Section 1: Weight Breakdown

1.1 Overview

This section aims to address the weight issue highlighted in the proposal feedback. This is done by evaluating previous missions for component-based weight breakdowns and then comparing it to our payload and mission requirements. The BEXUS user manual states two guidelines [3]:

1. Payload mass and size should be minimised.
2. The maximum payload mass for the ESCARGO gondola is 100kg.

1.2 Mission 1: RSONAR Payload [1]

The RSONAR payload was designed and flown for a similar purpose to that mission objectives of SOBER, albeit with one less piece of instrumentation. The RSONAR payload consisted of COTS hardware. This includes the camera and lens, the system-on-chip (SoC) development board, the global position system (GPS) sensor, cabling, harnesses, and connectors. It was deigned to sit within a modified 2U CubeSat chassis.

Table 1 - Components of the RSONAR payload and their corresponding masses.

Item	**Mass (g)**
Fasteners (screws, nuts, washers)	80
Aluminium chassis	780
PCB and breakout boards	230
Optics and antenna	955
Wires and cables	100
Total	**2145**

Since the payload was a success, it can be established that this design and hardware level is appropriate for our mission which will also be mounted on a stratospheric balloon.

1.3 Mission 2: RSONAR 2 Payload [2]

The RESNAR 2 payload was designed as a follow up to the original RSONAR project, advancing the payload of the original from a 2U to a 4U CubeSat structure and including two payloads rather than just one.

Table 2 - Components of the RESNAR 2 Payload and their corresponding masses.

Item	**Mass (g)**
Payload Components	2236.3
Fasteners (screws, nuts, washers)	150
Aluminium Parts and Frames	1428.9
Interface Plates	1488
Total	**5303.2**

1.4 Mission 3: IRISC [7]

The IRISC mission, developed by Luleå University of Technology, aimed to capture near-infrared (NIR) images of astronomical targets, including the Andromeda Galaxy and Eagle Nebula, using a stabilized telescope on a BEXUS balloon. By operating at high altitudes, the balloon-borne telescope avoided most atmospheric interference and used a gimbal system for stabilization, enabling high-quality imaging at a lower cost than orbital telescopes.

Item	**Mass (g)**
Payload (Telescope	5000
Electrical	1500
Mechanical (Gimbal)	5000
Total	**13000**

1.5 Weight Breakdown for Project SOBER

The weight breakdown for SOBER is based upon both known components and estimation based on historic projects. In general, the SOBER project appears to align closely with the RSONAR 2 project, as both involve a similar number of optical payloads and are mounted on stratospheric balloons, requiring design considerations to withstand the mechanical stresses associated with this environment. Information is from spec documents [5] [6].

Table 3 - Preliminary components of the SOBER Payload and their corresponding masses (estimate).

Item	**Mass (g)**
RADIA M100	820
UI-3370CP-M-GL camera	52
Generic Payload Components	~2000
Fasteners (screws, nuts, washers)	~150
Aluminium Parts and Frames	~2000
Total	**~5022**

To ensure sufficient estimation a safety factor of 1.5 is used, giving a total estimated mass of 7533 grams.

Section 2: Payload Mounting Diagram and Rationale

2.1 Overview of Payload Mounting

The payload mounting and vision cone was raised as an issue in the preliminary feedback for the mission proposal. In this original document it was posited that the payload will require an “unobstructed line of sight to observe space objects”. This must be addressed historic review and analysis of the SOBER payload.

2.2 Historic Examples of Payload Mounting

- **Example 1: RSONAR 1 & 2**
  Both the RSONAR 1 and 2 missions utilised optical payloads inclined at 45 degrees to facilitate the collection of data relating to RAO detection during stratospheric balloon flights.
- **Example 2: IRISC**
  The IRISC payload was mounted on the side of the gondola at an angle of 60 degrees.

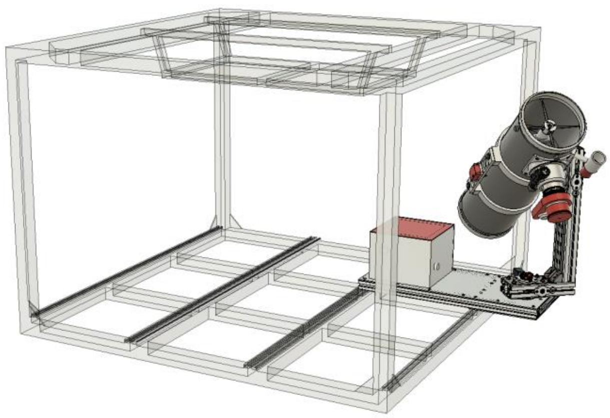

Figure 1 - IRISC mounting.

