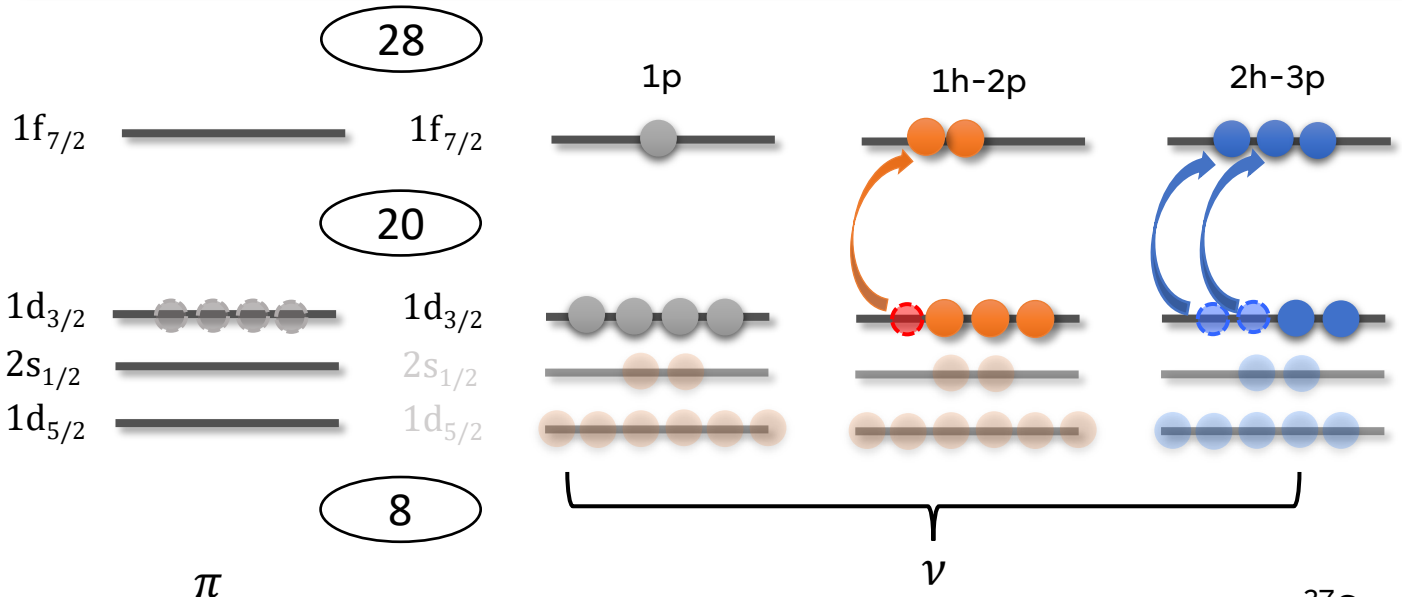
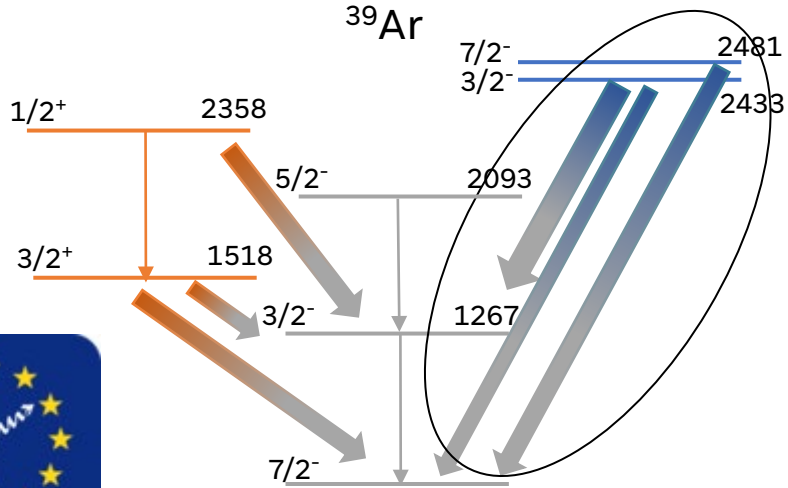
Report on EXP_001

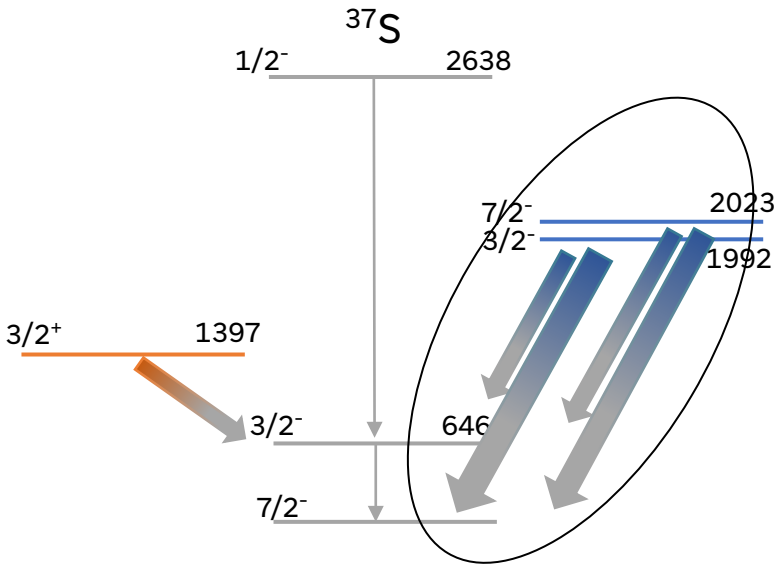
Mixing between single particle and intruder states towards the N=20 island of inversion: lifetimes in ^{37}S

