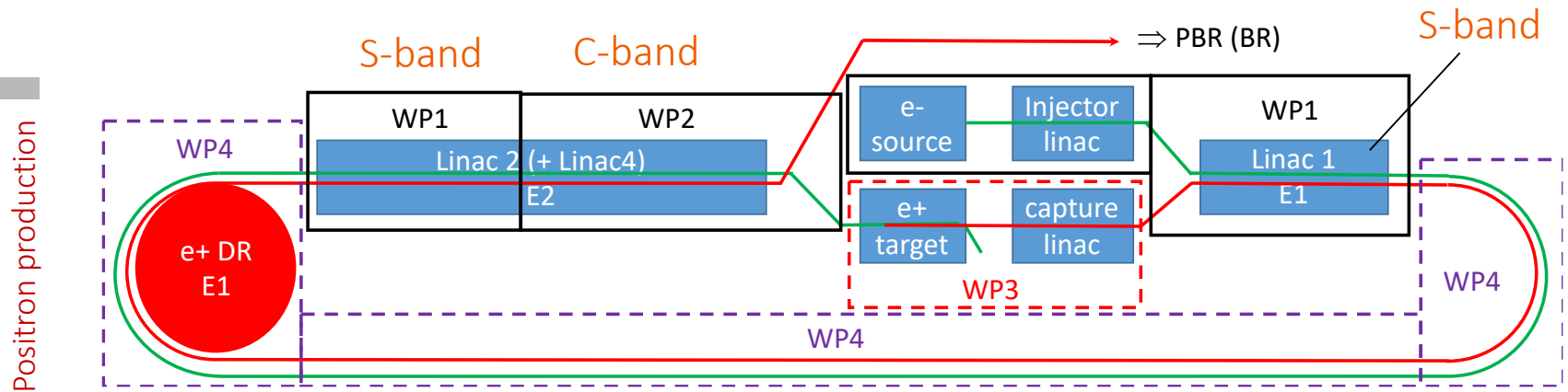
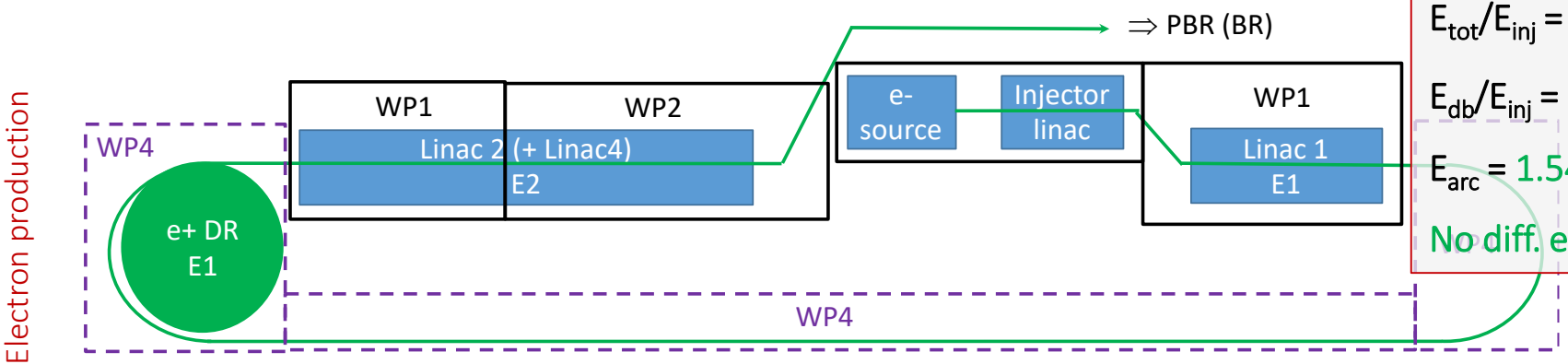
Some slides presented at last FCC week June 2021

