Status of *TASCA* – on overview

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TASCA 06

5th Workshop on

Recoil Separator for Superheavy Element Chemistry

September 29, 2006

Garching, Germany

UNILAC Proposal U219: TASCA Commissioning

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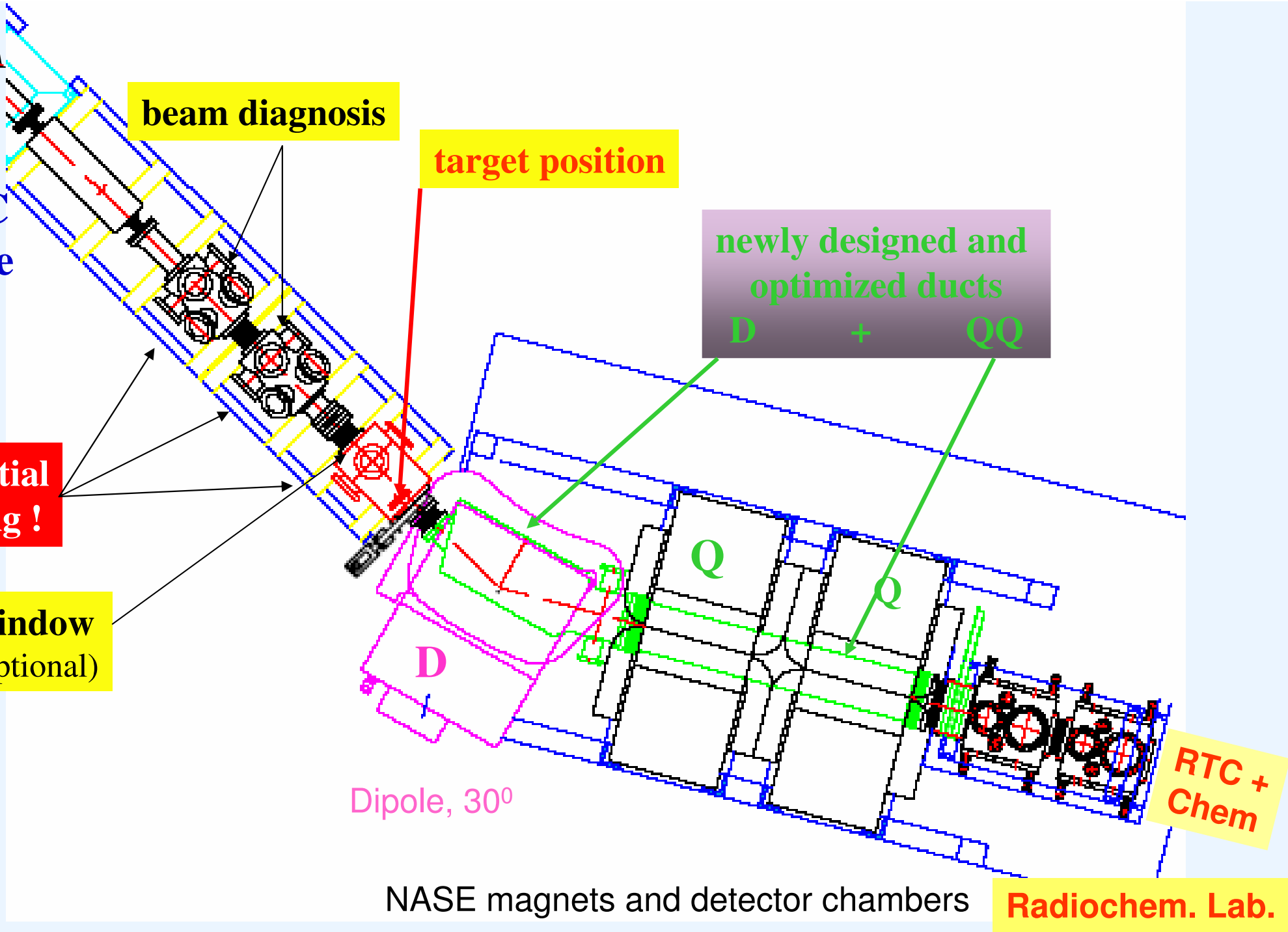
Mainz, Johannes Gutenberg-Universität
München, Ludwig Maximilians-Universität
München, Technische Universität
Oslo, University
Villigen, PSI

Everybody who likes to join is cordially invited to do so!

TASCA @ GSI's UNILAC beam line X 8



TASCA – Status (Fall 2006): Commissioning started

* $DQ_hQ_v + DQ_vQ_h$ Configuration optimized, built and tested ✓

* Installed at beam line X8 - close to a radiochemistry laboratory ✓

* Ion-optical Calculations to optimize the design and operational parameters ✓
  ➔ very good agreement: calculation ⇔ exp. results !!!