L. Zago, *INFN LNL and UniPD*

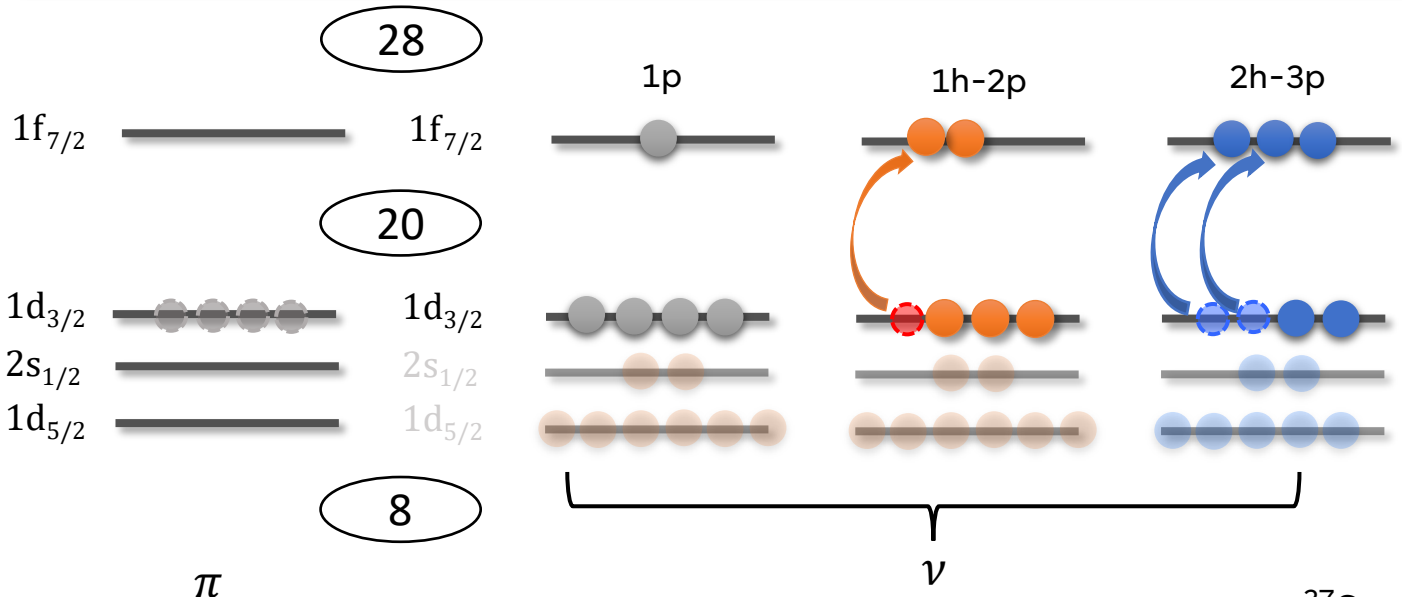
Mixing in the N=21

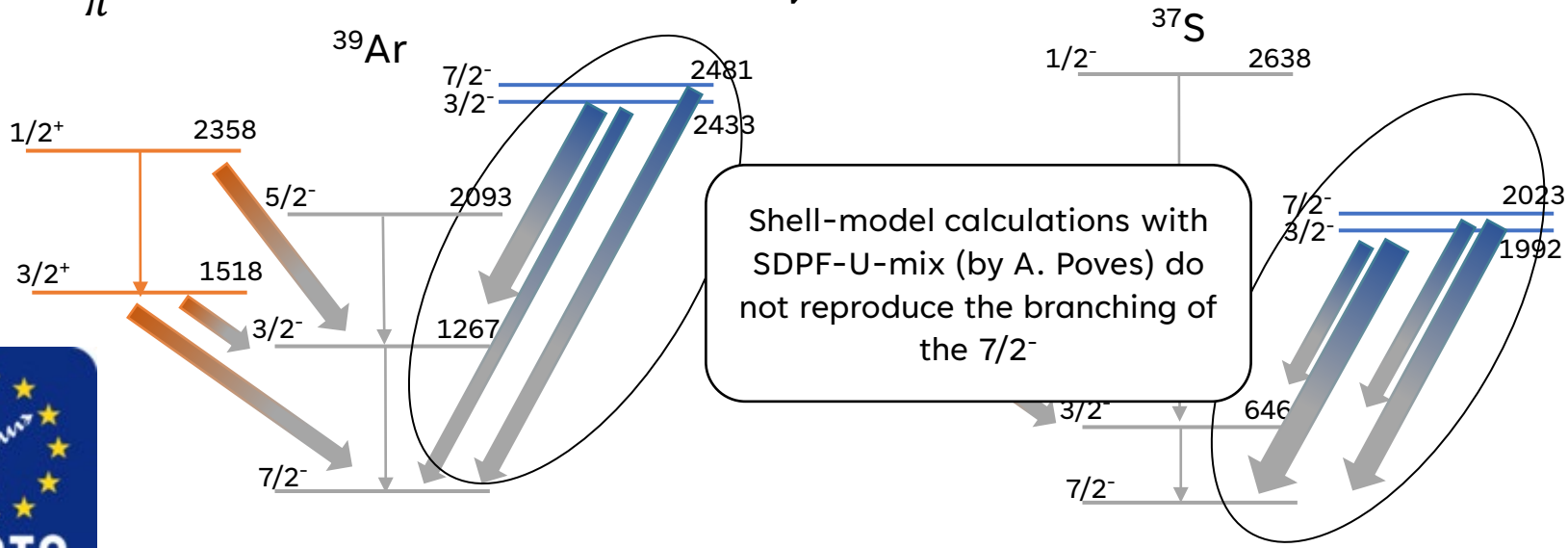




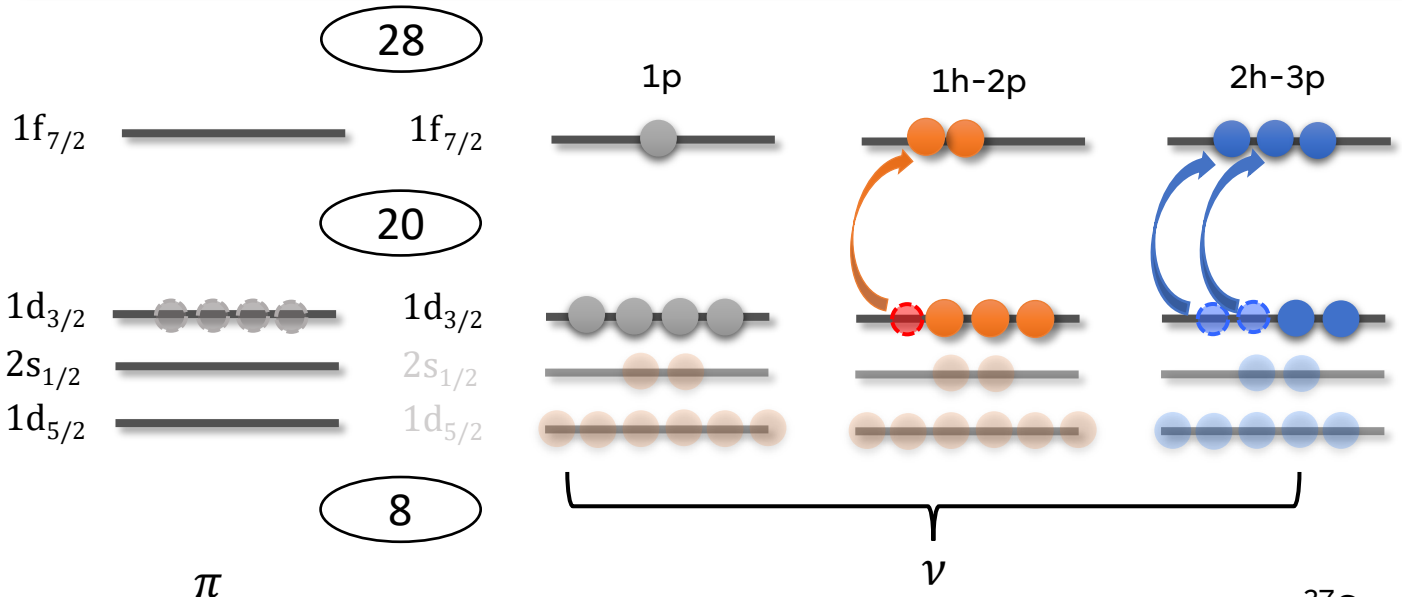


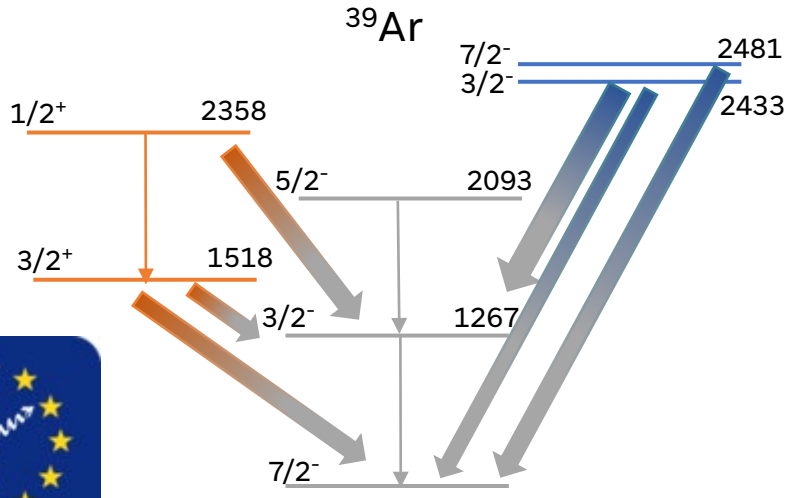
Mixing in the N=21

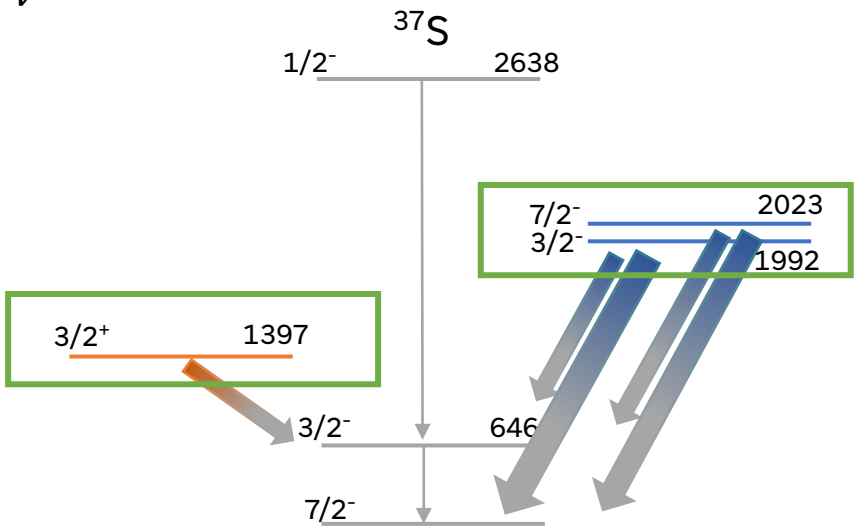




Mixing in the N=21





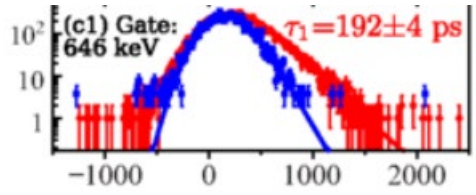


^{37}S: previous results

CLARA+PRISMA ^{36}S+ ^{208}Pb (~2004)
only spectroscopy

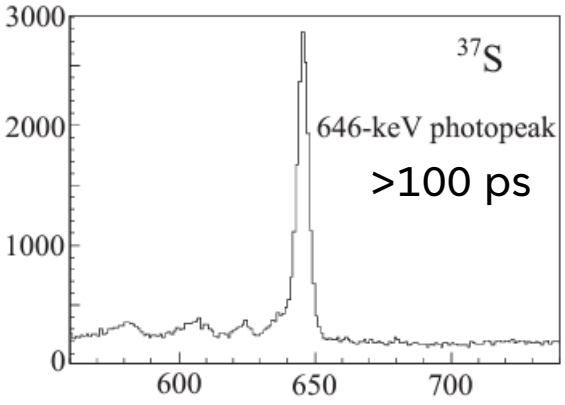
AGATA+PRISMA ^{36}S+^{208}Pb (June 2011)
5 plunger distances: 7-120 μm
only upper/lower limits

