Particle Accelerators on Earth

Common Particle Accelerator Designs

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Proseminar Understanding The Universe
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Outline

Introduction

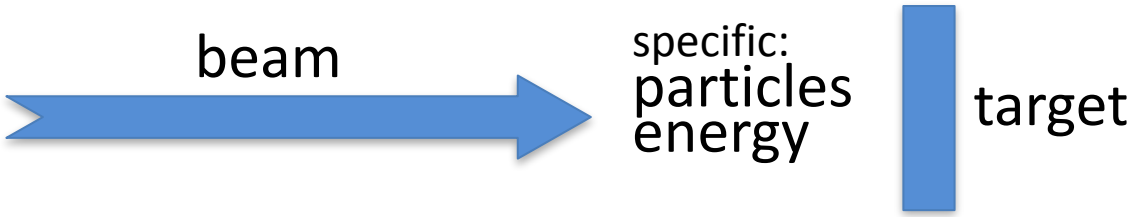
Common Parts for accelerators

Particle Acceleration

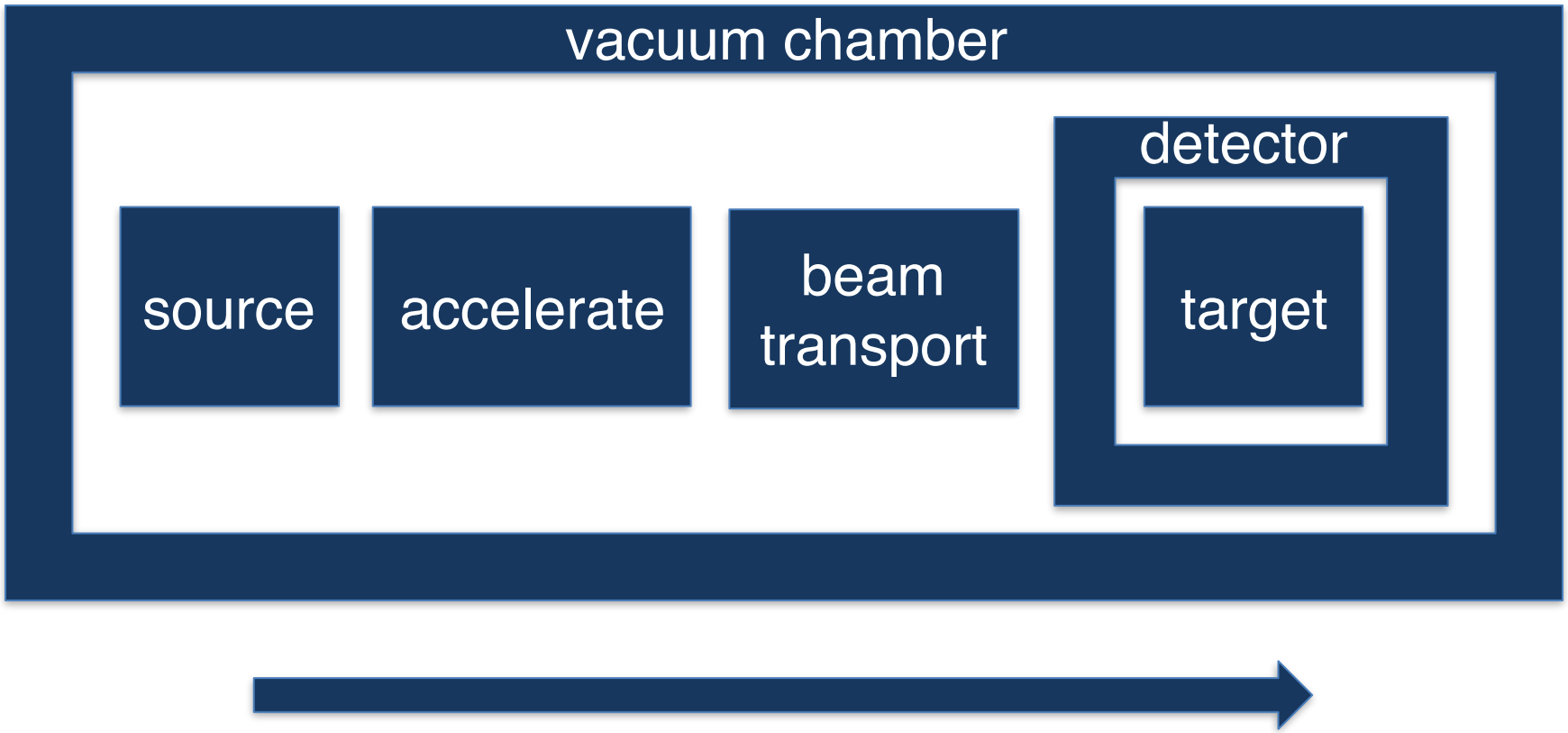
- electrostatic acceleration
- oscillating field acceleration

