Electric Dipole Moment: Search for New Physics

OUTLINE:

1) Probing Physics Beyond Standard Model & Fundamental Symmetries

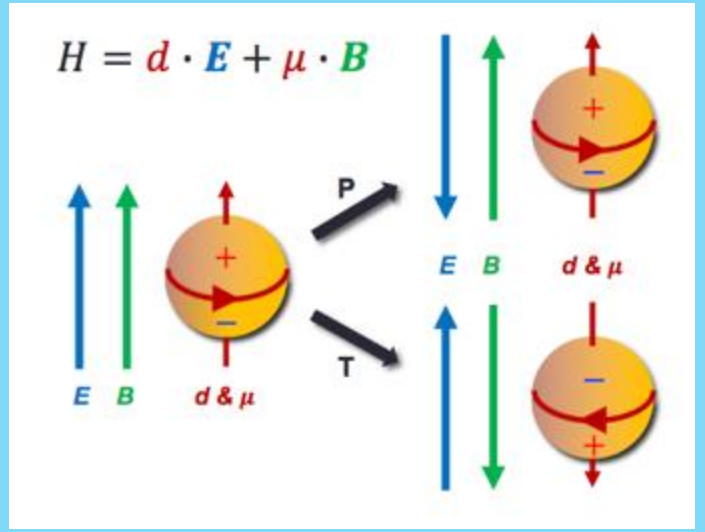
2) Electron EDM measurements

3) Reactive BaF Molecules in Para-Hydrogen&Neon @ Low Temperature

4) Set-up for Isotopic Molecular Beam Production and Crystal Formation & Characterization

5) Conclusions

EDM Searches



- The EDM is an asymmetric charge distribution along the particle spin
- The EDM violates time reversal symmetry through CPT conservation – CP violation
- CP violation is required to generate a cosmological matter-antimatter asymmetry.
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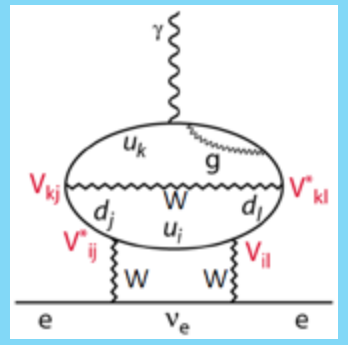
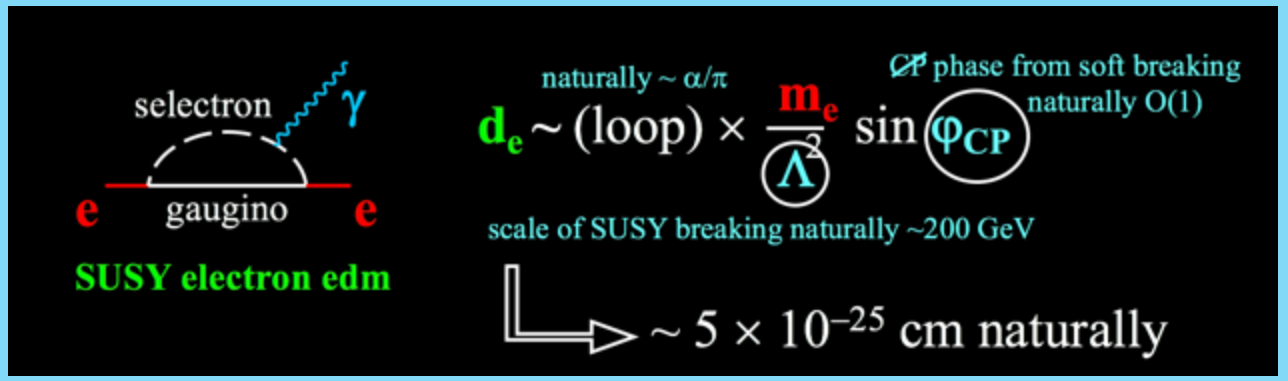
- It is present in the SM, through the complex phase in CKM matrix, however many order of magnitude below what is necessary
- EDM's in SM are tiny ($d_e < 10^{-38}$ ecm), but most SM extensions include new CP violating phases that contribute to EDM's.



