

Laser Polarization of $^{23}\text{Mg}^+$, $^{39}\text{Ca}^+$ at IGISOL for MORA

ACCLAIM MORA



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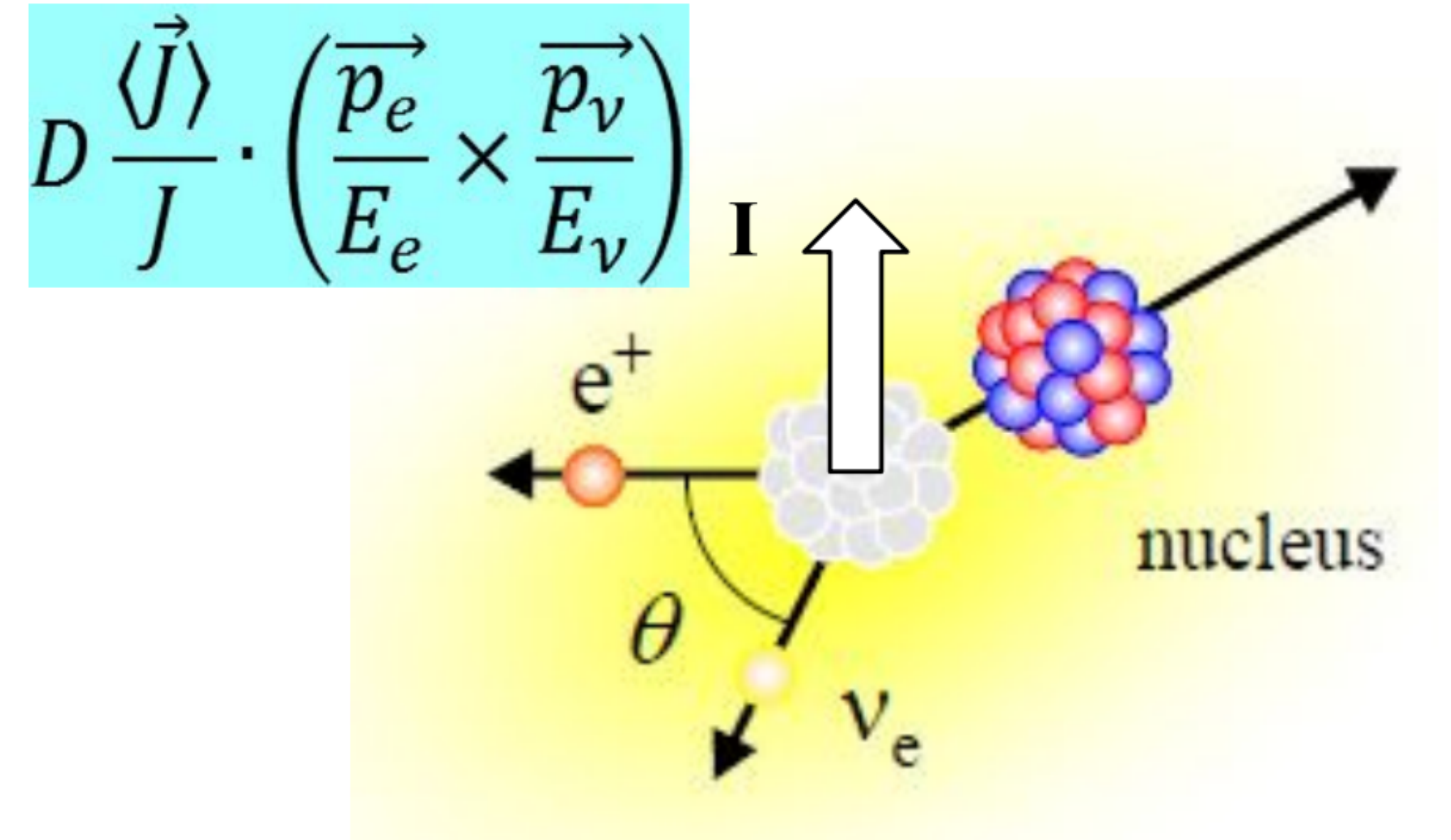


Layout

- Motivation
- Laser Infrastructure at IGISOL
- Laser polarization of $^{23}\text{Mg}^+$
- Laser polarization of $^{39}\text{Ca}^+$
- Plans at IGISOL to support $^{39}\text{Ca}^+$ laser polarization

Motivation

- Big question : Matter- antimatter asymmetry
Requires CP violating mechanism
- CP violation can be probed in weak interactions
via **D-corr in nuclear beta decay**
- D is an interference btw. F and GT interactions

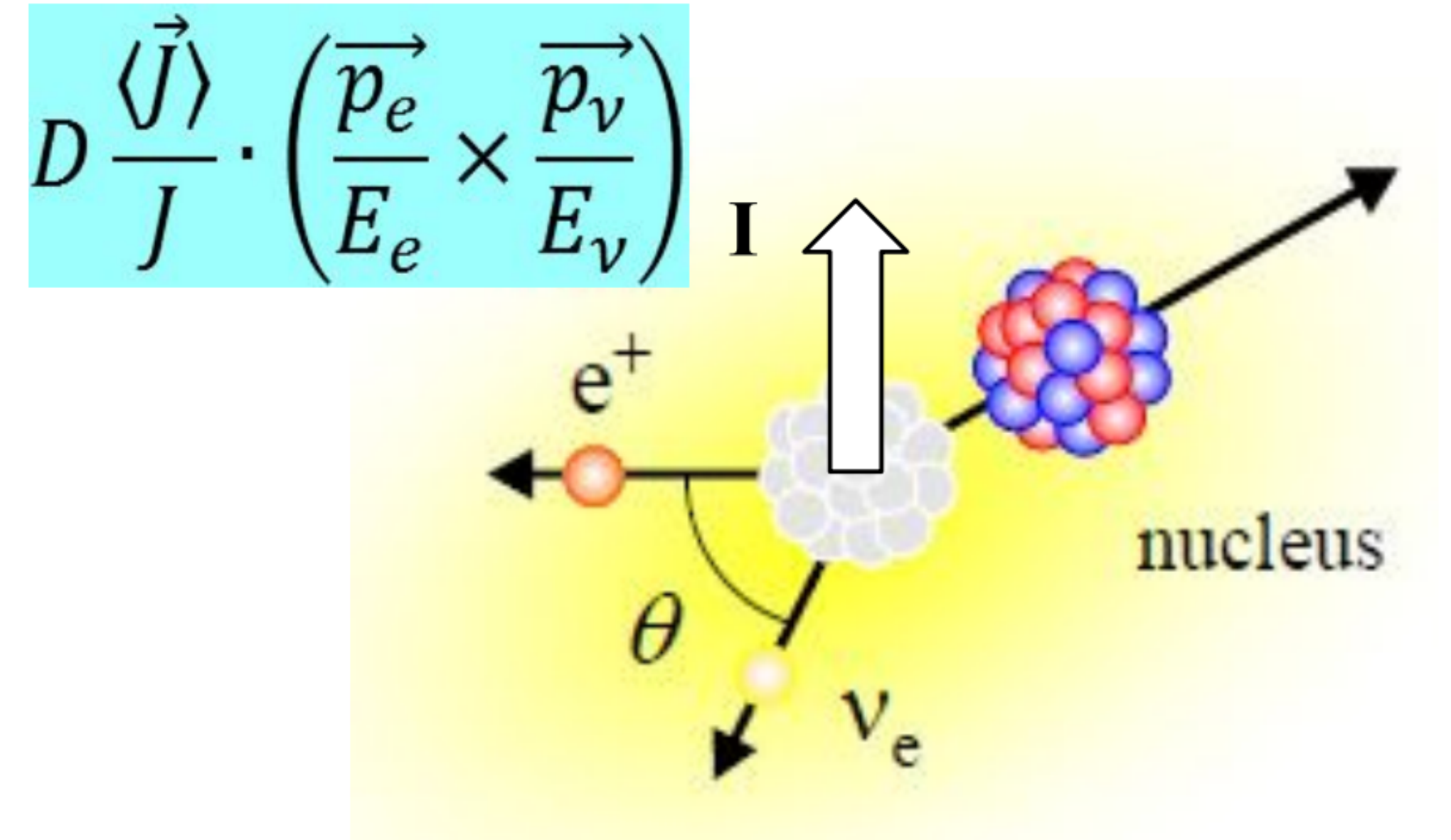


Experimental requirements

- High degree of GT-F in for decay between analog states in mirror nuclei
i.e, ^{23}Mg , ^{39}Ca , ^{19}Ne , ^{35}Ar , ..
- Half lifes $\sim 100\text{ms}$ / few s and decaying to stable nuclei
Offers lower background, high RIB production
- **Laser polarization** of ions - simple (single e^-) and efficient schemes,
high polz. efficiency and fast (\sim few ms)

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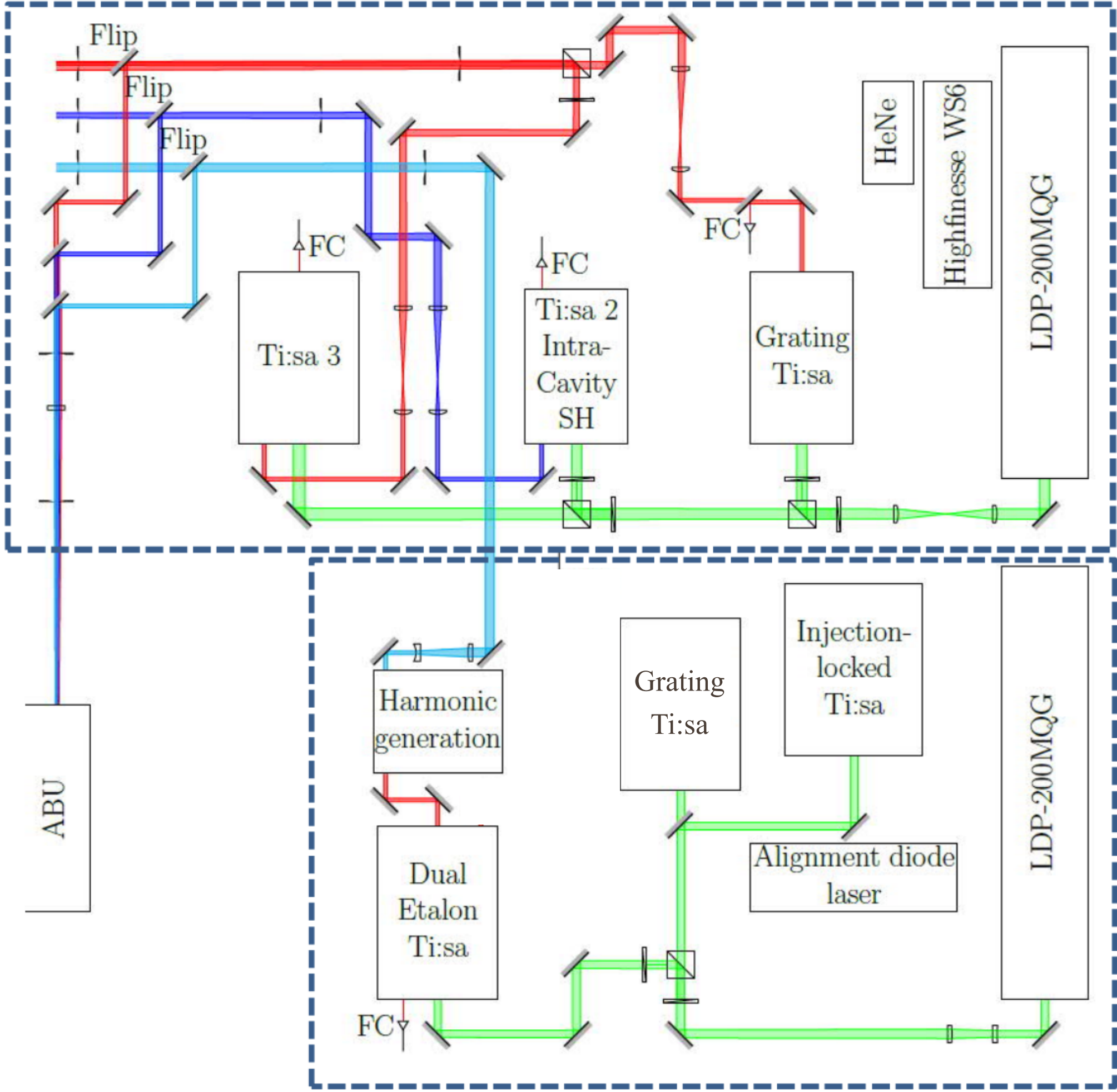


