

POLARIZED NEUTRONS AT J-PARC

REPORTED BY K. HIROTA (ISSP, UNIV. TOKYO)

ACKNOWLEDGMENT:

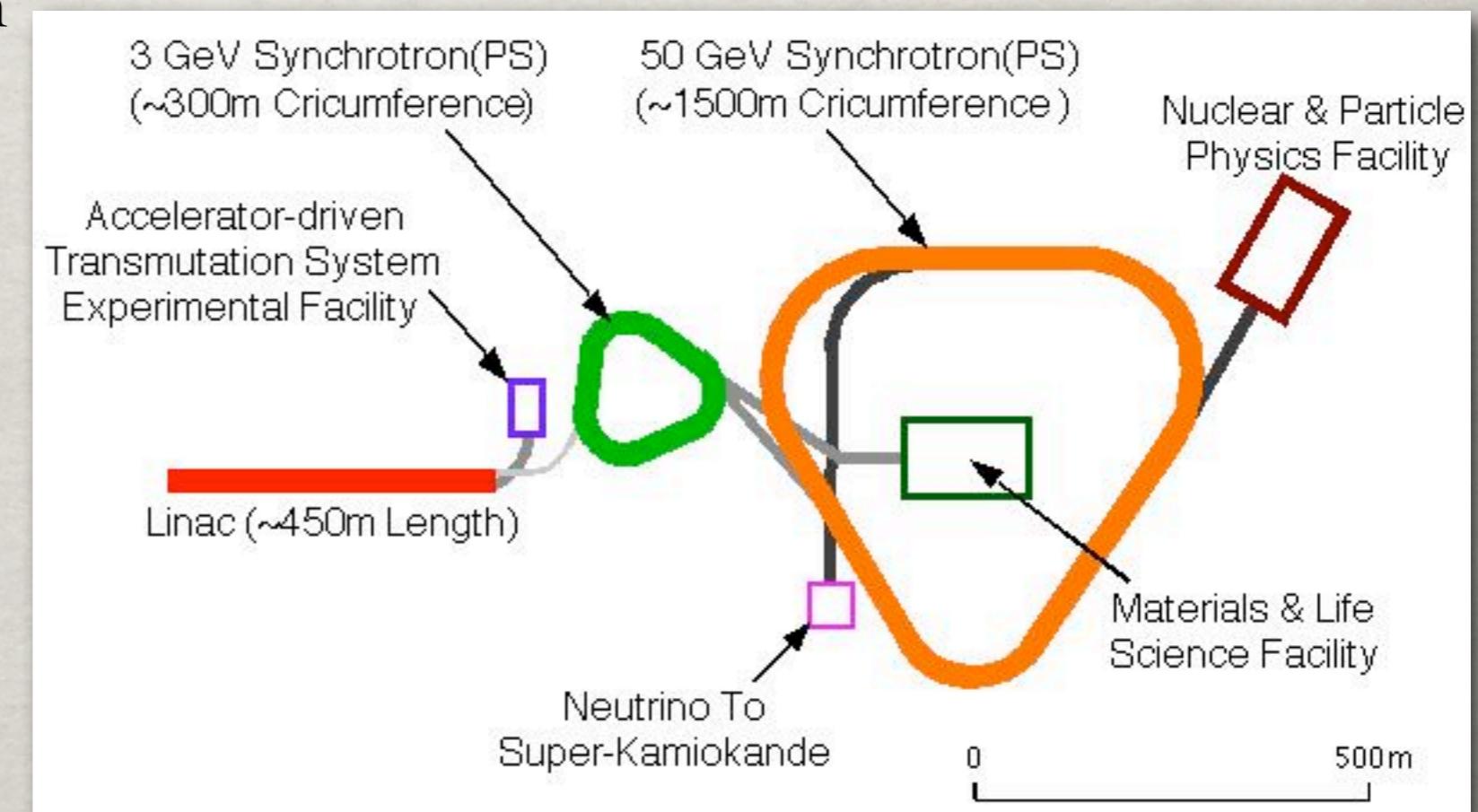
M.ARAI, *M.HINO, †T.INO, †S.ITOH, R.KAJIMOTO,
*Y.KAWABATA, K.NAKAJIMA, M.NAKAMURA, ‡H.SETO,
†H.M.SHIMIZU AND THEIR COLLABORATORS

(JAEA, *KUR, †KEK, ‡KYOTO U.)

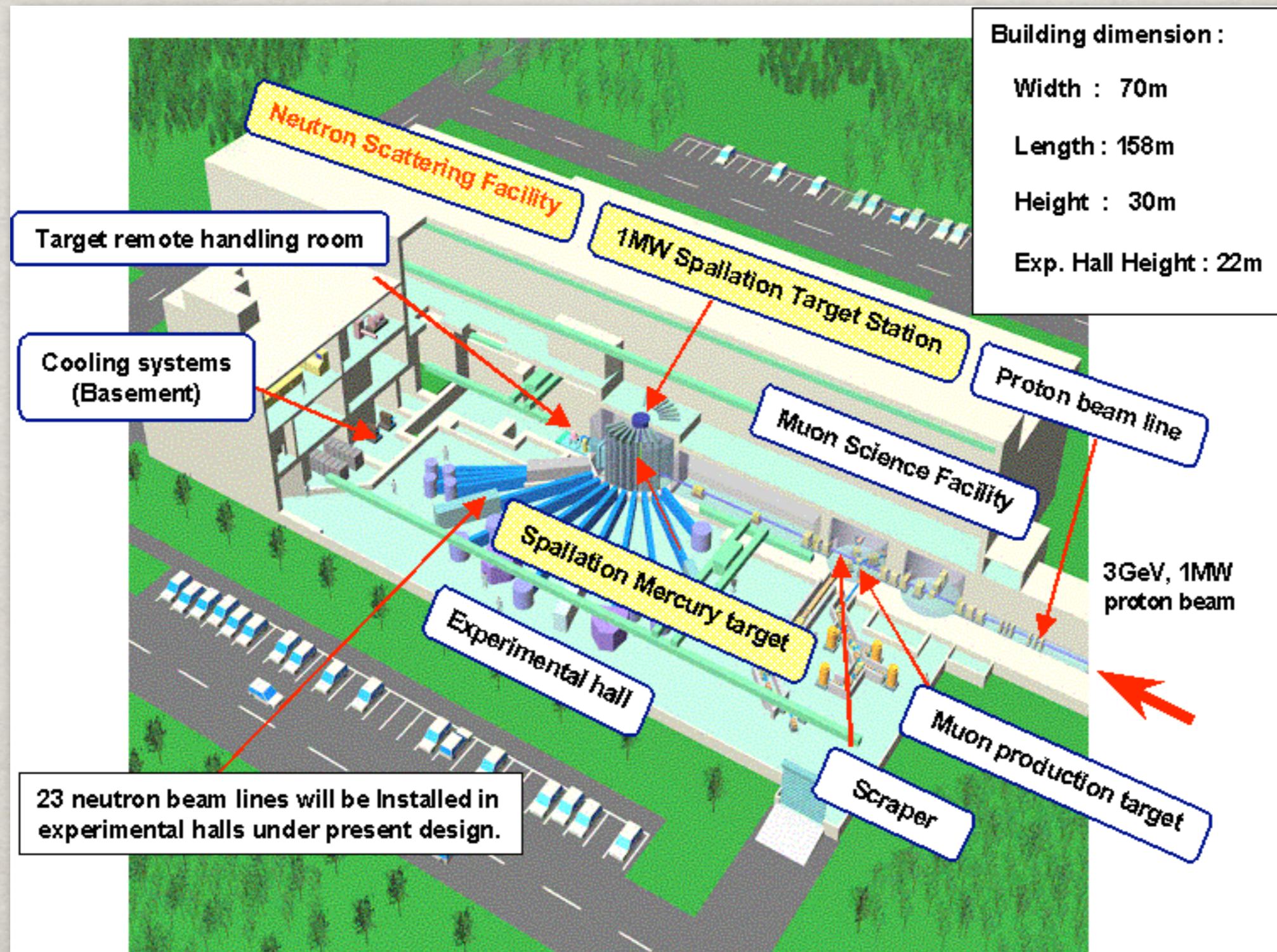
WHAT IS J-PARC?



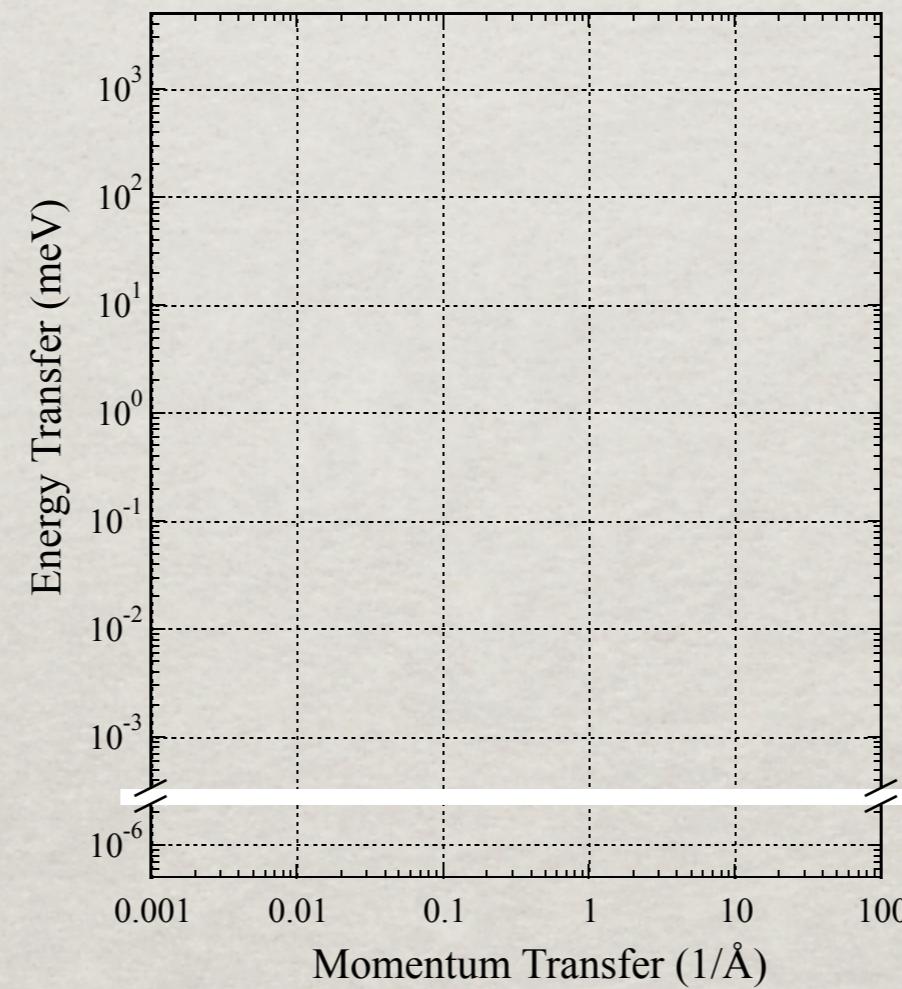
- ✿ Japan Proton Accelerator Research Complex
- ✿ Nuclear & Particle Physics
- ✿ Materials & Life Science
- ✿ Transmutation
- ✿ Acceleratoer



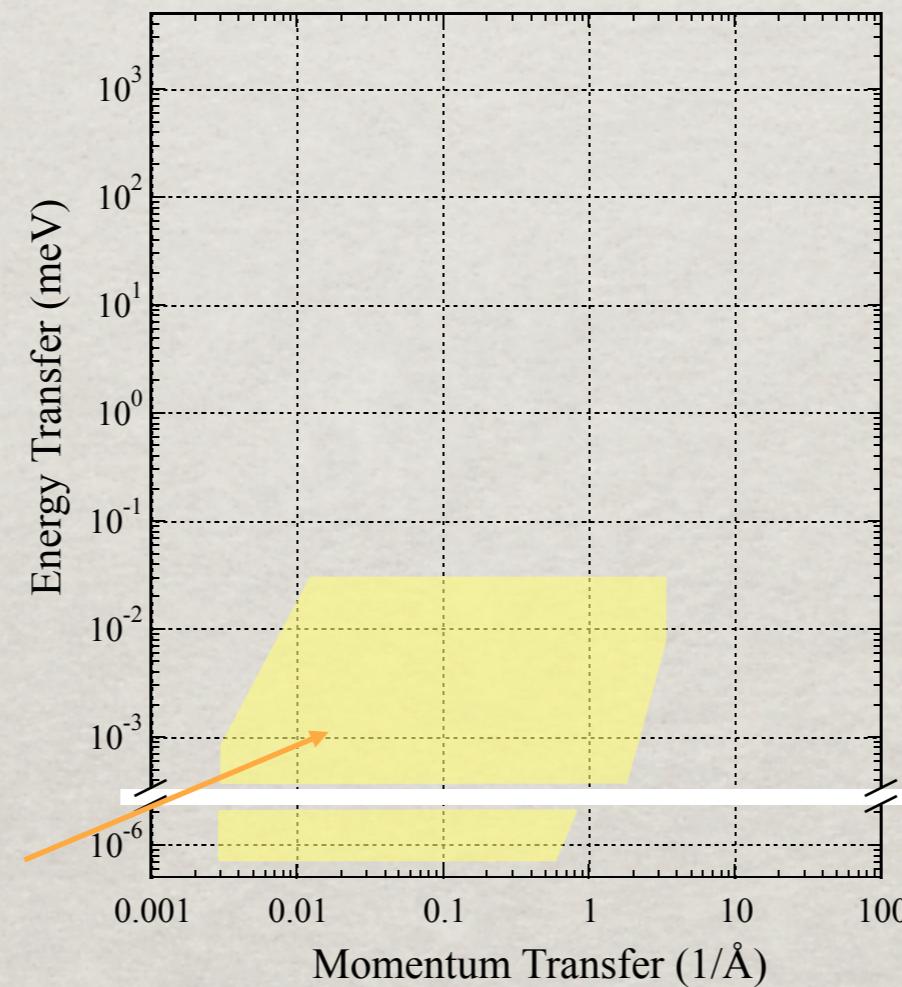
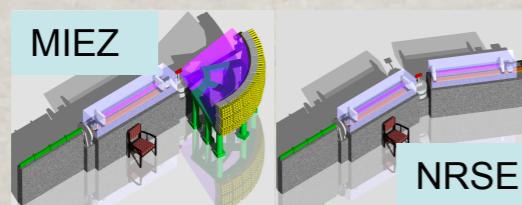
NEUTRONS AT J-PARC



