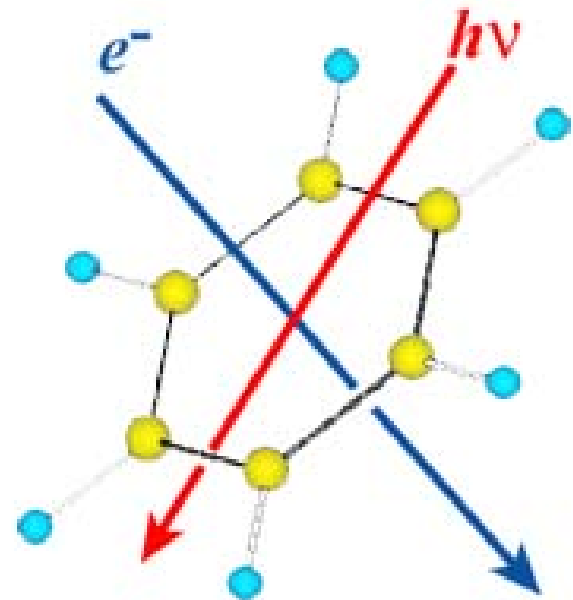
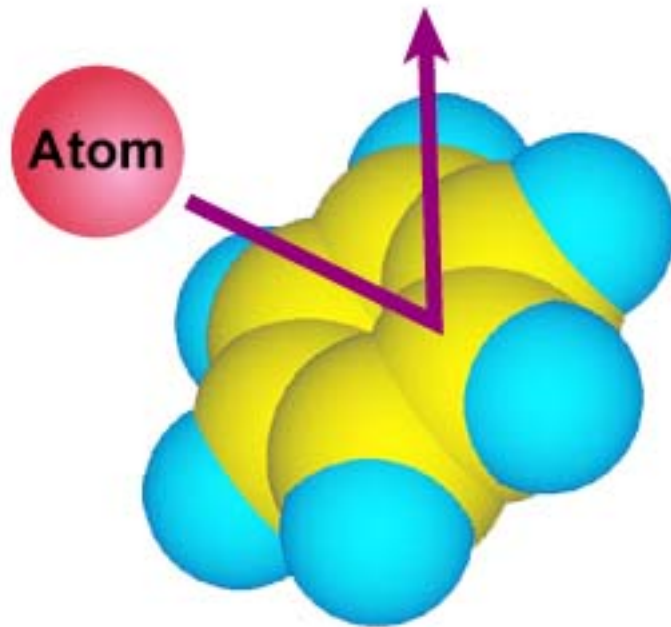


*EXTERIOR CHARACTERISTICS OF  
MOLECULAR ORBITALS AND MOLECULAR SURFACES  
AS STUDIED BY ATOMIC PROBES*

**Koichi Ohno**

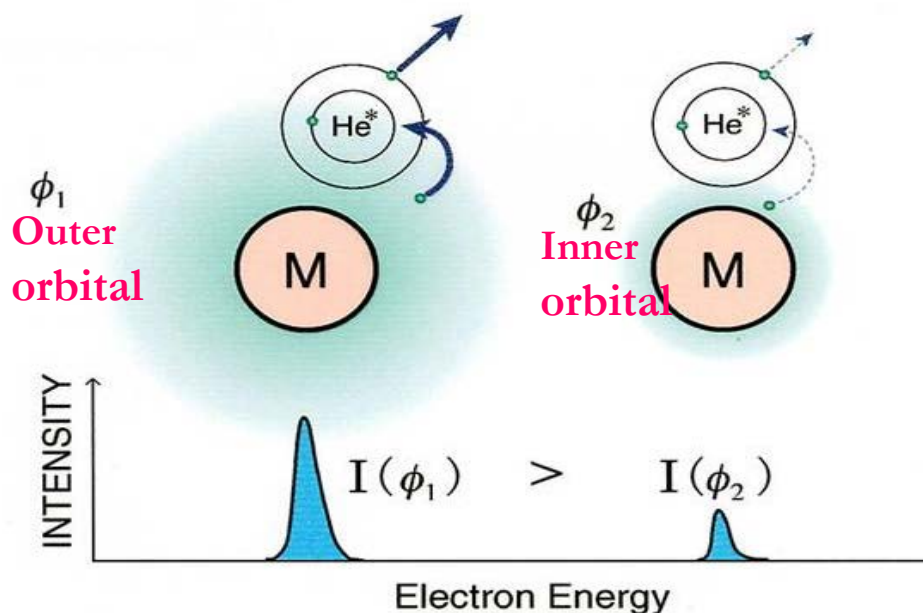
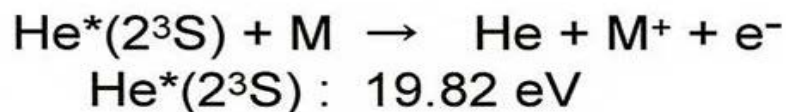
**Graduate School of Science  
Tohoku University  
JAPAN**

