HIE-EBIS design parameters

Andrey Shornikov, HIE-EBIS workshop, CERN, 16-17.10.2012

Outline

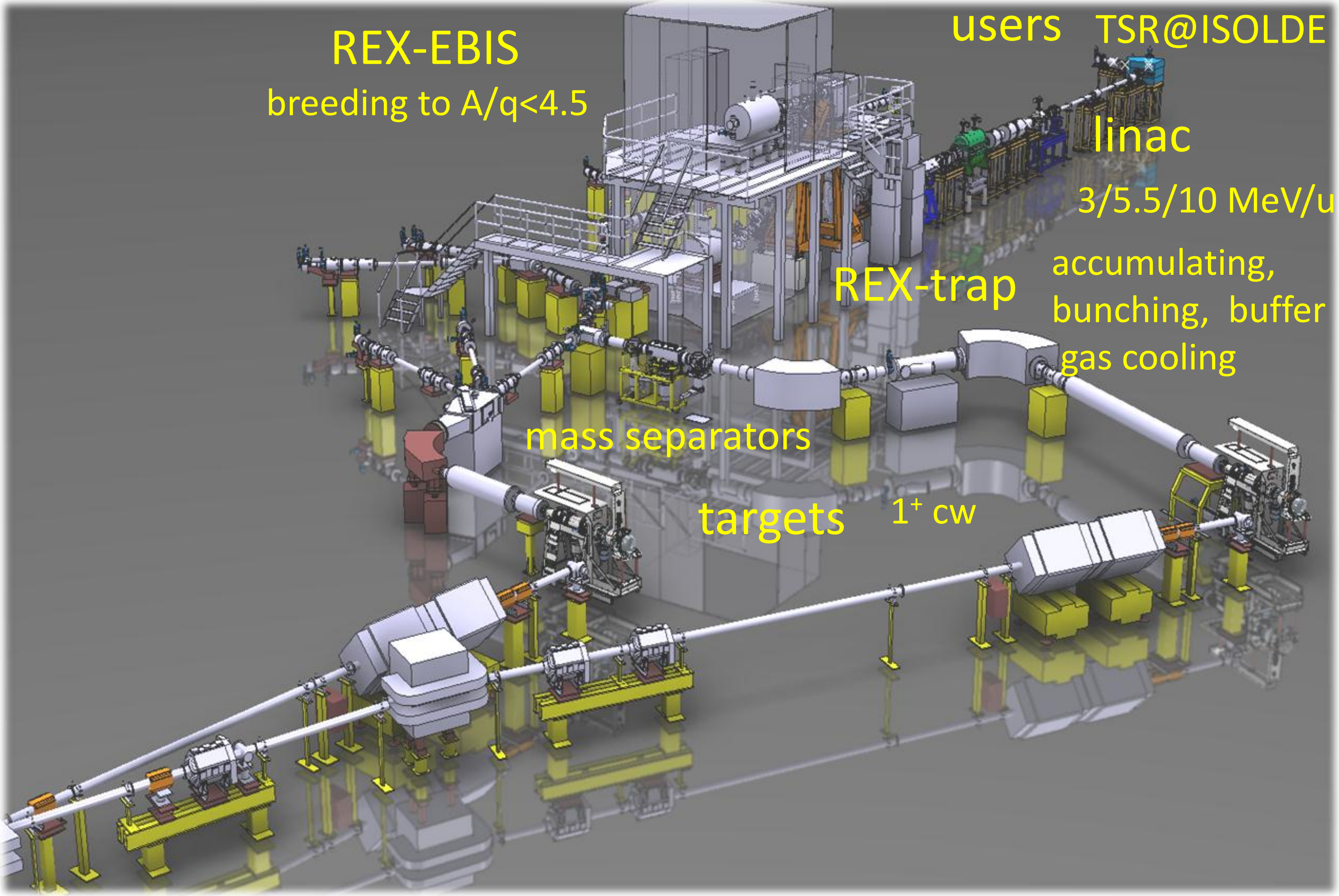
A. Infrastructure and users requests.