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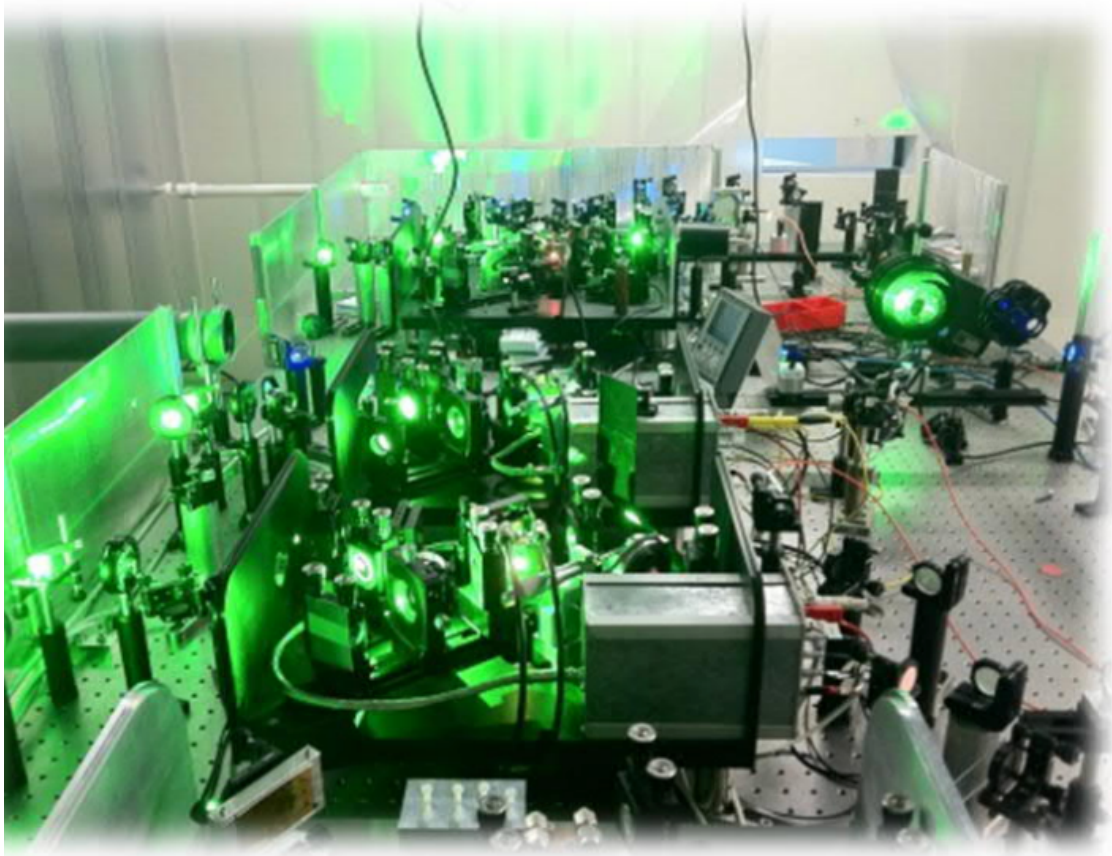
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$^{23}\text{Mg}^+$, $^{39}\text{Ca}^+$ are the best cases
to start with

Laser Infrastructure at IGISOL



FURIOS Cabin



Repetition rate 10kHz

Tuning range:

Fundamental 680-1050nm

Frequency Doubled 340-525nm

Tripled 250-330nm

Quadrupled 205-250nm

Line width >5GHz (broad),

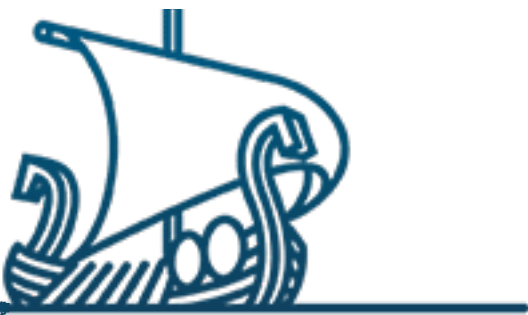
<1 GHz narrow

- Offline RIS studies - ABU
- Hot cavity laser ion source
- In-source laser spectroscopy

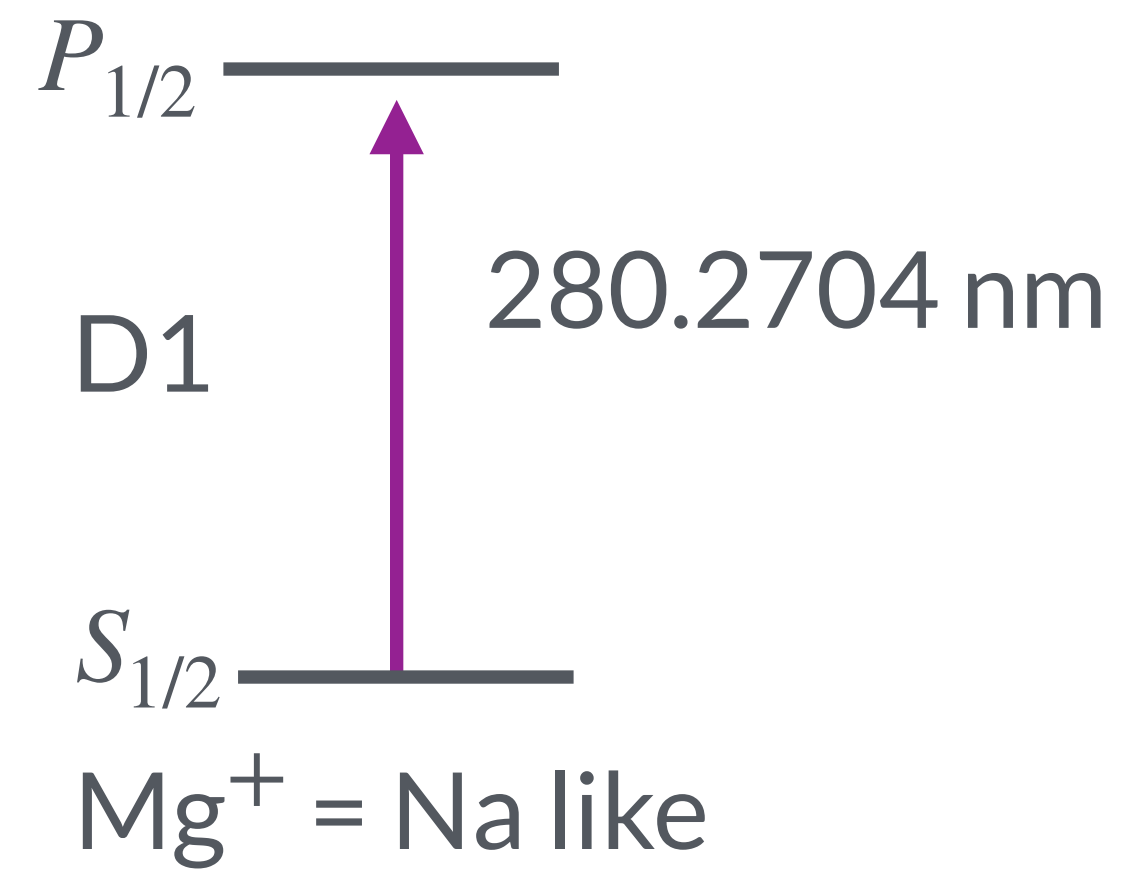
•Collinear RIS (RAPTOR)

•Laser Cooling

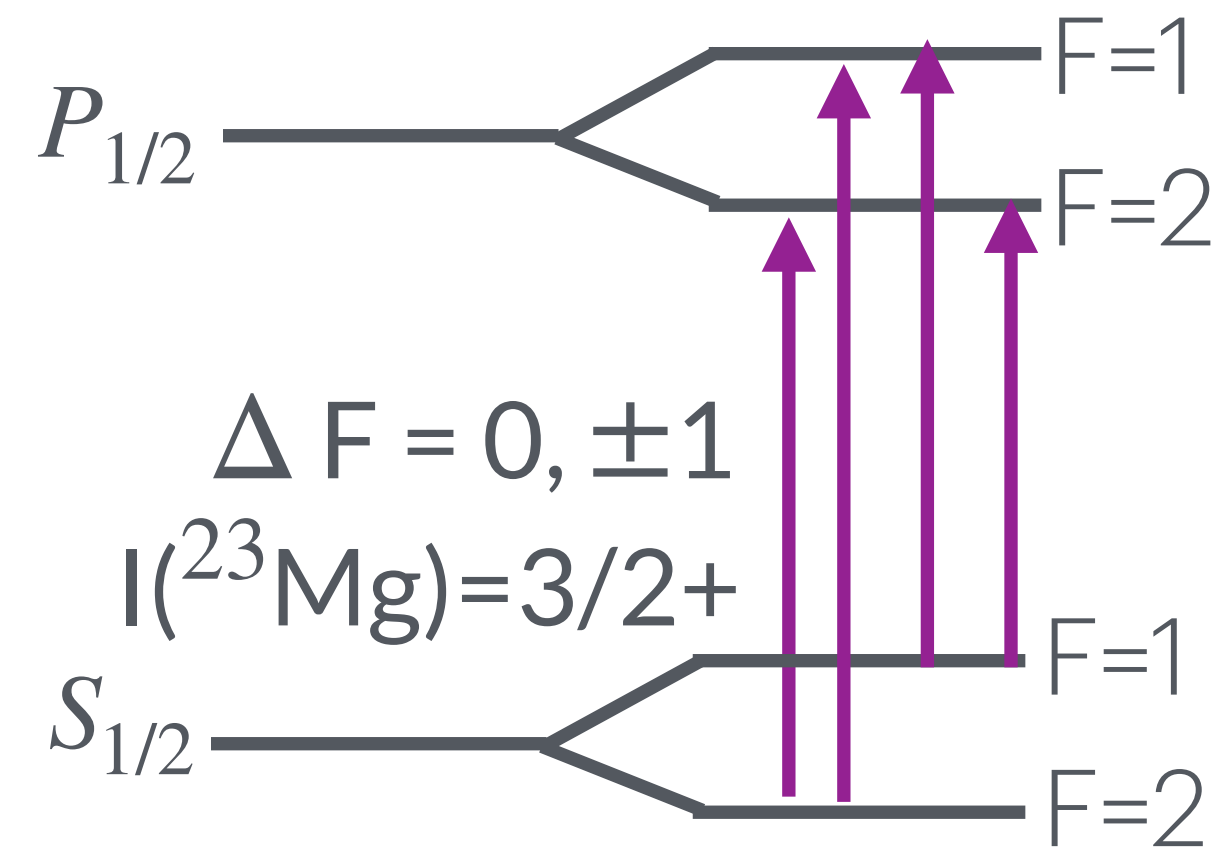
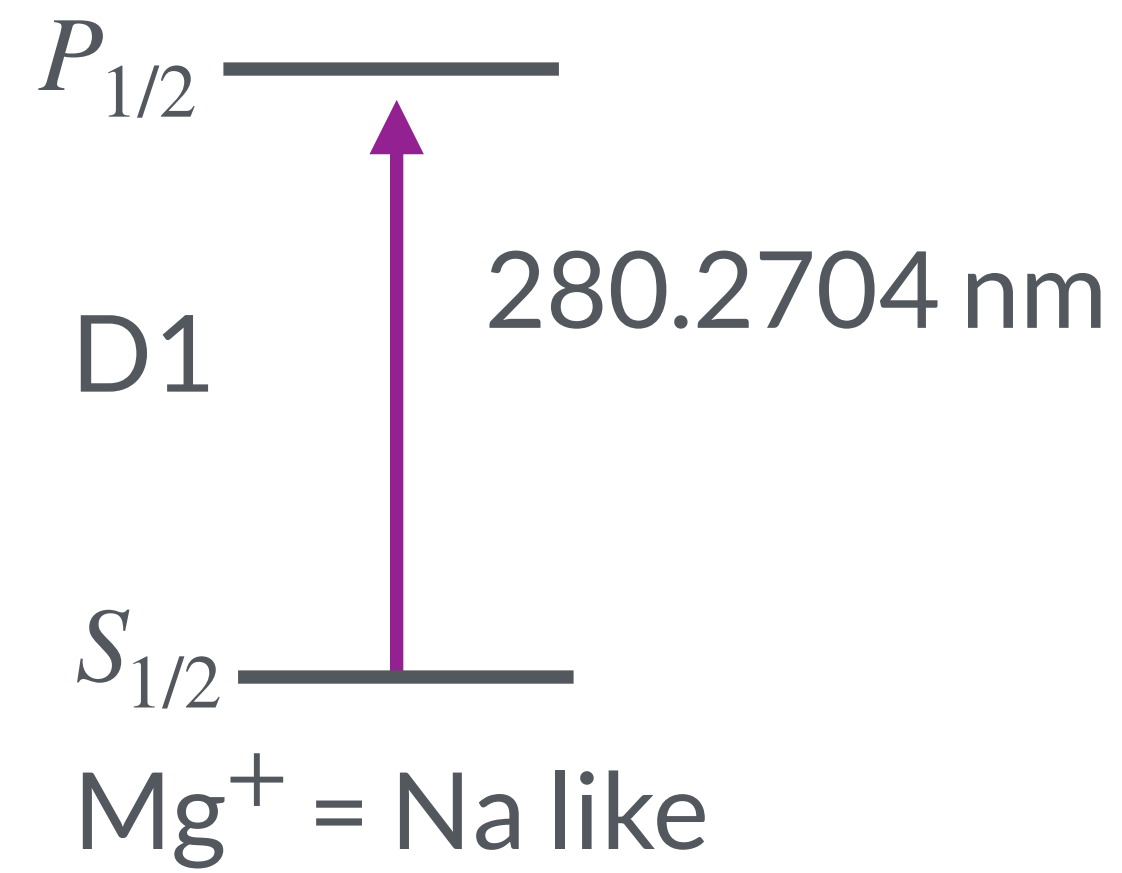
•MORA