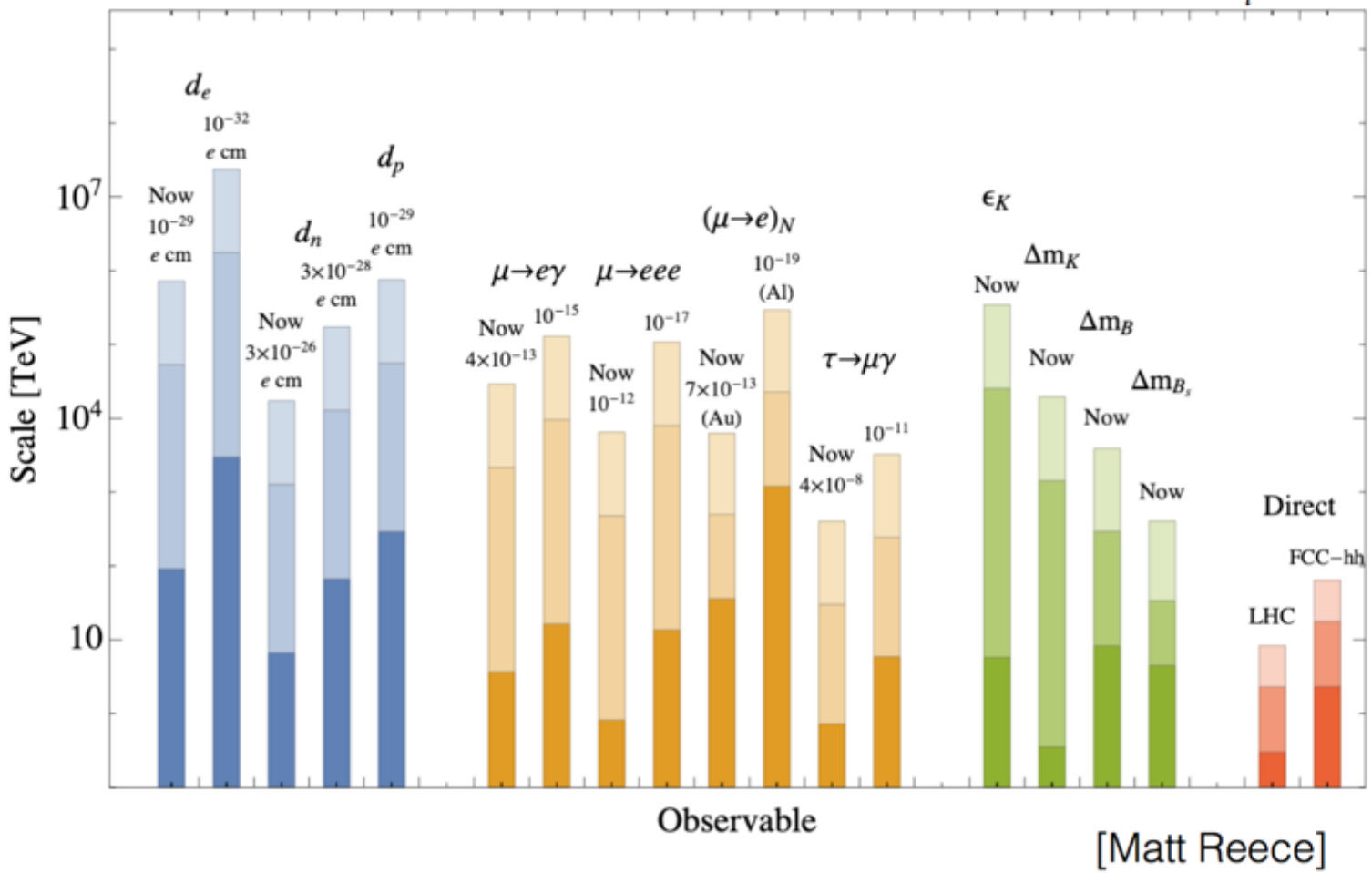
four-loop level in perturbation theory



THIS MAKES EDM's an ideal probe for detecting NEW PHYSICS associated with CP violation and a powerful window on energy scales much larger than those that can be probed directly at LHC

