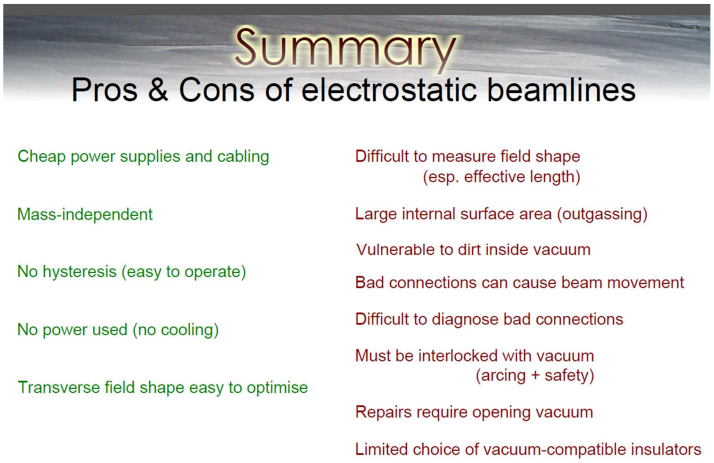
ELENA Transfer Line Workshop, 25th January 2012

Main outcomes after general discussion:

1. Decision to use exclusively electrostatic devices in the Elena extraction lines:



Based on the summary list of Tim Giles' talk it is assumed that the vacuum requirements in the line of about 1e-9 mbar shall be feasible even with the larger outgassing volume of electrostatic devices. Dirt in the pipe, interlocking and diagnostics of bad connections must be carefully taken into account in the design. Opening the vacuum due to repairs is not necessarily a disadvantage but needs to be considered in the spare policy. Magnetic shielding is considered to be a big advantage for electrostatic lines, as well as cheap production, low power consumption, no hysteresis and therefore easy operation. The difficulty of shielding in case of many feed throughs (strong effect of holes seen on shielding at ISOLDE) in order to have a good monitoring on bad connections could be solved by shielding boxes a la ISOLDE at the very critical places close to the experiment solenoids.
Until it is clear if bakeability is required at least in the first part of the TLs for differential pumping between machine and line vacuum, compatibility with baking out has to be considered in the design.

2. Decision to stay with maximal four bunches at extraction:

Input from the experiment side makes clear that the turn-around time of experiments is often longer than the AD cycle itself which means that it is not necessary to serve all experiments within the same AD cycle with beam. High flexibility for different switching scenarios is considered useful. The optimum extraction scenario is extraction of all bunches at once and switching in the line. The feasibility of a fast switchyard in the line together with an extraction kicker pulse length of ~ 6 us and rise time of ~1 us needs to be studied.

3. Alignment of electrodes within the vacuum pipe remains unclear:

Recommendation from ELISA that this is not necessary, they mount the electrodes rigidly in the chamber wrt to the flanges. ISOLDE has rigidly mounted electrodes, too. Tim Giles' experience shows that errors due to misalignment shall be rather overcome by a generous amount of steerers. ISOLDE is changing ~every two weeks their source and has to retune the complete lines. Carsten Welsch claims an easy and cheap way of aligning the electrodes at Cockroft with screws within the chamber.

Discussions after talks:

1. Stephan Maury – Introduction:

The question is if Gbar will be installed at the same time as ELENA which is answered to be true.

2. Pavel Belochitskii – Present TL Status:

The AD beam has a special bunch shape with 75% of the beam in less than 1 pi, but long tails. Small momentum spread from AD is preferable to create smaller mismatch at the injection transfer. A shorter layout of the injection line is possible. According the mismatch, we should have 1.4 m Dx, now the line is far from being matched. Less than 5 % mismatch expected.

It should be possible for the operators to easily change the destination of the beam, it is not easy to get experiments wishes. The extraction kicker good field region is critical.

3. Francois Butin – Integration and experimental areas:

As soon as element positions are defined they shall go into CATIA.