B. Technical parameters of the future EBIS.

C. Our preliminary view of it.

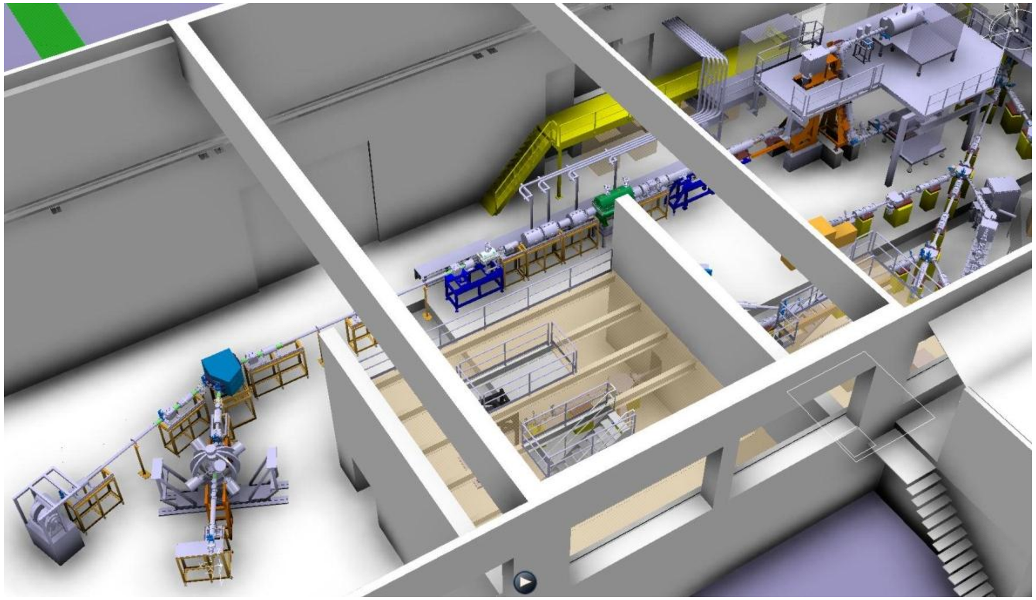
D. What we would like to focus on.

A. HIE-ISOLDE chain



A. Existing users requests

Current users: Coulex and nuclear transfer experiment + visitors



Present: 50 µs pulses with max rep. rate. (50 Hz, linac).

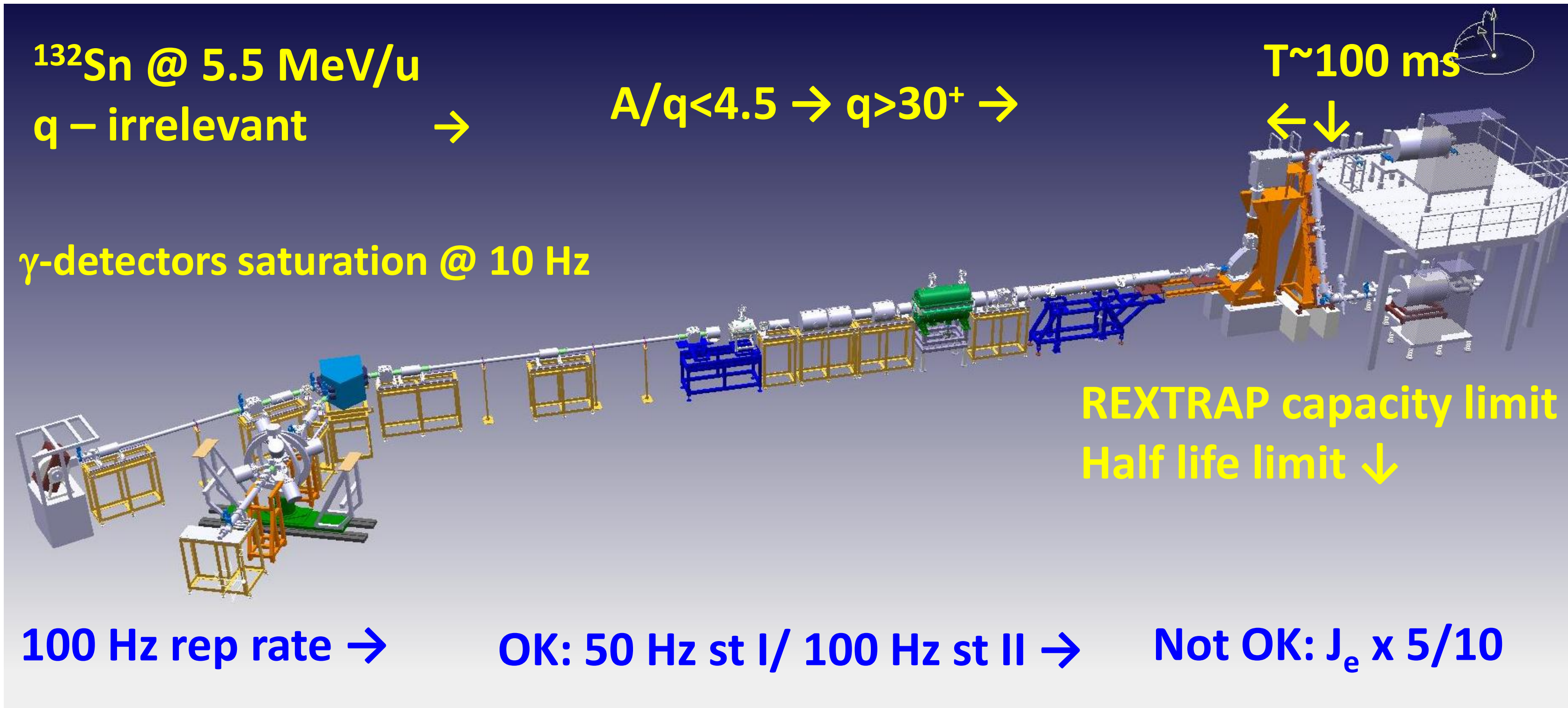
Request:
- 1.5 ms pulses ;
- less particles per pulse, more pulses.

