Numerical Validation of a New Extraction System for the ECR Source LEGIS at INFN-Legnaro National Laboratories

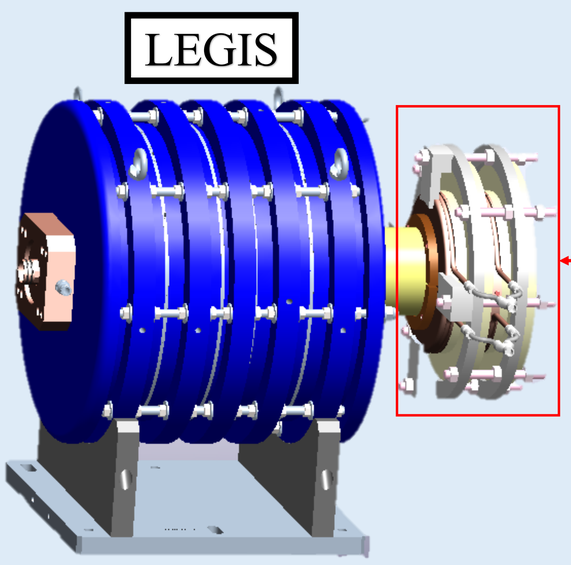
Carmelo Sebastiano Gallo[1], Giada Rachele Mascali[1,2], Alessio Galatà[1], Taneli Kalvas[3], Marco Miglioranza[1], Massimo Rossignoli[1], Paolo Francescon[1], Francesco Giraldo[1], Denis Martini[1], Osvaldo Carletto[1]

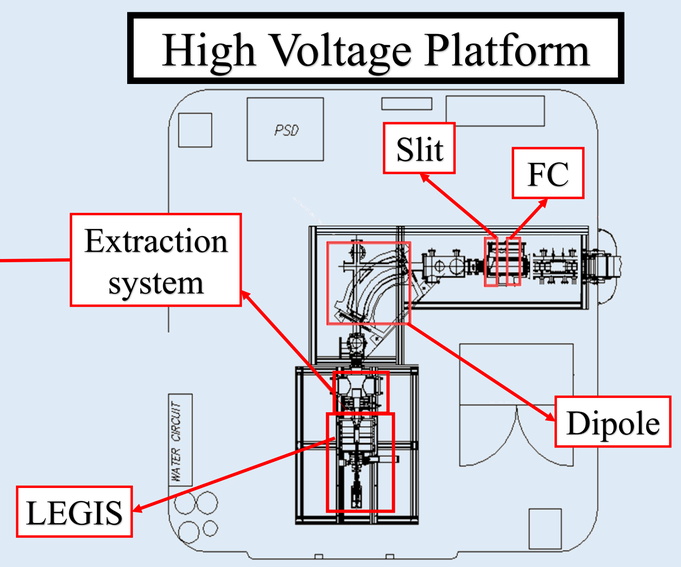
[1)] *INFN - Laboratori Nazionali di Legnaro, viale dell'Università 2, 35020 Legnaro (PD), Italy*
[2)] *Dip. di Fisica, Università Sapienza di Roma, P.le Aldo Moro 5, 00185 Roma, Italy*
[3)] *Accelerator Laboratory, Department of Physics, University of Jyväskylän (JYFL), FI-40014 Jyväskylän, Finland*