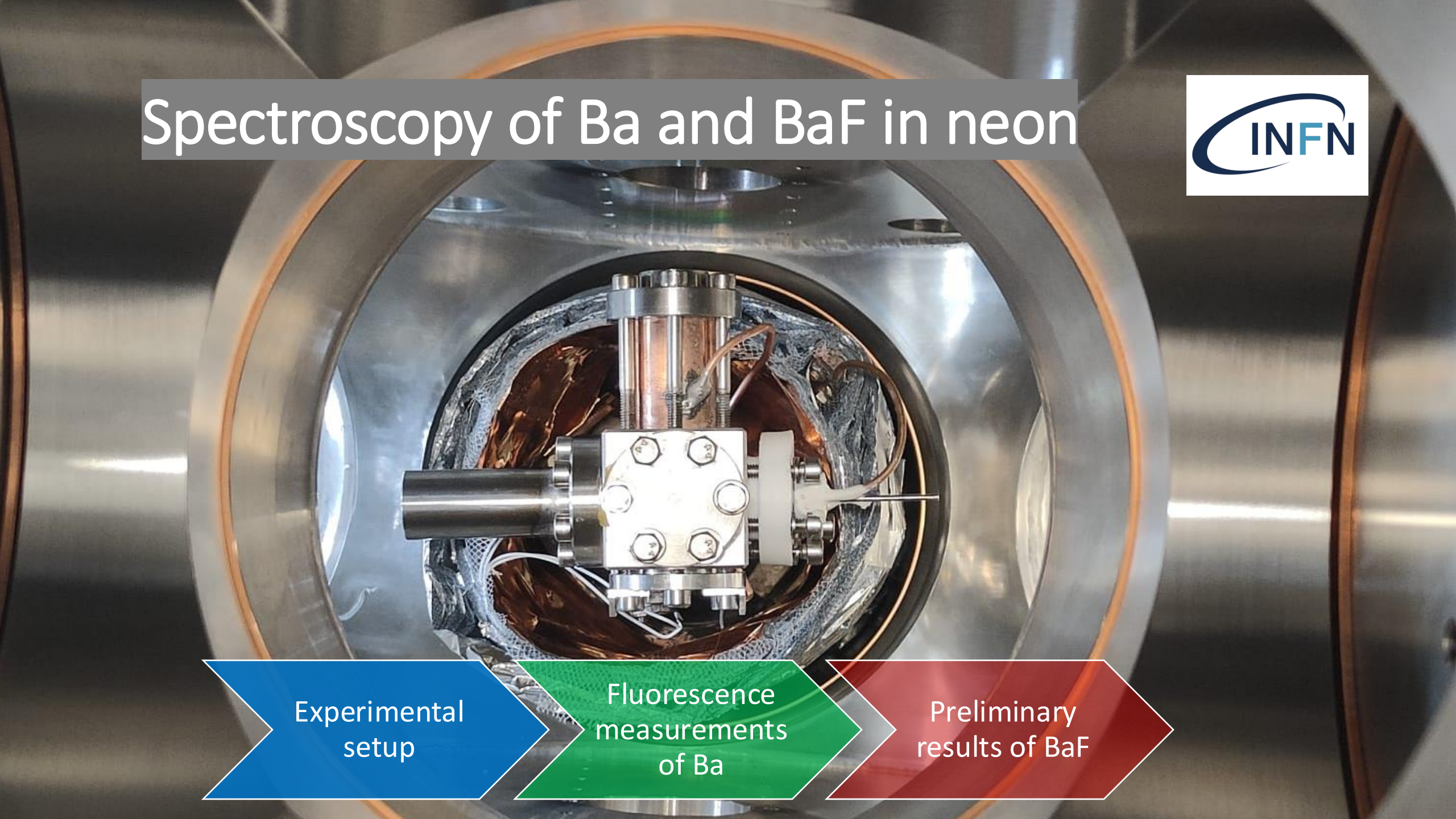
Bounds on scale of NP for various indirect precision observables (current and future)

Bounds on Λ (scale of NP) for dimension six (4-fermion) operators O_i : $\sum_i \frac{C_i}{\Lambda^2} O_i$



[Matt Reece]

