



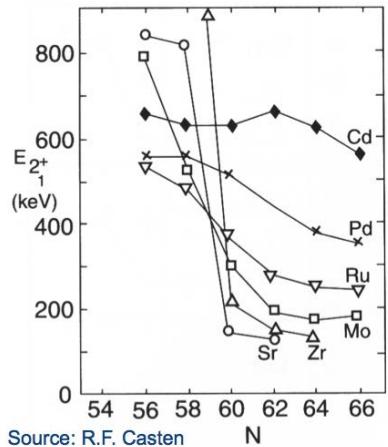
Canada's national laboratory
for particle and nuclear physics
and accelerator-based science

Exploring the onset of the N=60 shape coexistence in Sr

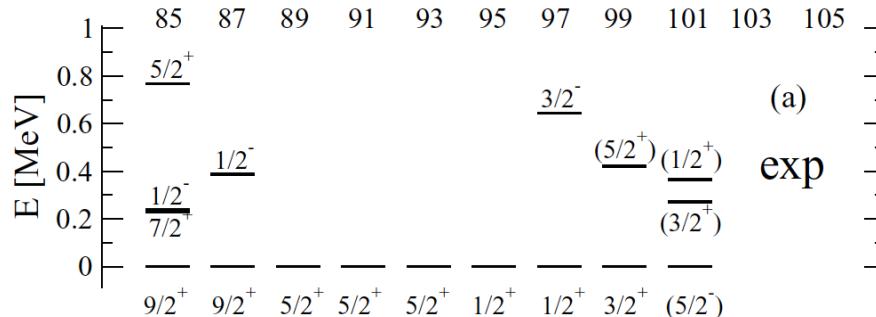
Reiner Kruecken
TRIUMF
UBC

September 12th, 2016

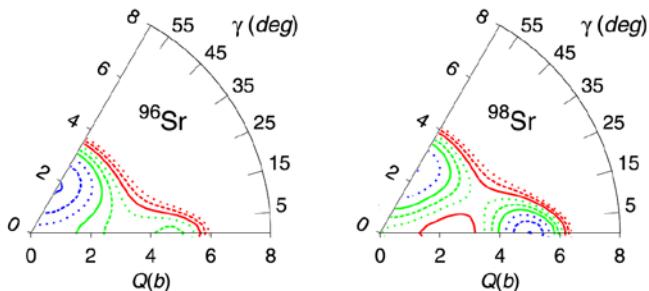




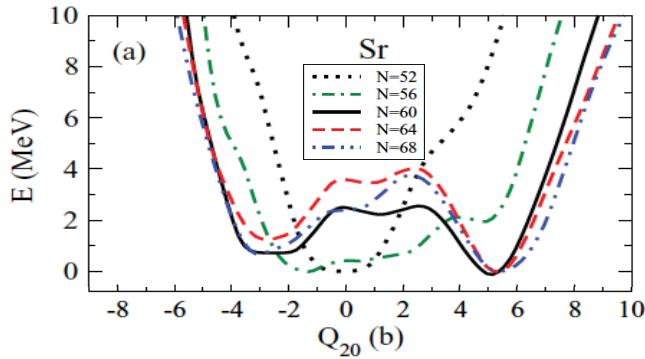
Single-particle evolution not established