Dream (t>10y):
$T_{pulse} = T_{breeding}$ + 2 EBISes in a push-pull mode = cw output beam.

To EBIS: fast breeding, slow extraction, $2<A/q<4.5$.

A. Existing users requests

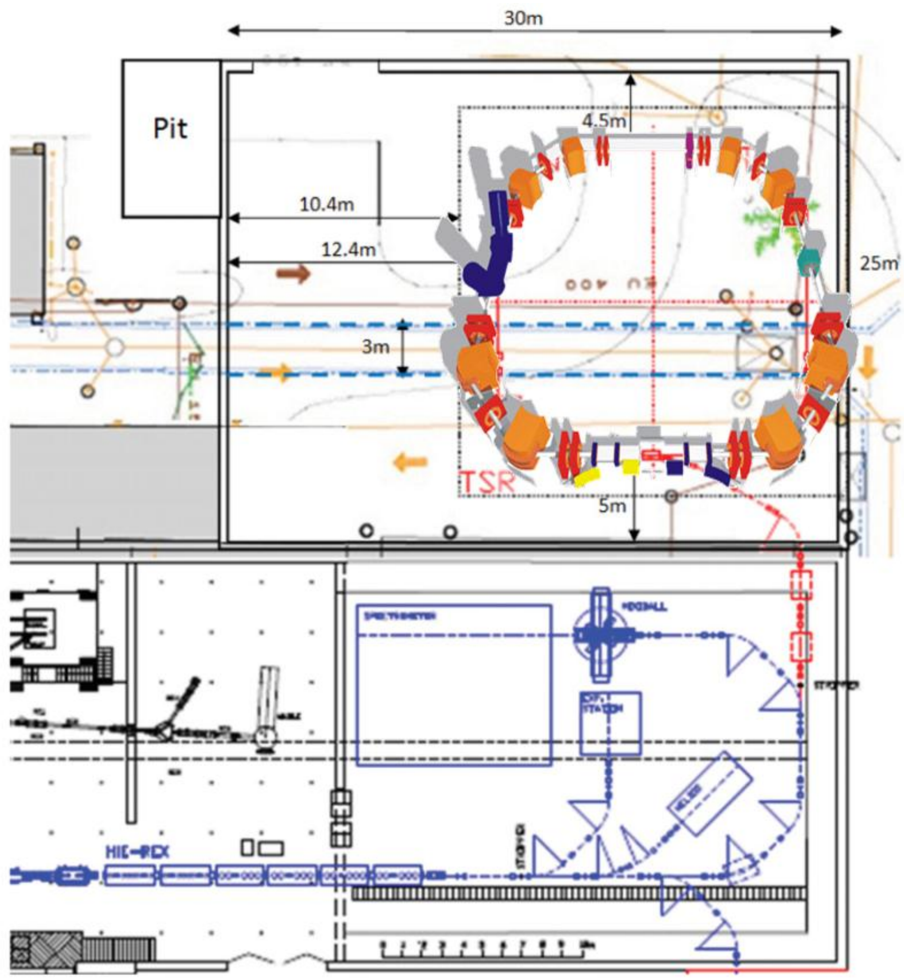
Coulomb excitation of ^{132}Sn on ^{206}Pb target, proposal by Reiter et al. for HIE-ISOLDE.



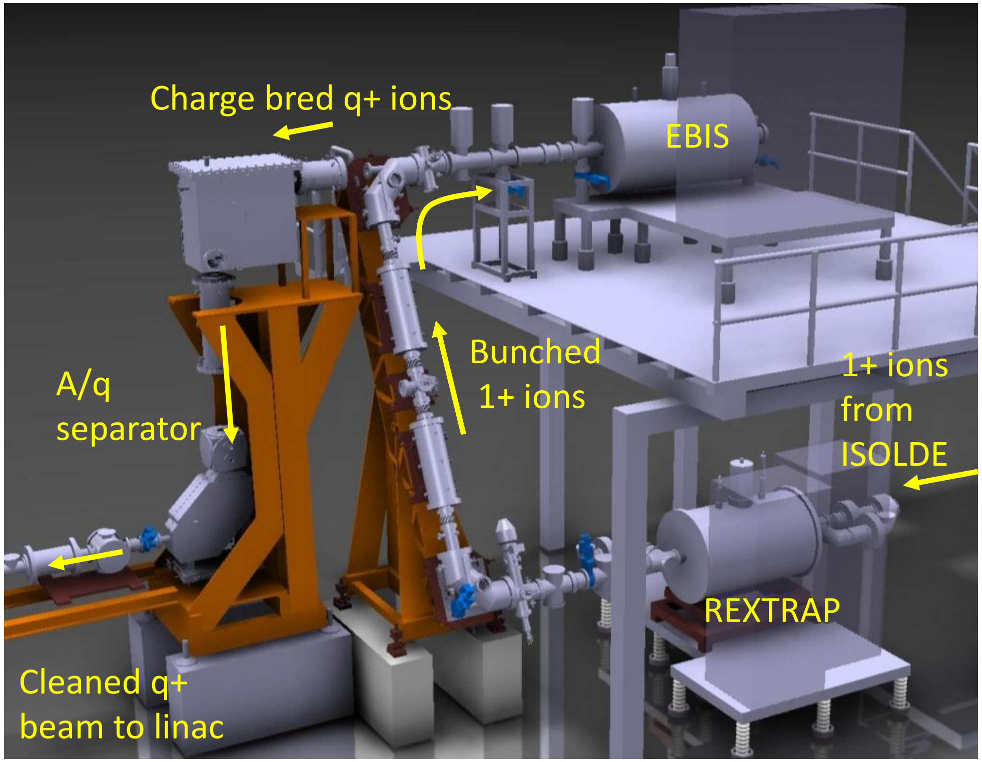
A. Prospective user request: TSR@HIE-ISOLDE