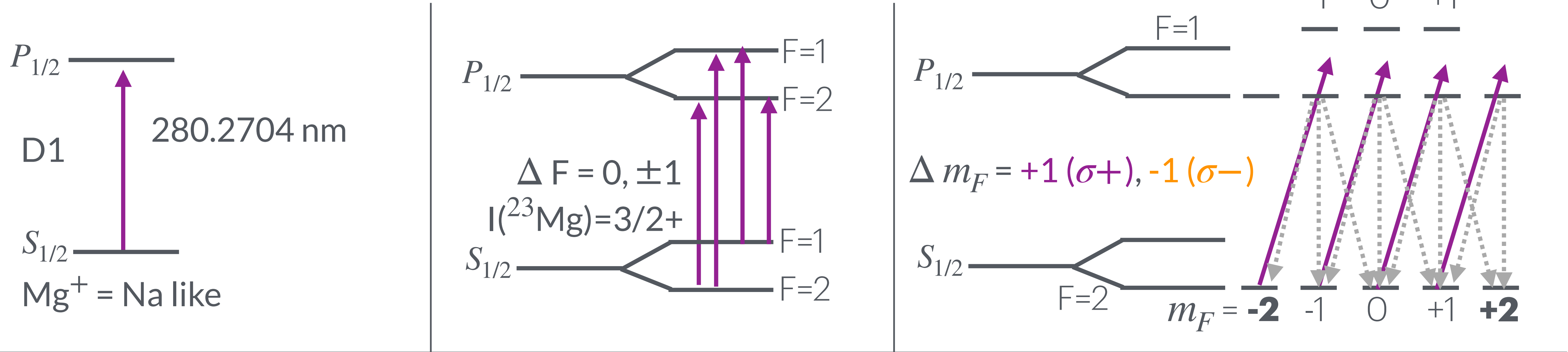
Laser Polarization of $^{23}\text{Mg}^+$ for MORA experiment



