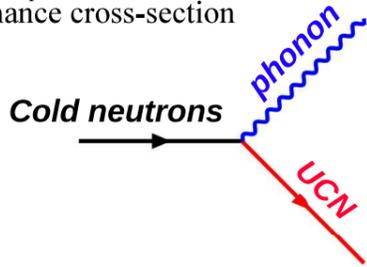


Conversion and superfluid He

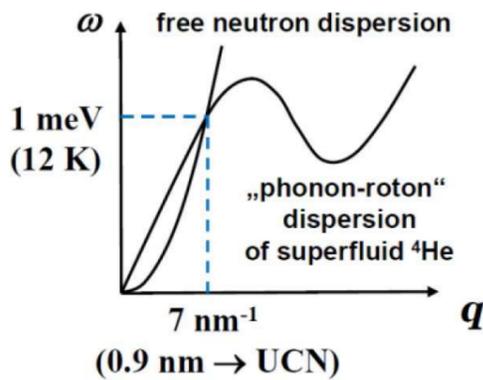
- Conversion principle
- Single scattering
 - Non thermal equilibrium
 - $E_{\text{phonon}} \gg 3/2 kT$
 - Resonance cross-section



R. Golub, J.M. Pendlebury, *PL* 53A (1975) 113

Phonon exchange in helium

R. A. Cowley and A. D. B. Woods, *Canadian Journal of Physics* 49/2 (1971) 177-200



Advantages of superfluid helium

- Low losses from absorption
- Ultra pure ^4He : $\sigma_a = 0$ barn
- Long storage time due to the low temperature.

$$\tau_{\text{up}}^{-1} \approx \frac{(T[\text{K}])^7}{100 \text{ s}}$$

At 0.6 K, $\tau_{\text{up}}^{-1} = (3572 \text{ s})^{-1} \ll \tau_{\beta}^{-1}$

R. Golub, *PL* 72(4-5) A (1979), 387-390.



Overview of SuperSUN: A superthermal UCN source

E. Chanel, S. Baudoin, M.H. Baurand, N. Belhier, E. Bourgeat-Lami, S. Degenkolb, M. van der Grinten, M. Jentschel, V. Joyet, M. Kreuz, E. Lelièvre-Berna, J. Lucas, X. Tonon, O. Zimmer

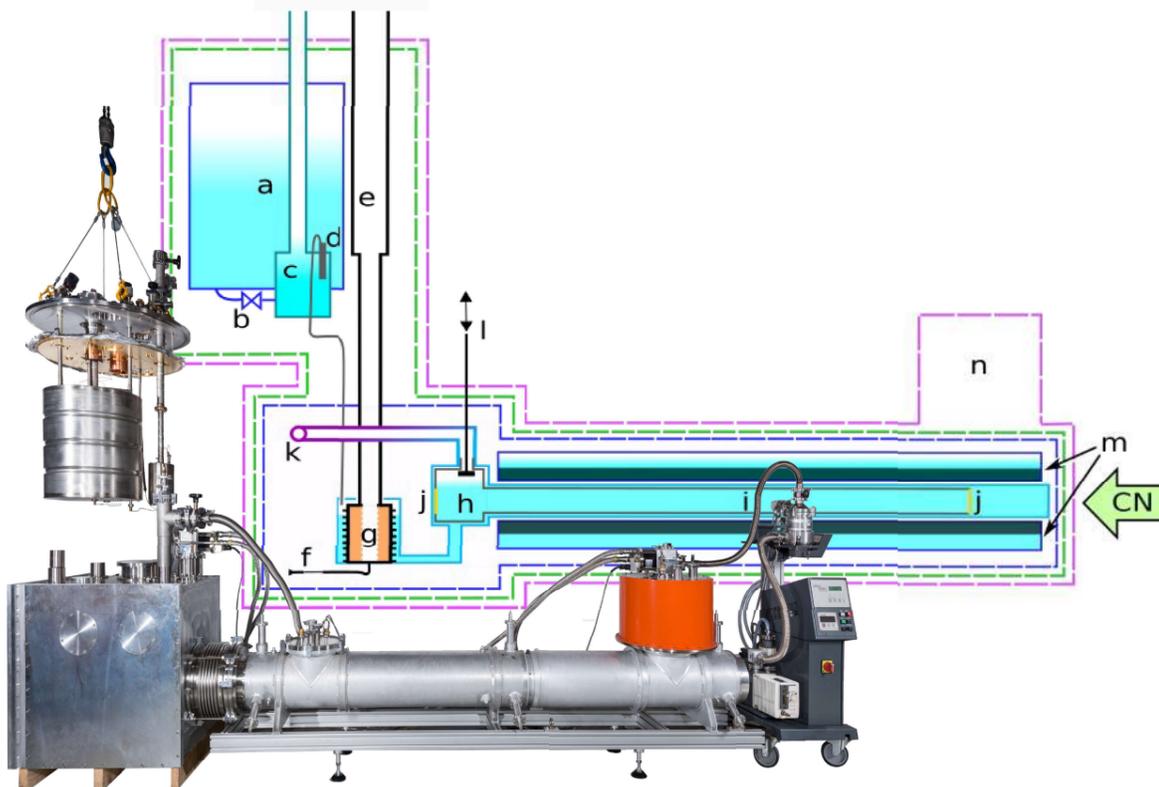
PSI 2022

workshop



Legend

- (a) 100-L liquid helium bath,
- (b) needle valve,
- (c) 1-K pot,
- (d) ^4He superleak,
- (e) ^3He pumping column,
- (f) ^3He impedance,
- (g) $^3\text{He}/^4\text{He}$ heat exchanger
- (h) UCN box,
- (i) conversion volume at 0.6 K,
- (j) two beryllium windows,
- (k) UCN extraction system,
- (l) UCN valve,
- (m) superconducting magnet for phase II
- (n) the 4-K cryostat