SPECTROMETERS IN 2008

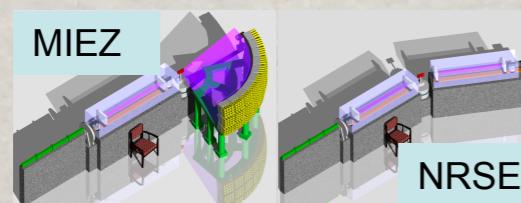


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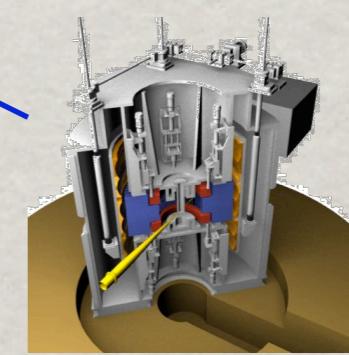
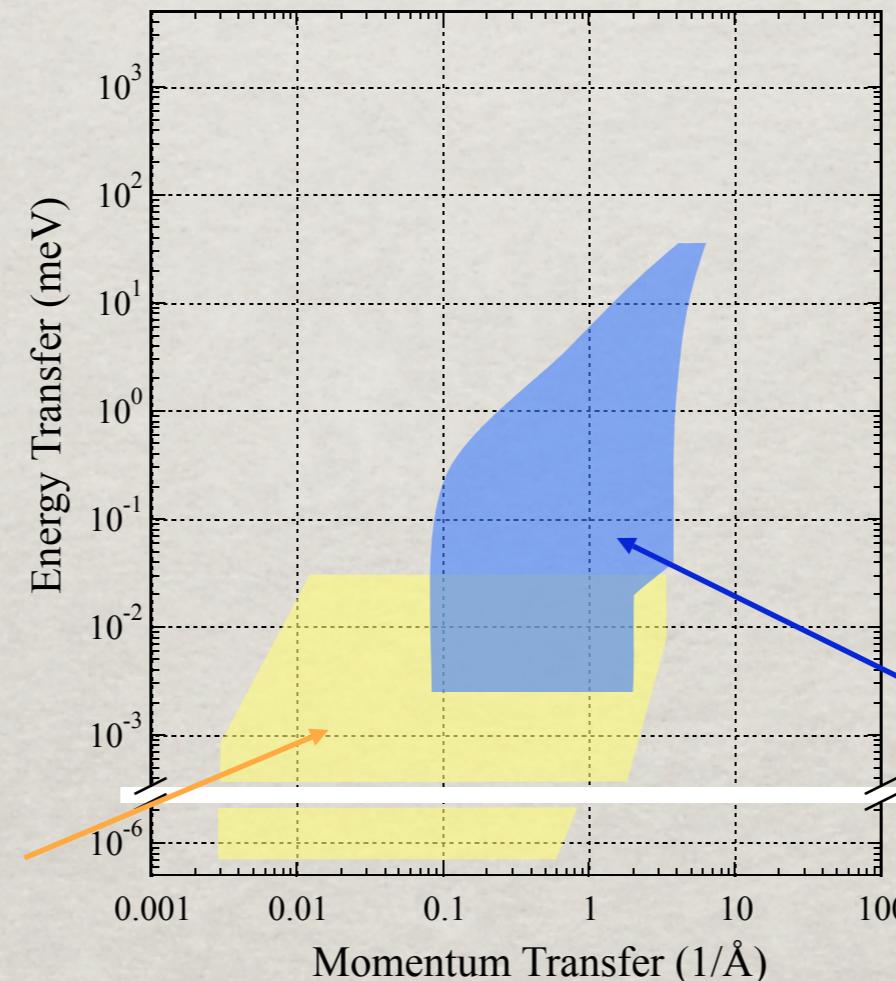


Spin Echo
 $E = 7 \times 10^{-7} - 0.03 \text{ meV}$
 $\Delta E/E = 10 \%$

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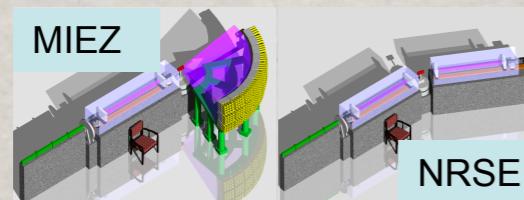
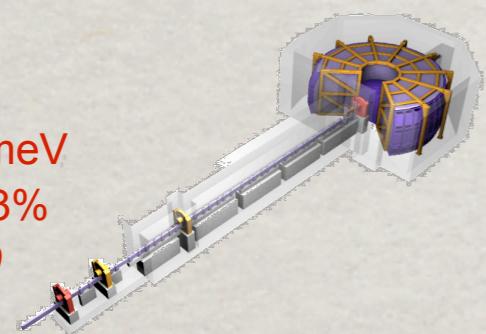
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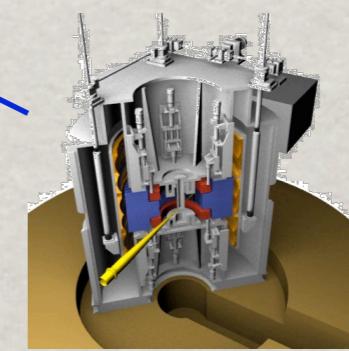
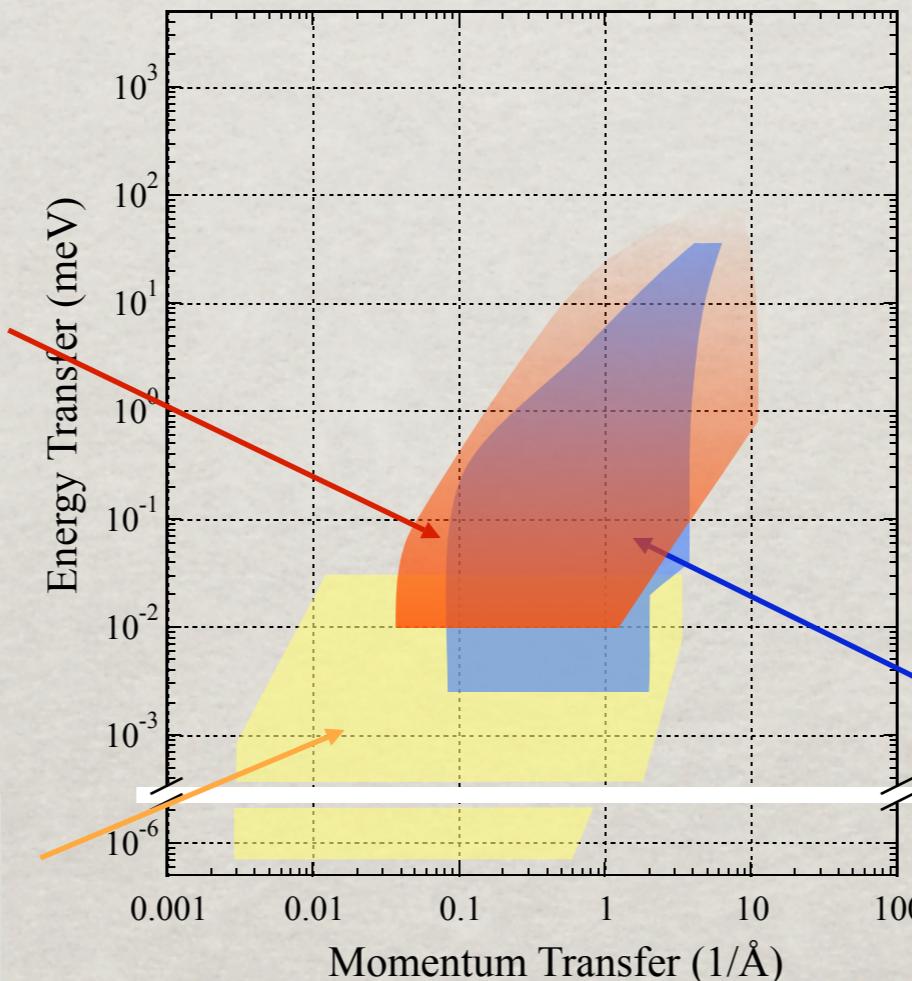
DIANA
 $E = 0.02 - 35 \text{ meV}$
 $\Delta E/E_f = 0.15 - 0.75\%$
IRIS x24

SPECTROMETERS IN 2008

CNDCS
 $E_i = 1\text{-}80 \text{ meV}$
 $\Delta E/E_i = 1\text{-}3\%$
 $MAPS \times 10$



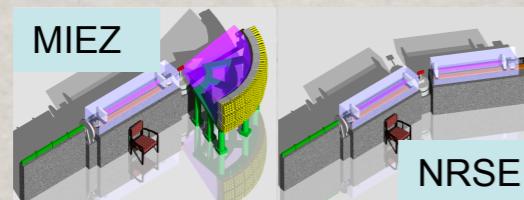
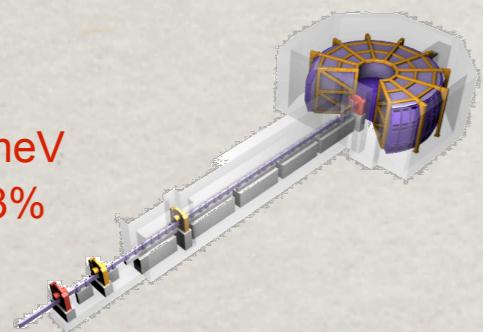
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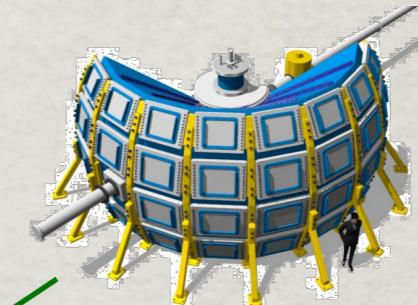
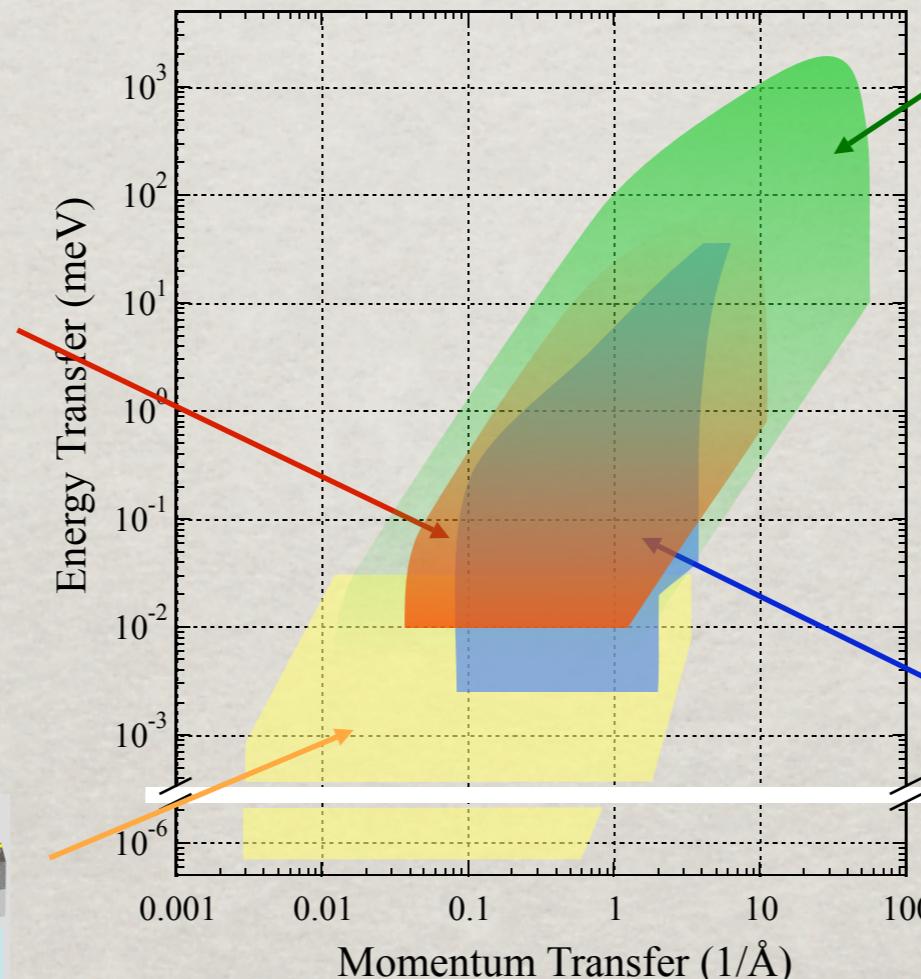
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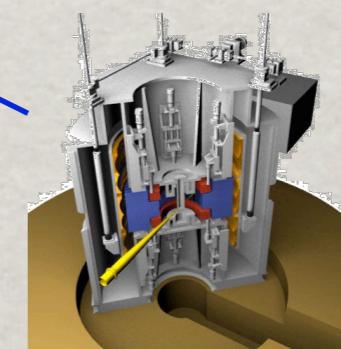
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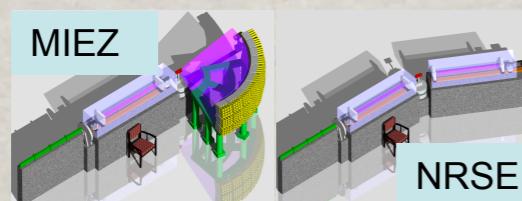
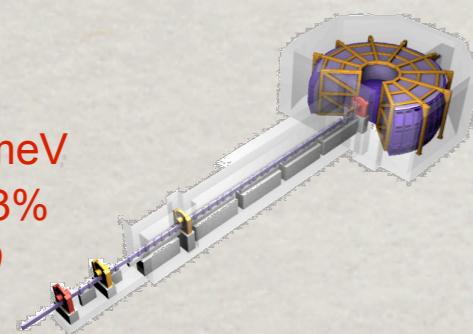
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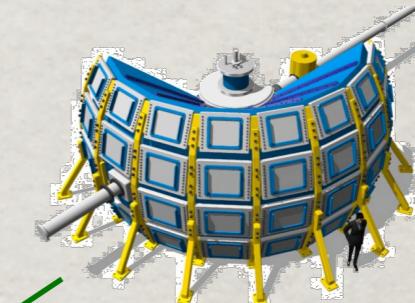
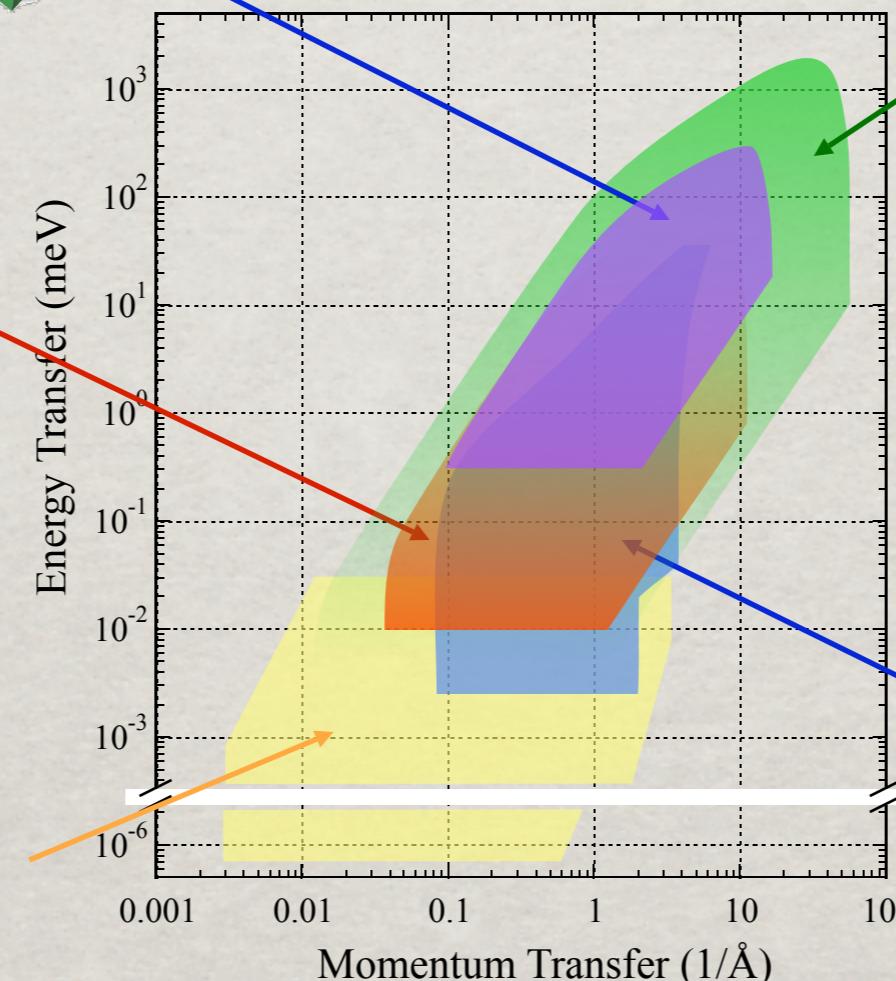
4SEASONS
 $E_i = 5\text{-}300 \text{ meV}$
 $\Delta E/E_i = 6\%$
 $\text{MAPS } \times 100$