Final proposal of the layout: 6(20) GeV





$E_{tot}/E_{inj} = 1$

$E_{db}/E_{inj} = 1$

$E_{arc} = 1.54$ GeV

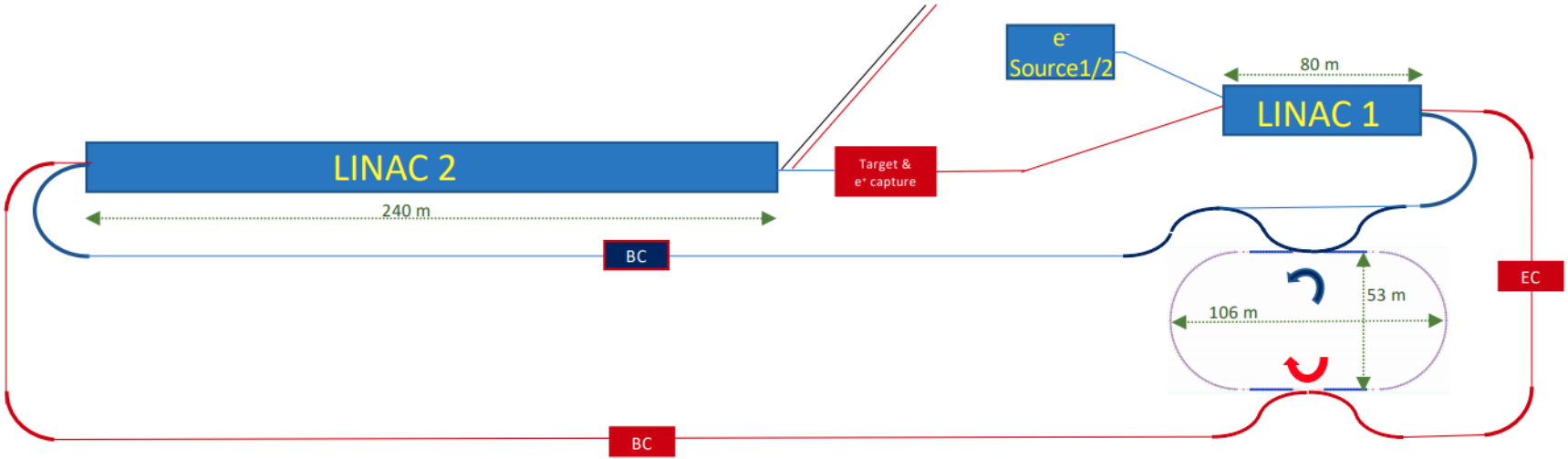
No diff. energy

Outcome from WP0.2 meetings leading by A. Grudiev

Damping Ring and Transfer Lines WP4

Catia Milardi, Oscar Blanco, Antonio De Santis (INFN-LNF)

