TECHNISCHE UNIVERSITÄT MÜNCHEN

GSI

TASCA 06

5th Workshop on Recoil Separator for Superheavy Element Chemistry

September 29, 2006, Garching, Germany

Gas phase chemistry experiments at TASCA

- Which SHE elements are relevant
- Comparison of chemical approaches with TASCA and without TASCA
- Future experiments

Which SHE elements are relevant

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
										5 B	6 C	7 N	8 O	9 F	2 He
										13 Al	14 Si	15 P	16 S	17 Cl	10 Ne
21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	18 Ar
39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	36 Kr
	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	54 Xe
	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh	117 Uus	86 Rn

$Rf(hfacac)_2$; $Sg(CO)_6$; $HBhO_4$; HsO_4 Volatile metals

57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu
89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr

- Volatile elements (metals), (hydro)oxides and new organometallic compounds are candidates for „new" gas phase chemistry
- Adosrption on a detector surface is most efficient

Comparison of chemical approaches

	with TASCA	without TASCA
Beam intensity	≥ 1 pμA ☺	0.3 – 1 pμA
Target thickness	~ 0.6 mg/cm^2 ☹	~ 1 mg/cm^2
Recoil transmission	10…70% ☹	~100%
Beam sensetive chemistry in RC	yes ☺	no
Destroying of aerosols	no ☺	yes
Preseparation	yes ☺	no
Detector to RC	yes ☺	no
Target contaminants	no ☺	yes

Possible future TASCA experiments

Based on mentioned above crucial points
our suggested future experiments at TASCA:

- Volatile metals — E114/E112 (vacuum) chromatography /with liquid metallic catcher/
- Organometallic compounds and carbonyls — $Rf(hfacac)_2$ ^{261}Rf gas phase chemistry; $Sg(CO)_6$ ^{265}Sg gas phase chemistry
- (Hydro)oxides — $HBhO_4$ and HsO_4
- Nuclear spectroscopy of ^{261}Rf and ^{265}Sg

What is common for all gas phase experiments?

- High volatility of species under study
- Chemical reaction in the RTC (if possible)
- Detector as chromatographic channel
- Directly connected to the RTC detector
- No aggressive reagents
- No aerosols

- Question: How can we monitor chemical yield with lighter homologs?

Vacuum chromatography of E114/E112 at TASCA

TASCA

Chemical interface for vacuum chromatography

^{244}Pu

^{48}Ca

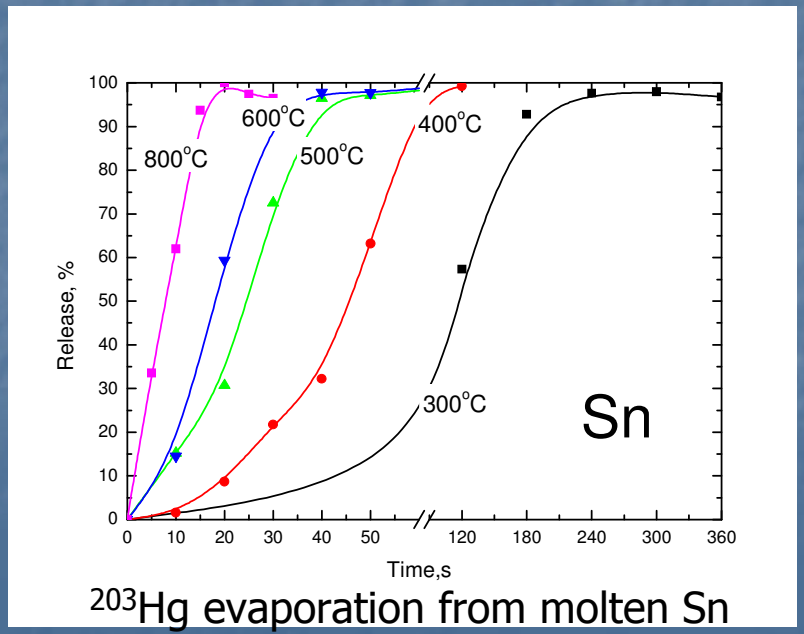
D

Q1

Q2

RTC

Hot catcher (thin Sn layer on Fe foil)



^{203}Hg evaporation from molten Sn

Rectangular channel 1x1x32 cm from 4 x 32 PIPS detectors

T

50

-100

-200

Cryopump

Organometallic compounds, oxides and carbonyls: problems to solve

- Rf chemistry

- Test experiments with Hf at BGS have been done by Ch.E. Düllmann et al.
- Continuation of these experiments at TASCA with Rf