Working for TSR@HIE-ISOLDE injection:

- ❑ A/q ~ 3 for machine reasons;
- ❑ H-like and bare up to 60+ for physics;
- ❑ Fast extraction <30 µs;
- ❑ Low rep rate 0.5 Hz<f< 5Hz;
- ❑ High pulse intensity.



A. EBIS cw injection for TSR@HIE-ISOLDE and very unstable ions for MINIBALL



1. For a few Hz injection of high intensity beams: shoot directly to EBIS in cw due to low REXTRAP capacity of $10^{7\text{-}8}$ ions.

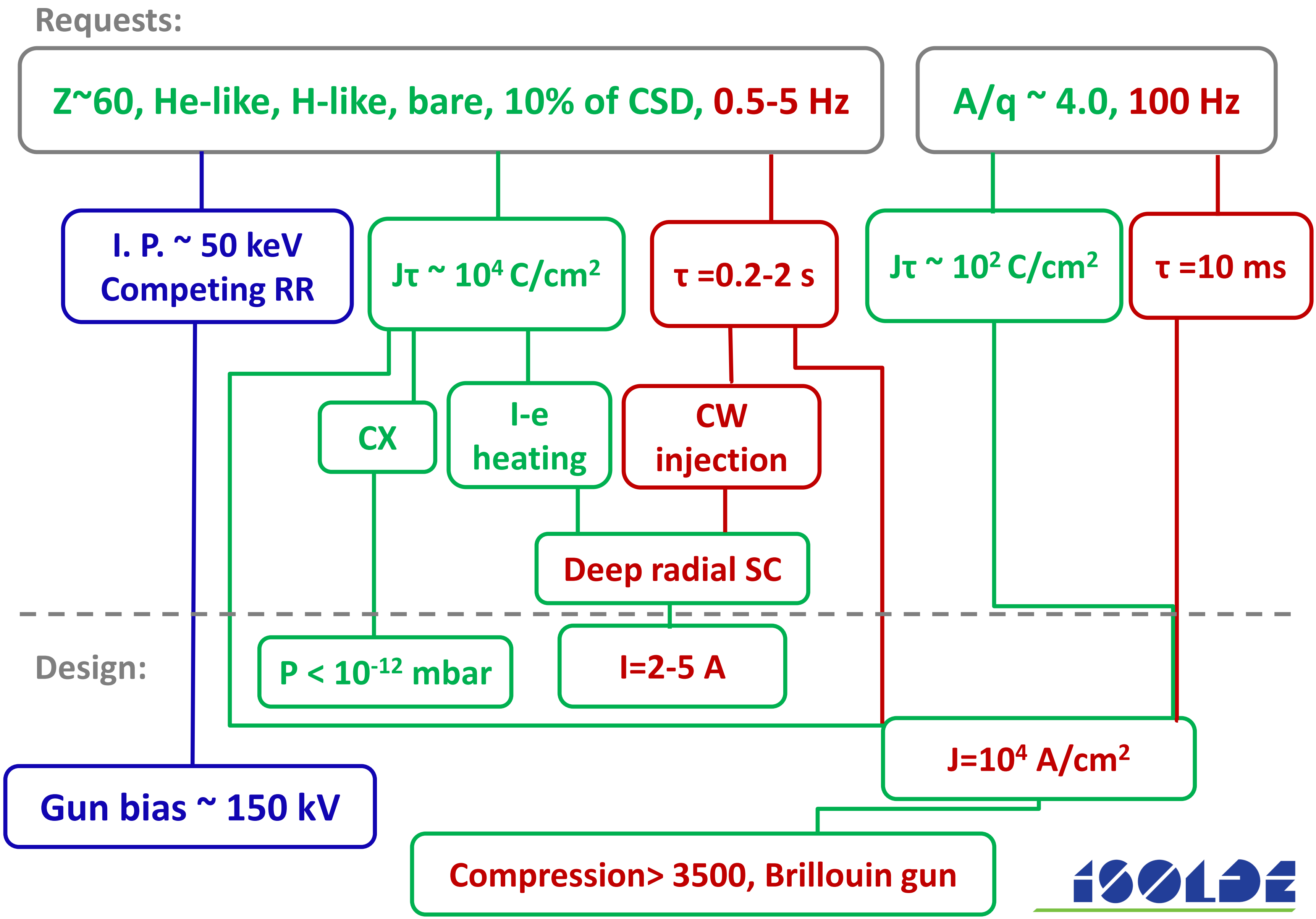
2. Short lived isotopes with $\tau \sim t_{breeding}$ should be shot directly to reduce losses.