* Window-less Operation (differential pumping) for "unlimited" beam intensity ✓

* Control and Safety System designed for use of highly radioactive actinide targets ✓

* Target Wheels for highest beam intensity available + ongoing developments ✓

* Recoil Transfer Chamber (very thin window !) under construction at TUM, MZ, Oslo ✓

* Focal Plane Detector (1st generation) from a spare SHIP detector ✓ - *work in progress*

* Shielding built for max. future beam intensity; I (^{40}Ar) ≤ 30 μA_{part} ✓

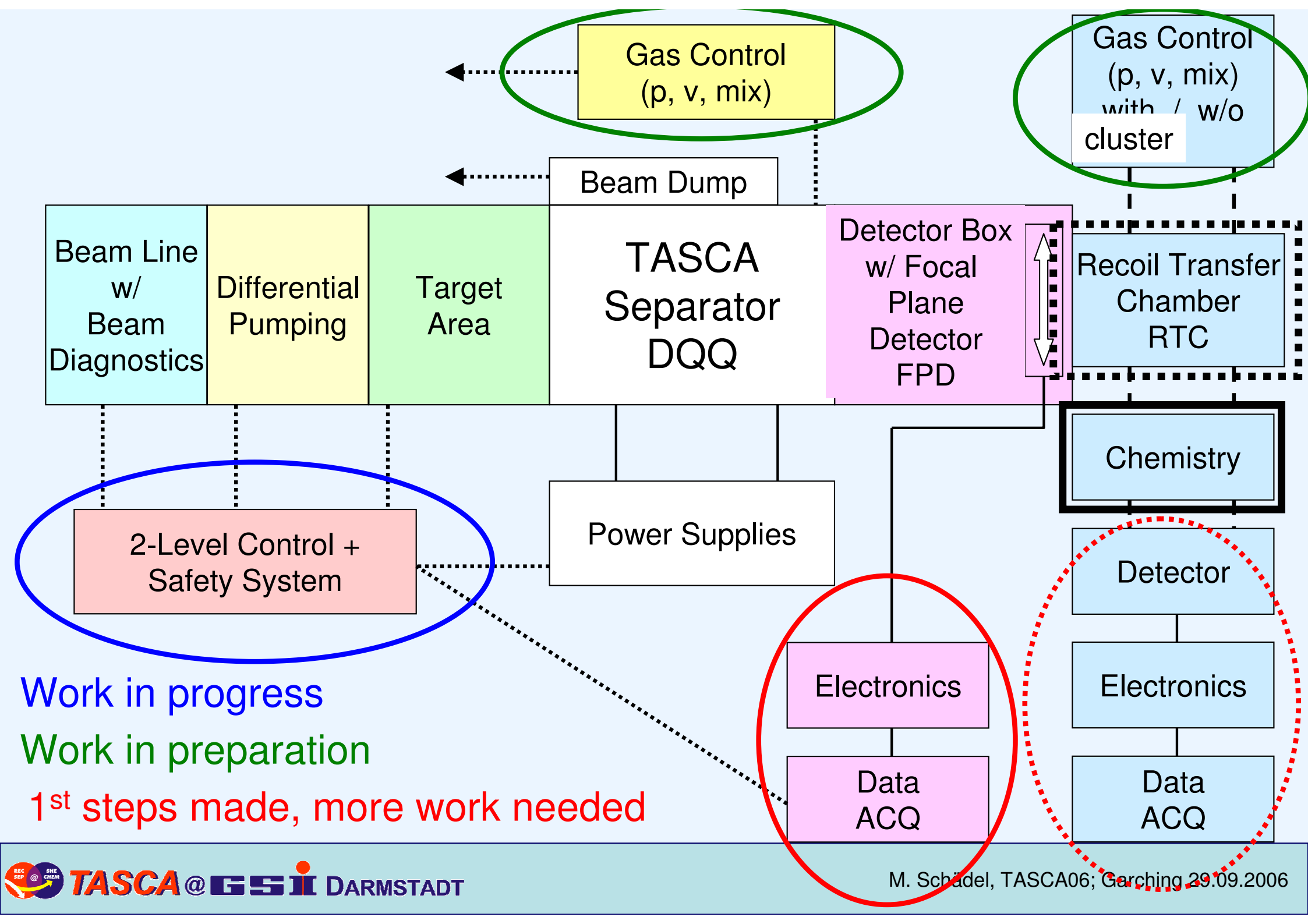
* Operation w/ Various Gases (He, H_2, N_2, Ne, CH_4, ...) planned; gas supply installed ✓

Comparison of gas-filled separators in SHE research

Separator	DGFRS	GARIS	BGS	TASCA	TASCA
Configuration	DQ_hQ_v	DQ_hQ_vD	Q_vD_hD	DQ_hQ_v	DQ_vQ_h
Length / m	4.0	5.8	4.7	3.5	3.5
Bend. angle / deg	23	45+10	70	30	30
$B\rho_{max}$ / Tm	3.1	2.16	2.5	2.4	2.4
Dispersion / mm/%	7.5	9.7	20	9	1
Solid angle / msr	8.8	12.2	45	13.1	4.3
Transmission / %	41	40*	49-59	60§	36§

Transmission for
$^{48}Ca + {}^{238}U/{}^{244}Pu \rightarrow 112/114$

§ Monte Carlo simulation
400 µg/cm² target
* Estim. from test reactions; K. Morita priv. comm.