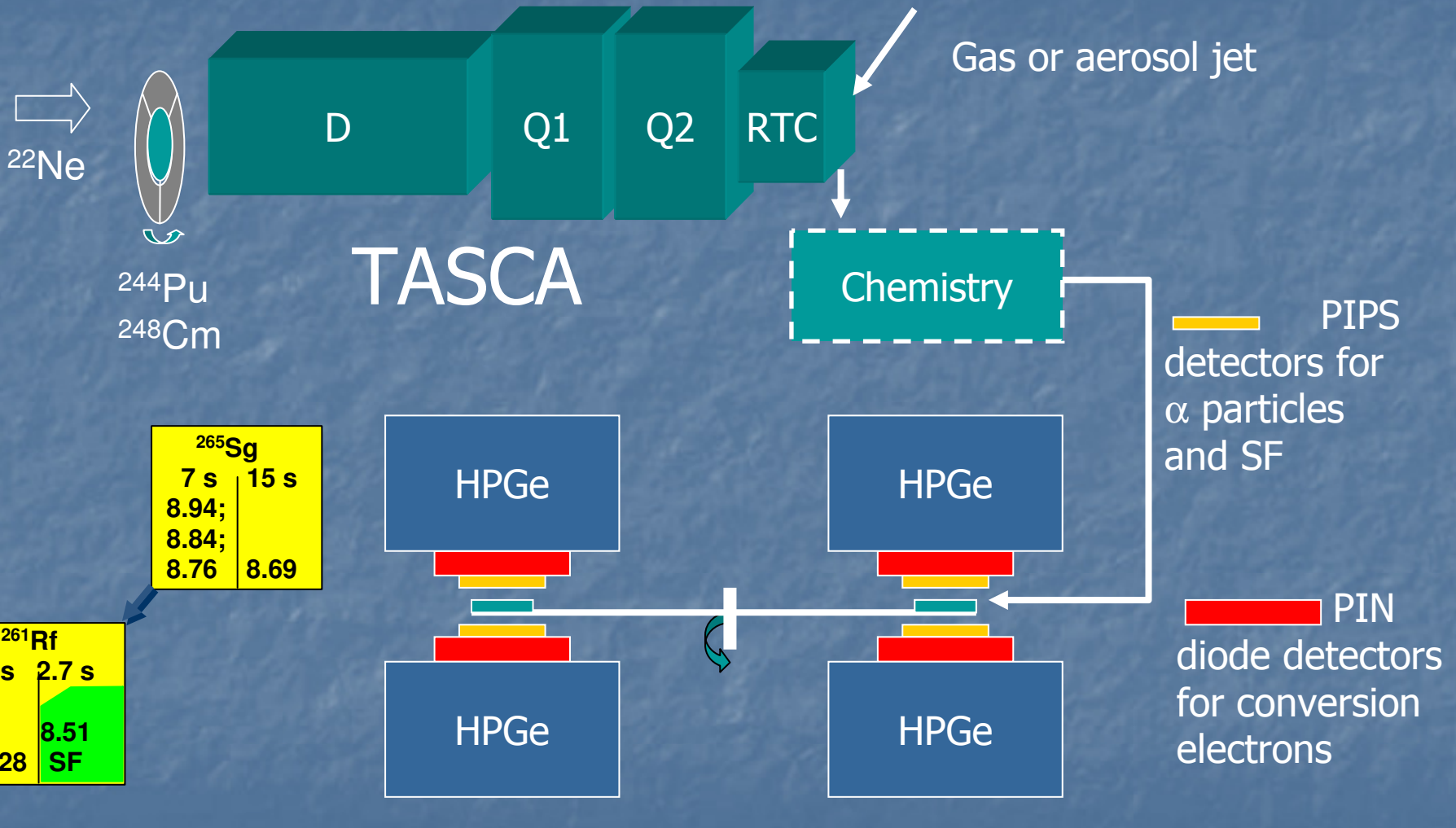
- Sg chemistry

- Study of $W(CO)_6$ formation with single hot atoms
- Study of adsorption of $W(CO)_6$ moleculs

- Bh and Hs chemistry

- Study of kinetics of (hydro)oxides formation

Nuclear spectroscopy with ^{261}Rf and ^{265}Sg



We can overcompensate losses in chemistry with high detection efficiency
Very low background after TASCA separator + chemistry

Conclusion

- Experiments at TASCA – new challenges in gas phase chemistry
- A lot of developments have to be done
- What is the first future gas phase experiment?
  - E114/E112 gas or vacuum chromatography
  - ?

  We have to give the answer as soon as possible
- Combination of advantages of gas phase chemistry and preseparation in TASCA is important
- Study of chemical and nuclear properties is possible