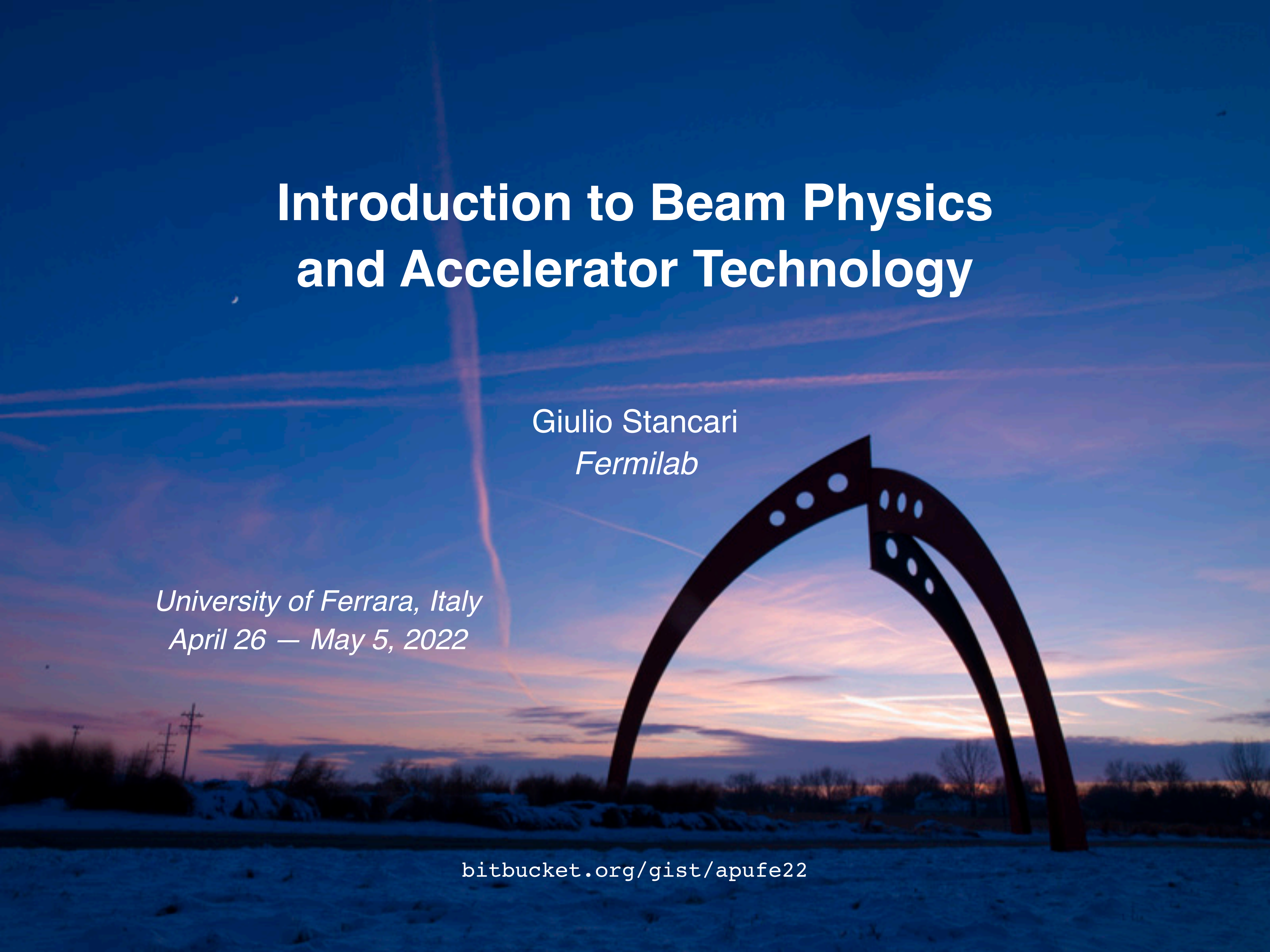

Introduction to Beam Physics and Accelerator Technology

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`bitbucket.org/gist/apufe22`

Critical paper review

Why work on a critical paper review?

- **Learn** about research areas or technology
- **Become a reviewer** for conference proceedings and peer-reviewed journals and **improve the quality** of technical reports and scientific literature
- **Practice focus and critical thinking**, essential skills in our age of enormous information flux
- **Become a better scientific writer**

"It is of great advantage to the student of any subject to read the original memoirs on that subject, for science is always most completely assimilated when it is in the nascent state…"
— J. C. Maxwell, Treatise on Electricity and Magnetism

Parts of the critical review

Synthesis

What is the paper about as a whole?

- Briefly state the main topic
- Define the issues that the authors intend to address

Analysis

What is being said in detail and how?

- List the main parts of the paper and summarize their content, identifying the main statements and logical arguments
- Identify keywords and compile a glossary with definitions

Assessment

Are statements and claims true? What consequences do they have?

- Determine whether there are parts where the authors are *uninformed* (lack of information), *misinformed* (incorrect understanding), *illogical* (consequences that do not follow from premises) or *incomplete* (missing important aspects)
- Which problems were solved? Which issues remain open?
- Discuss possible applications or extensions. Be creative.

Do all papers and books need to be read this way?

Of course not.

Sometimes, a **superficial reading** is sufficient to gather the information we need.

