Design concept
of the Japanese Spallation Neutron Source

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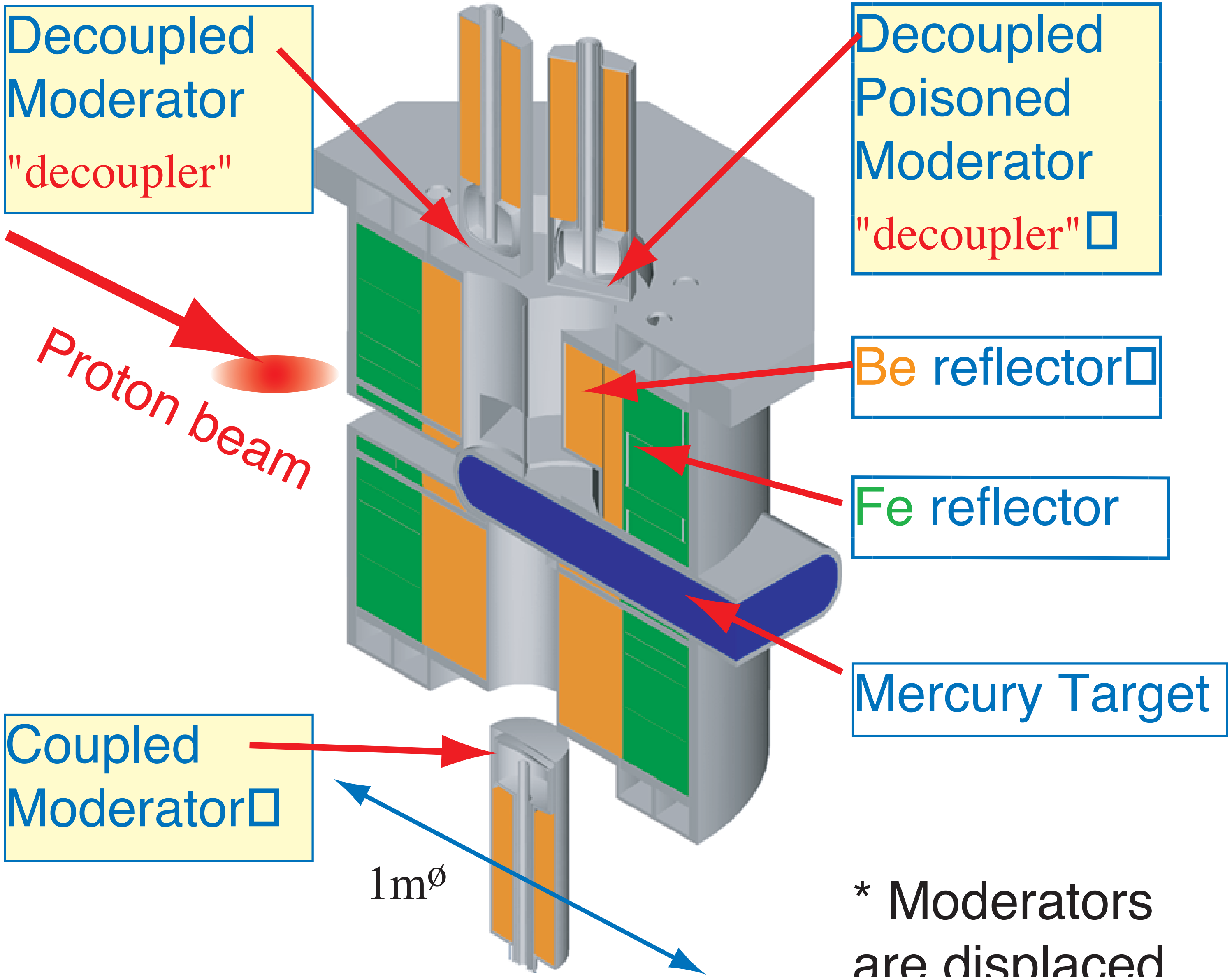
Moderator-Reflector-Assembly

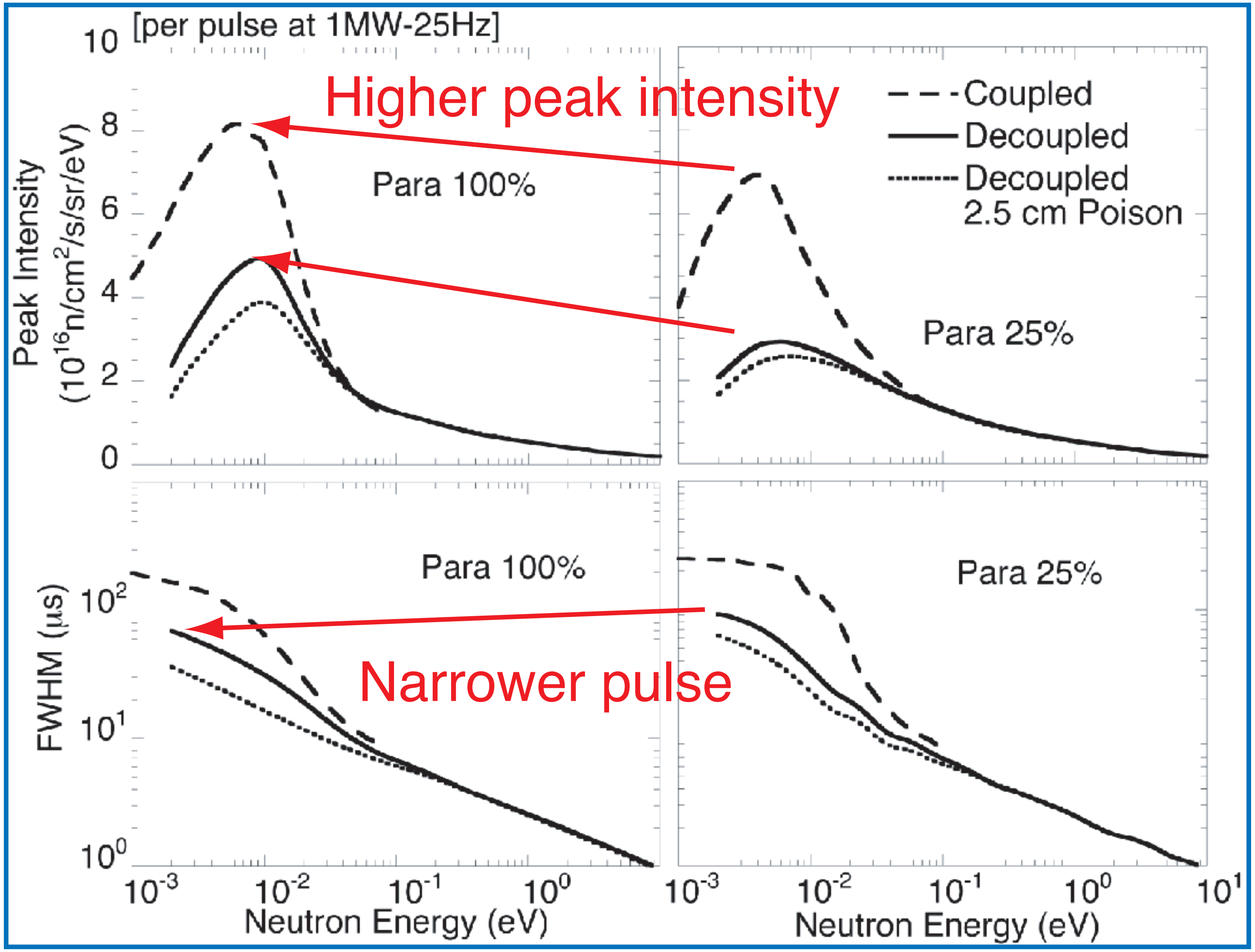
- Supercritical Hydrogen Moderators
  - Only three Moderators
  - No water moderator
- 100 % “Para” hydrogen assumed
  - AIC 1eV decoupler (Ag-In-Cd)
  - Nearly no absorber near coupled moderator



