User Requirements for Physics at EURISOL

Nigel Orr
LPC-Caen

[TASKS 6 & 10]

- questionnaire circulated to Task 10 group June & Nov 2005
- questionnaire discussed by Task 6 (Nov 2005)
- feedback during EURISOL Week in Caen (Nov 2005)
- discussion sessions at ECT* Physics & Instrumentation Workshop (Jan 2006)
- reported and discussed at joint Task 6, 9 & 10 meeting in Orsay (May 2006)
- reported and discussed at MB meeting at PSI (June 2006)

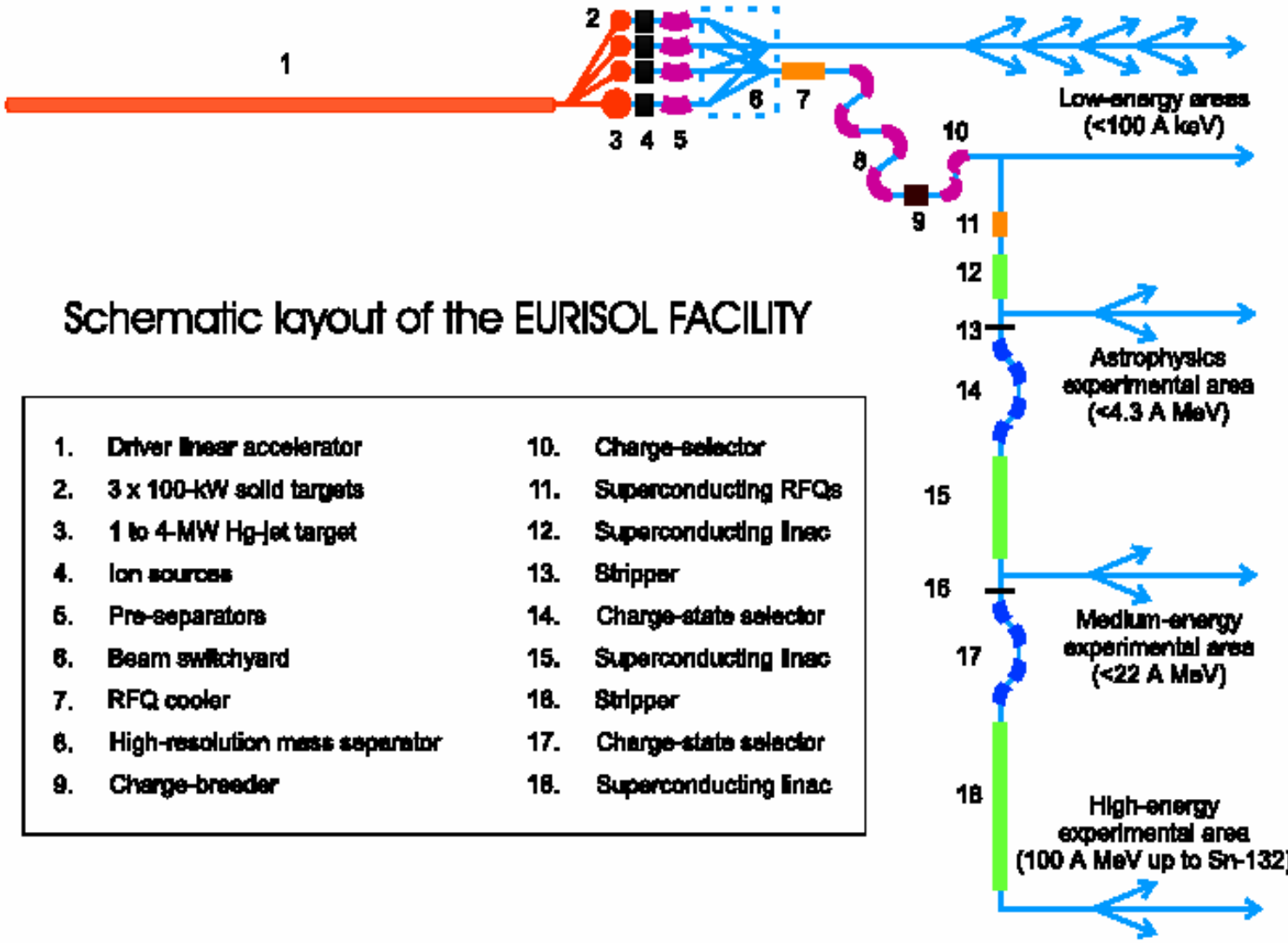
- Town Meeting at CERN … further feedback from community

