

Transfer reactions at the neutron dripline with triton target

K RIISAGER ON BEHALF OF

M.J.G. BORGE, L.M. FRAILE, H.O.U. FYNBO, J. GOMEZ CAMACHO, J.G. JOHANSEN, H.T. JOHANSSON, B. JONSON,
S. KLUPP, R. KRÜCKEN, J. KURCEWICZ, I. MARTEL, A. MORO, D. MÜCHER, T. NILSSON, G. NYMAN, R. RAABE,
S. SAMBI, A.M. SANCHEZ-BENITEZ, O. TENGBLAD

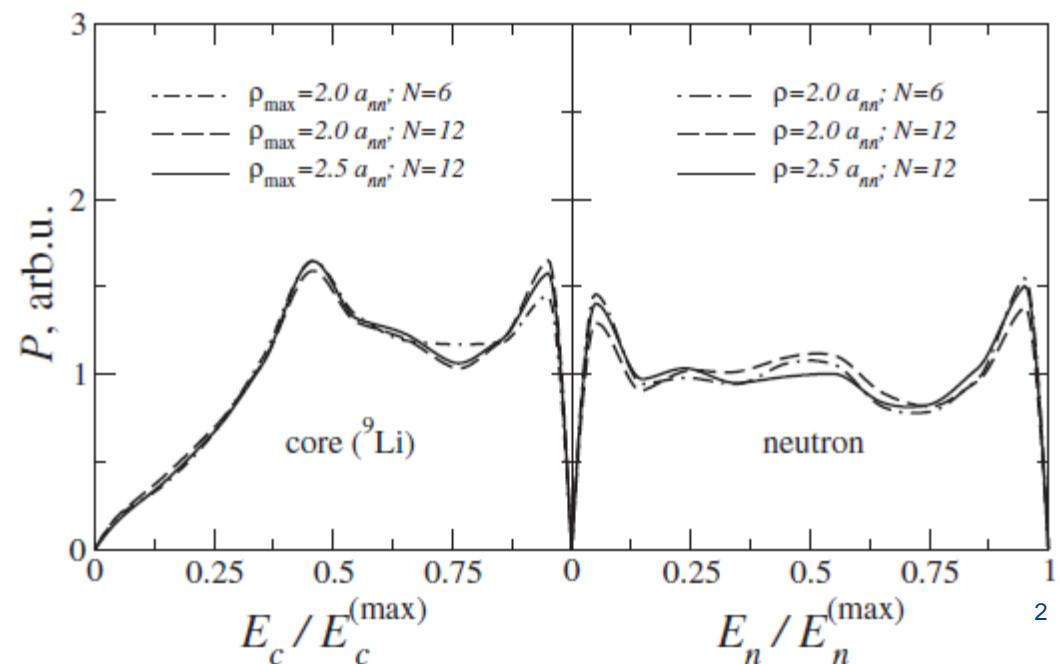
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MOTIVATION: RESONANCES IN ^{11}Li ?

- › Not clear for 2n-halos (not needed for 1n-halo Coulomb dissociation)
- › Some theoretical 3-body calculations predict low-lying resonances in ^{11}Li
- › If occurring: unique decay properties (“Efimov effect” PRL 96 (06) 112501)
- › Populate: not from ^{11}Li