Spectroscopy of Ba and BaF in neon

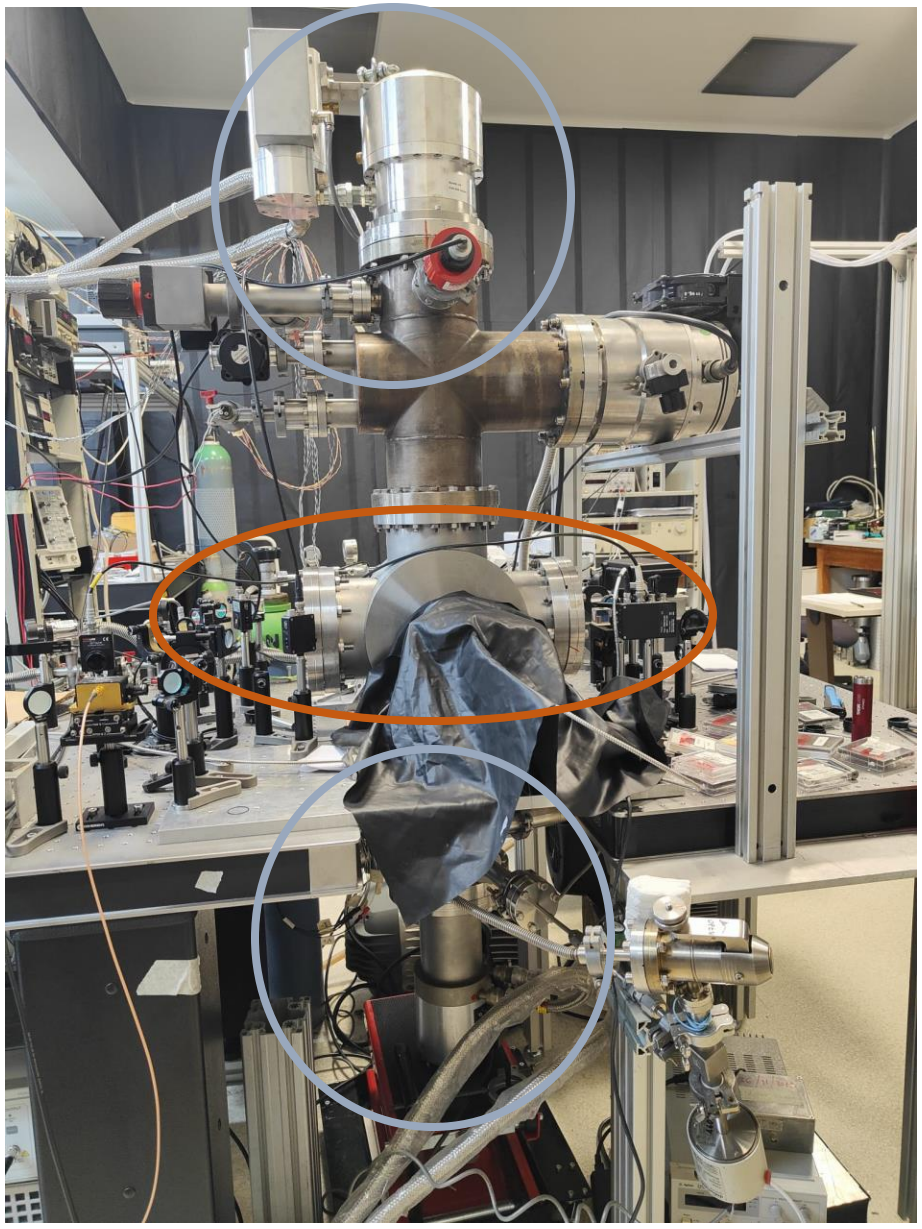


Experimental setup

Fluorescence measurements of Ba

Preliminary results of BaF

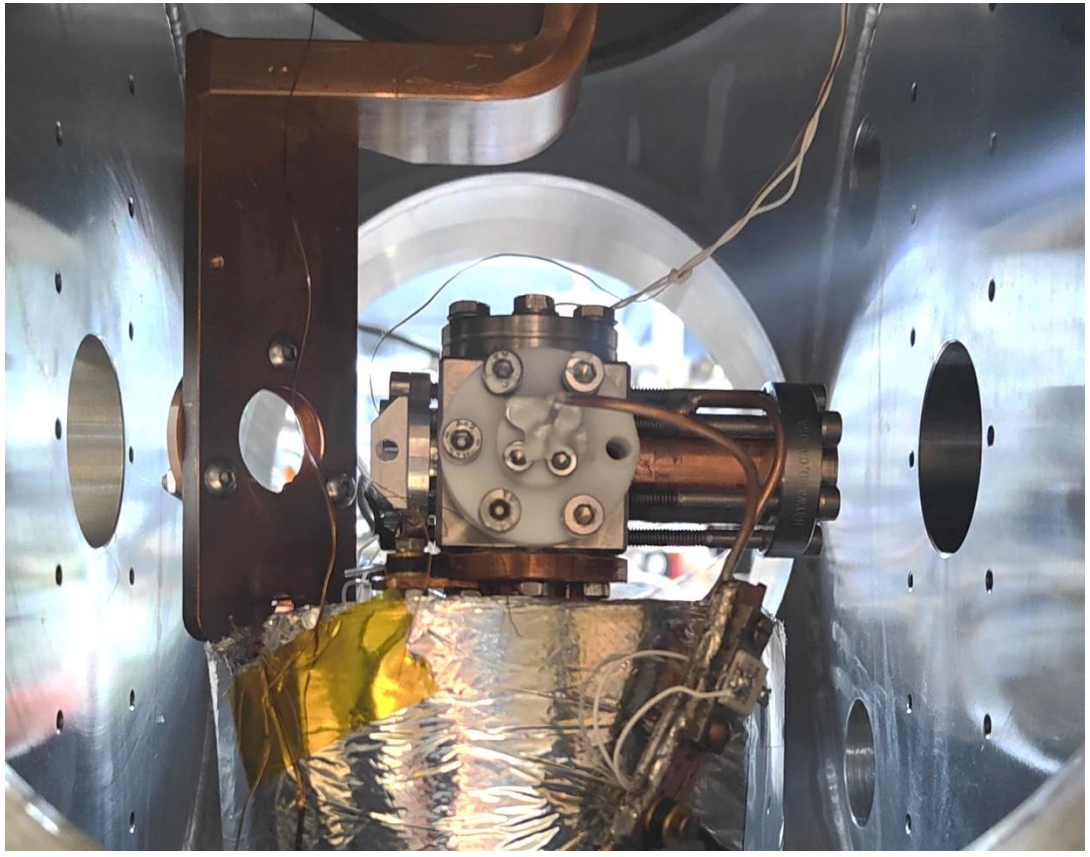
