



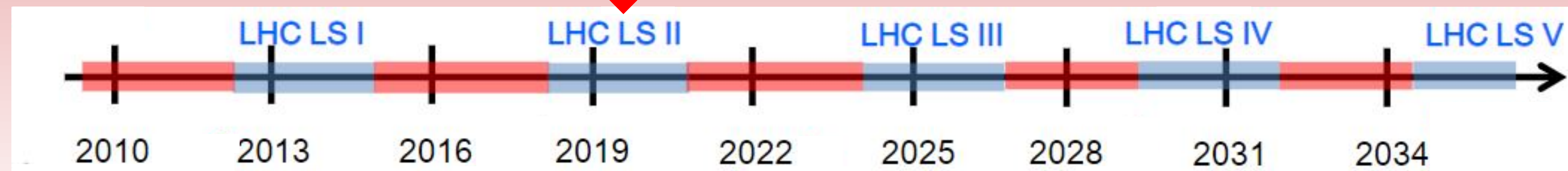
Phase-I Upgrade of the LHCb Detector

Ben Flaggs, Rohan Rajagopalan & Jorge Ramirez

Advised by Professors Manuel Franco Sevilla & Hassan Jawahery



Today ↓

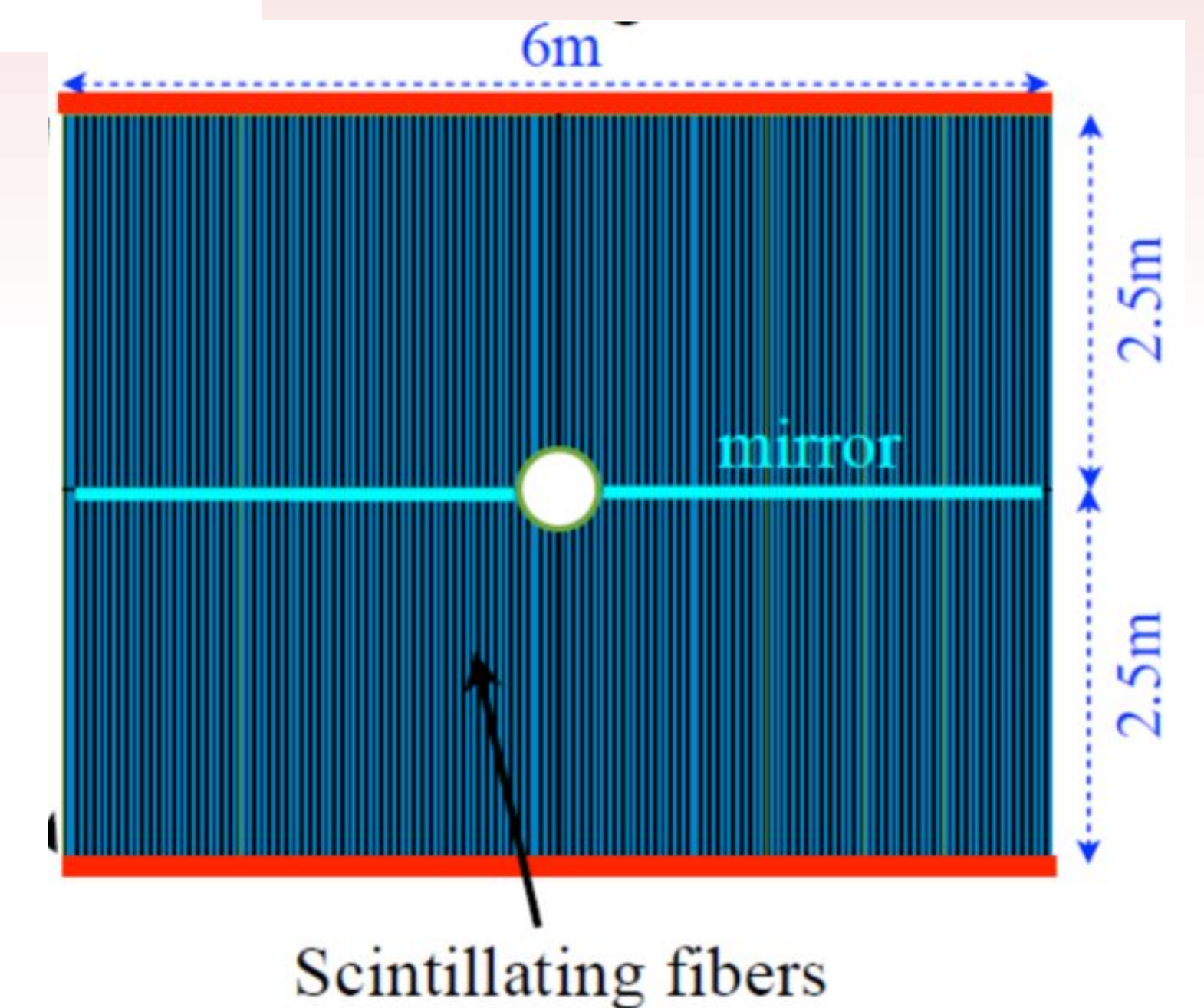
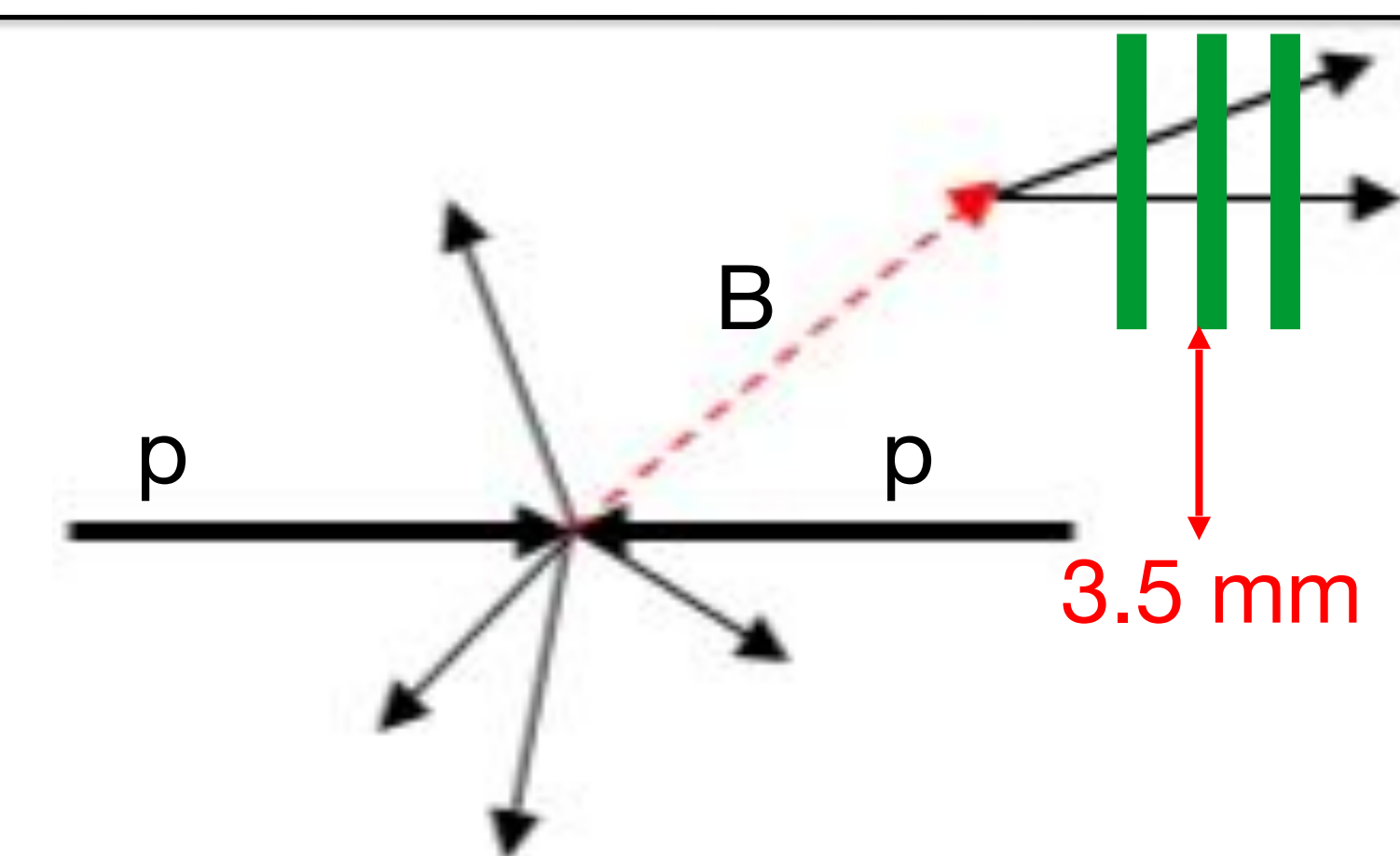
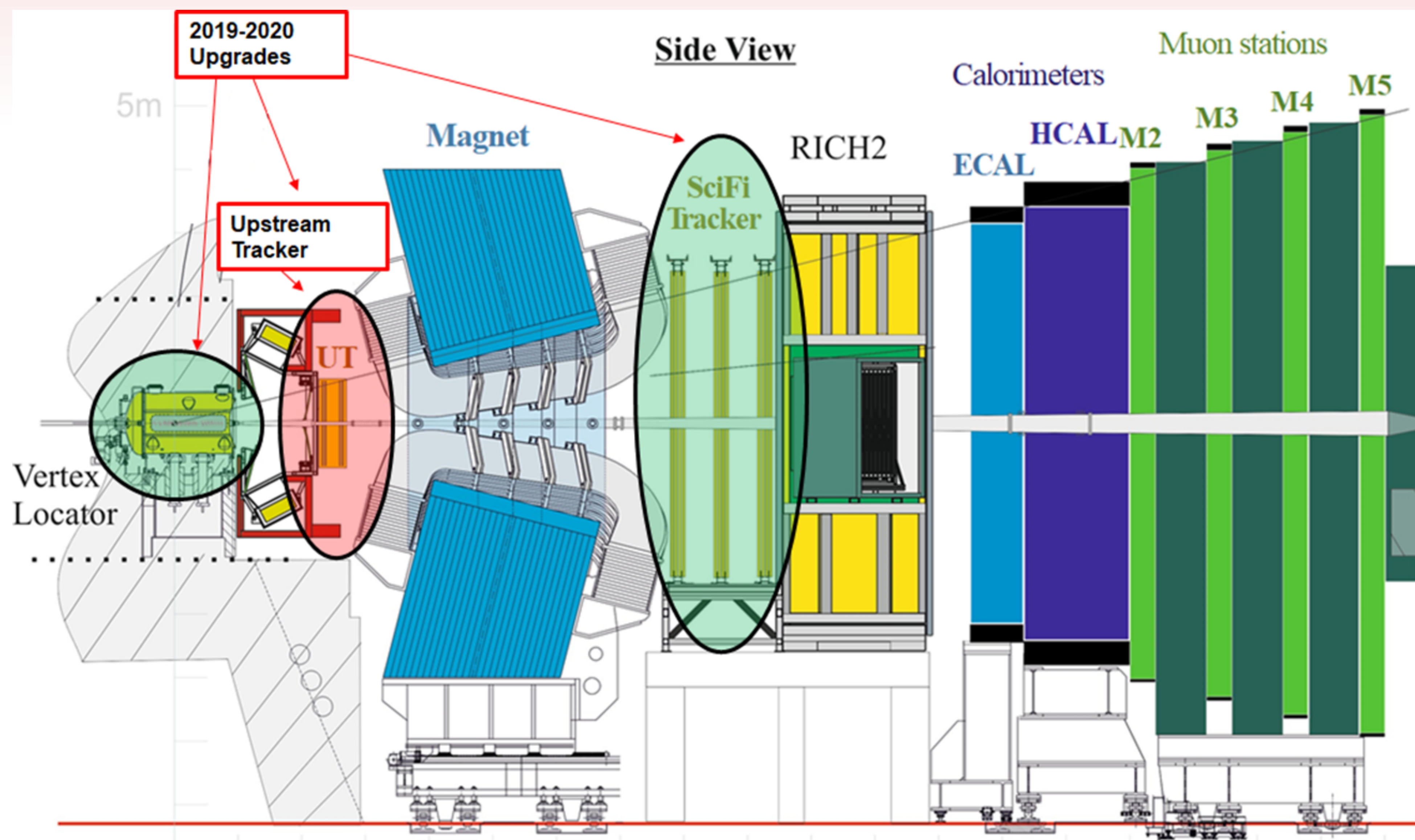