Comparison/ Overview

Basic Purpose

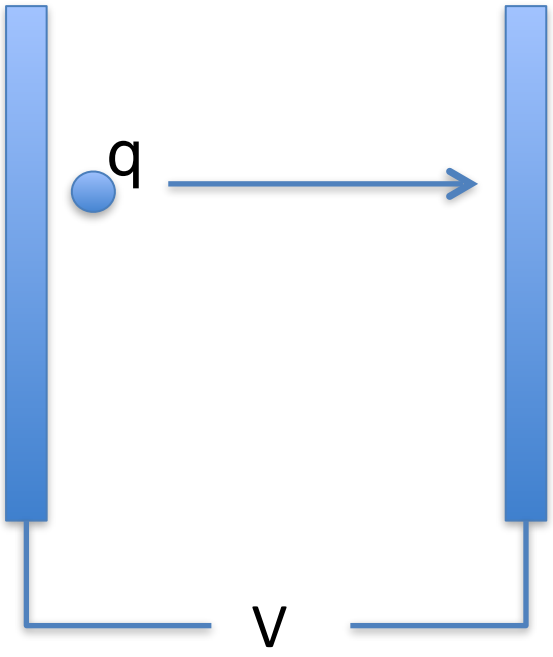


Common Parts



Particle Acceleration

- Electrostatic Acceleration



$$E = q\,V$$

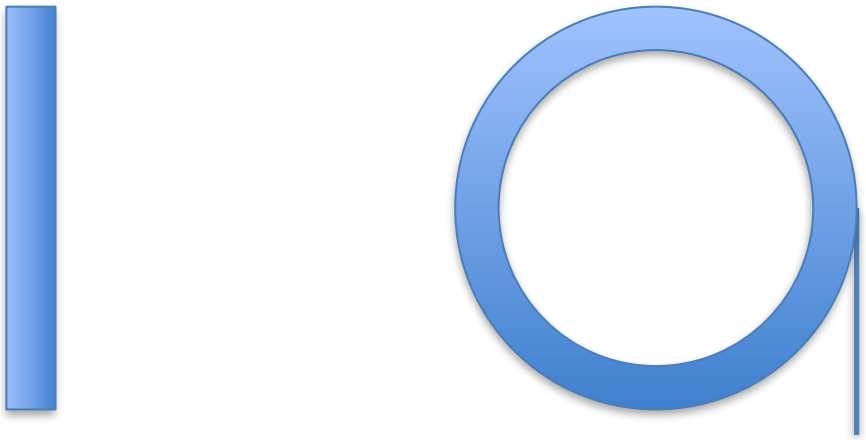
limited by
electrical breakdown