- Questionnaire -

Experimental Requirements : Beam and Machine Characteristics

- Maximum Beam Energy
- Minimum Beam Energy
- Energy Variability
- Beam Energy Definition/Absolute Beam Energy
- Time Resolution
- Beam pulse rate and "chopping"
- Beam Sharing
- Stable Beam Operation

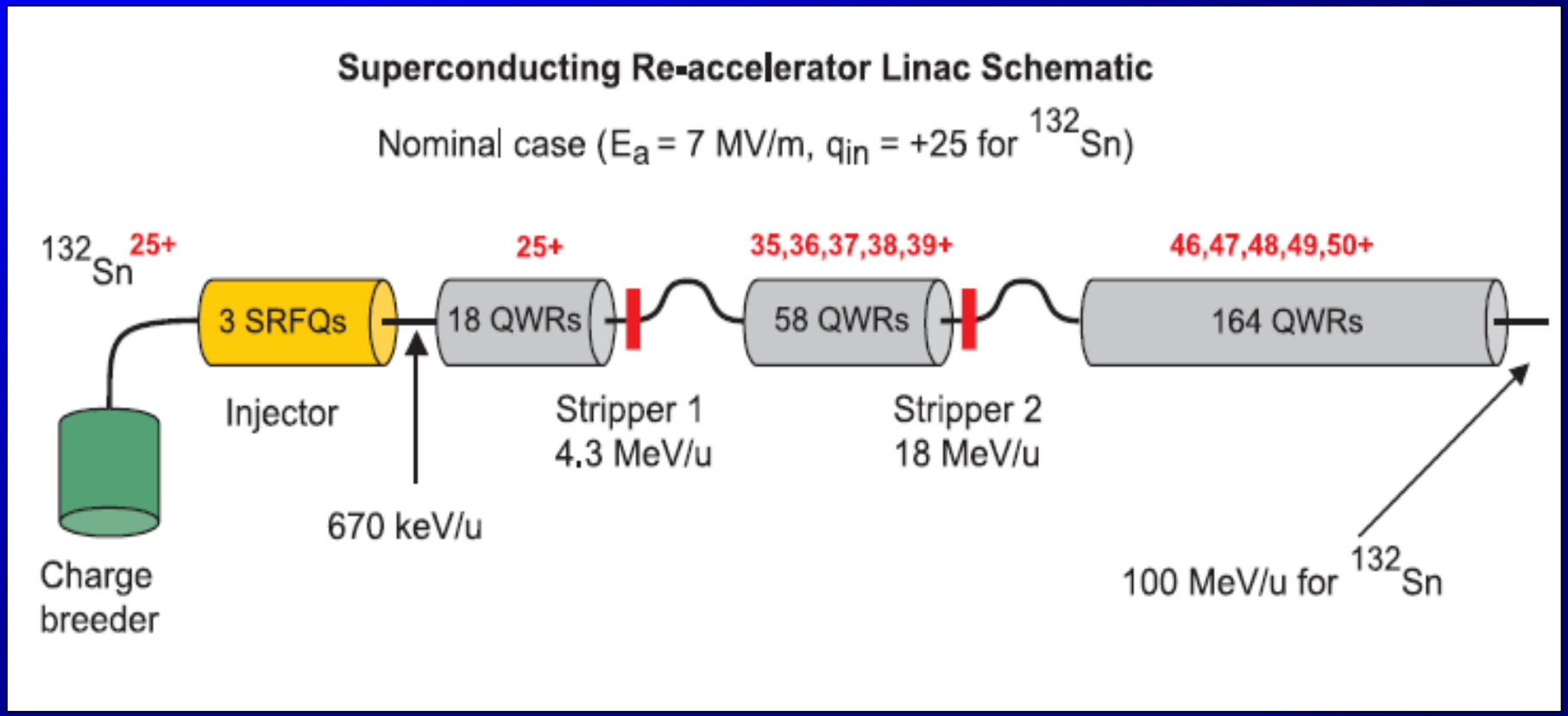
EURISOL CONCEPTUAL DESIGN: FP5 Design Study



Schematic layout of the EURISOL FACILITY

1.	Driver linear accelerator	10.	Charge-selector
2.	3 x 100-kW solid targets	11.	Superconducting RFQs
3.	1 to 4-MW Hg-jet target	12.	Superconducting linac
4.	Ion sources	13.	Stripper
5.	Pre-separators	14.	Charge-state selector
6.	Beam switchyard	15.	Superconducting linac
7.	RFQ cooler	16.	Stripper
8.	High-resolution mass separator	17.	Charge-state selector
9.	Charge-breeder	18.	Superconducting linac

