

→ 1 INTRODUCTION

1.1 Background

European involvement in low gravity research began more than 35 years ago, with nationally funded programmes (in particular those of France and Germany) and US collaborations. Later, in January 1982, the ESA member states initiated a European Space Agency (ESA) funded programme, agreeing on a strategy by which governments could contribute according to their interests and budgets. Hence, the European Microgravity Programme (EMIR) Phase-1 was established for the period 1982-1985. This allowed ESA to participate in the German Texus Sounding Rocket programme (later extended to include Swedish Maser Sounding Rockets) to perform short duration microgravity experiments. EMIR also covered the development of an initial set of multi-user experiment facilities to be flown on the Space Shuttle Spacelab and SpaceHab missions.

Since then, ESA has sponsored more than 2000 experiments, payloads and facilities, which have been integrated and operated on various types of low gravity platforms, including:

- drop towers;
- parabolic flights;
- sounding rockets;
- retrievable orbital capsules;
- the Space Shuttle;
- the MIR Space Station;
- the International Space Station (ISS).

1.2 Relation to ground-based facilities

Besides the four major low-gravity platforms, outlined in this User Guide, ESA also supports access to specific facilities on Earth that simulate the space environment. Extensive and timely use of the research capabilities offered by these facilities will not only improve the preparation and impact of spaceflight experiments, but will also increase the level of scientific knowledge of the influence of gravity and/or extraterrestrial environments on life, physical and interdisciplinary processes.

In addition to providing support to users in accessing these facilities, ESA also regularly announces calls for proposals to participate in large coordinated scientific investigations, which are of strategic importance to long-duration human space missions. Examples of these include studies of bedrest in France and Germany and confinement and isolation at both the Concordia Antarctic base and during the Mars500 programme. These types of studies are aimed at investigating the physiological and psychological problems that may arise in conditions of isolation and confinement, such as those that will be experienced during a long-duration space mission.

1.3 Structure of the User Guide

This user guide has been developed to provide potential and existing users with the basic information related to the access and utilisation of the four major low gravity platforms and a suite of ground-based facilities currently supported and sponsored by ESA.

Each of these platforms and facilities is covered separately in five dedicated chapters together with an initial chapter describing the process by which users can access the various platforms:

- [Chapter 2](#) describes the access process applicable to utilisation of the various platforms;
- [Chapter 3](#) provides an overview of the ground-based facilities and contains more specific access and utilisation information related to the different ground-based facilities available in Europe;
- [Chapter 4](#) provides an overview of drop towers and contains more specific access and utilisation information relating to the ZARM drop tower based in Bremen, Germany;
- [Chapter 5](#) covers the general aspects of parabolic flights as a way of experiencing low gravity, and concentrates on the Novespace Airbus A300 “Zero-G” aircraft based at the Bordeaux-Mérignac airport;
- [Chapter 6](#) highlights the most important aspects involved in utilising the three ESA-supported sounding rockets (Texus, Maser and Maxus),

which are launched from the Esrange base near Kiruna, Sweden;

- [Chapter 7](#) is the most detailed of the five chapters, covering the most complex low gravity platform currently accessible through ESA - the International Space Station.

A common content structure has been applied to all five chapters, containing the same level of information. The two main driving factors for this approach are that this makes it easier to compare two or more platforms (especially for potential users), as well as making it easier to use when transitioning from one platform to another.

Dedicated web pages for Human Spaceflight Research have been set up, which allow users to monitor the various chapters making up the Guide. This website is accessible from the main Human Spaceflight portal which has the following URL:

www.esa.int/Our_Activities/Human_Spaceflight/Research

The Guide represents the first step in discovering the capabilities of the suite of research platforms offered

by ESA, and is a synthesis of a large number of reference documents and various other sources. It is intended for the Guide to contain sufficient utilisation information, however where necessary, and at appropriate points in the text, references to more detailed documentation and other information sources are made. The fundamental aim is to provide a clear, complete and easily understandable utilisation path for users to follow.

