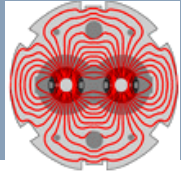
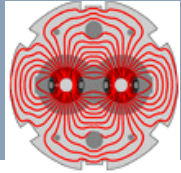
Introduction



- This documents highlights the main features and structures of the 2015 settings and hypercycles for
  - **Low beta* - standard high lumi operation,**
  - **Medium beta* - VDM and LHCf run,**
  - **High beta* (90m) – TOTEM & ALFA special runs.**
- A summary of the BP structures and configurations can be found on the link below.

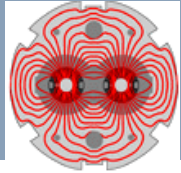
https://docs.google.com/spreadsheets/d/15k2d8RUwkJjFaFQfbxwOj-KYEDwn3WcvKHyA46NVkeg/edit?usp=sharing

General remarks



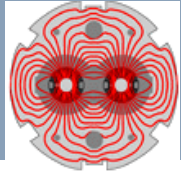
- The injection and ramp beam processed are programmed so far with **injection tunes 0.28/0.31**.
- The tunes are changed to **collision tunes 0.31/0.32** during the Q-CHANGE beam process that is inserted between ramp and squeeze.
  - *Only RQTF/D and sextupoles change (for the moment).*
  - *Length is 20 seconds only.*
  - *At a later stage it may be possible to move the tune change to the ramp, the squeeze etc. The tune change is implemented as a tune trim knob – simple to change !*
- At injection the **separation in IR8** is increased to **±3.5mm** (±2 mm in the other IRs). In addition a **vertical parallel angle** of **-40 μrad** (B1 convention) is added to optimize aperture.
  - *The change is made to accommodate 25ns beams with both spectrometer polarities.*

General remarks (2)



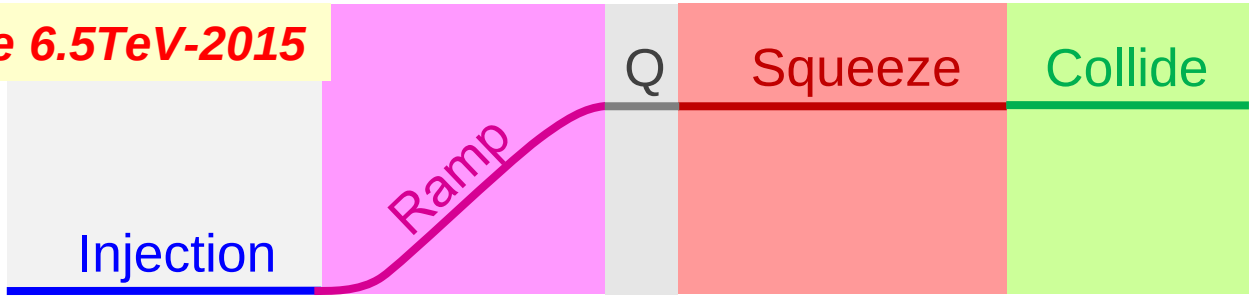
- The **same injection, ramp and tune change beam processes** are used for low, medium and high beta (90m).
- Like in run1 the **spools** (**MCS, MCO, MCD and MSS**) have their settings in a **separate ramp beam process**. That beam process is longer and will be used to trim decay correction for the flat top (b3 / MCS only !).