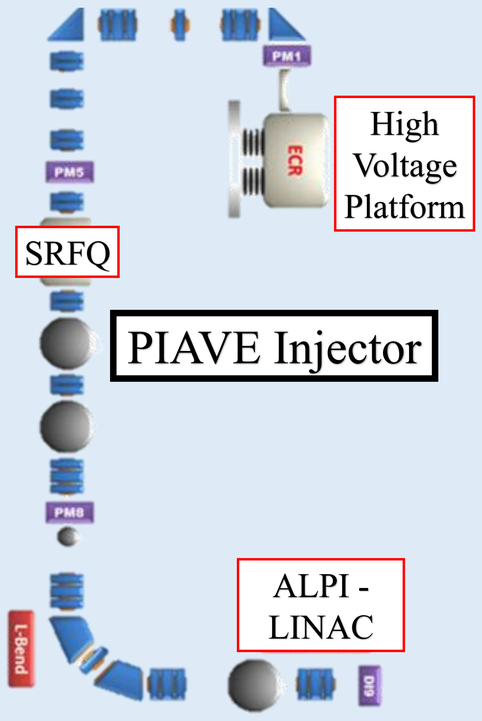
Abstract

The extraction system of the Electron Cyclotron Resonance Ion Source LEGIS (LEGnaro ecrIS), installed at INFN - Legnaro National Laboratories, and the following Low Energy Beamline (LEBT) have been recently characterized by numerical simulations, whose results showed a very good agreement with experimental evidences. The study correctly reproduced the beam transmission downstream the ion source, as well as some criticalities emerged during the beam transport for the scheduled nuclear physics experiments. Even if the beam properties (quality and intensity) are still suitable for the injection into the PIAVE-ALPI accelerator complex, their optimization would be desirable in view of the upcoming production and extraction of U beams, whose intensity in the desired mass-over-charge ratio could be lower than usual. This contribution describes a possible optimization, validated by numerical simulations, of the extraction system of the LEGIS source. The results revealed an improved extracted beam quality, thus foreseeing a higher transmission and an easier setting of the downstream LEBT. Starting from the conceptual design used in the numerical simulations, a possible mechanical implementation in the beamline has been studied and will be also presented.

Why optimize?
- ✅ Transmission must be maximized
- ✅ Improved extraction eases downstream tuning
- ✅ U beams have lower intensity at desired charge states