4. Fredrik Wenander:

Fredrik ask about reproducibility of Twiss parameters at extraction and recommends avoiding any bottlenecks like their merging dipole. Compact emittance meters together with a good optics model shall be in place.

Fredrik mentions a note from Rick Baartman on the ELENA beam lines with the message to go to short lattice structures being less sensitive to stray fields, space charge and misalignment and ease customization of beam lines for new experiments.

Magnetic shielding is crucial but should be feasible in case of ELENA. At ISOLDE instead of a factor 50 field reduction only a factor 10 was reached due to iron support structure.

The bottleneck at ISOLDE comes from a beam line combination magnet, should not be an issue for Elena. Cylindric electrodes vs spheric ones, fabrication might be easier for cylindric ones, although they can give big errors in case of large bending angles and misalignment. Rick mentions advantages for spheric electrodes if the aperture is similar to the length.

Switching between lines for electrostatics elements is not considered to be a problem. Using quadrupoles as steerers is possible at ISOLDE due to the big voltage difference between focussing and steering, but it is not recommended.

5. David Nisbet

Electrostatic elements positive for power supplies due to low power consumption as soon as charge is in and hardly cooling. Standardising to a few number of different types is highly recommended. DC power supplies are in a wide range commercially availabe. Pulsed systems need more care, much higher peak current and power, rise and fall times are critical, commercially not available. EPC has a few pulsed systems at ISOLDE, to be checked with ABT if in their competence. Diagnostic requiremens to be considered.

Unipolar powering for quads and bends which is preferable from PC side is not feasible. The cost estimate includes pulsing systems and will not change tremendously for faster pulsing times.

6. Tim Giles

Beam acceptance in lines up to 40 pi mm mrad emittance. The primary use for electrostatic devices at ISOLDE is mass independancy. Voltage scales quadratically with electrode aperture, shunts are used to limit the field in longitudinal direction. For the optics and FD-DF system is used.Avoid wide beams and short focal length for 3rd order distortions. Tim wrote automatic optimisation of distortion. The vacuum chamber has to be taken into account for field calculations. Using quads as steerer is not recommended.

If shunts be simulated is not clear. According lens design constraints it is probably better to avoid baking if possible (see general discussion). A vacuum chamber inside the electrodes to ease the pumping is an interesting idea, but probably creates many other difficulties.

7. Carsten Welsch:

When starting there was no benchmarking between different codes available like MADX, COSY INFINITY. Benchmarked these two codes at Coc kroft. Developed SIMULINK to properly treat transverse-longitudinal coupling. Three dimensional field calculation worth after first order design. Alignment possibility within vacuum chamber which is cheap and easy is used at Cockroft (see general discussion). Also electrostatic kicker and septa are simulated within the code.

Carsten suggests that Cockroft could check a first order design with SIMULINK for further improvement.

Cockroft is also using shunts.

8. Daniel Barna:

Alignment is controversial, Daniel suggests rigid mounting for mechanical simplicity but also to know where the electrodes are (see general discussion). Many feed throughs can influence shielding effect. Recommendation from Tim to take the vacuum chambers into account for field calculations, not only the 1.65 ratio. Is this design bakeable – since there is a fixation only from one side, the structure allows for movement.

9. Masaki Hori

Masaki presents a clear shopping list for the TL BI with:

- ~30 Microwire SEMs for beam profile and 1-2 mm spatial resolution
- 2 Cherenkov detectors to measure the timing profile
- Aluminium activation mesurements for absolute number of antiprotons
- Beam transformer

Classical pick ups are difficult at these intensities because applied voltages need to be strong and could disturb the beam.

10. Wolfgang Bartmann

Experiments' wishes, there is only response from ALPHA and ASACUSA. The beam size quoted for ALPHA is on the plasma, so the solenoid effect needs to be taken into account.

The bunch length should be smaller or maximal 300ns.

According timeline, the Gbar test stand should not be a hard constraint. Some refinement on the workpackage interfaces is needed.

Summary by Wolfgang Bartmann