SRC @
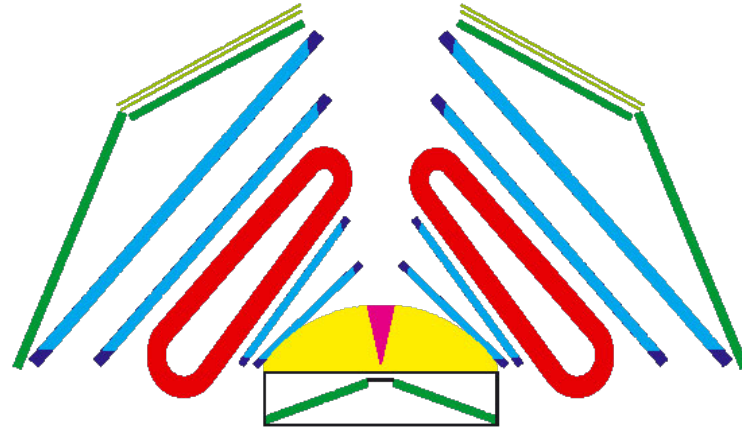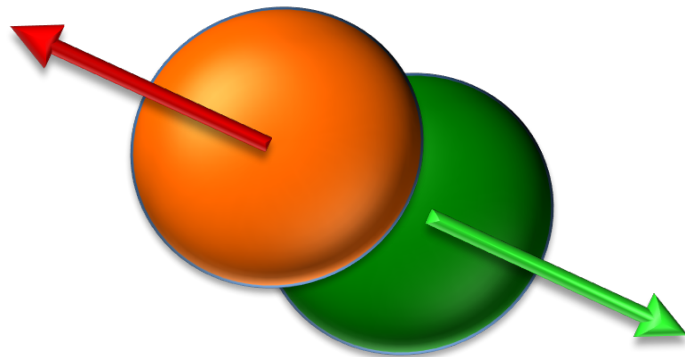

HADES

SRC are pairs of nucleon that are close together in the nucleus (wave functions overlap)

=> Momentum space: pairs with _high relative momentum_ and _low c.m. momentum_ compared to the Fermi momentum (k_F)
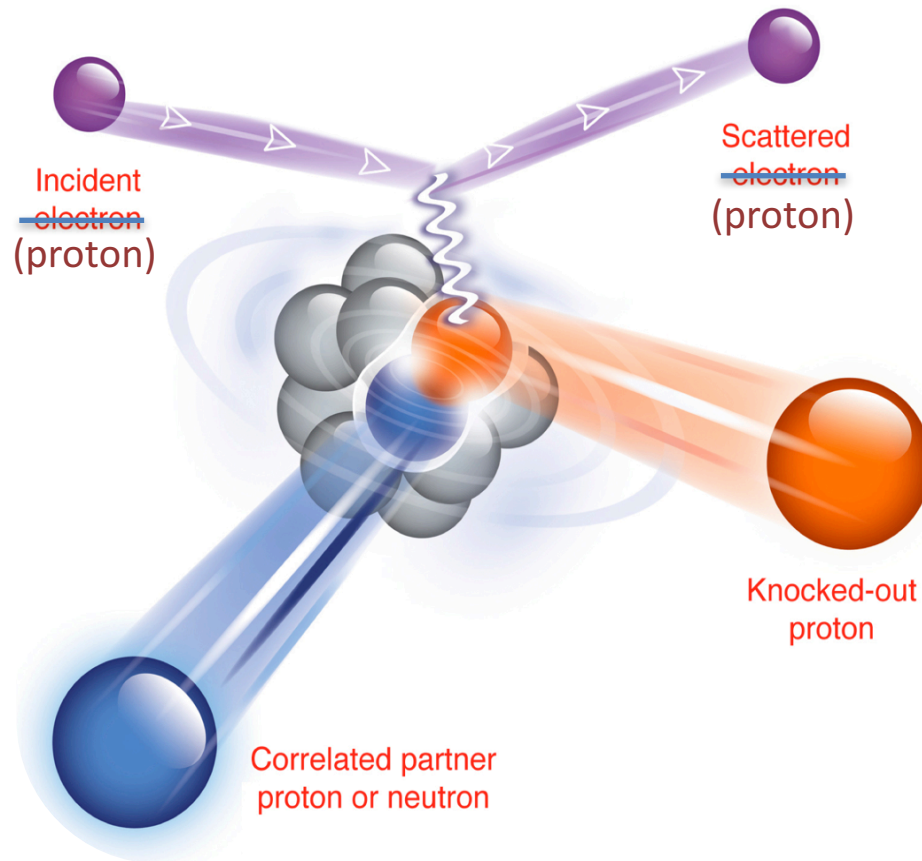
Probing SRCs

