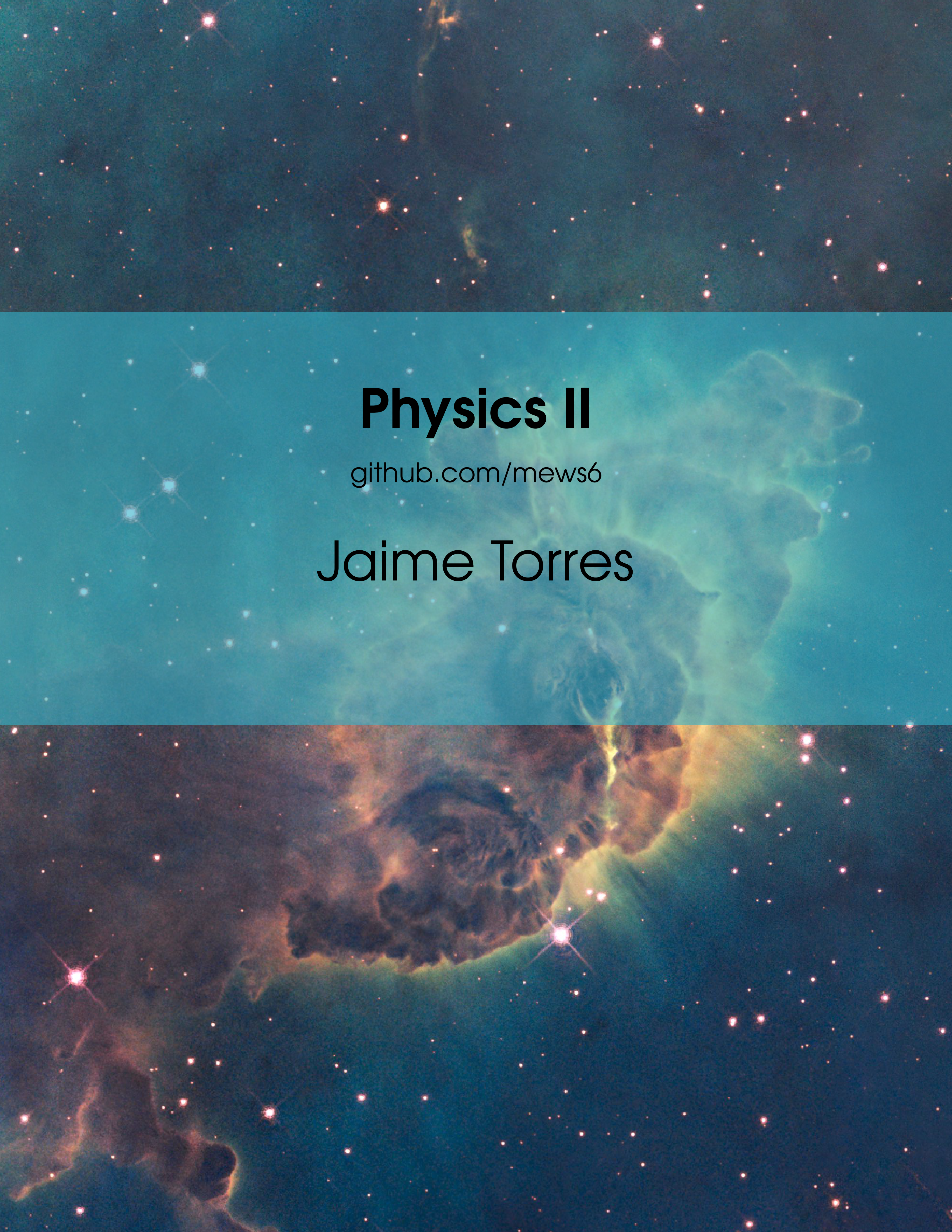

Physics II

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1. Introduction

First of all, Welcome! I hope i can explain Physics II in a somewhat friendly way, and i hope that whatever it is you need this text for, you can succeed on it. Sometimes these topics can feel a bit dense (because they are) and even though not the most rigurous of texts, i hope this little guide helps you. Now, before we start with anything, there are a few things i think we should take into account:

There's a mistake in this book! What do i do?

Tell me what it is, just let me know and maybe even correct it yourself, i have no reservations on making changes in case it happens to be necessary or otherwise useful.

As a little (final) side note, here's some cool people i took Physics II with, they speak spanish and might not respond, but if you can contact them (and know how to speak spanish), they might help you!

- Daniel Esteban Olaya (de.olaya1318@uniandes.edu.co)
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2. Fundamentals

The II in 'Physics II' is of course, a signifier of continuity, and you sometimes don't really remember the things that you saw one, or a few semesters ago. So before you start thinking on the concpts unique to Physics II, a few reminders might be on course for this text. This non-comprehensive collection of topics should be a quick reminder of a few concepts. But i urge you to read them on your own.