* Moderators are displaced.

Para hydrogen is better

Computer simulation

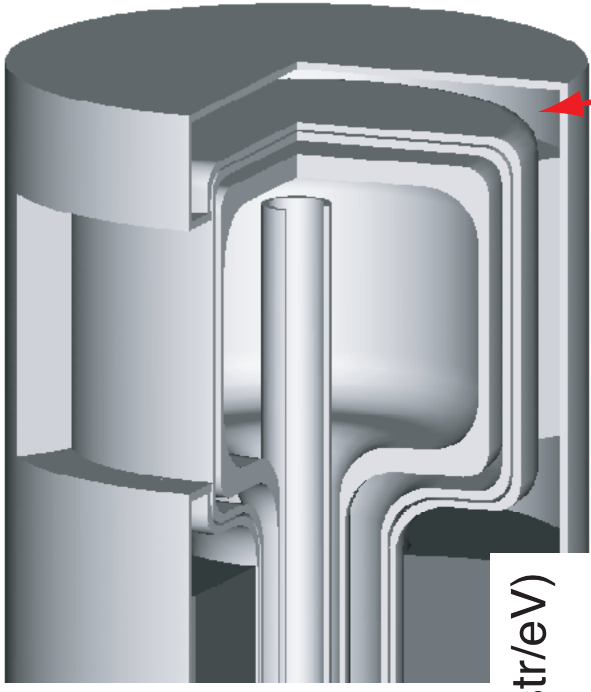


99.8% para at 20K

- Ortho-para ratio "uncontrollable" & unknown at high power source.
- We assume ~100% para
- LANL experiment.

High Performance Coupled Moderator

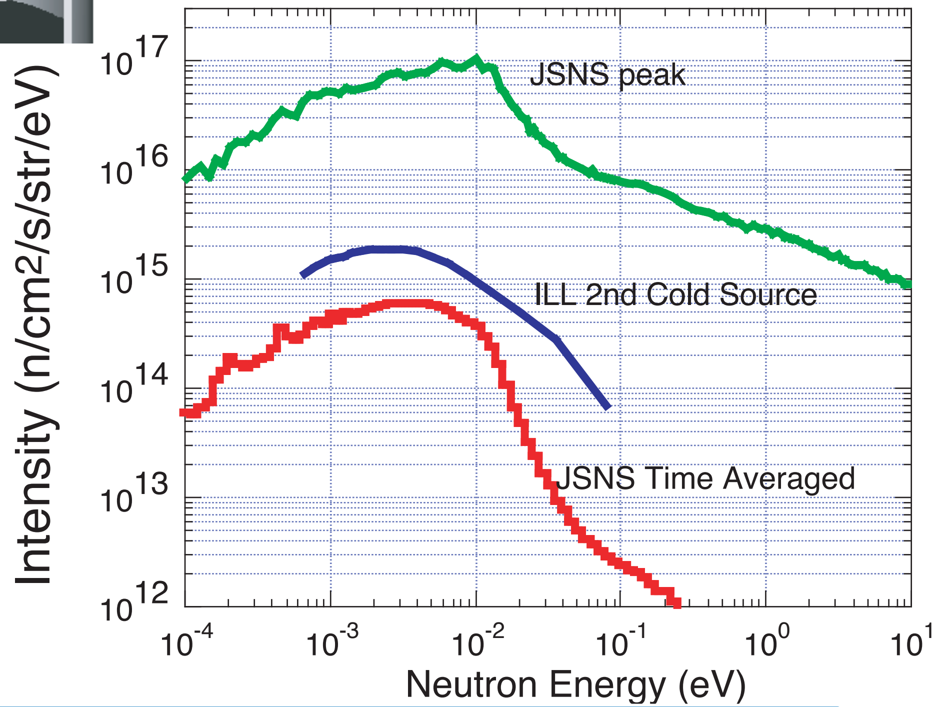
- "Para" hydrogen is transparent
  14 cmØ × 10 cmH
- Cylindrical shape
  – To minimise angular dependence.
- Avoide absorber near the moderator
  - e.g. No decoupler, SUS
- About 50% of the Instruments veiws Coupled moderator



premoderator

14 cmØ × 10 cmH

Usually ~5cm thick



High-Intensity: Time-averaged and Peak

– 3GeV and 25Hz

400MeV Linac + 3-GeV RCS approach

→ 25Hz result in Higher proton peak-intensity

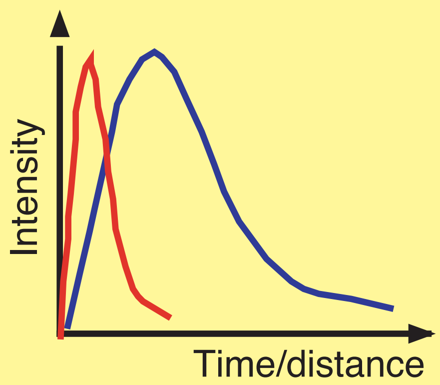
– Combined with a coupled moderator

Coupled moderator → Intense time averaged & peak intensity

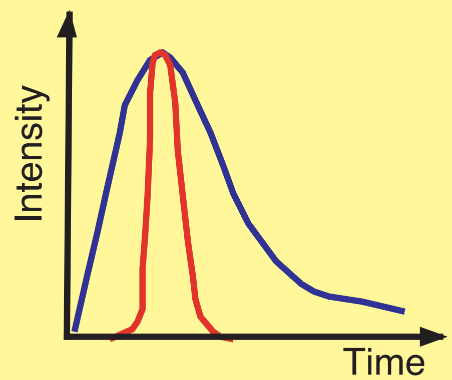
Long guide tube → Higher resolution $\Delta t/t = \Delta\lambda/\lambda$

