

Cyclotrons

Beam Dynamics and Design

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Introduction Round

Turn your camera on and tell us:

- who you are,
- why did you register to this course,
- what do you expect to learn from it?

Course Structure

In this course we will cover

- Cyclotrons: Why? How?
- Transverse Dynamics
- Longitudinal Dynamics
- Extraction
- Space Charge
- Resonances

... or as much of these topics as we have time for.

Text Book

<http://lin12.triumf.ca/text/Cyclotrons.pdf>

username: USPAS, password: cyclotron

About every other day will be dedicated to a 'lab', where we will:

- Help you choose a set of design parameters for your final report
- Transverse dynamics with the cyclotron code `cyclops`
- Longitudinal dynamics with the cyclotron code `cyclops`
- TBD: depending on your need/request.

Most of it will take place on the [sirepo Jupyter](#) server.

Course Schedule (google calendar or cal.ics)

	MON	TUE	WED	THU	FRI
	7	8	9	10	11
08:00					
09:00	Course Intro and round table 09:00 – 10:15	Lab 1: basic cyclotron parameters 09:00 – 11:30	Due homework #1 08:45 Lecture 2: transverse dynamics 09:00 – 11:30	Lecture 3: longitudinal dynamics 09:00 – 11:30	Due: table of parameters for the final Lab 2: transverse dynamics with cagegs 09:00 – 11:30
10:00	Lecture 1 (basics) 10:15 – 12:00				
11:00					
12:00					
13:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00
14:00					
15:00					
	MON	TUE	WED	THU	FRI
	14	15	16	17	18
08:00					
09:00	Due homework #7 08:45 Lab3: longitudinal dynamics with cagegs 09:00 – 11:30	Lecture 4: space charge (or resonances) 09:00 – 11:30	Due Homework #3 AND draft final report Lecture 5: resonances (or space charge) 09:00 – 11:30	Lab 4: resonances? 09:00 – 11:30	Final reports 08:45 Final presentations 09:00 – 12:00
10:00					
11:00					
12:00					
13:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	tutoring on gather town 13:00 – 15:00	
14:00					
15:00					

Grading System

- 20%** Class participation: there will be a lot of quizzes, answer them all and you will get full credit.
- 30%** Homework assignment: 3 in total.
- 50%** Design report: each of you will choose a set of design parameters and produce a design document.

Assignment Schedule

Assignments due in the morning, before the start of the lecture/lab:

Wed. 9 Homework #1

Fri. 11 Table of parameters for your final report

Mon. 14 Homework #2

Wed. 16 Homework #3 + first draft of your final report

Fri. 18 Final report

Please reach out to us an anytime (tplanche@triumf.ca + baartman@triumf.ca) and help each other ([gather.town](#)).

Final report

Each student to produce a separate 3 to 8 page design document for:

- an isochronous fixed-magnetic-field machine,
- a machine that has never been designed or built before,
- no two students with the same set of design parameters.

The grade will depend on:

- how novel your design is,
- how realistic your design is,
- how well you integrate what will be taught in the lectures+labs.

On the last day of the course you have 20 min to defend your design: the grade will depend on the quality of your document, not on your presentation skill.

Final report – first step by Friday

By Friday we expect to receive from you a table like this one:

Particle type(s)	H^-
Injection energy	300 keV
Injection radius	26 cm
Extraction energy	520 MeV
Extraction radius	7.9 m
RF frequency	23 MHz
RF harmonic number	5
Average beam power	0.1 MW
Extraction method	stripping

Add a couple of sentences to motivate your choice, explain the intended application of your cyclotron, its advantages/disadvantage w.r.t. existing machines. . . We will give you feed back, and help you to produce a novel yet realistic cyclotron design!

We will be there every day until 15:00 PDT: [link](#) password: USPAS2021



gather.town - Guidelines

This virtual space will ALWAYS be open to you. Feel free to use it outside of the class hours as well. However, make sure that you:

- Use your full name when joining,
- Turn on your video (preferably),
- Mute yourself when possible,

Important notes:

- Interaction (video + audio) is based on proximity or private spaces,
- The room on the right is a big private space,
- The two exterior rooms on the left are two private spaces,
- The surroundings of a table is a private space,
- Press “x” to interact, or “g” for ghost mode

What we will not teach

Because 2 weeks is not that long, we will not teach:

- magnet design,
- rf technology,
- vacuum technology,
- ion sources,
- inflectors and other injection methods,
- stripping foil technology,
- septum/extraction channel technology,
- targets, diagnostics, gantries, etc.

We are open to discuss these topics (afternoon). And if we don't know how to answer a question, we will try to figure out the answer together.