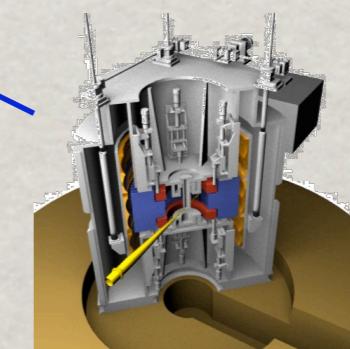
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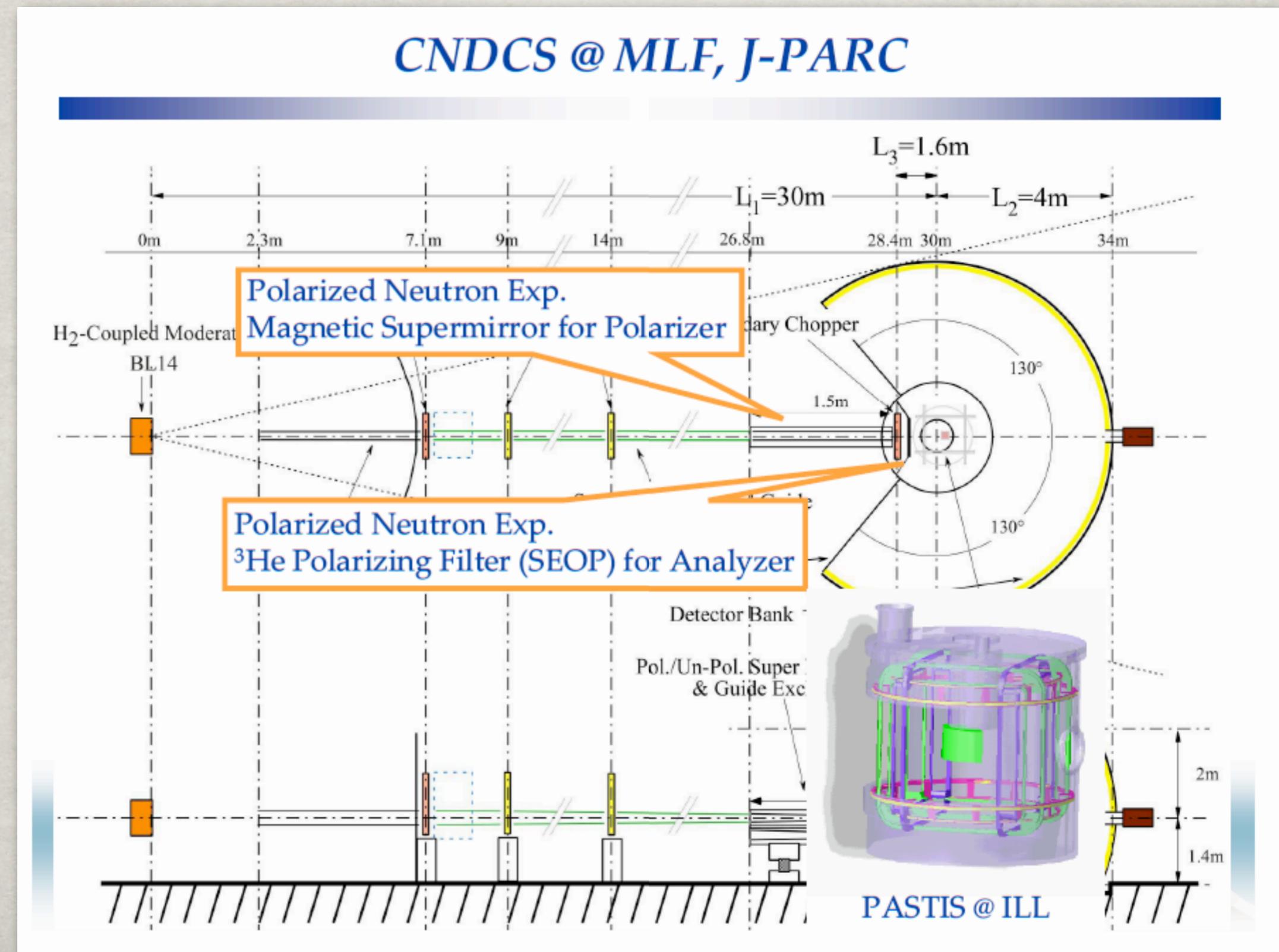
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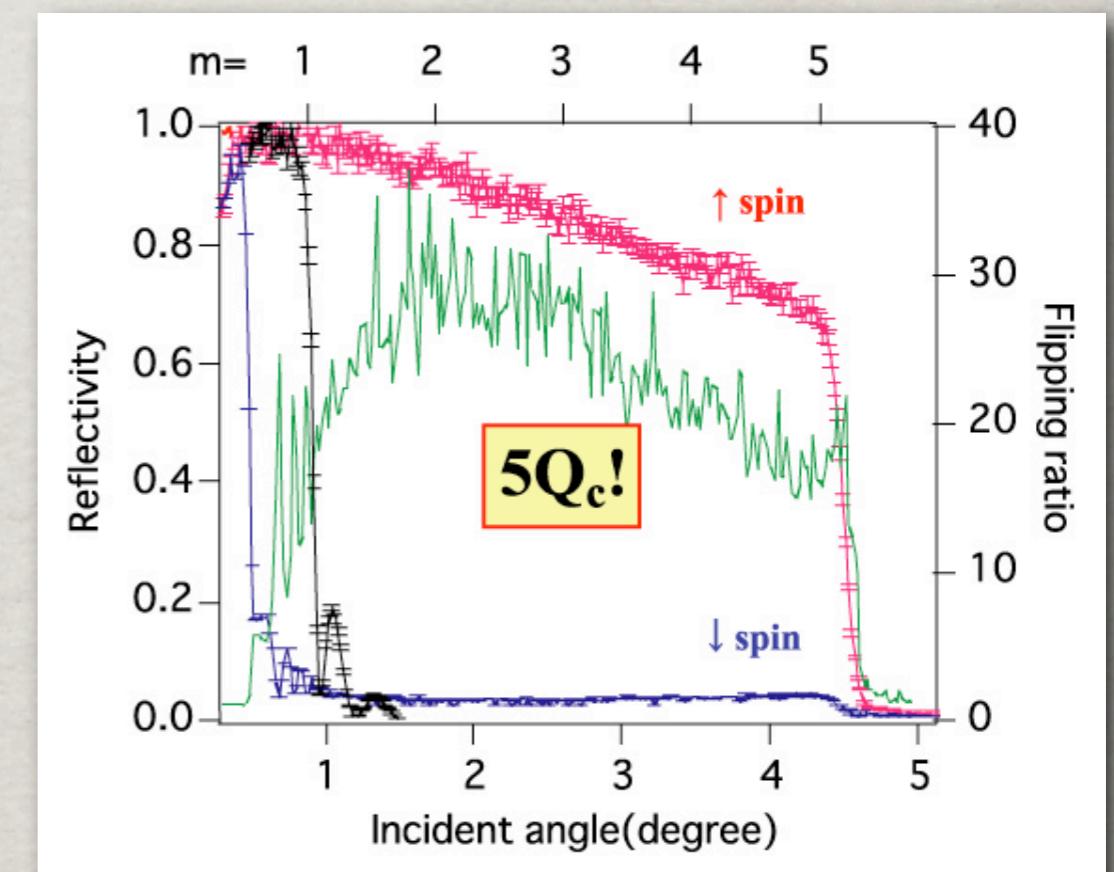
POLARIZATION DEVICES FOR CHOPPER SPECTROMETERS

CNDCS @ MLF, J-PARC



MAGNETIC SUPERMIRROR

- ✿ Developed by NOP for KUR
- ✿ $m=5$ Fe/Ge (3750 layers)
- ✿ deoxidized Fe
- ✿ 45mT
- ✿ $R > 0.67$
- ✿ Flipping Ratio ~ 20
- ✿ $\lambda_i = 0.88$ nm (2.7% FWHM)



^3He FILTER

- ✿ Spin-dependent Cross Section
 - ✿ ^3He : $\sigma_{\uparrow\downarrow} \approx 10000\text{b}$, $\sigma_{\uparrow\uparrow} \approx 0$ vs. ^1H : $\sigma_{\uparrow\downarrow}/\sigma_{\uparrow\uparrow} \approx 20$
- ✿ SEOP method (Spin Exchange Optical Pumping)
 - ✿ **Optical Pumping** by circularly polarized light
 - ✿ Rb atomic polarization
 - ✿ ^3He polarization through **Spin Exchange**

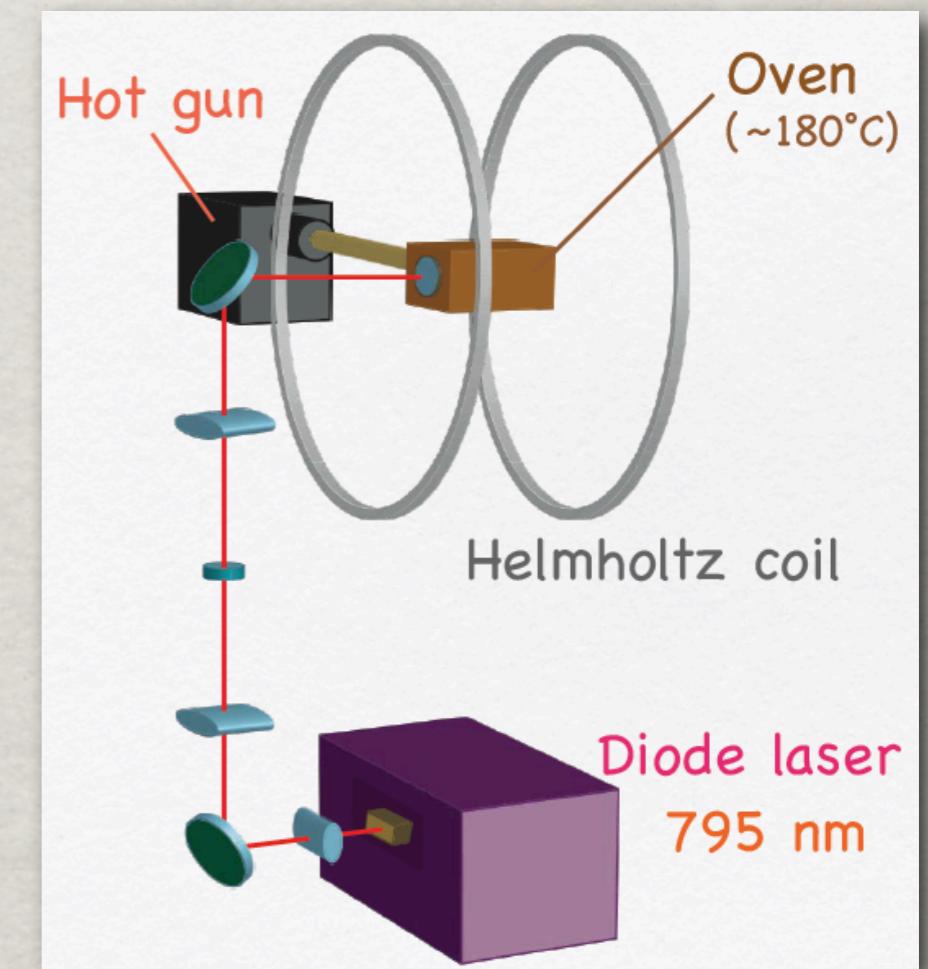
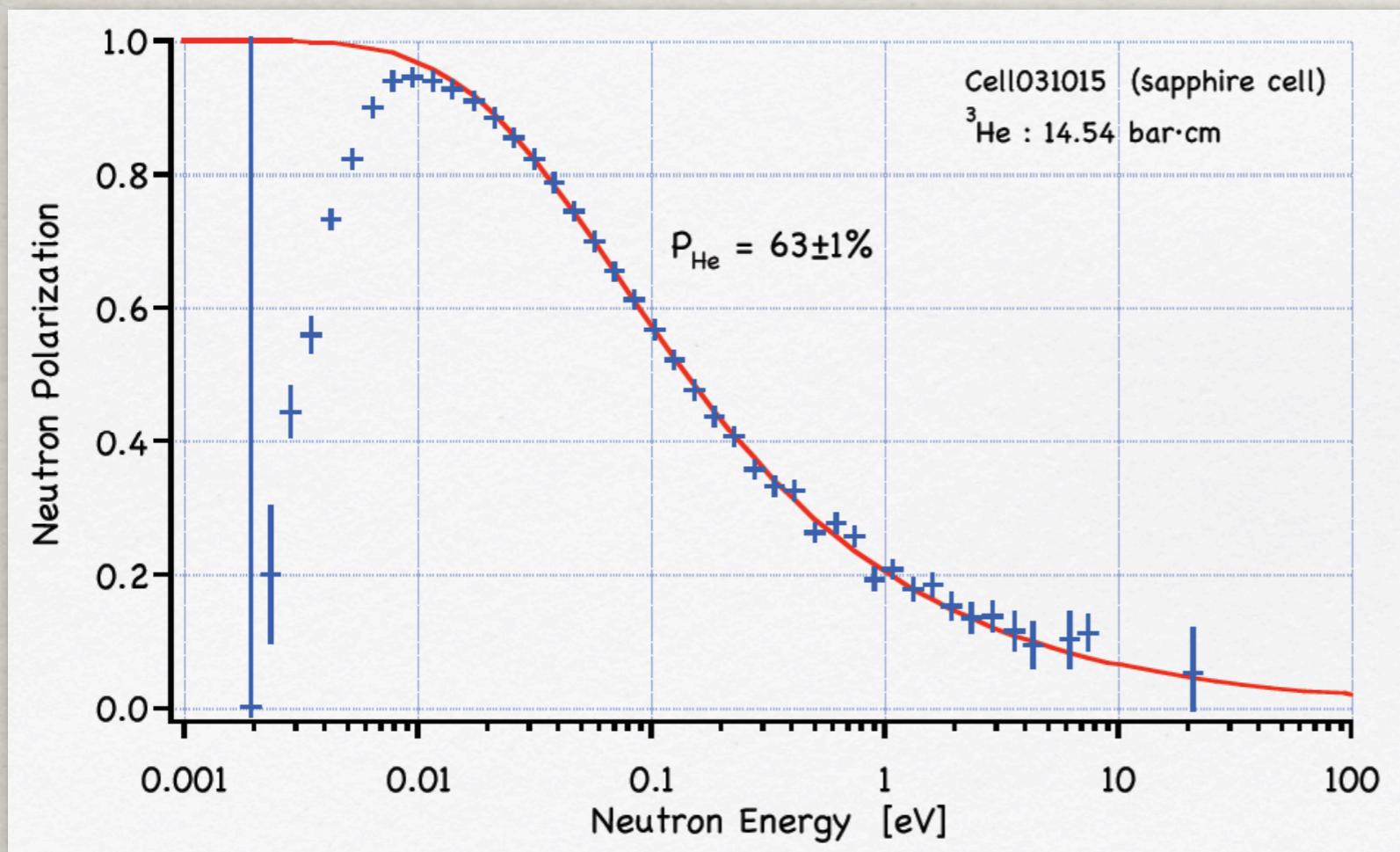
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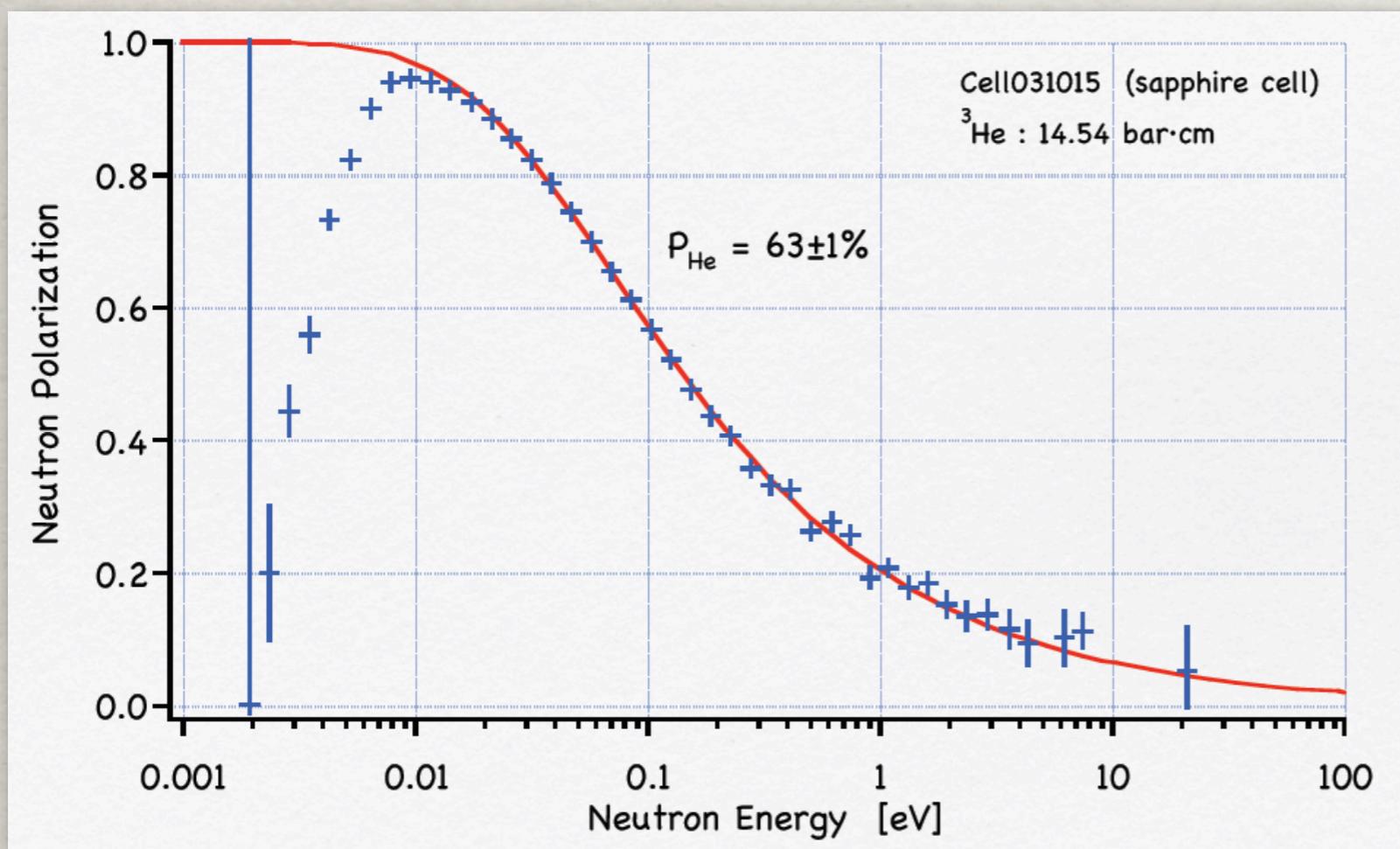
^3He FILTER

