

International Workshop
UCN Sources and Experiments
Sept. 13-14, 2007
TRIUMF, Vancouver, BC

- Welcome!
- Workshop goals
- TRIUMF plans
- A surprise assignment for all presenters

This Workshop and TRIUMF

- Proposal to construct a UCN source at TRIUMF in collaboration with Y. Masuda (KEK)
- Strong interest from Canadian groups (primarily Winnipeg and Manitoba at this time)
- This would be a world-class facility achieving highest UCN density in the world
- Flagship physics experiment at this facility would be world's best

Recent Progress at TRIUMF

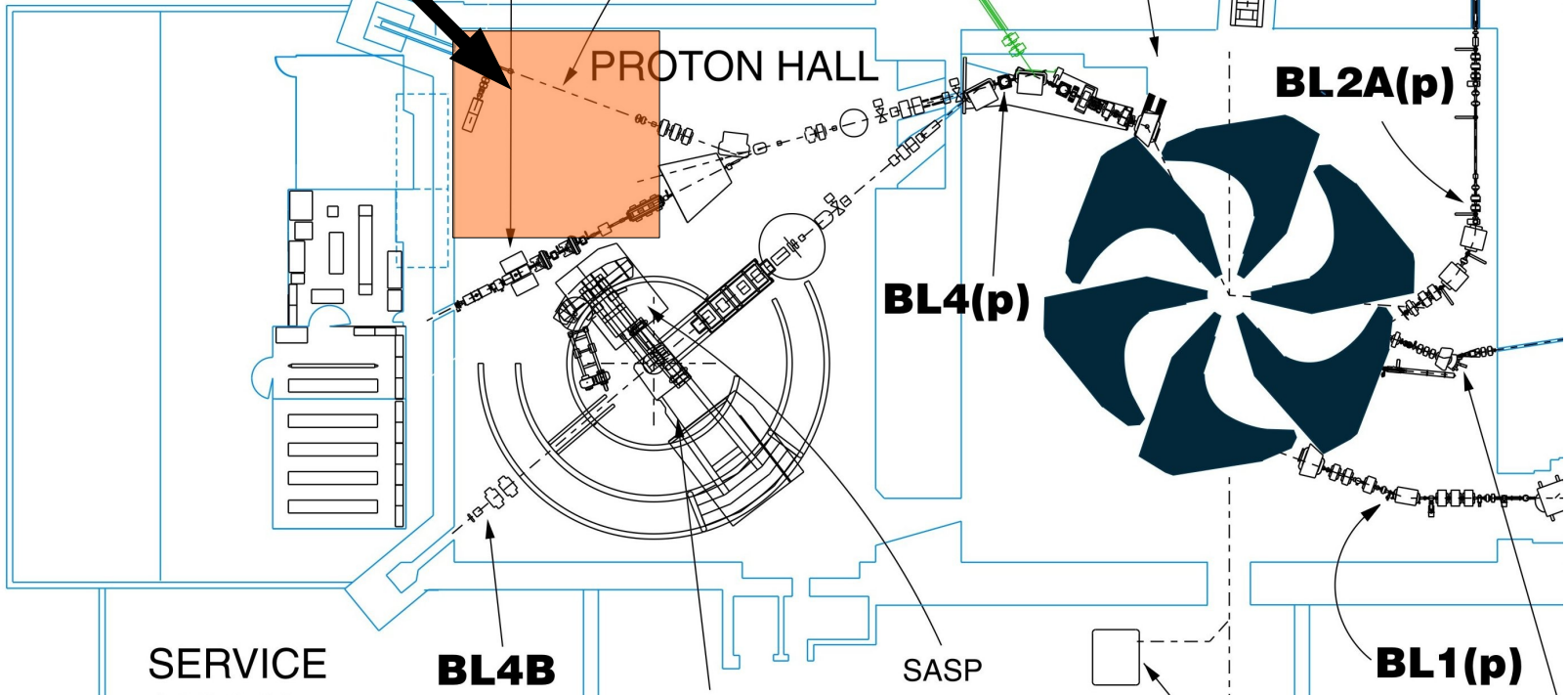
- Fall 2006 – UCN project included as part of white paper for TRIUMF 5-year plan
- Early 2007 – started planning this workshop and next steps
- August 2007 – 3-day working group at TRIUMF townhall meeting (related to 5-year plan)
- September 2007
 - white paper drafted and sent to management
 - technical issues discussed with accel group
 - presentation to the board of management Sept. 14 (tomorrow).