If we come across an interesting article, **abstract** and **conclusions** may help us decide if we want to read it in depth.

Example of a critical review

Let's look at an example of a critical review

We consider this article

Available online at www.sciencedirect.com
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Nuclear Instruments and Methods in Physics Research A 568 (2006) 475–487

NUCLEAR INSTRUMENTS & METHODS IN PHYSICS RESEARCH Section A
www.elsevier.com/locate/nima

Beam cooling with ionization losses

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The paper and the review are available on the shared drive

Practicing the critical review process: group exercise

We will use the 2 short articles by Cockcroft and Walton (Nature, 1932) on the production of high voltages and on the first artificial transmutation, because of their scientific and historical importance

Artificial Production of Fast Protons

A HIGH potential laboratory has been developed at the Cavendish Laboratory for the study of the properties of high speed positive ions. The potential from a high voltage transformer is rectified and multiplied four times by a special arrangement of rectifiers and condensers, giving a working steady potential of 800 kilovolts. Currents of the order of a milliampere may be obtained at a potential constant to 1-2 per cent.

Protons from a discharge in hydrogen are directed down the axis of two glass cylinders 14 in. in diameter and 36 in. long, and accelerated by the steady potentials of the rectifier. They are then passed into an experimental chamber at atmospheric pressure through a mica window having a stopping power of about 1 mm. air equivalent. Luminescence of the air can easily be observed.

The ranges of the protons in air and hydrogen have been measured using a fluorescent screen as a detector. The range in air at S.T.P. of a proton having a velocity of 10^9 cm./sec. is found to be 8·2 mm., whilst the corresponding range for hydrogen is 3·2 cm. The observed ranges support the general conclusions of Blackett on the relative ranges of protons and α-particles, although the absolute values of the ranges are lower for both gases. The ranges and stopping power will be measured more accurately by an ionisation method.

The maximum energy of the protons produced up to the present has been 710 kilovolts with a velocity of $1{\cdot}16 \times 10^9$ cm./sec. and a corresponding range in air of 13·5 mm. at S.T.P. We do not anticipate any difficulty in working up to 800 kilovolts with our present apparatus.

J. D. COCKCROFT.
E. T. S. WALTON.

Disintegration of Lithium by Swift Protons

IN a previous letter to this journal[1] we have described a method of producing a steady stream of swift protons of energies up to 600 kilovolts by the application of high potentials, and have described experiments to measure the range of travel of these protons outside the tube. We have employed the same method to examine the effect of the bombardment of a layer of lithium by a stream of these ions, the lithium being placed inside the tube at 45° to the beam. A mica window of stopping power of 2 cm. of air was sealed on to the side of the tube, and the existence of radiation from the lithium was investigated by the scintillation method outside the tube. The thickness of the mica window was much more than sufficient to prevent any scattered protons from escaping into the air even at the highest voltages used.

On applying an accelerating potential of the order of 125 kilovolts, a number of bright scintillations were at once observed, the numbers increasing rapidly with voltage up to the highest voltages used, namely, 400 kilovolts. At this point many hundreds of scintillations per minute were observed using a proton current of a few microamperes. No scintillations were observed when the proton stream was cut off or when the lithium was shielded from it by a metal screen. The range of the particles was measured by introducing mica screens in the path of the rays, and found to be about eight centimetres in air and not to vary appreciably with voltage.

To throw light on the nature of these particles, experiments were made with a Shimizu expansion chamber, when a number of tracks resembling those of α-particles were observed and of range agreeing closely with that determined by the scintillations. It is estimated that at 250 kilovolts, one particle is produced for approximately 10^9 protons.

The brightness of the scintillations and the density of the tracks observed in the expansion chamber suggest that the particles are normal α-particles. If this point of view turns out to be correct, it seems not unlikely that the lithium isotope of mass 7 occasionally captures a proton and the resulting nucleus of mass 8 breaks into two α-particles, each of mass four and each with an energy of about eight million electron volts. The evolution of energy on this view is about sixteen million electron volts per disintegration, agreeing approximately with that to be expected from the decrease of atomic mass involved in such a disintegration.

Experiments are in progress to determine the effect on other elements when bombarded by a stream of swift protons and other particles.

J. D. COCKCROFT.
E. T. S. WALTON.

(papers available in the course folder)

Practicing the critical review process: group exercise

Within each group (30 minutes)

- Read and annotate the 2 papers, treating them as a whole
- Following the guidelines, draft the three parts of a critical review: summary, analysis, assessment. Don't worry about making it perfect. The important thing is to go through the whole process.

Class discussion

- Present the draft of your review and compare it with other groups

Additional topics for discussion

– *How do you read scientific literature? Are you part of a journal or book club?*

– *What do you like about your reading habits? What would you like to improve?*

Critical paper review: your assignment

1. **Examine the list of landmark papers** on the course website.

2a. **Choose a paper** that interests you.

2b. If you want, you may **propose a paper** that is not on the list. In this case, *it must be approved* by your instructor. Main criteria: peer-reviewed on a high-impact journal, well written, relevant to beam physics or accelerator technology.

3. **Critically review the paper** according to the guidelines described in class.

4. **Submit your report by Tuesday, May 31**. Start working on it now!

I will evaluate your report and send you feedback.

For undergraduate students: you will be asked questions about your report during the oral exam.

Questions?