EBIS should be capable of effective capturing 10π mm mrad beam in cw.

A. General requests

- Increased capacity (increase space charge of the EBIS);
- Capturing efficiency in cw over 50%, breeding efficiency over 10 % (new optics). Base scenario: keep REXTRAP for most of the cases;
- Minimized unscheduled downtime;
- Minimized R&D and untested solutions.

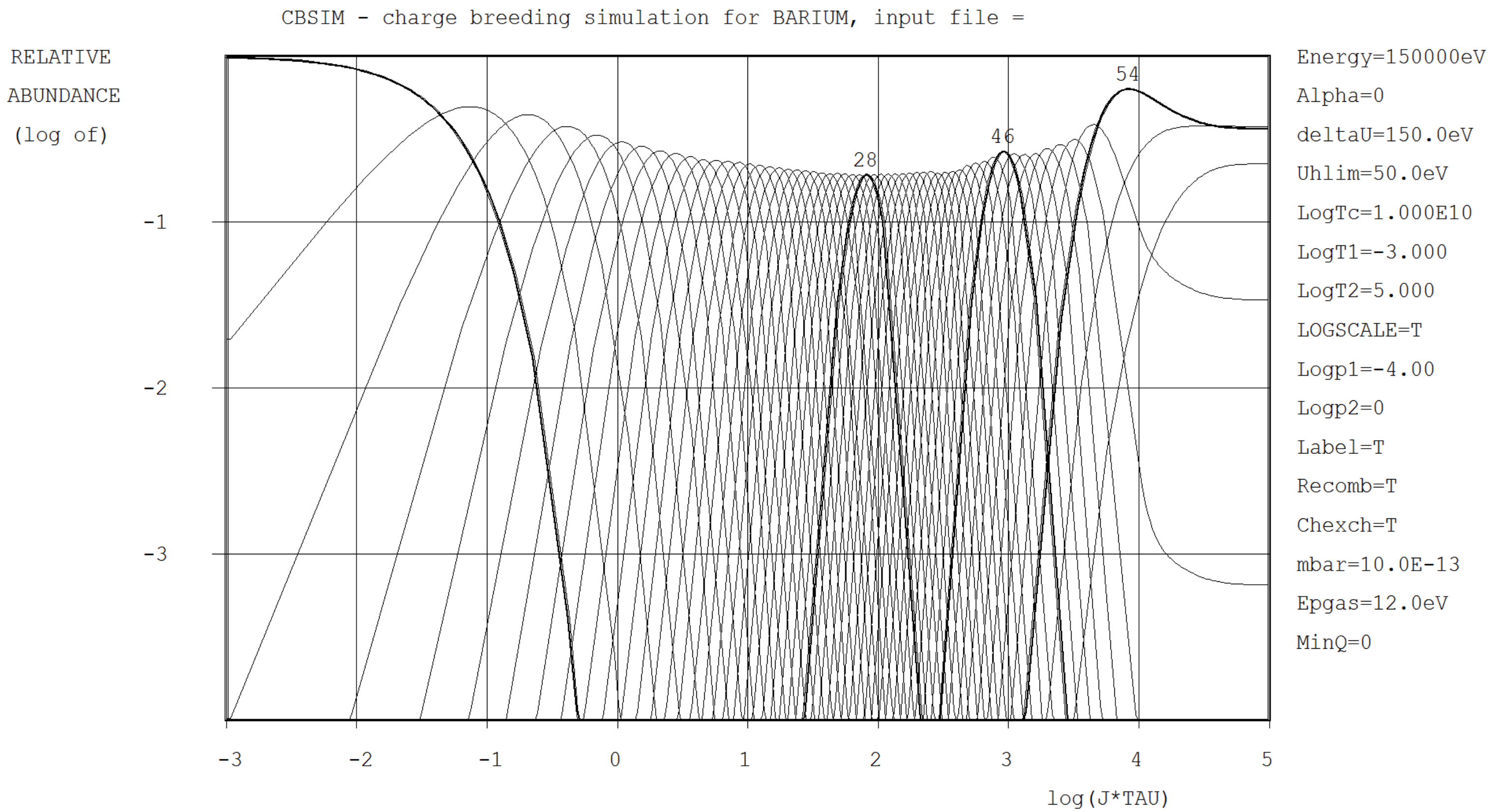
B. Technical parameters



B. Operation conditions required

Beam parameters	Value
Energy, keV	150
Current, A	3.2
Magnetic field of the main solenoid, T	6
Cathode temperature, K	1500
Carthode radius, mm	6
R_H beam, µm	50
Current density, A/cm^2	40000
Space charge of the beam, V	150
Geometrical acceptance @ 30kV injection, π mm mrad	5.0 π
Breeder length, m	~ 1
Collector power, kW	200

B. Ba example



Heating rate of Ba^{+56} in the trap 3.9 keV/s, breeding time ~ 500 ms.