EURISOL HI-LINAC CONCEPTUAL DESIGN
FP5 Design Study : ^{132}Sn reference beam



f = 88 MHz ⇒ Δt = 12 nsec

E_{max} = 100 MeV/u ^{132}Sn

Experimental Requirements : Beam and Machine Characteristics

- *Maximum Beam Energy*
- *Minimum Beam Energy*
- Energy Variability
- Beam Energy Definition/Absolute Beam Energy
- Time Resolution
- Beam pulse rate and "chopping"
- *Beam Sharing*
- Stable Beam Operation
- Purity
- Emittance, spotsize

Experimental Requirements : Beam and Machine Characteristics

- Maximum Beam Energy (^{132}*Sn reference beam*)

> 150 MeV/u – secondary fragmentation*, knockout*,
>
> reaction dynamics, charge exchange, … $^{A}Z > {}^{132}Sn$
>
> $E < 150$ MeV/u

* ⇒ *high-acceptance, high resolution fragment separator*

NB: LINAC operation without stripping v. highly desirable for weakest beams – both modes of operation should be possible (?)

- Minimum Beam Energy (see also "Beam Sharing")

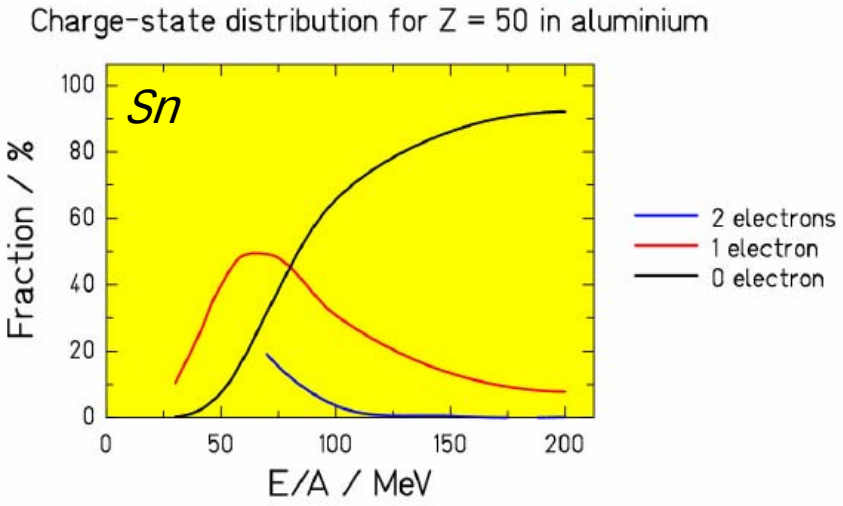
FP5 "design" minimum defined by RFQ ~ 0.7 MeV/u

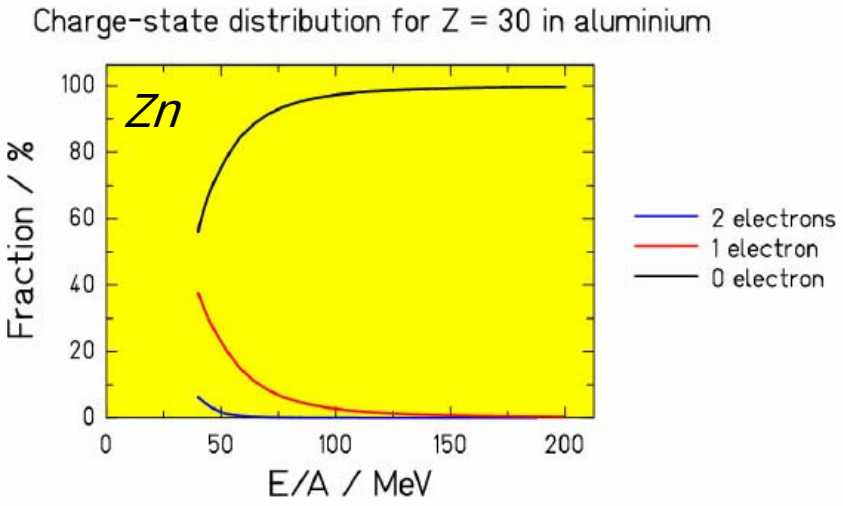
> ⇒ *dedicated "LE" accelerator for astrophysics etc*
>
> *E ~ 0-1 MeV/u ≡ instrumentation **