光や電子は透過性が高い  
原子は表面で跳ね返る



# An Excited Atom $\text{He}^*$ can be used to Probe Outer Properties of Molecules

## Penning Ionization



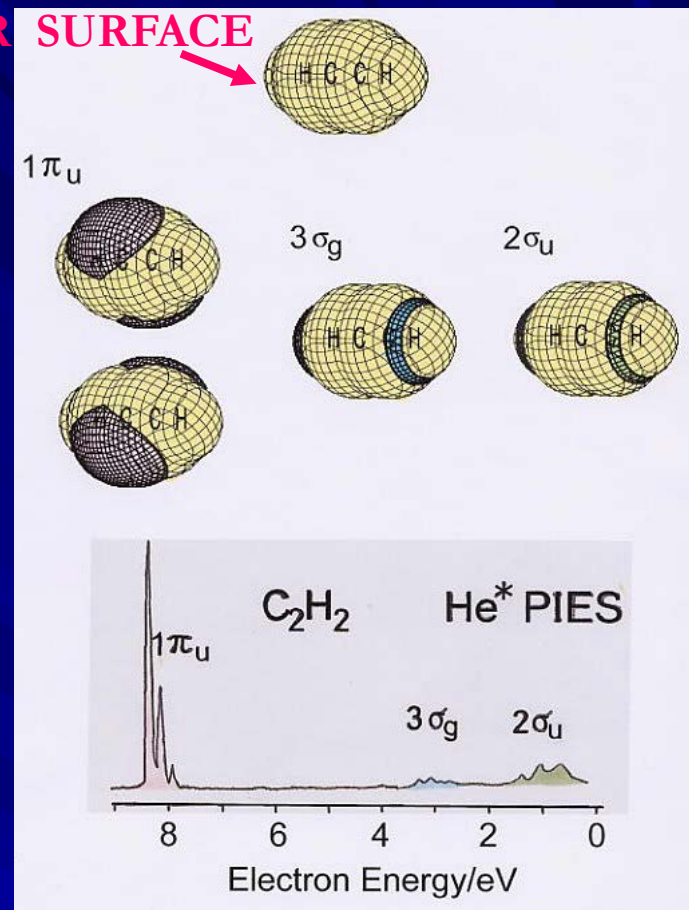
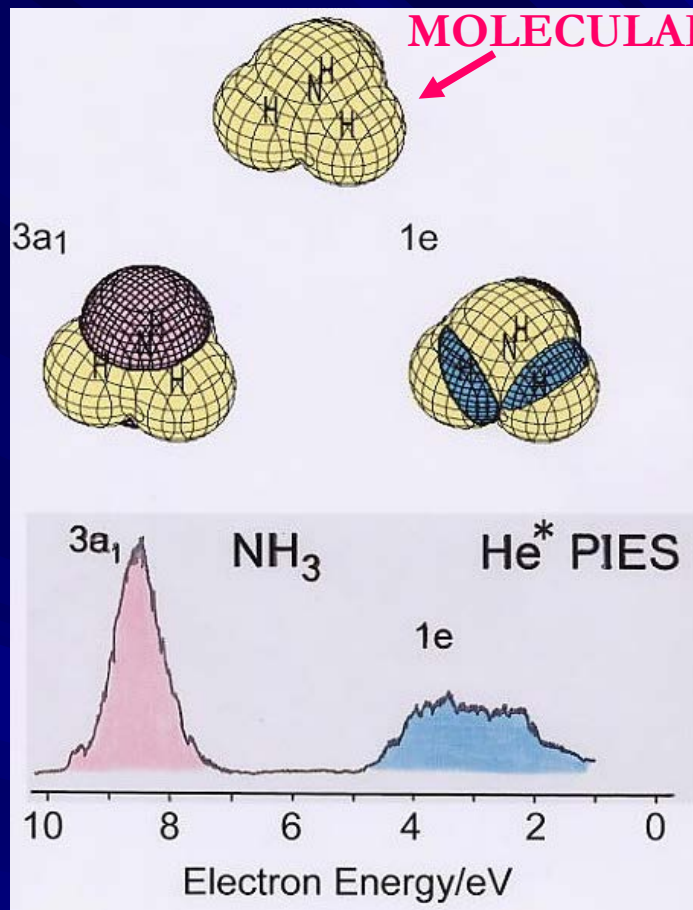
**PIES**

K. Ohno,  
H. Mutoh, &  
Y. Harada

*J. Am. Chem. Soc.*  
105, 4555, (1983)

K. Ohno,  
H. Mutoh, &  
Y. Harada

*J. Am. Chem. Soc.*  
105, 4555, (1983)



EXTEIOR

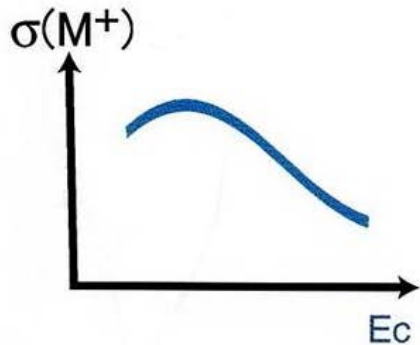
**MOLECULAR  
SURFACE**

INTERIOR

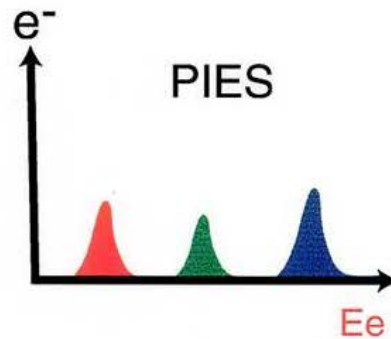
Molecular Surface is important,  
because it divides chemically active  
exterior parts from inactive interior  
parts.