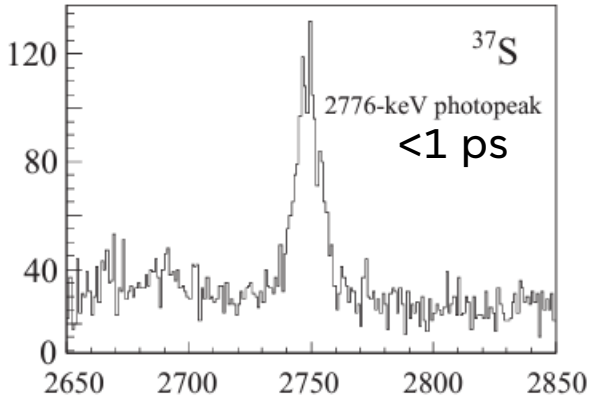
Fast timing measurement (2014)
only 646-keV 3/2$^-$ lifetime



Wang *et al.*, Phys. Rev. C, **94** 044316 (2016)

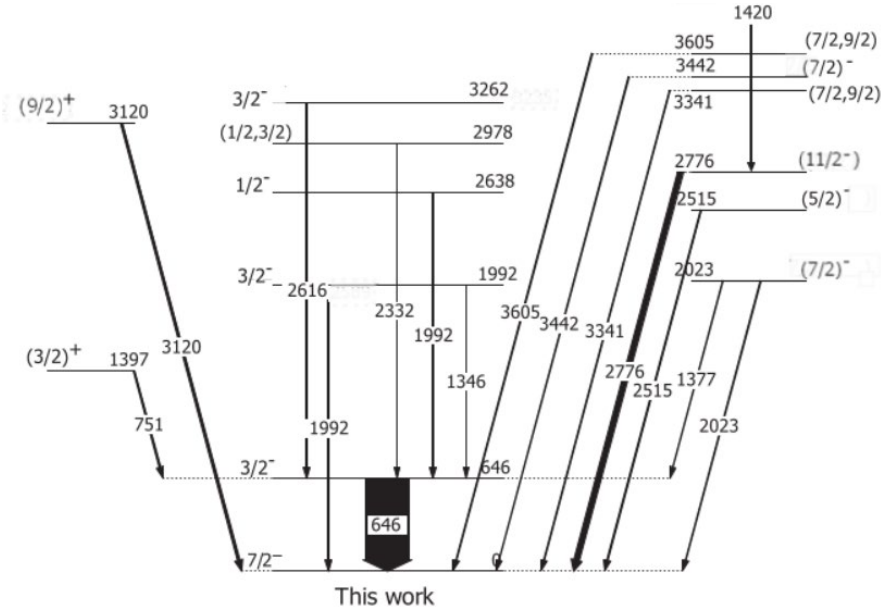
Grocutt *et al.*, Phys. Rev. C, **106** 024314 (2022)





AGATA+SPIDER ^{36}S(d,p) (EXP_001)
sp: F. Galtarossa, A. Gottardo

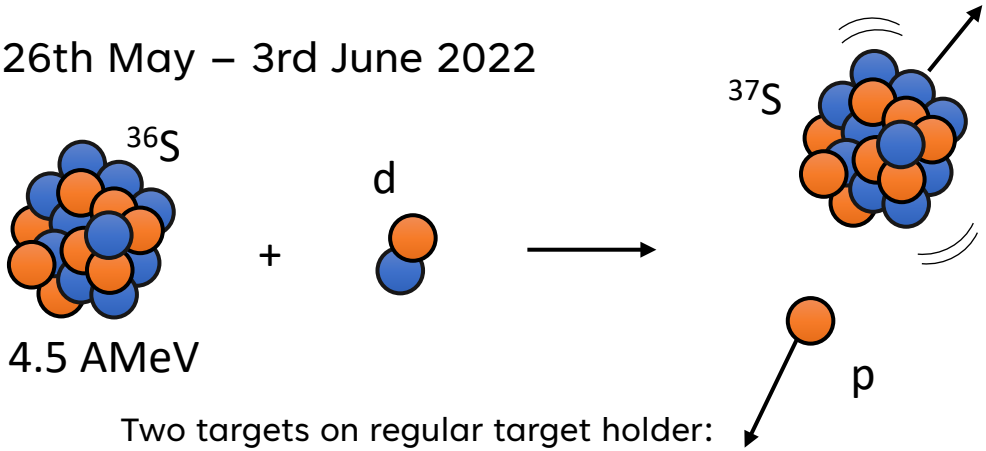
AGATA+PRISMA ^{36}S+^{208}Pb (EXP_010)
DSAM measurement, talk by R. Nicolás del Álamo



Chapman *et al.*, Phys. Rev. C, **93** 044318 (2016)

EXP_001 (LNL PAC 22.07)

26th May – 3rd June 2022



Two targets on regular target holder:

1 CD_2 + 30 ^{197}Au

0.3 CD_2

for DSAM only measurements

11 ATC present on the array:
00, 01, 02, 04, 05, 06, 07, 08, 09, 10, 11
Full traces written on disk:
~31 TB/7 days
No trigger condition applied in data taking.

AGATA

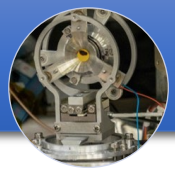
Two targets on Cologne plunger cone:

0.5 CD_2 + 4 ^{197}Au

0.5 CD_2 + 6 ^{197}Au

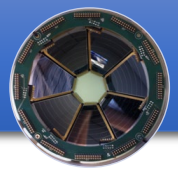
all facing a **^{181}Ta stopper**.
Distances covered
0.7, 1, 1.5, 3, 3.8, 5, 7, 10 mm
for about 1 day/distance