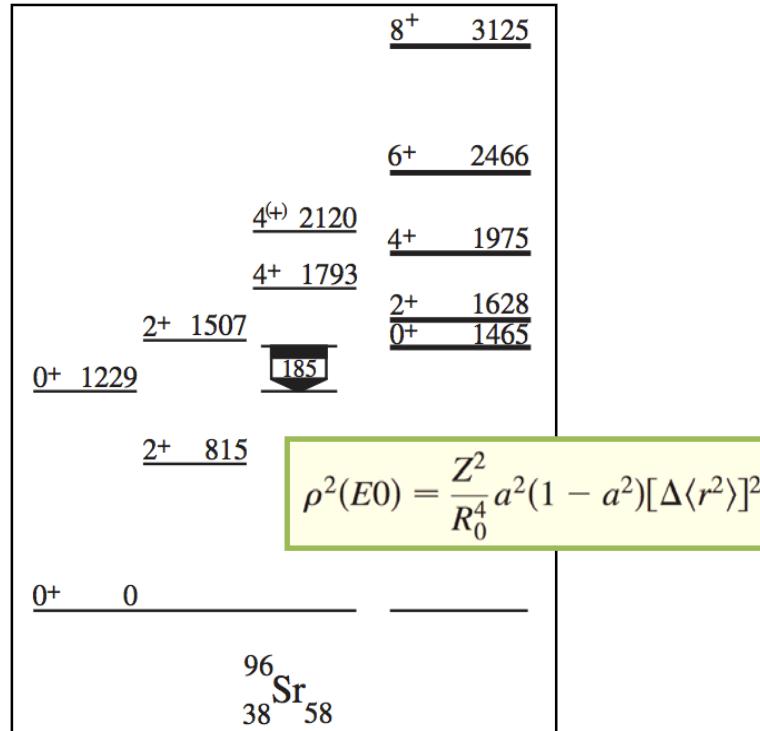
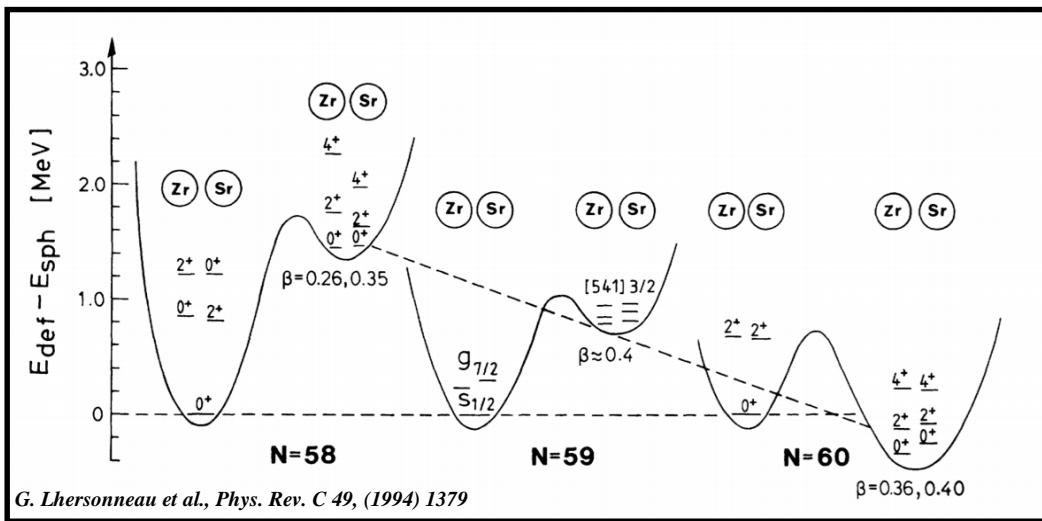
R. Rodríguez-Guzmán et al. PHYSICAL REVIEW C **82**, 044318 (2010)



R. Rodríguez-Guzmán et al. / Physics Letters B 691 (2010) 202–207

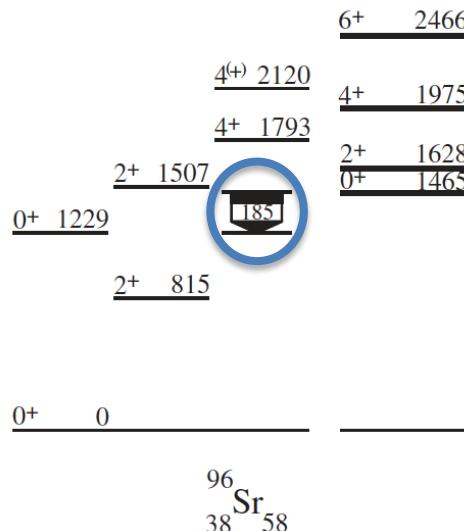


- The strong 0_3^+ (1465 keV) $\rightarrow 0_2^+$ (1229 keV) E0 transition is characteristic of coexisting shapes.
- The deformed 0_3^+ state at 1465 keV is expected to be the same structure as the ^{98}Sr ground state.