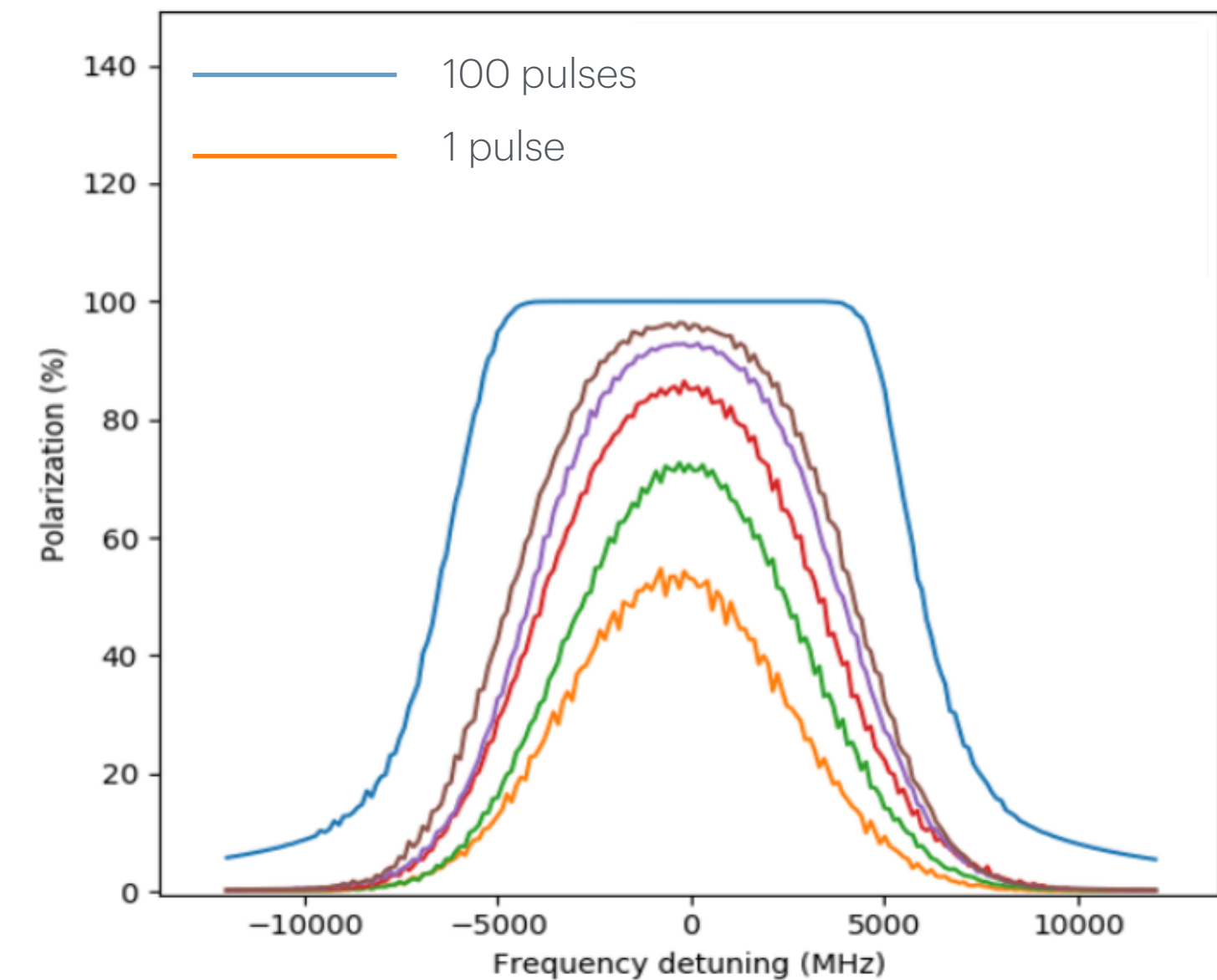
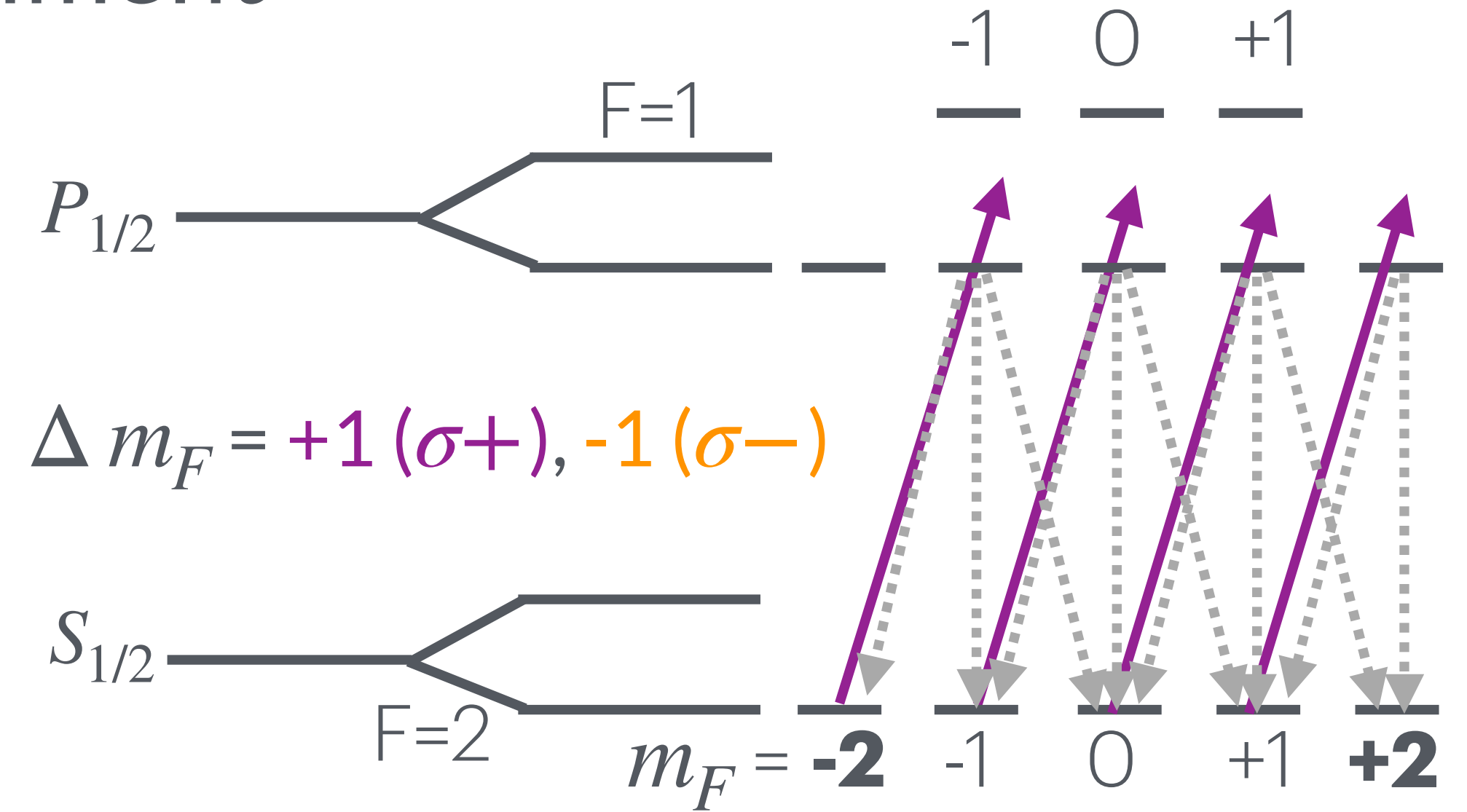
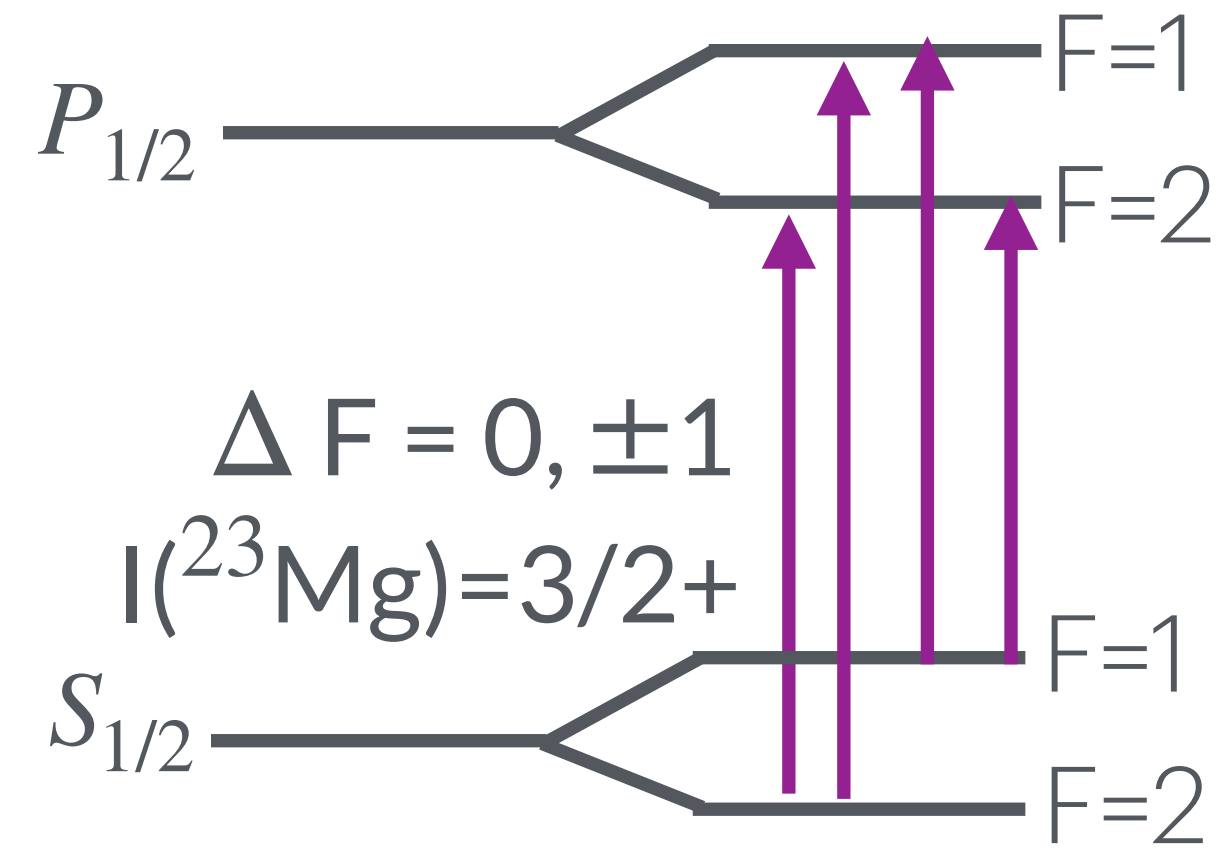
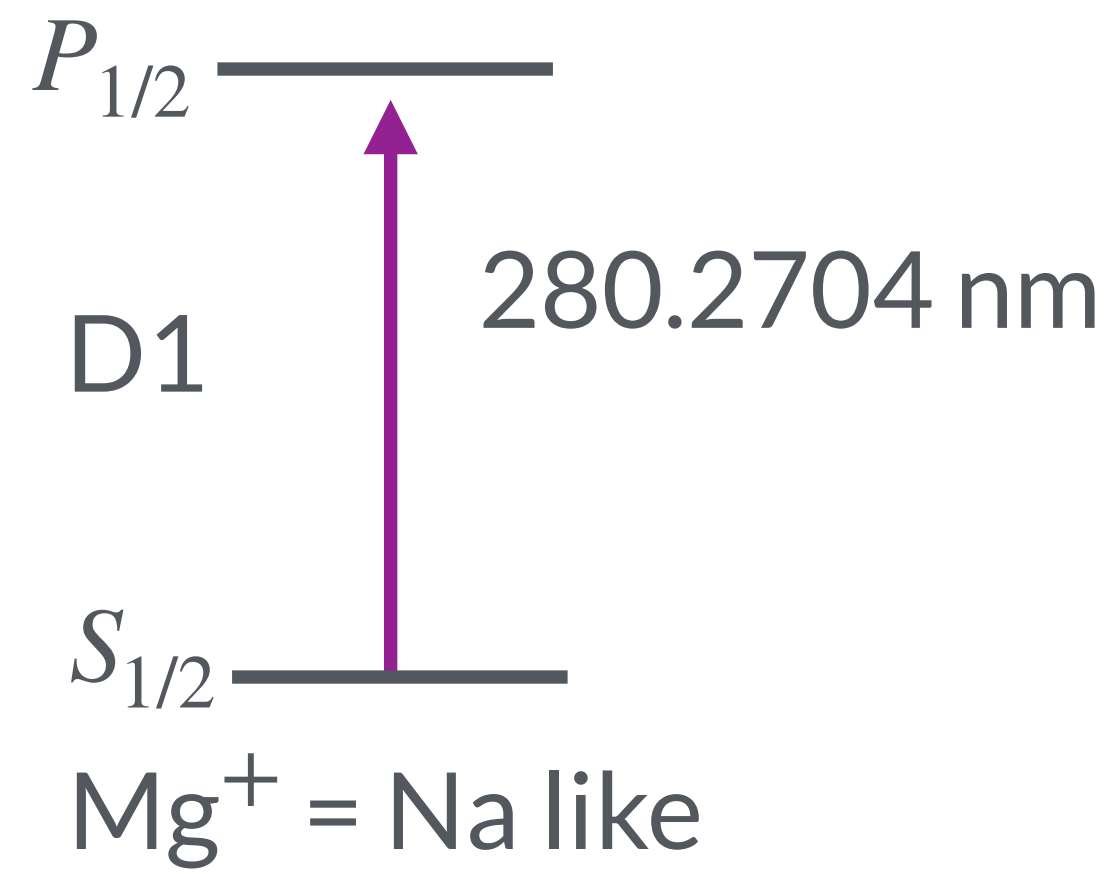
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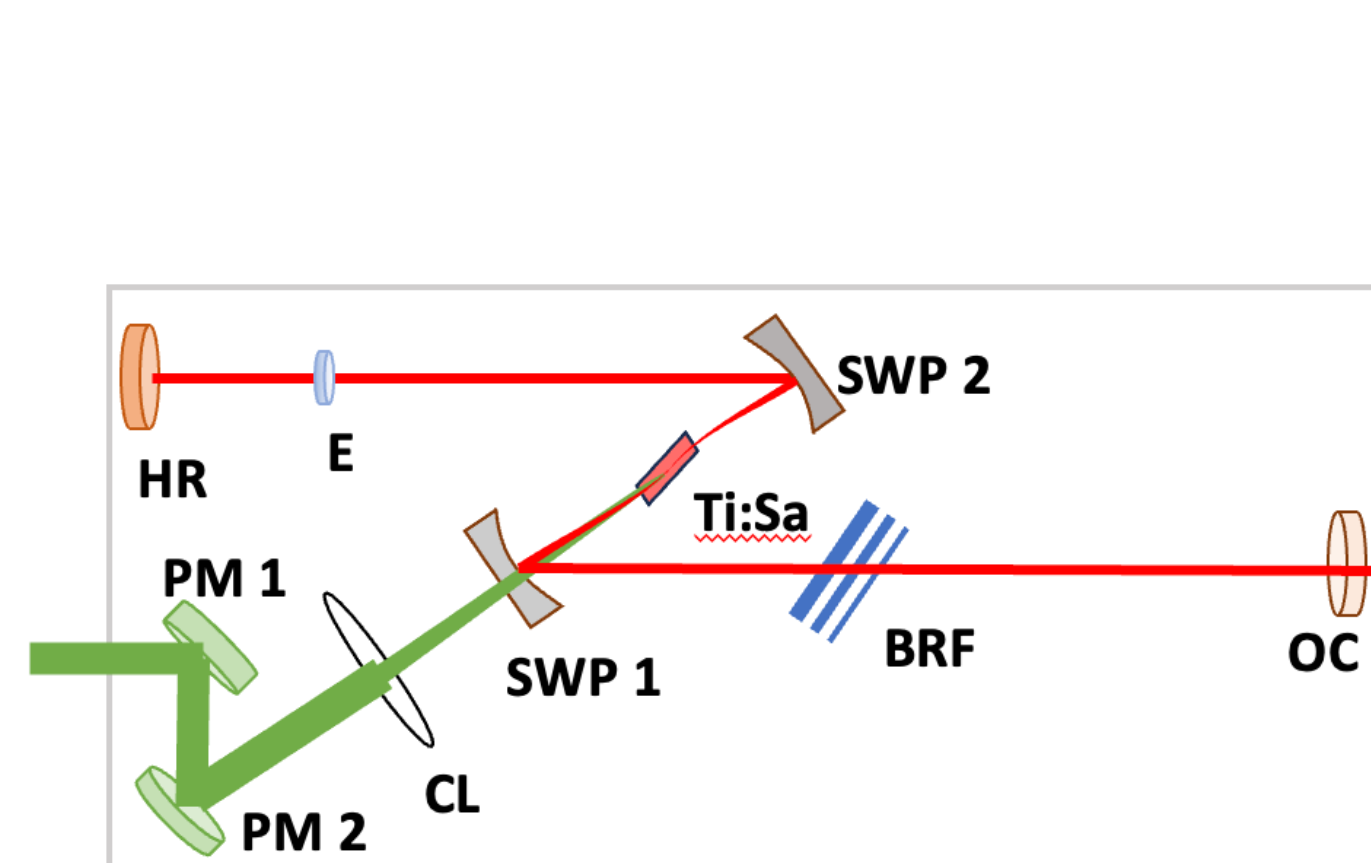