- Research and Development at KEK and JAEA



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SPIN ECHO AT J-PARC

- ✿ Complex and collective phenomena in nano-scale
 - ✿ $1 \sim 100$ nm
 - ✿ $10^{-12} \sim 10^{-4}$ s

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J-PARC

JRR-3

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J-PARC	JRR-3
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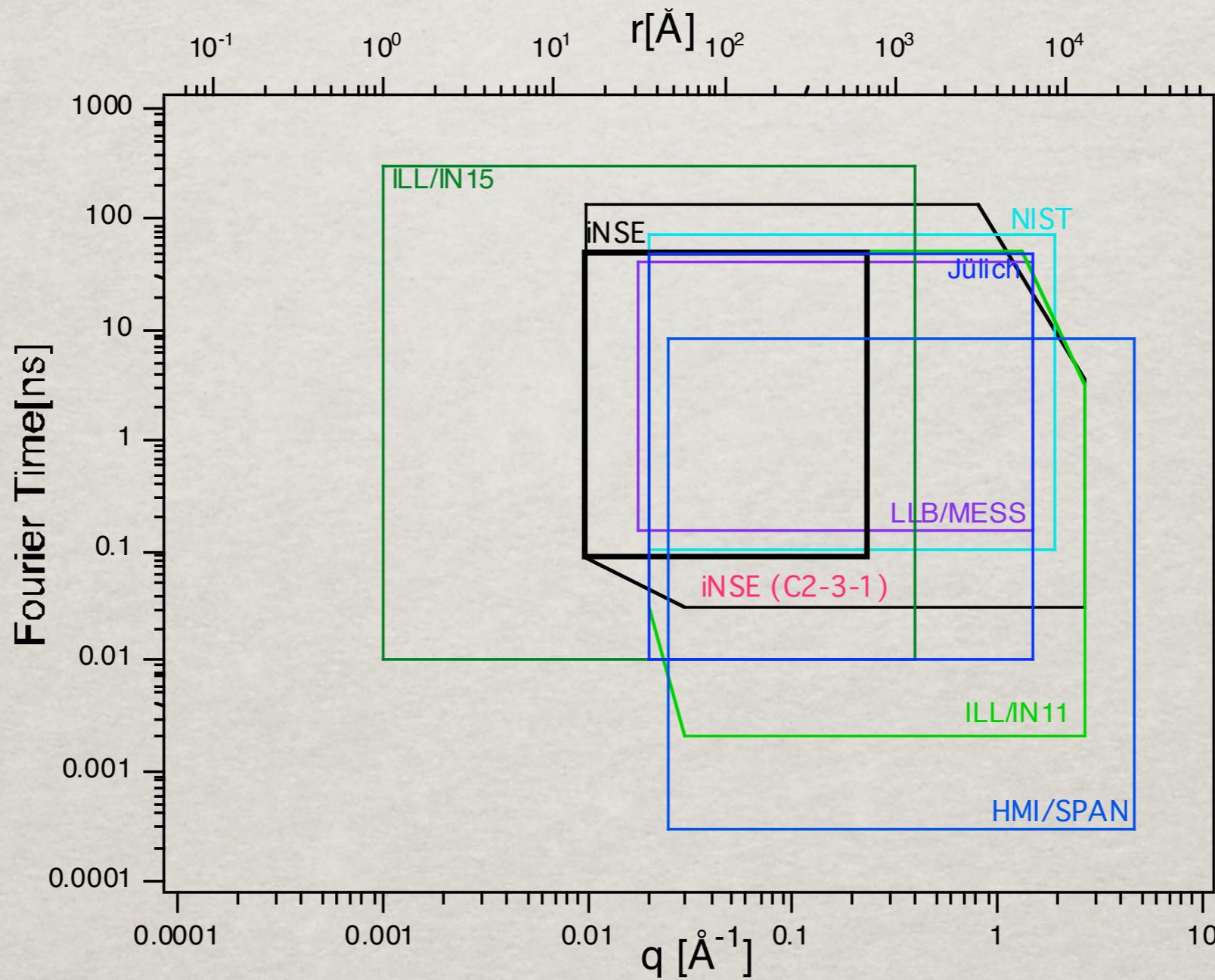
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SPIN ECHO AT J-PARC

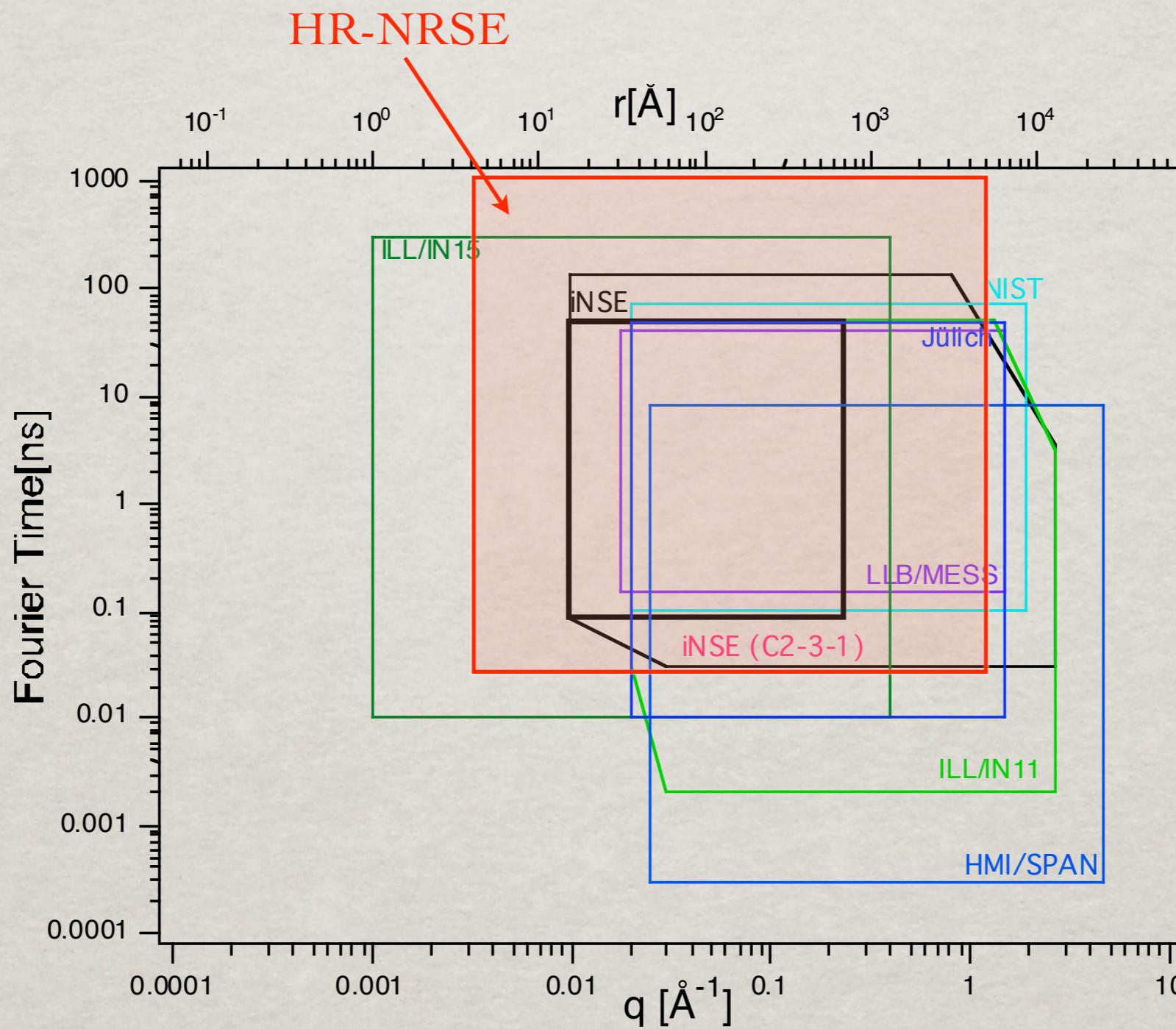
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Overviewing	Extreme conditions

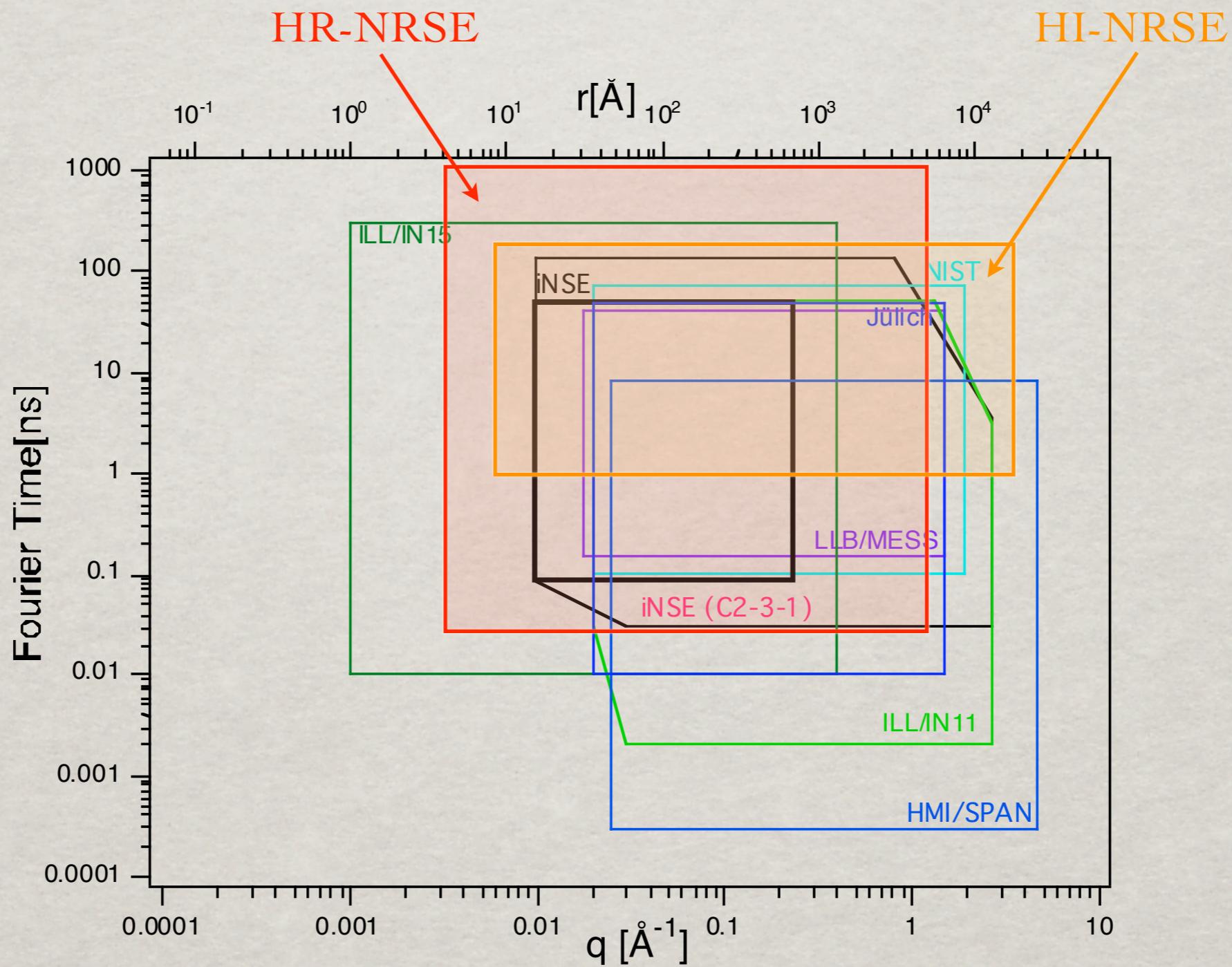
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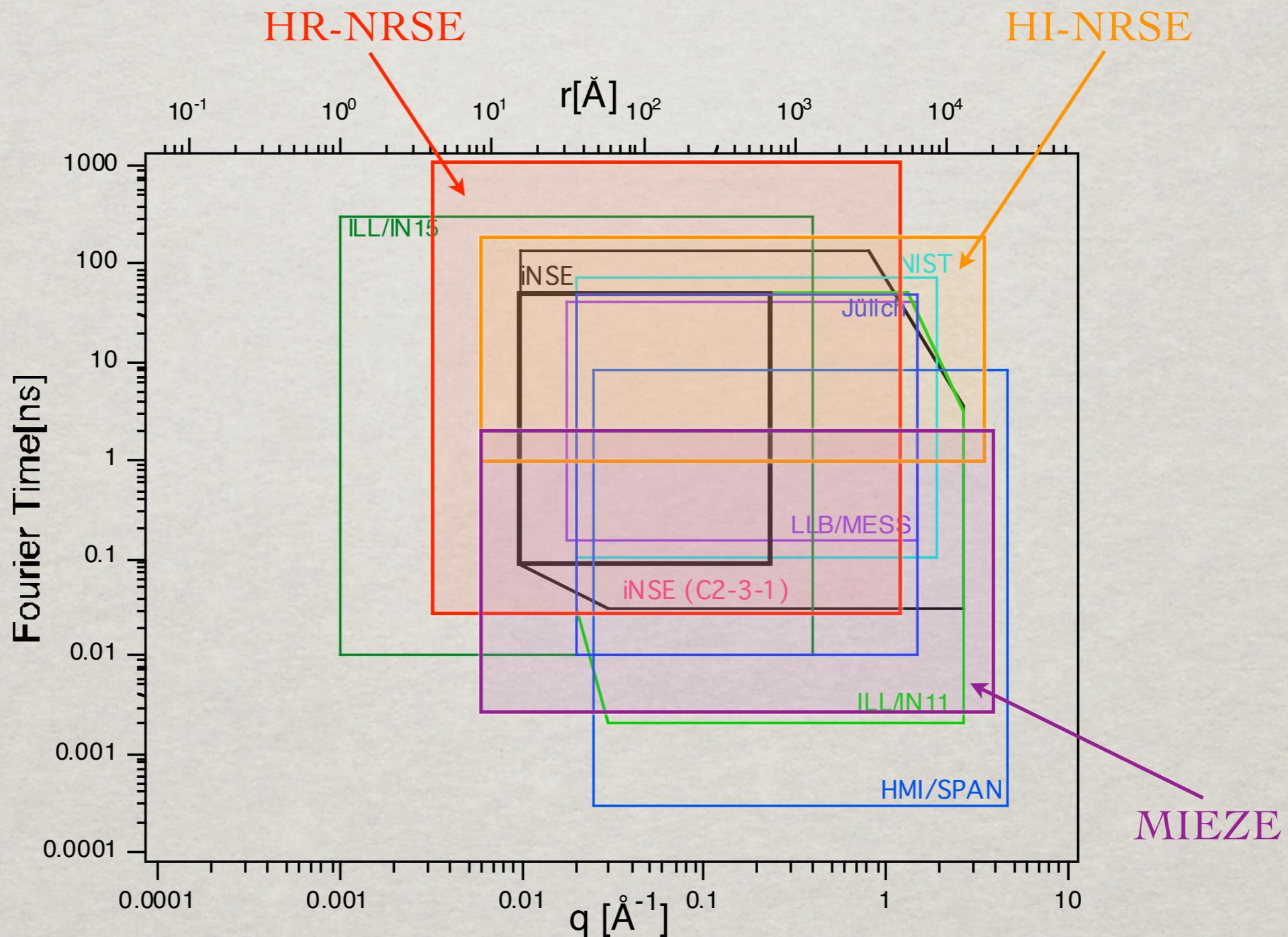
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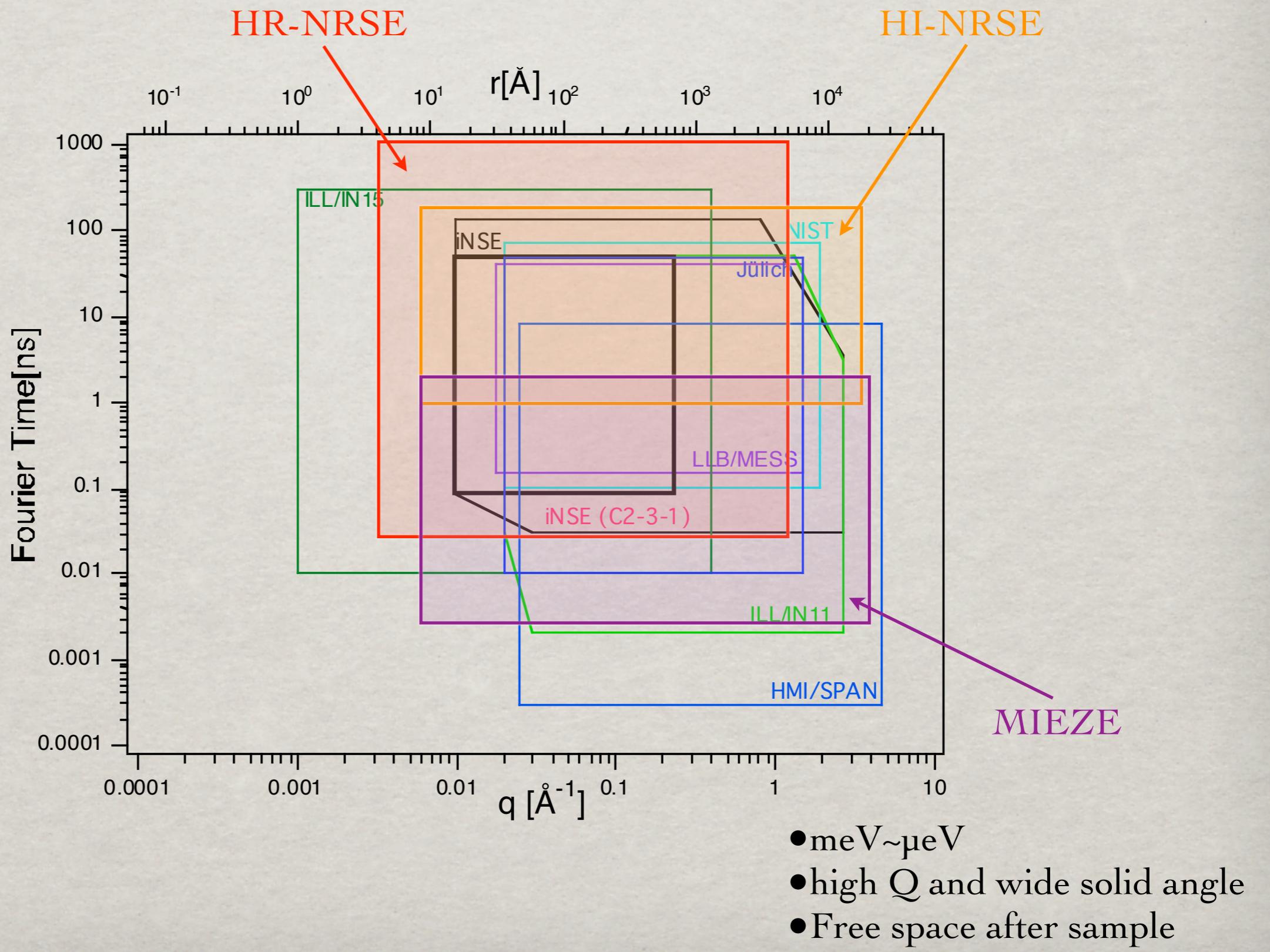
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NEUTRON OPTICS

