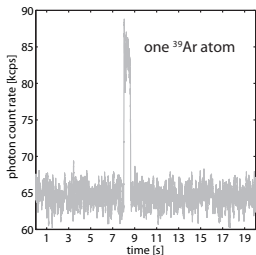


# $^{39}\text{Ar}$ -ATTA at Heidelberg - the atom optical aspect

Florian Ritterbusch, University of Heidelberg



# <sup>39</sup>Ar-ATTA at Heidelberg - collaboration



Werner  
Aeschbach-Hertig



Institute  
of  
environmental  
physics



Dietmar  
Wagenbach



Robert  
Schwefel



Thomas  
Reichel



Markus  
K. Oberthaler



Kirchhoff-institute  
for  
physics



Joachim  
Welte



Sven  
Ebser



Florian  
Ritterbusch

former diploma students



Matthias  
Henrich



Isabelle  
Steinke

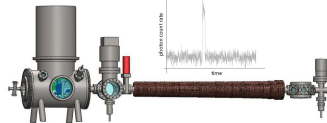


Christoph  
Kaup

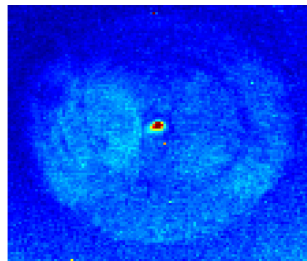
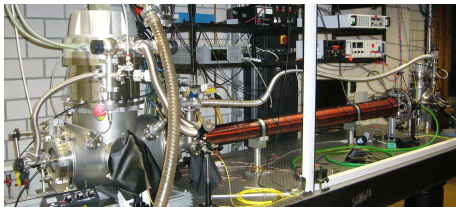
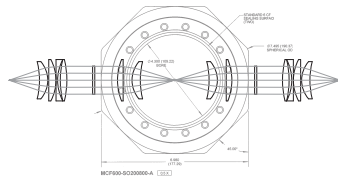
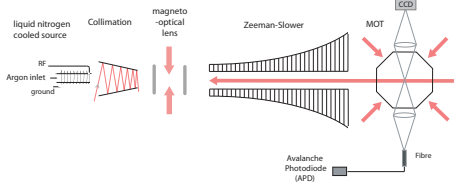
Argon extraction