Particle Acceleration

- Oscillating field Acceleration

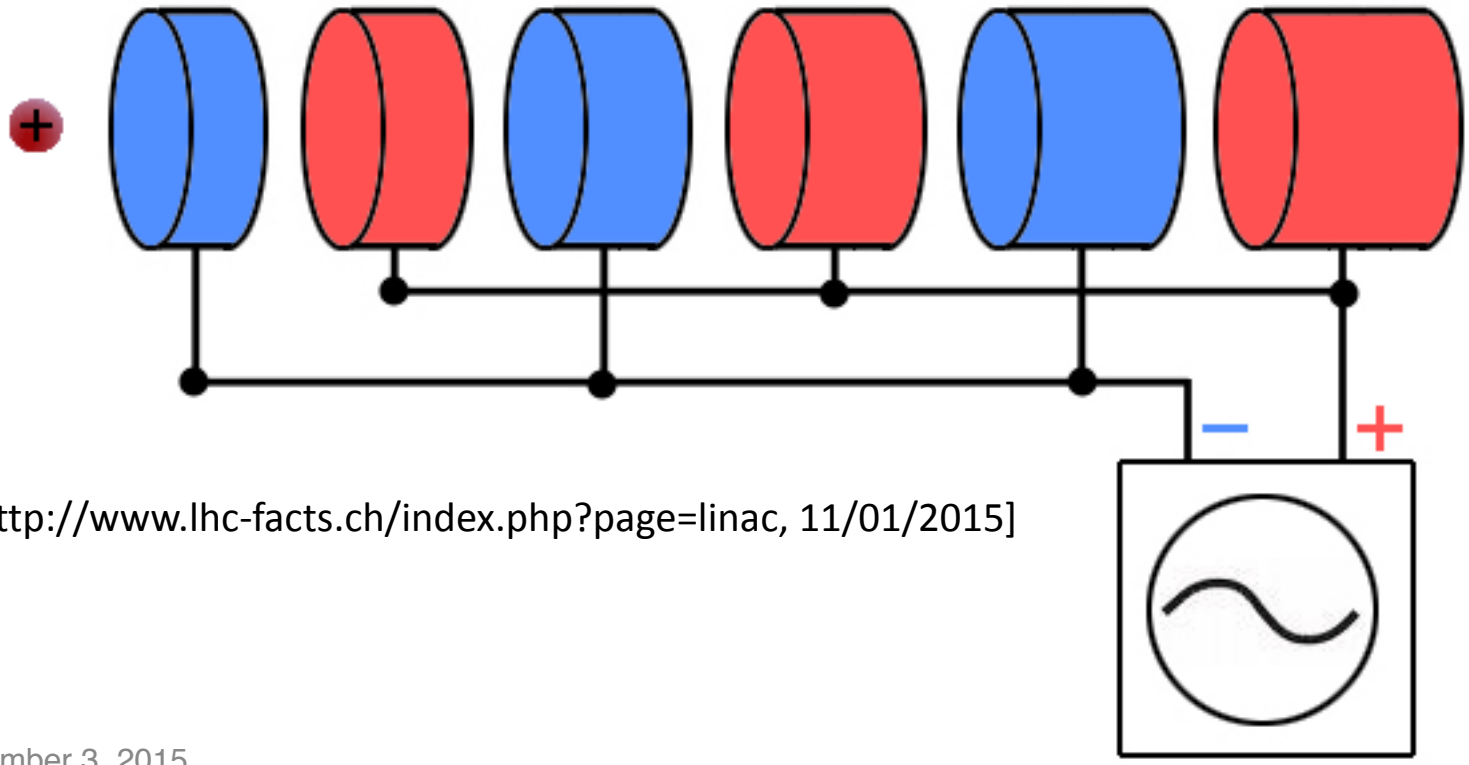
Radio Frequency (RF) electromagnetic fields

more than one lower but oscillating voltage source



Linear Accelerator (LINAC)