Longer period → Still get wide λ range

Using a guide tube

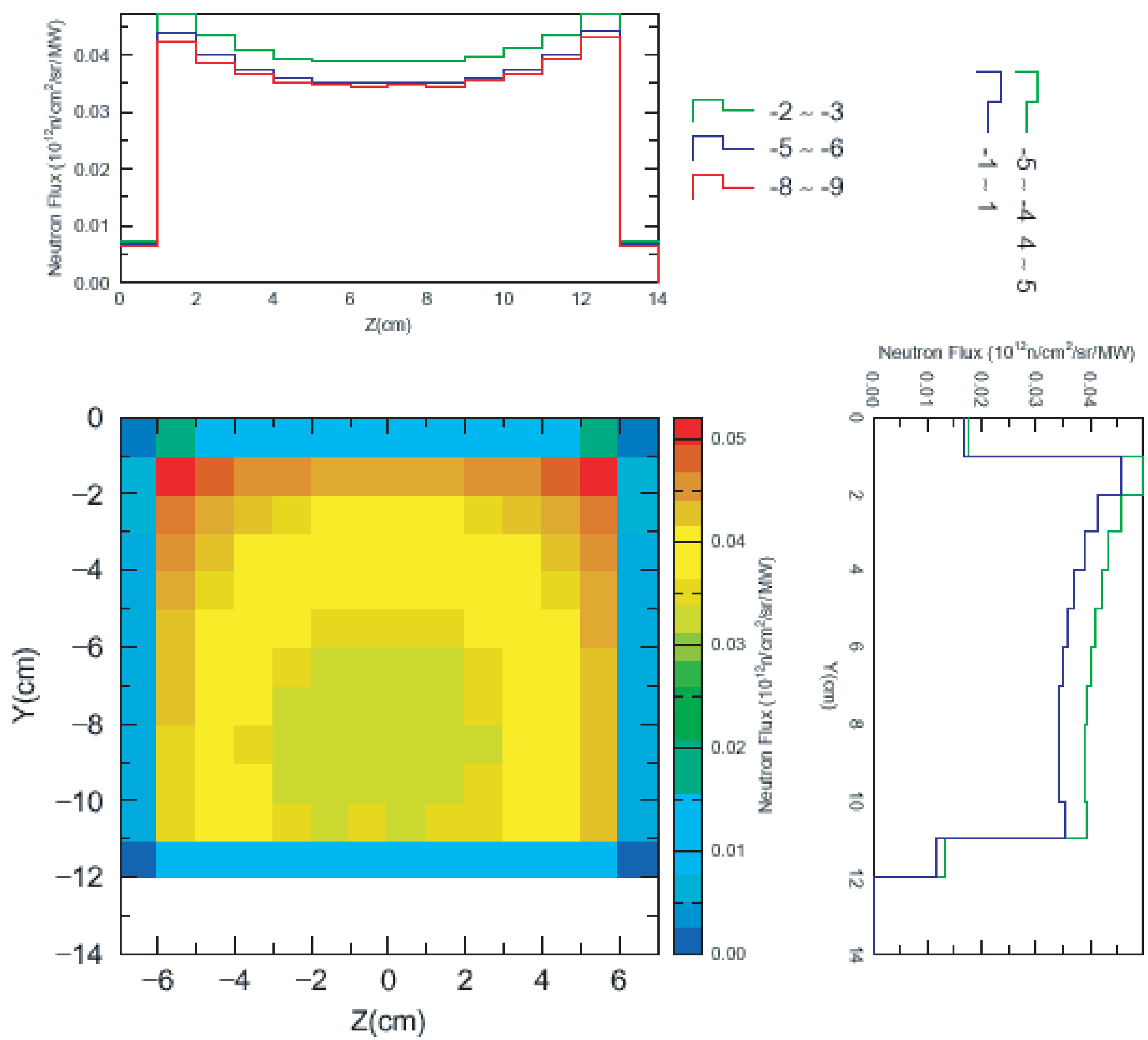


Using a chopper & frequency multiplication



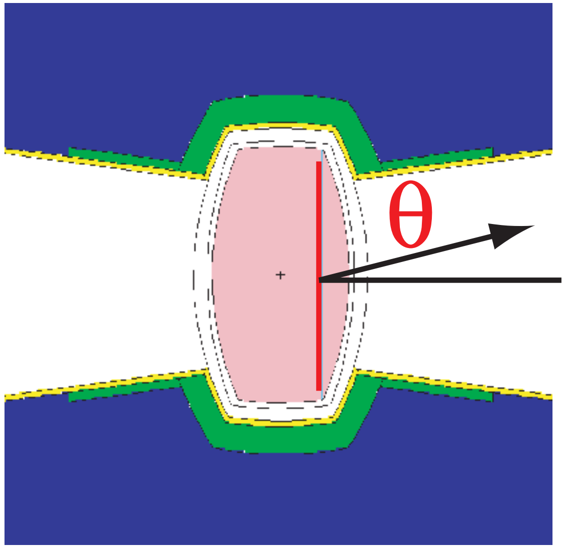
Flux distribution / coupled moderator

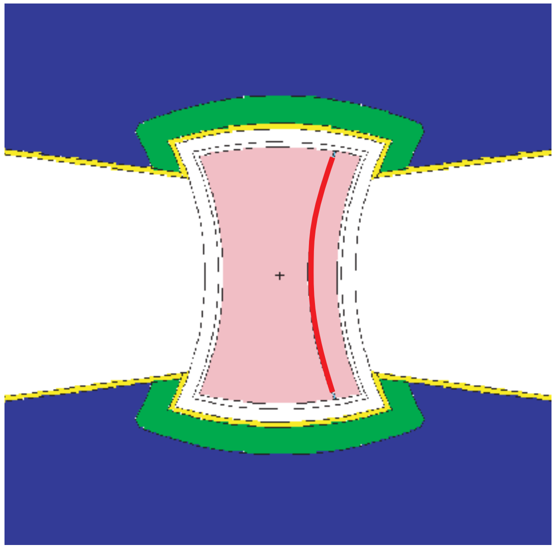
Brighter at edges.
Para-hydrogen is transparent below 14 meV.