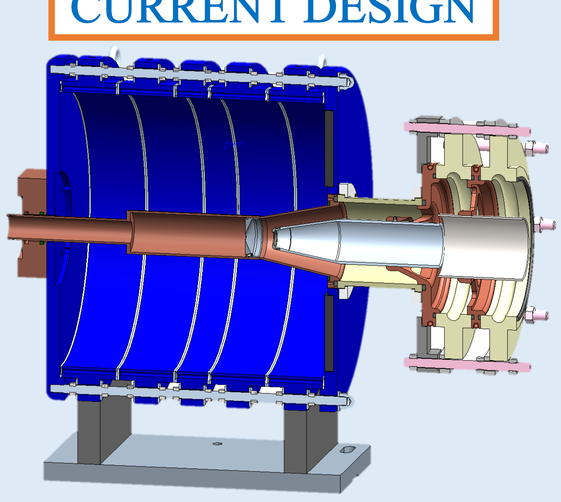


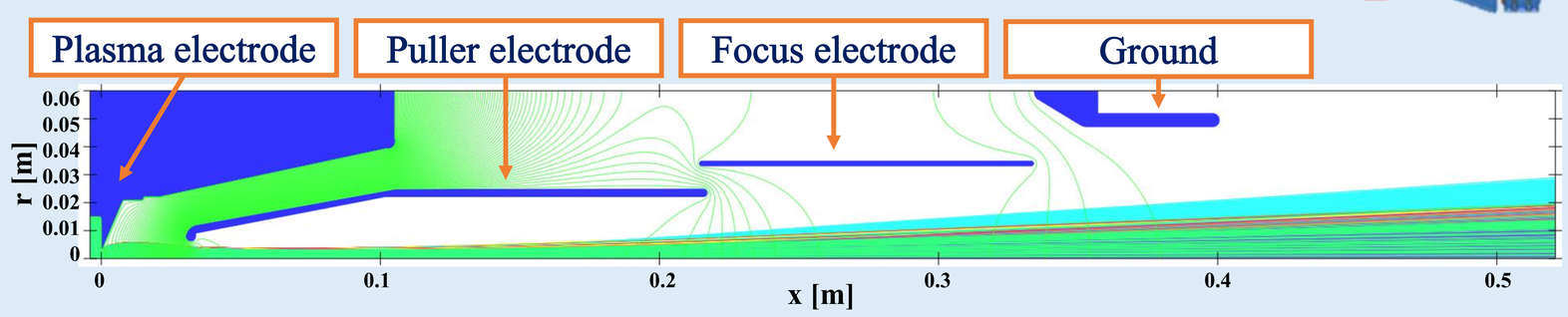




EXTRACTION SIMULATIONS

CURRENT DESIGN





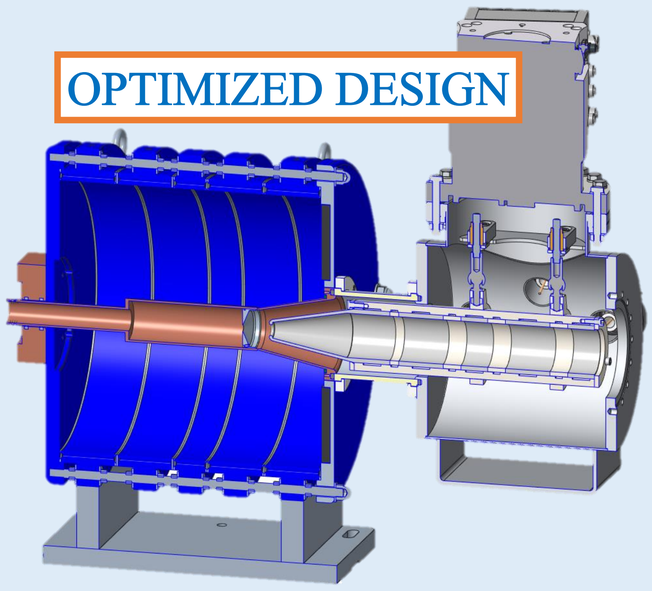
Twiss Parameters

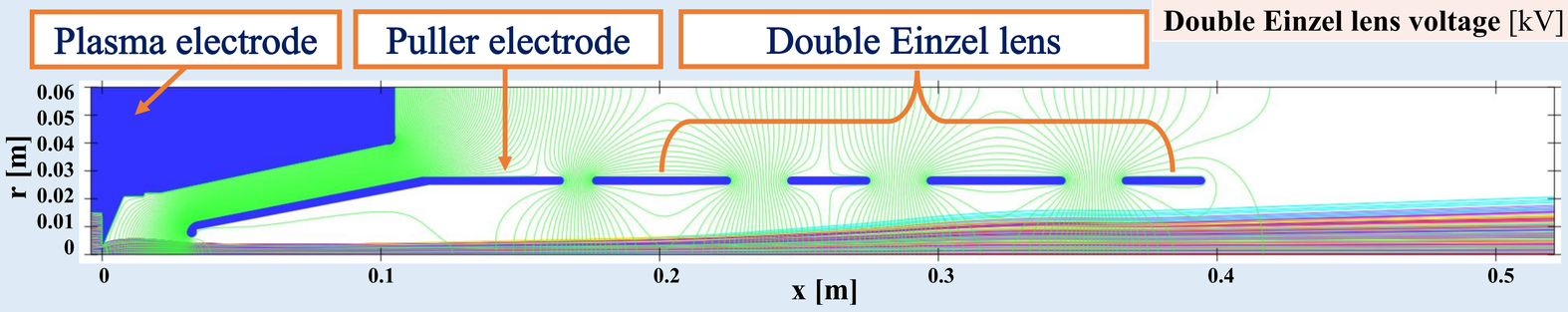
ε_{rms} (mm.mrad)	α	β	x_{max} (mm)	x'_{max} (mrad)
28.6438	-6.95819	3.29883	9.72065	20.7144

EXTRACTION PARAMETERS

	NOW	UPDATE
Extraction hole radius [mm]	3.5	3.5
Source voltage [kV]	24	24
Puller voltage [kV]	-1	-1
Focus voltage [kV]	1	-
Double Einzel lens voltage [kV]	-	-10 0 10 0