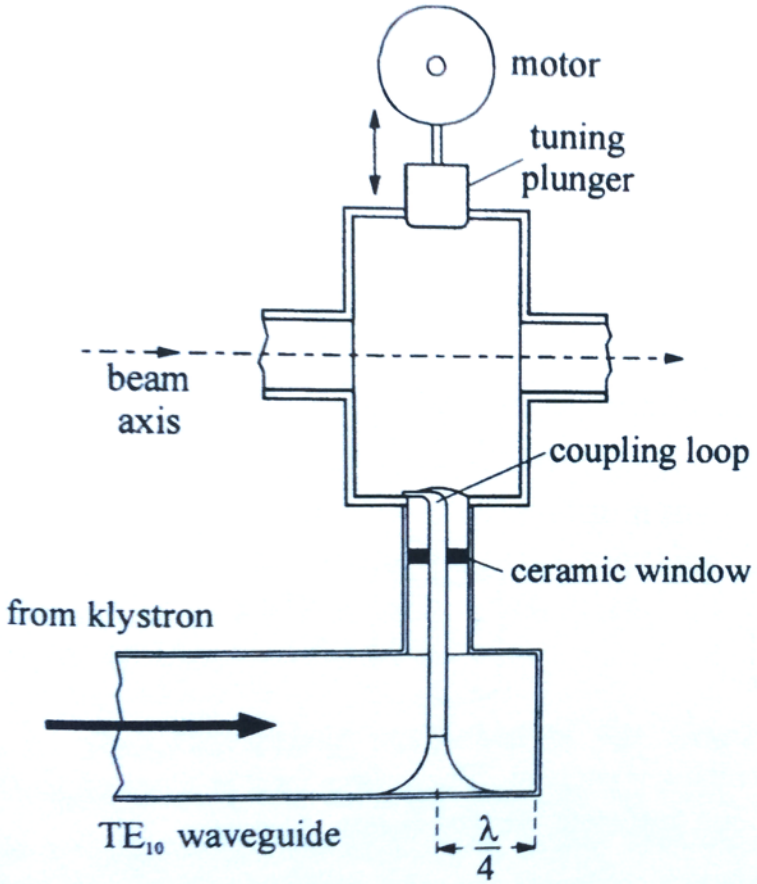
- drift tubes

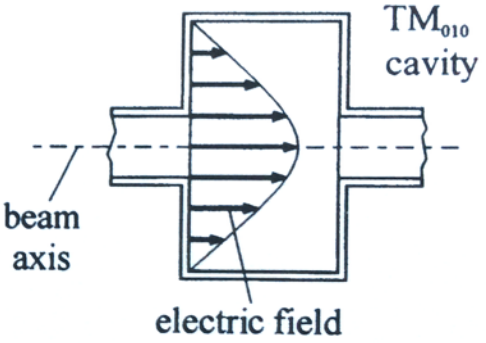


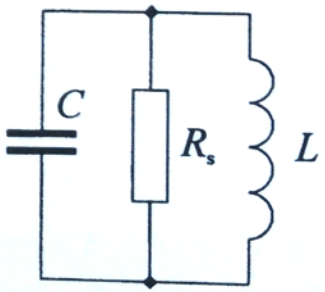
[http://www.lhc-facts.ch/index.php?page=linac, 11/01/2015]

RF Cavities

- radio frequency cavities







- cavity resonator for standing e/m waves
- large acceleration voltages
- multicell cavities for more efficient use of available RF power