Water sampling

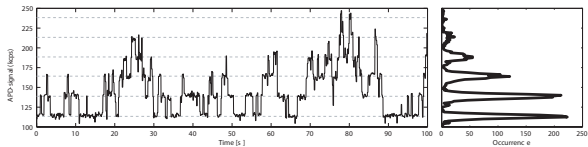


# apparatus

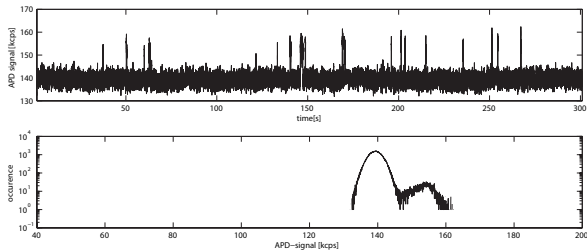


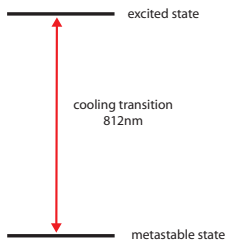
# single atom signals

$^{38}\text{Ar}$



enriched  
 $^{39}\text{Ar}$   
sample

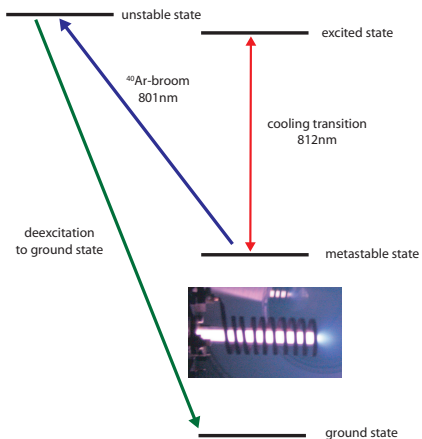




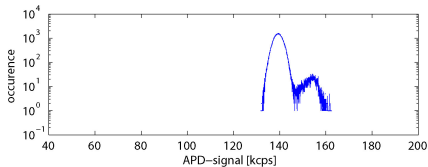
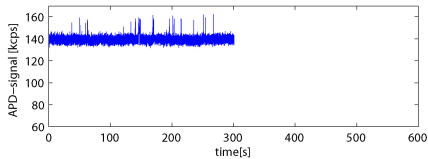
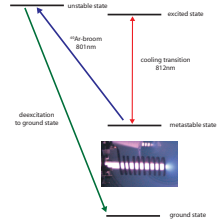
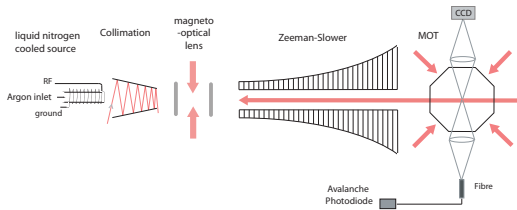
ground state

—

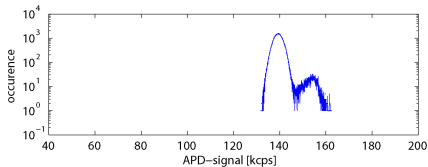
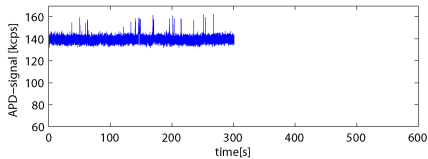
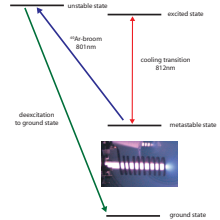
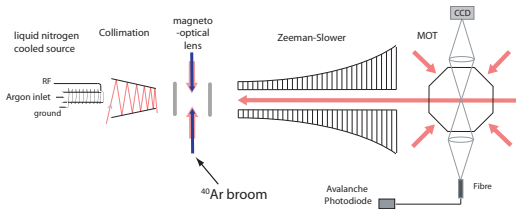
# $^{40}\text{Ar}$ broom



# $^{40}\text{Ar}$ broom

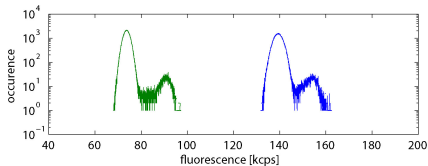
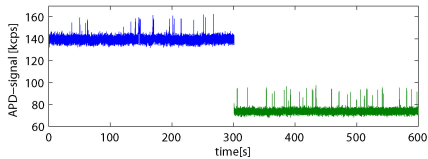
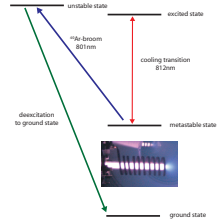
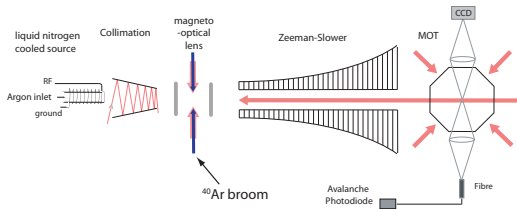


# $^{40}\text{Ar}$ broom

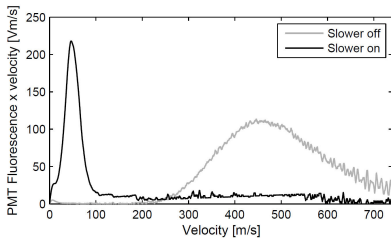
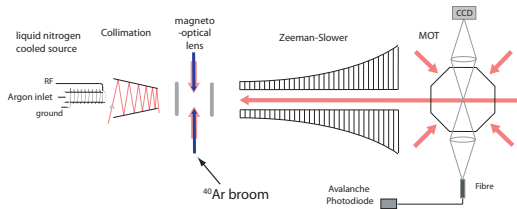