OPTIMIZED DESIGN



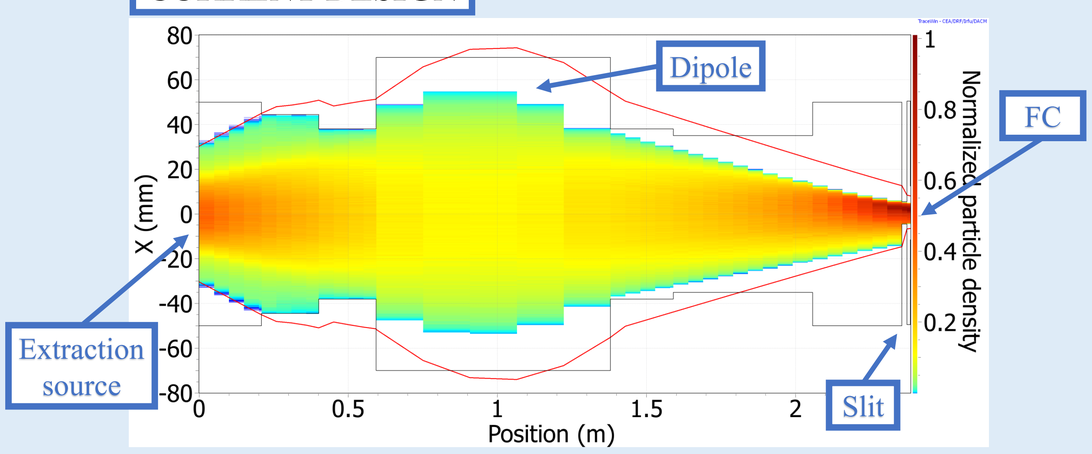


Twiss Parameters

ε_{rms} (mm.mrad)	α	β	x_{max} (mm)	x'_{max} (mrad)
29.7528	-2.60094	1.90606	7.53064	11.0094

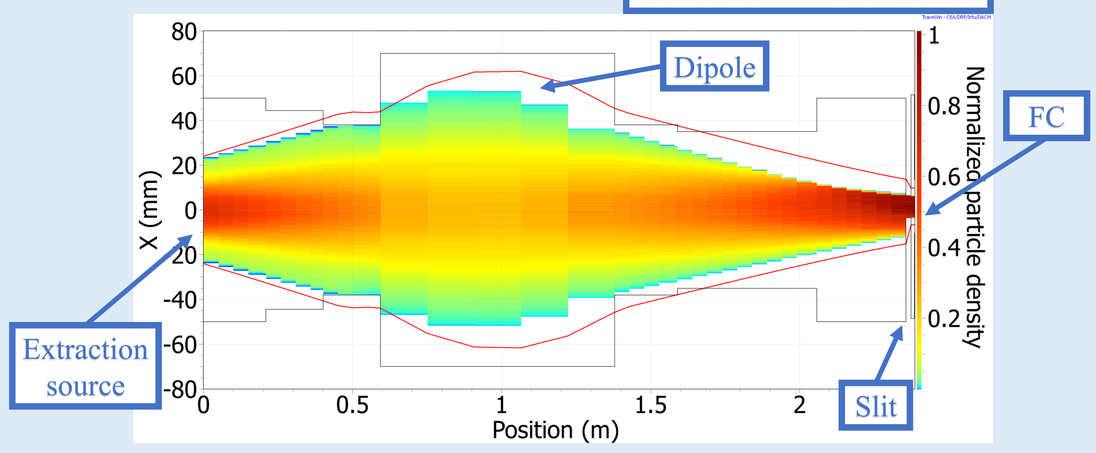
TRANSPORT SIMULATIONS

CURRENT DESIGN



Beam Density Comparison

OPTIMIZED DESIGN



53.1 % → **Transmission** → **69.5 %**