

# FCC-ee Vacuum Installation Schedule (very tentative)

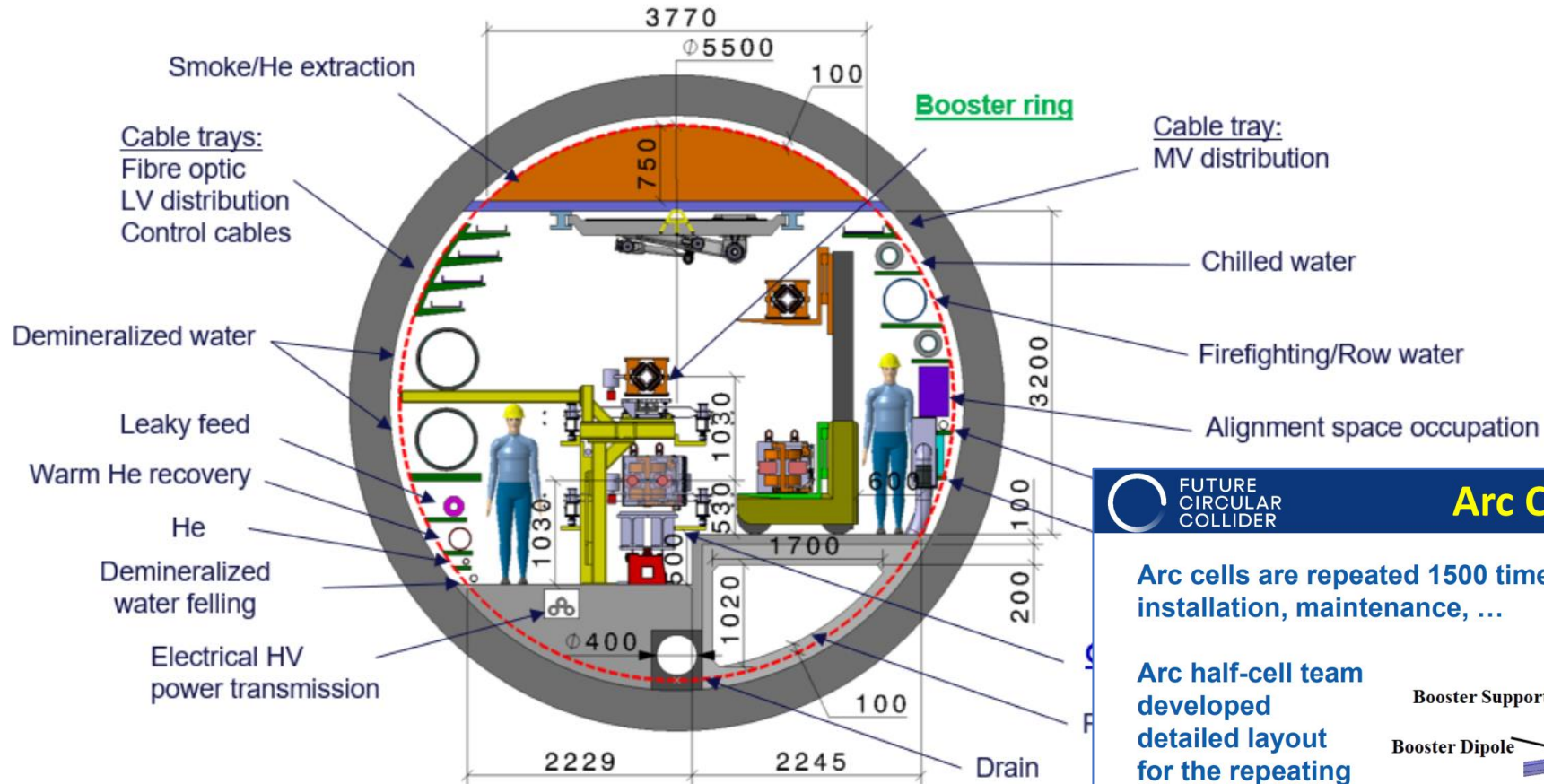
FCC Schedule WG #8, 13 October 2023

R. Kersevan, C. Garion, TE-VSC

- The tunnel along the arcs has a typical cross-section as shown here...