Gas Control
(p, v, mix)
Gas Control
(p, v, mix)
with / w/o
cluster
Beam Dump
Beam Line
w/
Beam
Diagnostics
Differential
Pumping
Target
Area
TASCA
Separator
DQQ
Detector Box
w/ Focal
Plane
Detector
FPD
Recoil Transfer
Chamber
RTC
Chemistry
2-Level Control +
Safety System
Power Supplies
Detector
Electronics
Electronics
Data
ACQ
Data
ACQ
Work in progress
Work in preparation
1st steps made, more work needed

Commissioning Experiments – Parameter Studies

Beam line, diagnostics *TASCA* components	Magnets, controls + safety system, interlocks, differ. pumping, (actinide) targets@ high beam intensity
Separator in DQ_hQ_v and DQ_vQ_h mode	Transmission (exp. ⇔ model), separation effic., focal spot Target thickness, gas pressure, charge state (50 – 1000) µg/cm^2 (0.1 – 1) mbar ^{40}Ar, ^{22}Ne + Sm, Gd, Au, Th, U → Hg, Pb, Ac, (Fm), No
*F*ocal *P*lane *D*etector and *D*ata *Ac*quisition	Ar+Lu,Ta,Pb→Ac,Pa,Fm; Ne+U→No: **100 µb-20 nb**, *hv* α-α-, α-SF-, α-γ-correlation, rate, fast beam shut-off
*R*ecoil *T*ransfer *C*hamber	Window, transport w/ + w/out cluster, coupling chem.
Final full test, element 104	*Cold fusion, ^{50}Ti+^{208}Pb→^{257}Rf: - FPD, excitat. fct.; vh* *(15 nb) - liquid chemistry; hv* Hot fusion, ^{22}Ne+^{244}Pu→^{261}Rf: - FPD, excitat. fct.; *hv* (4 nb) - liquid+gas chem.; *hv*

➔ *"Understand" TASCA, be ready to perform Z≥104 chemistry + physics experiments*

Summary - Beam Time Request; ≈ 2 year program (2006-07)

	Topic	Beam	Shifts
✓	**Beam line** - beam diagnostics, focusing onto target	#	3
✓	**Beam through TASCA (vacuum)** - check magnets, calibrations, focusing	#	8
(✓)	**First product beam through TASCA (He)**	#	18
	Sum - parasitic beam time (8 h shifts)		29

 # Any parasitic 12 ≤ A ≤ 50 beam

	First full test of FPD, DAQ - α-α-correlations, fast beam shut-off	^{40}Ar	4
✓	**First test reaction** – FPD spot size, calc. <=> measured efficiency; DQ_hQ_v+DQ_hQ_v	^{40}Ar	10
	First RTC and window tests - w/ cluster, - w/o cluster	^{40}Ar	12
	Separator efficiency – fct. of target thickness (50 - 1000 µg/cm^2)	^{40}Ar ^{22}Ne	6 12
	Rotating target set-up + target stability – safety features w/ beam; transfers (✓)	^{40}Ar	3
	Transmission + focal spot size - fct. of p(He) (1-0.1 mbar) + charge state, minimizing transfer products; DQ_hQ_v + DQ_hQ_v	^{22}Ne	15
	RTC optim. + chemistry set-up coupl. - w/ cluster transport	^{22}Ne	9
	Final FPD check - DAQ, SF, test α-α -, α-γ,x-ray coincidences	^{40}Ar ^{22}Ne	6 6

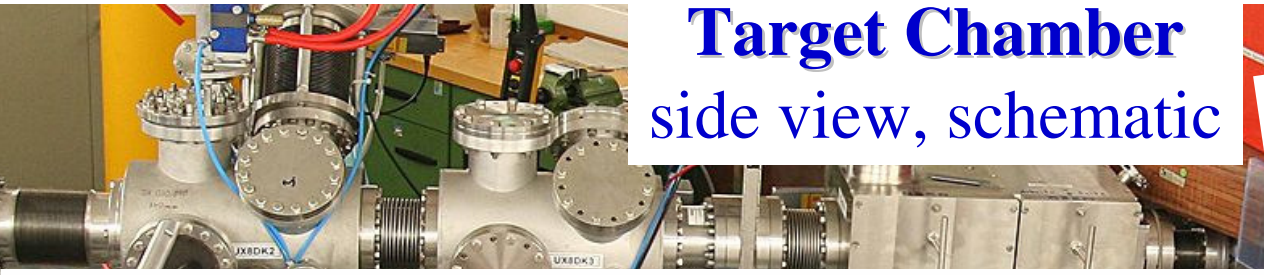
EA accepted (*preliminary* info) 83 shifts

