Investigation of group 8 metallocenes @ *TASCA*

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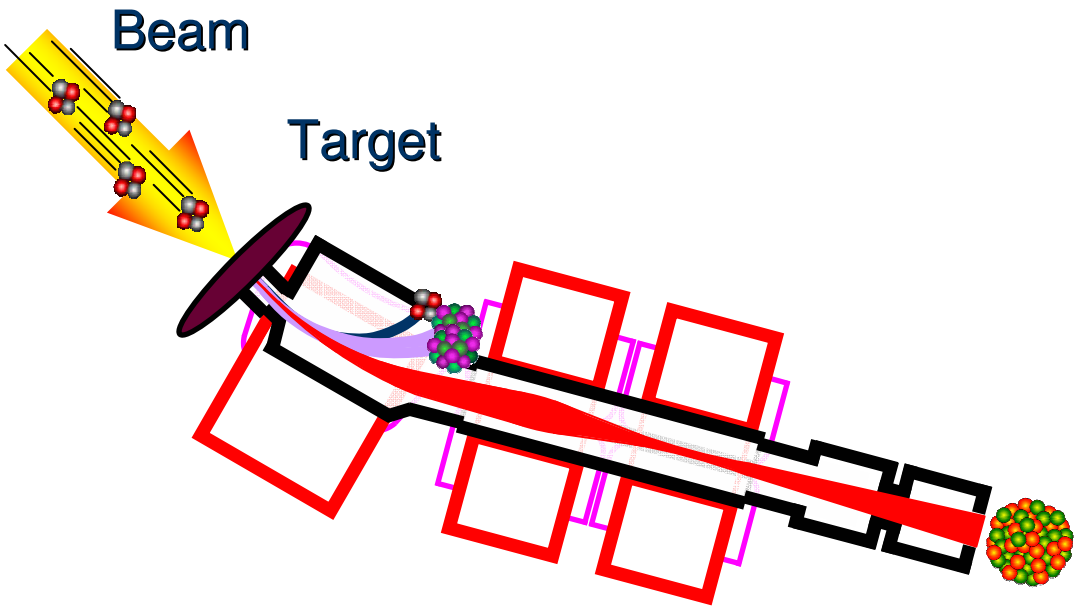
Transactinide Chemistry

