



# EURISOL

## beta-beam related tasks

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# The beta-beam in EURISOL



- **Target tasks:** 100 kW, solid fission target and MW targets
  - CERN
- **Beam preparation:** 60 GHz ECR source
  - IN2P3-LPSC
- **Heavy-ion accelerator:** acceleration up to
  - 100 MeV/u
  - GANIL
- **Physics:** Low energy beta-beam
  - IN2P3-Orsay
- **And more...**



# Target tasks



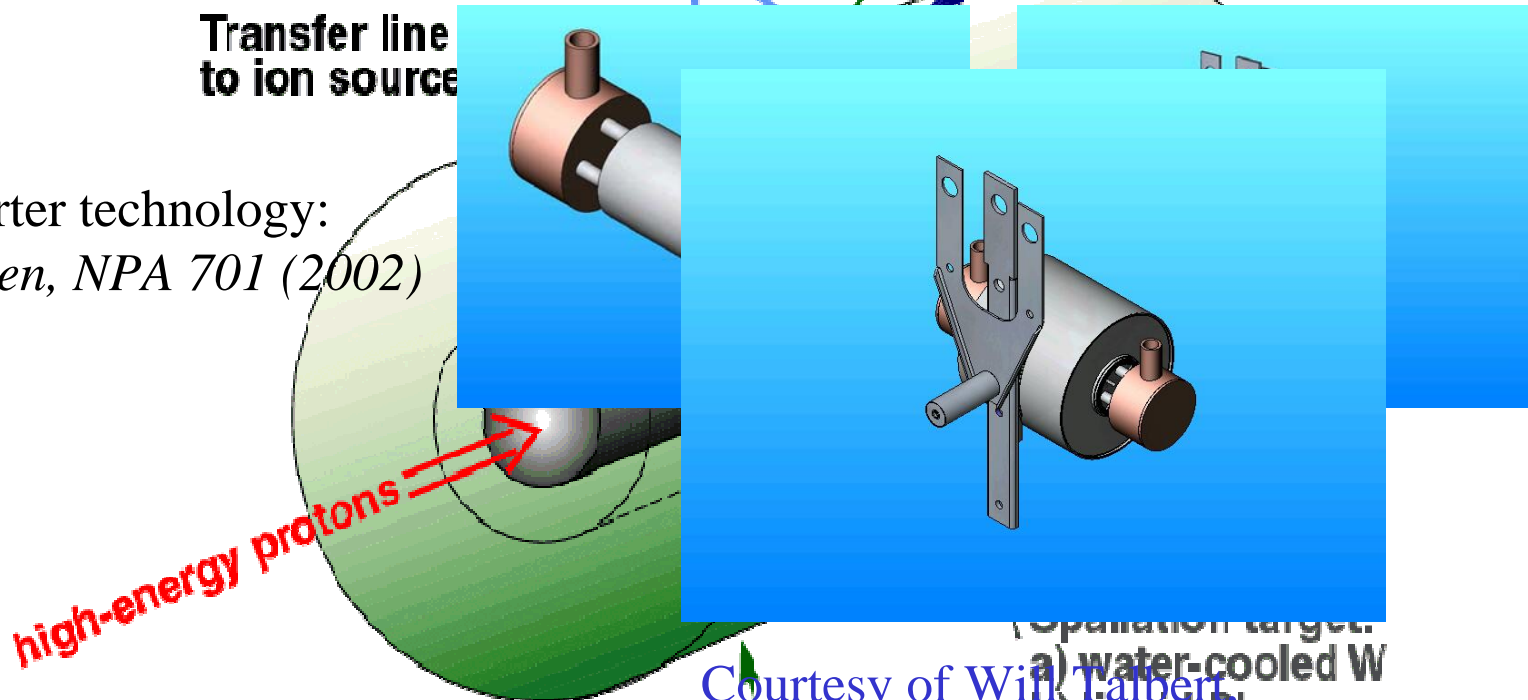
- Development of targets for  ${}^6\text{He}$  production and  ${}^{18}\text{Ne}$  production
  - Oxid targets
    - BeO and MgO in baseline
  - Converter technology
    - Solid converters
    - Liquid converters
- Open questions:
  - Intensities
  - Life time
  - Release time (structure)
  - Transport to ECR source
  - Isobaric contaminations
- Workpackage leaders: Jacques Lettry (CERN), Luigi Tecchio (LNL, INFN) and Yacine Kadi (CERN)