1.4 Overview

As stepping stones for the consultation of the Guide, Figure 1-1, Figure 1-2, and Figure 1-3, provide a global overview of some of the major utilisation aspects that need to be taken into account by users when deciding which platform is more suitable to their needs.

Figure 1-1 shows the average ranges of low gravity (with respect to Earth's gravity) experienced on each of the four low gravity platforms, and the average range of time to which experiments are exposed to these values. Users must bear in mind that these are average values, and may differ from mission to mission.

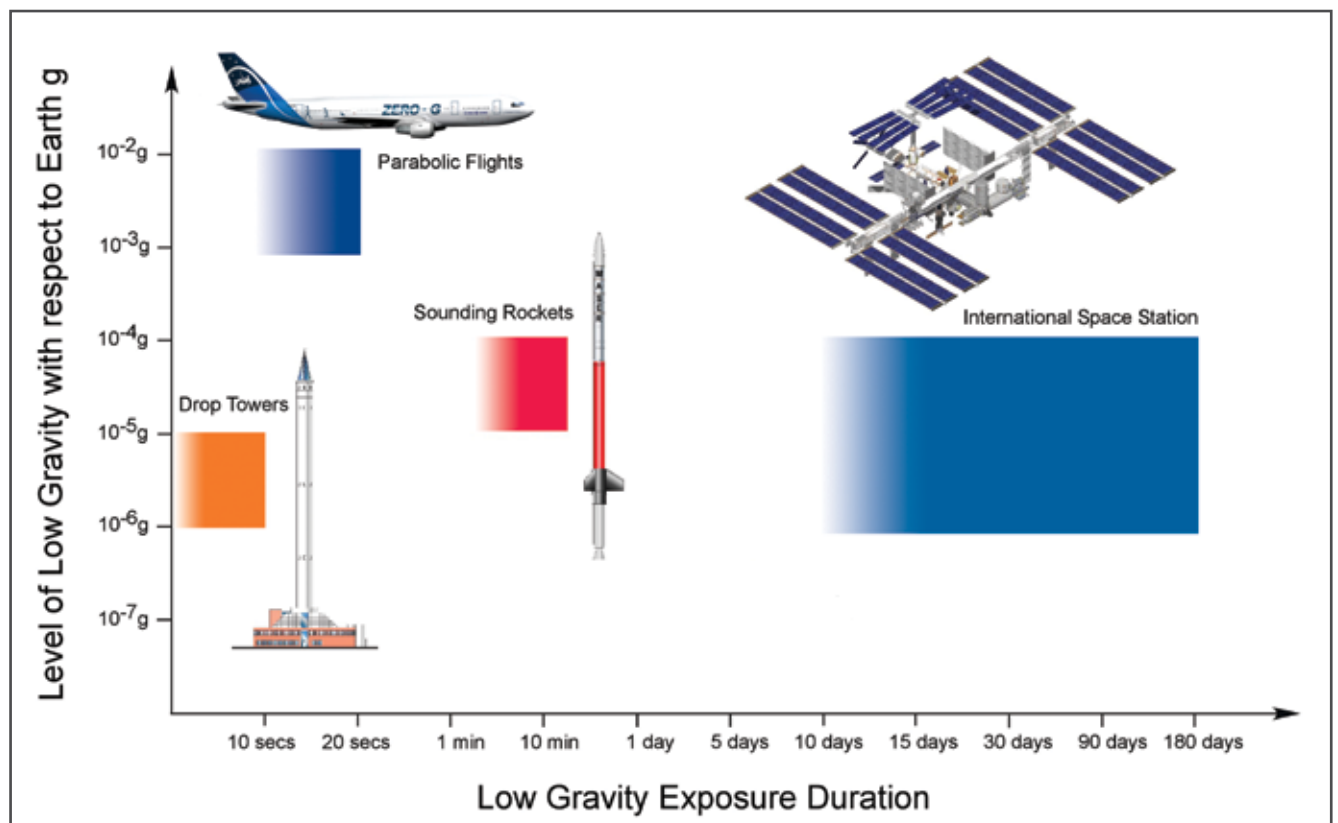


Figure 1-1: Low gravity magnitude and duration for the four low gravity platforms






