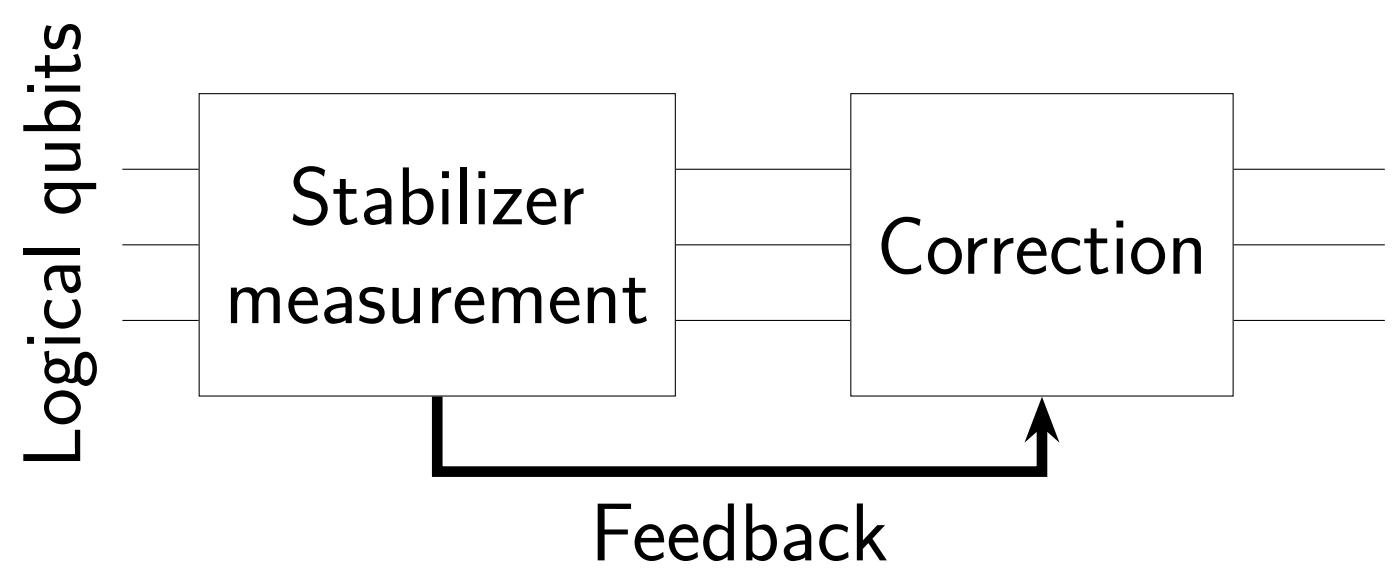


## Mid-circuit measurement and the *omg* architecture

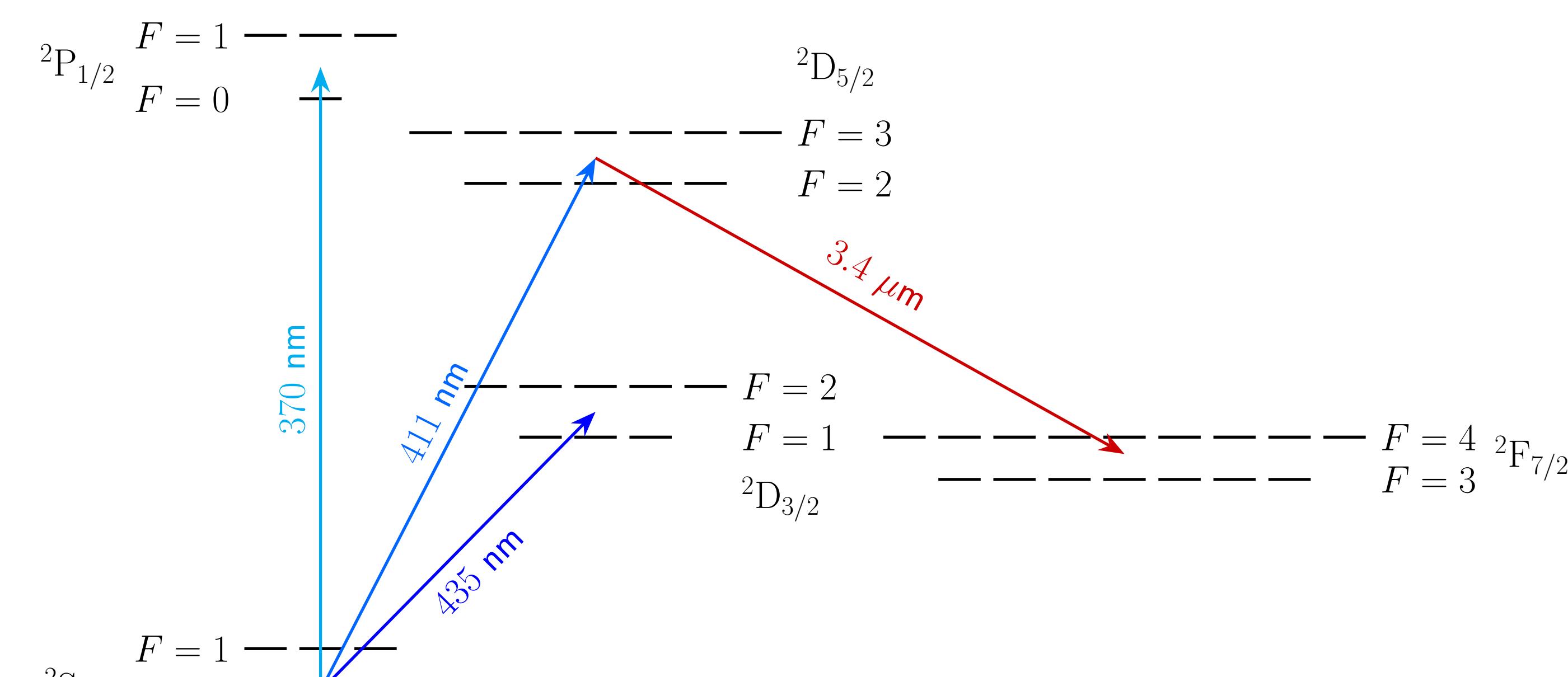
### Mid-circuit measurement

- Required for multiple rounds of error correction