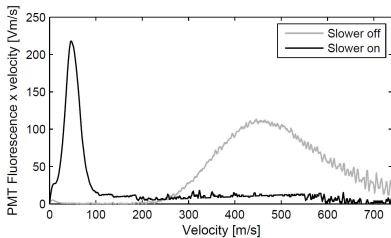
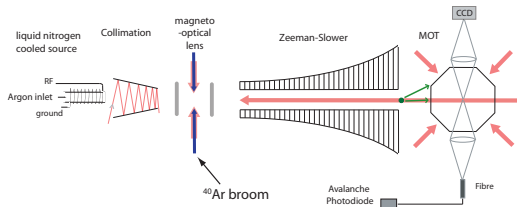
# $^{40}\text{Ar}$ broom



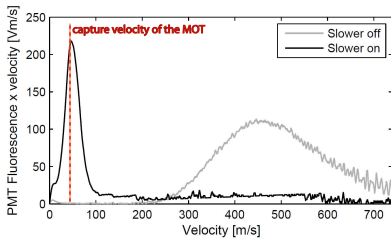
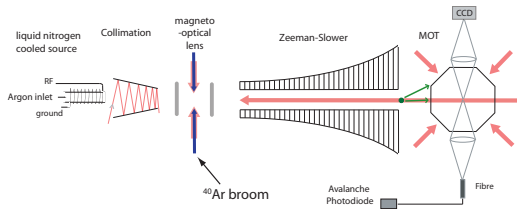
# 2nd Zeeman-Slower



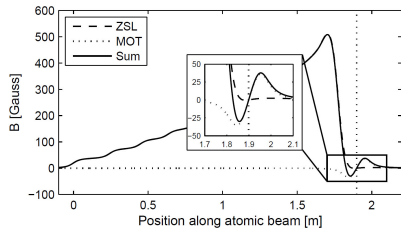
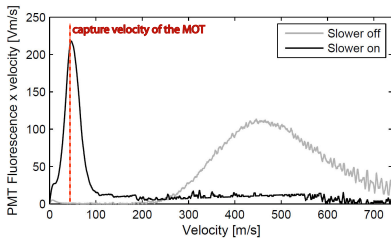
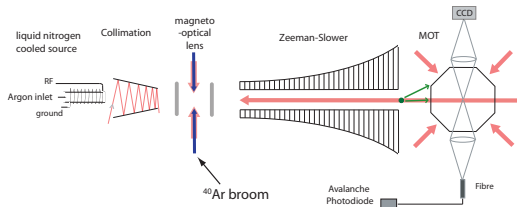
# 2nd Zeeman-Slower



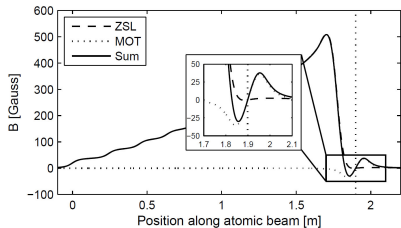
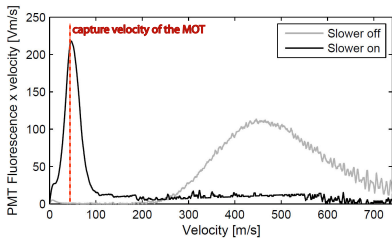
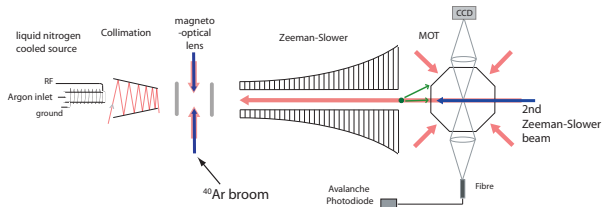
# 2nd Zeeman-Slower



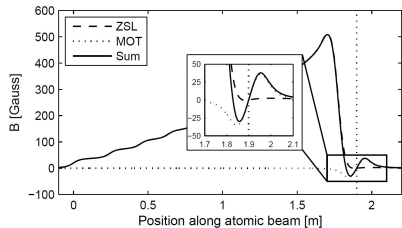
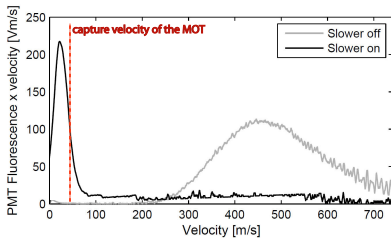
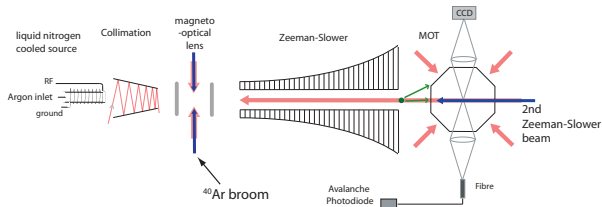
# 2nd Zeeman-Slower