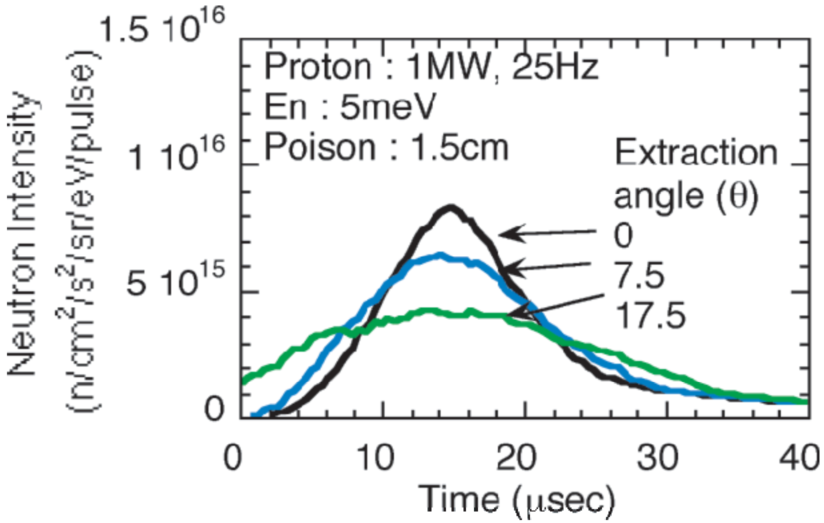
Poisoned moderator

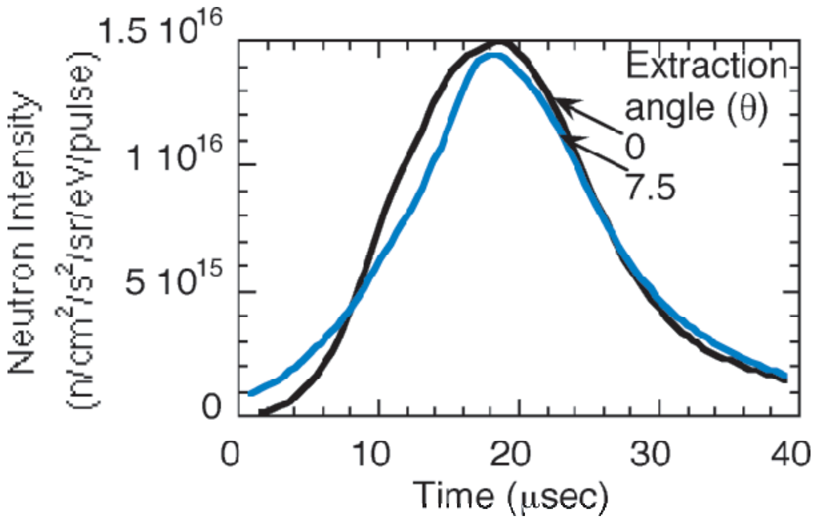
- Poisoned moderator for high resolution experiment.
- Intensity drops rapidly with increasing viewing angle.
  - Also pulse width increases.
- Concave shape one is better, but with engineering difficulties.