Schedule

- Prior to 2010, pursue development of new UCN cryostat for TRIUMF at RCNP, Osaka.
 - This would allow us to demonstrate all the gain factors from horizontal extraction, better UCN guides. (aside from beam power)
- After 2010, begin construction of UCN source at TRIUMF
 - (2010 = coincident with major reconstruction for ISAC-3 = actinide targets).

UCN
(12m x 12m)

PROTON HALL
EXTENSION



PARITY
BL4A2
(p)

BL4A(p)

PROTON HALL

BL4(p)

BL2A(p)

BL4
EXTENSION

TARGET AREA
EL. 264.00'

EL. 264.00'

EXISTING TARGET HALL
ISAC -1

SUPPORTING
AREA
EL. 264.00'

REMOTE
HANDLING
FACILITY

BL4N (<math>< 200 \mu A</math>)

BL2A (<math>< 100 \mu A</math>)

SERVICE
BRIDGE

CYCLOTRON
VAULT

SERVICE

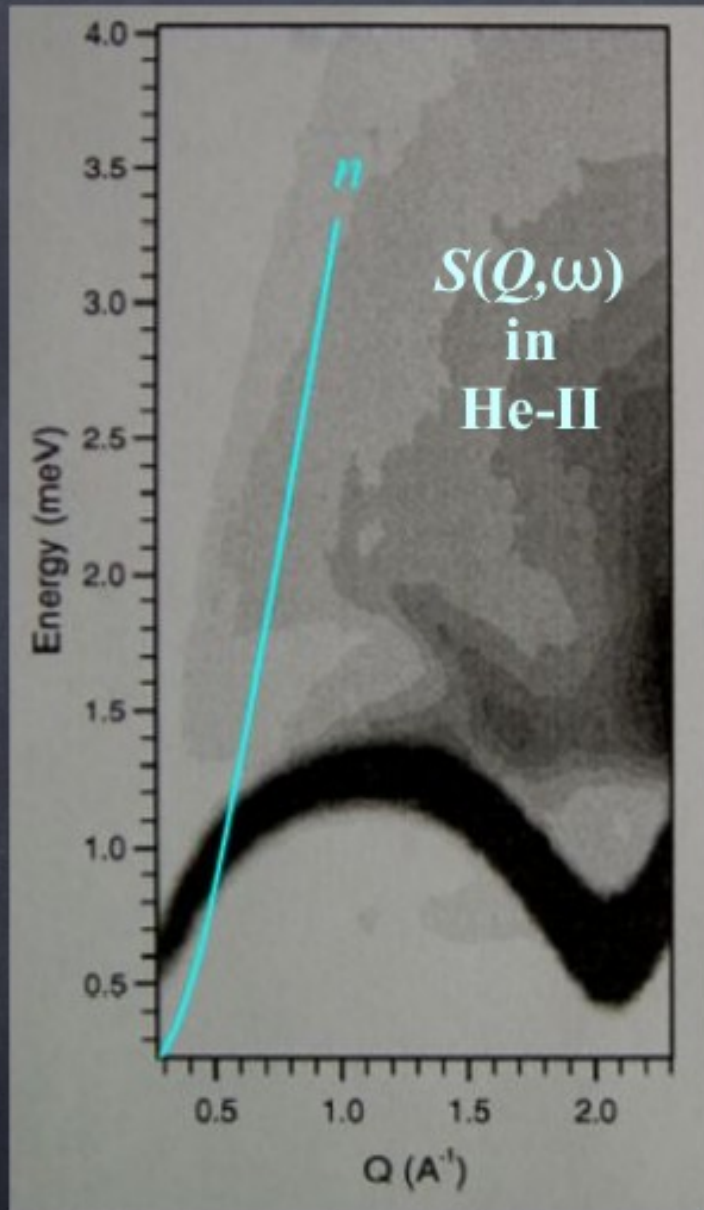
BL4B

SASP

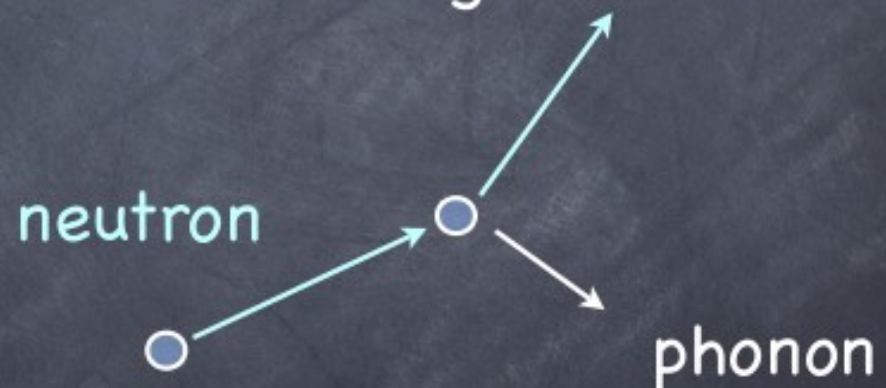
BL1(p)

Superthermal UCN production in He-II

Coherent inelastic neutron
scattering in He-II



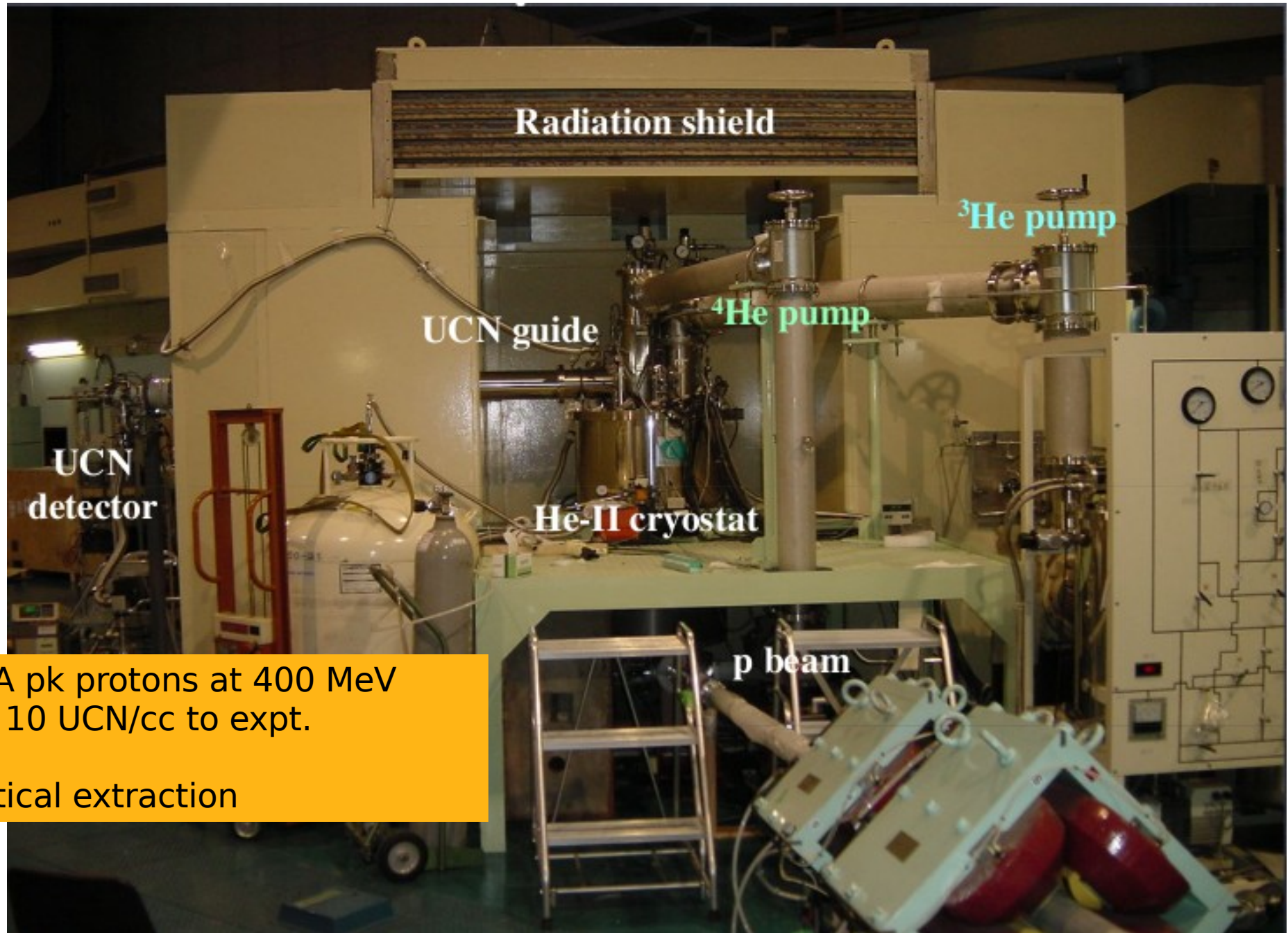
M.R. Gibbs et al. (1999)