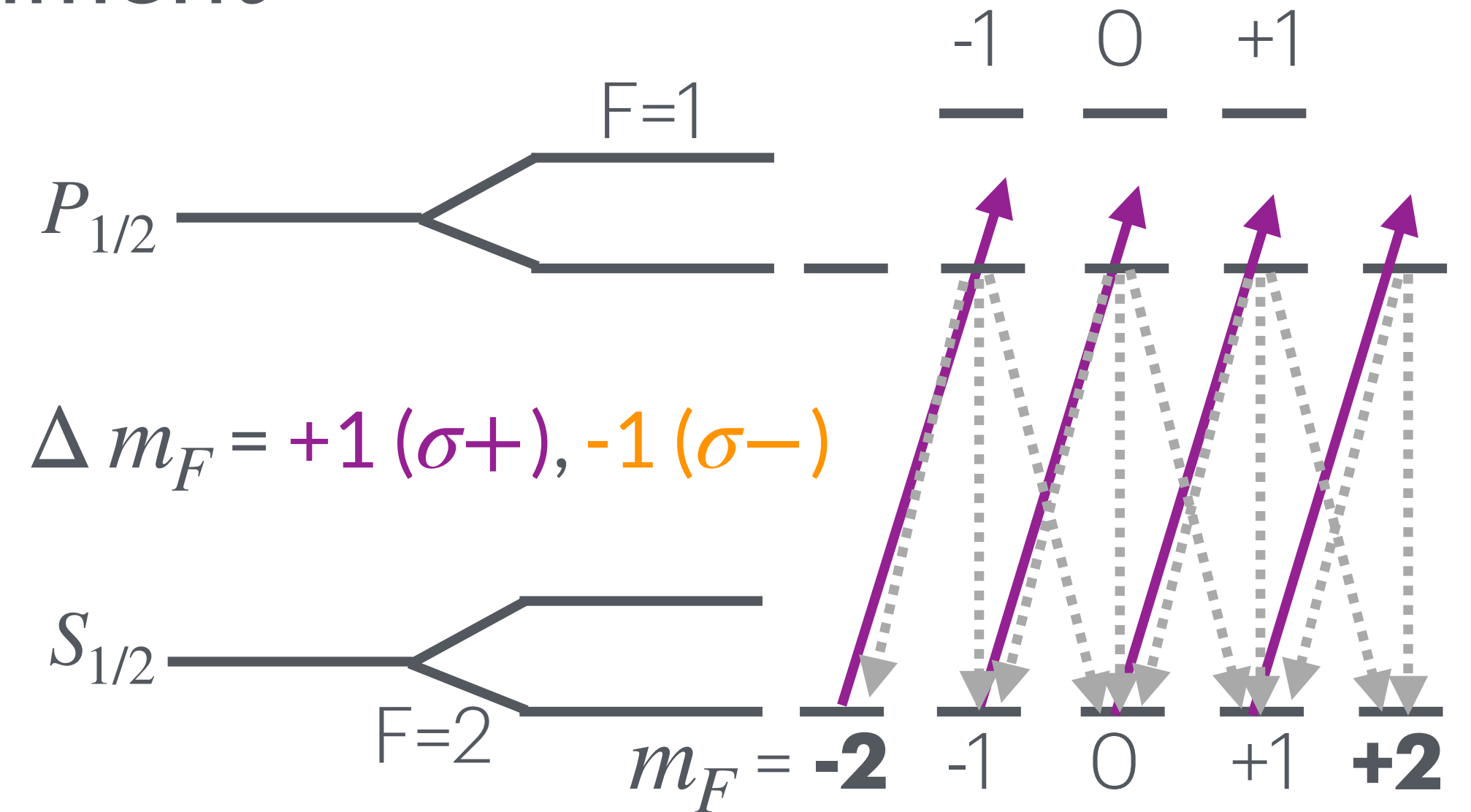
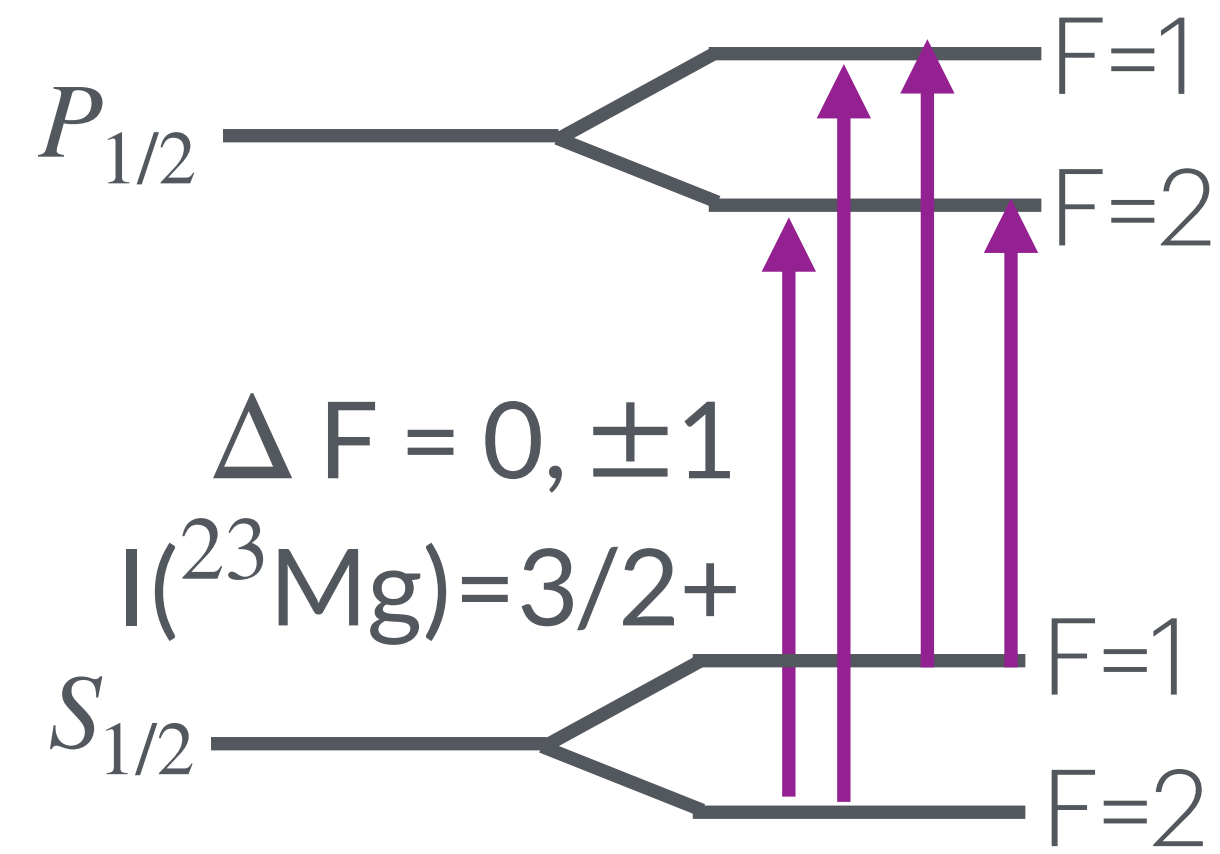
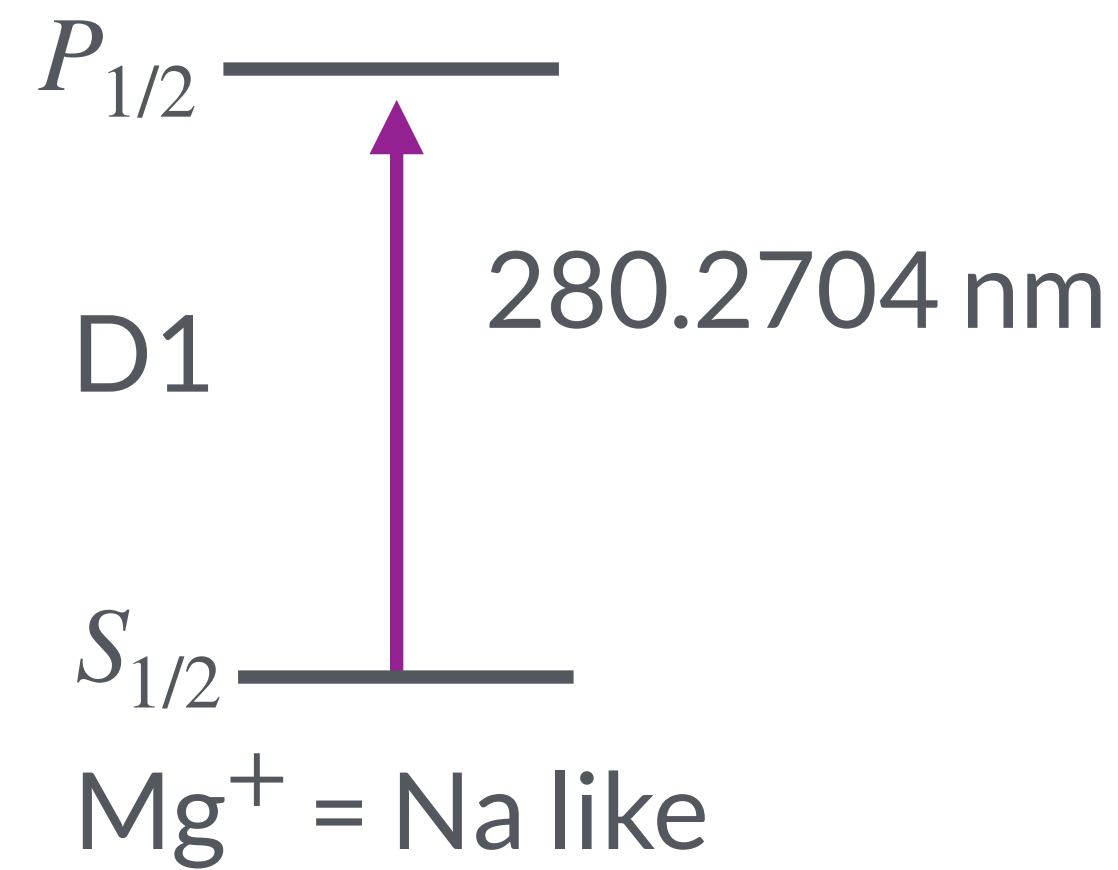
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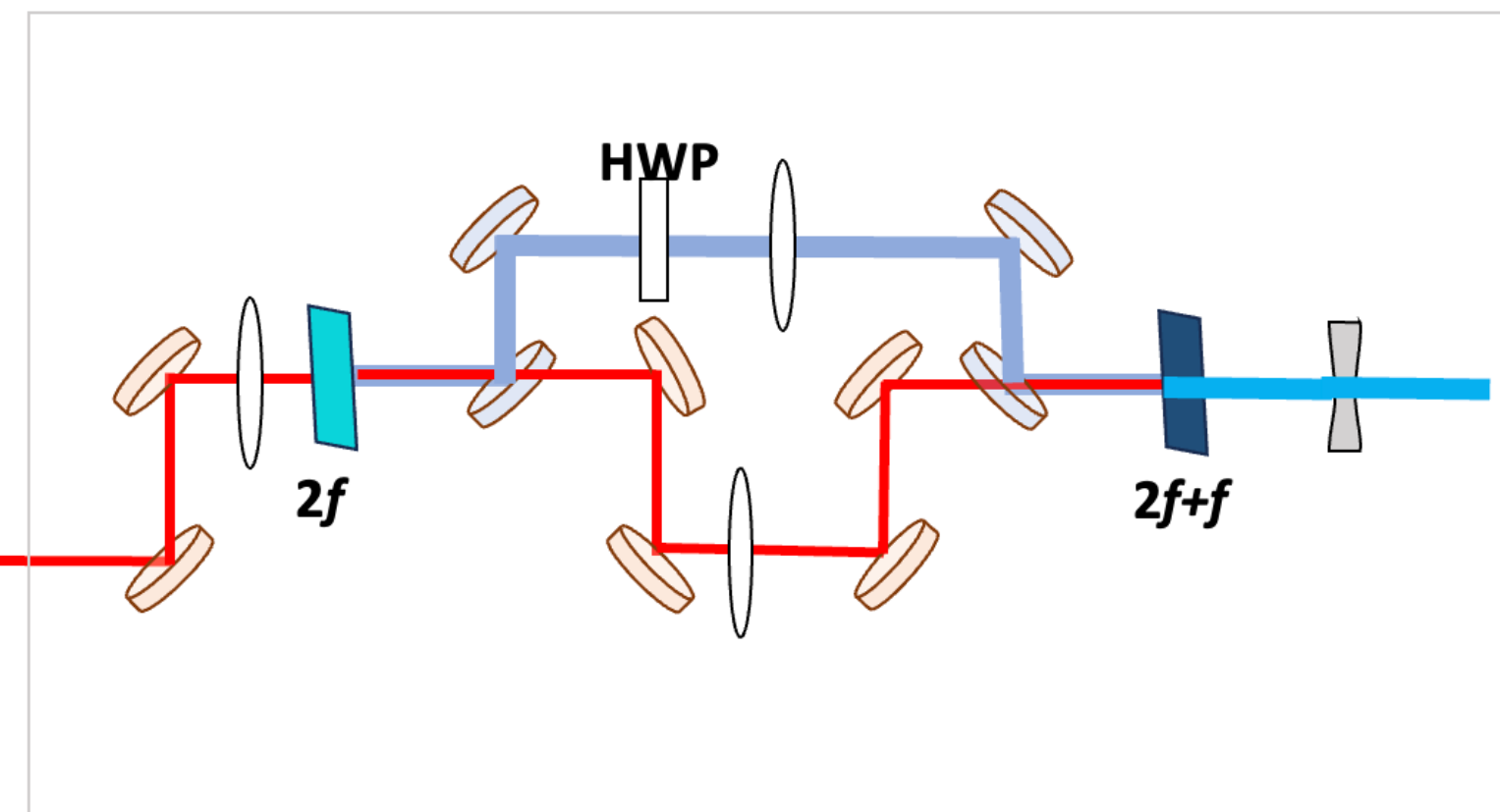
Laser Polarization of $^{23}\text{Mg}^+$ for MORA experiment