					
	Ground-based facilities	Drop Towers	Parabolic Flights	Sounding Rockets	ISS
Fundamental Physics	✓	✓	✓	✓	✓
Atmospheric and Environmental research	✗	✗	✓	✗	✓
Materials sciences	✓	✓	✓	✓	✓
Physics of fluids and combustion	✓	✓	✓	✓	✓
Astrobiology	✗	✗	✓	✗	✓
Biology	✓	✓	✓	✓	✓
Human physiology and performance	✓	✗	✓	✗	✓

Figure 1-2: Fields of research applicable to the four low gravity platforms and ground-based facilities

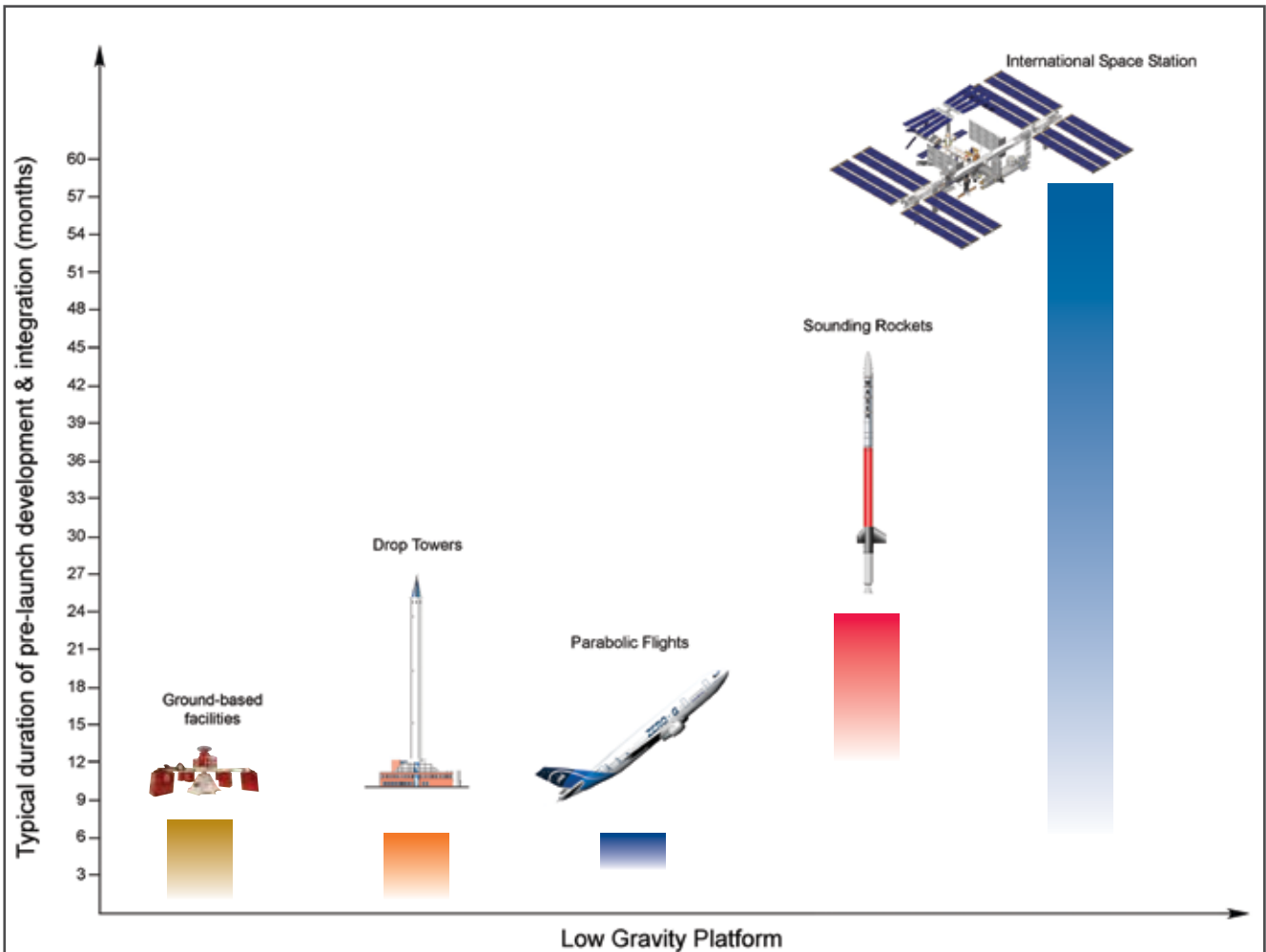


Figure 1-3: Payload development & integration times for the four low gravity platforms and ground-based facilities

Figure 1-2 provides an indication of which platforms are more suitable to what type of scientific field of research, based on the seven scientific domains of the ELIPS programme. The green tick marks refer to cases where experiments belonging to a cornerstone, or key research area, have been carried out on a particular platform in the past. Cases, in which experiments belonging to a particular scientific field of research are generally not suitable to a platform due to limitations and restrictions, are identified by red 'X' symbols. Users should keep in mind though, that the objective of the table is only to provide an overview of what is generally possible on each platform.

Figure 1-3 shows the development and integration times usually required before launching experiments, payloads or facilities on-board each of the four ESA-sponsored low gravity platforms. The coloured bars in the figure are average ranges of time in terms of months, but users must remember that these will depend highly on the mission and on the complexity of the hardware being flown.

1.5 General information and advice

The scientific entry and selection of experiments that users wish to accommodate on/in the four low gravity platforms and ground-based facilities discussed in this Guide, is carried out via the ESA 'Announcement of Opportunity' process, described in detail in chapter 2. However, as a first step, potential users who would like additional information or advice on the ESA research platforms can contact the Erasmus Centre (EC).

The Centre is located at ESA's Science and Technology Centre in Noordwijk, the Netherlands. The EC is part of the Directorate of Human Spaceflight and Operations and has the mandate to inform and advise institutional and commercial users interested in making use of space platforms and ground-based facilities. The Centre can provide the following:

