Introduction

The MariX Bubble Arc Compressor is a U-turn device able to multiply the beam peak current of a factor of $10^2$.

The high performance of this device is hampered by the emission of CSR which can ruin the beam quality (well-known issue in magnetic compressors) and by the complicated dynamics in the 2-way matching line.

We addressed those issues with simulations performed with Elegant considering CSR and longitudinal space charge effects. The proposed solutions can be further explored in the MariX Conceptual Design Report.

Matching line

The magnetic effect of a quadrupole is opposite for bunches traveling in opposite directions.

The line is set to match to the arc compressor the forward travelling beam (green lines) and to properly collimate the backward travelling beam (blue lines).

CSR compensation

Two important strategies allowed to reduce the deteriorating effects of the CSR on the beam.

1. We performed a Current profile shaping in the injector to obtain a triangular-like current profile (green line) that shows much better performance than Gaussian profiles (blue line).

2. By using an accelerating high harmonic cavity we pre-compensate the curvature induced by the CSR emission doubling the final peak current.

Dispersion damping

Particles in the main spike inevitably undergo a betatron kick induced by the CSR that unbalances the bunch.

We modified the last DBA to compensate the retained dispersion residue and the horizontal centroids drift effects.

Tracking

Spike @ exit

Conclusion & perspectives

- A new U-turn device “bubble arc compressor” reinserts ultra-compressed bunches, with negligible $\epsilon_n$ degradation.
- A 10 quads matching line satisfies two RD tasks:
  1. match the beam to the arc,
  2. focus and collimate coming back bunches.
- Coming soon: analysis of jitters and a deep study of the $\phi$-bunching instability, considering that:
  1. The MariX layout can host a laser hocker.
  2. Preliminary evaluations with CSR and LSC give indication of moderate $\mu BI$ gain (not a show-stopper).

Thanks!

Visit the MariX initiative website for more material (scan the QR code):
- Executive Summary (published on NIM-A).
- Foreword & theses on the topic.

COMING SOON (submitted to PRAF):
- A. Bacci et al., “Two-pass two-way acceleration in a Super- Conducting CW line to drive low jitters X-ray FELs”.

Visit us

Main actors

Fun fact

The color used in this poster is identified by the Hex code:

#EAAC19