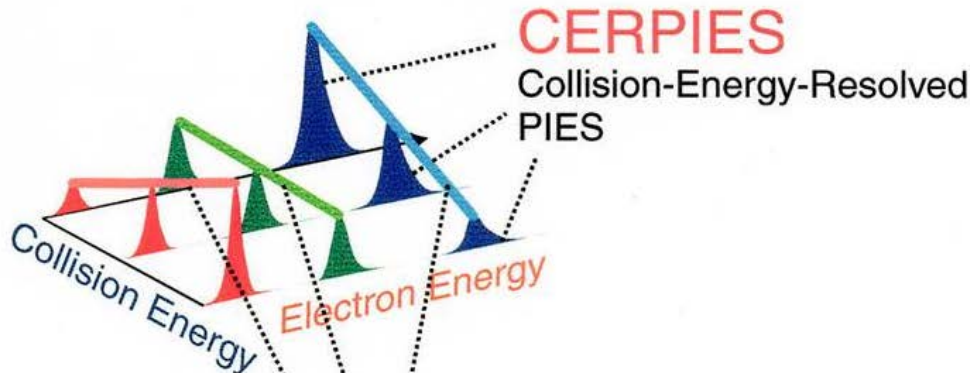
$E_c$   
Collision Energy



$E_e$   
Electron Energy



**2D-PIES**



**CEDPICS**  
Collision Energy Dependence  
of Partial Ionization Cross Sections

# Development of 2D-PIES

Simultaneous  
Analyses of  
Reactants &

Products result in  
5 orders of Signal  
Reduction !

1D-PIES      2D-PIES  
3 hrs → 34 years !