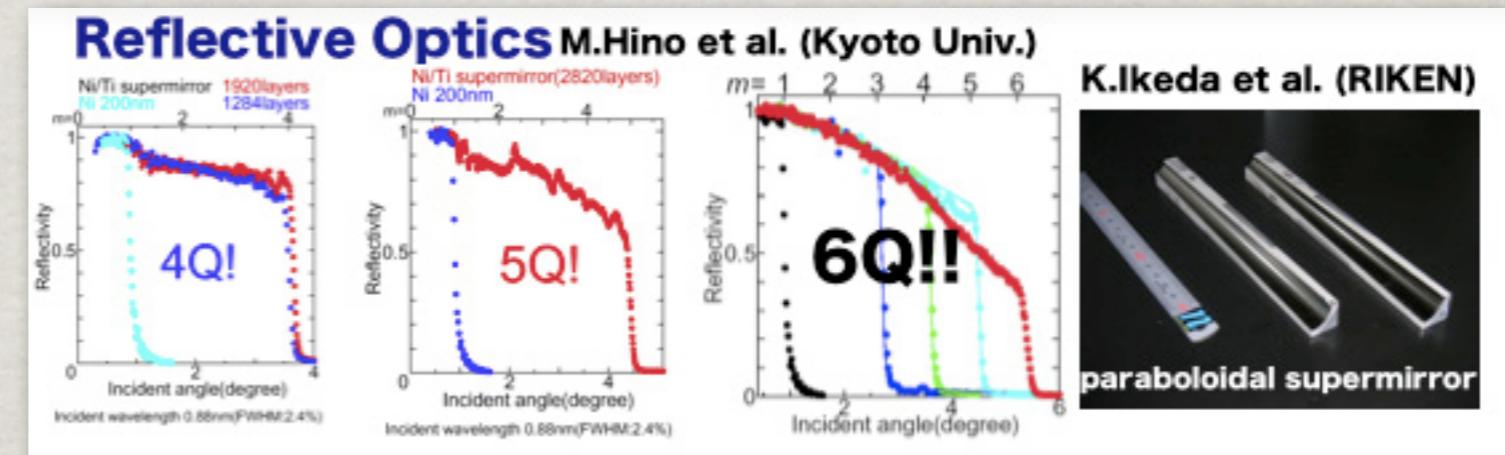


- ❖ Device Level Achievement

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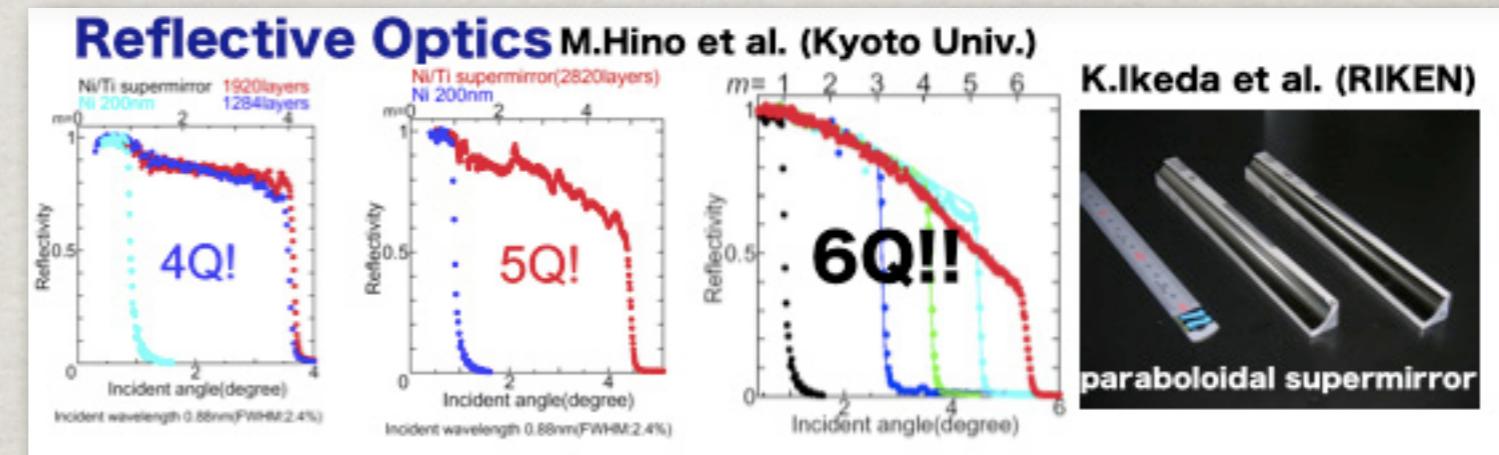
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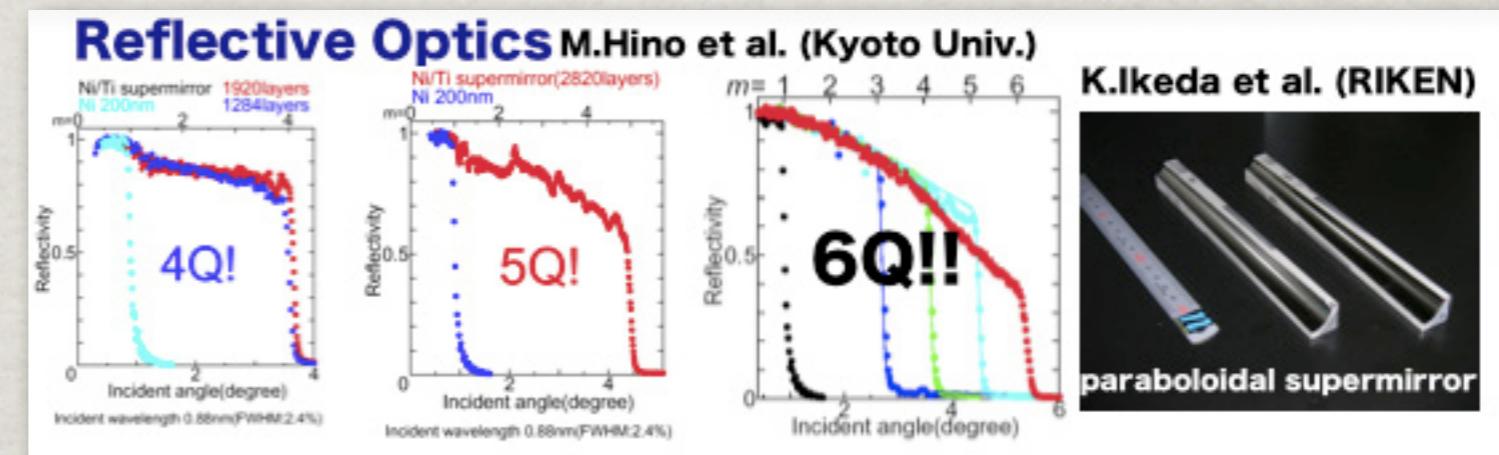
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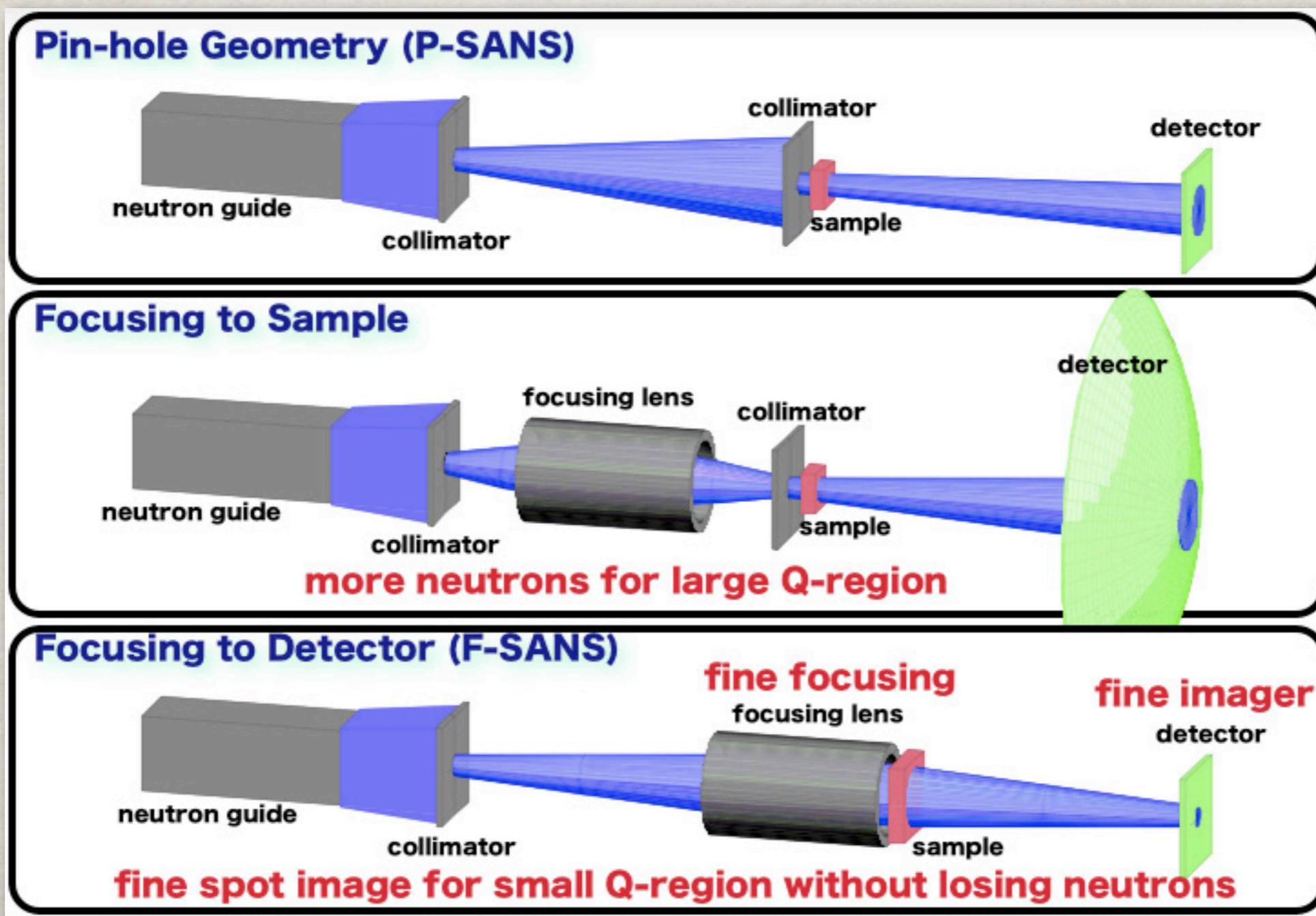