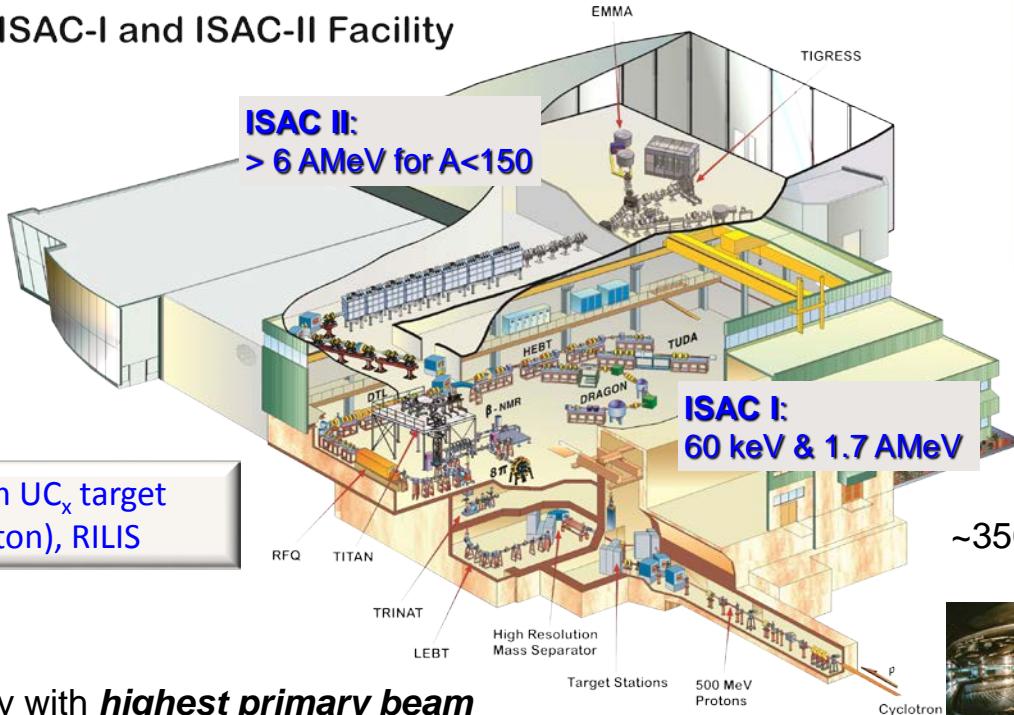


Shape coexistence in atomic nuclei [Rev. Mod. Phys. 83, 1467 (2011)]

- Aim: investigate the evolution of single-particle levels through the onset of deformation and the shape transition
 - ➔ single-particle transfer reactions are an ideal tool
- ^{95}Sr ($N=57$) near the transition point from spherical to deformed
- ^{96}Sr shows clear signs of shape coexistence
- $^{94}\text{Sr}(\text{d},\text{p})^{95}\text{Sr}$
 - ➔ establish spins for excited states in ^{95}Sr ($N=57$)
 - ➔ determine dominant single-particle occupancies
- $^{95}\text{Sr}(\text{d},\text{p})^{96}\text{Sr}$
 - ➔ probe $(s_{1/2})^2$ content of coexisting 0^+ and 2^+ states
- $^{96}\text{Sr}(\text{d},\text{p})^{97}\text{Sr}$
 - ➔ establish spins for excited states in ^{97}Sr ($N=59$)
 - ➔ determine dominant single-particle occupancies



ISAC-I and ISAC-II Facility



ISOL facility with **highest primary beam intensity** (100 μA , 500 MeV protons)