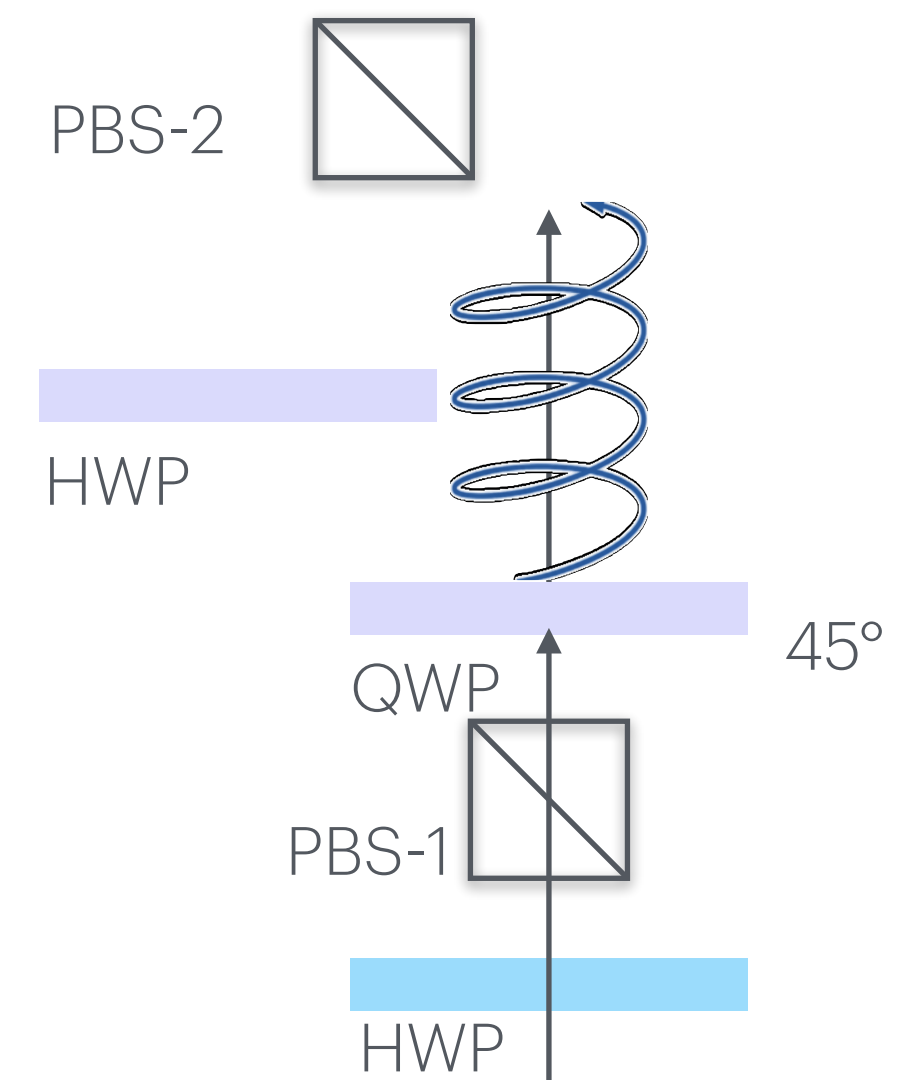
Laser Polarization of $^{23}\text{Mg}^+$ for MORA experiment