Preseparation: a New Approach

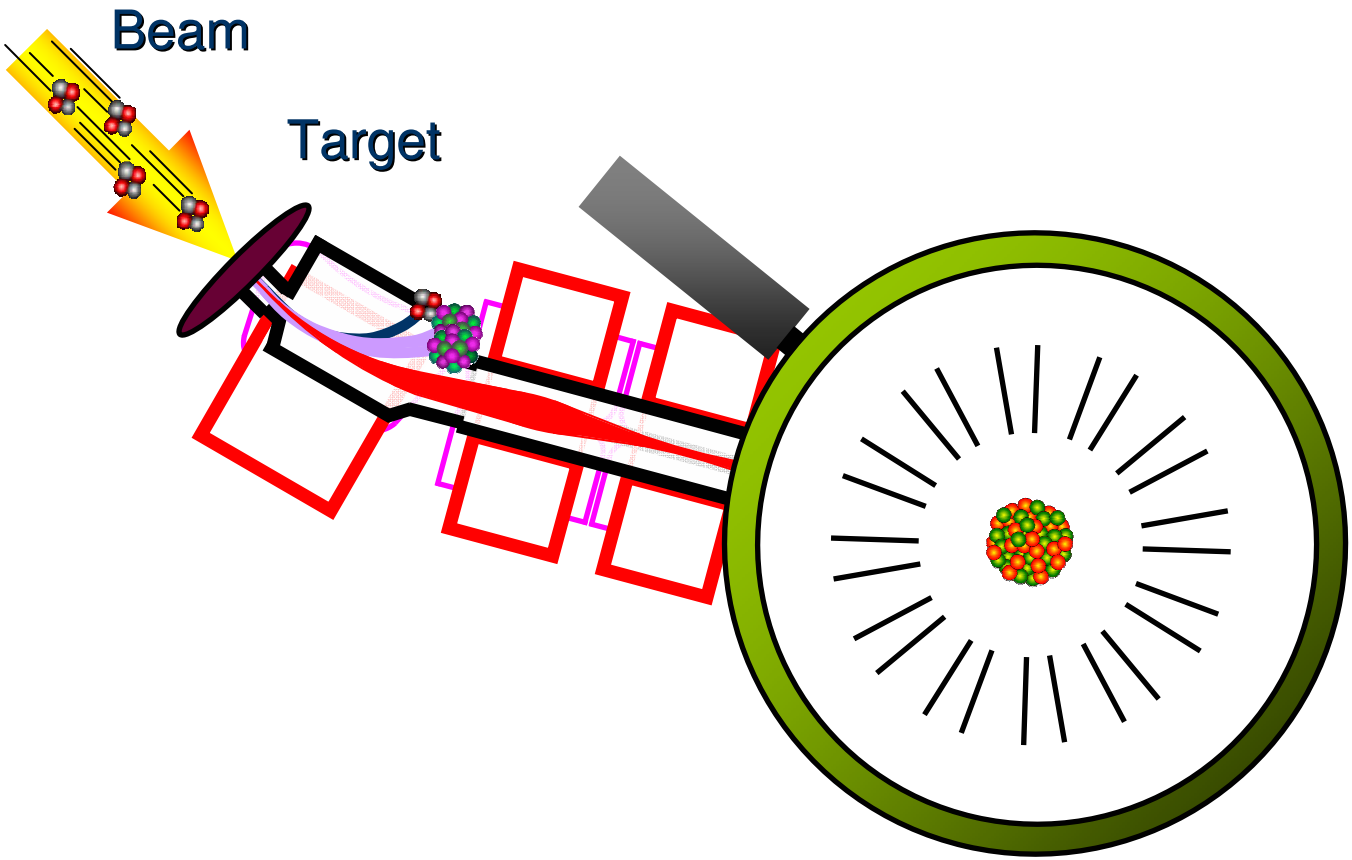


TASCA @ GSI

TransActinide Separator and Chemistry Apparatus

Transactinide Chemistry

Preseparation: a New Approach