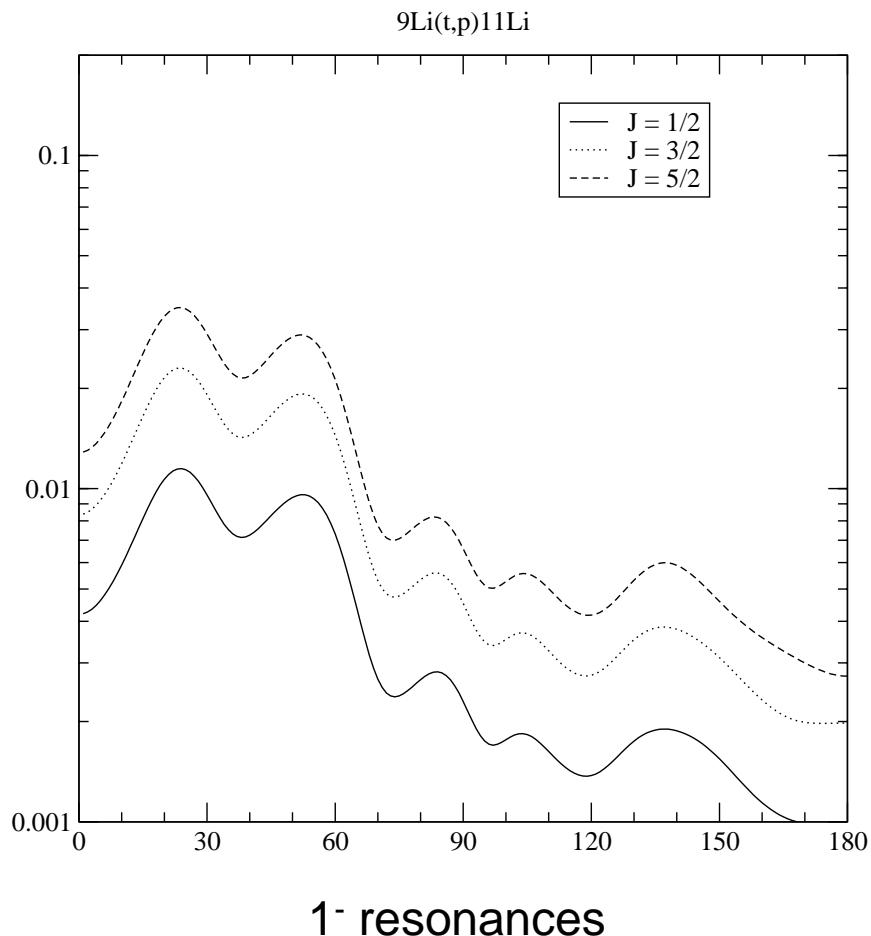
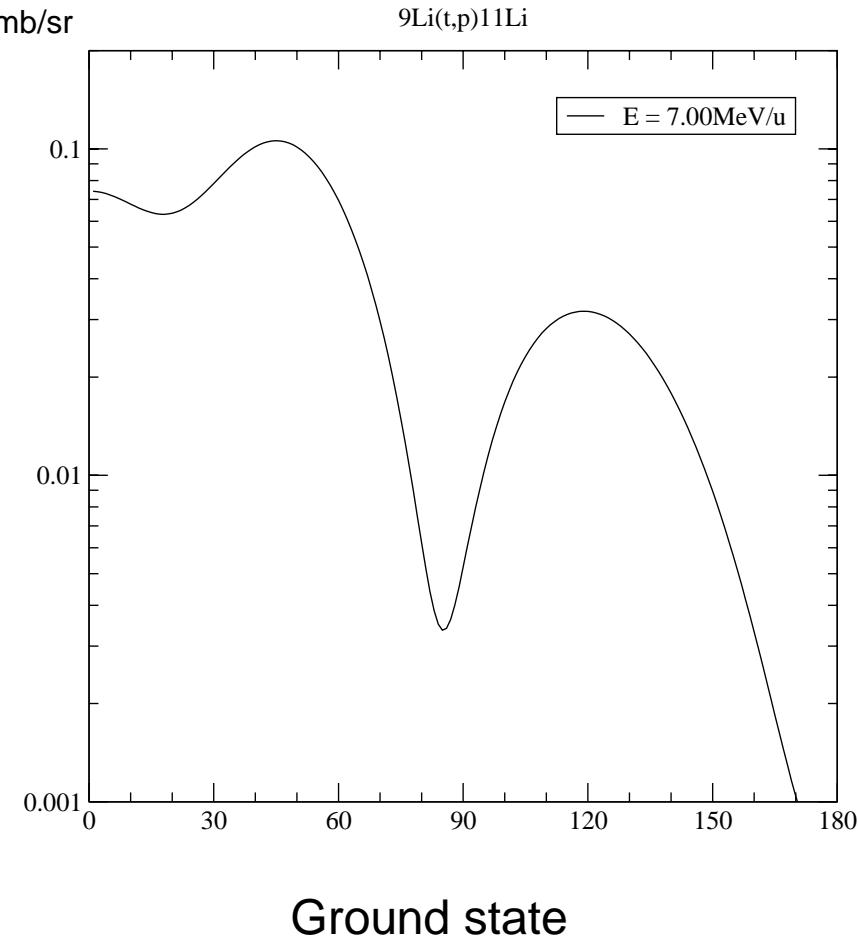
Will check Triumf $^{11}\text{Li}(p,t)$ exp