2.3 Rationale for Design Choice

The SOBER payload consists of two sub payloads: one containing a monochrome camera and the other a thermal imaging camera. The Field Of View (FOV) specifications are determined based upon the chosen lens. The "x" in the FOV values separates the horizontal and vertical angles, where the first number represents the horizontal FOV, and the second number represents the vertical FOV. Information is from spec documents [5] [6]. Based on this data sheet, the **largest FOV is fixed at 40° x 40°.**

Sub Payload	**FOV Options**
RADIA M100	Standard Lens (25 mm EFL, 14.6° x 11.7° FOV)
	Wide Angle Lens (13 mm EFL, 27.7° x 22.3° FOV)
	Telephoto Lens (50 mm EFL, 7.3° x 5.9° FOV)
UI-3370CP-M-GL camera	Telephoto Lens (16 mm, 40° FOV, 1:1 Aspect Ratio)

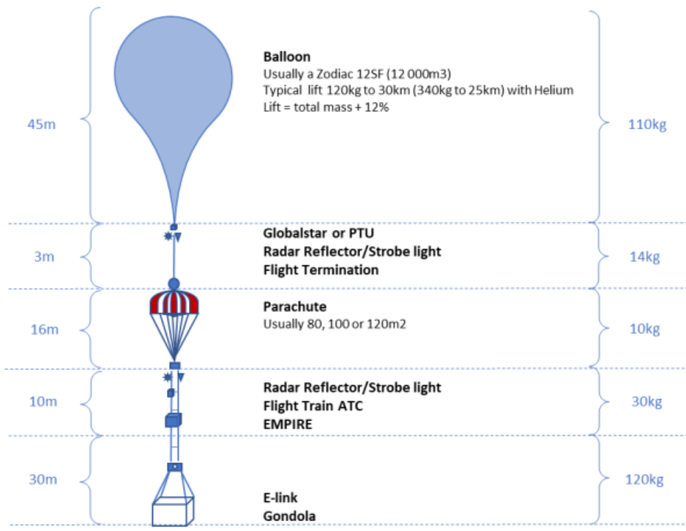

Figure 2 - Typical BEXUS flight train.

2.4 Diagram of Proposed Payload Mounting for Project SOBER

The chosen mounting is shown below, the sensors are mounted at a 45-degree angle with a 40 degree FOV. This should allow for an adequate line of sight for observing RAOs.

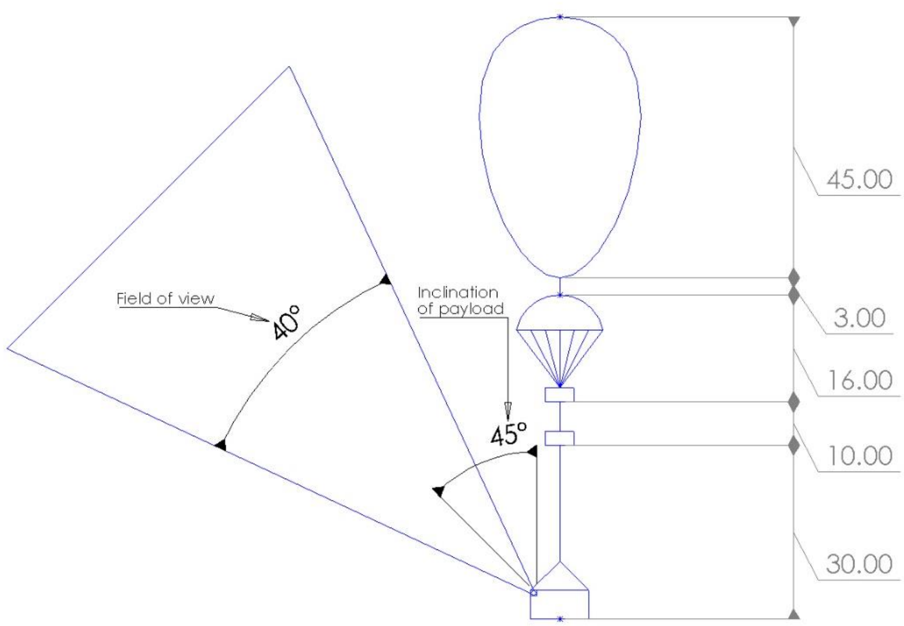

Figure 3 - Diagram of proposed payload mounting with FOV.

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3. Rexus/Bexus (2023) BEXUS User Manual v8.1. Available at: https://rexusbexus.net/wp-content/uploads/2023/12/BX_REF_BEXUS_User-Manual_v8-1_24Nov23-1.pdf (Accessed: 8 November 2024).
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