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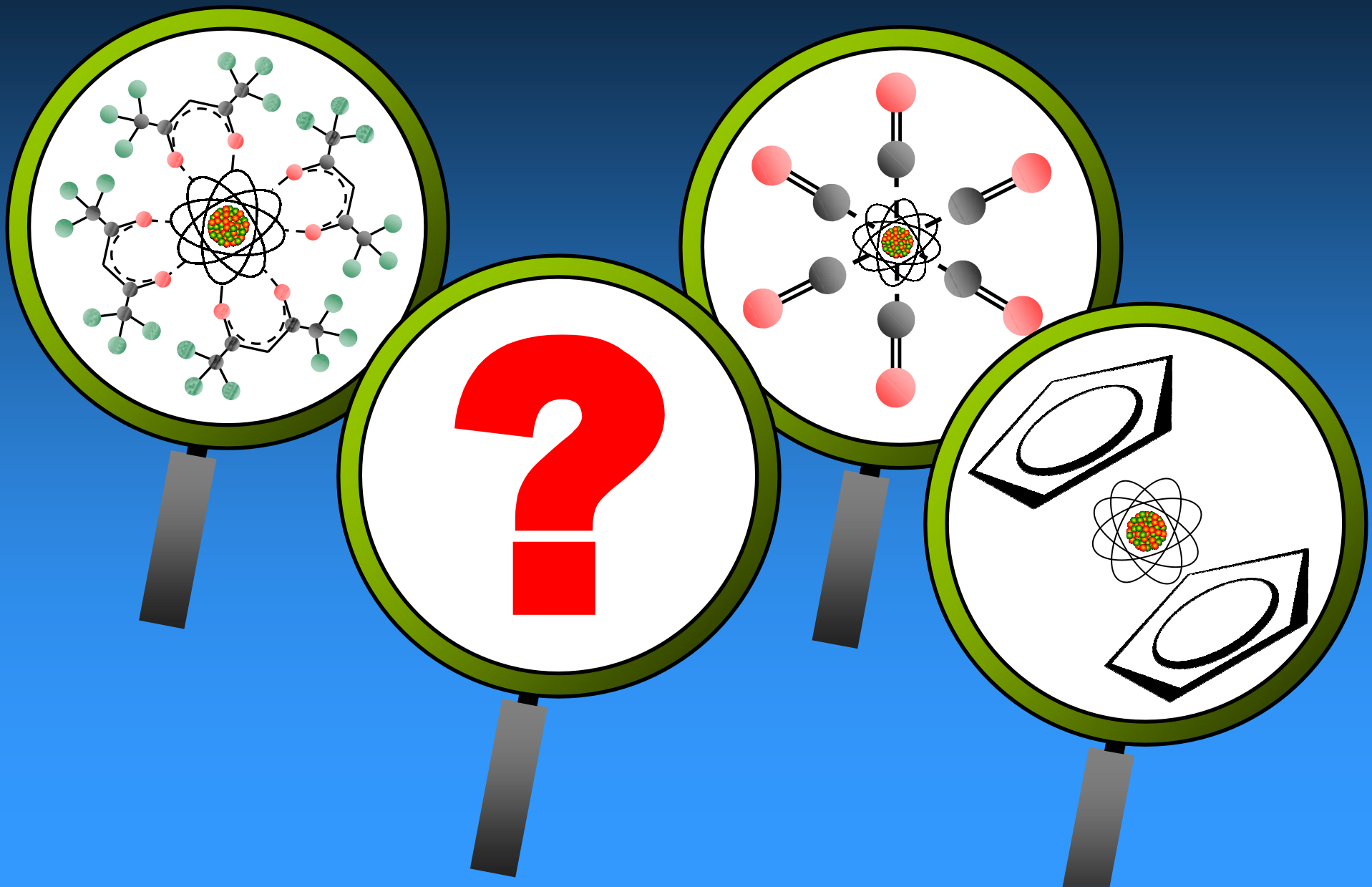
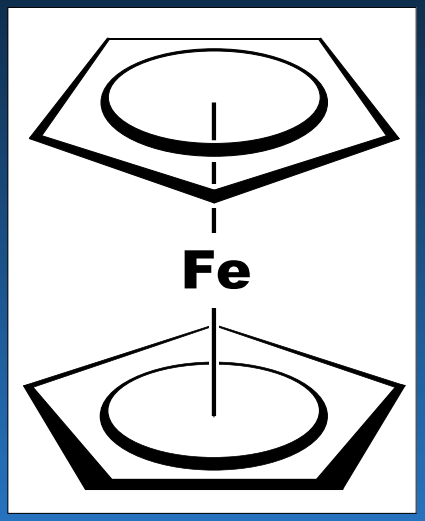
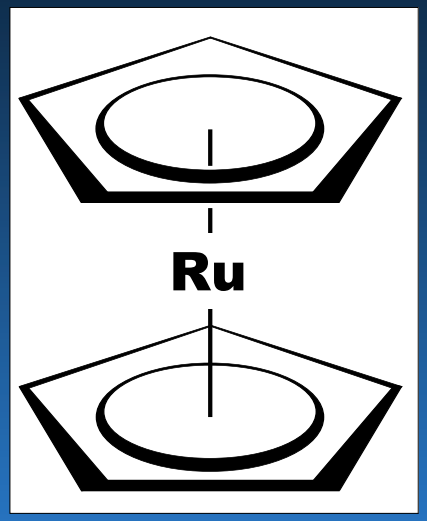
TransActinide Separator and Chemistry Apparatus