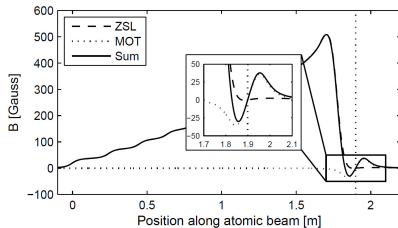
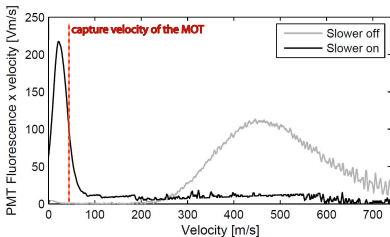
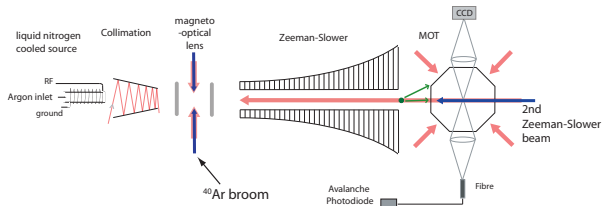
# 2nd Zeeman-Slower



# 2nd Zeeman-Slower



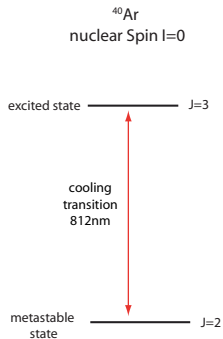
# 2nd Zeeman-Slower



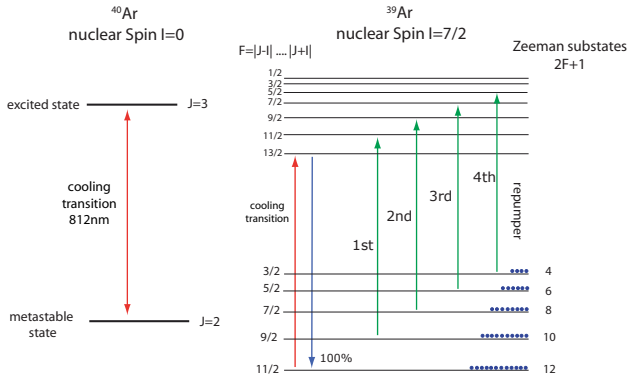
→ factor  $\sim 4$  increase in counting rate



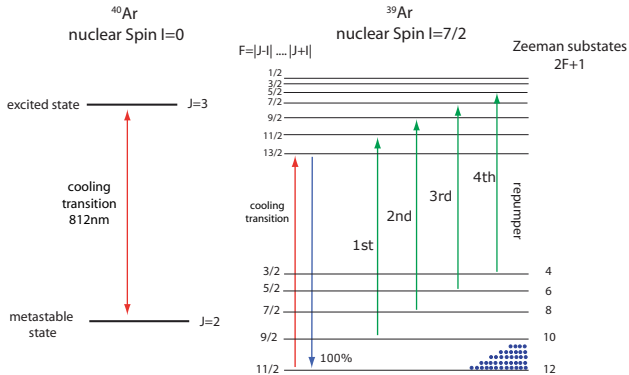
# hyperfine pumping



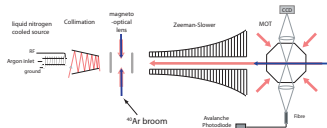
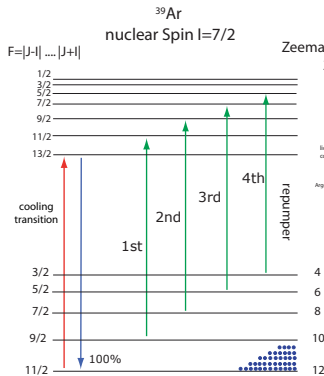
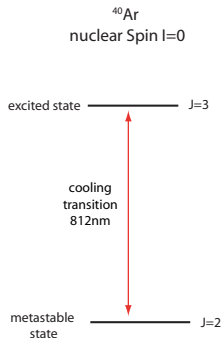
# hyperfine pumping