## Arc Cell Integration



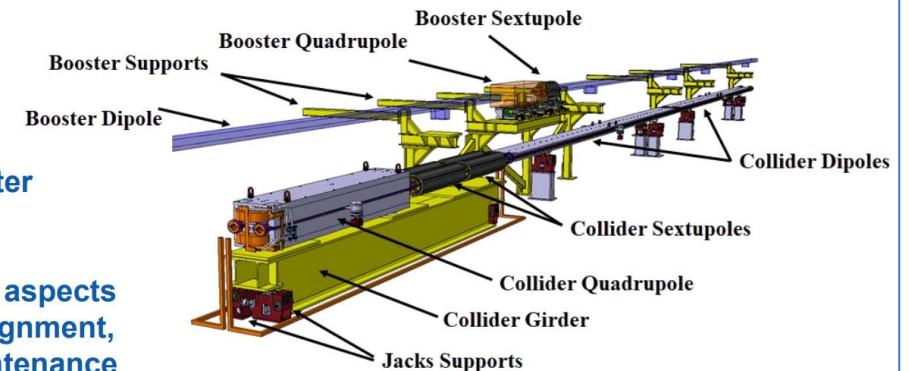
## Arc Cell Integration

Arc cells are repeated 1500 times → optimize the layout for performance, cost, installation, maintenance, ...

Arc half-cell team developed detailed layout for the repeating structure of Booster and Main Rings

Considered many aspects including cost, alignment, stability, and maintenance

Fully documented and starting phase-II with detailed engineering of a mockup



- The vacuum sectors' length has been tentatively set to 400 m (4x400m=1600 m, inter-alcove distance along the arcs)
- We assume that the booster gets sectored the same way, 400m
- Based on our group's experience at CERN, the **vacuum group**, in conjunction with **magnet group** (for pre-installation of quadrupole chambers) and **alignment group**, will have to carry out:
  1. pre-alignment (at surface? In the tunnel? TBD)
  2. pumpdown
  3. leak-check
  4. bakeout cycle (with activation of the NEG where present), including gauge and pump degassing
  5. final alignment
  6. removal of the material
  7. connection of cooling water manifolds
- We assume 2 beams **pumped in parallel** by same pumping groups: this requires prior installation of 2x400 m vacuum chambers (**NEW: booster is neither NEG-coated nor baked**)

- **The exact timing of the mentioned procedures can't be scheduled now**, it depends on too many **unknown factors**; we look forward to the **finalization of the tunnel mockup study**
- **Time**: based on our room temperature accelerators, we can **estimate in 2 weeks** the time needed to carry out the activities listed in 1-7 above, **provided enough manpower is available at the needed time: a team of 4 technicians can carry out those activities for the 2 rings in parallel. If the booster is to be done as well at the same time, 1-2 more technicians may be necessary (TBD)**
- In all of the above we assume that the **vacuum chambers' supports are pre-installed and aligned in the tunnel prior to the installation of the chambers**
- The timing/schedule for the installation of the chambers, to be done before 1-7, will ultimately **depend on the actual length of the chambers** (not finalized yet) **and mostly on the availability of the pre-installed quadrupole chambers** (see magnet installation schedule) (**→ *logistics of a very large tunnel? Transporting frames?*** TBD)
- The vacuum group will have to optimize the shape/size of the pre-pumping groups, as they will have to remain installed in the tunnel during the whole procedure (one every ~50 m or so → 8 per 400m sector): given the present cross-section of the tunnel, there's no much space left (**→ restrictions to movement along concerned sectors during 2-week bakeout???** → **logistics/safety?** Hot components with heaters under tension)

- The current design of the vacuum system for the two rings implements the Shape Memory Alloy version of the oval (elliptical) flanges: they need special tools/clamps which either heat or cool down ( $\text{LN}_2$  temperature) the SMA rings, for tightening/releasing the flanges
- Therefore, there will be a need to have (at least) **ONE  $\text{LN}_2$  dewar/sector available in the tunnel** during vacuum chamber installation ( $\rightarrow$   *$\text{LN}_2$  refill points?*)
- ...
- **Refinements to come in the incoming months:** we are prototyping right now most vacuum components, such as vacuum chamber extrusions, stir-friction welding, SR absorbers, SMA flanges, in-situ radhard bakeout system, etc...