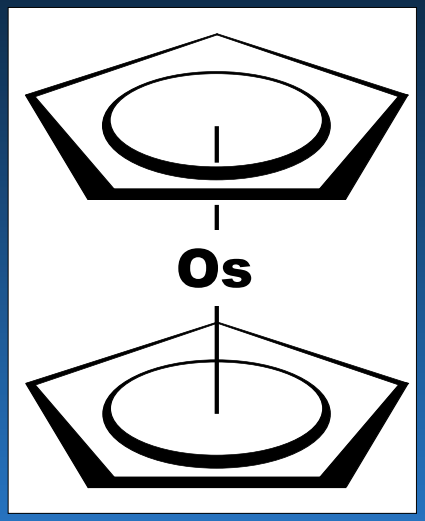
Potential chemical systems

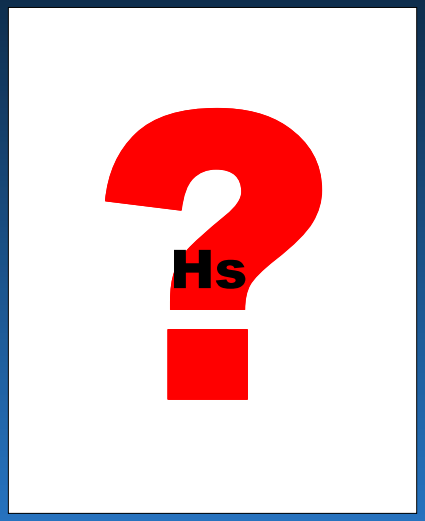


Hassocene – Science

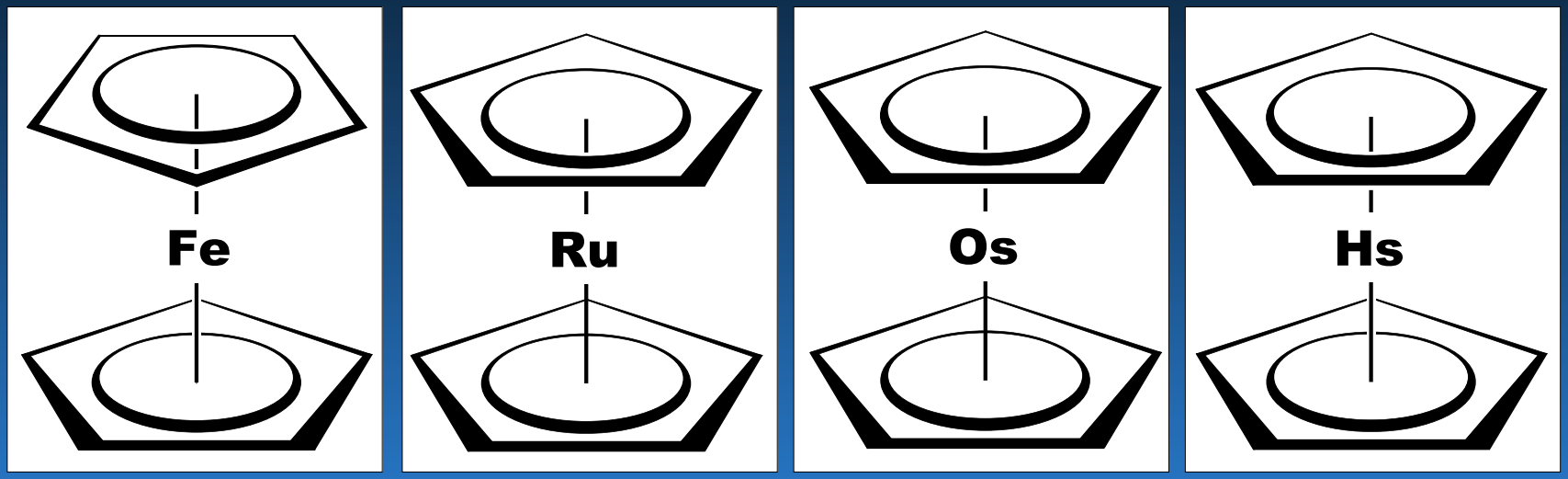








Hassocene – Science



-Group 8 metallocenes: 18 electrons

-$Ru(Cp)_2$ is the most stable metallocene!