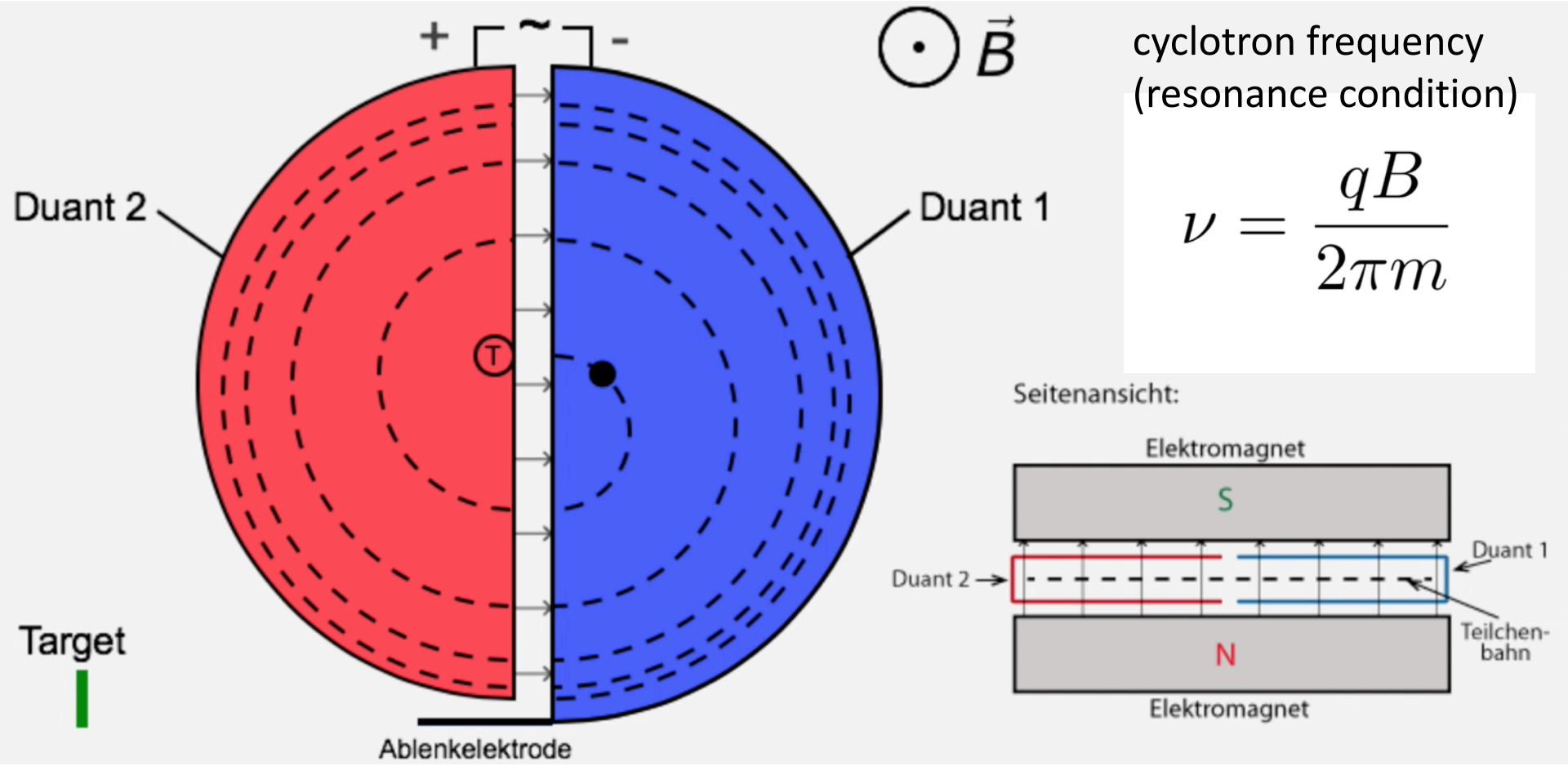
['The Physics of Particle Accelerators - an introduction', Klaus Wille, Oxford University Press 2000, p.161]

Circular Accelerator

- circular beam path – ‘continuous‘ acceleration
- smaller footprint, less driver devices