Plunger

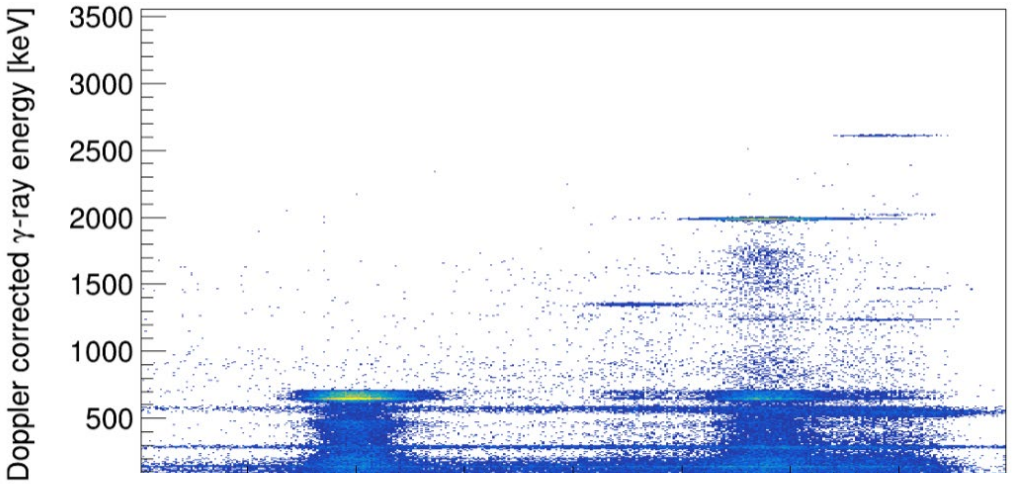


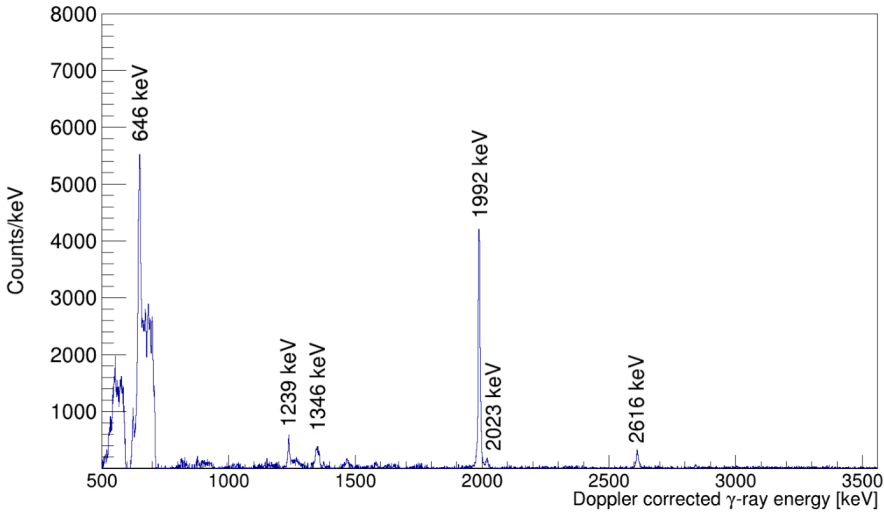
7x8 segmentation to detect recoil ^{1}H.
Angular range covered:
124°-161° ($\Delta\Omega$ = 17%)
Low energy protons near the detection threshold (~500 keV).