Experimental setup



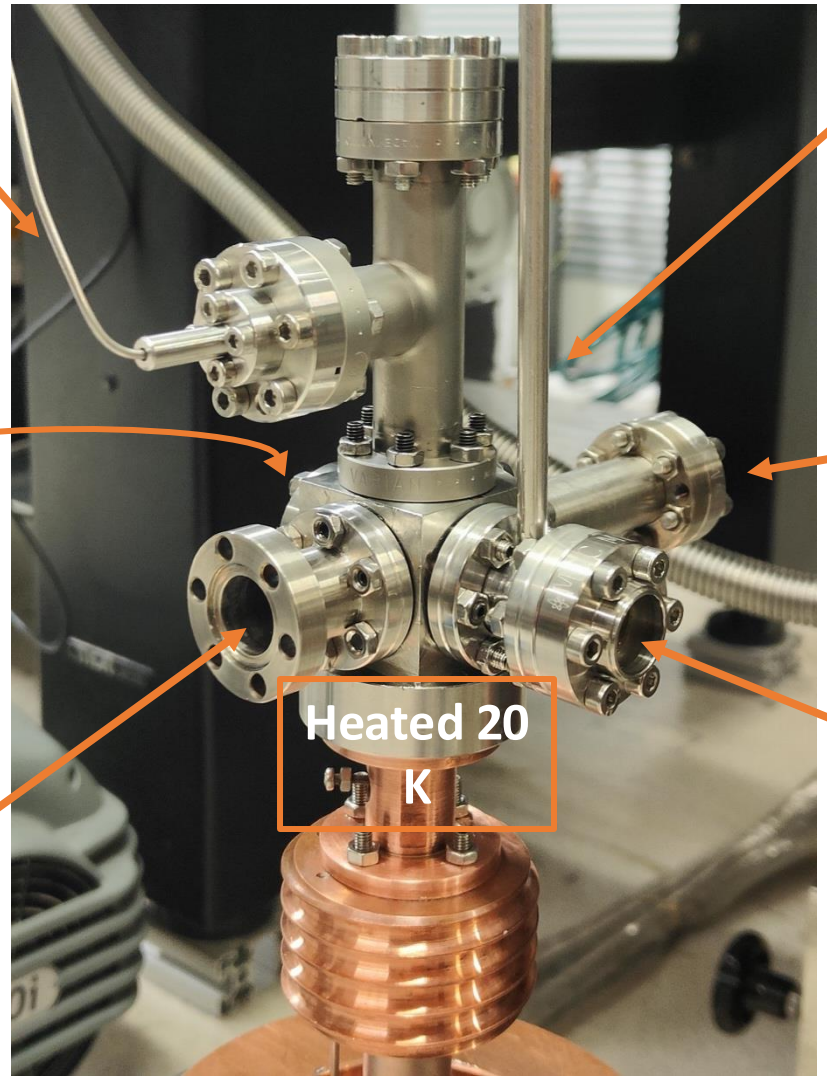
Sumitomo 3 K Crystal

Chamber with cell and sapphire window

Leybold 12 K source



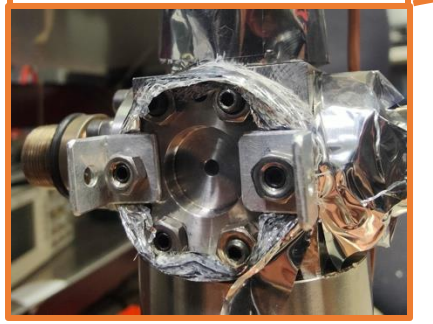
Buffer gas cooling cell



CF_4 line