- Partial readout without perturbing the rest of the system



### *omg* architecture

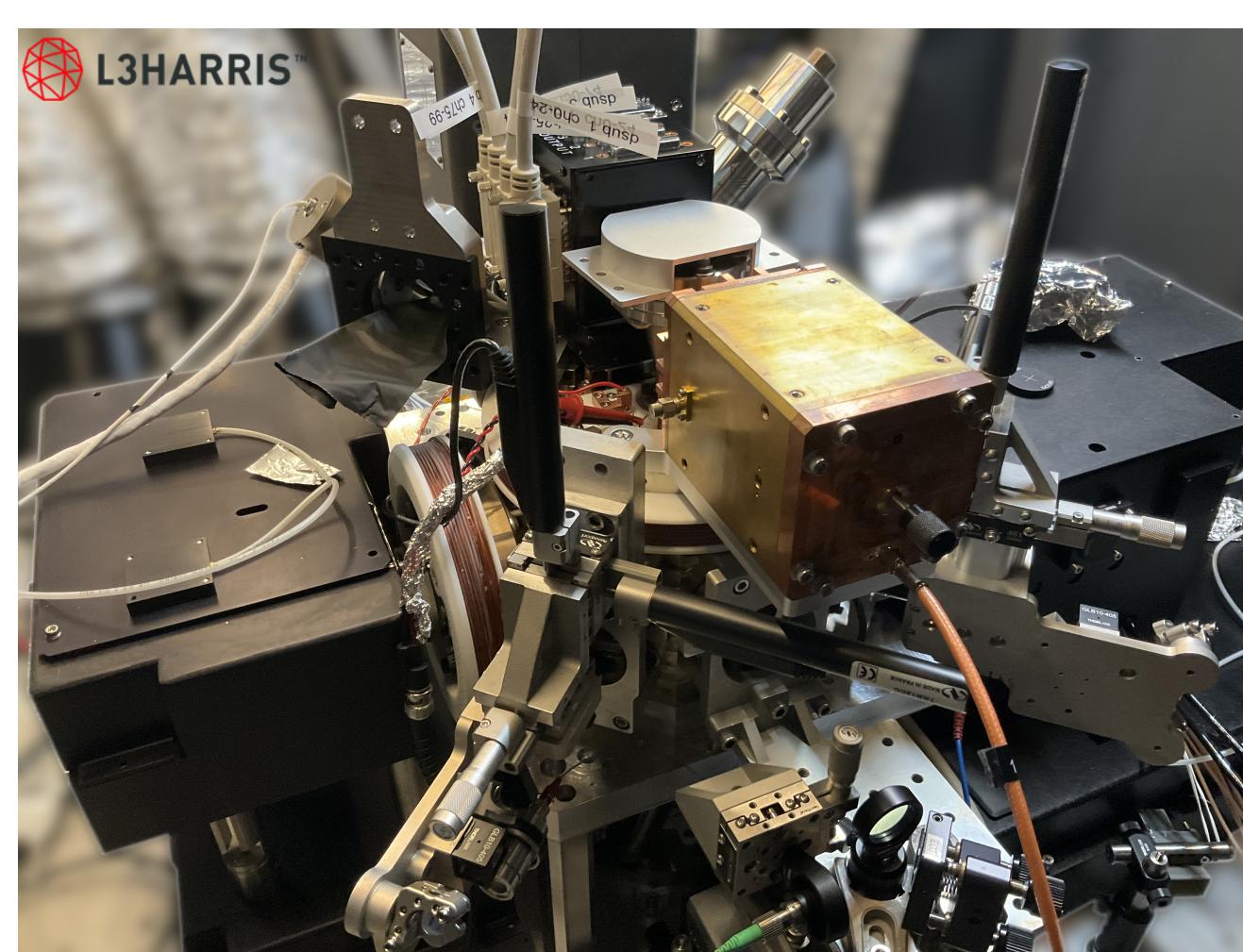
- Combining Optical Metastable and Ground state qubits
- Protecting quantum information by converting between qubit types
- Faster than ion-shuttling