# ${}^6\text{He}$ production by ${}^9\text{Be}(n, \alpha)$

${}^6\text{He}$  and  ${}^4\text{He}$        ${}^9\text{Be}$       Spallation neutrons

Transfer line  
to ion source

Converter technology:  
(*J. Nolen, NPA 701 (2002) 312c*)



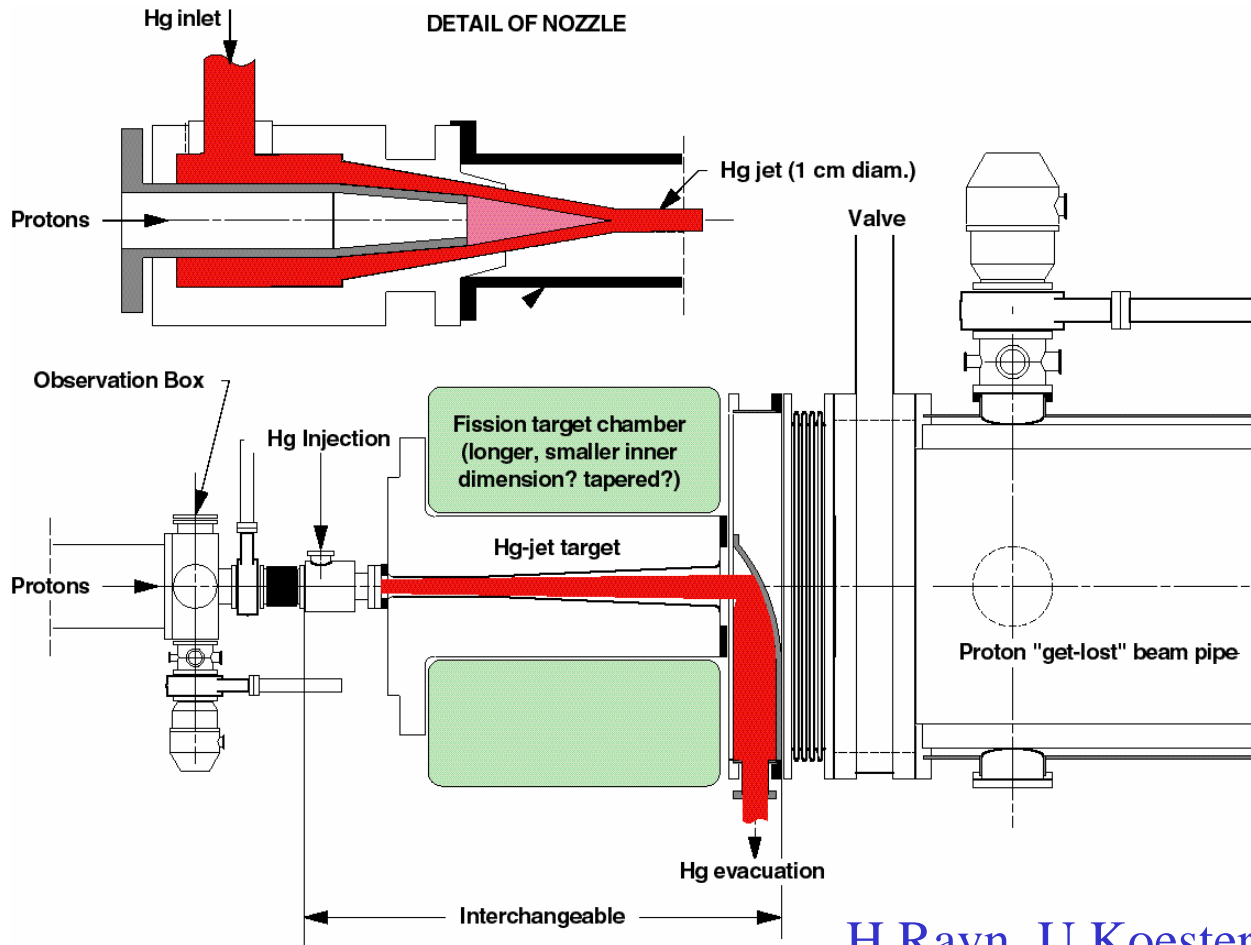
Courtesy of Will Talbert,  
Mahlon Wilson (Los Alamos)  
and Dave Ross (TRIUMF)