- inform and advise about the requirements and procedures related to the use of the low gravity platforms and ground-based facilities;
- access to metadata with information about past experiments;
- access to payload integration reference and applicable documentation.

1.5.1 Erasmus Experiment Archive (EEA)

An important resource of the EC is the Erasmus Experiment Archive (EEA). The EEA is a database of ESA funded or co-funded experiments covering a wide range of scientific areas, which were performed during missions and campaigns on/in various microgravity platforms and ground-based facilities over the past 35 years. The archive is continuously being updated and, as of November 2014, contains more than 2800 experiment records. The major items of information covered in the EEA include:

- title of experiment;
- missions/campaigns;
- research areas;
- processing facility;
- ESA contact person;
- research team;
- experiment objectives;
- experiment procedure;
- experiment results;
- list of publications/references;
- attachments (figures, graphs, videos, etc.).

Users who perform ESA-funded experiments are required to provide regular reports on the progress of their research, and copies of associated published papers to their specific ESA science coordinator (listed in chapter 2- The Access Process) in a timely fashion. Users are also required to provide an abstract of each of their experiments for the EEA to the EEA coordinators listed at the end of this chapter. Failure to meet this obligation will have immediate implications and will also be taken into account when deciding on new experiment opportunities/proposals from the user team in question.

Users are invited to visit the database, from which they can, among other things, obtain further information regarding experiments of their field of research already carried out in the past.

The EEA web address is the following:
eea.spaceflight.esa.int



Image 1-1: Erasmus Experiment Archive (EEA) home page

For more information on the Erasmus Experiment Archive, users should contact:

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1.5.2 Contacts

As this Guide has been written for the user, any updates or modifications to any of its content will depend significantly on the feedback received. Comments, suggestions or requests for further information on any of the low gravity research platforms or the Erasmus Experiment Archive, should be sent to:

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