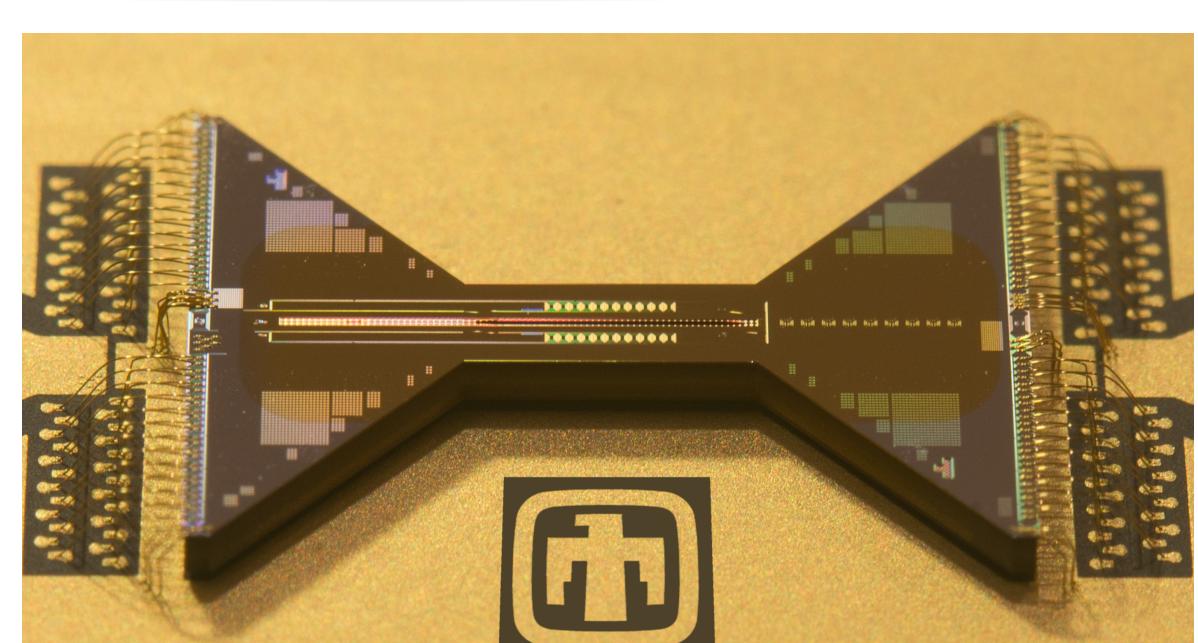
### System

### Optical control

- Global state preparation and detection with 370 nm
- Individually addressable Raman with 355 nm
- Global 435 nm for exciting to  $D_{3/2}$  states
- (Planned) Global 411 nm and 3.4  $\mu\text{m}$  for accessing  $D_{5/2}$  and  $F_{7/2}$  states