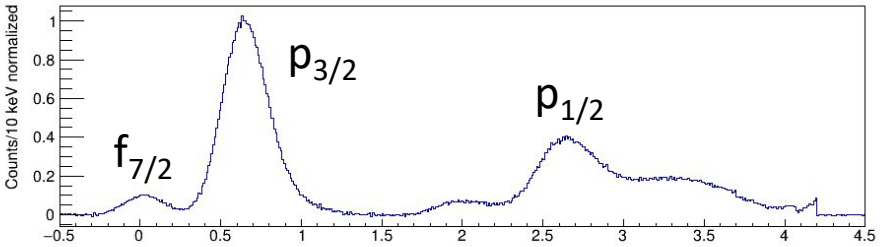
SPIDER

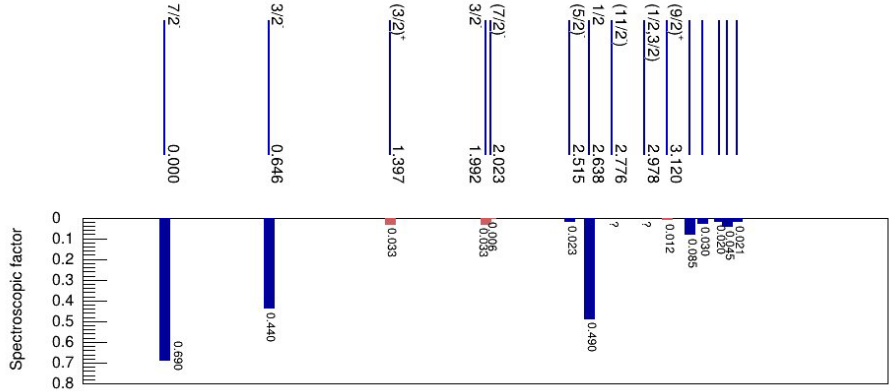


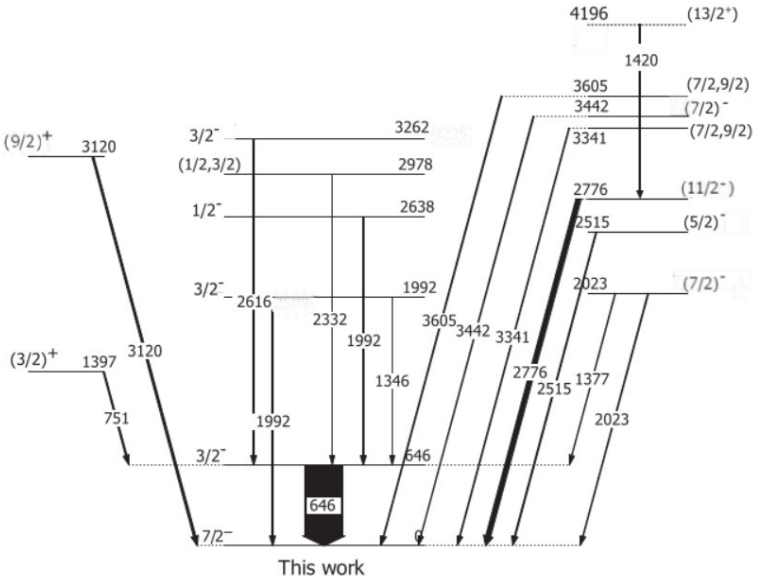
Spectroscopy





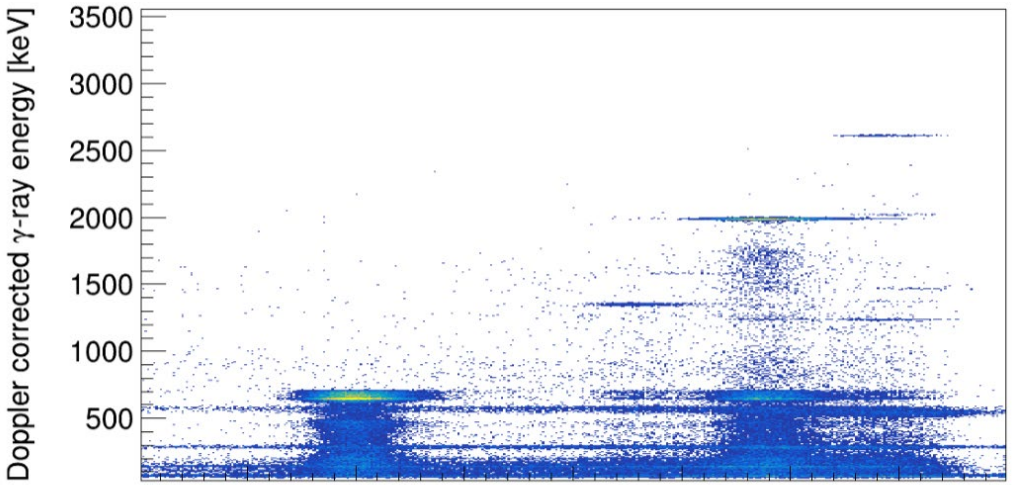


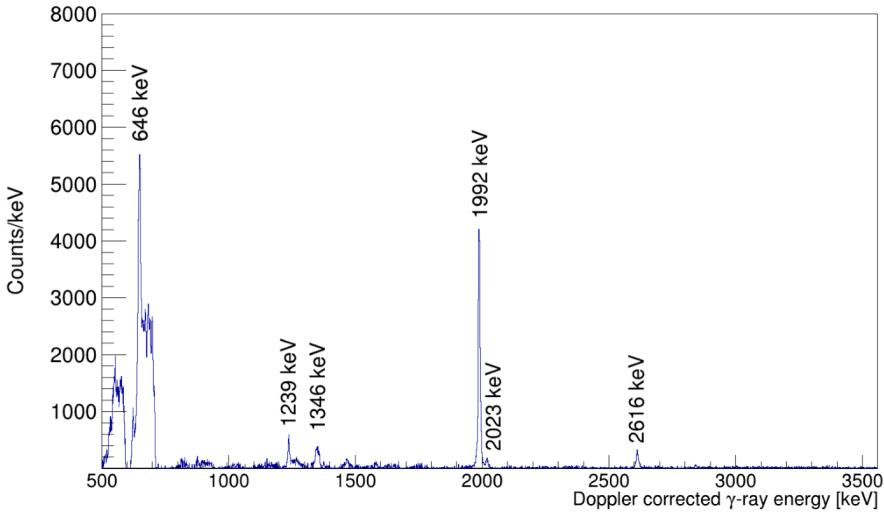


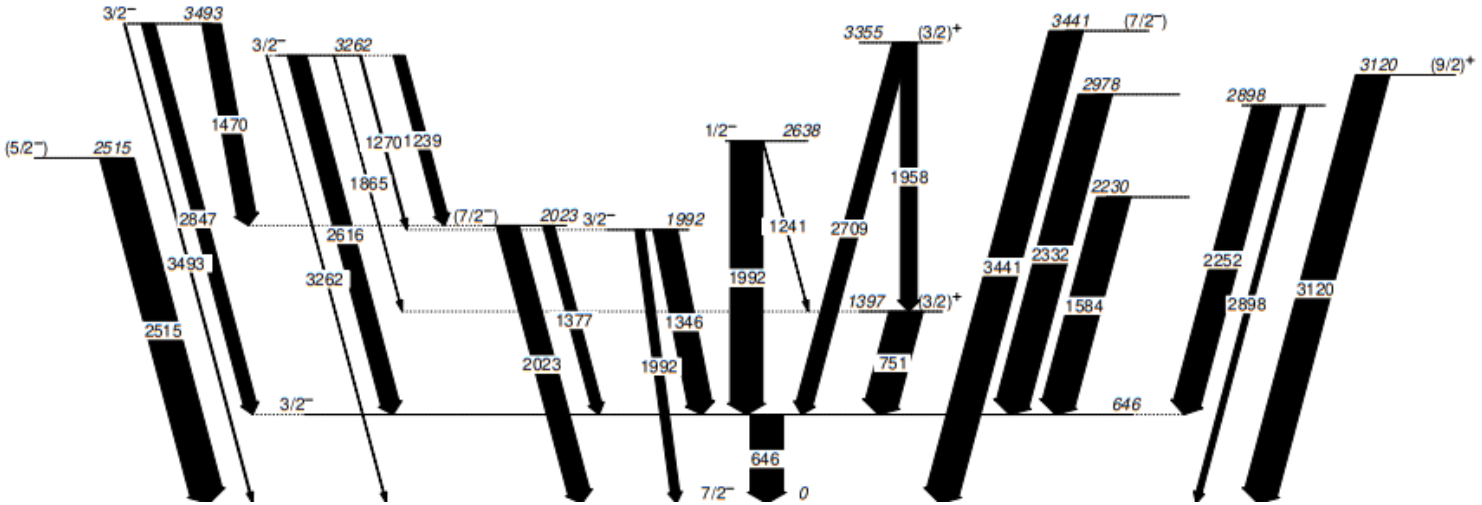


Chapman *et al.*, Phys. Rev. C, **93** 044318 (2016)

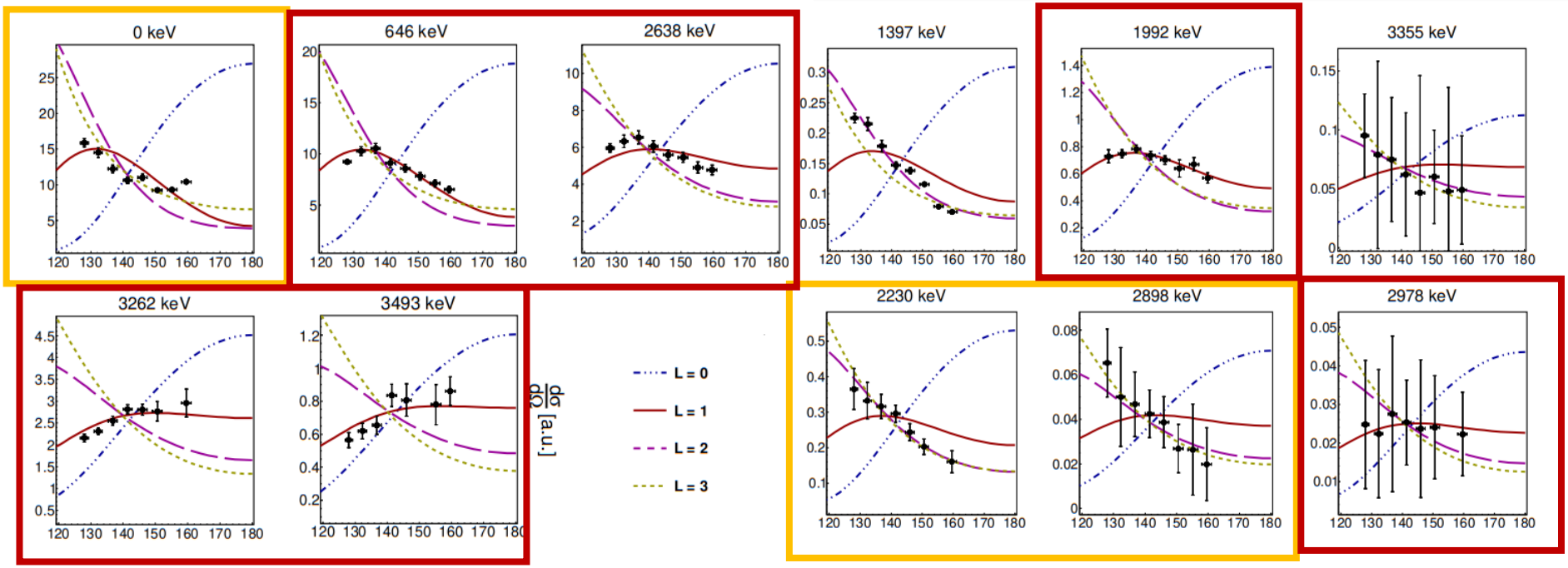
Spectroscopy







Spectroscopy

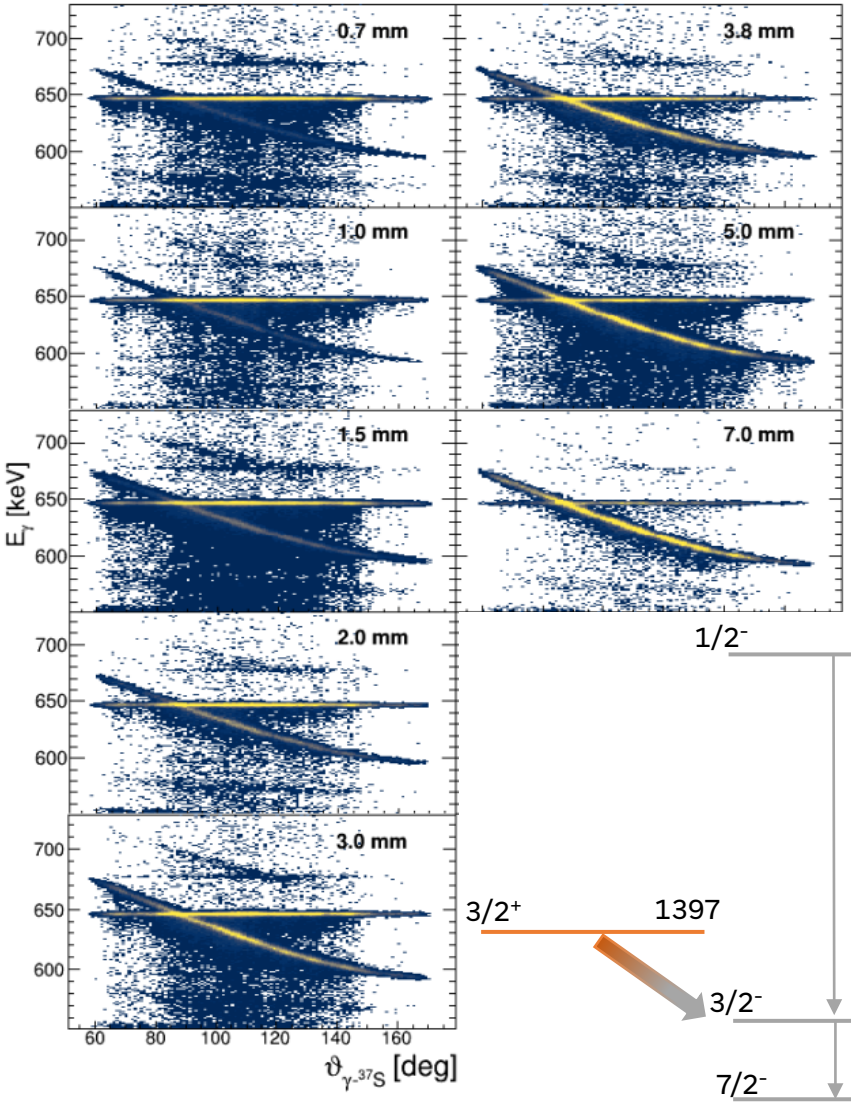


E [keV]	J^π	$S^{lit.}$ 100	$S^{exp.}$ 100		
			L=1	L=2	L=3
0	$7/2^-$	69	–	–	65(4)
0.646	$3/2^-$	44	–	–	–
1.397	$(3/2)^+$	3.3	–	5(1)	–
1.992	$3/2^-$	3.3	2.9(6)	–	–
2.230	–	–	2.3(5)	6(1)	13(3)
2.638	$1/2^-$	49	46(9)	–	–
2.898	–	–	0.3(1)	0.6(3)	1.4(6)
2.978	(1/2, 3/2)	–	0.2(1)	0.4(2)	0.9(4)
3.262	$3/2^-$	8.5	11(4)	–	–
3.355	$(3/2)^+$	3	–	1(1)	–
3.493	$3/2^-$	4.5	3(1)	–	–