# 改善しなければ不可能なことを実現

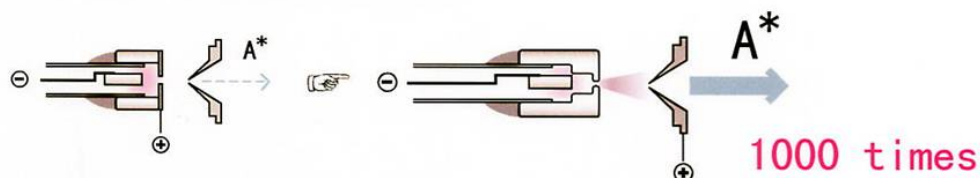
5桁の感度不足

37歳のときに計画

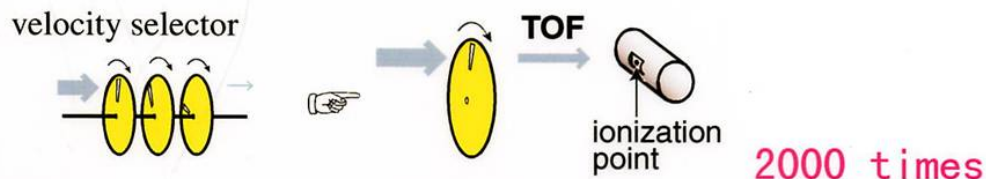
そのままでは、  
測定に34年かかる

技術改良により、  
3年間で実現

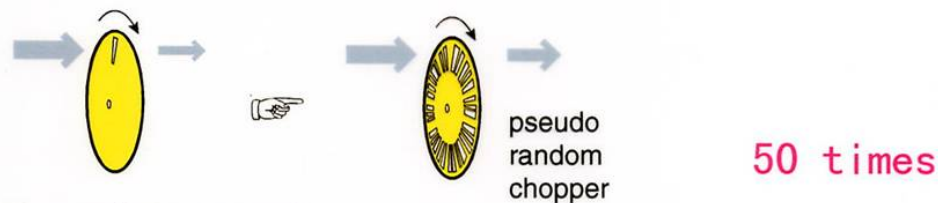