target materials: Si, Ti, Ni, Zr, Nb, Ta, U

Programs in

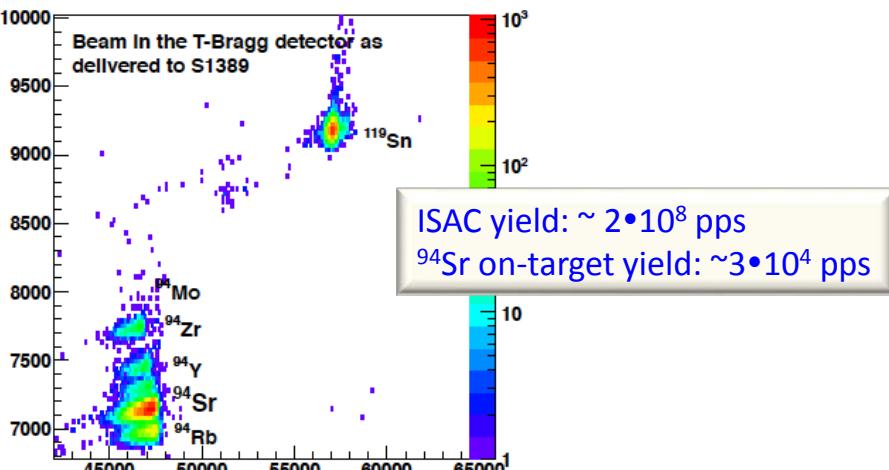
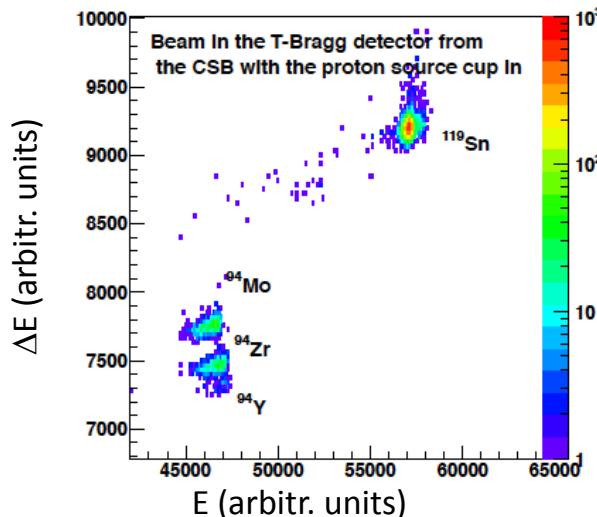
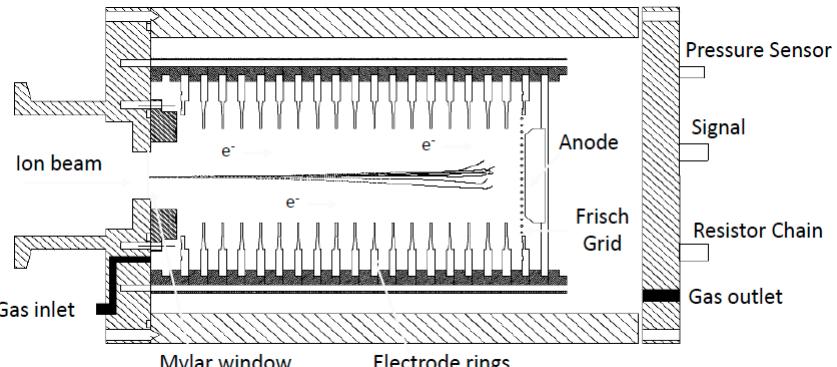
- Nuclear Structure & Dynamics
- Nuclear Astrophysics
- Electroweak Interaction Studies
- Materials Science

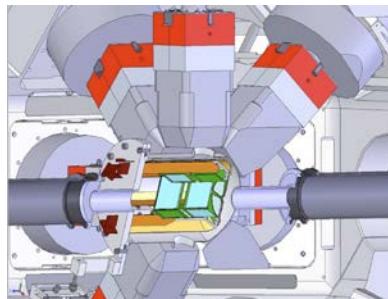
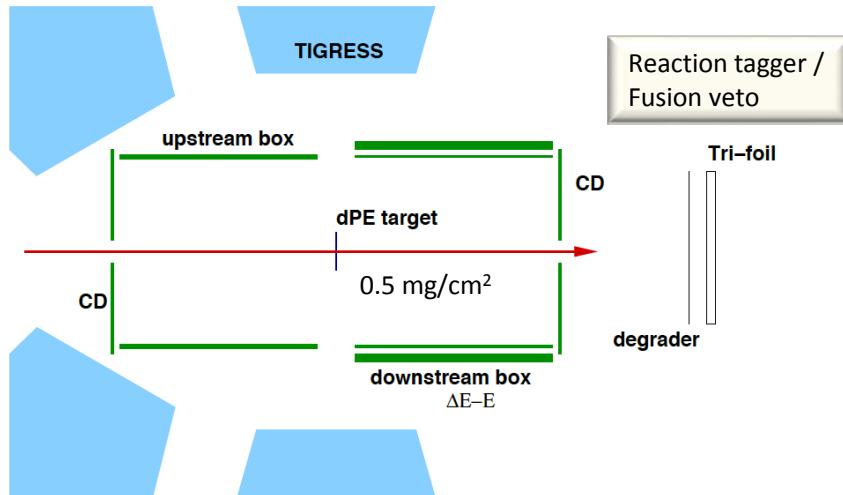
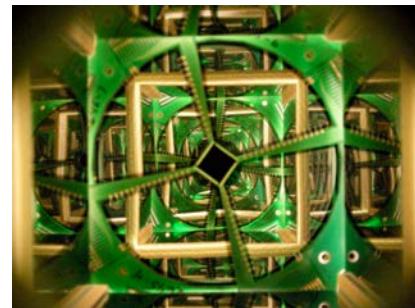
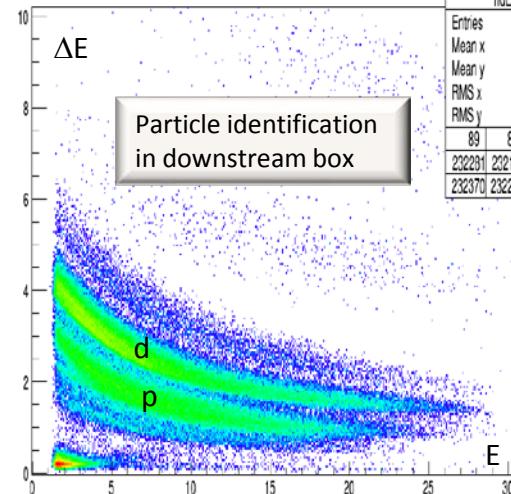
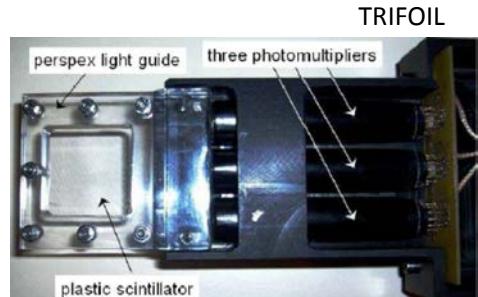
~3500 RIB hours /yr