Pulse shape

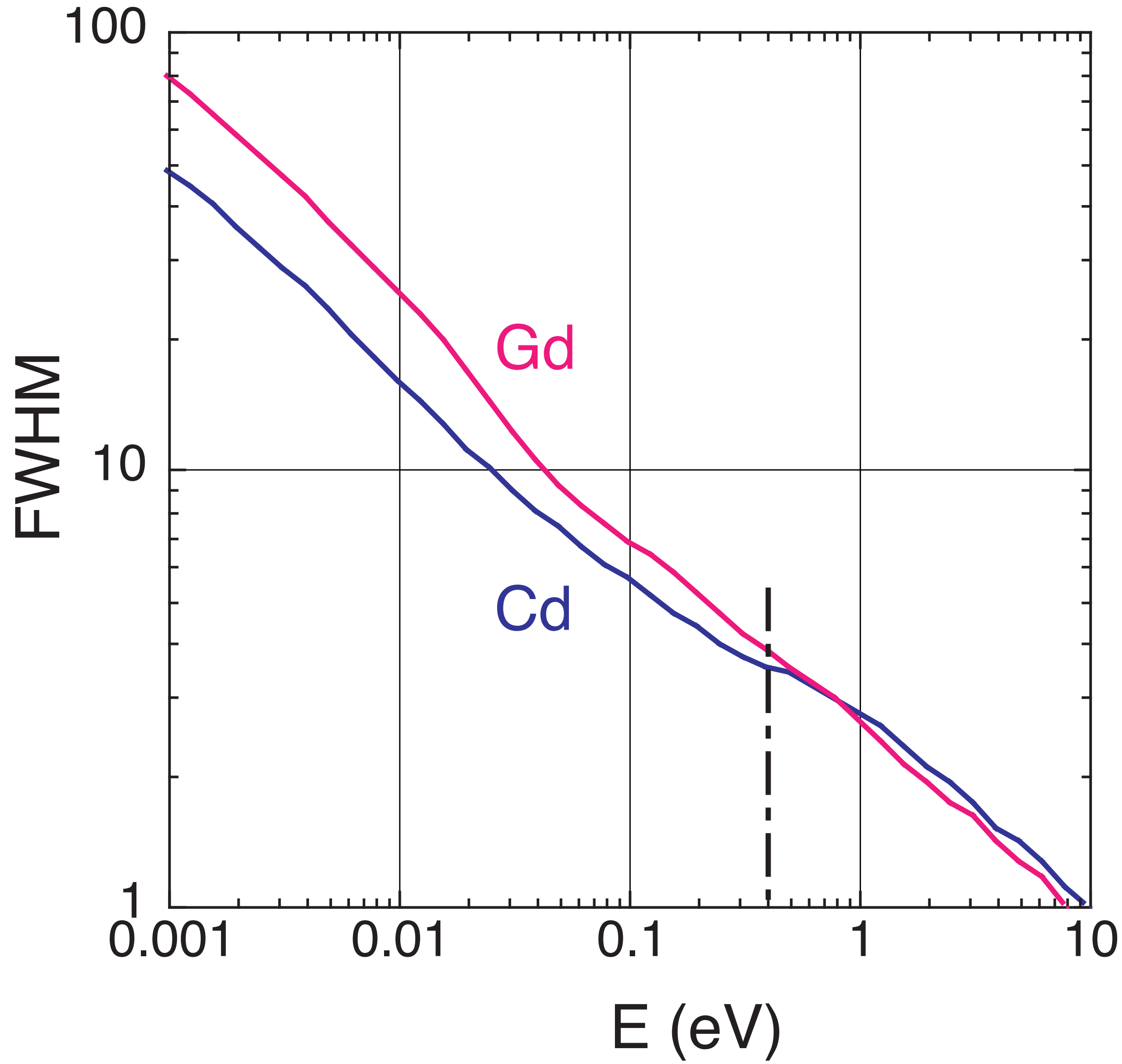




Cd vs. Gd poison

Poison Material Difference

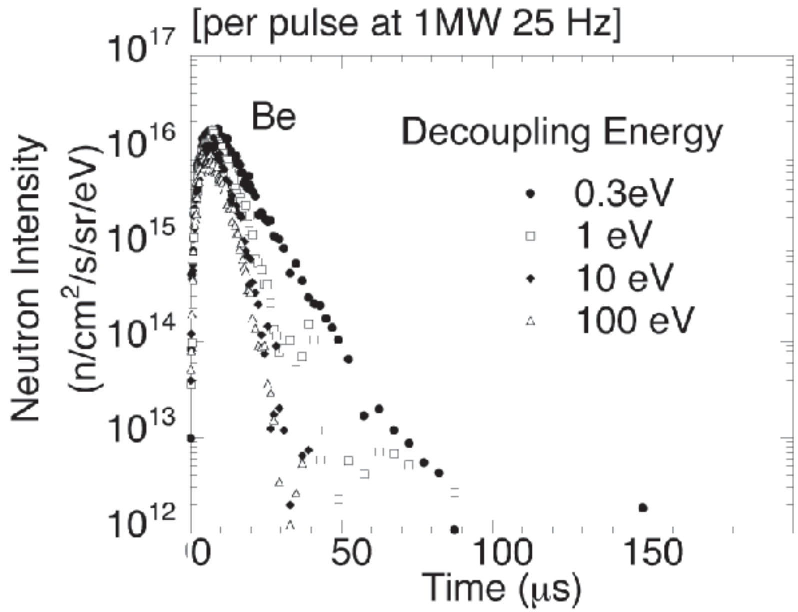
>>> Harada

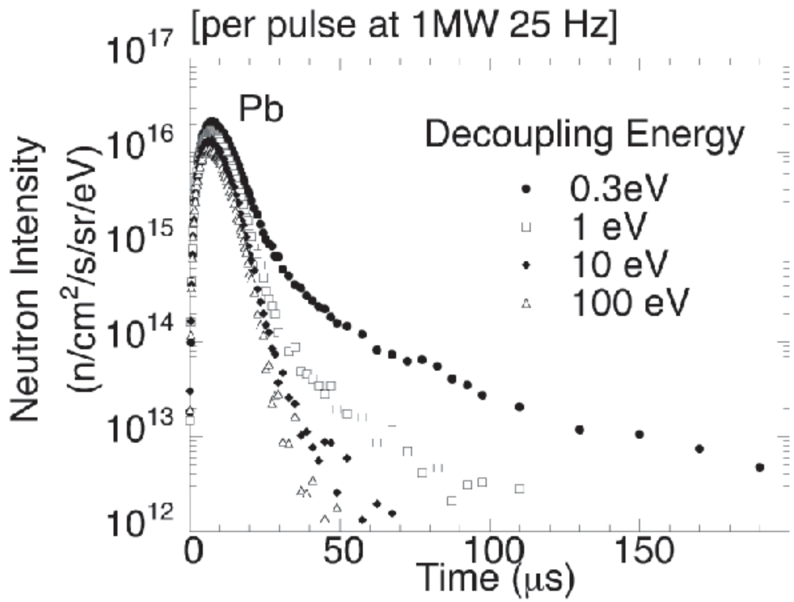


Pulse shape optimization

Decoupled moderator optimization:

- Pb reflector is slightly better, but difficult to use because of heat problem.
- Decoupling energy of 1 eV and above is necessary.
- Ag-In-Cd sheet for decoupler.
- B4C can not be used.