- › I. Tanihata et al, PRL 100(08)192502

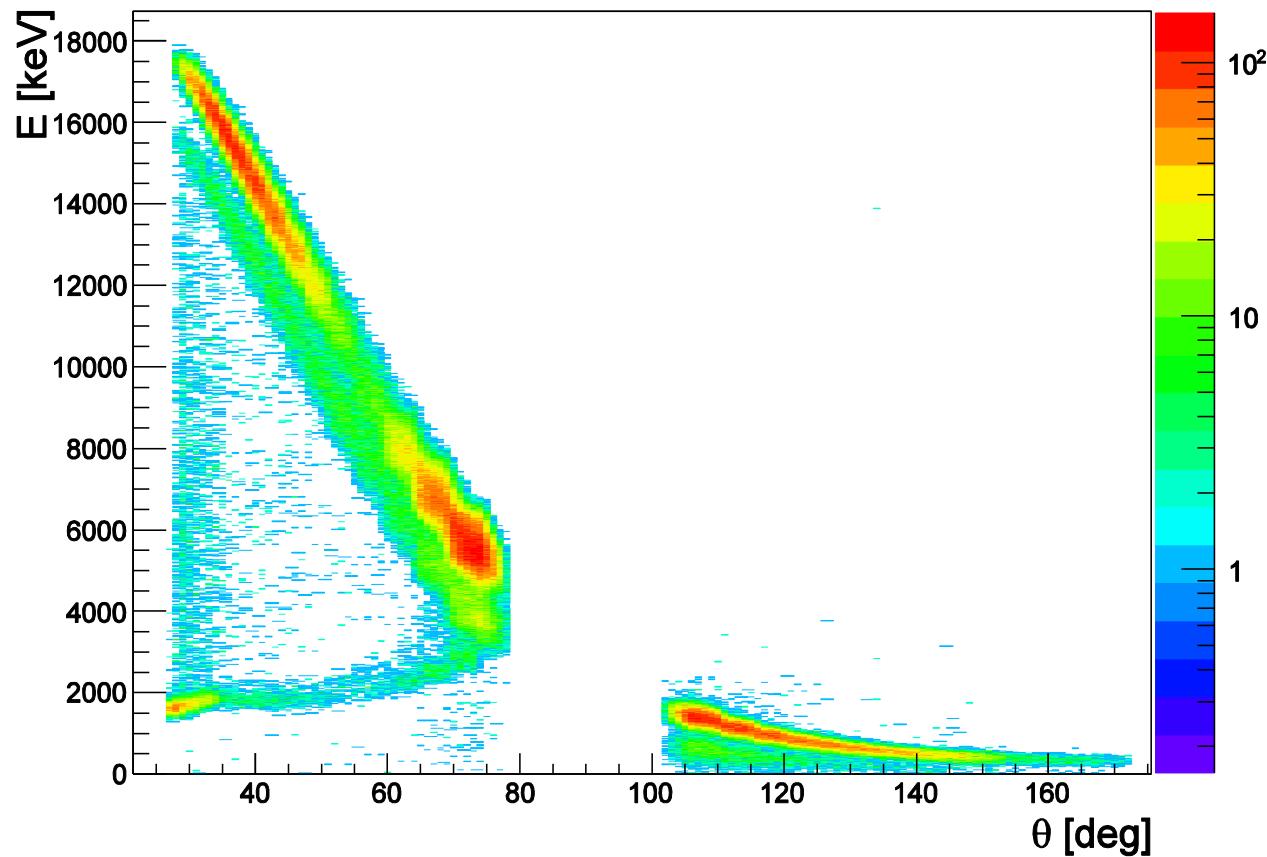


DWBA CALCULATIONS OF ${}^9\text{Li}(\text{t},\text{p}){}^{11}\text{Li}$

mb/sr



KINEMATIC CURVES FOR PROTONS



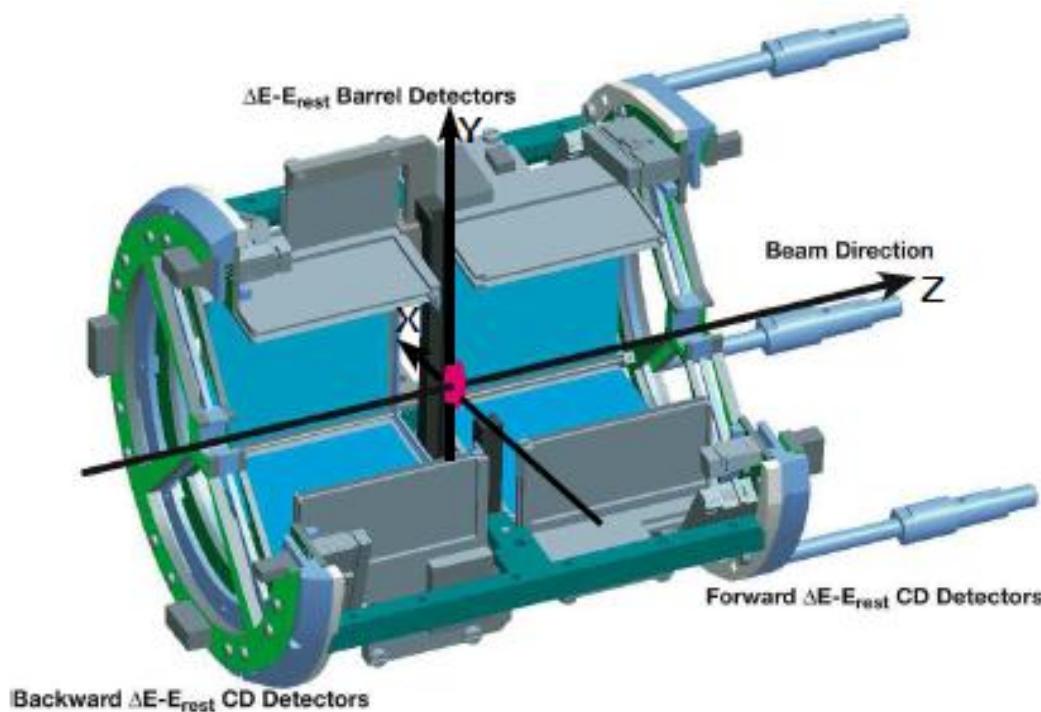
MAIN PHYSICS AIMS

- › (Re)check ^{11}Li halo composition / 2n-spectroscopic factor
- › Resonance(s) present ?
- › If decay neutrons – consistent with isotropic emission ?
- › (Neutron energies – not realistic now)
- › Will also look for other reaction channels:
 - › $^9\text{Li}(\text{t},\text{alpha})^8\text{He}$, done for $^7\text{Li}(\text{t},\text{alpha})^6\text{He}$
 - › $^9\text{Li}(\text{t},\text{t})^9\text{Li}^*$ unbound states
 - › $^9\text{Li}(\text{t},\text{d})^{10}\text{Li}$

EARLIER EXPERIMENTS

- › IS367 ${}^9\text{Li} + \text{d}$
- › IS466 ${}^8\text{Li} + \text{d}$
- › IS430 ${}^{11}\text{Be} + \text{d}$
- › Triton target:
 - › IS470 ${}^{30}\text{Mg}(\text{t},\text{p}){}^{32}\text{Mg}$
 - › IS499
 - › IS504 ${}^{66}\text{Ni}(\text{t},\text{p}){}^{68}\text{Ni}$
- › HIE-ISOLDE Loli I-108 (included also ${}^{11}\text{Li}$ beam)

PROPOSED SET-UP



T-REX or improved version (access lower energies)

SAND

The Small Array of Neutron Detectors @ University of Huelva, Spain

30 individual modules

Plastic scincillator 10x10x10cm/TPS-100

Fast PM tubes/XP4312 PHOTONIS

SY1527 CAEN Power Supply (neg. V)



MAIN OBSERVABLES

- › Protons – singles data sufficient (need to measure Ti target background)
- › If HIE-ISOLDE beam has sufficiently small emittance:
 - › Can look for ${}^9\text{Li}$ coincidences
- › Neutrons in coincidence with charged particles
- › Timing resolution of neutron detectors (experimental) 0.3 ns
- › Si detectors can go below 1 ns, i.e. rough time-of-flight possible
- › Background in SAND will be less than in Miniball
- › NB! Need minimal scattering of neutrons
- › Will not include gamma detection

BEAM PROPERTIES, COUNT RATES

Possible contaminants: (${}^9\text{Be}$,) ${}^{12}\text{C}$, ${}^{18}\text{O}$

- › Charge state ${}^9\text{Li}^{3+}$: stripping reduces C/O by $5 \times 10^{-5}/6 \times 10^{-4}$, **7 MeV/u**
- › Charge state ${}^9\text{Li}^{2+}$: only O, stripping reduction 5×10^{-3} , 5.5 MeV/u
- › Expected ${}^9\text{Li}$ intensity on secondary target 10^6 /s
- › Proton count rate: 60/shift to g.s., 30/shift to low-lying resonances
 - › 20 shifts (+ background measurement) will give decent angular distribution for g.s.
 - › This data will allow to exclude or prove presence of low-lying structures
- › Neutron efficiency 3% in compact geometry
 - › 20 shifts will only give 36 neutrons (for uniform distribution)
 - › Can at most get yes/no answer to “uniform”
 - › Energies not measurable unless cross sections are significantly higher
 - › (Data from other channels useful to estimate future neutron detection possibilities)

SUMMARY AND BEAM REQUEST

We ask for 30 shifts ${}^9\text{Li}$ (Ta, surface):

- 20 shifts on triton/Ti target
- 10 shifts on Ti target (background)

THE ${}^9\text{Be}(\text{T},\text{P}){}^{11}\text{Be}$ REACTION