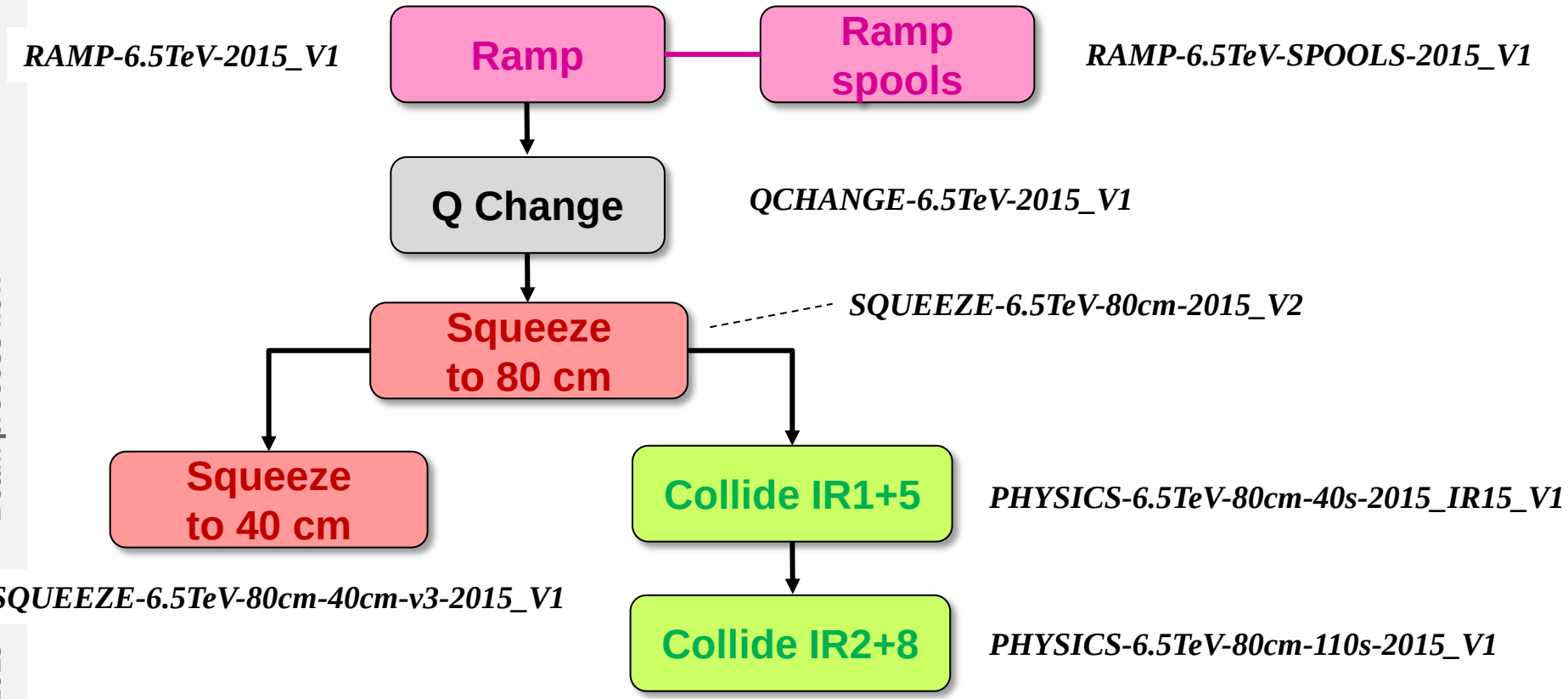
Low beta*



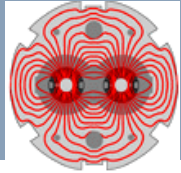
- During the squeeze β* is decreased to **80cm** in **IR1+5** and to **3m** in **IR8**. IR2 remains at injection β* of 10m.
- The crossing angles & separations are kept constant during the squeeze everywhere except for IR8.
  - *The IR8 crossing angle is increased from -230 to -250 μrad in the first step of the squeeze ⇔ current limitations on 2 correctors in IR8.*
- Following the recommendation of the beam-beam team **a first beam process will collide only IR1+5**. A **second beam process** is used to **collide IR2+8**.
- For the commissioning a second squeeze that brings **IR1+5** from **80cm to 40cm** is also present in the hypercycle.