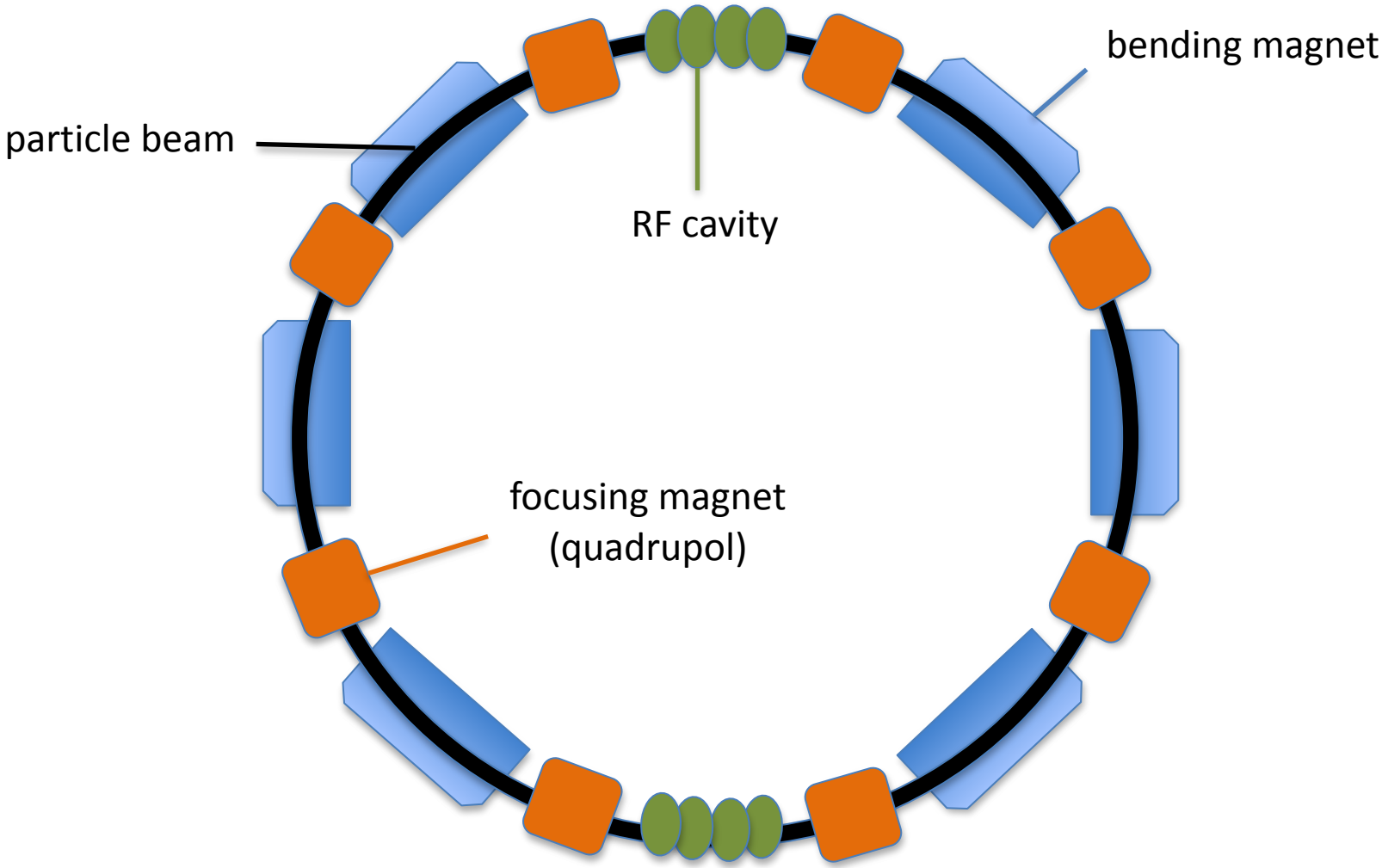
Cyclotron Synchrotron

Cyclotron

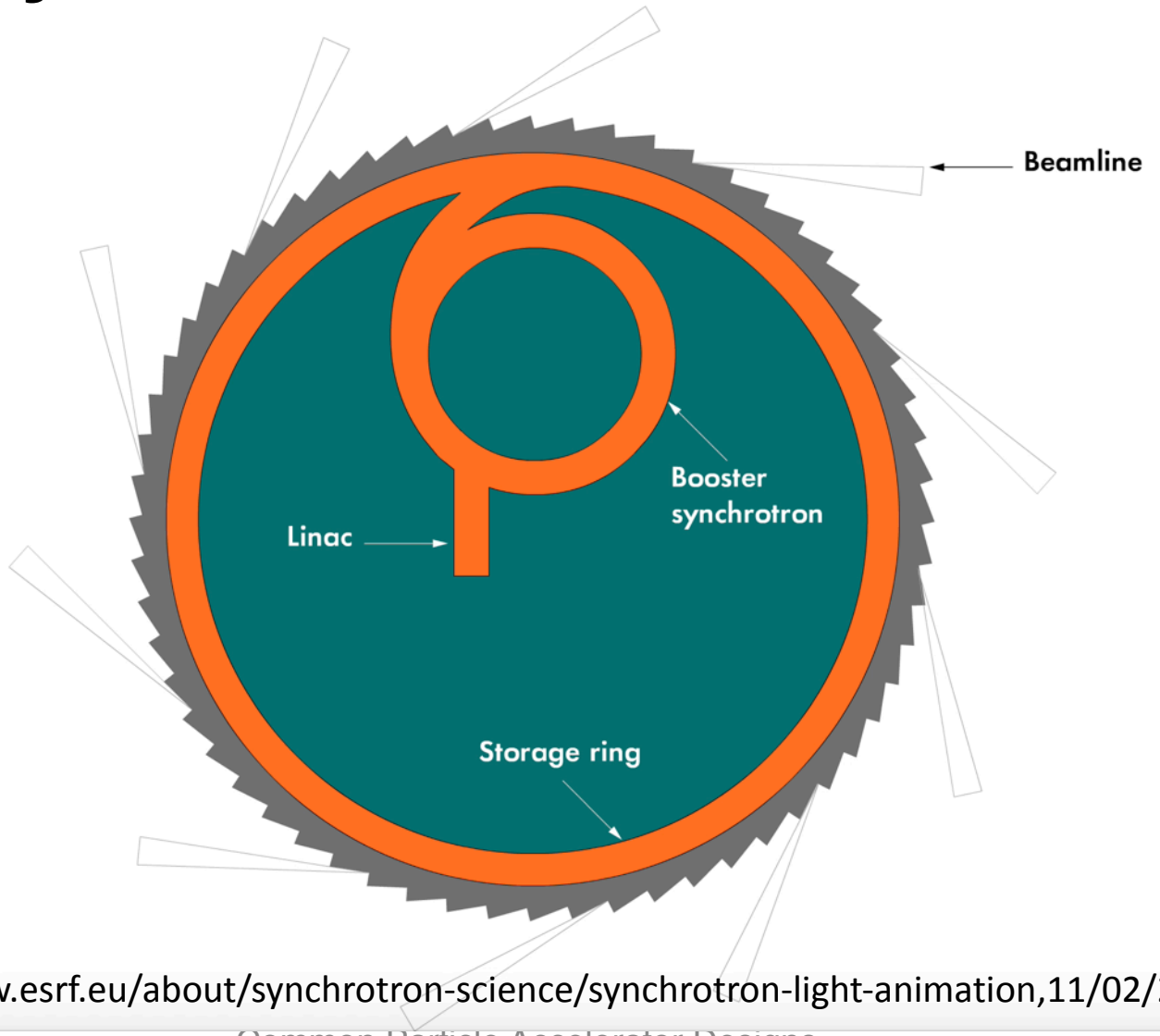


http://www.didaktik.physik.uni-muenchen.de/elektronenbahnen/b-feld/anwendung/zyklotron.php
11/02/2015