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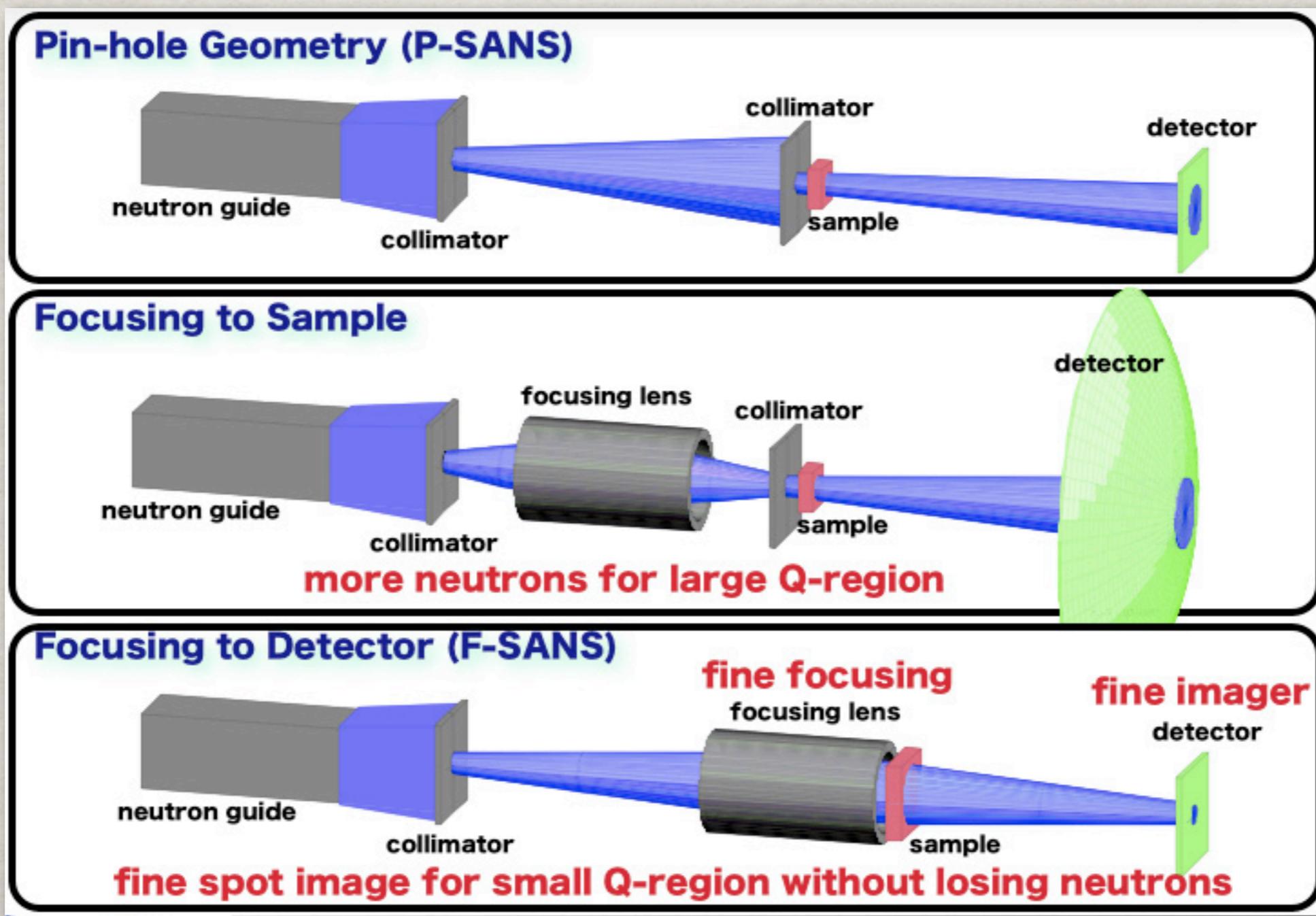
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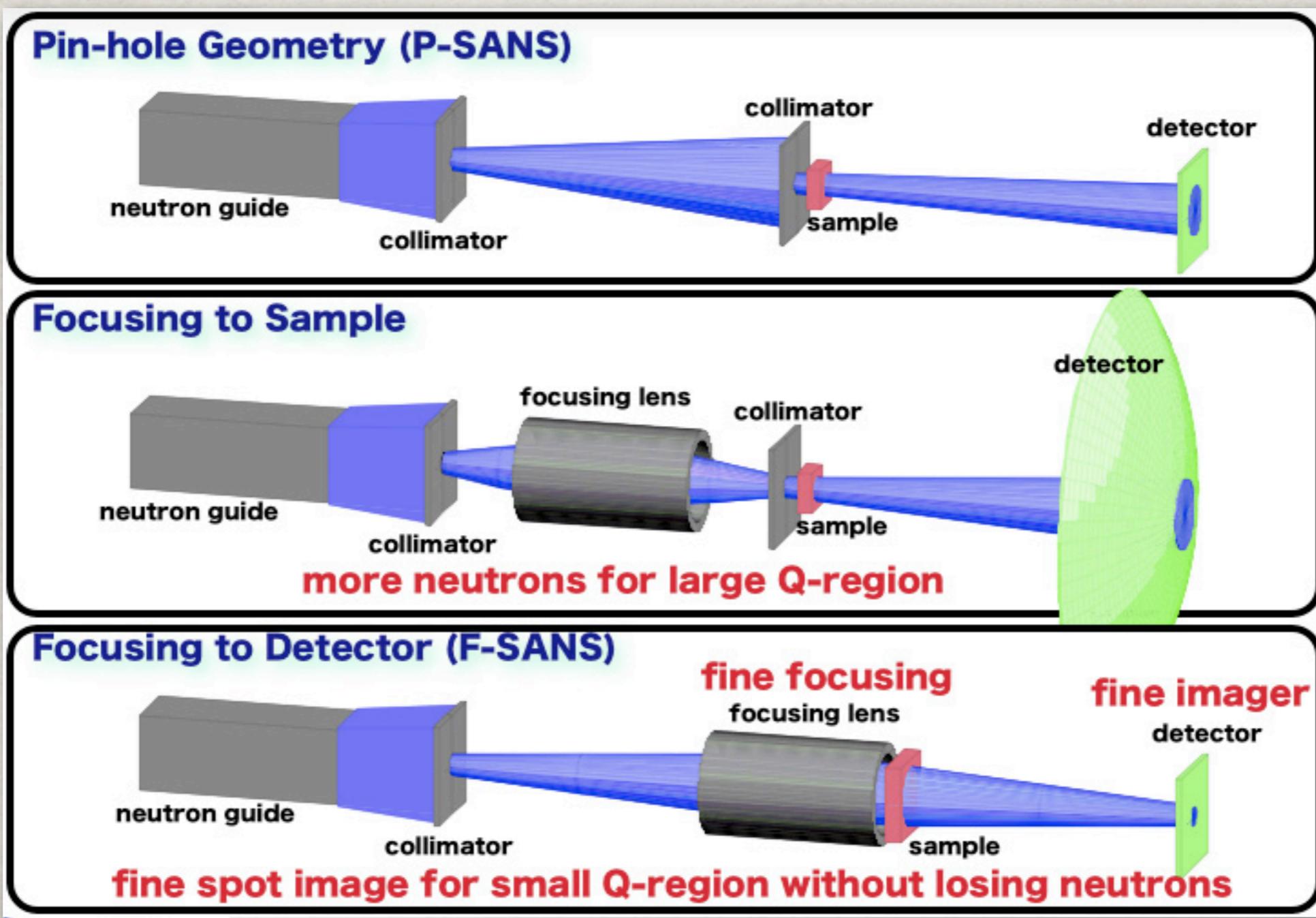
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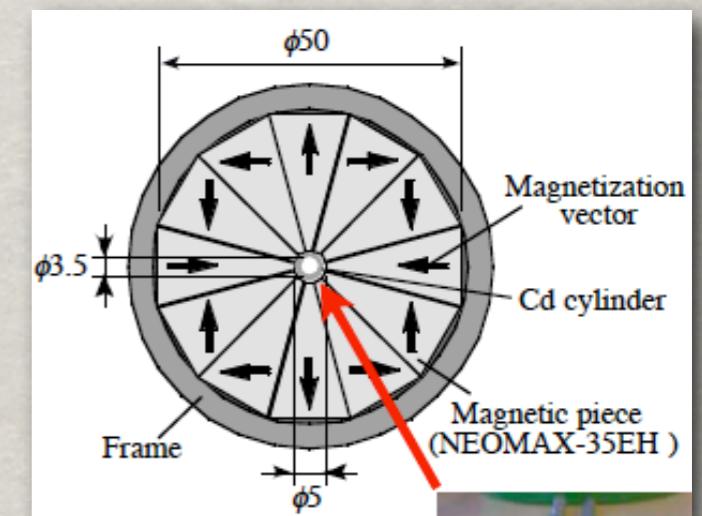
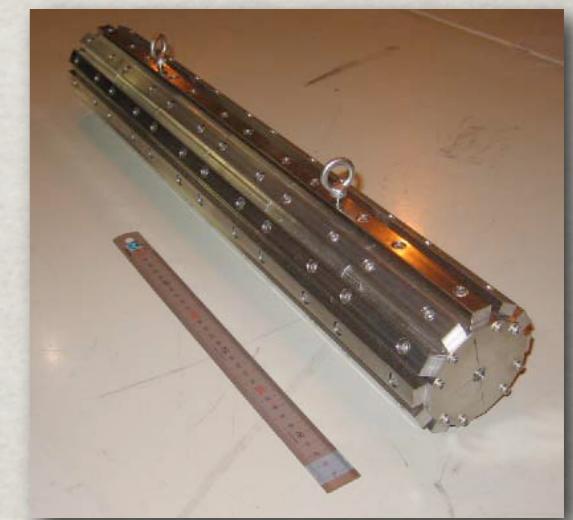
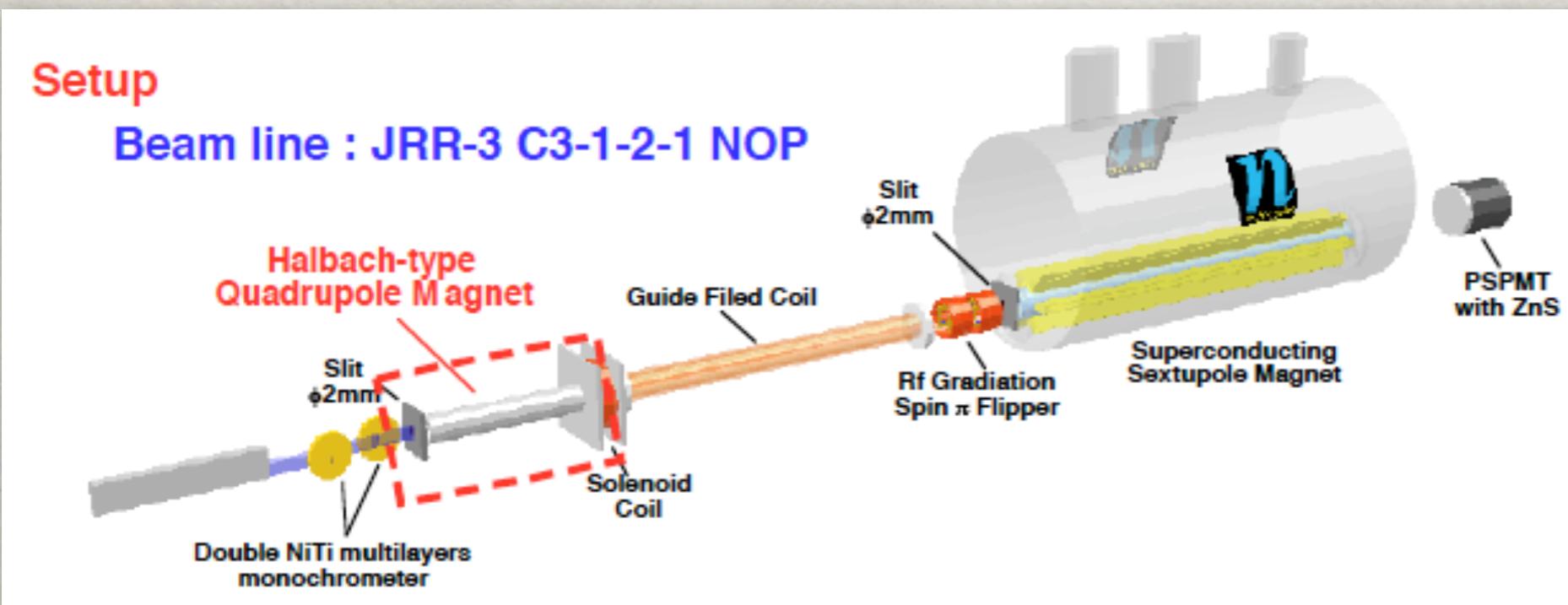
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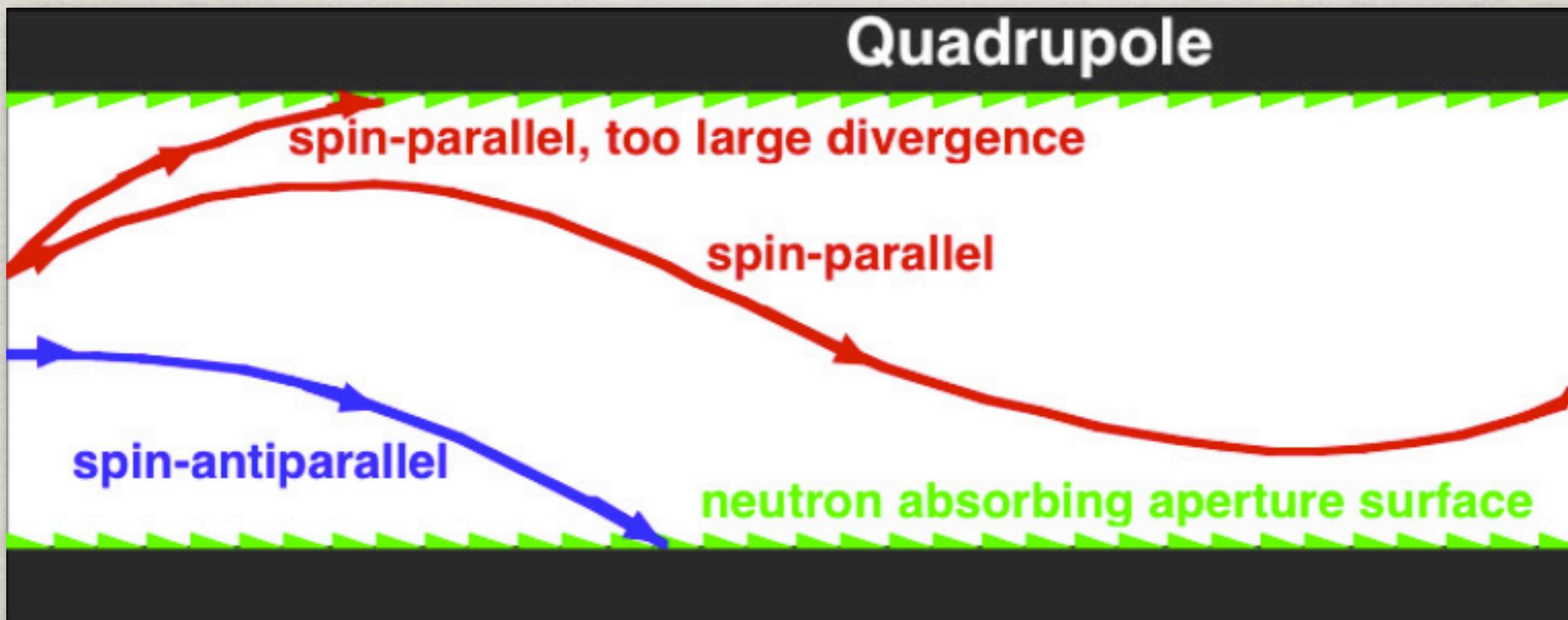