## ◆ Nozzle discharge source



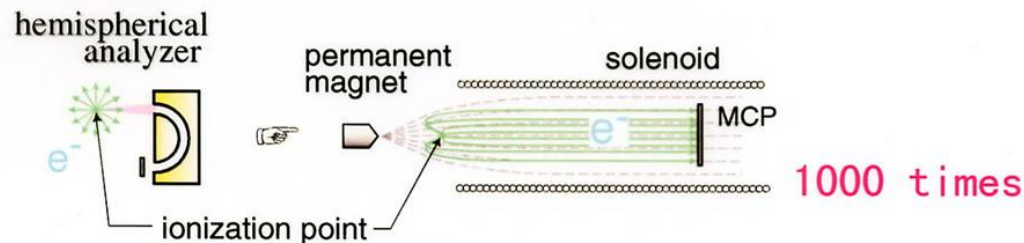
## ◆ Velocity selection by TOF



## ◆ Cross-Correlation TOF method

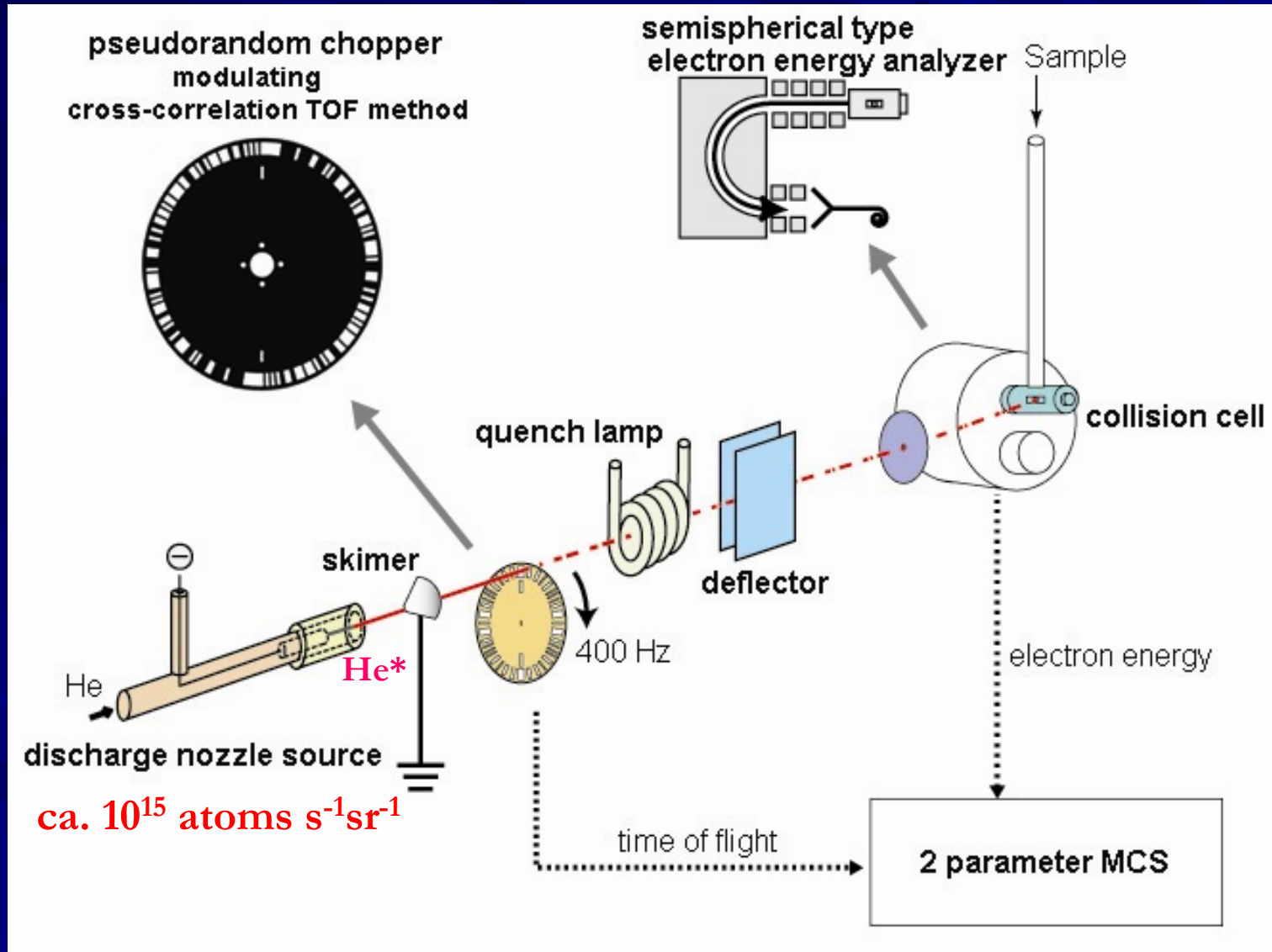