Spallation target:  
a) water-cooled W  
b) liquid Pb

**ISOL target ( $\text{BeO}$ ) in concentric cylinder**

Layout very similar to planned EURISOL converter target  
aiming for  $10^{15}$  fissions per s.

# Mercury jet converter



H.Ravn, U.Koester, J.Letry,  
S.Gardoni, A.Fabich



# Production of $\beta^+$ emitters



- Spallation of close-by target nuclides:  
 $^{18,19}\text{Ne}$  from  $\text{MgO}$  and  $^{34,35}\text{Ar}$  in  $\text{CaO}$ 
  - Production rate for  $^{18}\text{Ne}$  is  $1 \times 10^{12} \text{ s}^{-1}$  (with 2.2 GeV 100 mA proton beam, cross-sections of some mb and a 1 m long oxide target of 10% theoretical density)
  - $^{19}\text{Ne}$  can be produced with one order of magnitude higher intensity but the half life is 17 seconds!



# Beam preparation



- Magnetic separation, Low-energy transport, ionization and bunching with a 60 GHz ECR source
- Questions
  - Bunch length
  - Charge state distribution
  - Losses
  - Purification in cryo-trap
- Workpackage leader: Ari Jokinen, Jyvaskyla
- Workunit leader: Pascal Sortais, LPSC, IN2P3



1 - To bunch the gas in short time

*$\sim > 20 \mu\text{s}$*

2 - To ionize (>1+) with a time smaller than the effusion time

*$n_e \approx 10^{14} \text{ e/cm}^{-3} \quad \approx 60 \text{ GHz ECR discharge}$*