Breakup the pair =>
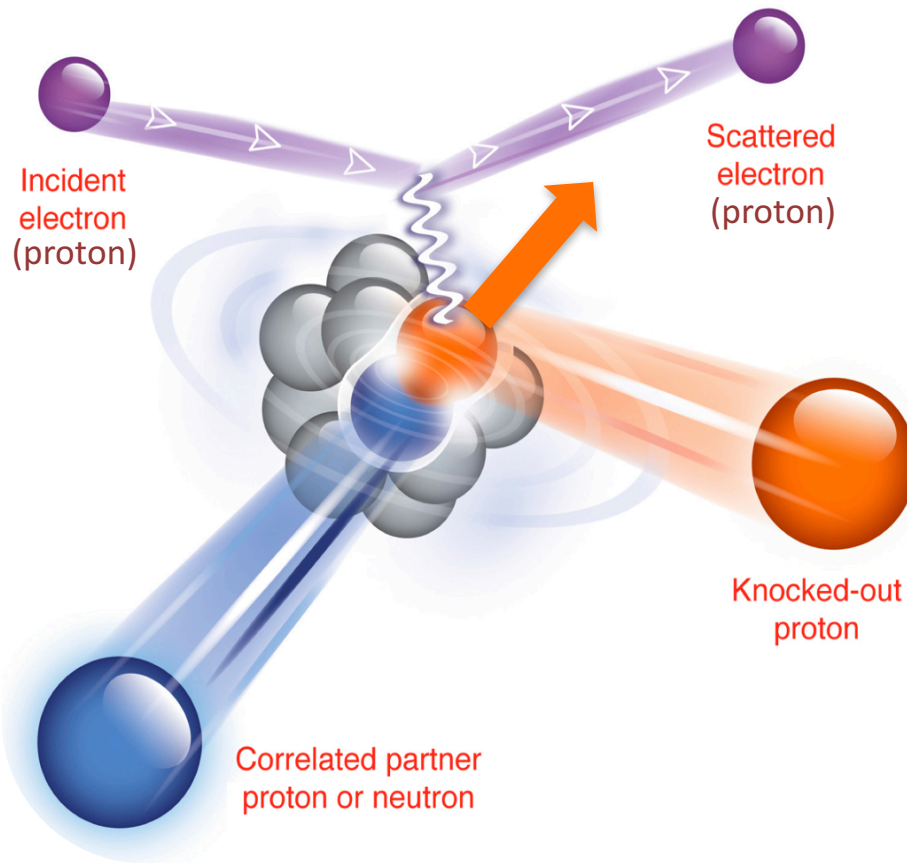Detect both nucleons =>
Reconstruct 'initial' state

Incident
electron
(proton)

Scattered
electron
(proton)

Knocked-out
proton

Correlated partner
proton or neutron

Probing SRCs

Breakup the pair =>
Detect both nucleons =>
Reconstruct 'initial' state

Incident electron (proton)

Scattered electron (proton)

Knocked-out proton

Correlated partner proton or neutron

Experimental signature:

High initial-momentum reconstructed proton back-to-back to a recoil neutron or proton

Path to proposals

- Formulate the physics motivation (~Done).
- Develop an SRC A(p,2pN) even generator, including HADES resolutions and acceptance effects (Done).
- Calculate expected event rate using event generator and benchmark against 3.5 GeV p+Nb data (Done).
- Propose a realistic design for a recoil proton / neutron detector (Work in progress).
- Propose realistic trigger, targets etc. <u>that are consistent with the rest of the proton beam program</u>! (Work in progress).
- Get collaboration support and go to the PAC ☺

But..... Very Low Statistics!