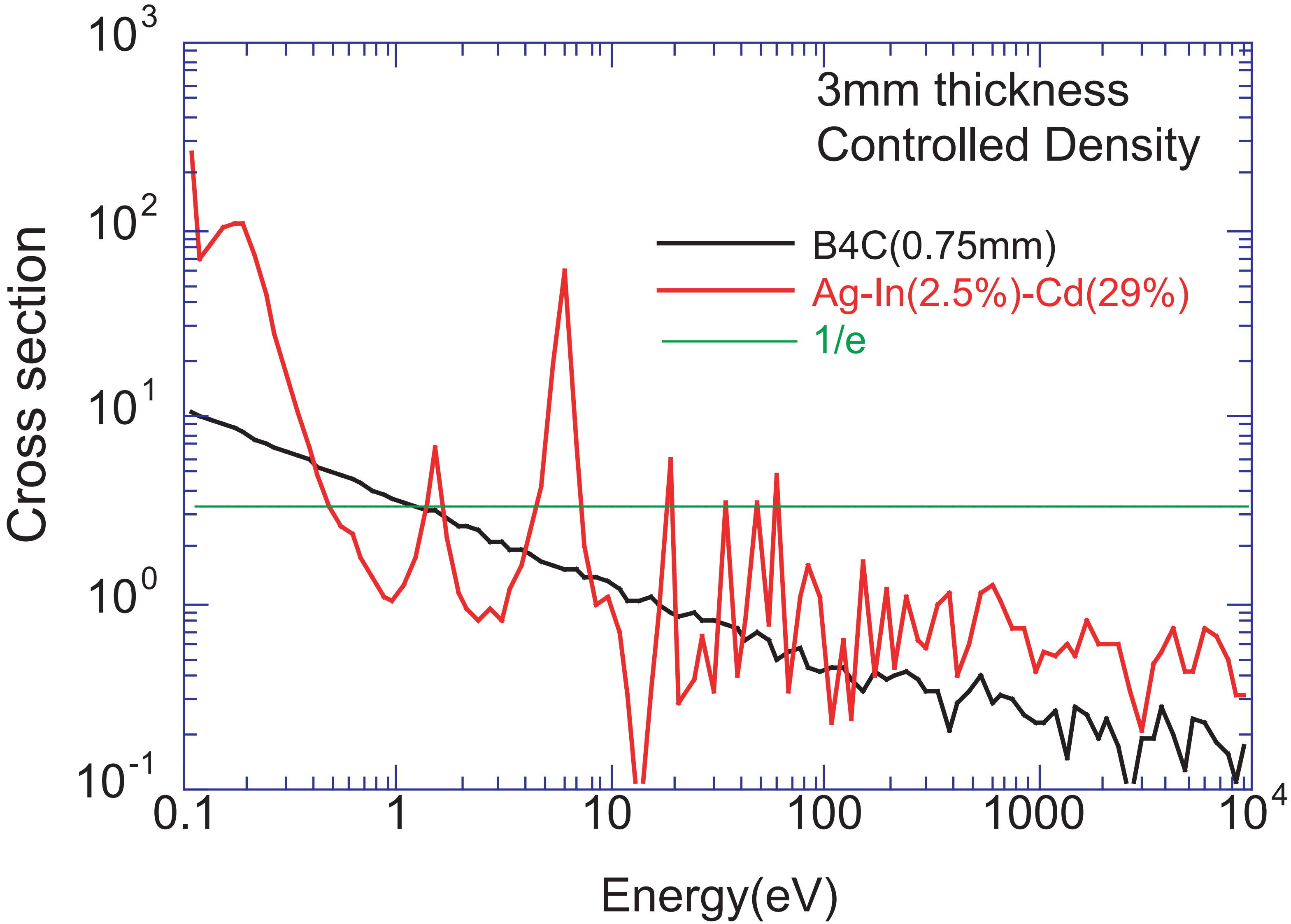




AIC as a decoupler

Cross section of AIC

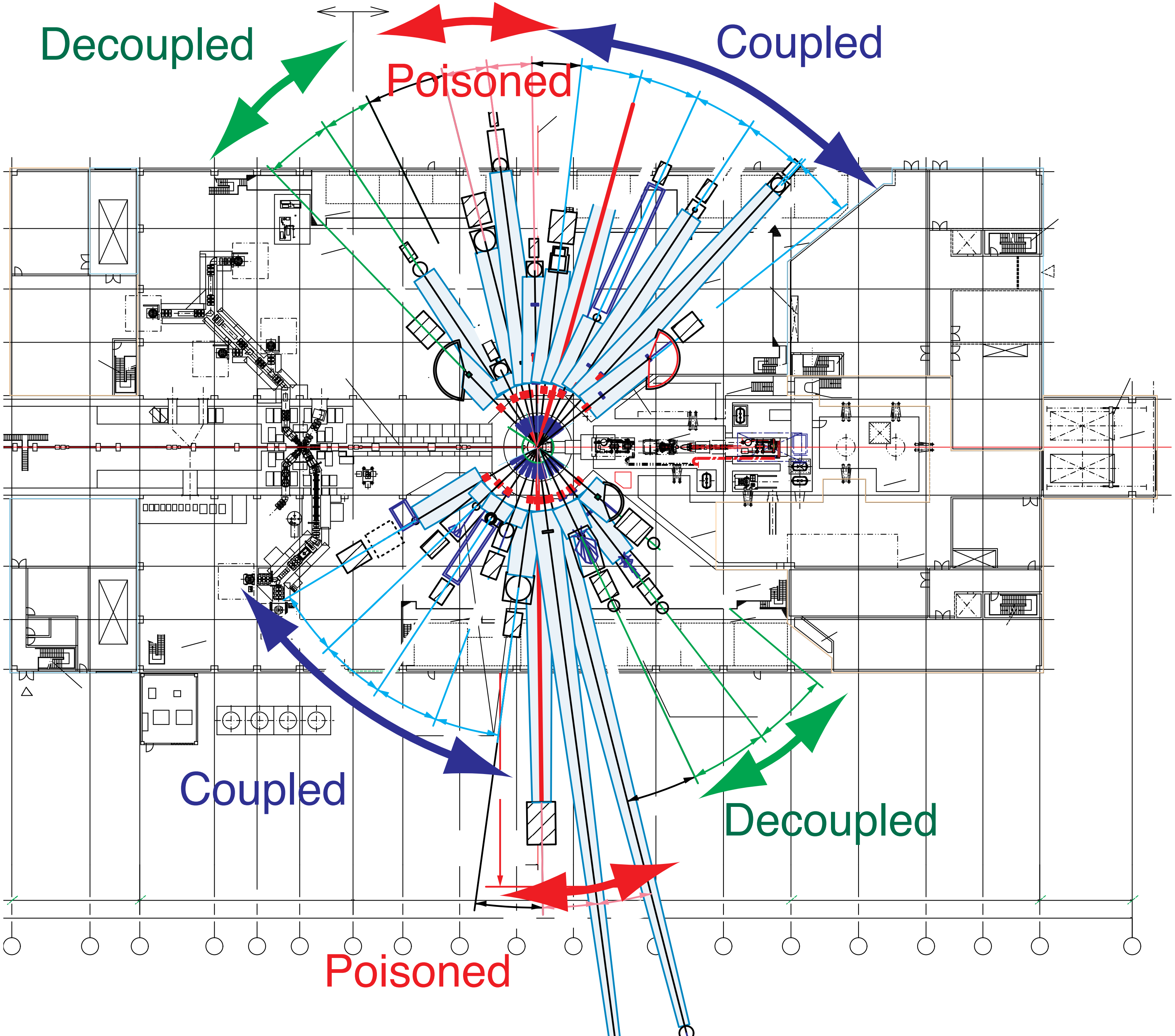
>>> Harada



Preliminary instrument layout

About half of the instruments are viewing at the coupled moderator.

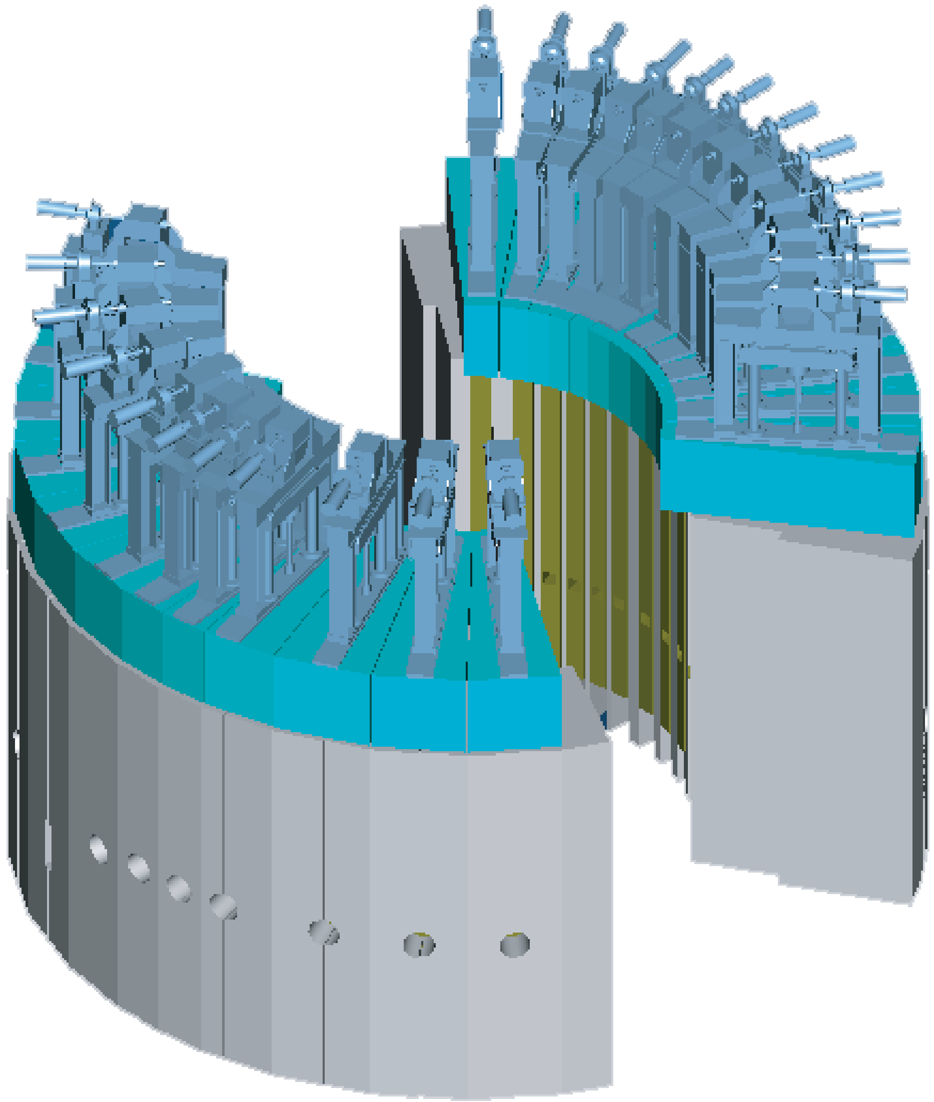
23 + (6) beamlines with individual shutters.