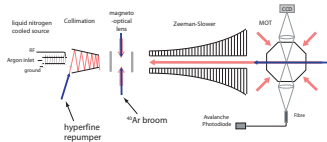
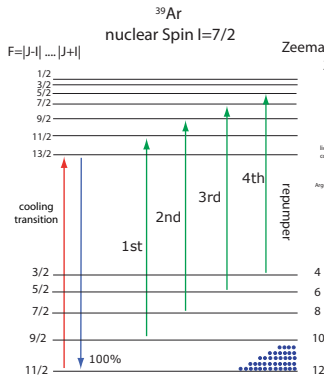
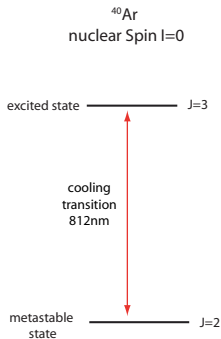
# hyperfine pumping



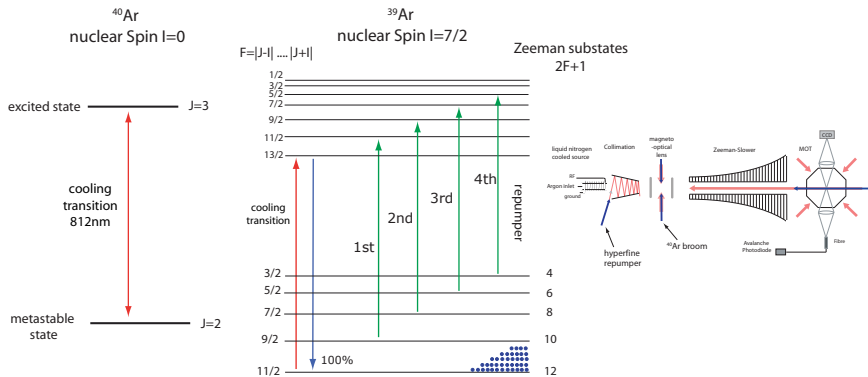
# hyperfine pumping



# hyperfine pumping

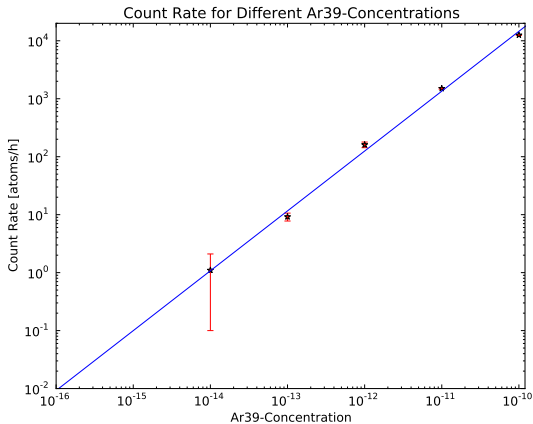


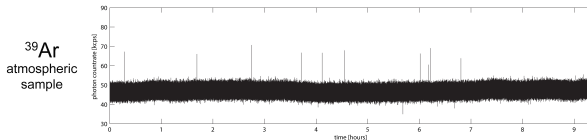
# hyperfine pumping



repumpers on	$^{39}\text{Ar}$ atoms in 120s	relative increase	theory
1	$241 \pm 14$		
1,2	$330 \pm 21$	$37 \pm 12\%$	36 %
1,2,3	$383 \pm 31$	$16 \pm 12\%$	20 %
1,2,3,4	in preparation		11 %

# systematics with enriched samples





- $^{39}\text{Ar}$  countrate for atmospheric sample:  
0.6atoms/h (45atoms/73h)
- increase  $^{39}\text{Ar}$  countrate
  - optimize vacuum system
  - more efficient cooling of source
  - improve excitation efficiency
- in principle only 1l of water or 1kg of ice necessary, but ...
- ... the sample size is currently limited by cross sample contamination
- dating with  $^{39}\text{Ar}$ -ATTA within reach