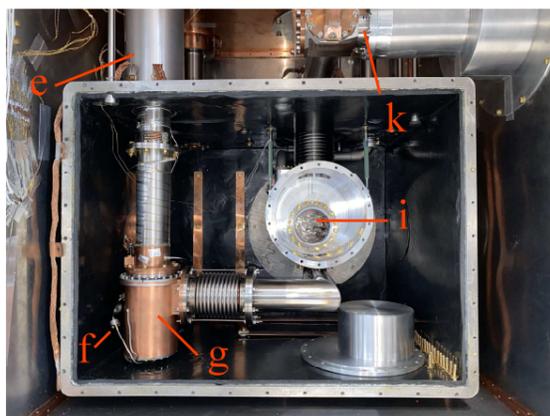


Adapted from © Ecliptique - Laurent Thion.

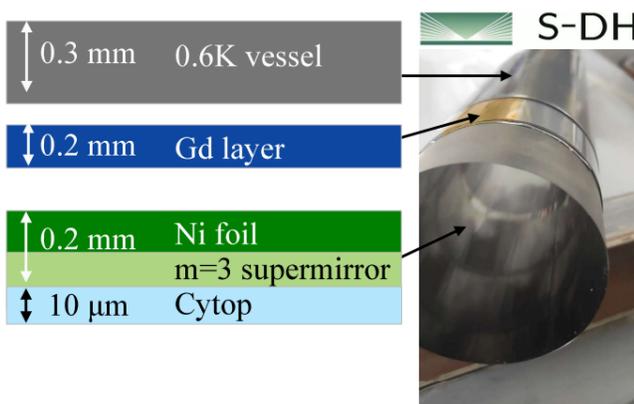
E. Chanel et. al., Concept and strategy of SuperSUN: a new ultracold neutron converter, [accepted to JNR](#)

SuperSUN

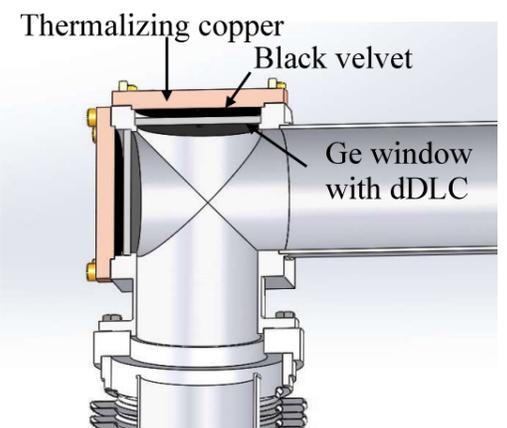
Heart of SuperSUN: superfluid injector and UCN extraction unit



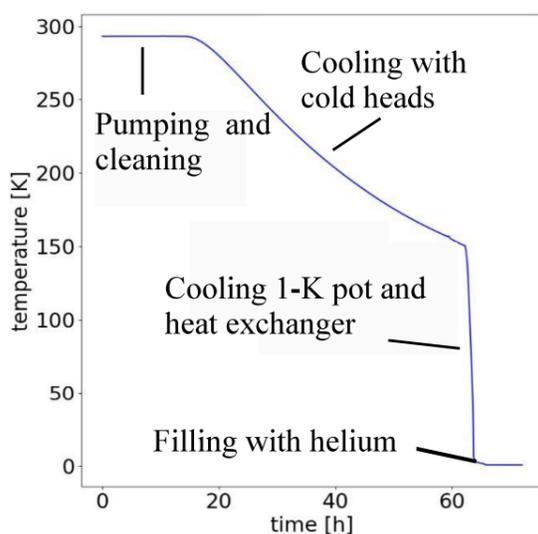
Conversion volume



Extraction system



Cryogenic characteristics

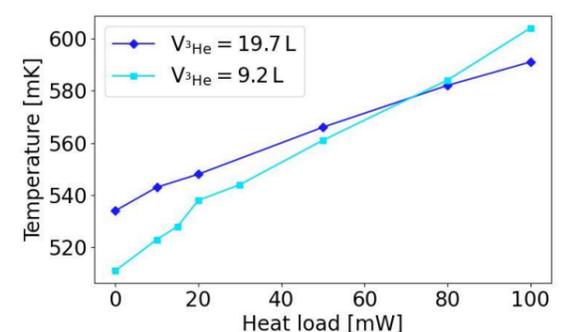


Cool-down cycle

- ≥48h Pumping insulation vacuum and cleaning circuits
- 24-72h Cooling with cold heads
- 3-4h Cooling 1-K pot and heat exchanger
- 8-16h Filling with helium
- Total 1 week

Warm-up cycle

- 1 day Emptying
- 24 h Pumping
- 72 h Warming up at atmosphere
- Total 4 days



Cooling power test

$T \leq 0.6 \text{ K}$ for an additional 100 mW. The more ^3He , the more power, but, the higher the temperature without additional heat load.