2.1 Newton's Laws

Newton's laws of motion are three basic laws of classical mechanics that describe the relationship between the motion of an object and the forces acting on it.

2.1.1 First Law

A body in state of rest, or in uniform motion in a straight line will have an overall summatory of forces equal to 0

$$\sum \vec{F} = 0 \tag{2.1}$$

2.1.2 Second Law

A net force that acts over a body makes it accelerate in the same direction as the net force. The magnitude of acceleration is directly proportional to the magnitude of the forces acting over it.

- if a net force acts over a body, this body accelerates
- The direction of acceleration is the same as a net force.

we can assume:

$$\vec{F}_{net} = m\vec{a} \tag{2.2}$$

$$\vec{F} = \frac{d\vec{p}}{dt} \tag{2.3}$$

2.1.3 Third Law

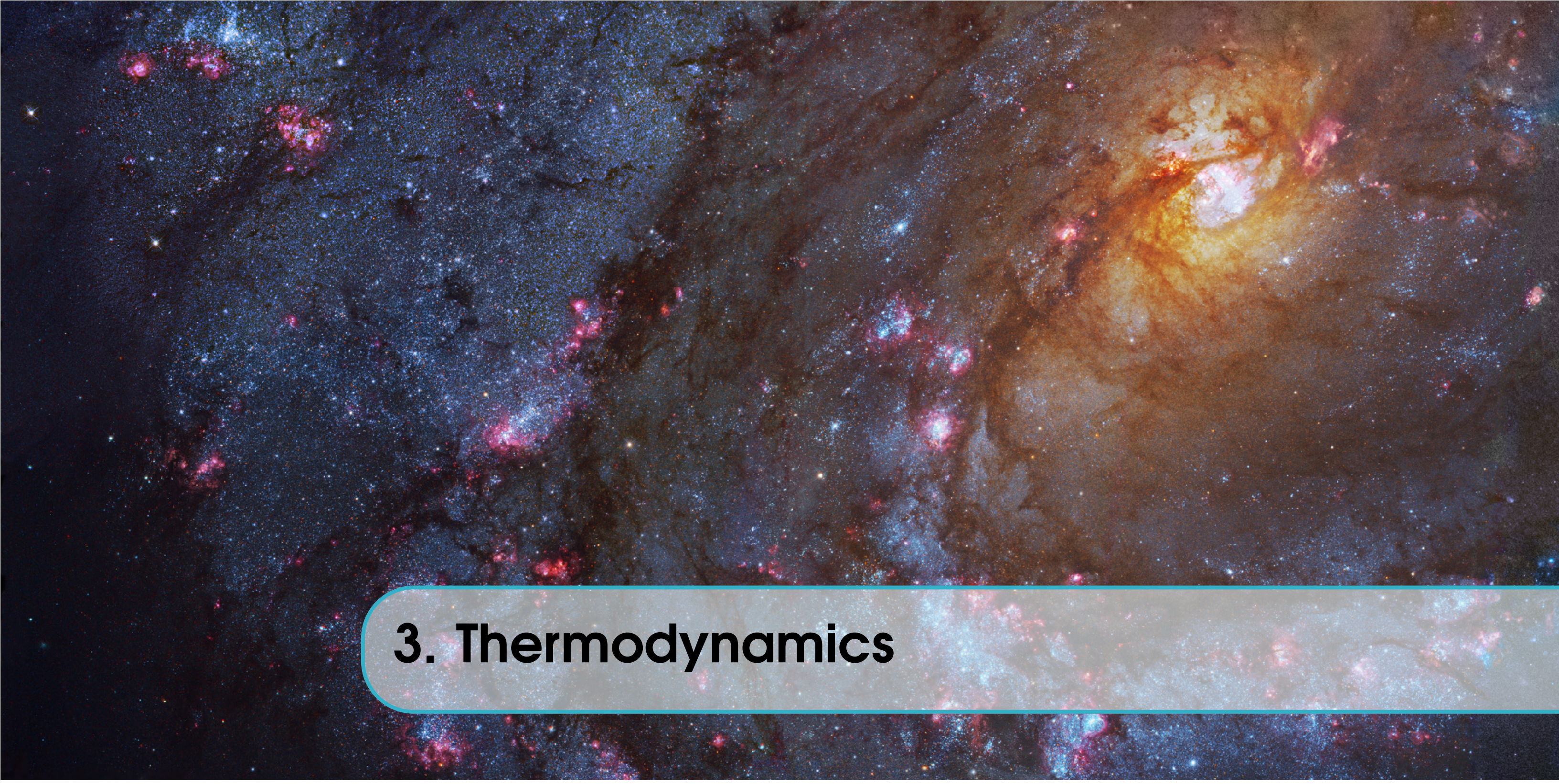
When two bodies interact their forces are always equal in magnitude and opposed in direction. This can be expressed as:

$$\vec{F}AB = -\vec{F}BA \tag{2.4}$$

Important Equations

$$\vec{F} = m\vec{a} \tag{2.5}$$

$$\vec{T} = I\vec{\alpha} \tag{2.6}$$



3. Thermodynamics

As it is defined on Sears and Zemanzky's University Physics:

"Thermodynamics are the study of energy transformations where there is an intervention between mechanical energy, heat, and other forms of energy (...)" [You+12]

In this section, we'll be talking about the different ways we can analyze, comprehend and manage such topics.