## ◆ Magnetic bottle effect



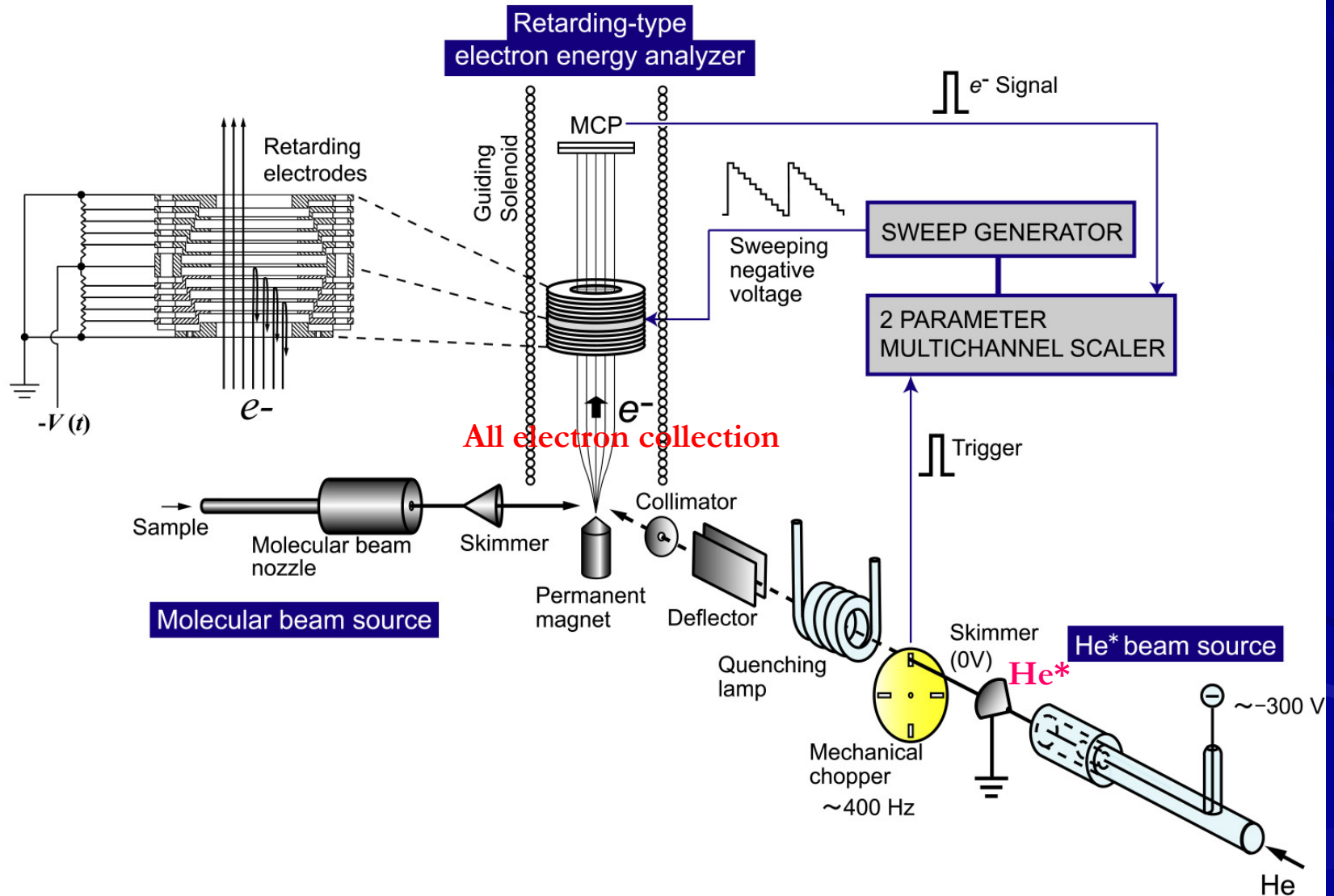
Total  $10^{10}$  times

# 2D-PIES Apparatus



# Crossed Molecular Beam 2D-PIES

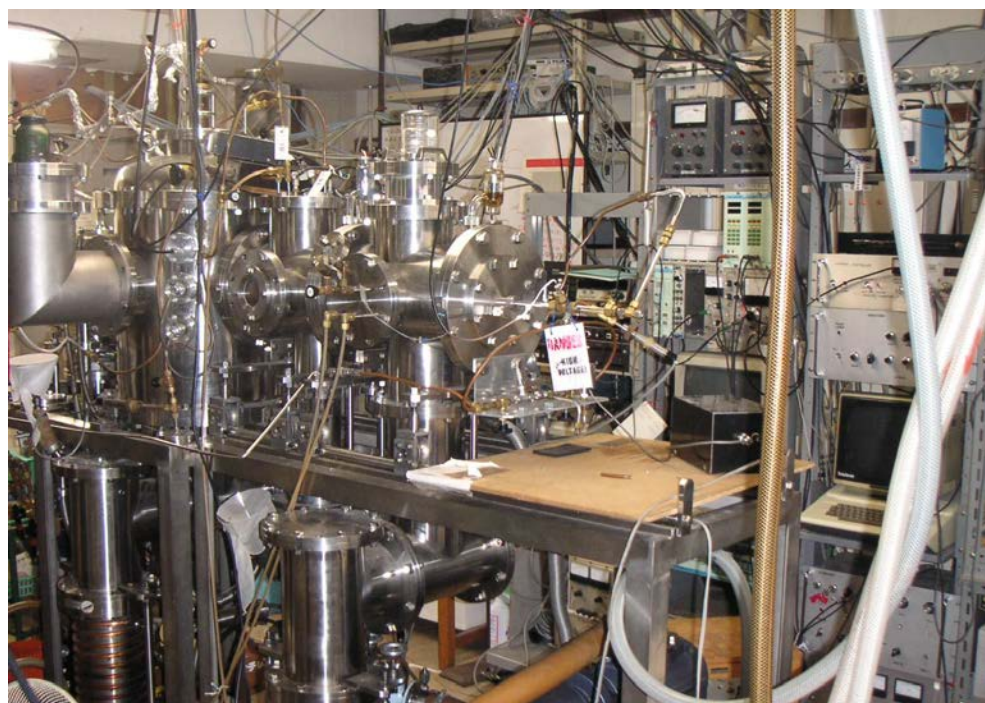