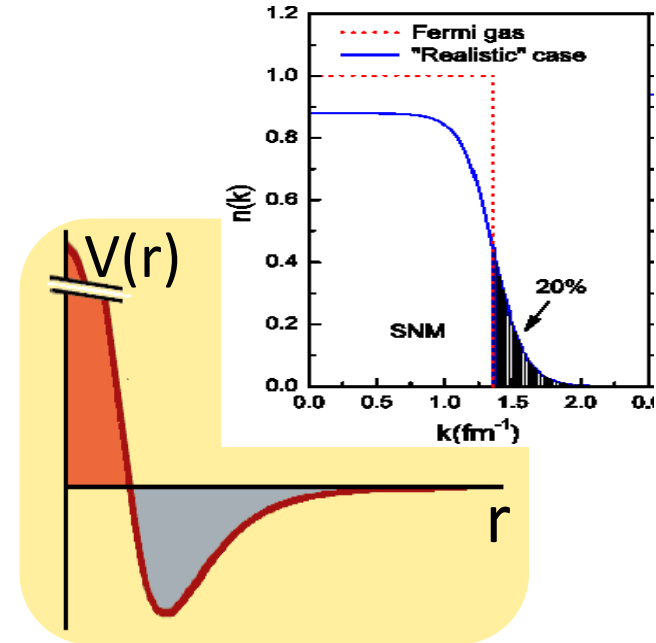| experiment	pp pairs	np pairs	nn pairs
EVA/BNL	-	18	-
E01-015/JLab	263	179	-
E07-006/JLab	50	223	-
CLAS/JLab	1533	-	-
Total	<2000	<450	0

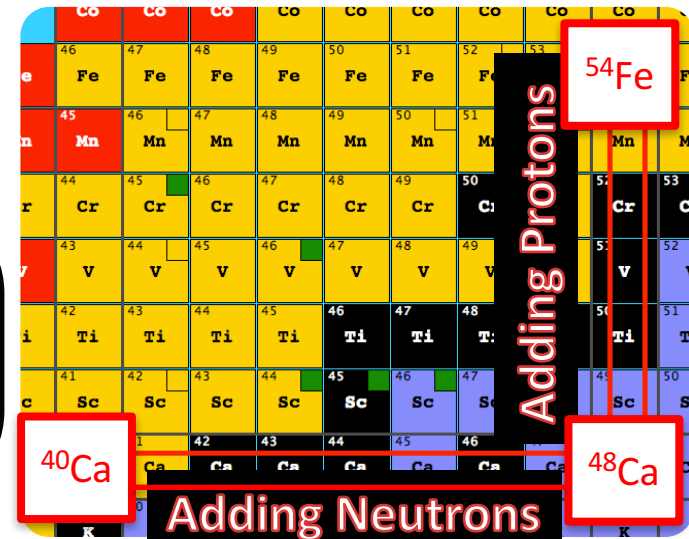## => Need 1-2 orders of magnitude improvement to address next generation BIG questions
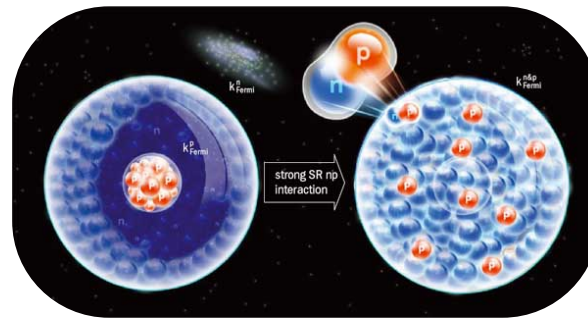
- ## Onset of SRC dominance.
  ('Migdal Jump' in nuclei)

- ## Repulsive core of NN interaction.
  (Transition from np-dominance)

- ## SRCs in asymmetric nuclei.
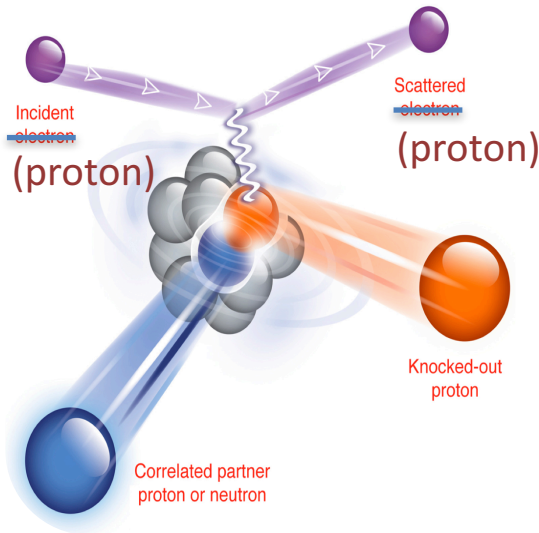 (number of pairs and c.m. motion in nuclei)

- ## 3N-SRC.