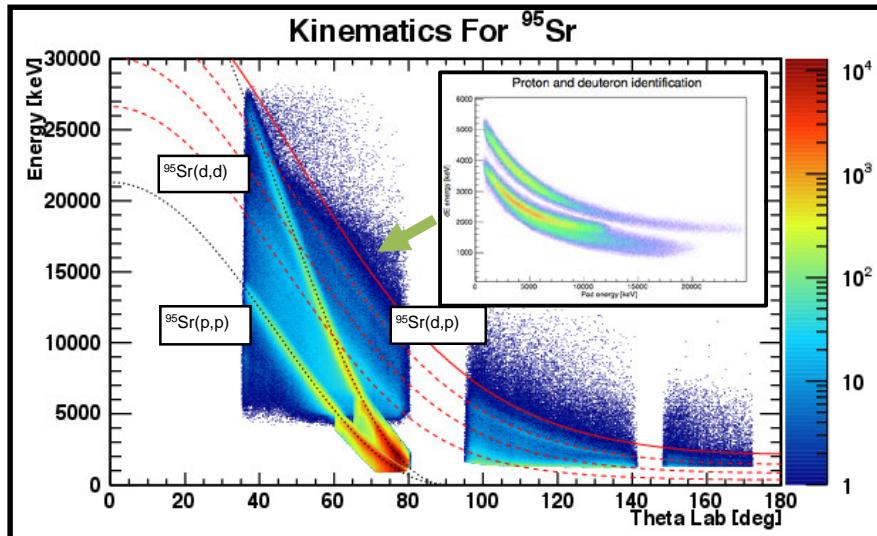


- Cylindrical chamber with axial drift
- P-8 gas ~ 700 mbar
(Ar/CH₄ 92:08, non-flammable, non-toxic)
- Digitization of Anode Signal
- Pulse shape analysis
→ “ ΔE ” and “ E ” values

Weinzierl, Diploma TU Munich
Nobbs, MSc, Univ. Surrey

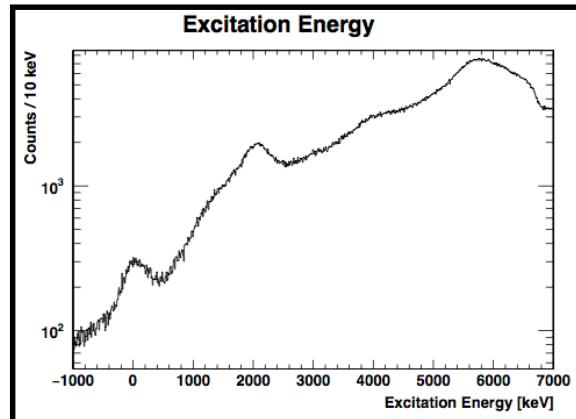
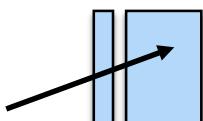