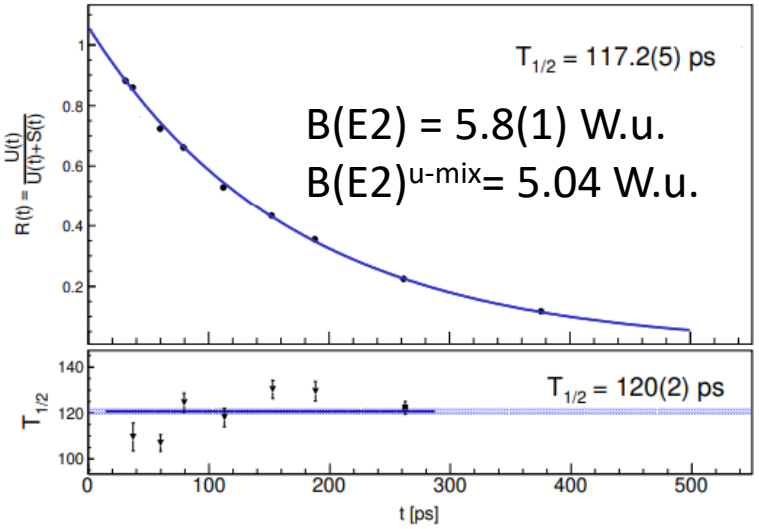
Obtained relative SF within 1σ with the Adopted ones, except 3 cases with 2σ.

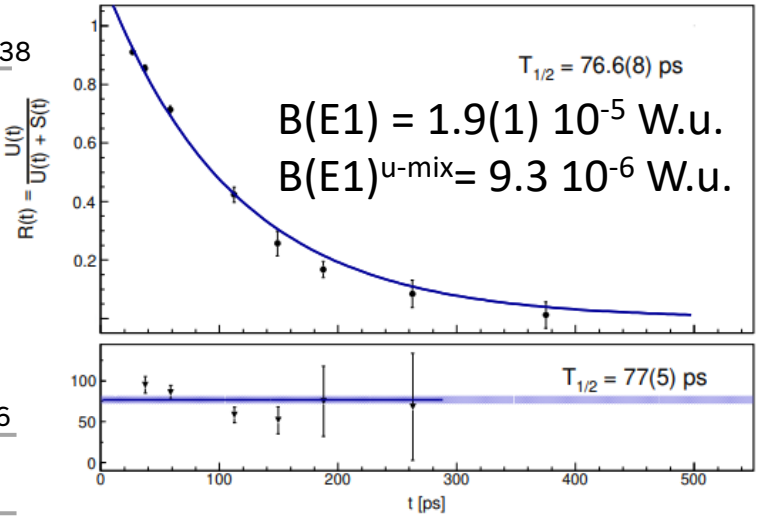
Relative SF for 3 new states measured.