## Experimental setup



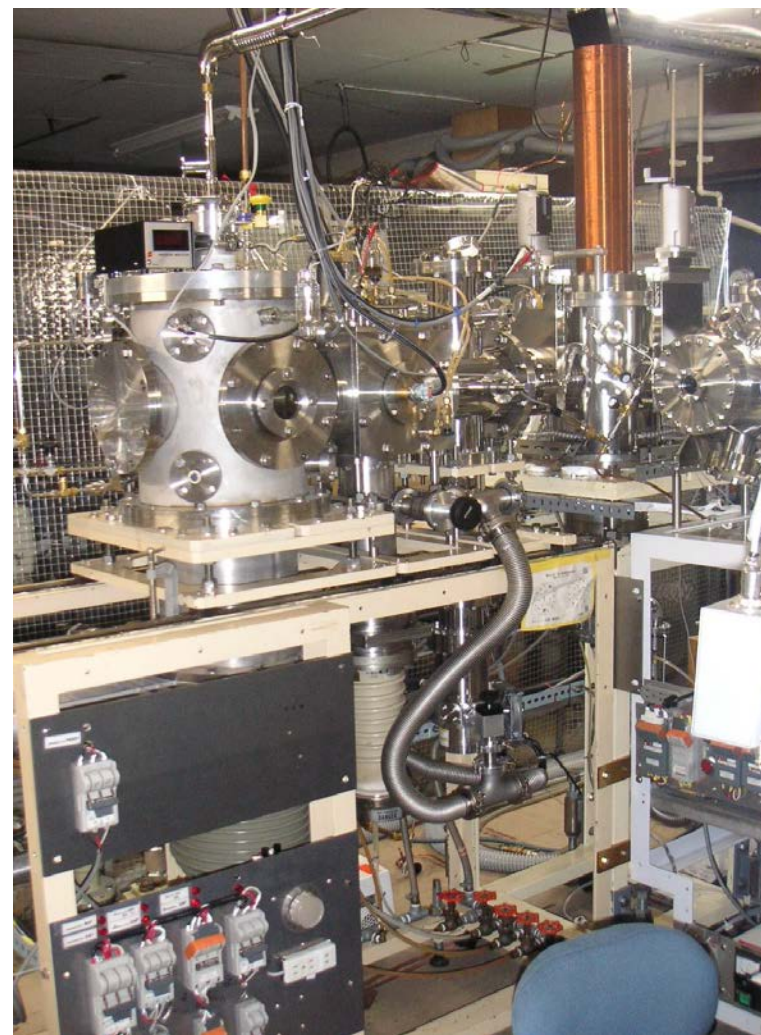


# 2D-PIES装置

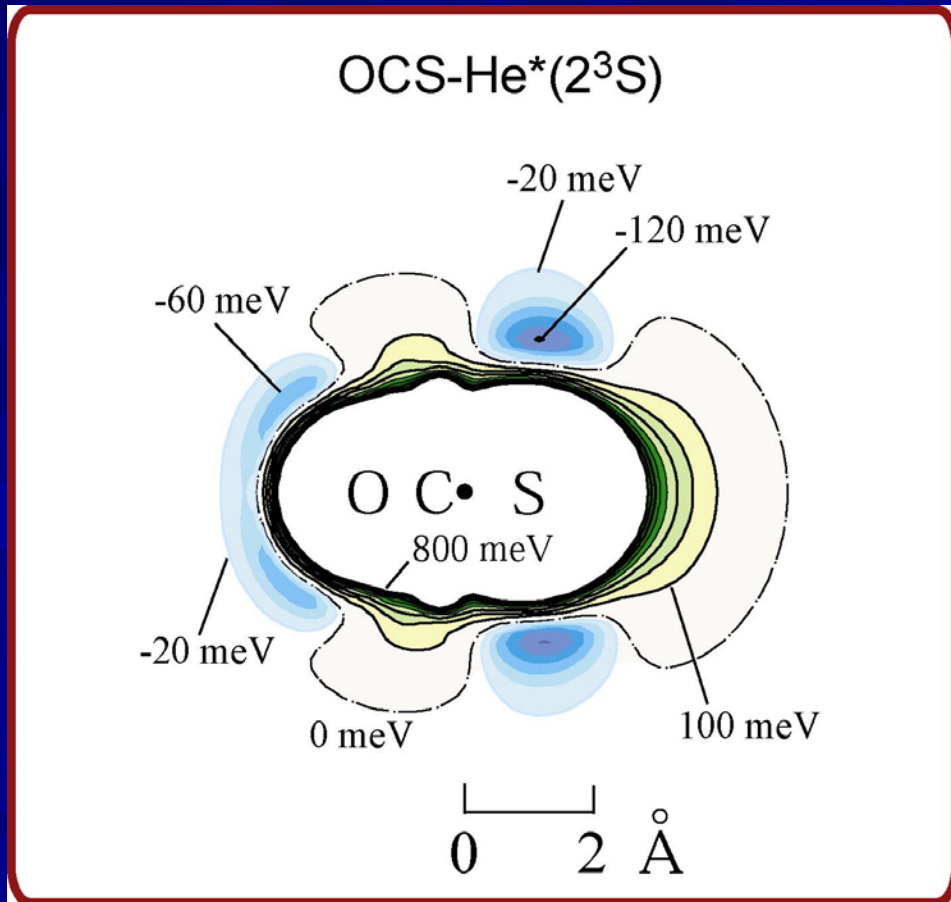
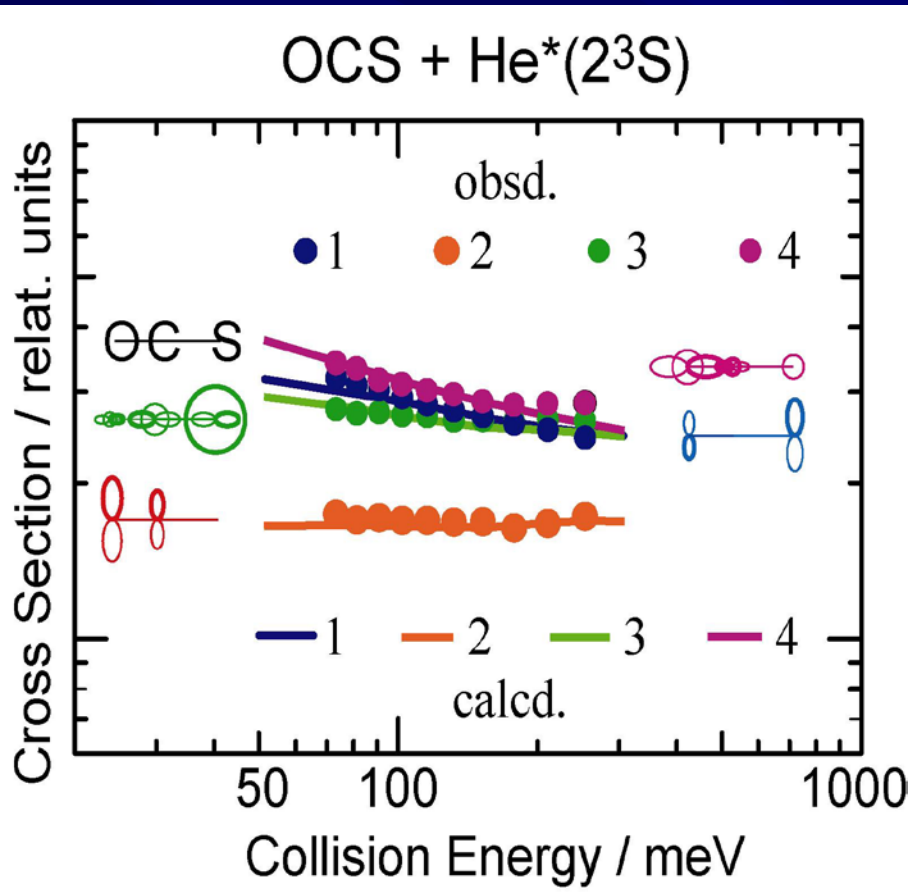
速度分解・角度分解  
ペニングイオン化電子分光装置