Synchrotron



Synchrotron Radiation



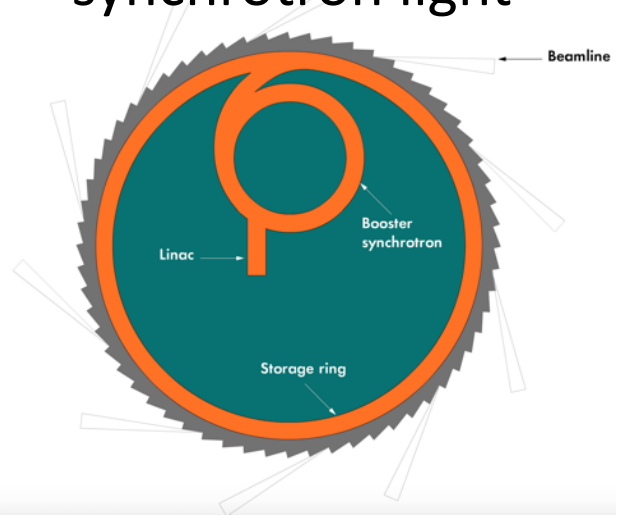
[http://www.esrf.eu/about/synchrotron-science/synchrotron-light-animation,11/02/2015]

Storage Ring

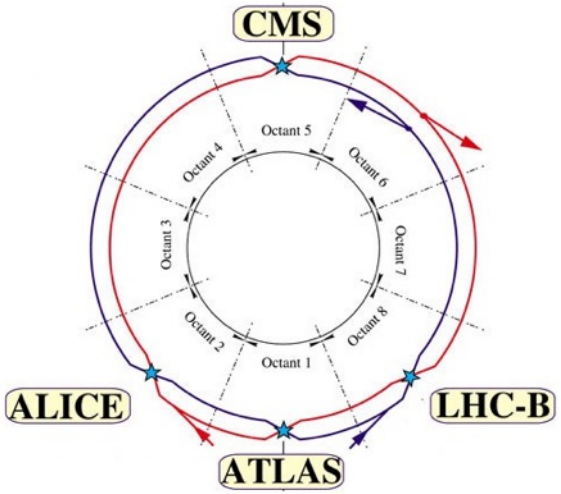
- basically a synchrotron
- no significant acceleration (storage)

usage:

synchrotron light

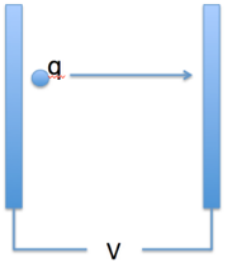


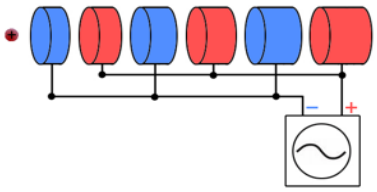
particle collider

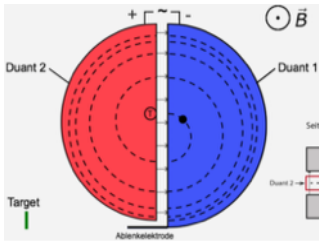


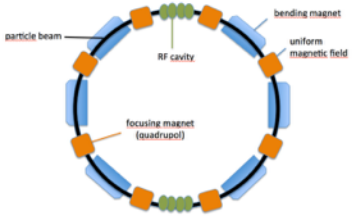
Comparison

	electrostatic acc	LINAC	Cyclotron	Synchrotron
+	• simple design • satisfactory for most nuclear studies	• no large magnets for path bending • no synchrotron radiation	• 'small' footprint • rather simple design	• const beam orbit • magn. field only at beam orbit
–	• max energy limited at 10 MeV	• very large in size • great number of driver devices	• limited energy (relativistic effects)	• max energy limited by magn. field • synchrotron radiation









Sources

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https:// en.wikipedia.org/wiki/Cyclotron, 11/01/2015

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