Low beta cycle





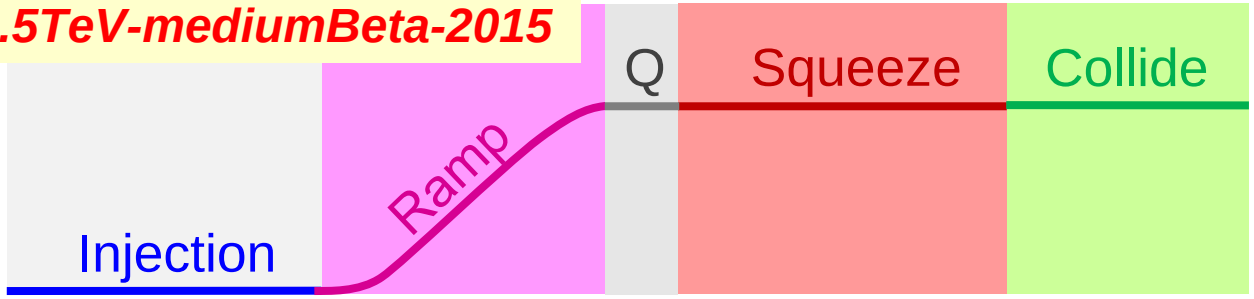
Medium beta*



- During the de-squeeze β^* is increased to **19m** in **IR1+2+5** and to **24m** in **IR8**.
- The crossing angles & separations are kept constant during the de-squeeze (at the flat top values).
- After the de-squeeze the crossing angles are adapted to VDM and LHCf configurations.
  - *The only difference between VDM and LHCf run is in IR1. For the LHCf run the angle remains at -145 μrad, for VDM the angle is set to 0.*
  - *The IR8 crossing angle is ramped from -230 to -310 μrad.*
- Finally the beams will **collide in all IPs at the same time** – head-on everywhere.

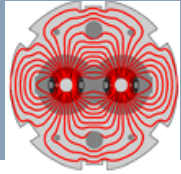
Medium beta cycle – VDM & LHCf

Hypercycle 6.5TeV-mediumBeta-2015



RAMP-6.5TeV-2015_V1	**Ramp**	**Ramp spools** *RAMP-6.5TeV-SPOOLS-2015_V1*
	Q Change	*QCHANGE-6.5TeV-2015_V1*
	De-squeeze to 19/24 m	*SQUEEZE-6.5TeV-vdM-19-24m-2015_V1*
	Adjust Xings	*PHYSICS-6.5TeV-Prep-19-24m-2015_V1*
	Collide All	*To be constructed*

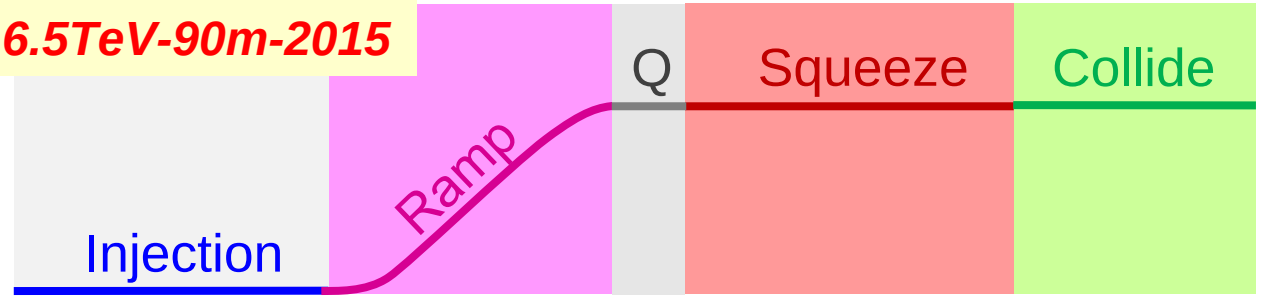
High beta*



- During the de-squeeze β* is increased to **90m** in **IR1+5**. IR2+8 remain at injection (flat top values).
- The **crossing angles in IR1+5** are ramped down from **±145 μrad to ±50 μrad** in the first part of the de-squeeze.
  - *Current limitations on the crossing angle bump at 90m.*
- The beams will **collide only in IR1+5**.

Medium high beta cycle – 90m

Hypercycle 6.5TeV-90m-2015



RAMP-6.5TeV-2015_V1

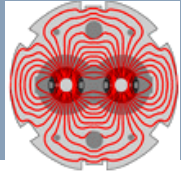
Ramp — **Ramp spools** — ***RAMP-6.5TeV-SPOOLS-2015_V1***