-Metal-ring bond strenght: Fe<Ru<Os

ΔH_{sub} [kJ/mol]	73.4±1.1	76-83	73-80	??

J.S. Chickos, W.E. Acree Jr., J. Phys. Chem. Ref. Data 31 (2002) 537

Hassocene – Science

- Metallocenes: metal in formal 2+ state (though, ring-metal bonding mainly covalent)

  → in contrast to past studies, where the metal was in its highest oxidation state

  → influence of relativistic effects better visible?

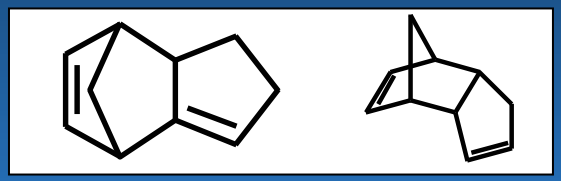
- Due to large number of $M(Cp)_2$: many effects studied systematically across the Periodic Table

- Highly symmetric systems with moderate number of atoms → fully relativistic 4c-DFT calculations under way

Hassocene – Technical

Cp trivia

Cp is commercially available, cheap, comes in dimeric form



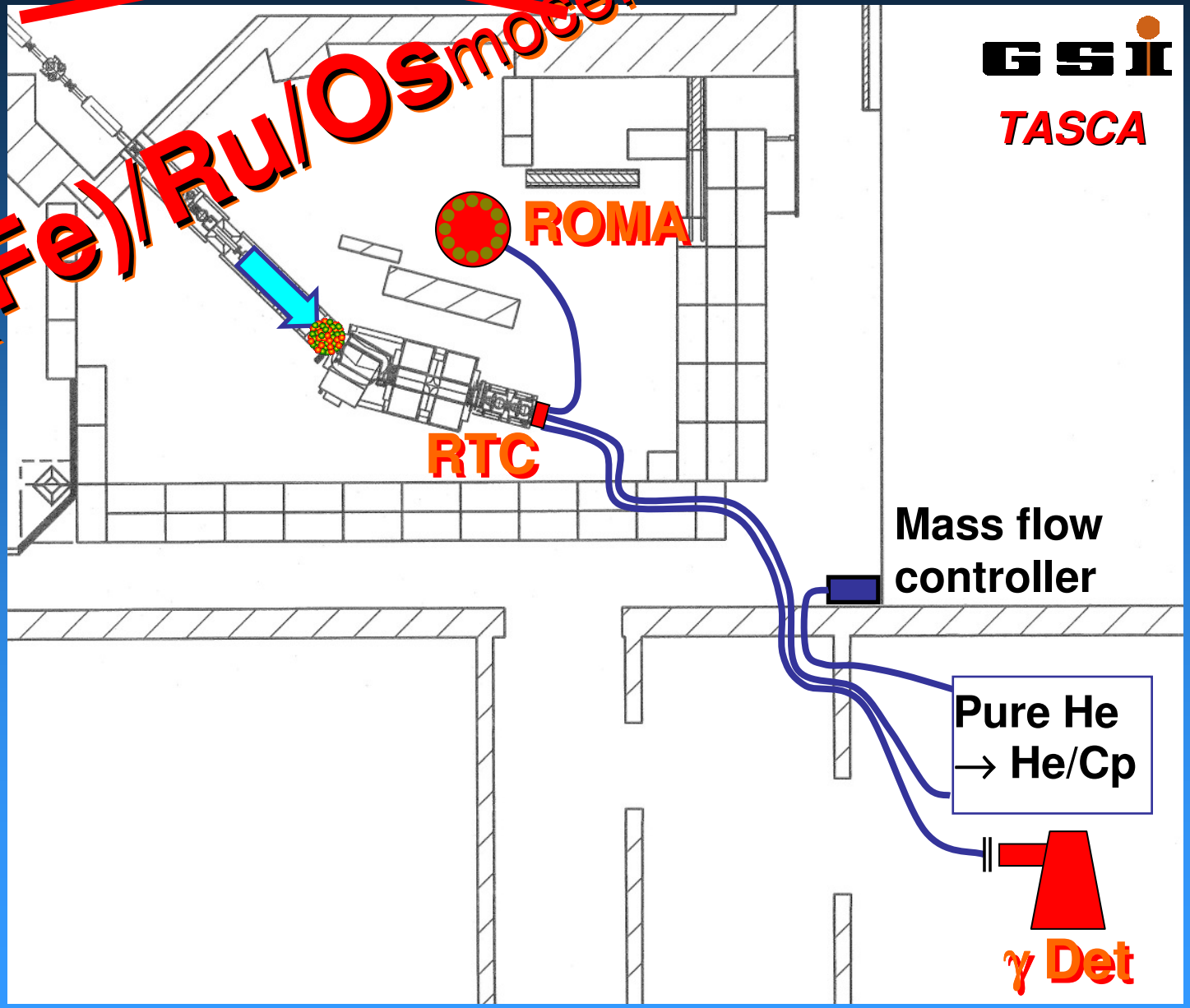
For synthesis, the monomeric form is needed