Born approximation

$$\frac{d^2\sigma}{dQd\omega}$$
$$= k_f/k_i a^2 S(Q, \omega)$$
$$= \sigma_{\text{coh}}/4\pi \cdot k_f/k_i \cdot S(Q, \omega)$$

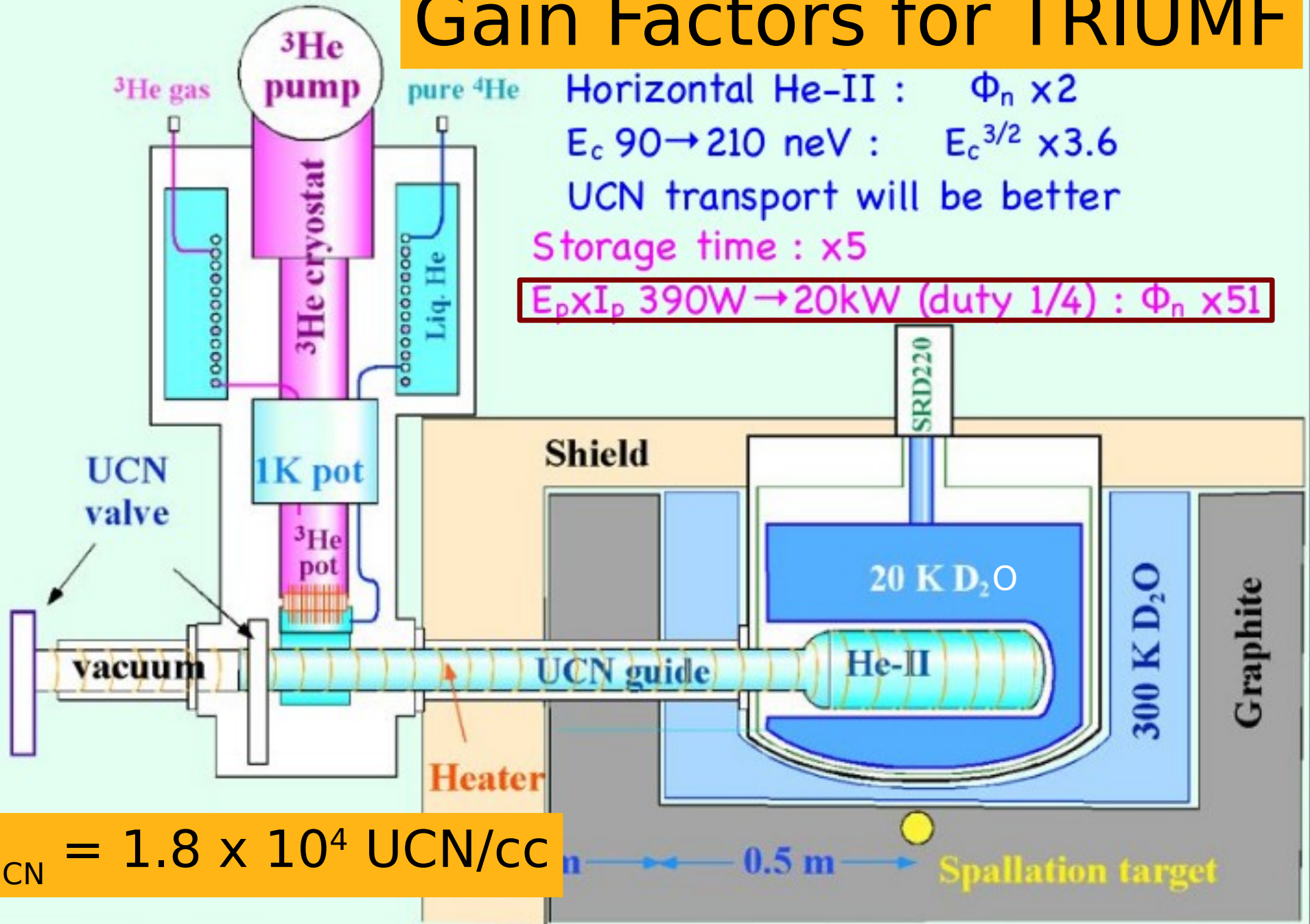
RCNP UCN Source (Masuda, et al)