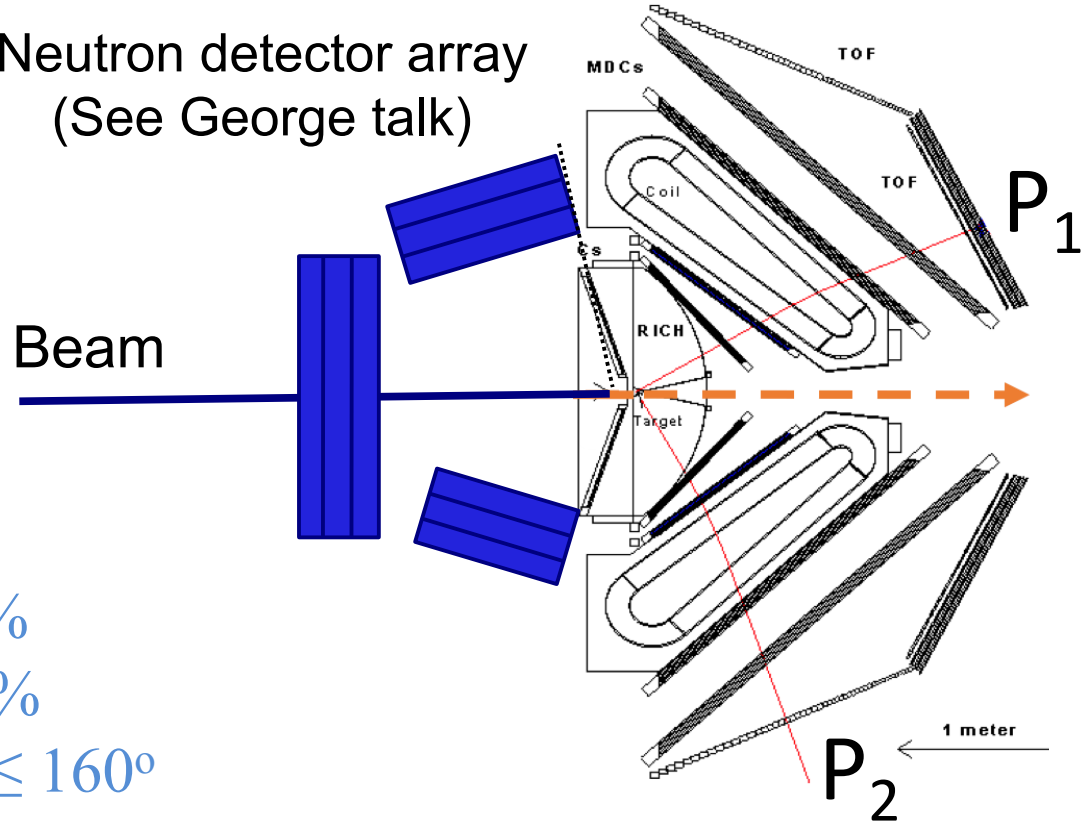- ## + FAIR feasibility
  (inverse kinematics)

Incident
electron
(proton)

Scattered
electron
(proton)

Knocked-out
proton

Correlated partner
proton or neutron

Neutron detector array
(See George talk)

Beam

MDCs

Coil

CS

RICH

Target

TOF

TOF

P_1

P_2

1 meter

Neutron Detectors:

$\Delta\Omega \approx 20\%$

$\varepsilon \approx 30\text{-}50\%$

$110^o \leq \theta_{recoil} \leq 160^o$

$\sigma_{TOF} \sim 400$ ps

$\Delta P/P < 4\%$

$\Delta P(500 \text{ MeV/c}) \approx 10\text{-}20 \text{ MeV/c}$

Groups interested in helping build the neutron detector are welcome!!

Possible target and trigger scheme

- **Trigger for (p,2p) events:**
  - <u>Ideally:</u> keep all events with two hits in opposite sectors of the TOF.
  - <u>IF we can't do it:</u> keep all events with two hits in opposite sectors of the TOF in a time window that match > 1.5 GeV/c protons (using diamond start detector).
  - <u>IF we also can't do it:</u> pre-scale ☺
- **Target:**
  - Multi-foil like HADES did in the past
  - Prefer to 'split' the foils to different nuclei, e.g. C, Ca, Nb, …

Rates (4 GeV, 5×10^7 protons/sec beam):

np pairs   Triple coincidence $^{12}C(p,2pn)$

~50 events/hour

=> 30 days (50% beam availability)   **50,000 events total**

pp pairs   Triple coincidence $^{12}C(p,ppp)$

~20 events/hour

=> 30 days (50% beam availability)   **20,000 events total**

Preliminary !

Reminder – we want to run ~4 target nuclei so the rate per-target will be x4 less.

- Neutron Detector:
  - George moved to GSI and is working on the design. Comments are welcome!
  - Readout electronics still open question. Input from HADES experts is crucial.

- Si proton detector: Looking for collaborators that can lead its development.

- Final Goal: First proposal draft ready for the collaboration review early 2017.