Lifetimes: RDDS

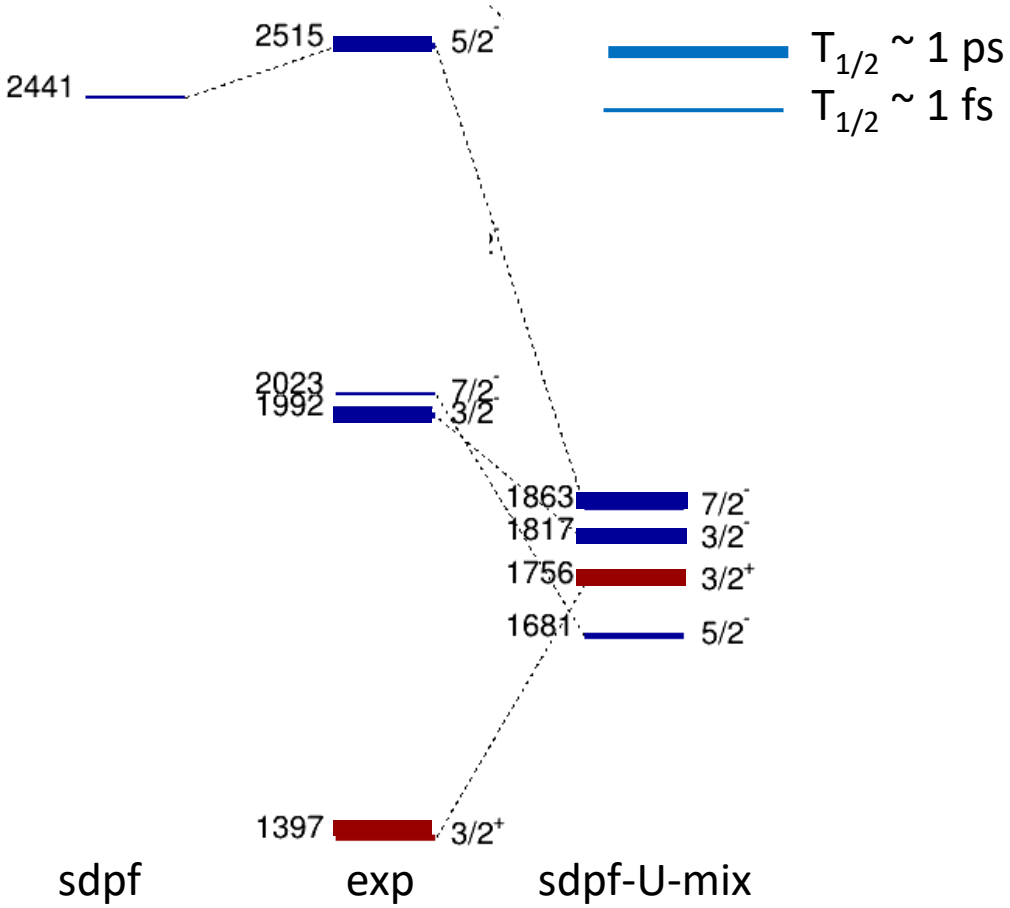


Calculations with *sdpf-u-mix* by A. Poves



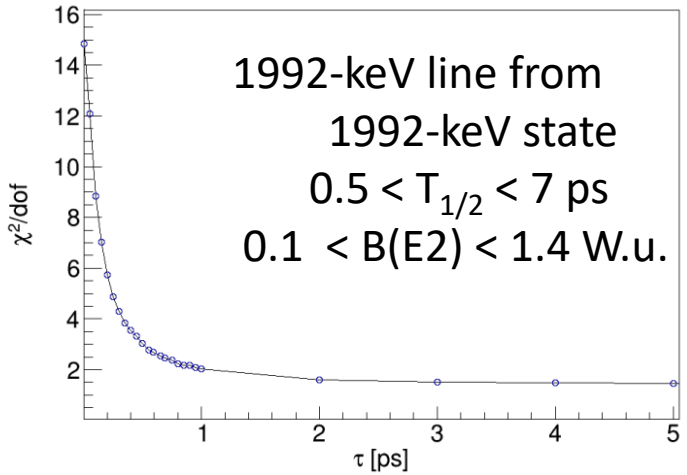


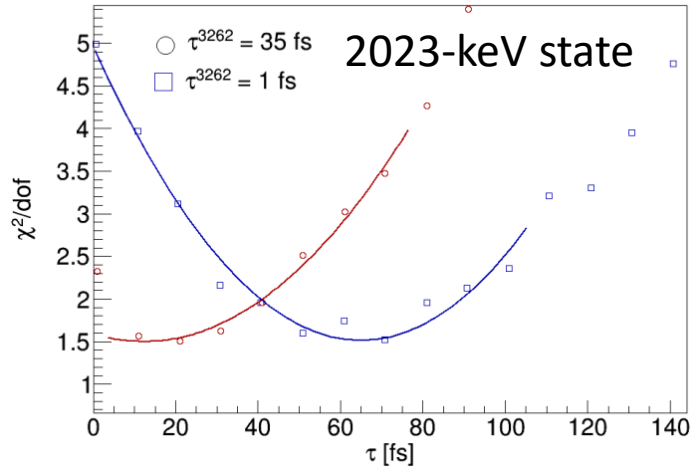
The low energy intruders



$T_{1/2}$ ~ 1 ps

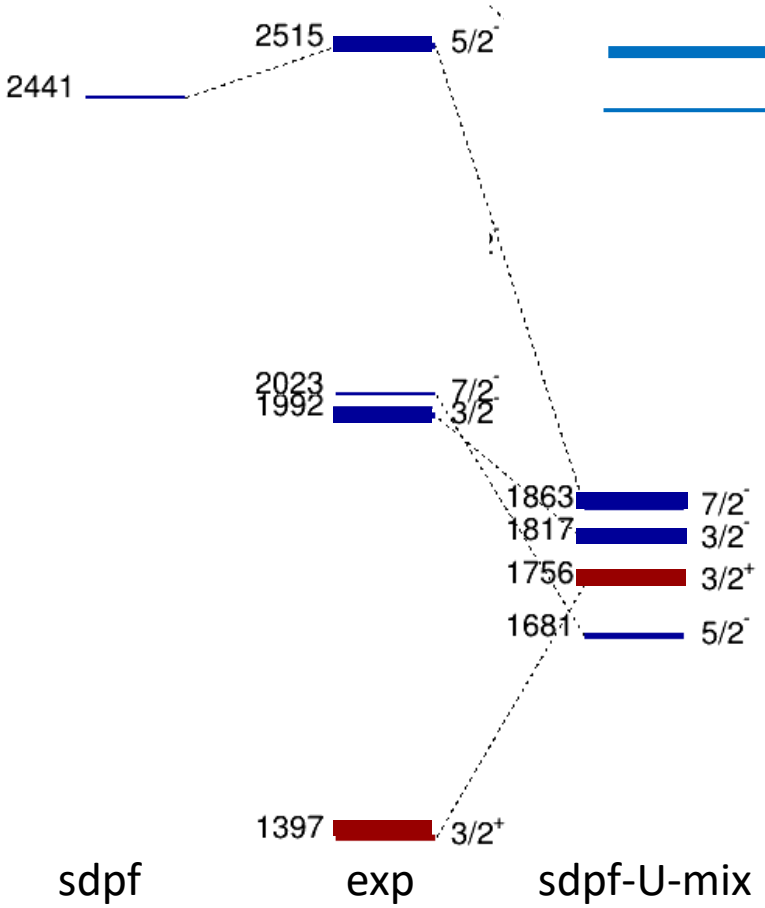
$T_{1/2}$ ~ 1 fs

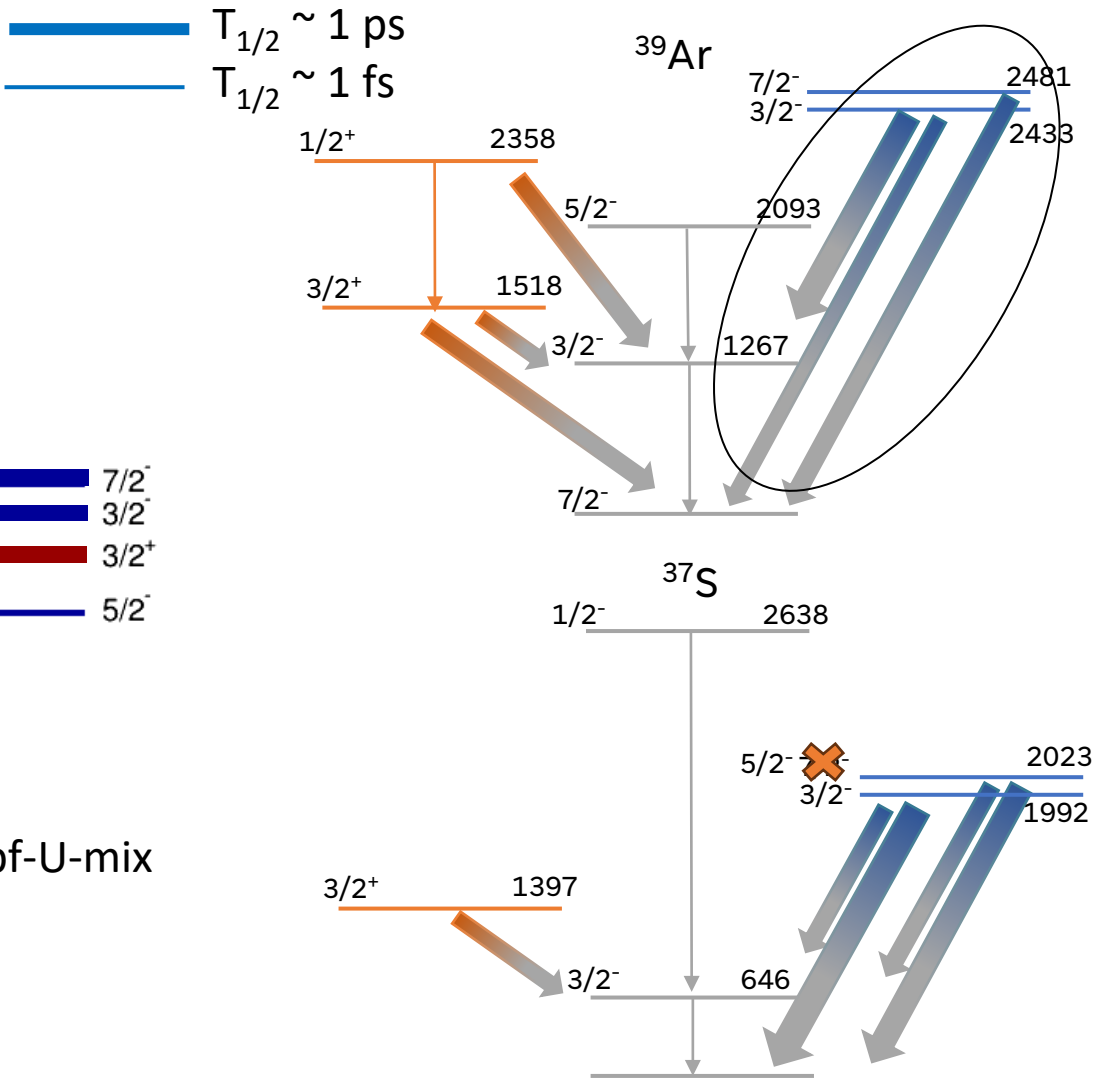




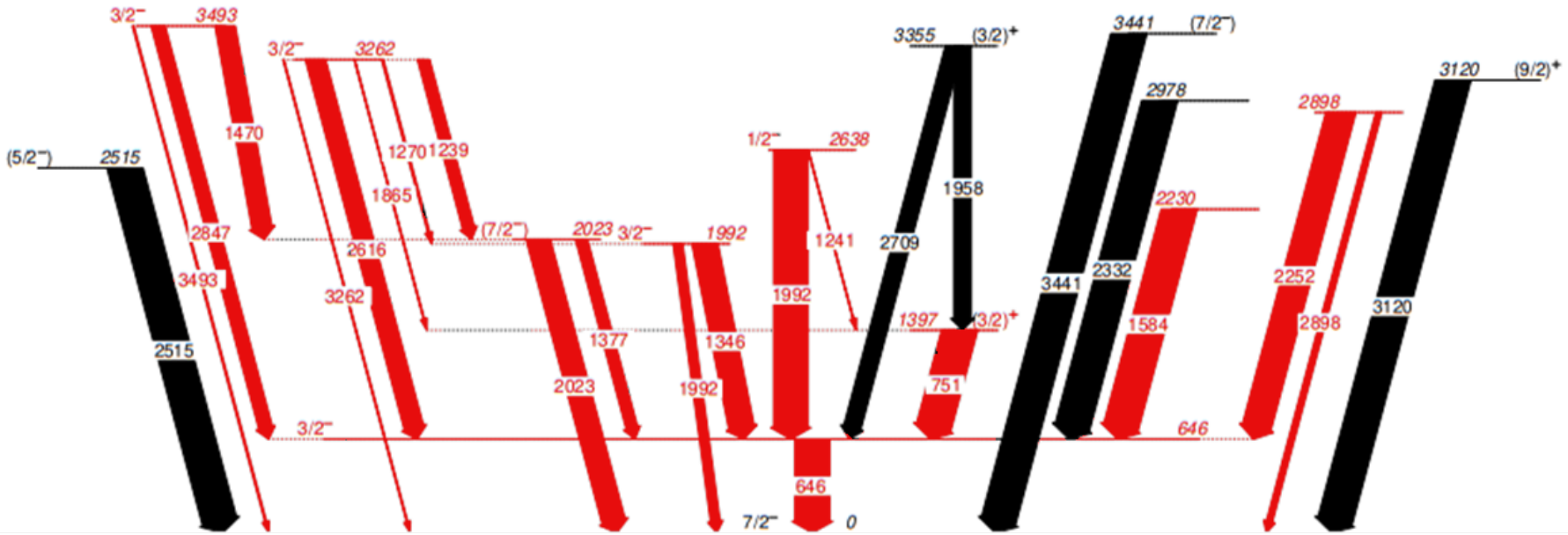
with $T_{1/2}$ < 70 fs, B(E2) > 70 W.u.
B(M1) > 0.04 W.u.