He-, H- like and bare Ba is reachable only with ion-ion cooling
P~1E-12 mbar is sufficient to supress CX.

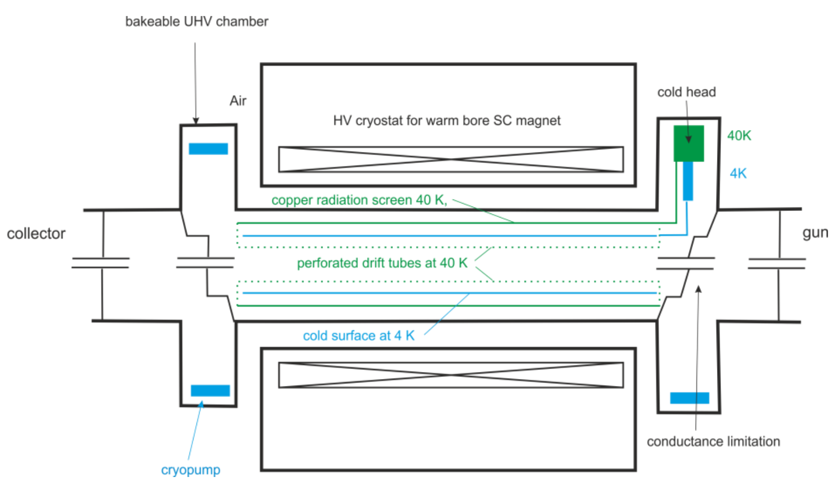
B. Technical parameters. Vacuum

Reliability:
- ✓ Separate magnet cryostat;
- ✓ Separable gun chamber;
- ✓ Redundant pumping.

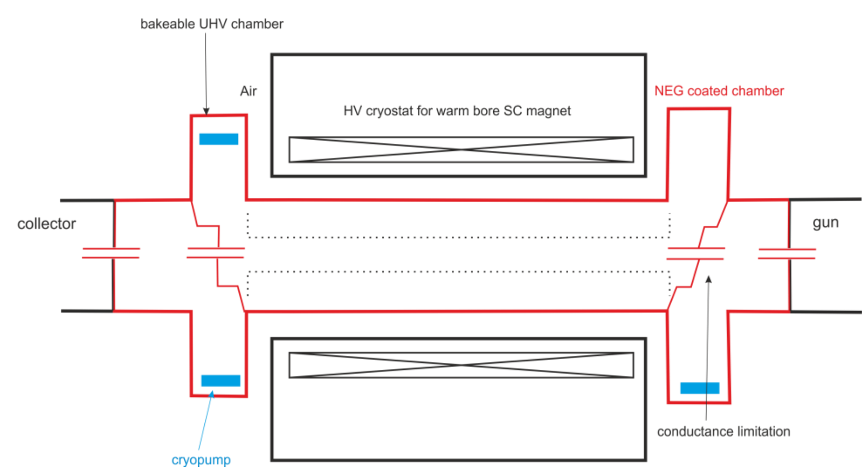
High current operation:
- ✓ Differential pumping stages;
- ✓ High rate distributed pumping.

Goal: reach pressure <10^{-12} mbar.