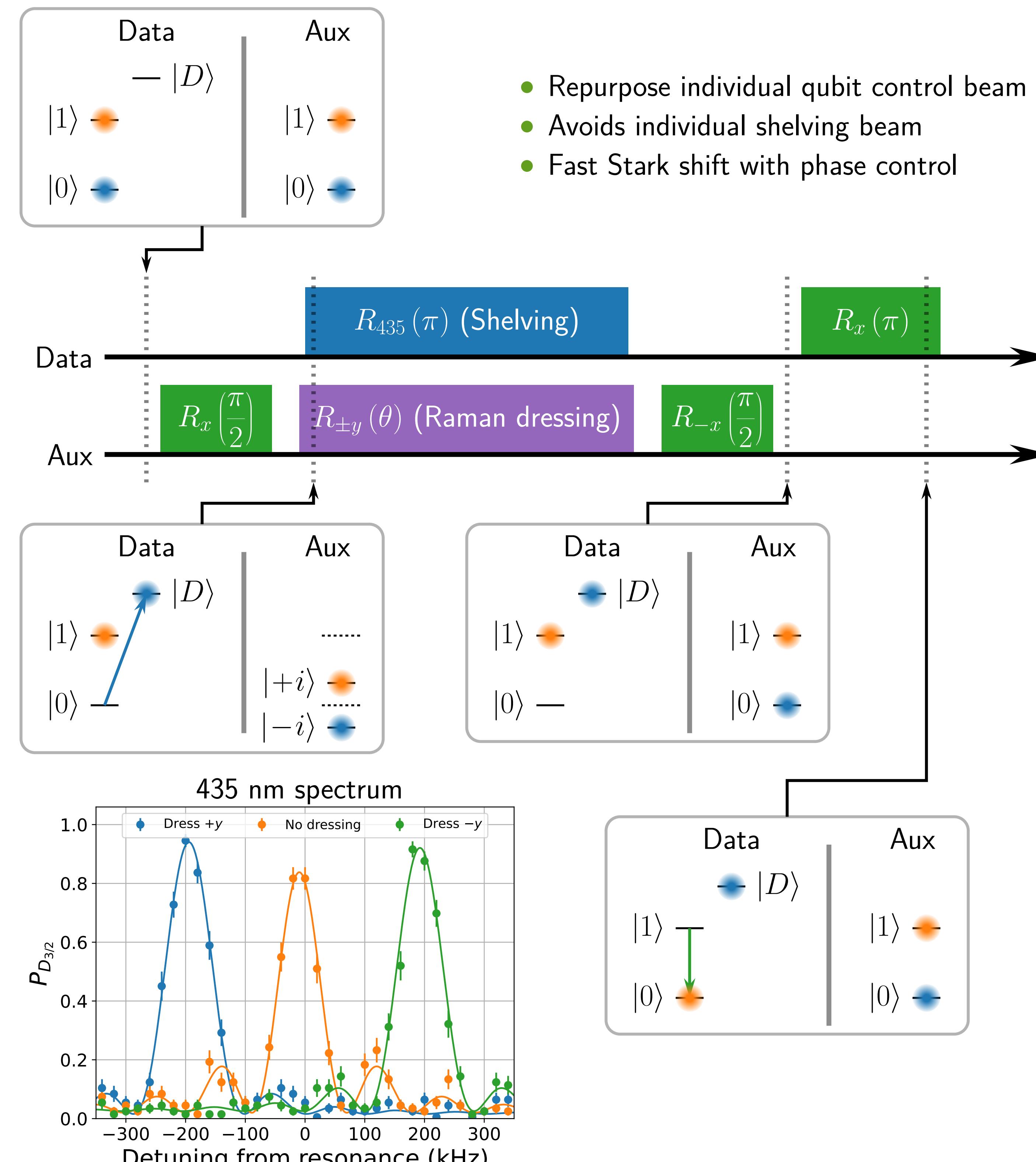


### Phoenix surface trap

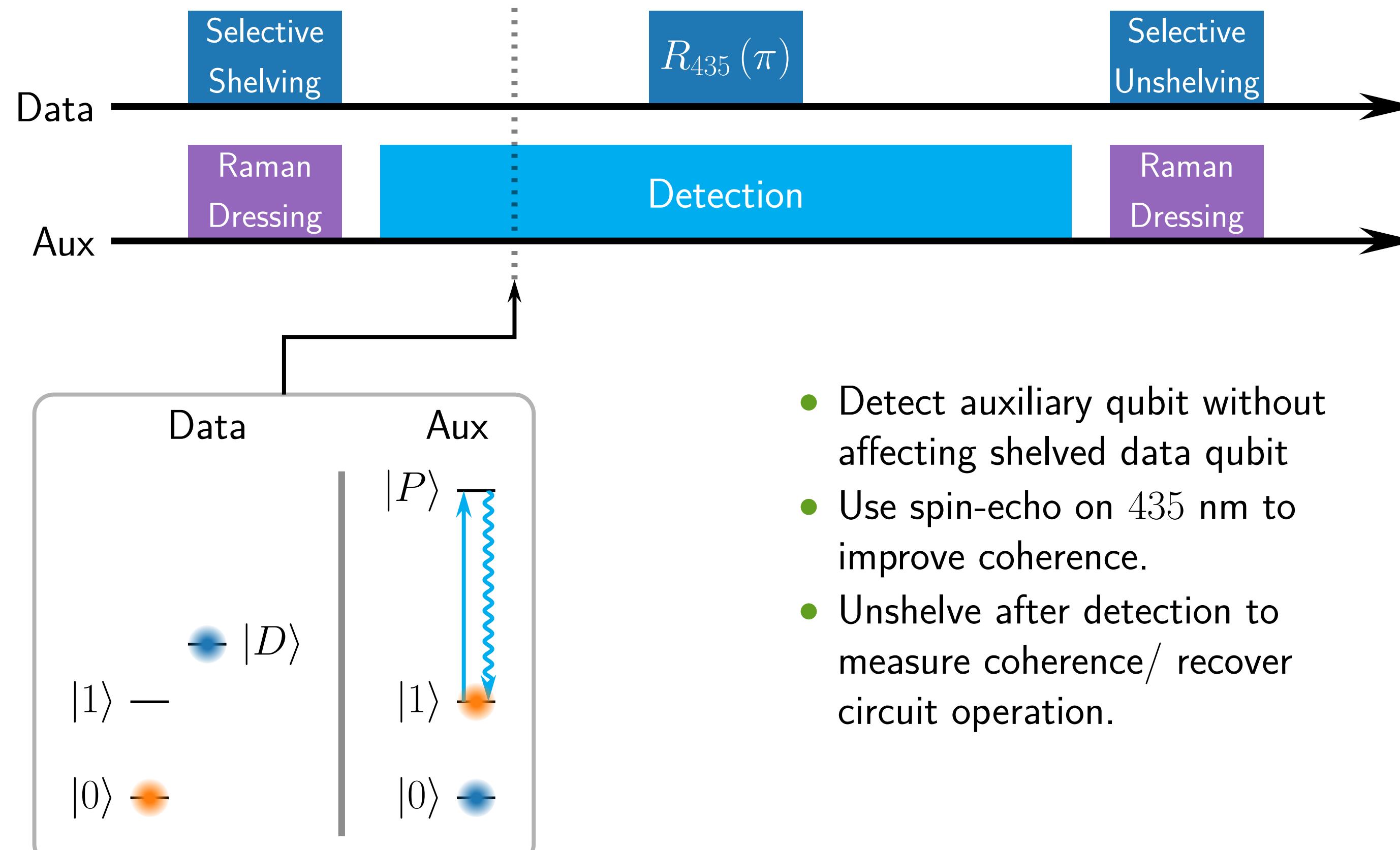


- Separate loading and quantum region
- Fine control of ion position
- Low heating rate