SHARC-TIGRESS

TIGRESS + SHARC

SHARC


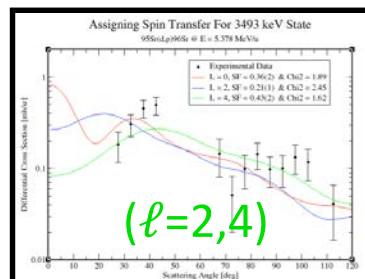
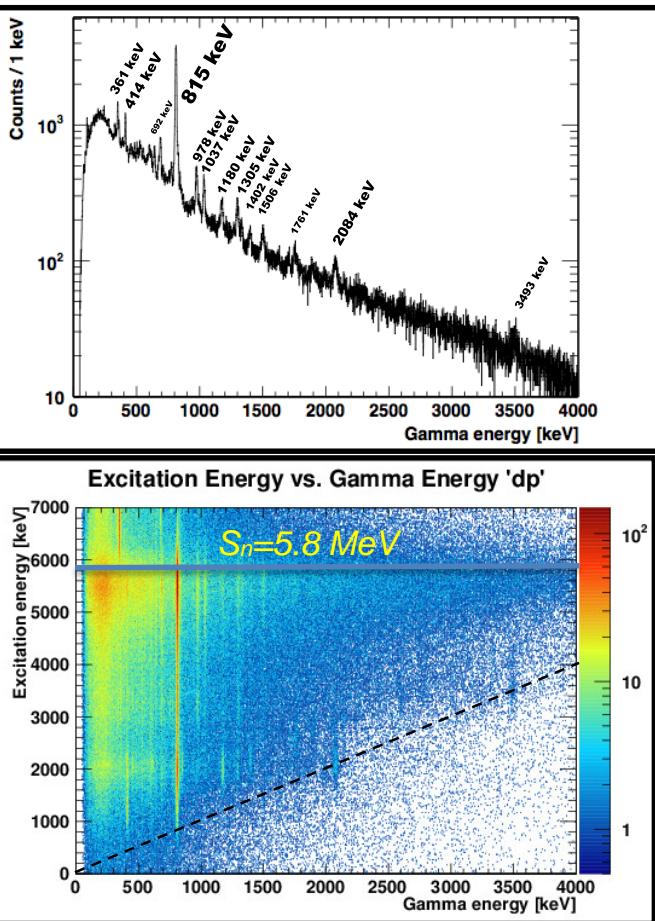
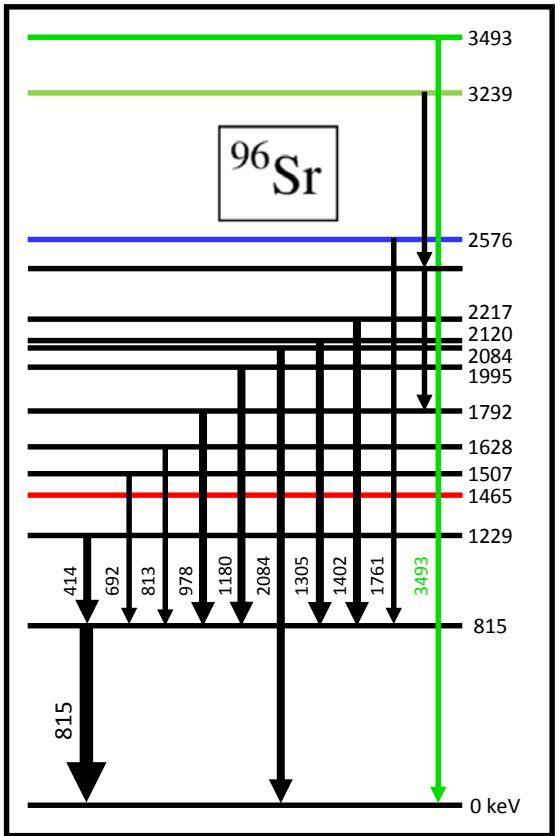


10^7 pps $^{95}\text{Sr}^{16+}$

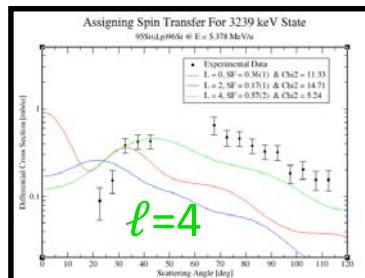
Particle identification used through $dE-E$ detector arrangement in SHARC



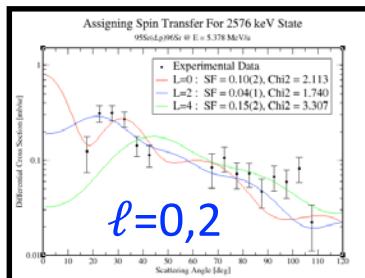
Poor energy resolution makes extracting ^{96}Sr states difficult.