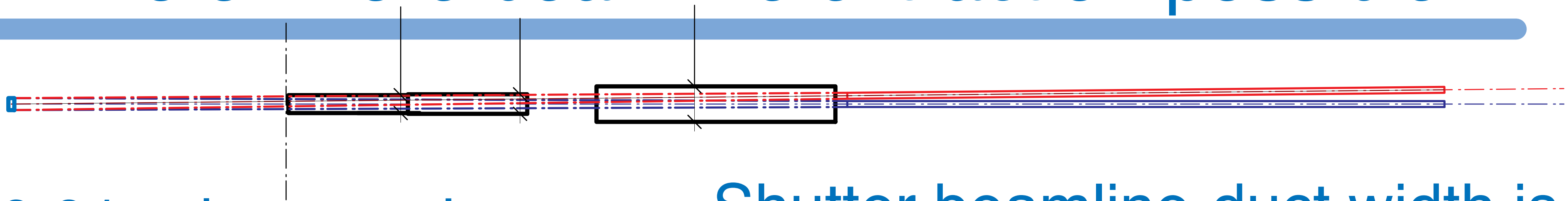
23-individual shutters

– All the same dimensions

– 3-moderators,
  6-face extraction
– 6-banks of shutter drives.
  Angle between the beamline:
  evenly spaced within the bank

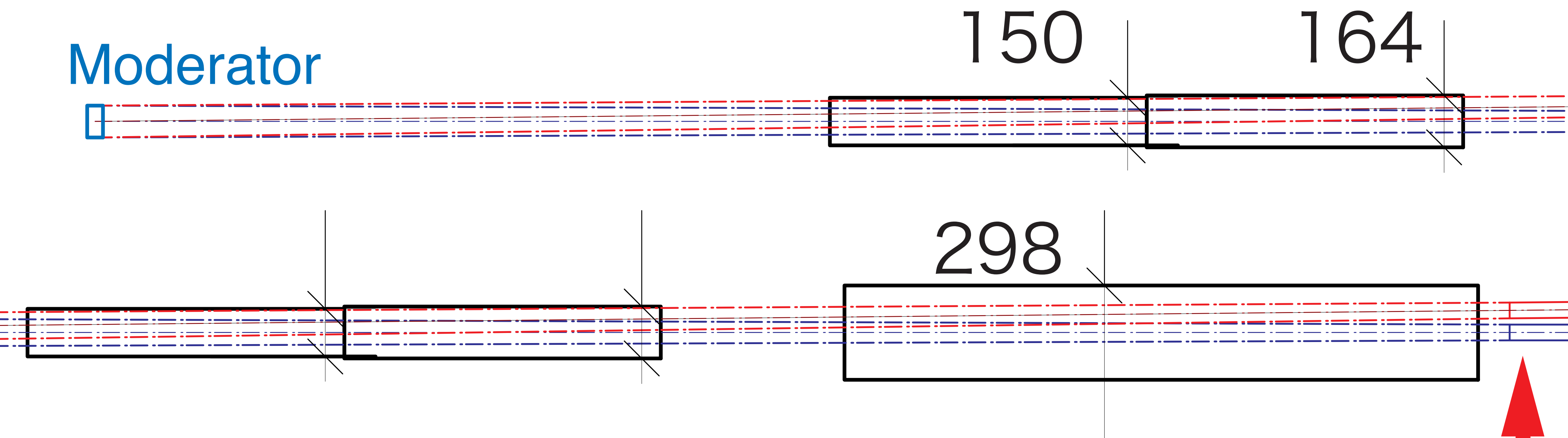


Two or more beamline extraction possible.