3.1 Temperature and Heat

Although easily interchangeable in common day language, when talking formally, Temperature and Heat are different physical concepts, For once, heat is a form of energy transference, measured in Joules (J). Temperature, instead, is an associated characteristic of an object. We'll treat both as diferent things during the course

3.2 Thermal Dilation

Temperature can make objects change their size, given a drastic enough Temperature change affecting the object. This is defined mathematically as:

$$\Delta L \propto \Delta T \tag{3.1}$$

$$\Delta L \propto L_0 \tag{3.2}$$

$$\Delta L = \alpha L_0 \Delta T \tag{3.3}$$

In those formulas, α represents the thermic expansion quoefficient. with their units being measured $[\alpha] = \frac{1}{C^o}, \frac{1}{K}, \vee \frac{1}{F^o}$ However, this is a quoefficient that is different depending on the material that is being worked on.

3.2.1 Volume

For a volume $V = L^3$ (such as a solid square cube), we can model a derivative of the sort:

$$dV = \frac{dV}{dL} \cdot dL \tag{3.4}$$

$$3L^2 dL \tag{3.5}$$

$$3L^2 \alpha L_0 dT \tag{3.6}$$

$$3\alpha \underbrace{L^2 L_0}_{V_0} dT \tag{3.7}$$

Therefore, volume changes at the rate of:

$$dV = 3\alpha V_0 dT \tag{3.8}$$

3α is the equivallent of a linear expansion for volumetric situations. we can simplify it as β. Therefore it is possible to write:

$$dV = \beta V_0 dT \tag{3.9}$$

3.3 The limits of Temperature

...Eventually, we would reach the apparent universal constant of:

$$T \geq 273.15C^o \tag{3.10}$$

This will come to define the Kelvin temperature scale, where Temperature is direcly proportional to the pressure applied by gasses at that specific temperature. This is a scale we'll eventually call the absolute scale of temperature, there is no possibility of an object going to a colder temperature than 0 Kelvin.

3.4 Thermic Equilibrium

Thermic equilibrium is a state between two objects such as they won't have any sort of energy exchange. This will happen if and only if both objects are at the same temperature. If two objects are at a different temperature, they will eventually exchange energy.

If the difference of temperature between two objects is greater, then the exchange of temperature will be larger.

3.5 Calorimetry

Calorimetry is a field of thermodynamics preoccupied with the exchange of heat between objects.

Heat has a mechanic equivalent that can be measured as energy. This would eventually leave us to the conclusion that heat is by itself, a form of energy.

$$Q = Cm\Delta T \tag{3.11}$$

In this formula, C is a constant that measures the specific heat of a material. This can be measured as $\frac{J}{kg \cdot (K \vee C^o)}$

Example

Suppouse an object 'A' and an object 'B', with masses '$m_a = 2gr$' and '$m_b = 1gr$' respectively, both golden. at two different temperatures $T_A = 20C^o$ and $T_B = 10C^o$. How will heat behave in this system?

$$\sum Q = 0 \tag{3.12}$$
$$\Delta T_A = T_F - T_A \tag{3.13}$$
$$\Delta T_B = T_F - T_B \tag{3.14}$$
$$m_a c_a \Delta T_A + m_b c_b \Delta T_B = 0 \tag{3.15}$$
$$m_a c_a (T_F - T_A) + m_b c_b (T_F - T_B) = 0 \tag{3.16}$$
$$m_a (T_F - T_A) + m_b (T_F - T_B) = 0 \tag{3.17}$$
$$T_F = \frac{m_a T_a + m_b T_b}{(m_a + m_b)} \tag{3.18}$$
$$T_F = \frac{T_a + T_b}{2} \tag{3.19}$$

3.6 Heat Capacity

3.6.1 Mol

A 'Mol' is the number of molecules of a substance contained in a specific volume. We define the specific quantity of $6.02x10^{23}$ molecules being a Mol. This is a form of measuring quantities that will be useful when we work in matter that is funcioning in gas form.