Injector Layout

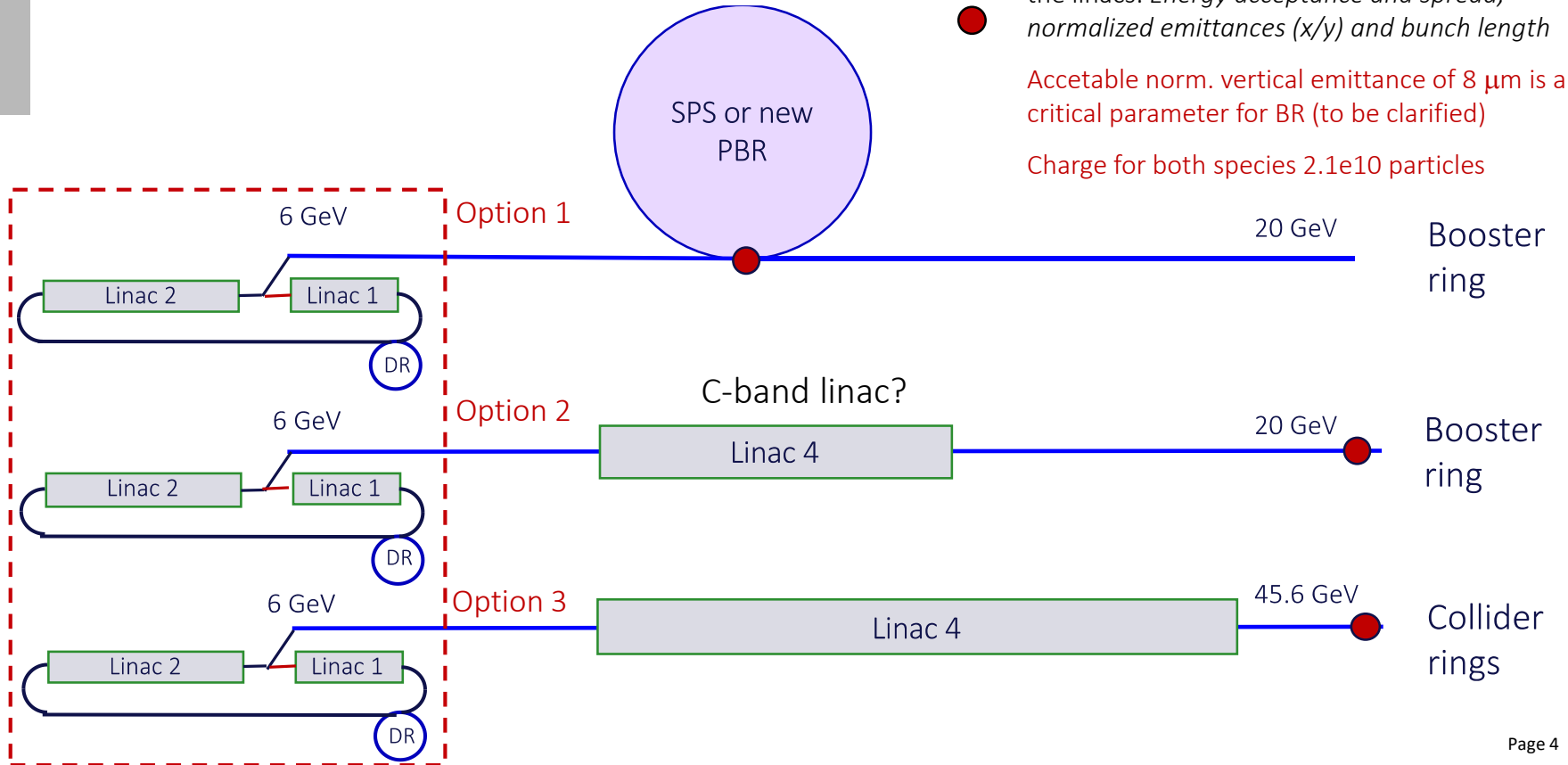


Three more options for injection into booster ring

Main beam parameters to be considered for the linacs: *Energy acceptance and spread, normalized emittances (x/y) and bunch length*

Accetable norm. vertical emittance of 8 μm is a critical parameter for BR (to be clarified)

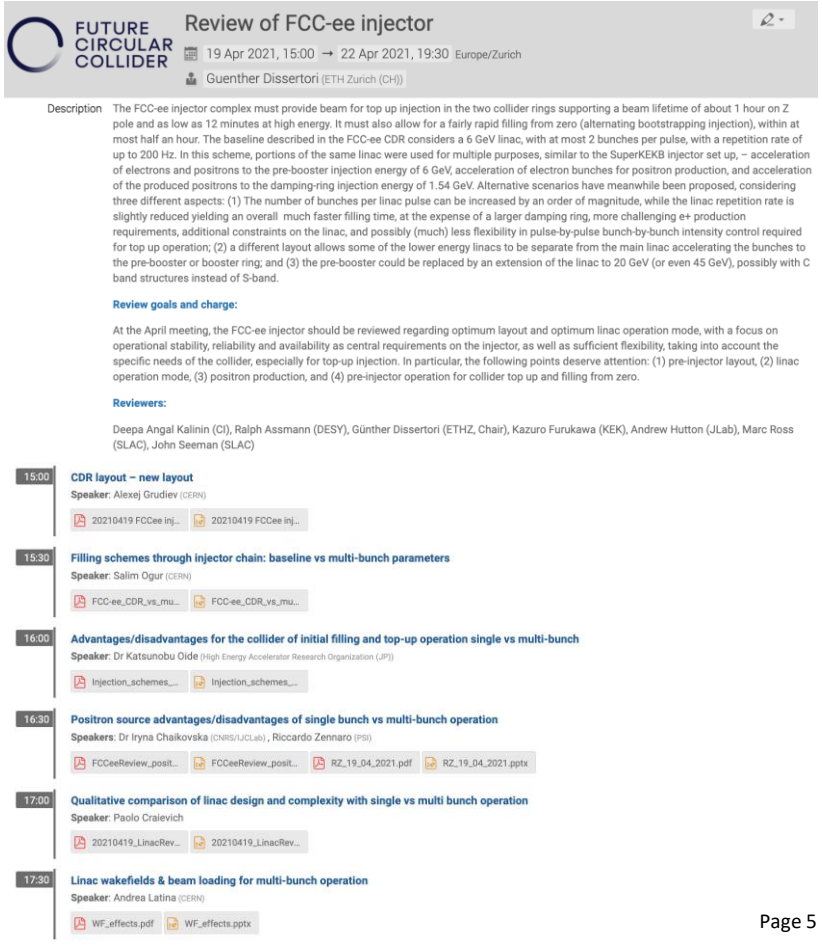
Charge for both species 2.1e10 particles



FCC-ee Injector Review Meeting

- We had a review on 19th of April 2021, reviewers from several international laboratories
- A detailed report from reviewers ready with comments and recommendations
- Here few important outcomes and remarks
- General requirements (seen from the collider, F. Zimmermann):
  - we would like to have a factor of 2 margin with respect to the maximum requirements in the case of 4 IPs, and for all modes of operation. This should be defining the minimum necessary performance of the injector.