MAGNETIC LENS FOR SPIN POLARIZATION

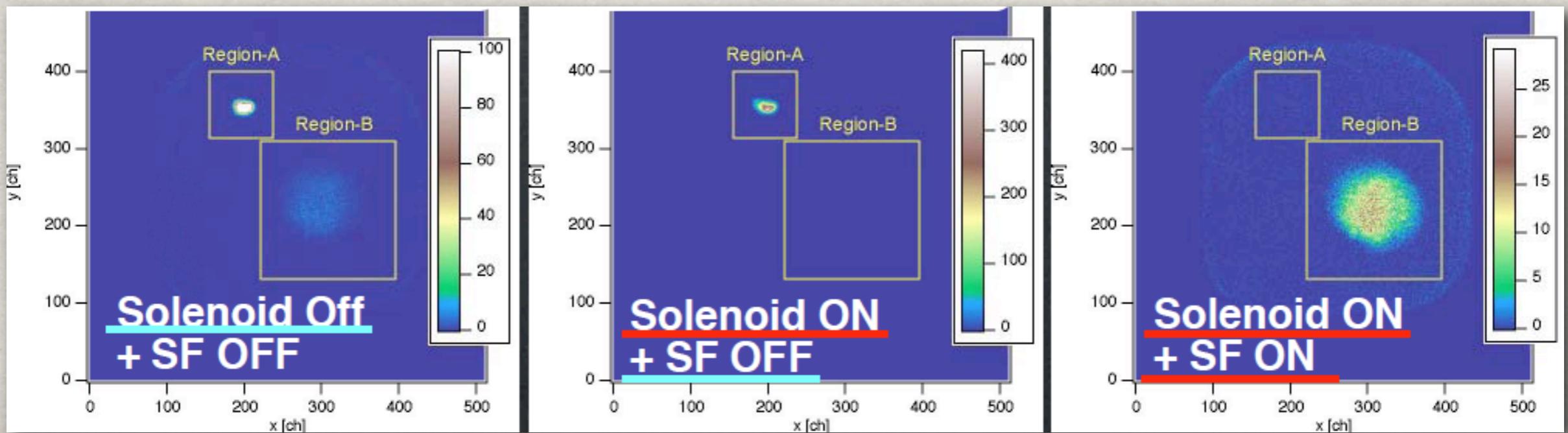
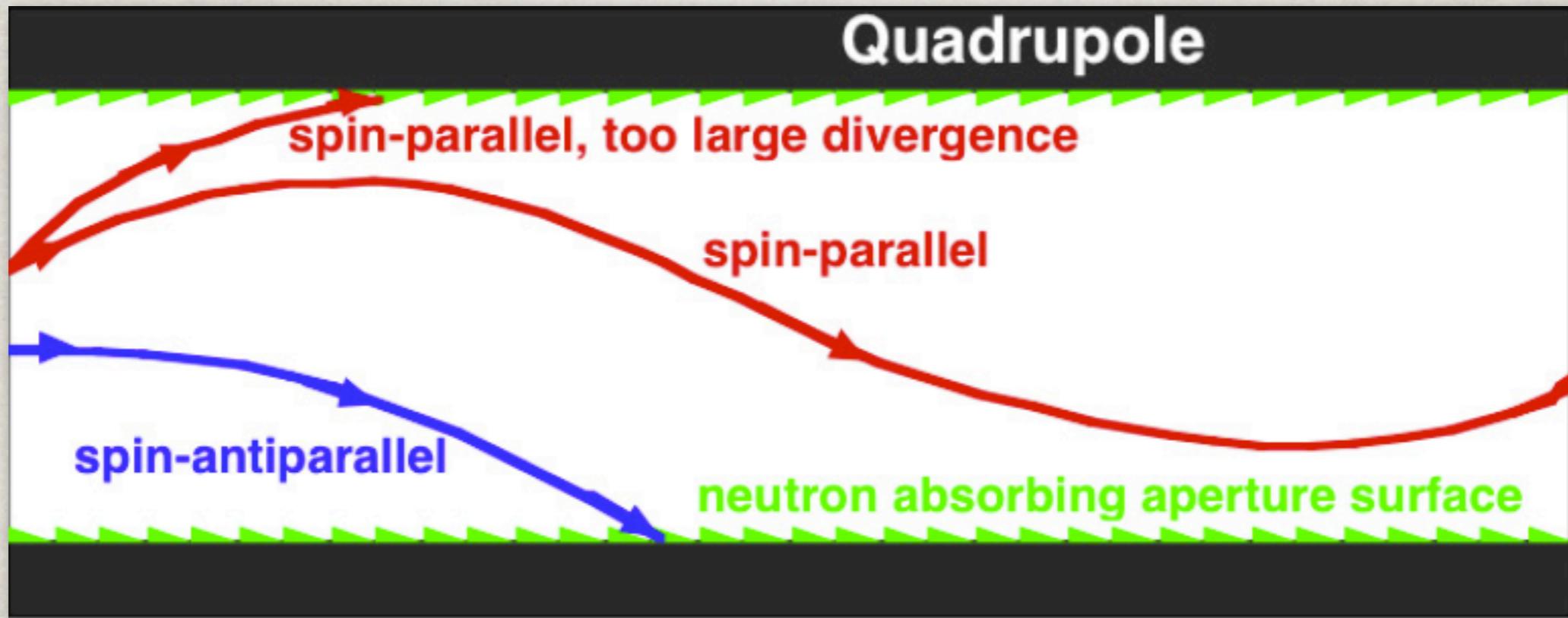
- ✿ inspired by Stern-Gerlach experiment (1922)
- ✿ Halbach-type Quadrupole Magnet
- ✿ 800 Tm^{-1}



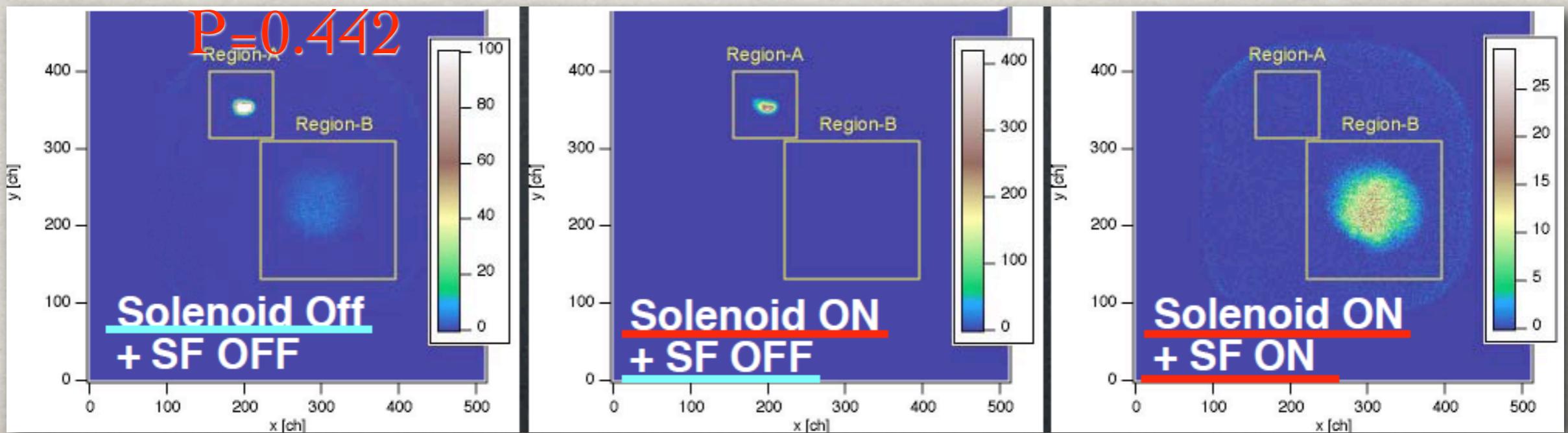
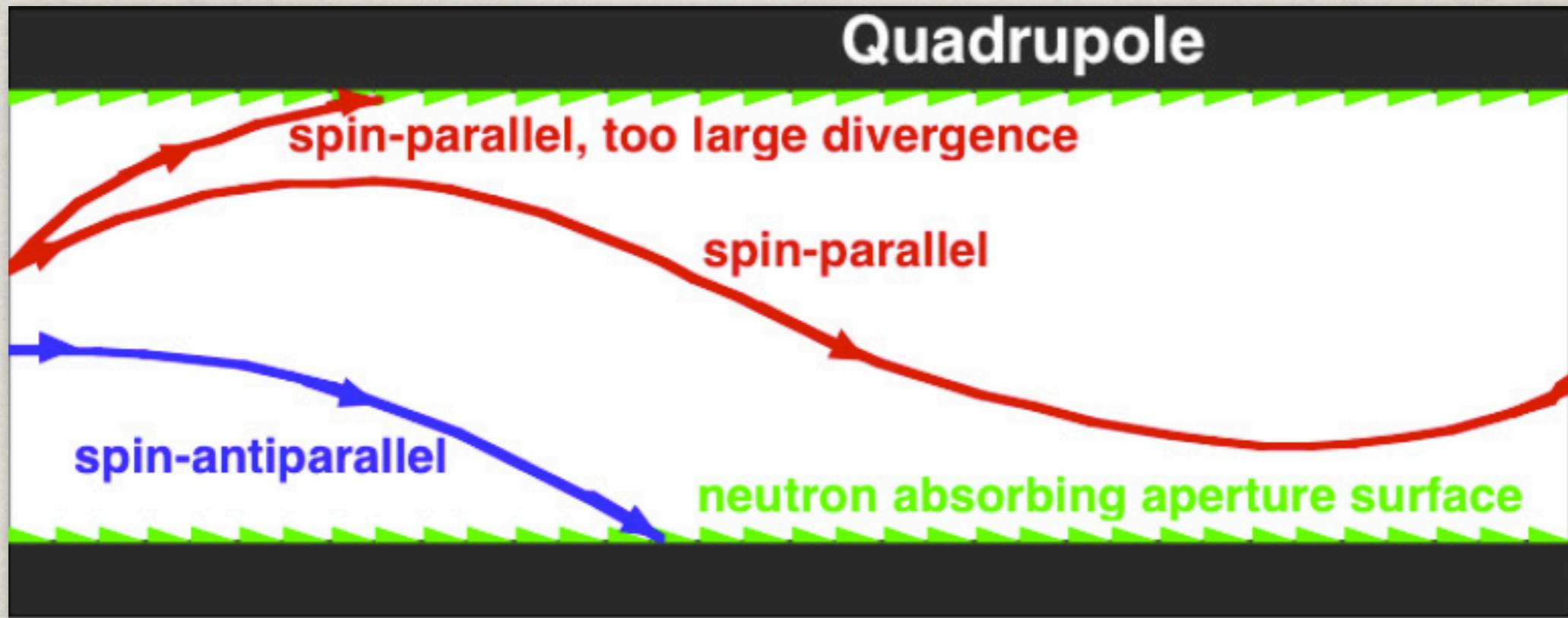
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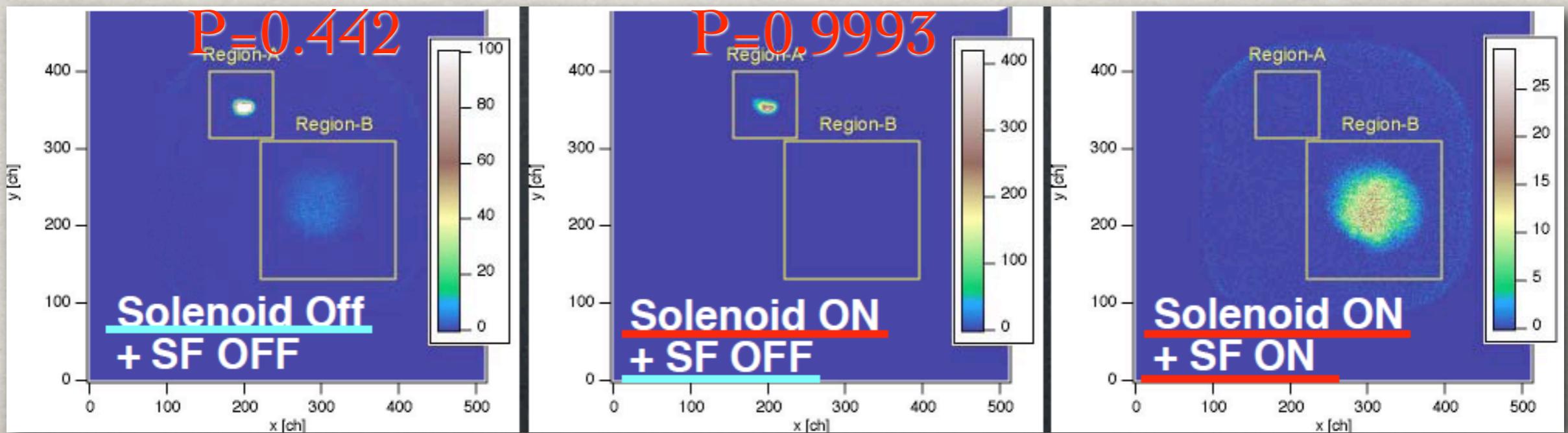
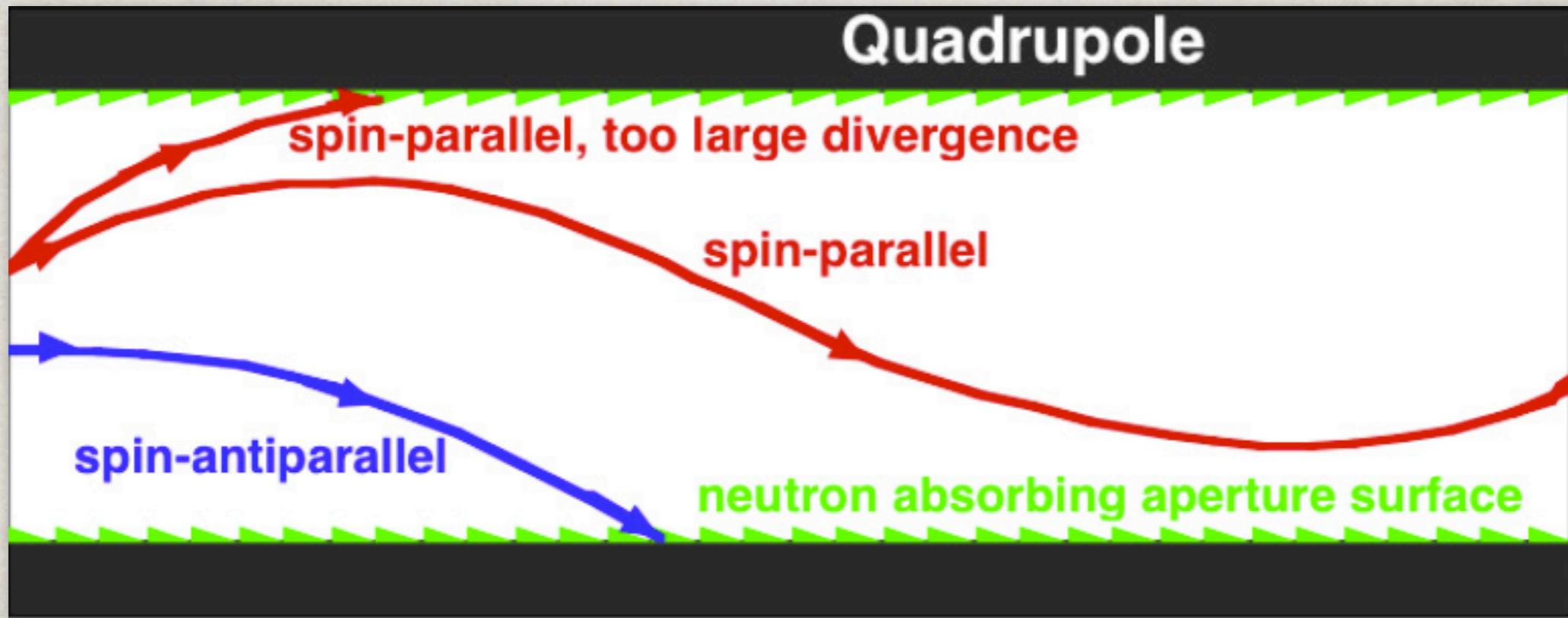
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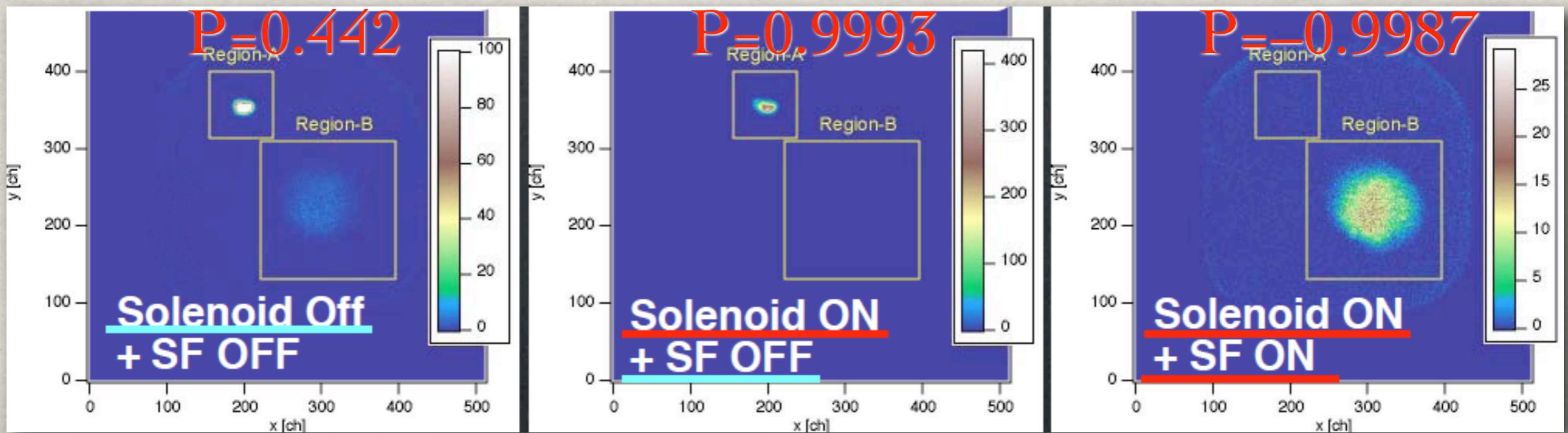
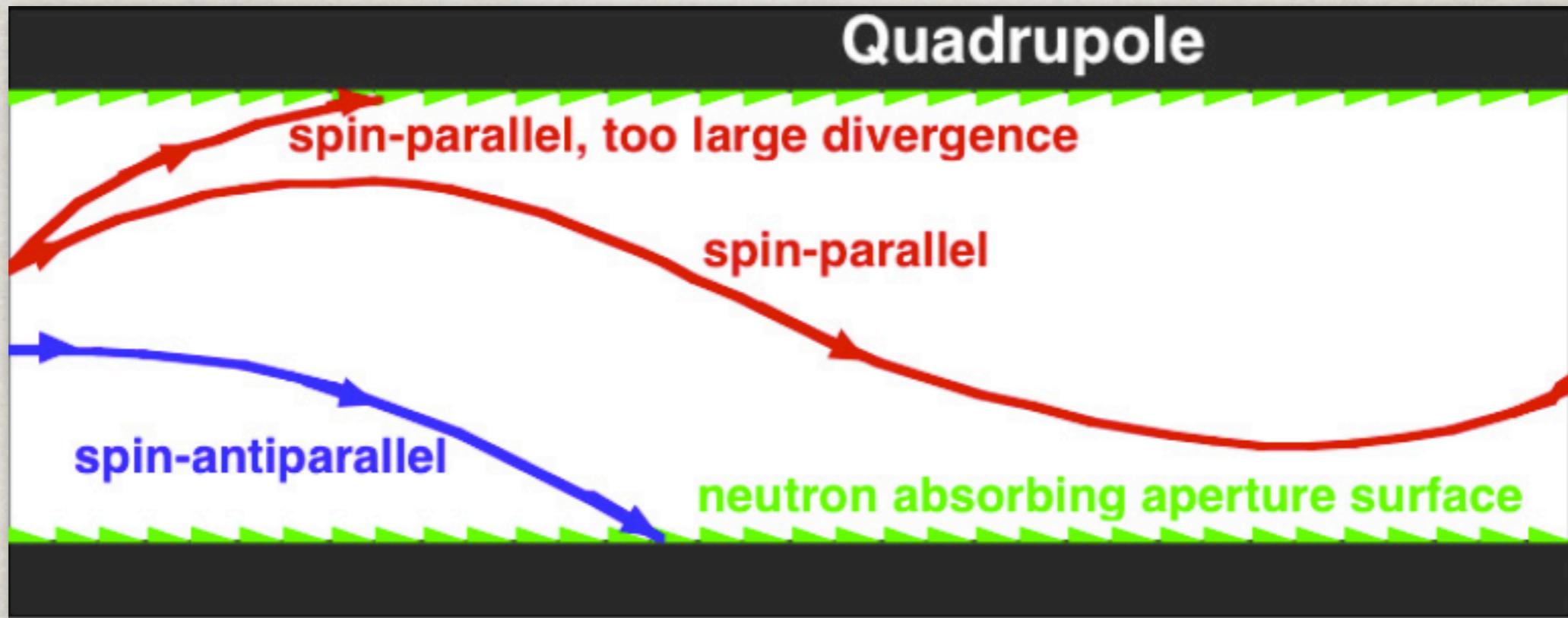
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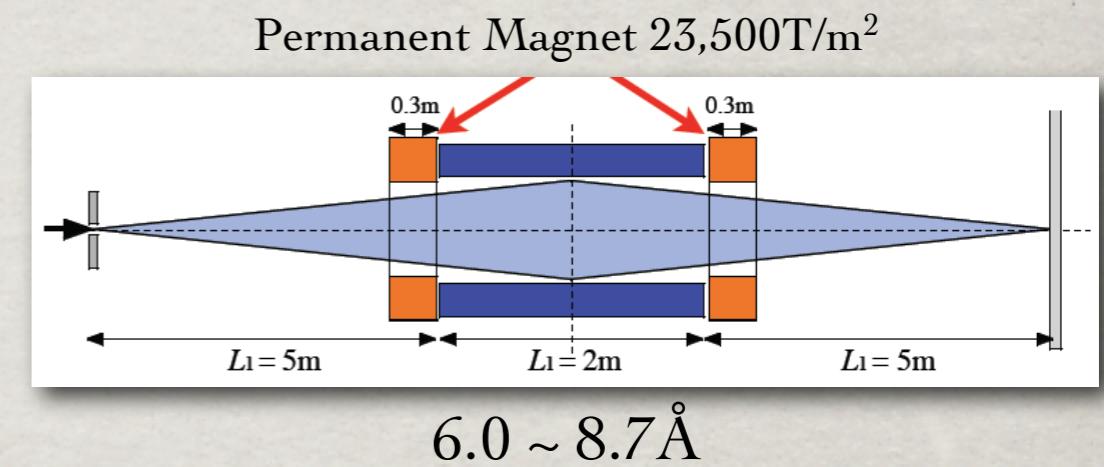