## Selective shelving with Raman dressing

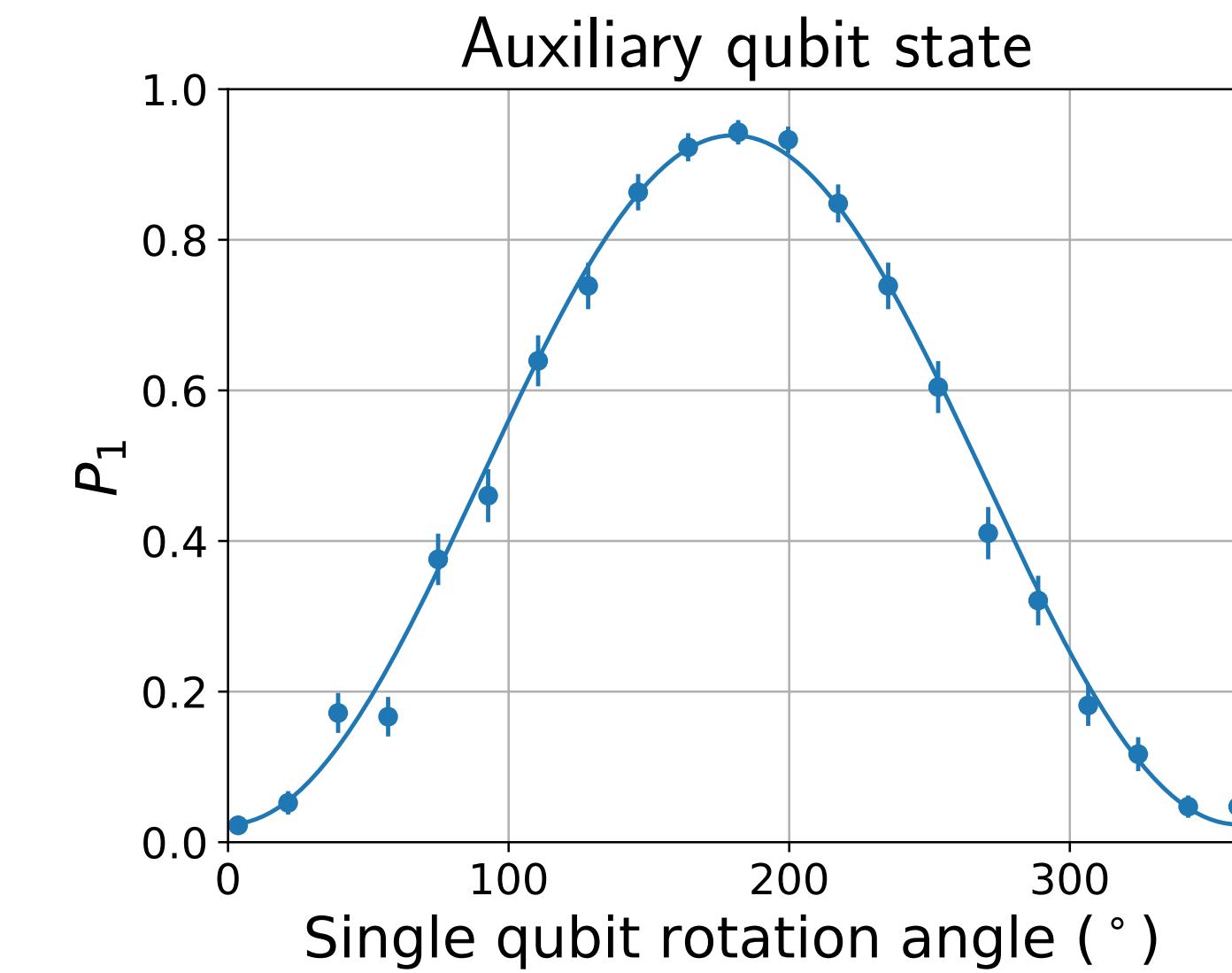


## Mid circuit measurement with selective shelving

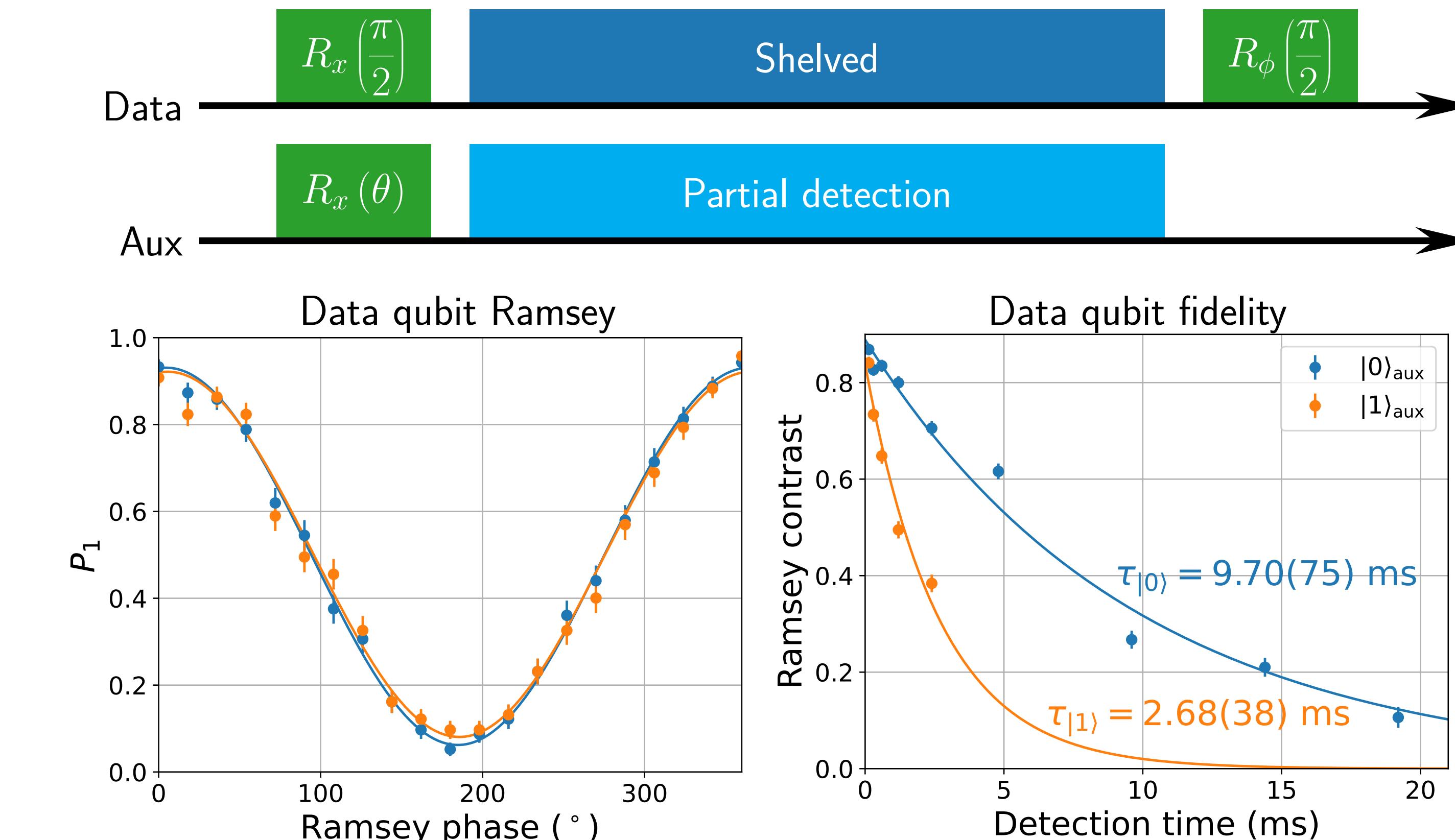