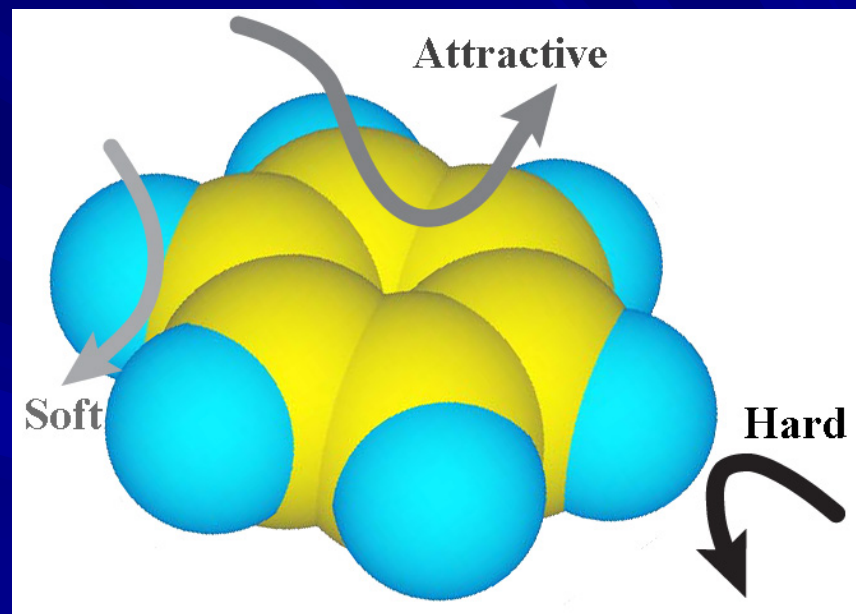
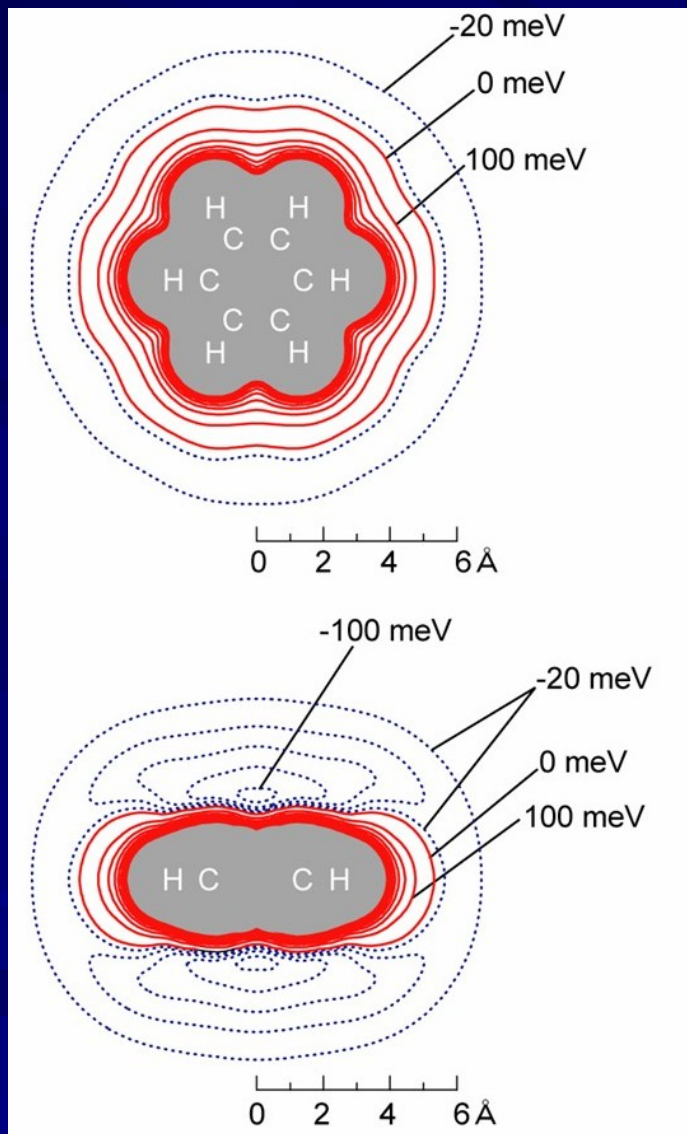
交差分子線速度分解磁気ボトル  
ペニングイオン化電子分光装置



# Interaction Potential for OCS / He\*

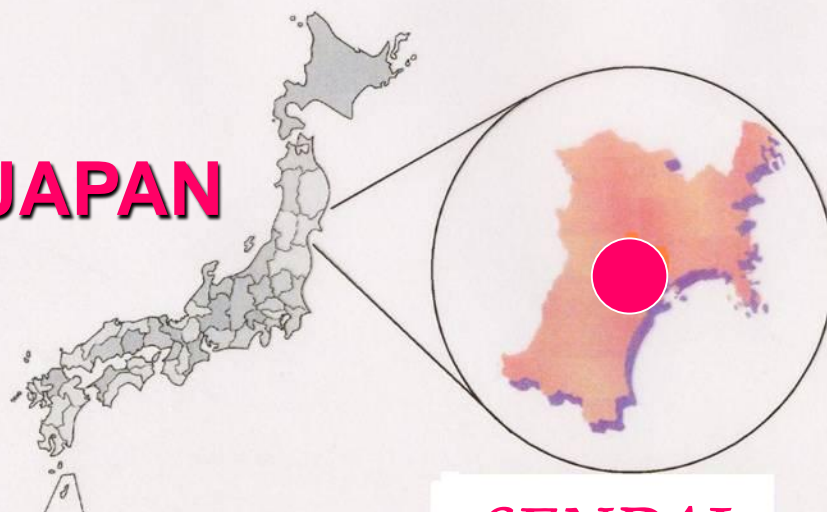


# Interaction Potential for $C_6H_6 / He^*$





**JAPAN**



***SENDAI***