1 μ A pk protons at 400 MeV
=> 10 UCN/cc to expt.

Vertical extraction

Gain Factors for TRIUMF



Horizontal He-II : $\Phi_n \times 2$

E_c 90 → 210 neV : $E_c^{3/2} \times 3.6$

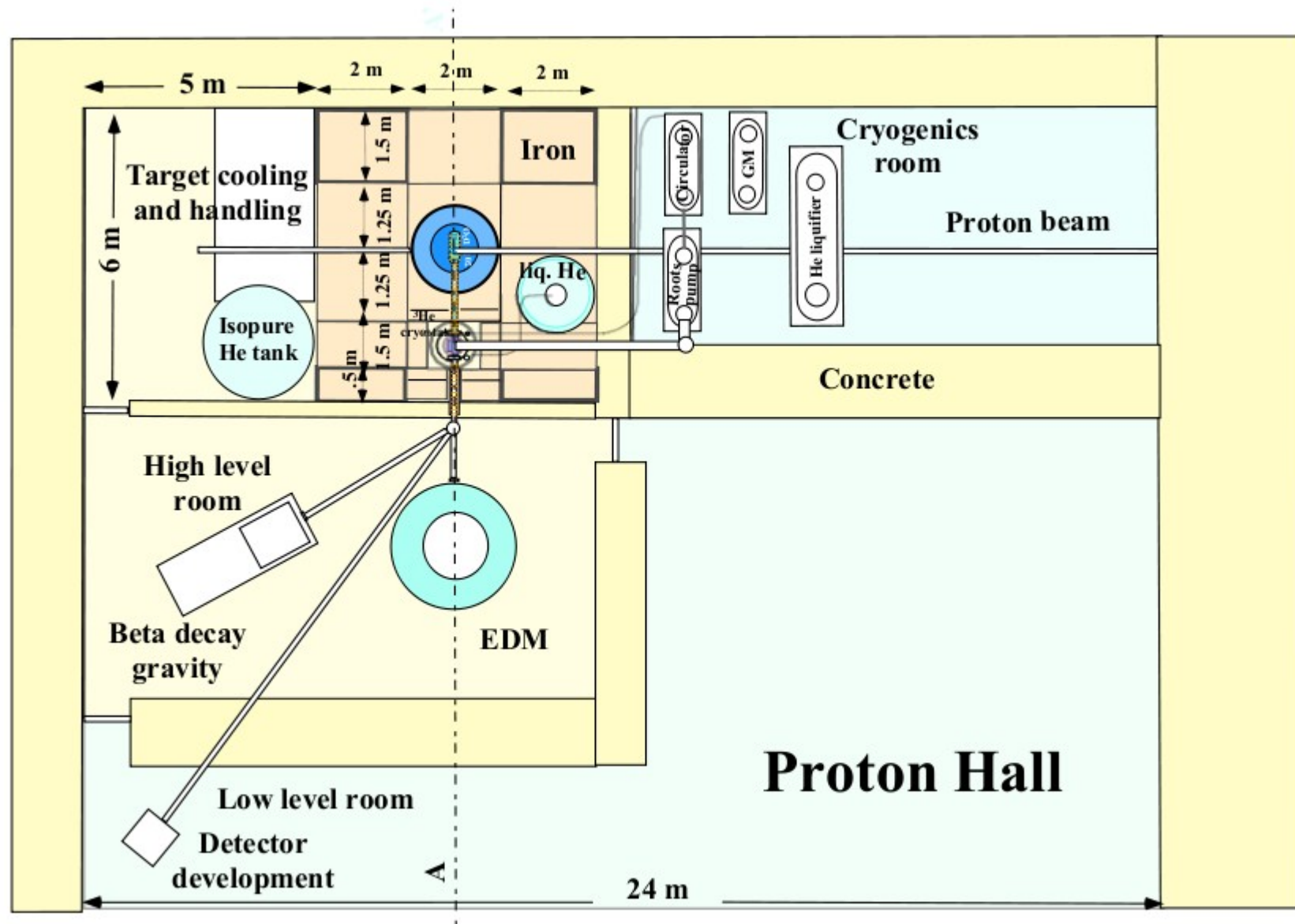
UCN transport will be better

Storage time : $\times 5$

$E_p \times I_p$ 390W → 20kW (duty 1/4) : $\Phi_n \times 51$

$$\rho_{\text{UCN}} = 1.8 \times 10^4 \text{ UCN/cc}$$

Potential Layout in Proton Hall (rev. 9/6/07)



layout still needs some work... cryogenics location, shielding, remote handling

Future UCN Densities Comparison

	Source type	E_c and τ_s	UCN density $\rho_{\text{UCN}}(\text{UCN}/\text{cm}^3)$
TRIUMF 5 kW_{av} proton	0.8K He-II	$E_c = 210 \text{ neV}$ $\tau_s = 150 \text{ s}$	1.8×10^4 at experimental port
Grenoble 60MW reactor	0.5K He-II	$E_c = 250 \text{ neV}$ $\tau_s = 150 \text{ s}$	1000 in He-II
SNS cold neutron beam	0.3K He-II	$E_c = 134 \text{ neV}$ $\tau_s = 500 \text{ s}$	430 in He-II
Munich 20MW reactor	SD ₂	$E_c = 250 \text{ neV}$	10^4 in source
North Carolina 1 MW reactor	SD ₂	$E_c = 335 \text{ neV}$	1300 in source
PSI 12 kW _{av} proton	SD ₂	$E_c = 250 \text{ neV}$ $\tau_s = 888 \text{ s}$	2000 in source
Los Alamos 2.4 kW _{av} proton	SD ₂	$E_c = 250 \text{ neV}$ $\tau_s = 2.6 \text{ s}$	120 in source

UCN Physics

- fundamental interactions of UCN
 - EDM
 - gravity
 - beta-decay
 - nnbar oscillations
- astrophysics
 - BBN
 - r-process
- surface physics
- development towards JPARC 2nd target station UCN source

Measuring (n,γ) cross sections of the r-process

^{132}Sn stored in ring interacts with free neutron (UCN) target.