Laser setup

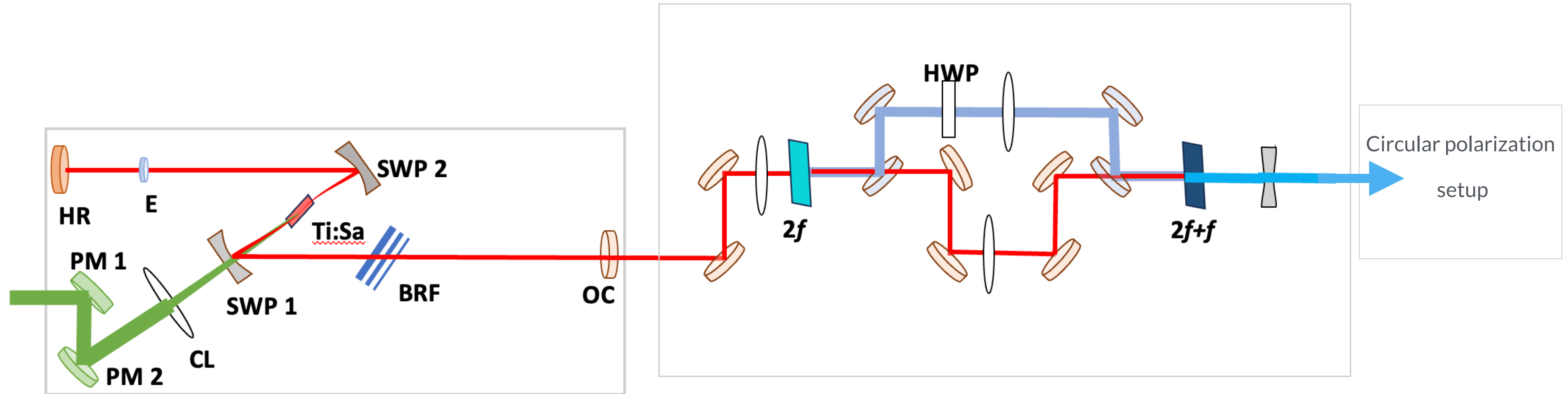


Frequency tripling



Circular polarization setup

Laser System Design: Frequency Selection and Harmonic Generation



BBO non-linear crystals

Doubling efficiency ~ 25%

After frequency tripling ~ 280 nm

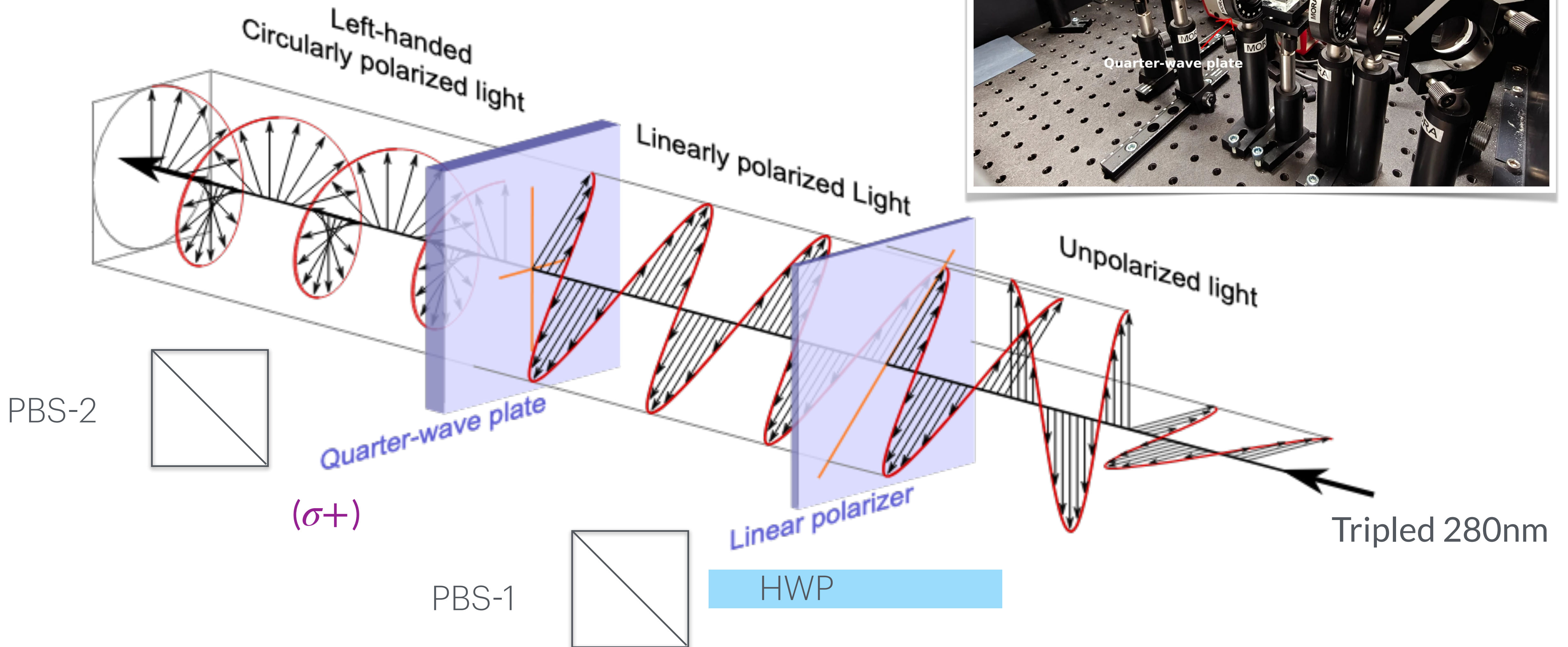
Tripled frequency power ~ 50-100 mW

Fundamental wavelength ~ 840 nm

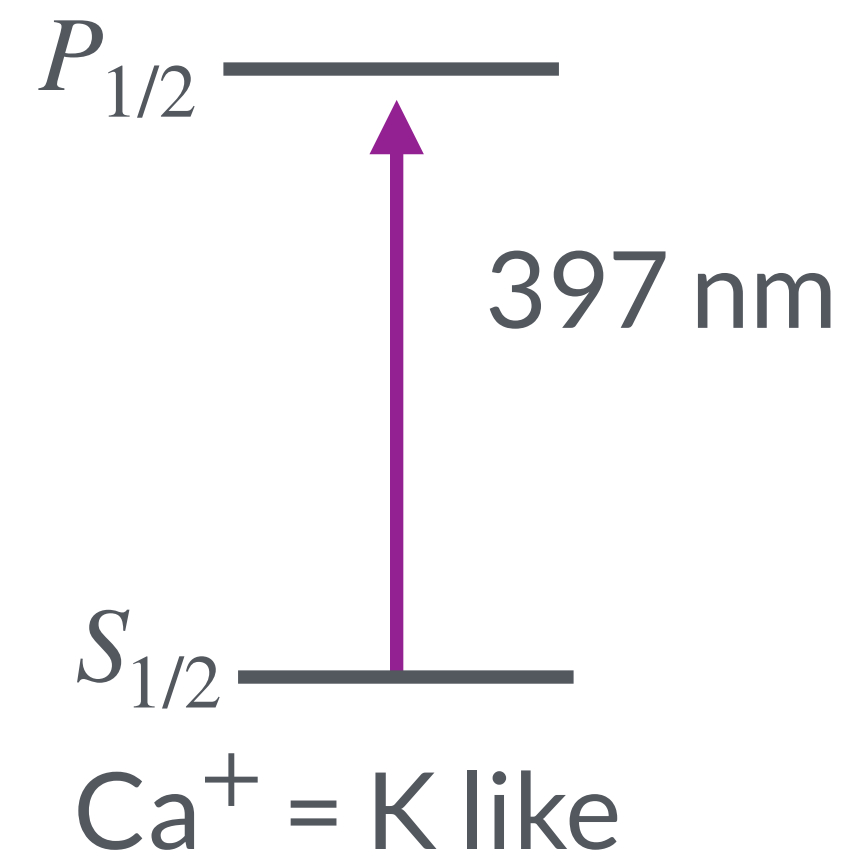
~3W @ 12-14W pump power

Circular Polarization setup

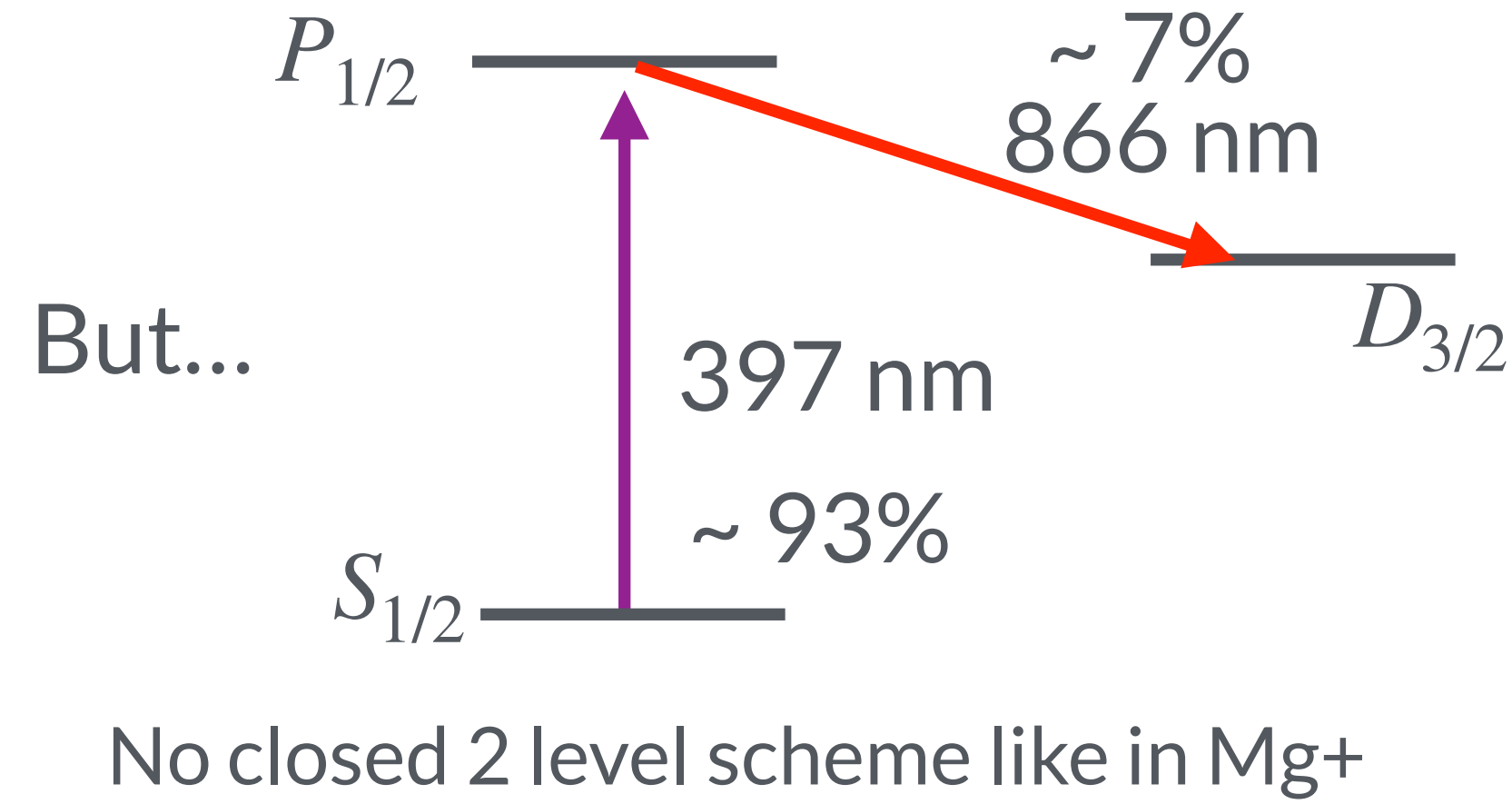
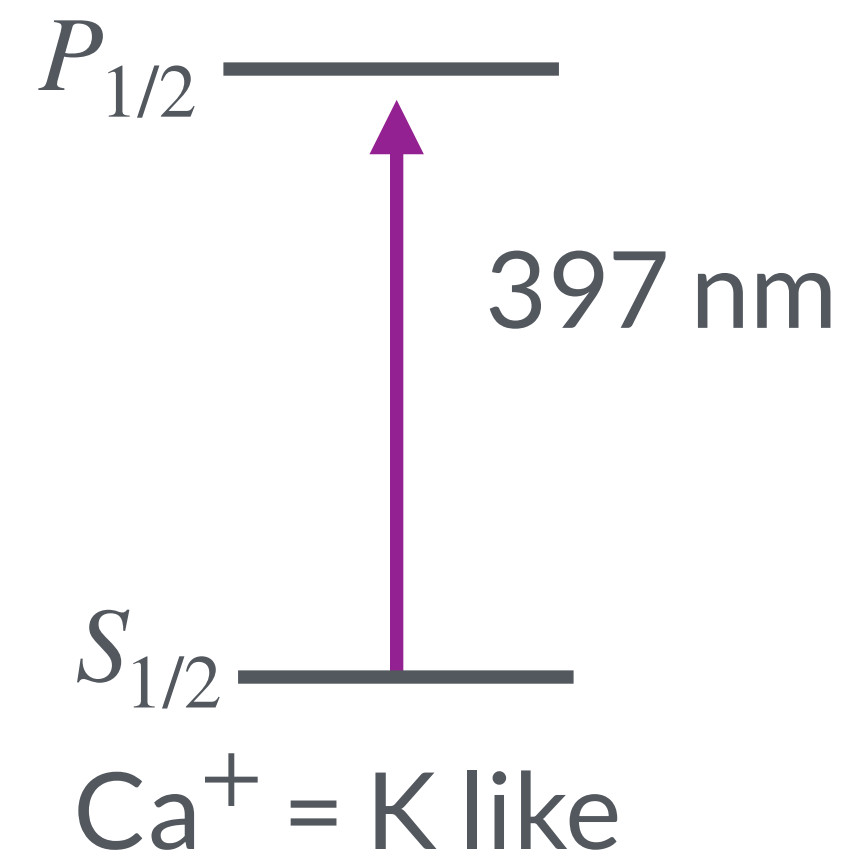
Light having equal amplitudes in orthogonal linear components of electric field and a constant phase difference of 90°



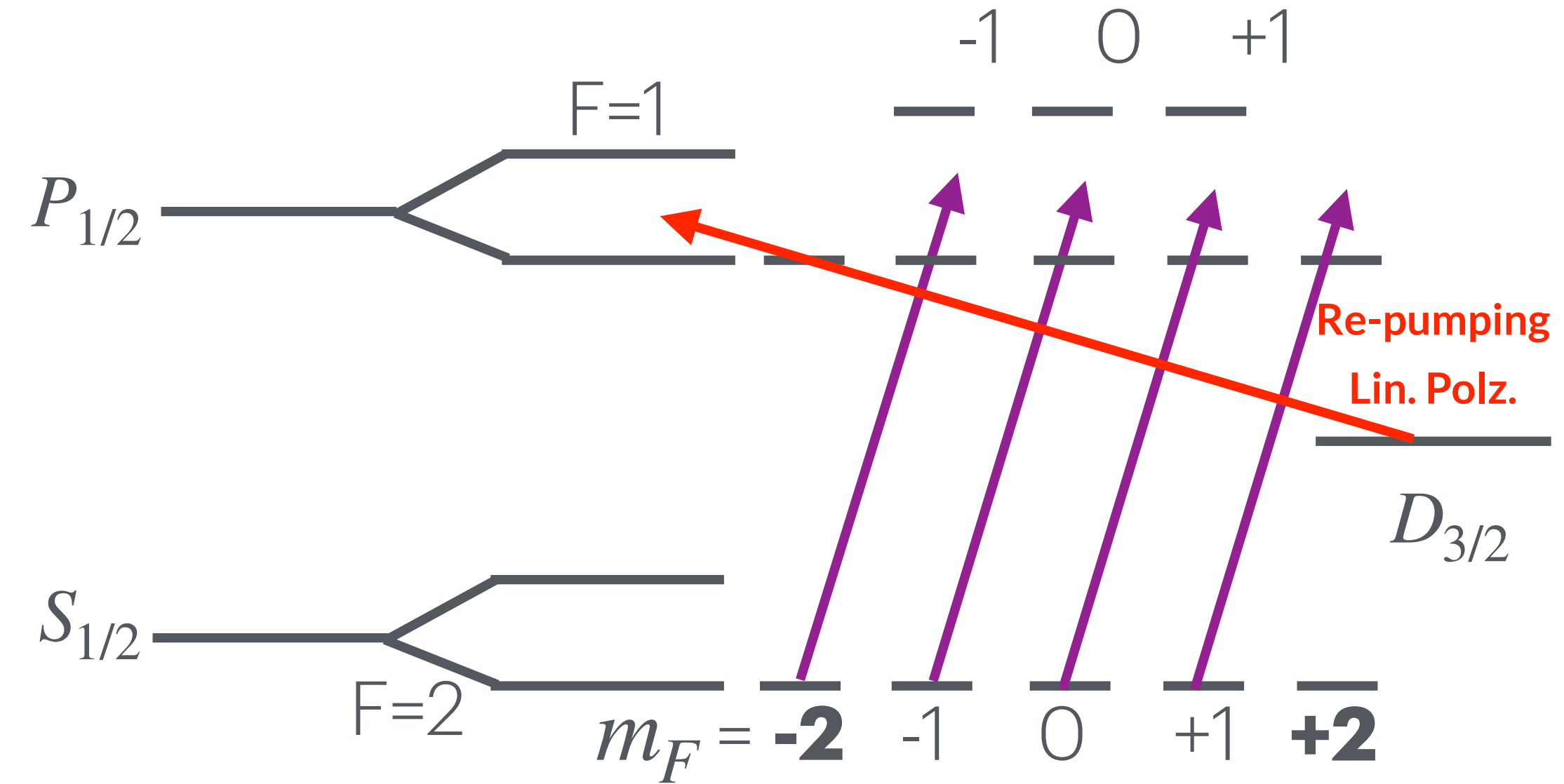
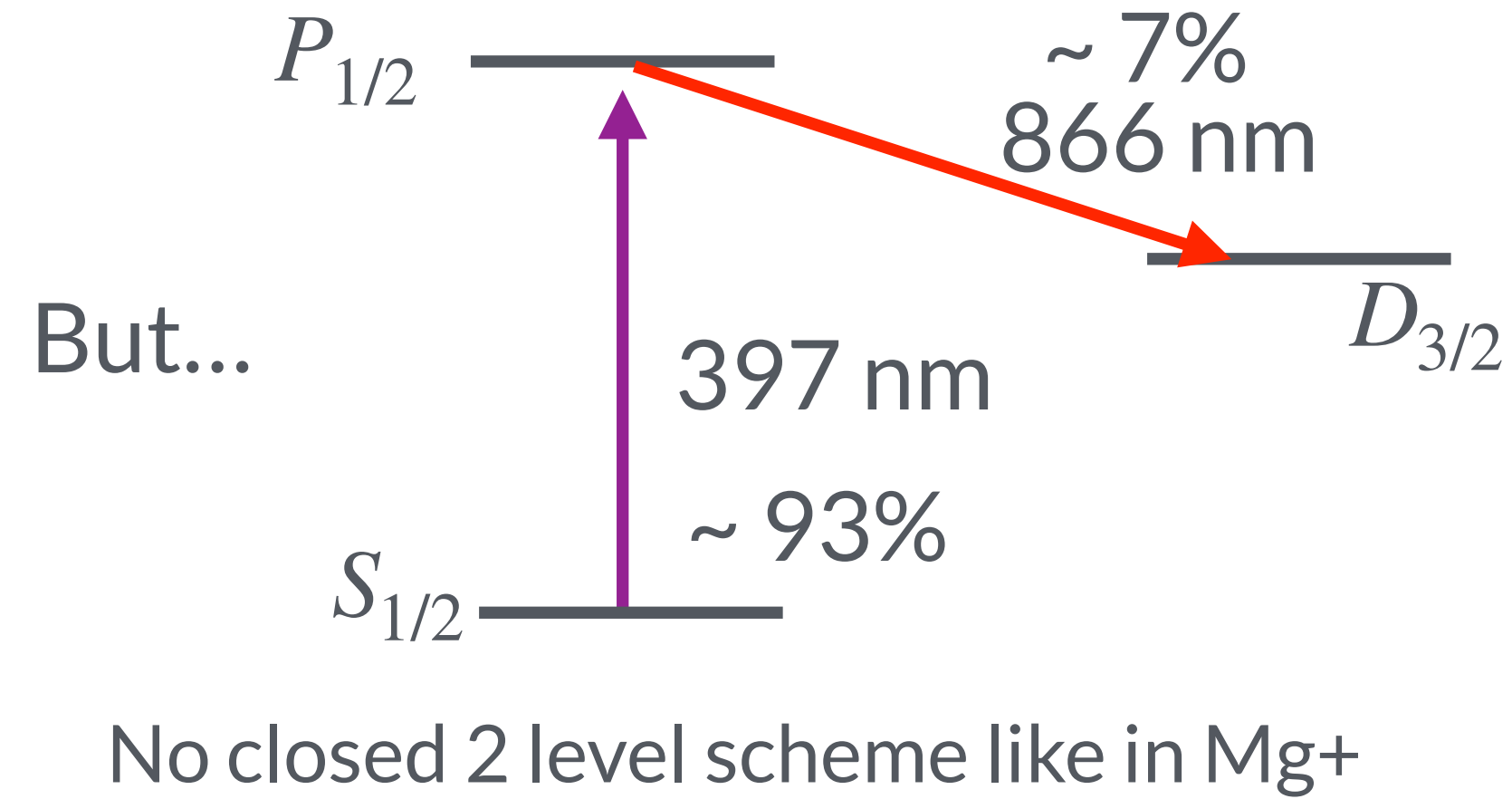
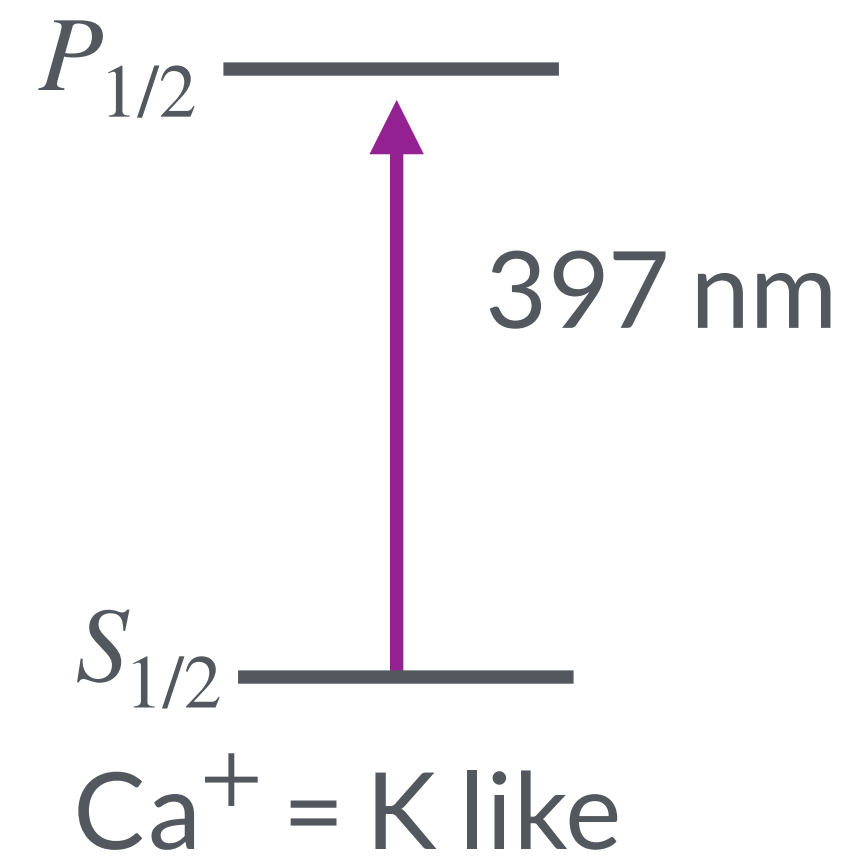
Laser Polarization of $^{39}\text{Ca}^+$ for MORA experiment