* ⇒ *not a task 6 issue*

Experimental Requirements : Maximum Secondary Beam Energy

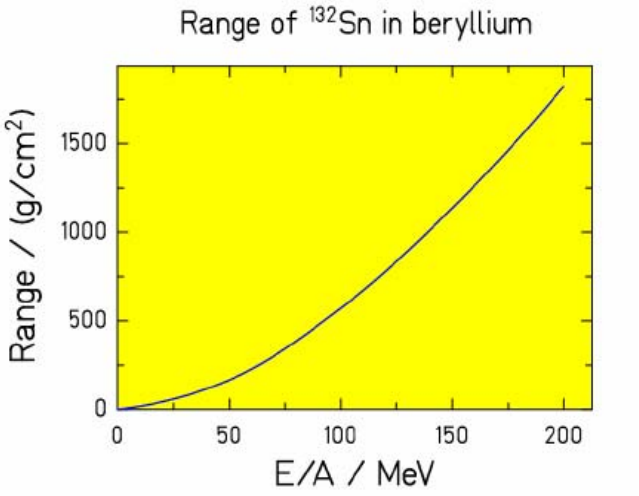
Fragmentation & "Knockout" Reactions – ^{132}Sn





^{132}Sn 4-nucleon removal
100 → 150 MeV/nucleon
⇒ Target ρ_s x 4
⇒ Transmission x 2
⇒ Rate x 8

LISE sims + FRS



Figures K-H. Schmidt

Experimental Requirements : Beam and Machine Characteristics

- Energy Variability

  ~0.5 % at low-medium energies (0-20 MeV/u)
  ~1 MeV/u at high energies (>20 MeV/u)

- Beam Energy Definition/Absolute Beam Energy

  ~ 0.1 % or better at low-medium energies (0-20 MeV/u)
  ~ 0.1 % at high energies (>20 MeV/u) iff possible (??)

  $\Rightarrow$ need <u>beam energy analysis spectrometer(s)</u>
  (at high energies fragment separator should fulfill this role)

  $\Rightarrow$ fast and precise beam energy changes at LE/Barrier Energies (0-5 MeV/u)

Experimental Requirements : Beam and Machine Characteristics

- Time Resolution (beam pulse width)

  δt = 1 nsec acceptable - lower iff at all possible (aim for 0.5 nsec)

  $\rightarrow$ is 100 psec possible ?? Consequences for δE ??

- Beam beam pulse rate & "chopping"

- f = 88 MHz δt = 12 nsec complicates expts using ToF

  δt ~ 100-200 nsec/10-5 MHz preferred for most applications

  (should retain 88 MHz option, especially for very intense beams)

- "chopping" : 10 nsec – 1 msec

Experimental Requirements : Beam and Machine Characteristics

- Beam Sharing

  - Essential aspect of facility, but FP5 proposal of sharing using unused charge state(s) from stripping of *very little utility*.

  - Many VLE and LE/Coulomb barrier expts (0-5MeV/u) require *very extended* periods of beamtime with *same* beam (astro', heavy elements, etc).

  ⇒ Dedicated VLE, LE and HE reaccelerator(s) [~0-1, ~1-5 and ~5-150 MeV/u] coupled to separate target-ion source beam preparation systems * …

  → ie. Beam sharing of driver accelerator beam

* see Ari Jokinen's talk Tuesday

Experimental Requirements : Beam and Machine Characteristics

- Stable Beam Operation

  - det calibrations, reference "expts" (C. 2015-20 unique machine), systematics with RNB not accessible with EURISOL , utilisation of facility during driver-linac/target ion-source downtime …
  - as plan to handle 10^{12}-10^{13} pps RNB, similar intensity stable beams easier (ECR's already available)

  $\Rightarrow$ *high-acceptance, high-resolution fragment separator*

- Beam Purity

  - in general isotopically pure beams preferred

    [latitude/acceptance for accelerating isobars ?]

Experimental Requirements : Beam and Machine Characteristics

- Beam emittance/spot size

  - ~2π mm.mrad
  - ~2 mm^2 spot size

  Most stringent requirements at VLE-LE/Barrier energies (0-~5 MeV/u)

  iff possible tandem-like beam quality desired.

Experimental Requirements : Beam and Machine Characteristics

- *ONGOING PROCESS –*

  FEEDBACK FROM TASKS 6, 9, …

- *INPUT, FEEDACK WELCOME …*