Molar Mass

We can call the molar mass as

$$M = \frac{gr}{mol}$$

We can use mol and grams to define

3.7 Ideal Gasses

Gasses are fairly unpredictable sometimes, so sometimes when we model them in

They are puntual particles that will be travelling with a certain mass but that won't be defin

$$pV = nRT \tag{3.20}$$

Ideal Gas Law

3.8 First law of Thermodynamics

given a rigid container, we can imagine

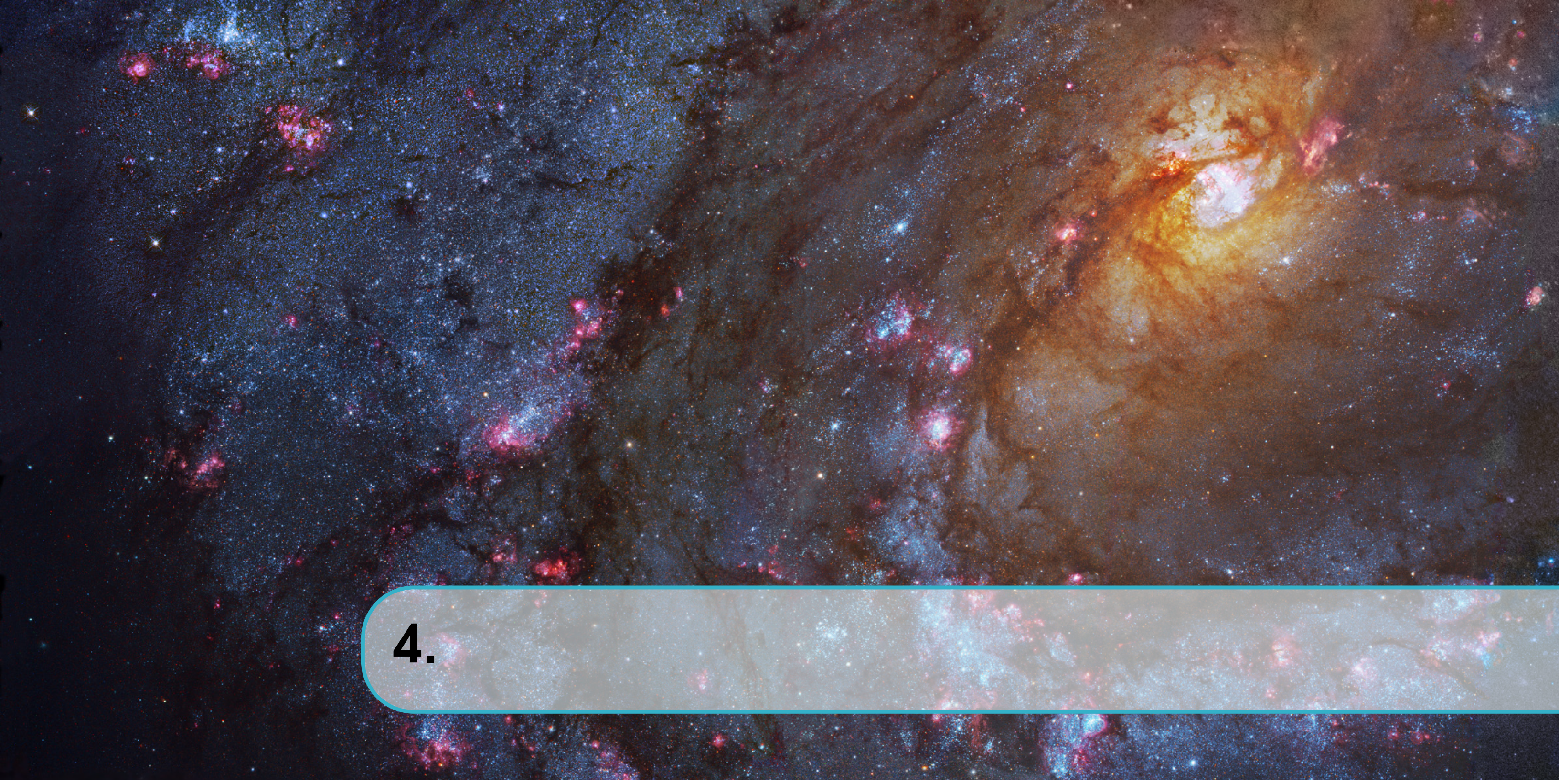
$$\Delta U = Q$$

we can also imagine the work being presented on the system by an ideal gas as:

$$W = \int \vec{F} \cdot d\vec{r}$$

$$W = \int \rho \cdot d\vec{r}$$

When expanding, this is going to be called an expansive movement, otherwise, this is a compressive movement.



4.

Bibliography

[You+12] Hugh D. Young et al. *Sears and Zemansky's University Physics: with Modern Physics*. Thirteenth. San Francisco: Pearson Addison-Wesley, 2012. ISBN: 9780321696861 0321696867 9780321696854 0321696859 9780321762184 0321762185 9780321741264 0321741269 9780321696229 0321696220 (cited on page 9).