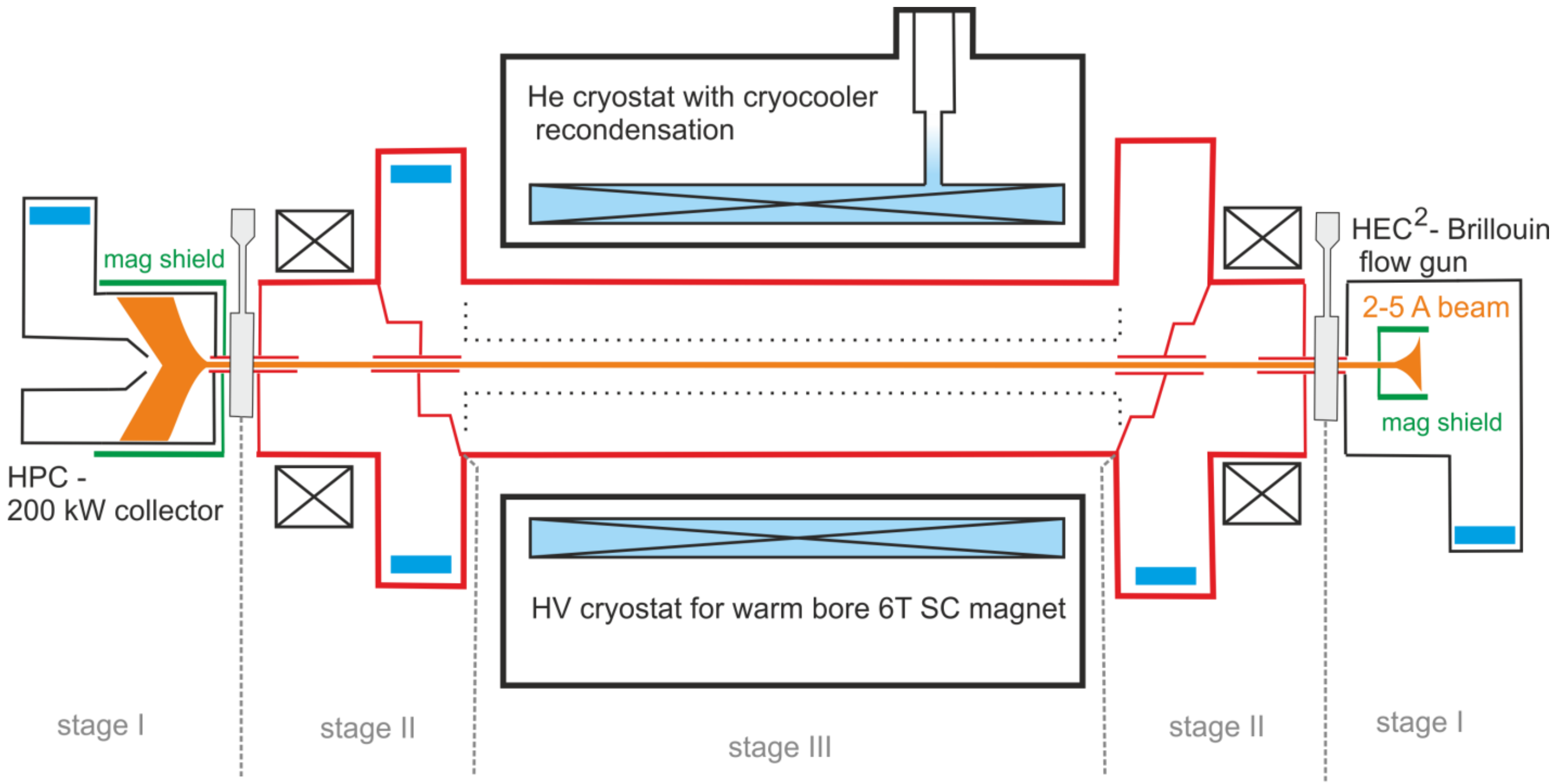
Option I



Option II



C. Preliminary general layout



3 stages, separable, high differential,distributed pumping system with redundance

D. Focus on

- ❑ Electron gun/optics/collector – beam dynamics
- ❑ Vacuum options
- ❑ Atomic physics processes @10^4 C/cm^2: e-i heating, i-i cooling, RR, DR, CX, something we are not aware of

Thank you, let's dig into details!

We are happy to see here expert from

We'd like to thank:

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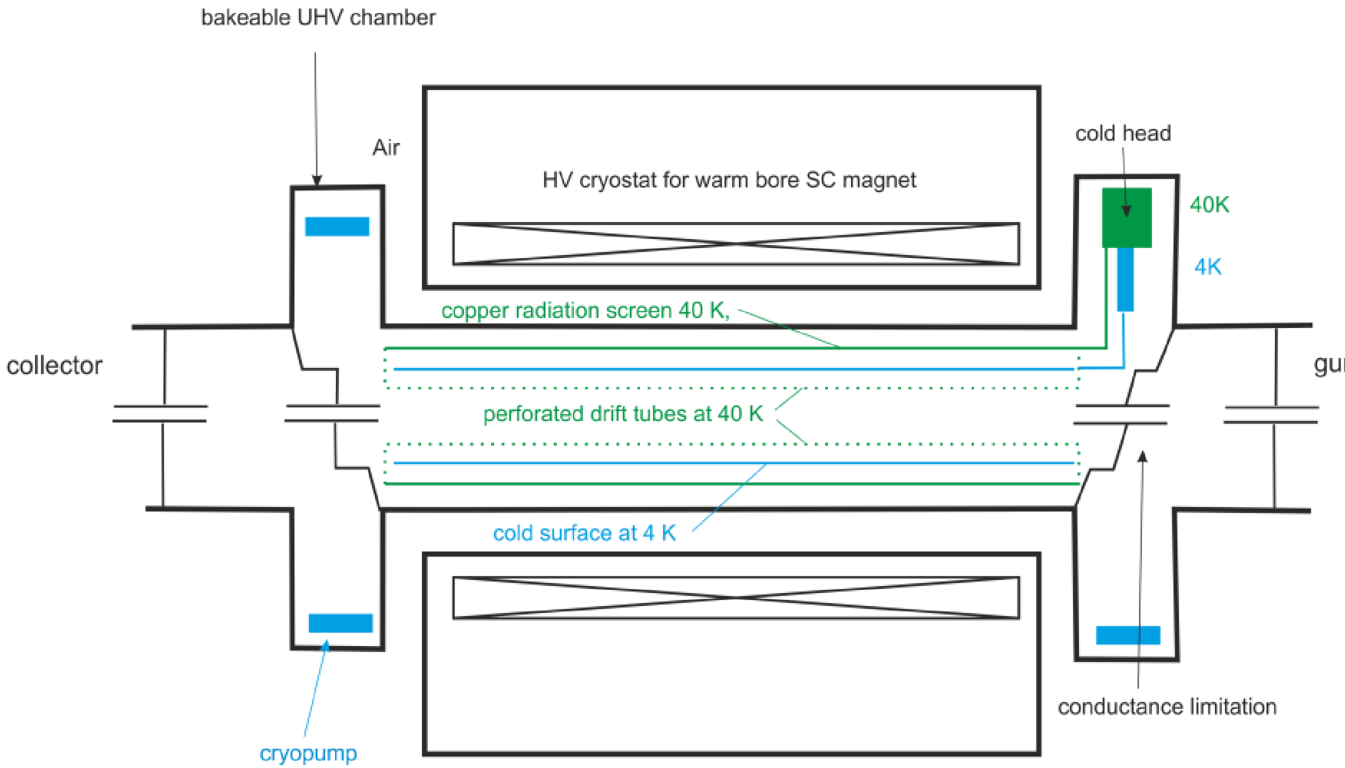
and our administrative officers for organization