*+ strong axial magnetic field during the discharge ( $\approx 2\text{T}$ )*

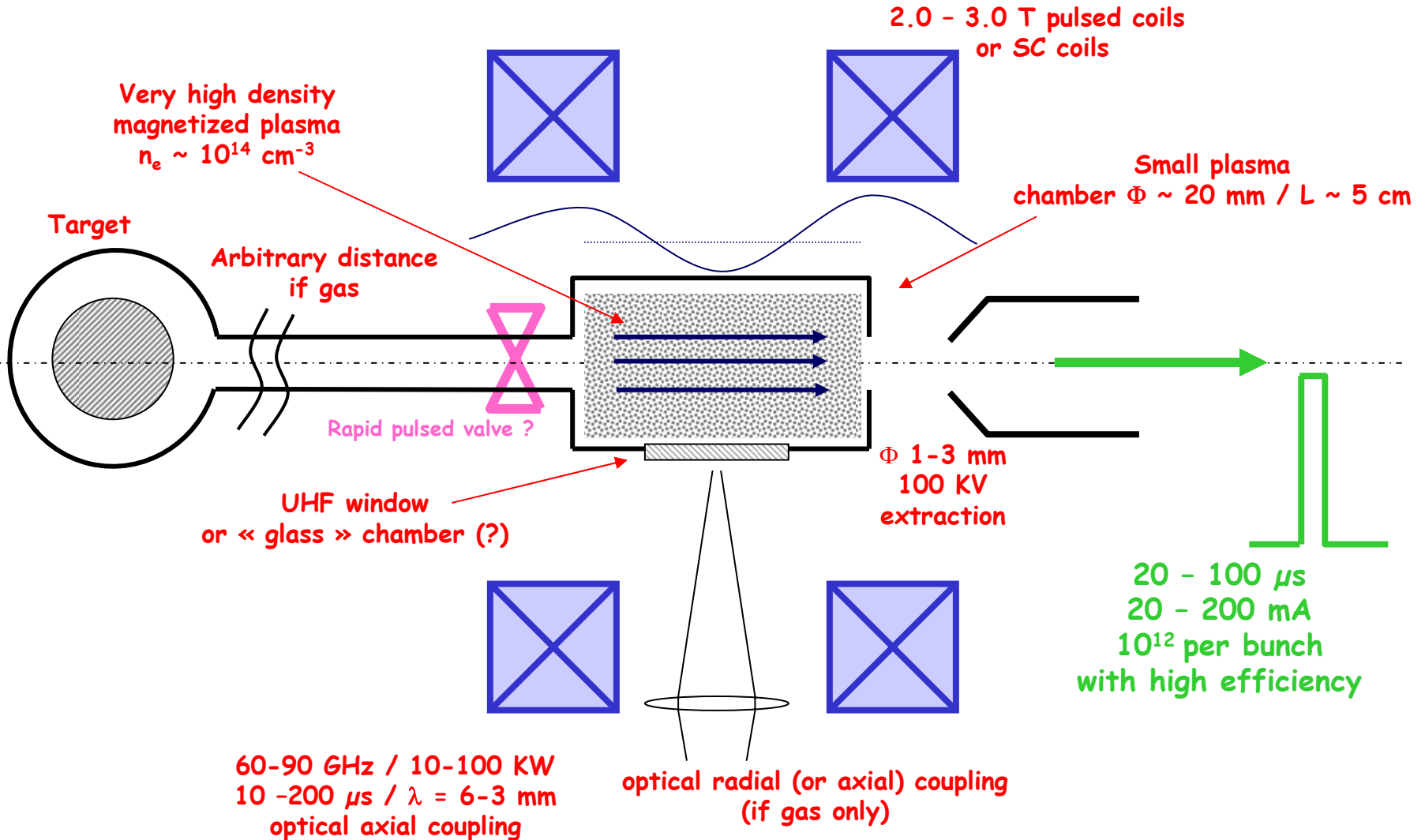
3 - To deliver a beam with a repetition rate compatible  
with the lifetime of the ions





# 60 GHz « ECR Duoplasmatron » for gaseous RIB

Eurisol / Isolde / LPSC collaboration





## *A - CW charge breeding*

*Beam matching*

*Technological developments*

## *B - Pulsed charge breeding and the Beta-beam project*

*Three « orders of magnitude » to find :*

*- intensity  $\times 10$*

*- rising time  $/ 10$*

*- bunching/efficiency  $\times 10$*



# Heavy-Ion accelerator



- Acceleration to 100 MeV/u
- Open questions:
  - Can the EURISOL baseline heavy-ion accelerator be used?
    - Intensity
    - Simultaneous use for Nuclear Physics
    - Multiple charge state acceleration
- Work package leader: M-H. Moscatello, GANIL



- Low energy beta-beam
- Open questions
  - Physics potential
  - Special beta-beam facility required
  - Test ring using existing facilities
    - AD ring at CERN
    - FAIR storage ring
- Work package leader: Rob Page, Liverpool
- Work unit leader: Cristina Volpe, IN2P3
- High energy beta-beam physics case to be handled by BENE work package (Mauro Mezzetto, INFN)



## High energy fragmentation:

EURISOL high intense easy beam (e.g.  $^{132}\text{Sn}$ )

+

post-acceleration to GeV region in PS

+

IF or direct

=

A major step further towards more exotic nuclei



# Conclusions



- Essential with strong and efficient coordination with other EURISOL tasks
  - Milestones for beam parameters in 2005
- Heavy-ion acceleration of ions for beta-beam will possible have to be done in dedicated linac
- The beta-beam is fully integrated in EURISOL
  - Expect that the nuclear physics community will be interested in other nuclei at high energies