Q Change — ***QCHANGE-6.5TeV-2015_V1***

De-squeeze to 90 m — ***SQUEEZE-6.5TeV-HighB-90m-2015_V1***

Collide IR1+5 — ***PHYSICS-6.5TeV-90m-2015_V1***

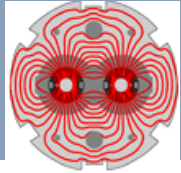
Configuration summary



- Low beta – spectrometer polarities for the startup

Parameter	Energy (GeV)	Value	Unit	Comment
Separation IR1+IR2+IR5	450	2	mm	
Separation IR8	450	3.5	mm	
Beam angle IR8	450	-40	microrad	
Crossing angles IR1	450	-170	microrad	
Crossing angles IR2	450	-170	microrad	
Crossing angles IR5	450	170	microrad	
Crossing angles IR8	450	-170	microrad	
ALICE Spectrometer/solenoid polarity		**POSITIVE**		Requires negative crossing angle knob (B1)
LHCb spectrometer polarity		**POSITIVE**		Good polarity
Separation IR1+IR5	6500	0.55	mm	
Separation IR2	6500	2	mm	
Separation IR8	6500	1	mm	
Crossing angles IR1	6500	-145	microrad	
Crossing angles IR2	6500	-120	microrad	
Crossing angles IR5	6500	145	microrad	
Crossing angles IR8	6500	-230	microrad	On flat top
Crossing angles IR8	6500	-250	microrad	At the first squeeze point (9m)

Configuration summary



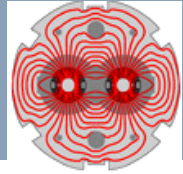
Medium beta squeeze

Parameter	Energy (GeV)	Value	Unit	Comment
Separation IR1+IR5	6500	0.55	mm	
Separation IR2	6500	2	mm	
Separation IR8	6500	1	mm	
Crossing angles IR1	6500	-145	microrad	
Crossing angles IR2	6500	-120	microrad	
Crossing angles IR5	6500	145	microrad	
Crossing angles IR8	6500	-230	microrad	

Medium beta collisions

Parameter	Energy (GeV)	Value	Unit	Comment
Crossing angles IR1	6500	0	microrad	**-145 in IR1 for LHCf**
Crossing angles IR2	6500	-120	microrad	same as physics, can lower if needed
Crossing angles IR5	6500	0	microrad	
Crossing angles IR8	6500	-310	microrad	as large as possible, value to be confirmed

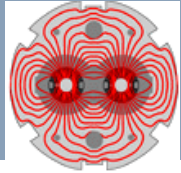
Configuration summary



- High beta squeeze

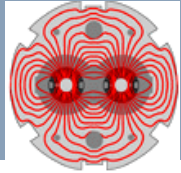
Parameter	Energy (GeV)	Value	Unit	Comment
Separation	6500	0.55	mm	
Separation IR2	6500	2	mm	
Separation IR8	6500	1	mm	
Crossing angles IR1	6500	50	microrad	ramp down during de-squeeze - at the limit !
Crossing angles IR2	6500	-120	microrad	same as flat top of std ramp
Crossing angles IR5	6500	50	microrad	ramp down during de-squeeze - at the limit !
Crossing angles IR8	6500	-230	microrad	same as flat top of std ramp

Rampdown



- Unique BP: **RAMPDOWN-6.5Tev_V1** contains settings for all PCs except:
  - *RQXs, IPQs, RQD/F*
- The circuits above are managed by the sequencer that sets them in the following state (while the others play their functions):
  - *RQXs - STANDBY*
  - *IPQs - OPENLOOP to 100 A*
  - *RQD/F - OPENLOOP to 350 A*
- **N.B.** these circuits have NO rampdown settings defined!!
- Just for info, in case you look at the functions: in order to decrease the time needed to go to Rampdown[START], thus optimizing the global process, the cycle for some of the 600 A starts at current =! 0…then goes to zero and starts the bipolar cycle.

Pre-cycle



- Settings are split in 2 separated BPs (similar strategy to that used for RAMP and RAMP-SPOOLS).
- One BP **PRECYCLE-6.5Tev-STANDARD_V1** contains the “standard” settings for all PCs but:
  - *RQXs, IPQs, RQD/F*
- The settings are generated with the same logic used during Run1 (scaled to 6.5 TeV when needed).
- One BP **PRECYCLE-6.5Tev-RAMP-UP-ONLY_V1** contains the RAMP+FLATOP for the other circuits. At the end of the settings (RAMP+FLATOP) the PCs are sent down with the logic used for ramp-down (while the others play their long functions):
  - *RQXs - STANDBY*
  - *IPQs - OPENLOOP to 100 A*
  - *RQD/F - OPENLOOP to 350 A*