3493 keV

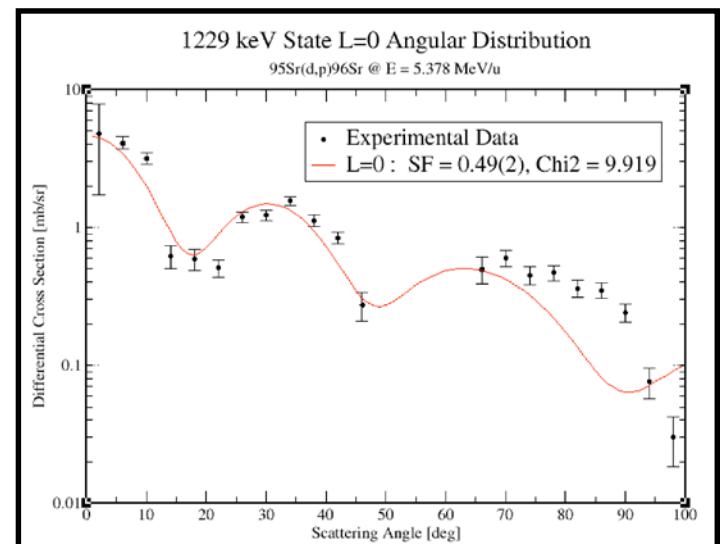
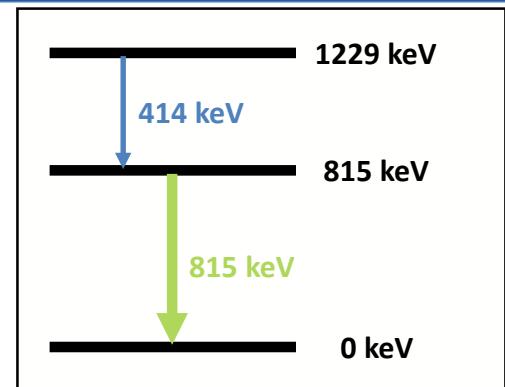
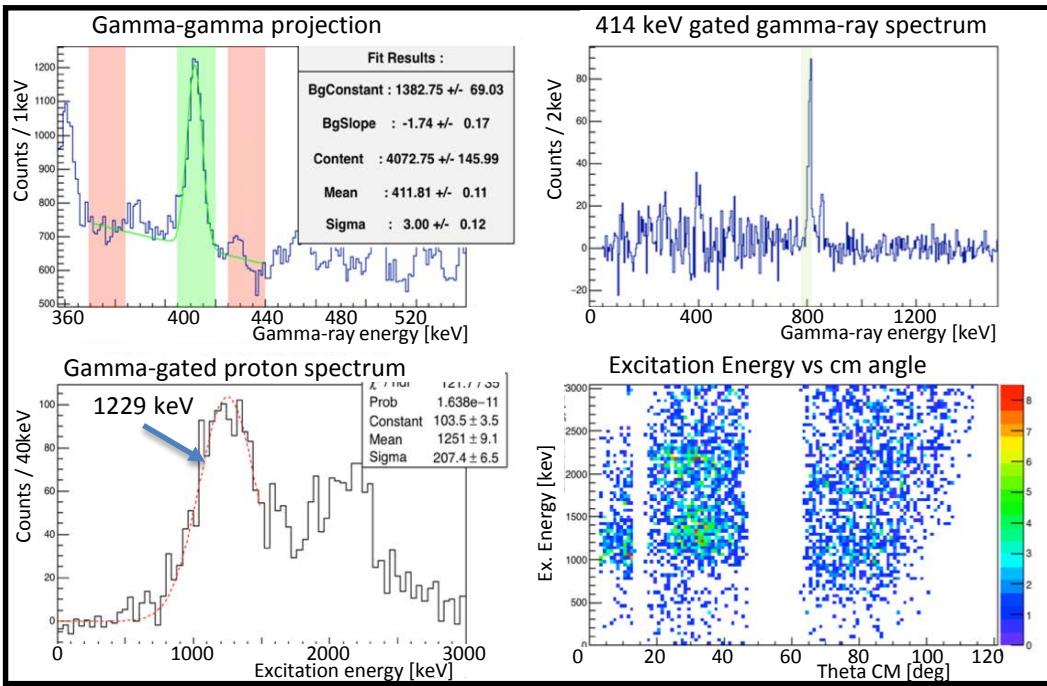