Window-less Operation – Differential Pumping

WKP 1000 / DUO 65 (not shown)

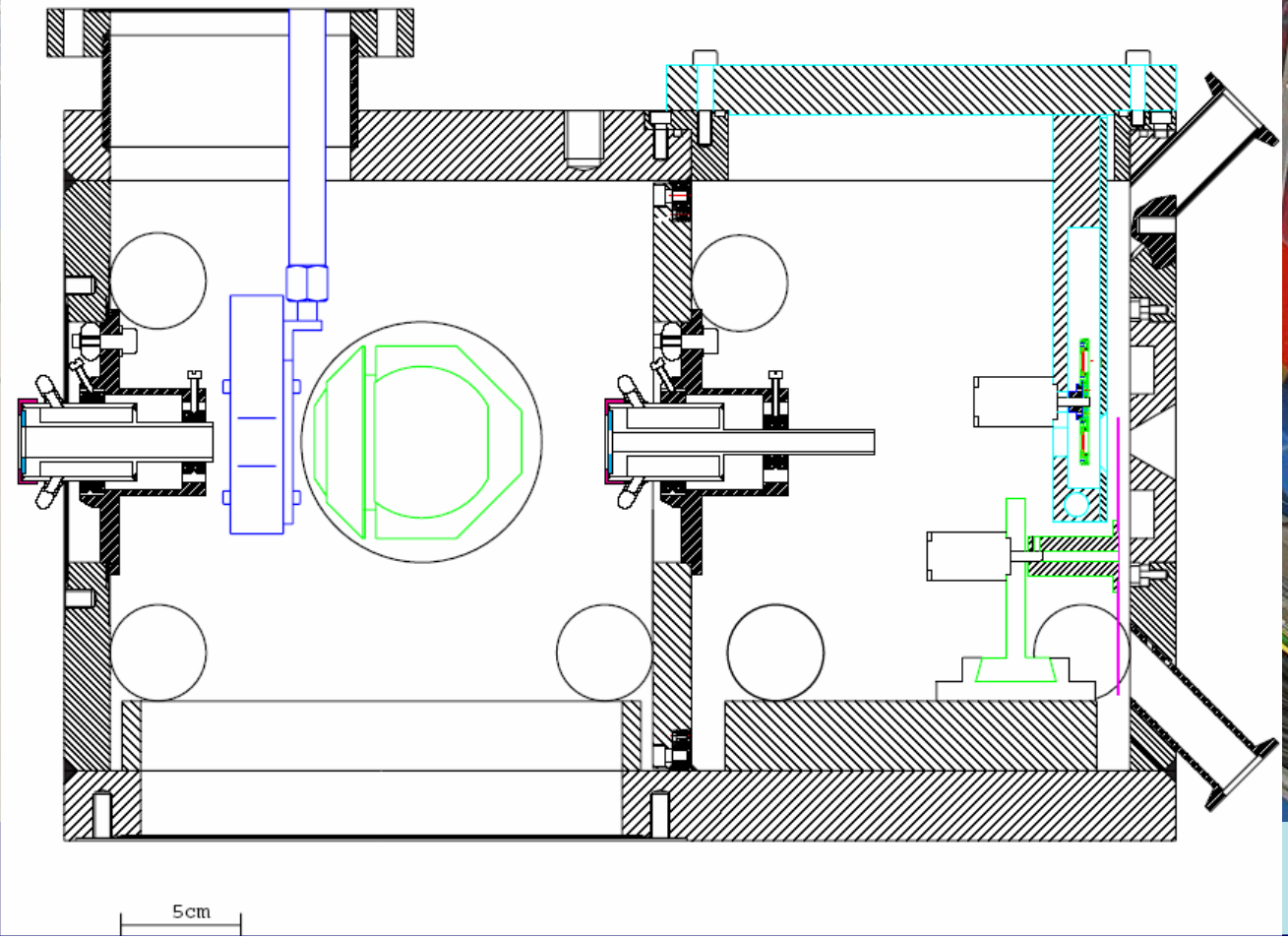
TMU 400 / DUO 35

TMU 1600 / DUO 20



Target Chamber

side view, schematic



TASCA@GSI

DQQ new ducts

w/ maximized aperture

DQQ-configuration

tested up to max. B-field