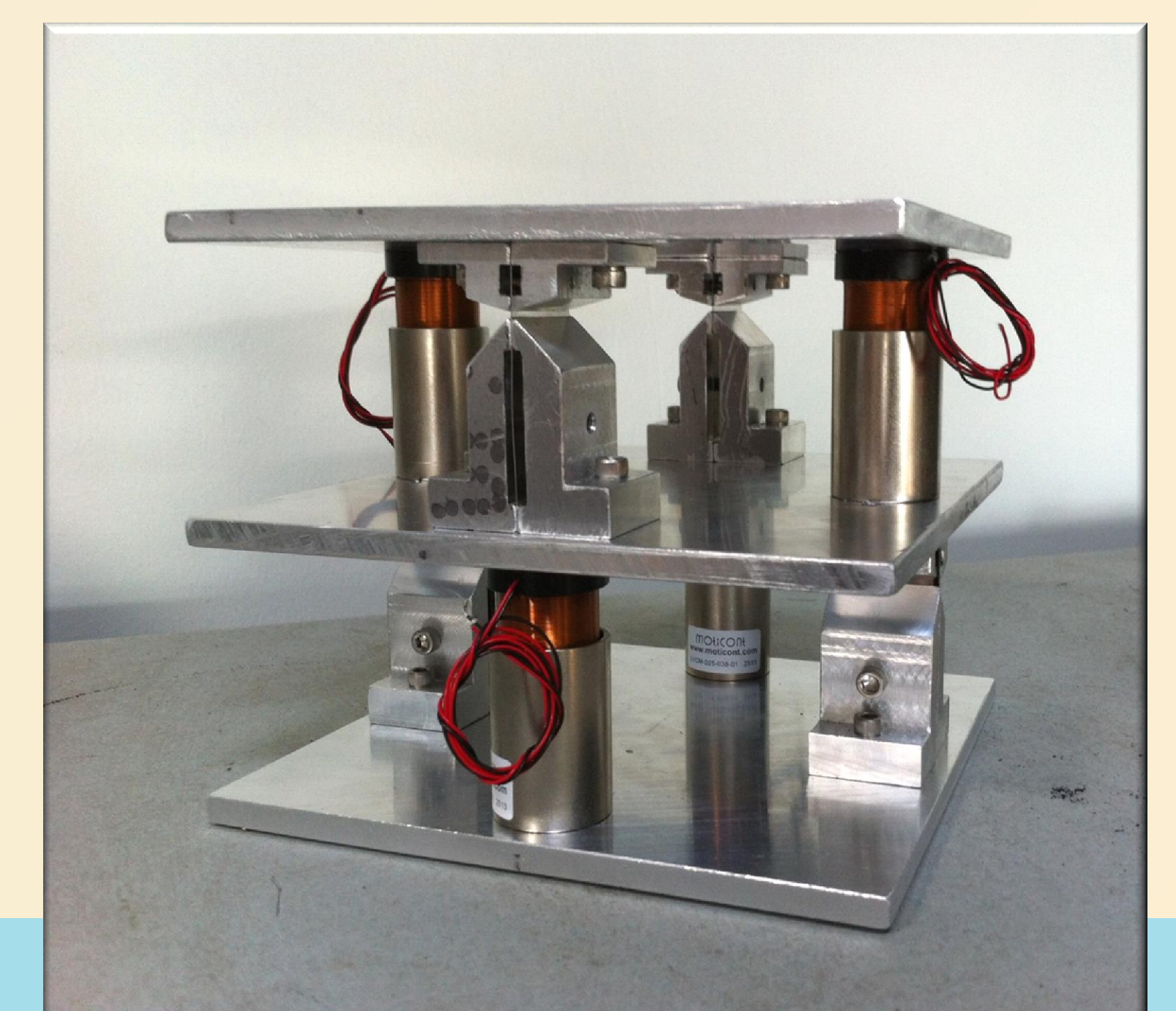
Design for a curved voice coil motor.

Future Work

- Improve the travel range angle to $\pm 5^\circ$
 - Build and design a custom made curved voice coil motor.
- Write control software for the pointing system.
- Testing:
 - Mount on a sun-tracker with 5% error from the direction of the sun and have the pointing system find the sun.
- Fly SPS and pointing system on the PARABLE mission.
- Utilise the pointing system for new instruments such as an Imaging Fourier Transform Spectrometer (IFTS) which is part of the FAST (Flights for the Advancement of Science and Technology) project.

Picture	Axis	Mirror Diameter (mm)	Tilt Angle (Degree)	Frequency (Hz)	Mass (g)	Dimension (mm)
	2	10	± 2.8	50	65	25x33x38
	3	250-300	± 0.07	-	1420	150x150x30
	6	100	$\pm 10, \pm 10, \pm 21$	(velocity of 10mm/s or 14.3°/s)	2200	136x136x114
	2	152	± 2.5	10	931	131x152x152

Prototype of the pointing system machined from aluminum.



References

1. www.physikinstrumente.com
2. Strong, K. & et. al., 2002. *The MANTRA 2002 Balloon Flight From Vanscoy, Canada. Proc. of Envisat Validation Workshop.*
3. Principal Investigator, Professor Charles Thomas (Tom) McElroy, *A Balloon-based Demonstrator for the PHEOS-Weather, Climate and Air Quality Imaging Fourier Transform Spectrometer (IFTS)*, An application to : Flights for the Advancement of Science and Technology (FAST 2013).