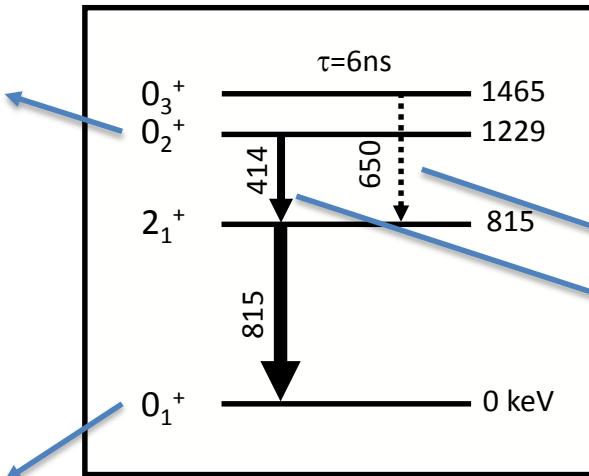
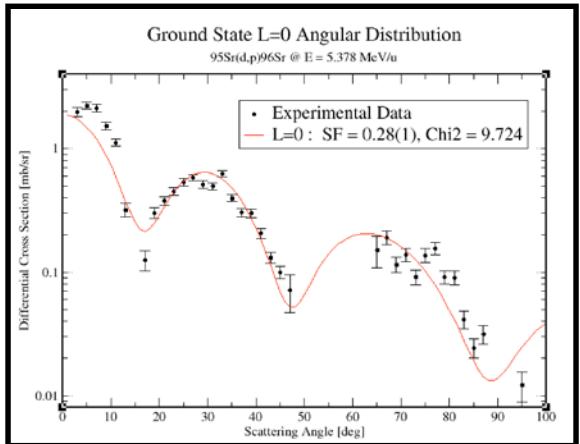
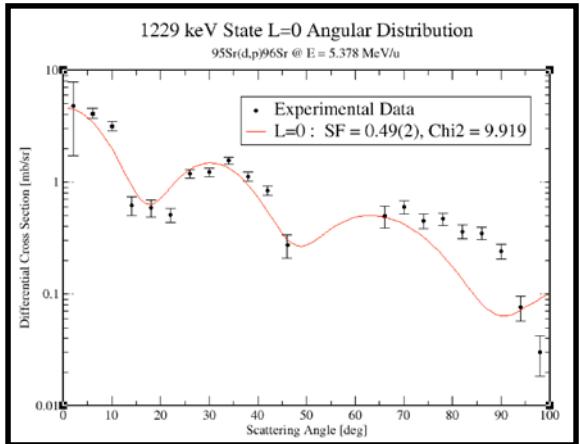
3239 keV



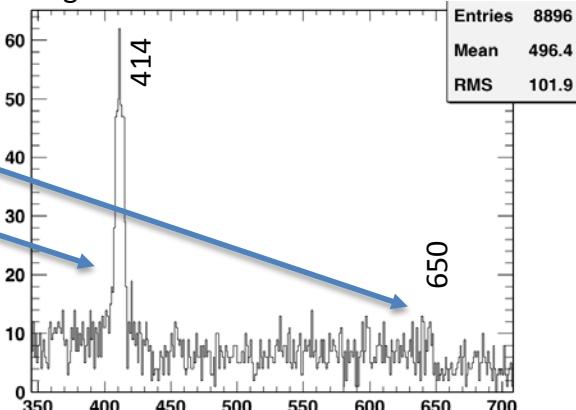
2576 keV

- Gamma-gate on 414 keV transition selects 1229 keV state.
- Clear $\ell=0$ character in angular distribution.
- Spectroscopic factor determined to be $0.49(2)$, larger than ground state.





Gamma spectrum gated on protons at forward cm angles in excitation energy range 800-1850 keV



- Strong population of 0_1^+ and 0_2^+
- 0_3^+ only weakly populated ($\sim 10\%$ of 0_2^+)

- $^{94,95,96}\text{Sr}$ are first high-mass ($A>30$) accelerated beams at TRIUMF.
- Population strength of low energy 0^+ states in ^{96}Sr has been measured.
 - 0_1^+ and 0_2^+ strongly populated, while 0_3^+ is barely populated.
 - 0_1^+ and 0_2^+ are (near) spherical in nature
 - 0_3^+ is strongly deformed
- Angular distributions determined for states up to 3.5MeV
- $^{94}\text{Sr}(\text{d},\text{p})$ and $^{96}\text{Sr}(\text{d},\text{p})$ analysis in progress

S. Cruz, P. C. Bender, R. Krücken, K. Wimmer, F. Ames, C. Andreoiu, C. S. Bancroft, T. Drake, R. Braid, T. Bruhn, W. Catford, D. S. Cross, A. Garnsworthy, G. Hackman, A. Knapton, K. Kuhn, J. Lassen, R. Laxdal, M. Marchetto, A. Matta, D. Miller, M. Moukaddam, N. Orr, A. Sanetullaev, C. Unsworth, P. J. Voss

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University of Surrey, LPC Caen



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for particle and nuclear physics
and accelerator-based science



Thank you!
Merci!

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