## Preliminary results

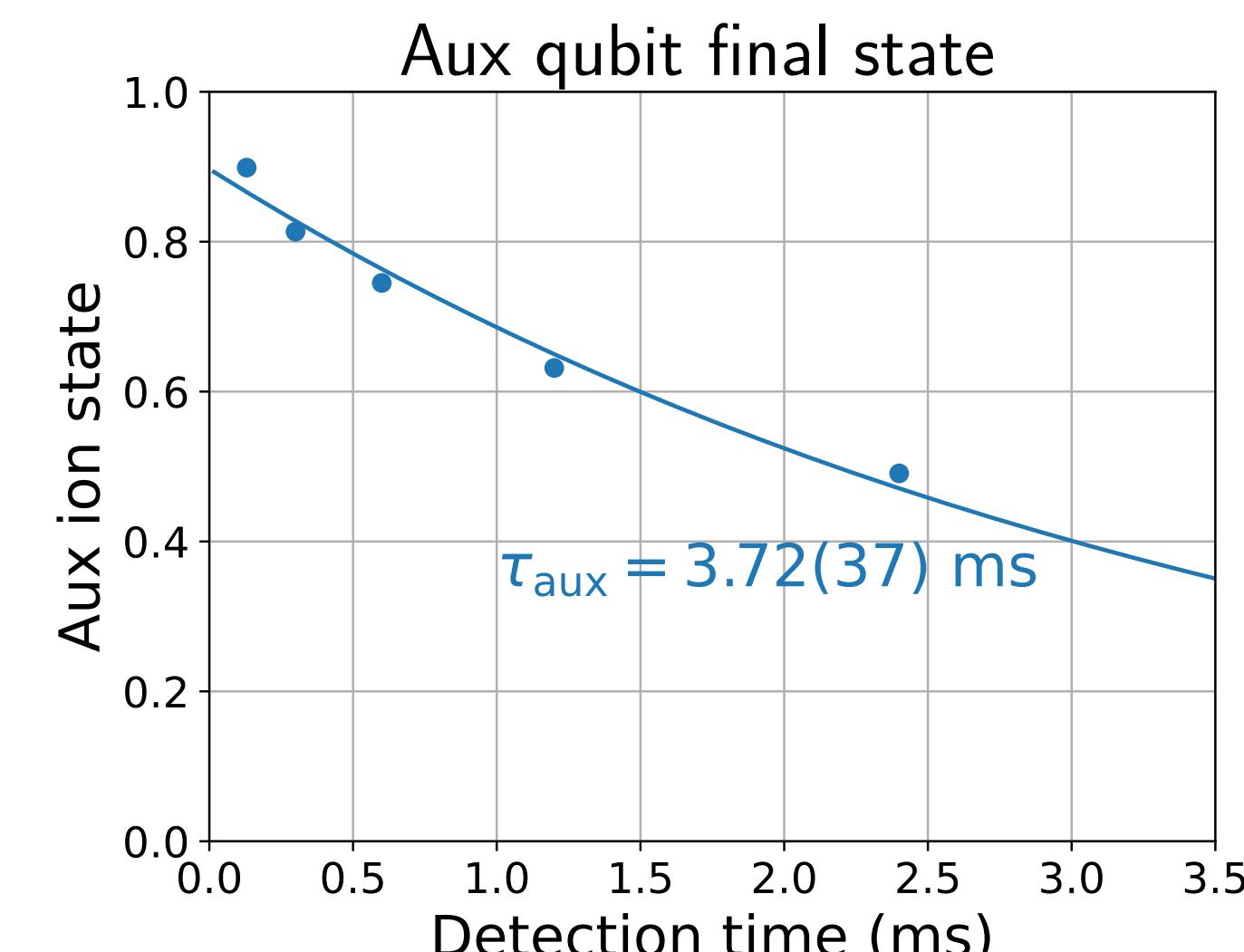
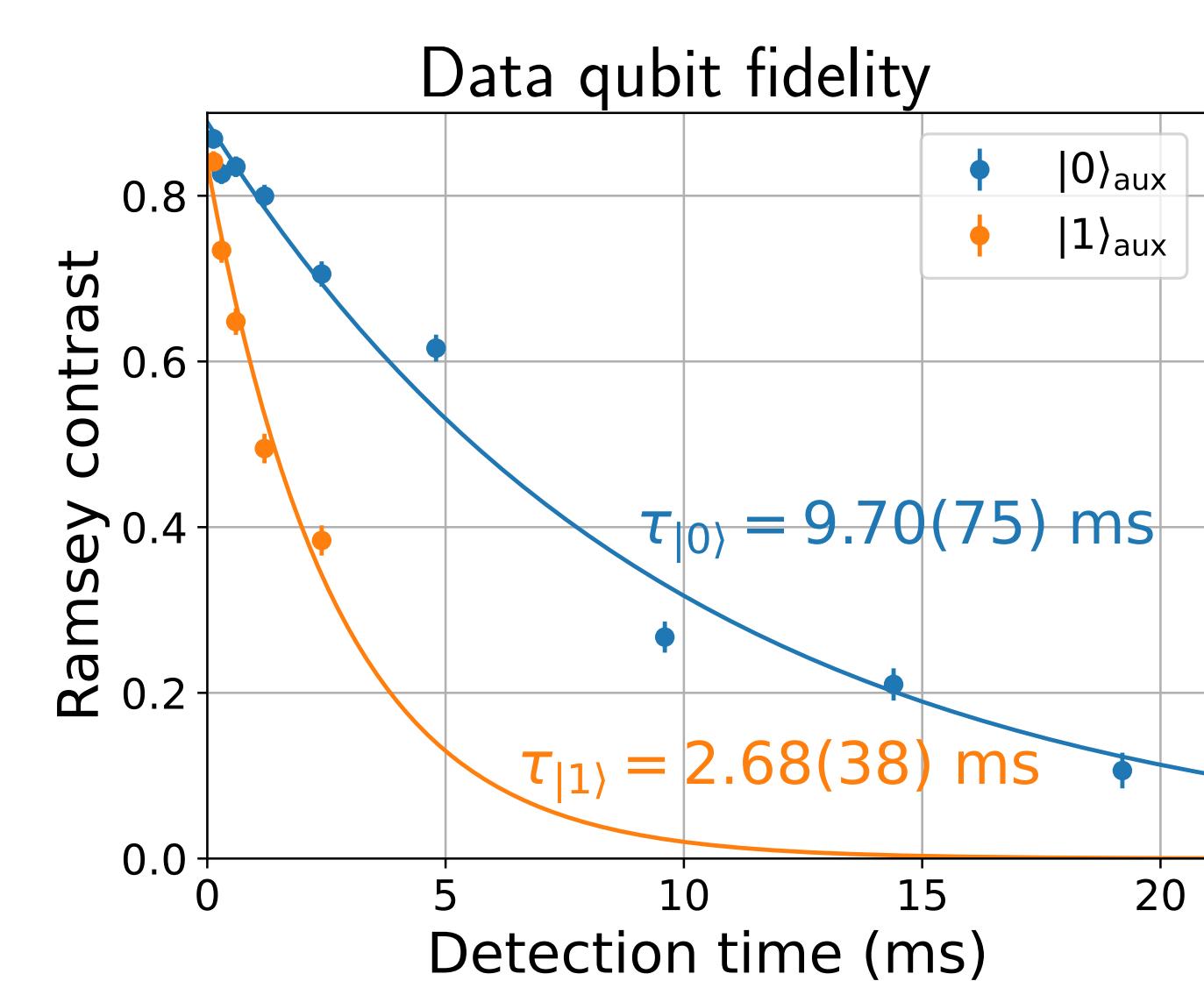
### Mid circuit measurement



### Data qubit coherence



### Data qubit fidelity



## Future works

- Improve qubit control
- Circuit integration
- Shelf to longer lived  $F_{7/2}$  state for better protection (Nature Physics vol. 18, 1058-1061 (2022))