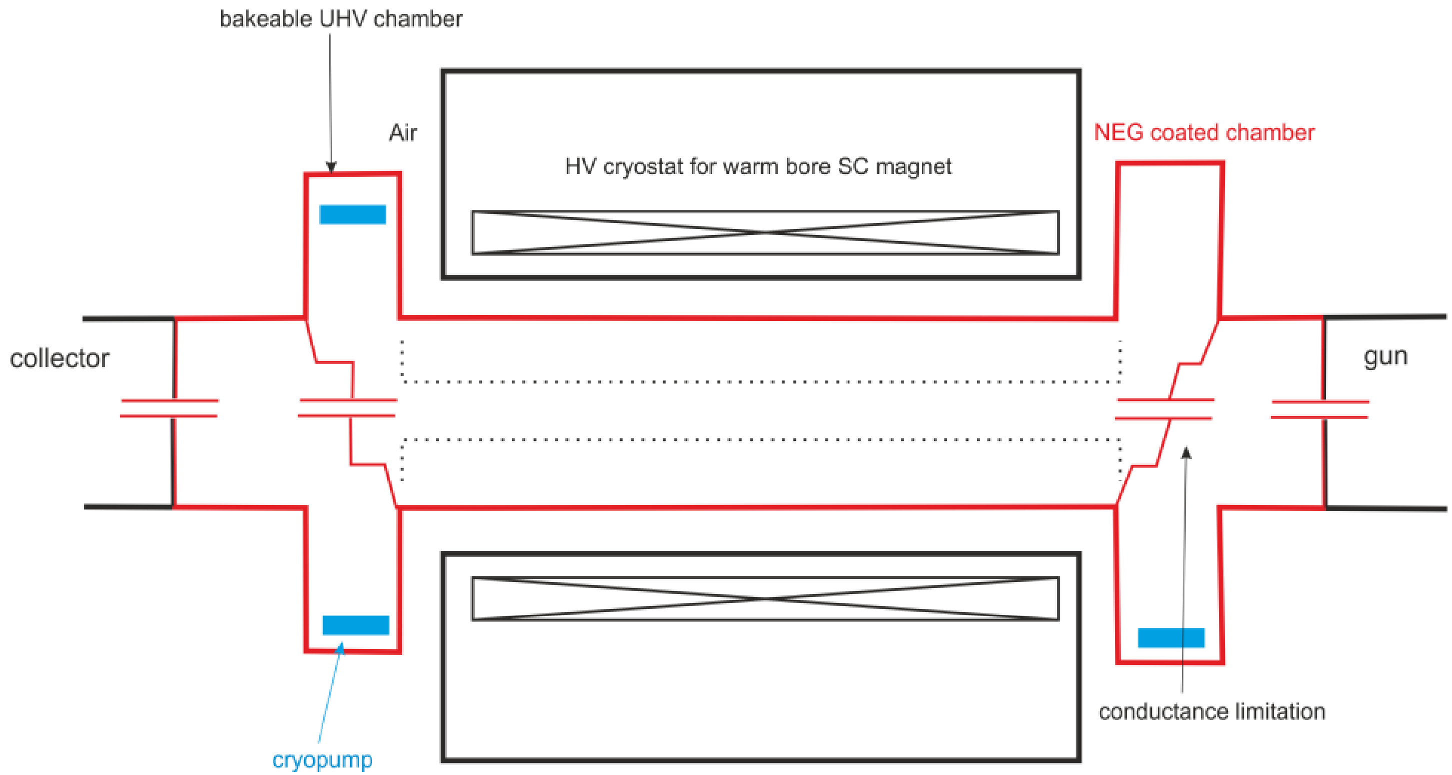
Delphine Rivoiron
Flora Ayda Berrenger
Elodie Kurzen-Brarda

Spares. Option I. Heat loads



Assuming 40K shield D=100 mm, vac tube D=150 mm, length 2 m
From mech. polished Steel to mech. polished Alu/Cu/Ag on Cu
Radiative heat load 18/12/4 W at 40 K @ 35-40 W available on CH
If NEGs have high ε combining will be impossible.

Spares. Option II. Pumping speed



Assuming D=150 mm tube of 2 meters, R(H_2, NEG=Ti-V-Zr)=0.3 l/cm^2
The total pumping rate of the trapping region = 2800 l/sec