±0.01rad separation

– Shutter beamline-duct width is larger for a downstream part



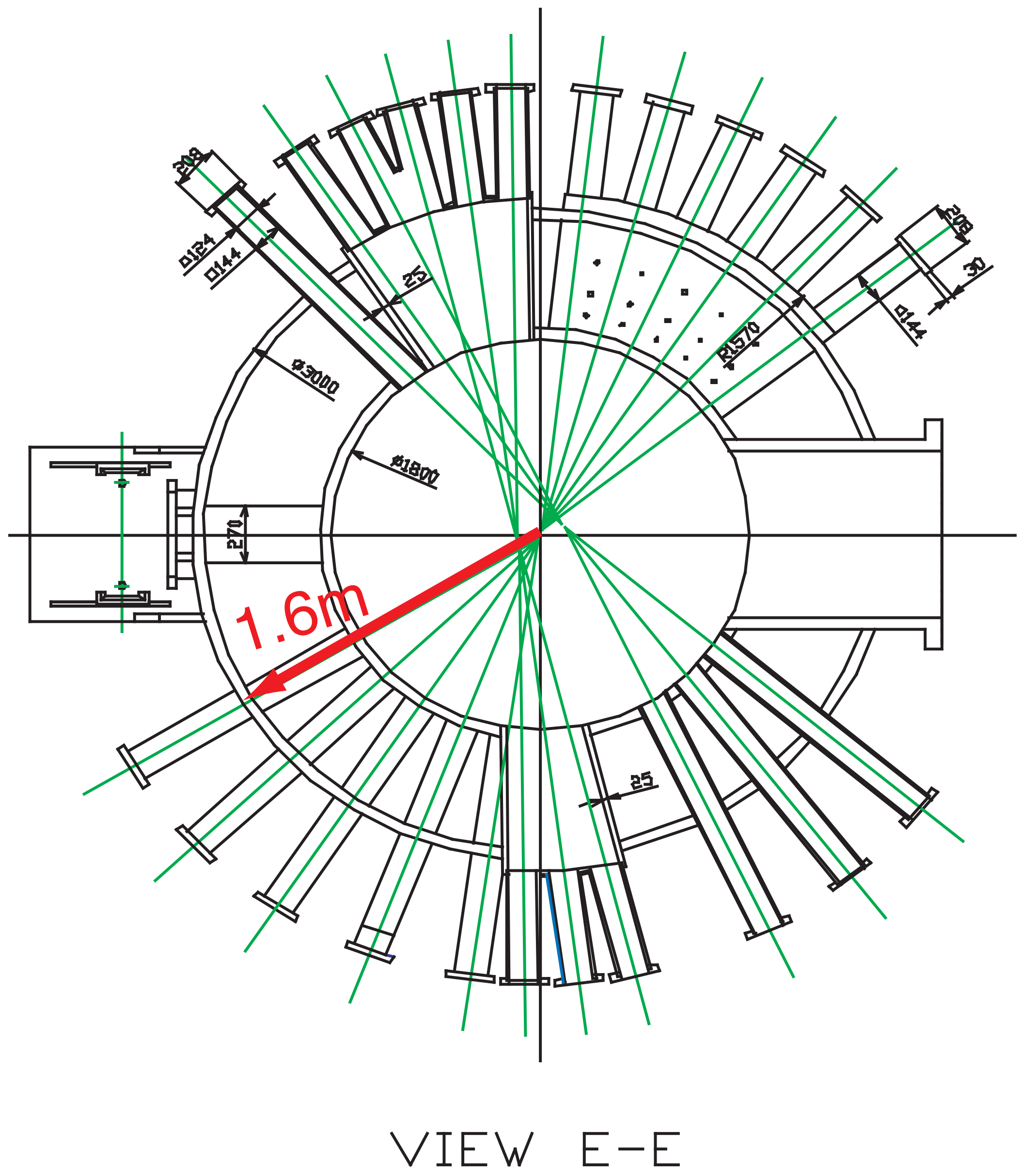
– Separate Guide tubes from outside of the target station

Guide and Collimator Inserts

– Guide Start:
  1.6m from moderator

– Only 4 Instruments
  assumed to have a guide

– Fixed Fe collimators in
  the He vessel for
  horizontal reflectometer

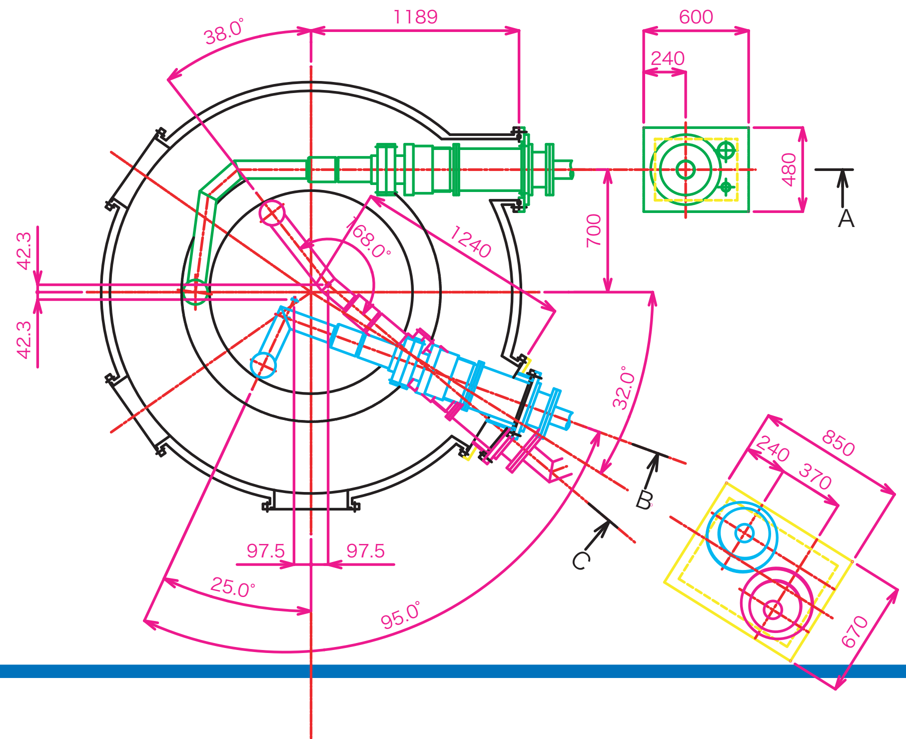


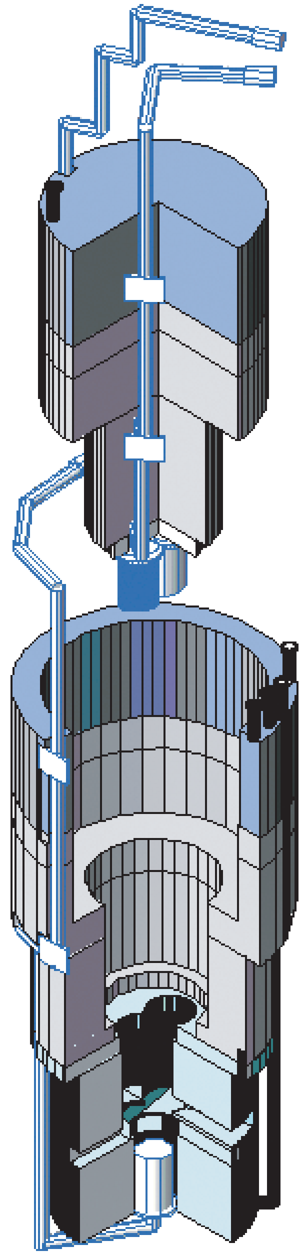
Individual replacement of moderators

>>> Teshigawara

— Couplers for the hydrogen transfer-lines

- above the reflector plugs
- Hands-on disconnection





Summary

– 1 MW at 25Hz result in high peak-intensity
– Only 3-supercritical hydrogen moderators.
– 100% para-hydrogen assumed
– Stress on a coupled moderator
– Choice of AIC decoupler & Cd poison
– 23 beamlines
– Possibility of two or more beam-extraction from 1 shutter.
– Individual replacement of moderator