MAGNETIC LENS FOR J-PARC

- ✿ Changing with *Time*
 - ✿ Magnetic field strength
 - ✿ Sextupole pulsed magnet
 - ✿ Focusing geometry
 - ✿ Variable L_1
 - ✿ Effective magnet length
 - ✿ multiplet lens with flippers

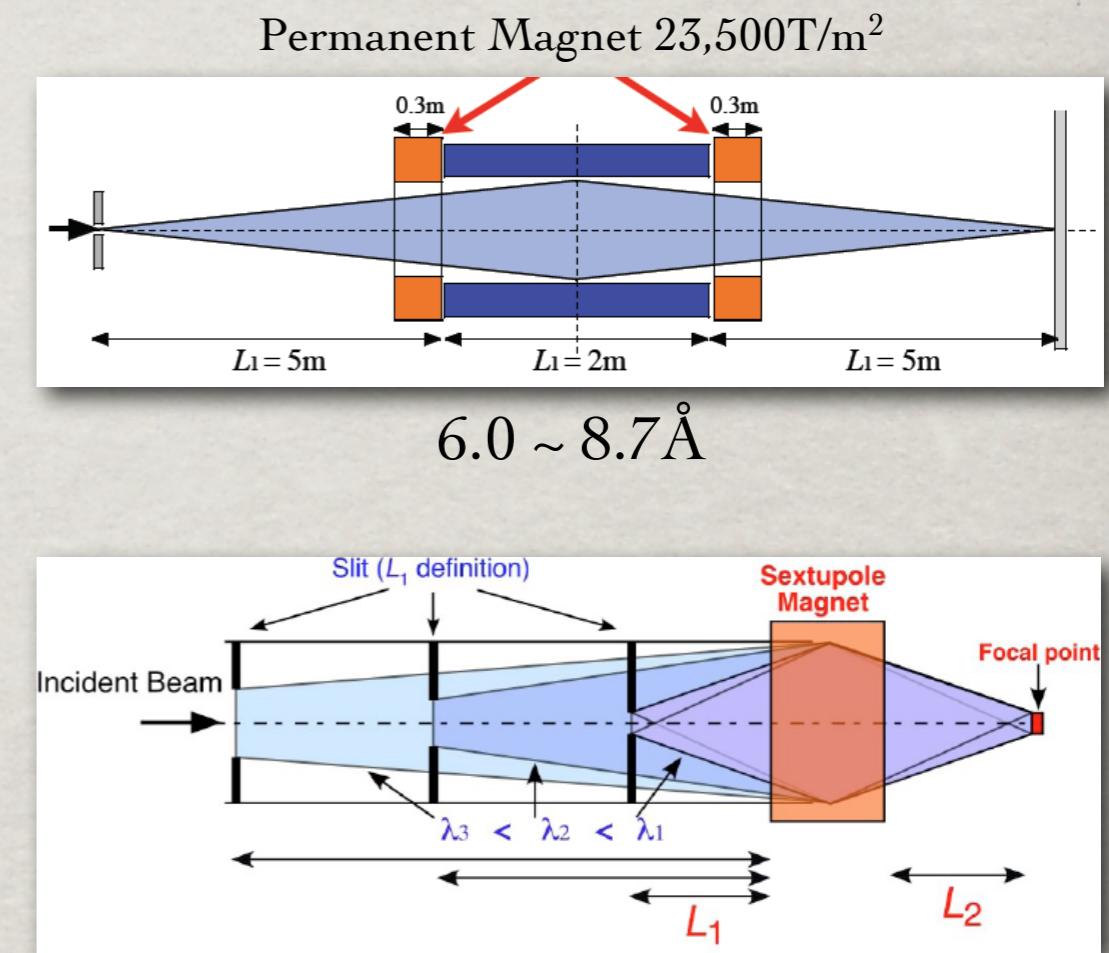
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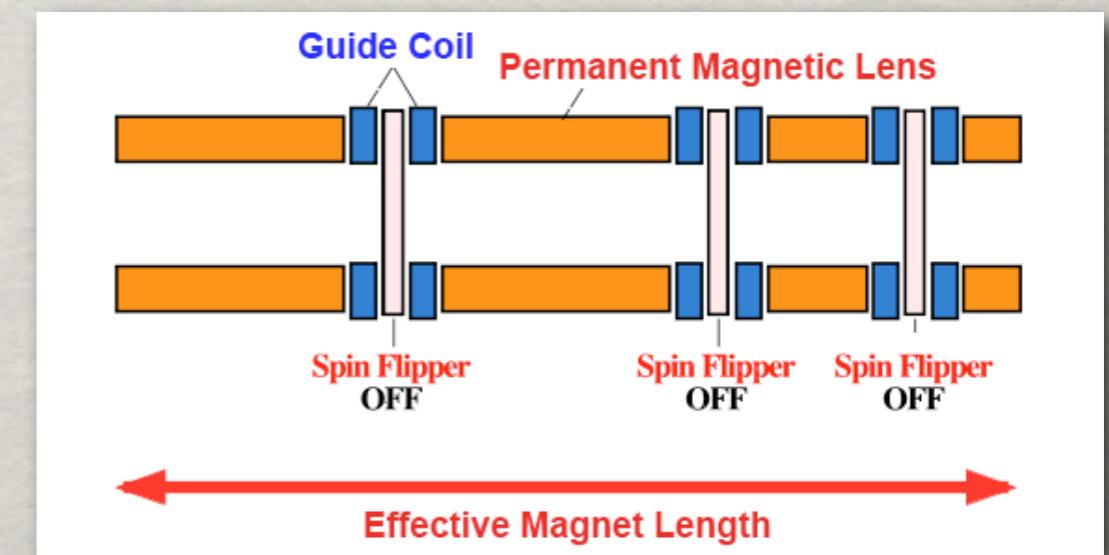
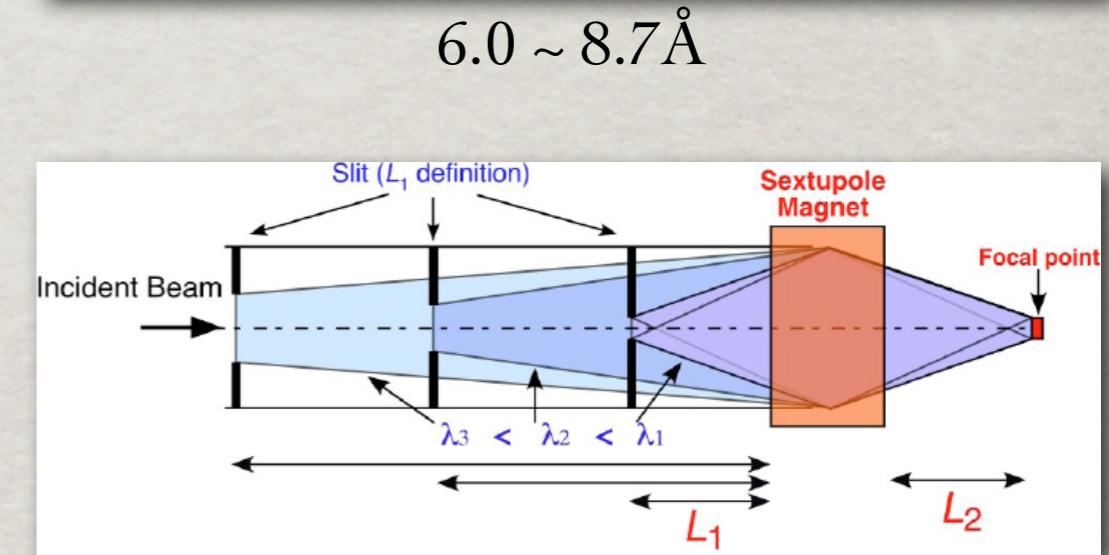
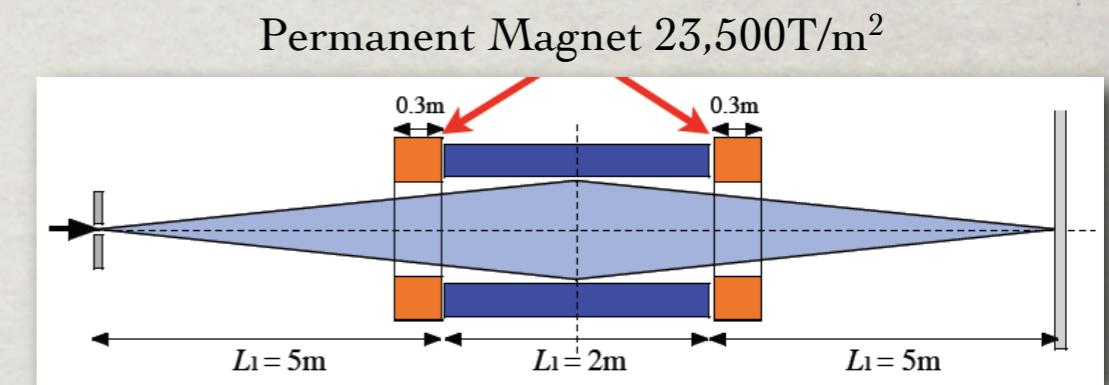
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 - ✿ Neutron Resonance & MIEZE types in J-PARC

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 - ✿ Magnetic Lens ~ Focusing and Polarizing