The low energy intruders

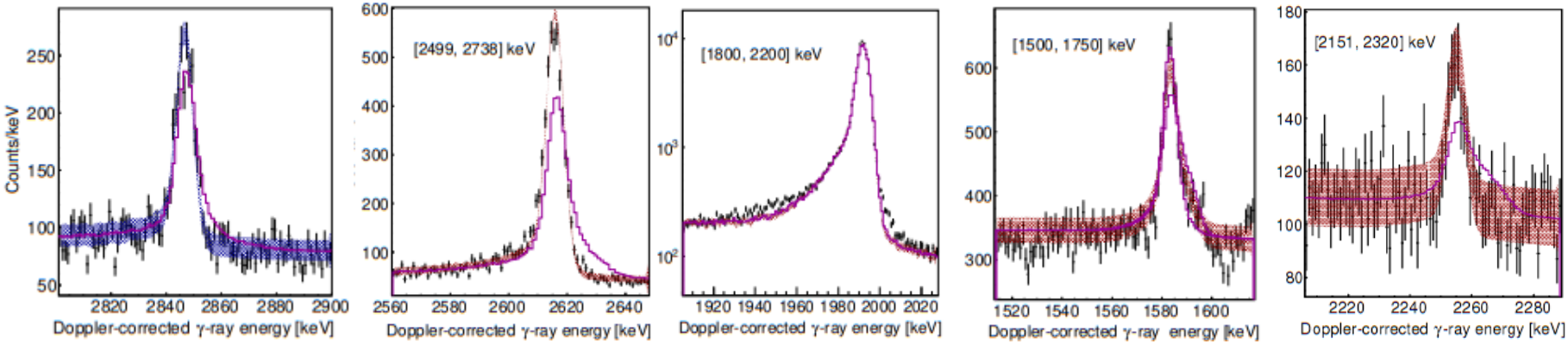




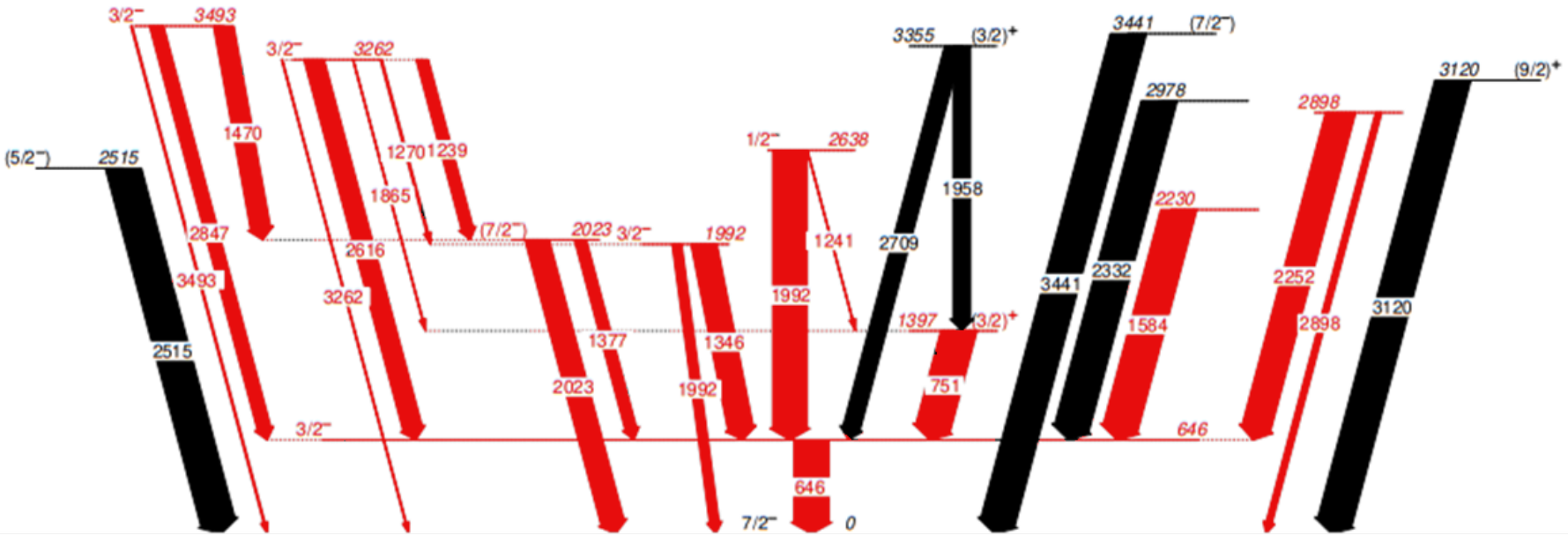
Lifetimes: DSAM



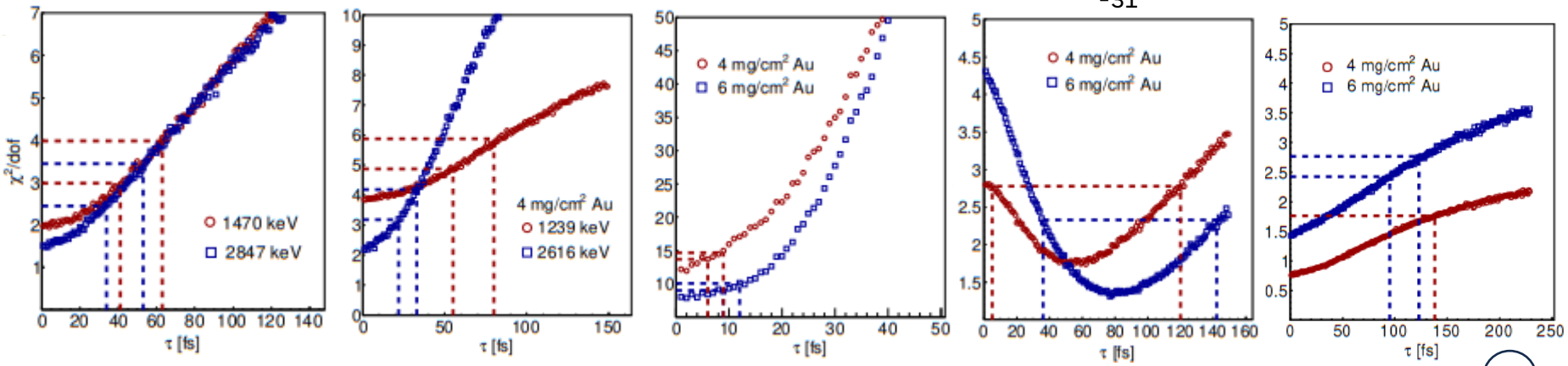
3493	3262	2638	2230	2898
< 70 fs	< 23 fs	< 9 fs	56^{+42}_{-31} fs	< 250 fs



Lifetimes: DSAM



3493	3262	2638	2230	2898
< 70 fs	< 23 fs	< 9 fs	56^{+42}_{-31} fs	< 250 fs



Conclusion

AGATA+direct transfer is a powerful tool, especially for DSAM

- High selectivity in the populated states
- Generally high cross-sections (depending on SF) + high γ efficiency
- High control on feeding
- Very low sensitivity limit for DSAM due to the high granularity in θ

SPIDER is a charged-particle detector well suited for (d,p) in inverse kinematics

- Very high angular coverage
- Enough granularity for angular distributions

Lifetimes and SF provide complementary information on structure of ^{37}S

- Extensive low-energy spectroscopy
- Bounds on spin assignment of new states based on L and decay pattern
- 2023-keV state assigned $5/2^-$ spin based on L transfer and B(E2) values
- Comprehensive comparison between ^{37}S and ^{39}Ar
- General good agreement between experimental data and SM

Thank you for your attention

List of collaborators:

L. Zago, A. Gottardo, F. Angelini, M. Balogh, D. Brugnara, J. Collado Ruiz, G. de Angelis, A. Ertoprak, A. Goasduff, B. Gongora Servin, A. Gozzelino, T. Marchi, D. R. Napoli, J. Pellumaj, R. M. Perez-Vidal, M. Sedlak , J. J. Valiente-Dobon, I. Zanon
INFN LNL

A. Gadea
IFIC

F. Galtarossa, N. Miani, P.A. Aguilera, D. Bazzacco, J. Benito Garcia, S. Carollo, Z. Huang, S. M. Lenzi, R. Menegazzo, D. Mengoni, S. Pigliapoco, E. Pilotto, M. Polettini, F. Recchia, K. Rezynkina, G. Zhang
UNIPD and INFN PD

G. Benzoni, S. Bottoni, G. Corbari
INFN MI and UniMI Statale

N. Marchini, A. Nannini, M. Rocchini
INFN FI

M. Beckers, F. Dunkel, C. Fransen, L. Kornwebel, C. Lakenbrink, F. von Spee
University of Cologne

J. Diklic
Ruder Boskovic Institute