→ Cracking (usually: thermal cracking @ T>180°C, or at lower temp. with catalyst)

Once cracked, it dimerizes within hours @ room temperature (Diels-Alder-reaction)

→ **On-line cracking+distillation!!**

~~Hassocene~~ – Technical



Hassocene – Timeline

Early 2009:

Submit proposal to G-PAC, requesting beamtime for preparation experiments with lighter homologs. Alternative: combined "chem. development" proposal ?

(Hopefully...) later in 2009:

Start with several rather short (3-5 shifts) runs as soon as beamtime is available. Initial experiments with γ-decaying isotopes

2010

Optimization, Hs preparatory experiments with α-decaying isotopes

As soon as ready: Hs experiment

Beamtime request

For test experiments:

2009: 9 shifts parasitic beam

2010 6 shifts main + 6 shifts parasitic

For Hs experiment:

Depends on σ and ε_{TASCA} of:

	σ (pb)	ε_{TASCA} (%)
$^{248}Cm(^{26}Mg,3\text{-}5n)$	4-8	?
$^{238}U(^{36}S,3\text{-}5n)$	<1 (?)	?
$^{226}Ra(^{48}Ca,3\text{-}5n)$	~10 (?)	60

Beamtime request

For test experiments:

2009: 9 shifts parasitic beam

2010 6 shifts main + 6 shifts parasitic

For Hs experiment:

Depend

If formation of $Hs(Cp)_2$ is fast, 1-2 weeks for a Hs experiment should be sufficient. Reliable final number only after tests.

22	(?)	60

Necessary technical developments

For initial studies:

-On-line cracking + distillaton

→ Exists on paper, should not take too long

For experiments with α-decaying isotopes:

-Detection system (ROMA)

→ Fair amount of work (+€?) on DAQ hardware + GO4 implementation needed

Manpower

Could be an ideal PhD or postdoc project

Initial experiments not manpower intensive, but regular presence at GSI necessary

ROMA upgrade!!!

Conclusions

- $Hs(Cp)_2$ is likely stable, preseparation should make its investigation possible
- Relatively high volatility expected
- 4c-DFT calculations under way
- Interesting science
- Experiments with (Fe)/Ru/$Os(Cp)_2$ could start in 2009