→ The two-bunch operation meets this requirement (talk by K. Oide during the review meeting)



FUTURE CIRCULAR COLLIDER

Review of FCC-ee injector

19 Apr 2021, 15:00 → 22 Apr 2021, 19:30 Europe/Zurich

Guenther Dissertori (ETH Zurich (CH))

Description The FCC-ee injector complex must provide beam for top up injection in the two collider rings supporting a beam lifetime of about 1 hour on Z pole and as low as 12 minutes at high energy. It must also allow for a fairly rapid filling from zero (alternating bootstrapping injection), within at most half an hour. The baseline described in the FCC-ee CDR considers a 6 GeV linac, with at most 2 bunches per pulse, with a repetition rate of up to 200 Hz. In this scheme, portions of the same linac were used for multiple purposes, similar to the SuperKEKB injector set up, – acceleration of electrons and positrons to the pre-booster injection energy of 6 GeV, acceleration of electron bunches for positron production, and acceleration of the produced positrons to the damping-ring injection energy of 1.54 GeV. Alternative scenarios have meanwhile been proposed, considering three different aspects: (1) The number of bunches per linac pulse can be increased by an order of magnitude, while the linac repetition rate is slightly reduced yielding an overall much faster filling time, at the expense of a larger damping ring, more challenging e+ production requirements, additional constraints on the linac, and possibly (much) less flexibility in pulse-by-pulse bunch-by-bunch intensity control required for top up operation; (2) a different layout allows some of the lower energy linacs to be separate from the main linac accelerating the bunches to the pre-booster or booster ring; and (3) the pre-booster could be replaced by an extension of the linac to 20 GeV (or even 45 GeV), possibly with C band structures instead of S-band.

Review goals and charge:

At the April meeting, the FCC-ee injector should be reviewed regarding optimum layout and optimum linac operation mode, with a focus on operational stability, reliability and availability as central requirements on the injector, as well as sufficient flexibility, taking into account the specific needs of the collider, especially for top-up injection. In particular, the following points deserve attention: (1) pre-injector layout, (2) linac operation mode, (3) positron production, and (4) pre-injector operation for collider top up and filling from zero.

Reviewers:

Deepa Angal Kalinin (CI), Ralph Assmann (DESY), Günther Dissertori (ETHZ, Chair), Kazuro Furukawa (KEK), Andrew Hutton (JLab), Marc Ross (SLAC), John Seeman (SLAC)

15:00 **CDR layout – new layout**
Speaker: Alexej Grudiev (CERN)
20210419 FCCee inj... 20210419 FCCee inj...

15:30 **Filling schemes through injector chain: baseline vs multi-bunch parameters**
Speaker: Salim Ogur (CERN)
FCC-ee_CDR_vs_mu... FCC-ee_CDR_vs_mu...

16:00 **Advantages/disadvantages for the collider of initial filling and top-up operation single vs multi-bunch**
Speaker: Dr Katsunobu Oide (High Energy Accelerator Research Organization (JP))
Injection_schemes_... Injection_schemes_...

16:30 **Positron source advantages/disadvantages of single bunch vs multi-bunch operation**
Speakers: Dr Iryna Chaikovska (CNRS/LJCLab) , Riccardo Zennaro (PSI)
FCCeeReview_posit... FCCeeReview_posit... RZ_19_04_2021.pdf RZ_19_04_2021.pptx

17:00 **Qualitative comparison of linac design and complexity with single vs multi bunch operation**
Speaker: Paolo Craievich
20210419_LinacRev... 20210419_LinacRev...

17:30 **Linac wakefields & beam loading for multi-bunch operation**
Speaker: Andrea Latina (CERN)
WF_effects.pdf WF_effects.pptx

Guidelines for the future studies

Extracted from the review report

1. adopt new layout for 6 GeV with only one energy in each linac & e+ production at 6 GeV
2. linac RF frequency should be chosen to be an appropriate multiple of the FCC-ee collider RF frequency to make potential future injection operation much easier to perform
3. check the acceptance of the booster ring in terms of emittance because this parameter will greatly influence the injector itself, i.e. RF guns and damping ring
4. carry out start-to-end simulations for the new baseline layout
5. rough relative cost comparison for new and old layout (probably only marginal differences)
6. concentrate on 2 bunch per pulse conservative scheme as recommended by review, with e+ target inspired by SLC's
7. study of 6-to-20 GeV linac, including rough cost estimate; e+ source performance at e- energy of 20 GeV
8. consolidation and confirmation of e+ yields expected at 6 and 20 GeV
9. preparation of PSI e+ experiment based on a target compatible with FCC 2-bunch operation