^{132}Sn current $5e17$ /s

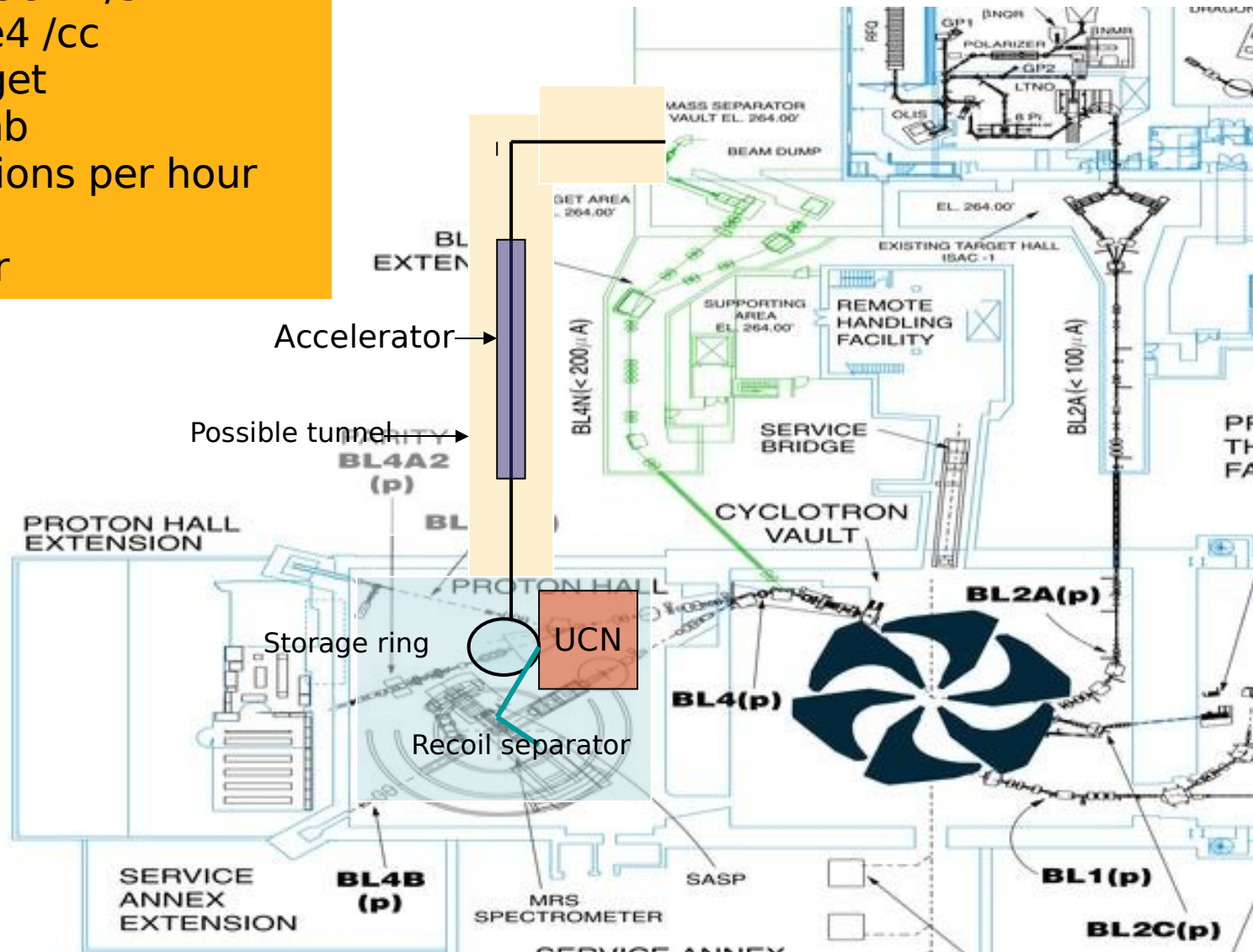
UCN density $2e4$ /cc

meter-long target

$\sigma \sim 100$ mb

\Rightarrow 50 interactions per hour

recoil separator



See Lothar Buchmann's talk Friday afternoon

Your Assignment

- For those giving talks about UCN sources, please help me fill in the table with your most up-to-date specs and schedule.
- For those giving talks about neutron experiments, please comment on how your experiment would profit from a significantly larger UCN density.
- Invitation to submit Letters of Intent for UCN physics experiments to the TRIUMF EEC, December 2007.

Thank you and enjoy the workshop!

- laptop provided for talks
- all talks uploaded to website
 - if not uploaded to laptop, please email them to me jmartin@nuclear.uwinnipeg.ca
- please keep to time
- lunch at 12:15 in the courtyard is complementary for attendees (please display your nametag)