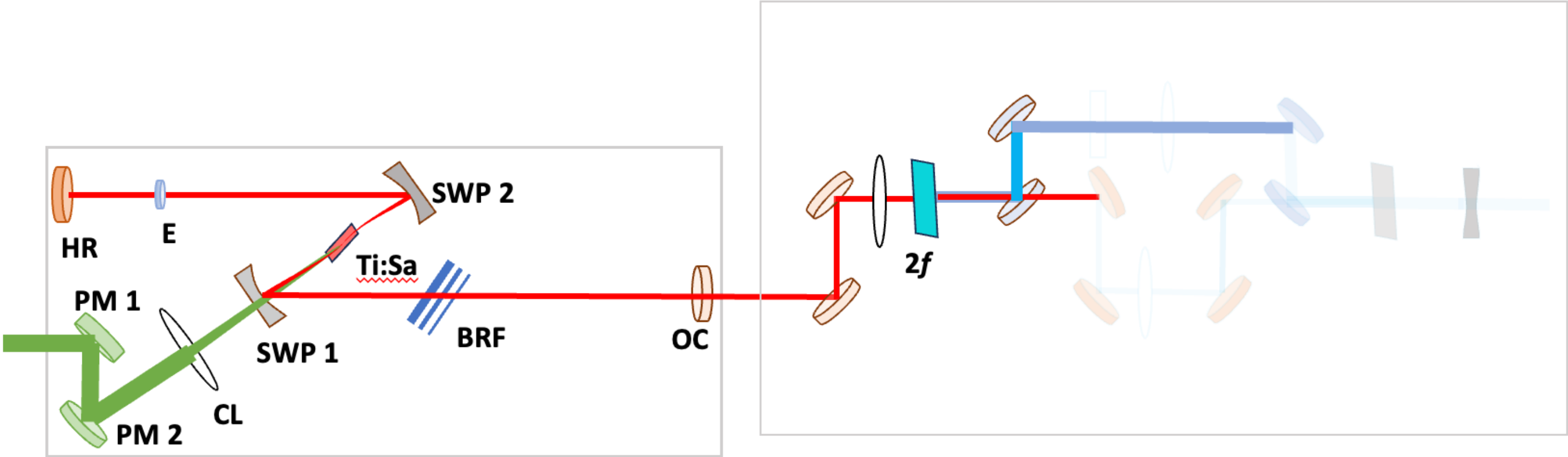
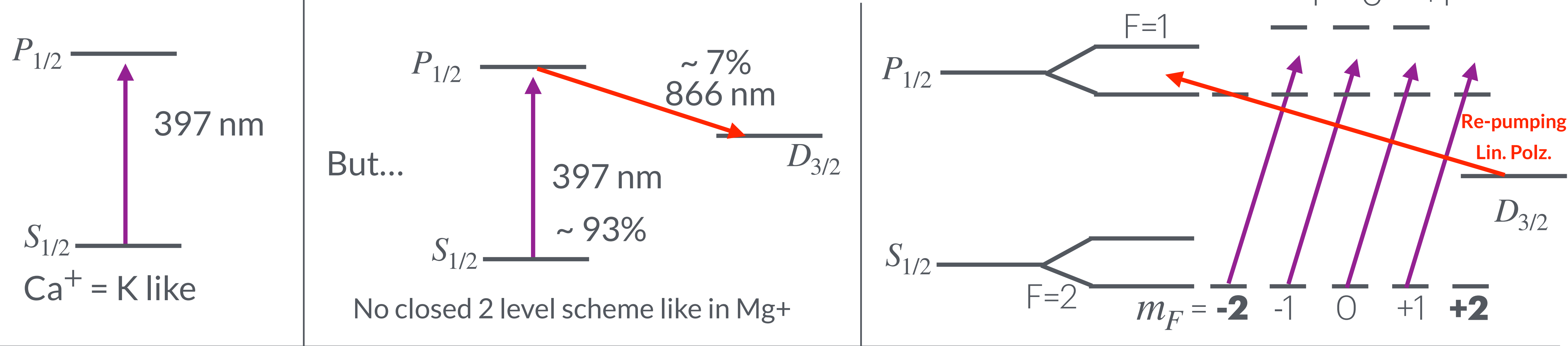
Laser Polarization of $^{39}\text{Ca}^+$ for MORA experiment



Laser Polarization of $^{39}\text{Ca}^+$ for MORA experiment



Laser Polarization of $^{39}\text{Ca}^+$ for MORA experiment



Laser setup

Frequency Doubling

Expected powers:

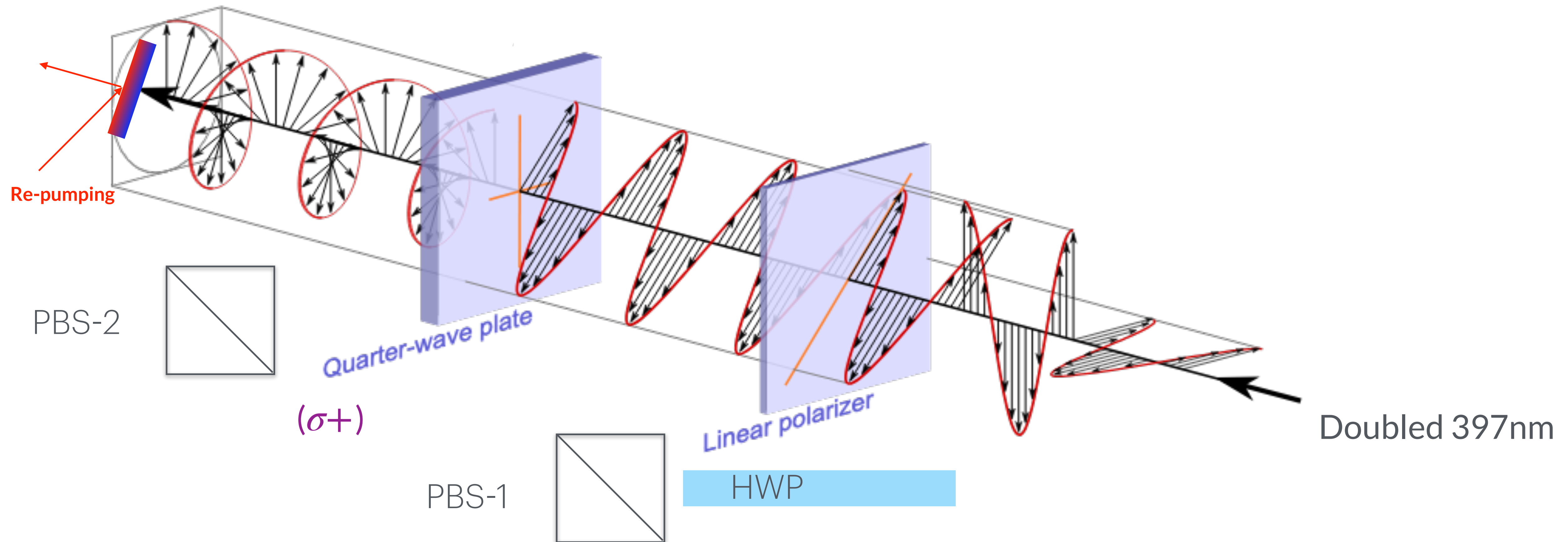
866nm ~ 2-3 W

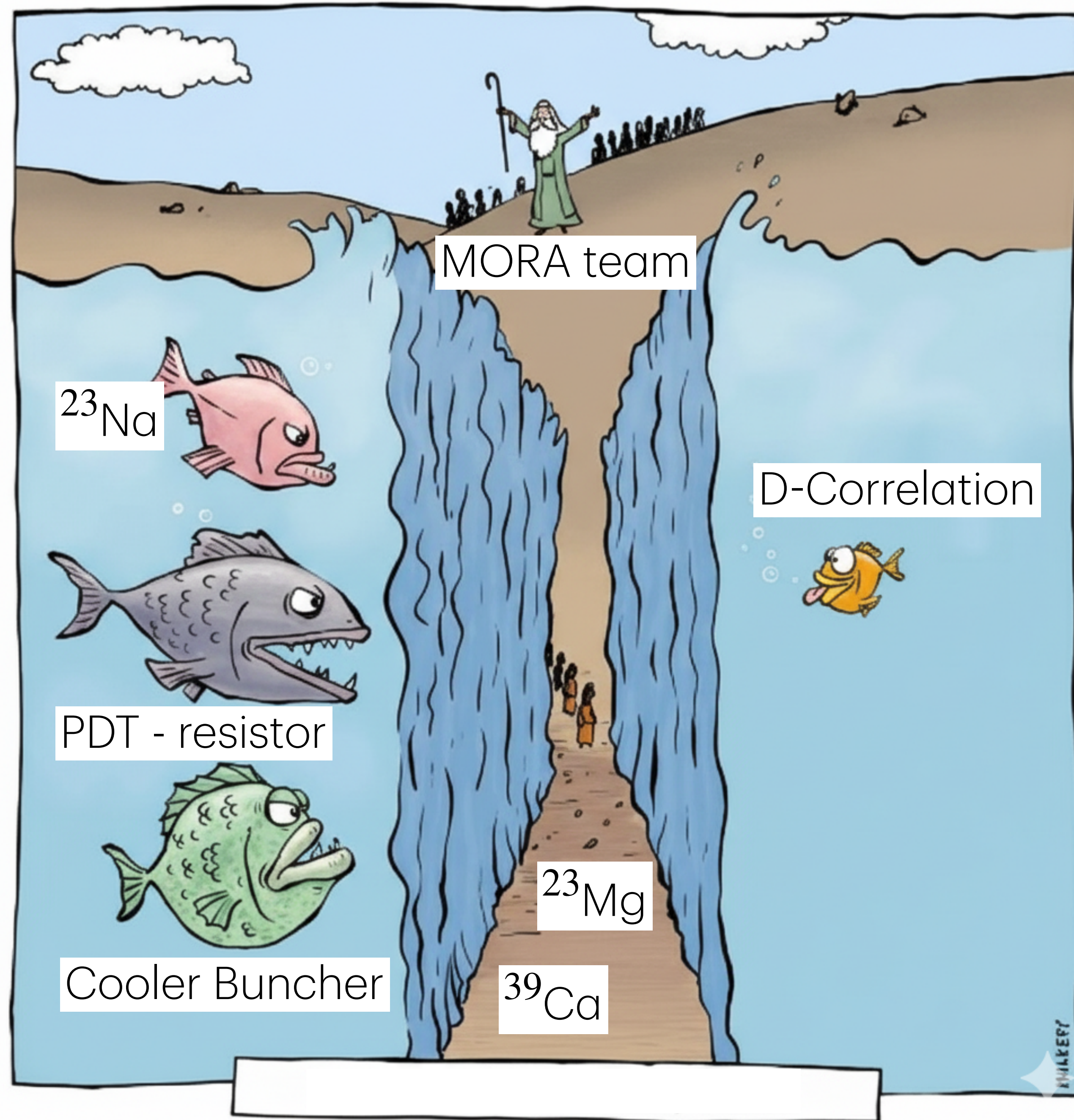
397nm ~ 0.75 - 1 W

Plans at IGISOL to support $^{39}\text{Ca}^+$ optical pumping

- Dedicated laser cavity in FURIOS cabin
- Laser path until the downstairs table already exists

- Just SHG for main pumping level
- Change of optics (Waveplates, cubes, mirrors)
- Modification of entry optics for red+blue path mixing





Thank You