Intro

- Currently LHCb is having its second long shutdown (LS II) during which upgrades are being made in order to ensure that data can be collected more rapidly in future runs
- Two major upgrades are being carried out in LS II
 - Implementing the **first software-only trigger** in a hadron collider experiment
 - Increasing the data acquisition rate** of LHCb by a factor of 5-10
- Upgrades aim to collect approximately **10 times more overall data** as well as **20 times more exclusive hadronic events**

Vertex Locator (VELO)

- Experiment will collide protons where the collision will result in a multitude of particles flying out in all directions
- B mesons** can be tracked because these mesons do not decay immediately after the proton-proton collision
- Upgrade will **move detectors closer** to the point at which the B mesons decay
- Will allow for improved resolution of the B meson decay points (i.e. better position and momentum measurements of the B meson decays)



Scintillating Fiber (SciFi)

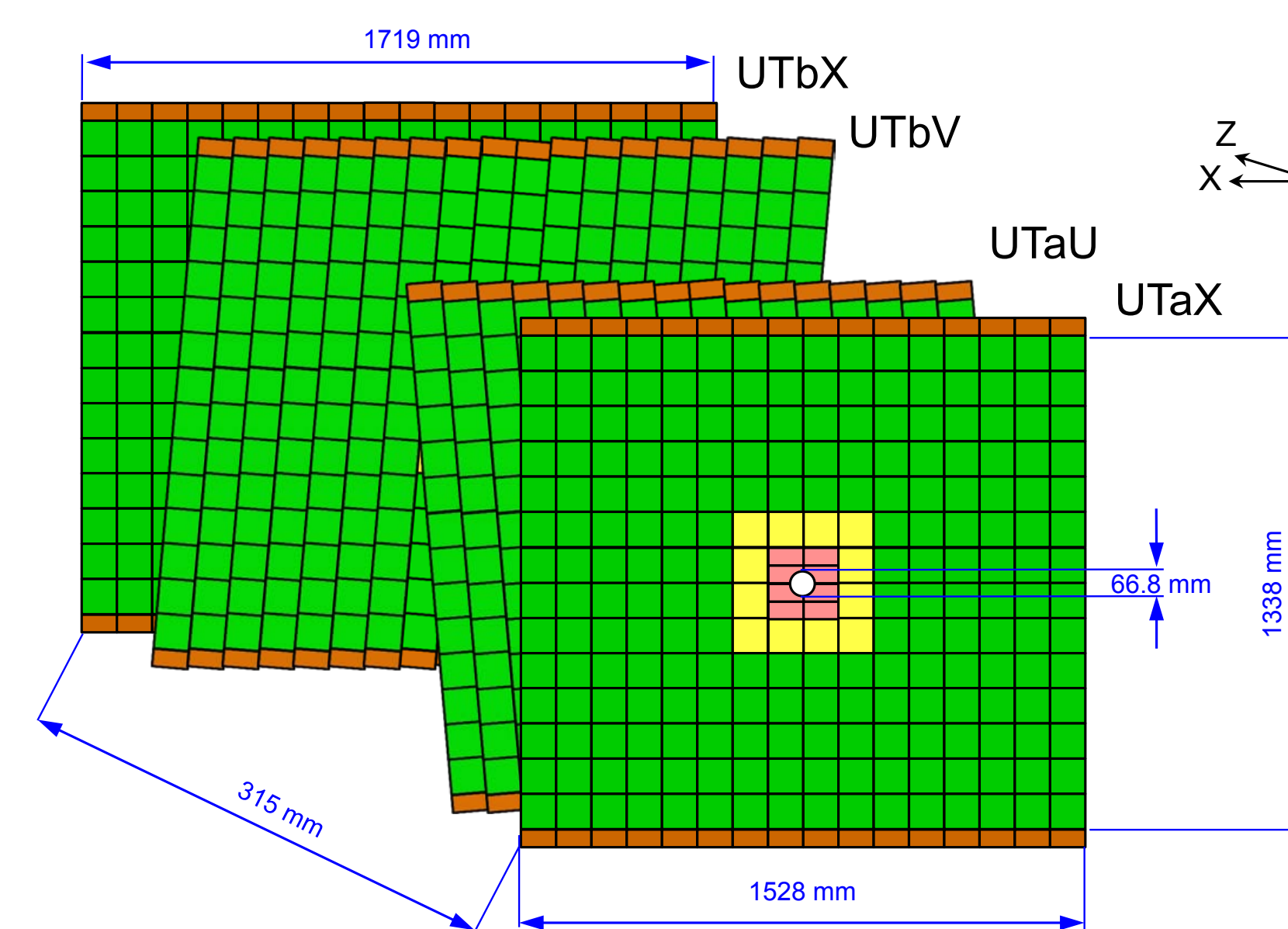
- Completely new detector based on scintillating fibers
- Will **track the paths of particles** which will lead to better position and momentum measurements
- Each fiber has a length of 2.5 m and a diameter of 250 μm
- Total width of detector will be 6 m

Trigger and DAQ Upgrade

- The **trigger** plays a key role in selecting signal events and rejecting background. It currently consists of two stages: a hardware trigger followed by a high-level trigger implemented in software.
- With the most recent upgrade, this trigger will be converted completely to that of a software-based system.
- Currently, the LHCb's DAQ (Data acquisition) numbers range at approximately 0.5 GB/s. With the new trigger system in place, these DAQ numbers are expected to increase to 2-5 GB/s!

Upstream Tracker (UT)

- The **Upstream Tracker** is the second detector in line to detect particles from the proton collision.
- The **particles** that pass through the detector **deposit charge through four layers of silicon**. These charge deposits are then analyzed and the particle's trajectory can be deduced.
- This upgrade focuses on improving the experiment's ability to track the paths of charged particles following collisions, as well as multiply the electronics' ability to record data by a factor of 10.



UMD work on UT upgrade

- The University of Maryland is contributing to the LHCb upgrade with the **design, construction, and installation of three electronic systems** that will organize the flow of data from the sensors, package the data and convert it to an optical signal, and provide power to the detector.
- We will undertake a large-scale production of these three electronic systems and then rigorously stress-test them in laboratory conditions to ensure their stability for use in the LHCb until the next long shutdown.
- Expect to construct **260+ data control boards**, **30+ backplanes**, and **300+ LV regulators** by 2020.

