The cooler Storage Rings Project in Lanzhou

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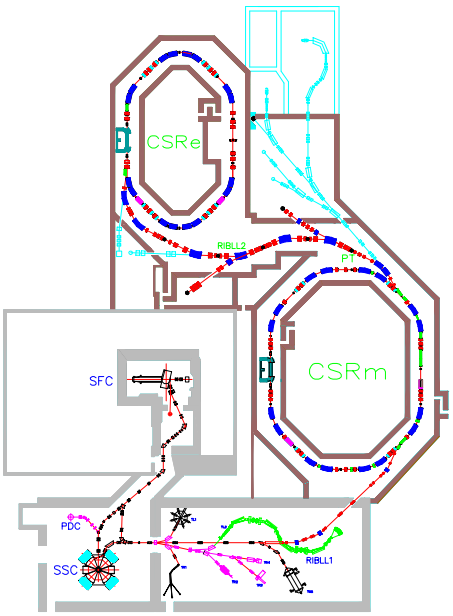


Overall Layout of HIRFL–CSR

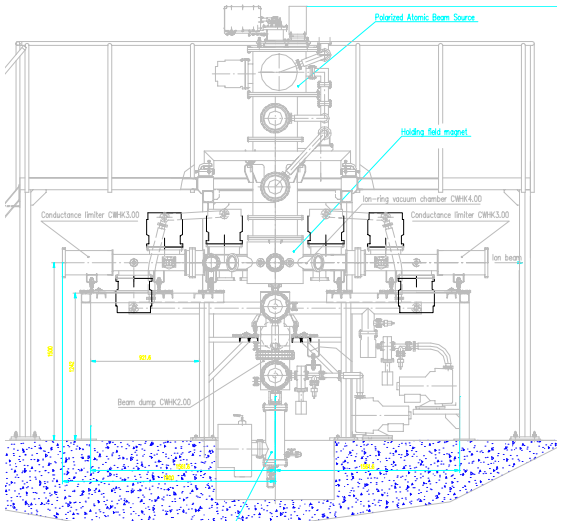
Atomic physics researches

High precision x-ray spectroscopy at internal gas target
Dielectronic recombination and laser assistant recombination at cooler
Reaction dynamics of ion-atom collisions at relativistic velocity-REMI
Polarization studies and new instrumentation

Internal gas target at CSRe

Normal cluster tagets, with a density of several 10^{13} atoms/cm^3 , background pressure 5×10^{-9} Pa;
Polarized H, D targets, with a density several 10^{12} atoms/cm^3, background pressure 5×10^{-9} Pa;
polarization of ±0.9

Internal target at the CSRm for nuclear Physics experiment

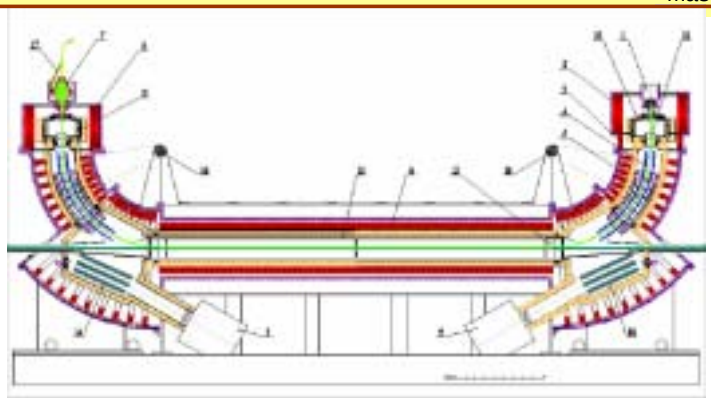


Internal gas target

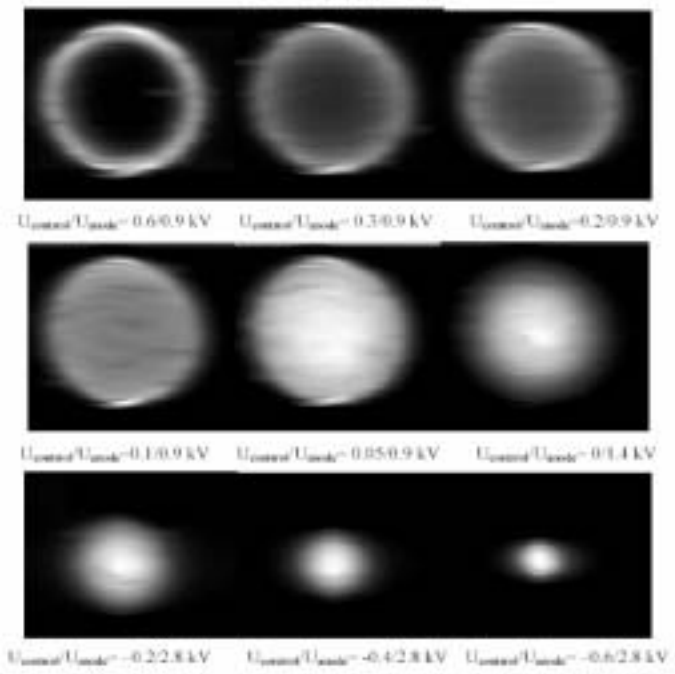
Main features of CRSm and CSRe:

Ion species	Stable nuclei: C — U RIB(A<238) : neutron-rich, proton-rich
Max. energy	900 MeV/u ($^{12}C^{6+}$) 400 MeV/u ($^{238}U^{72+}$)
Intensity	10^5—10^8 pps (stable nuclei)
Shortest RIB lifetime1	μs
Momentum spread	$\frac{\Delta P}{P} \sim 10^{-4}$ (stable nuclei) $\frac{\Delta P}{P} \sim 10^{-3}$ (RIB)
Emittance	≤ 5 π mm-mrad (stable nuclei) ~ 25 π mm-mrad (RIB)
Cooler voltage	15--35 kV
Intrnal target	for nuclear physics experiment

Ion species	Fully stripped heavy ions: C — Ta H-like, He-like heavy ions: Ta — U RIB(A<238): neutron-rich, proton-rich
Max. energy	600 MeV/u ($^{12}C^{6+}$) 400 MeV/u ($^{238}U^{90+}$)
Intensity	$10^{11\text{-}14}$ pps (stable nuclei, internal target) $10^{7\text{-}12}$ pps (RIB, internal target)
Shortest RIB lifetime	10μs (Isochronous mode, short time measurements) 10ms (Low β mode, Quasi-continuous beam 1s (Low γ_t mode, high-resolution experiments)
internal gas-target	for high-resolution experiments
Momentum spread	$\frac{\Delta P}{P} \sim 10^{-5}$
Emittance	≤ 1π mm-mrad
Mass resolution	10^{-6}



Sketch of the new cooler for the Cooler Storage Ring at Lanzhou. 1-electron gun, 2-main solenoid of the gun, 3-auxiliary solenoid of the gun, 4-electrostatic deflector, 5-toroid, 6-cooling section solenoid, 7-collector, 8-main solenoid of the collector, 9-ion pumps, 10-compensation coil, 11-titan sputter, 12-pickup electrodes, 13-vacuum chamber, 14-getter pumps, 15-heating jackets, 16-hinge, 17-cooling system of the collector



Electron beam density distributions at different controller- and anode- voltages

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