Buffer gas line

Extraction hole 3mm

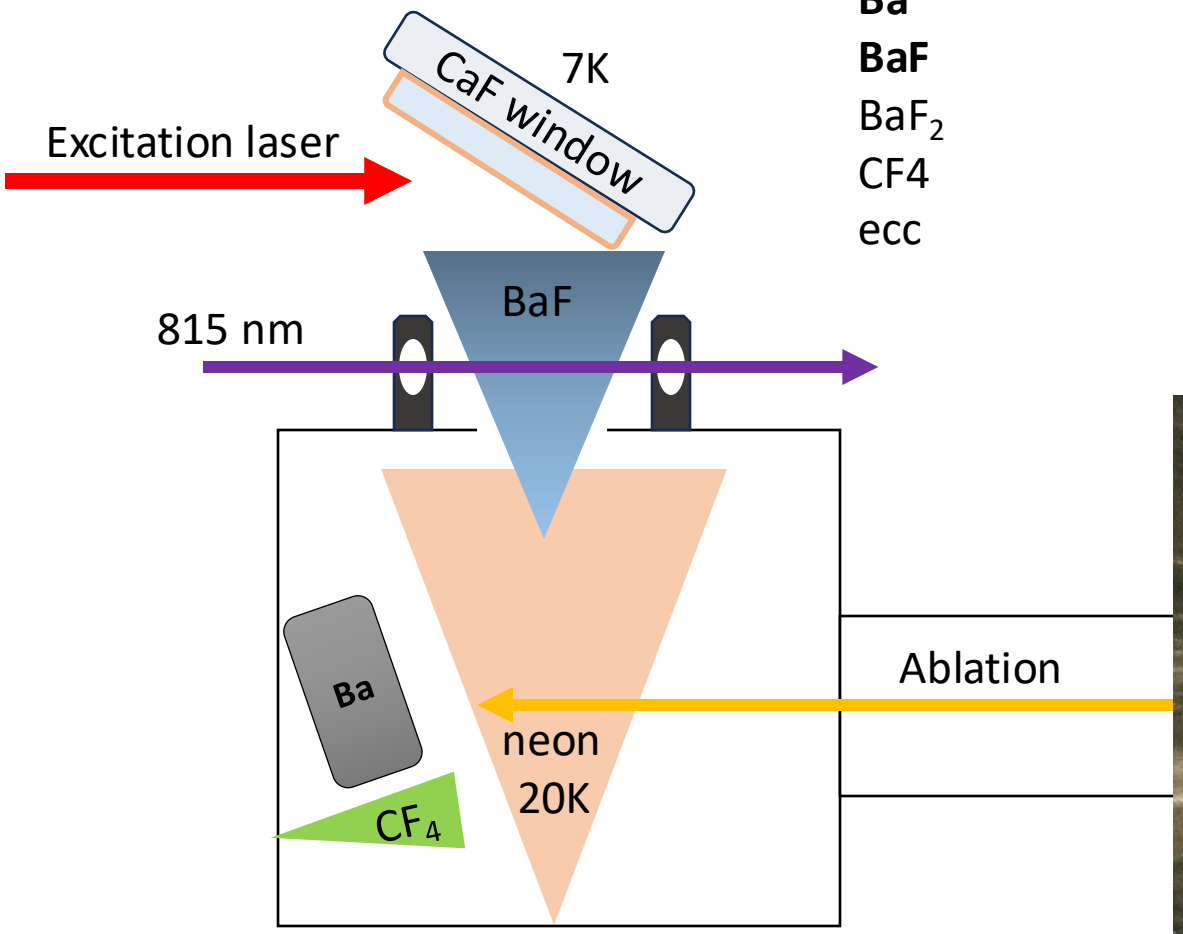


Ablation laser entrance window

Ba crystal

Absorption entrance window

Absorption and fluorescence setup



Neon doped with:

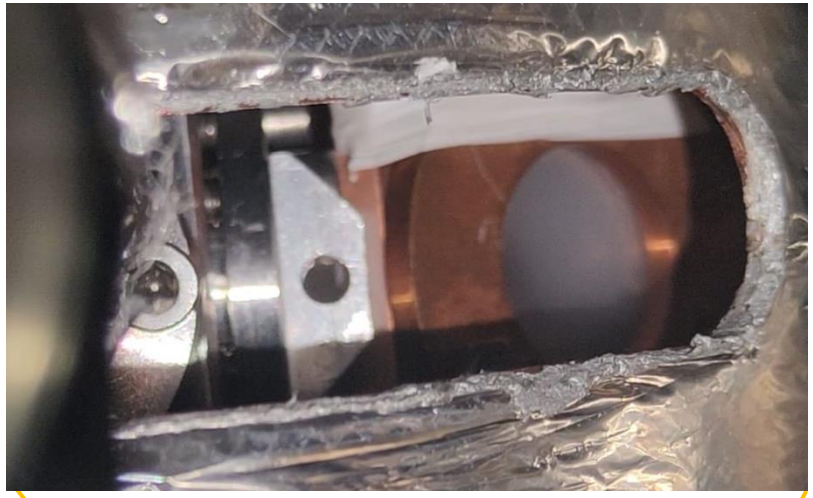
Ba

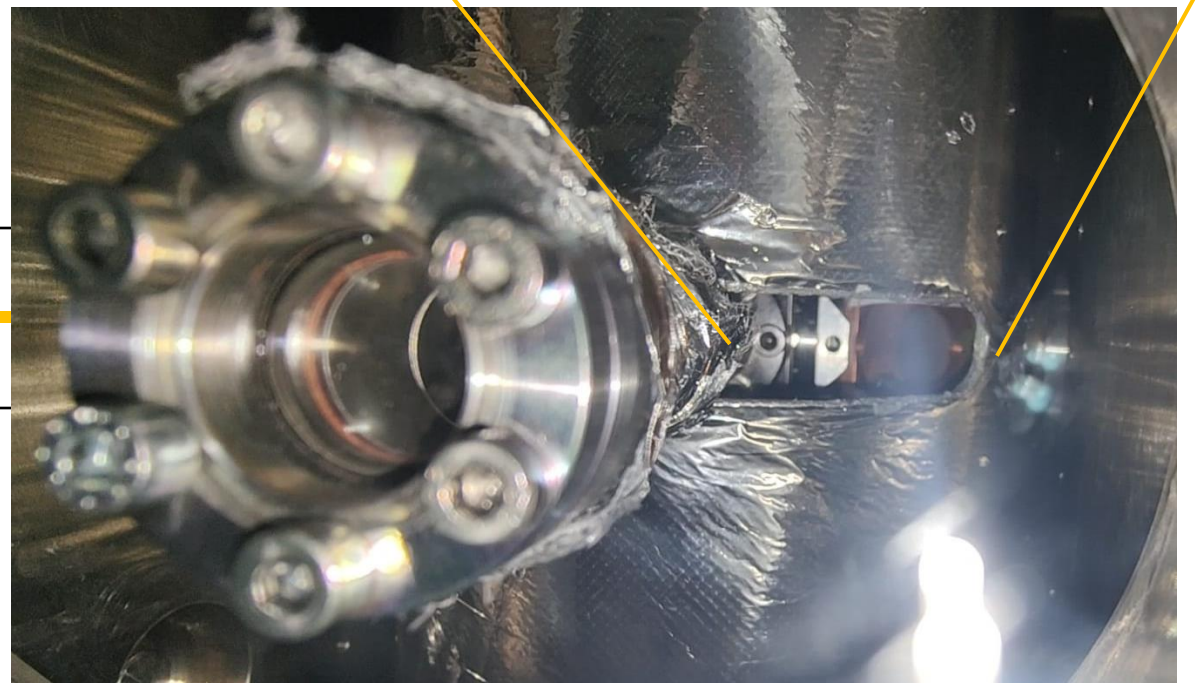
BaF

BaF_2

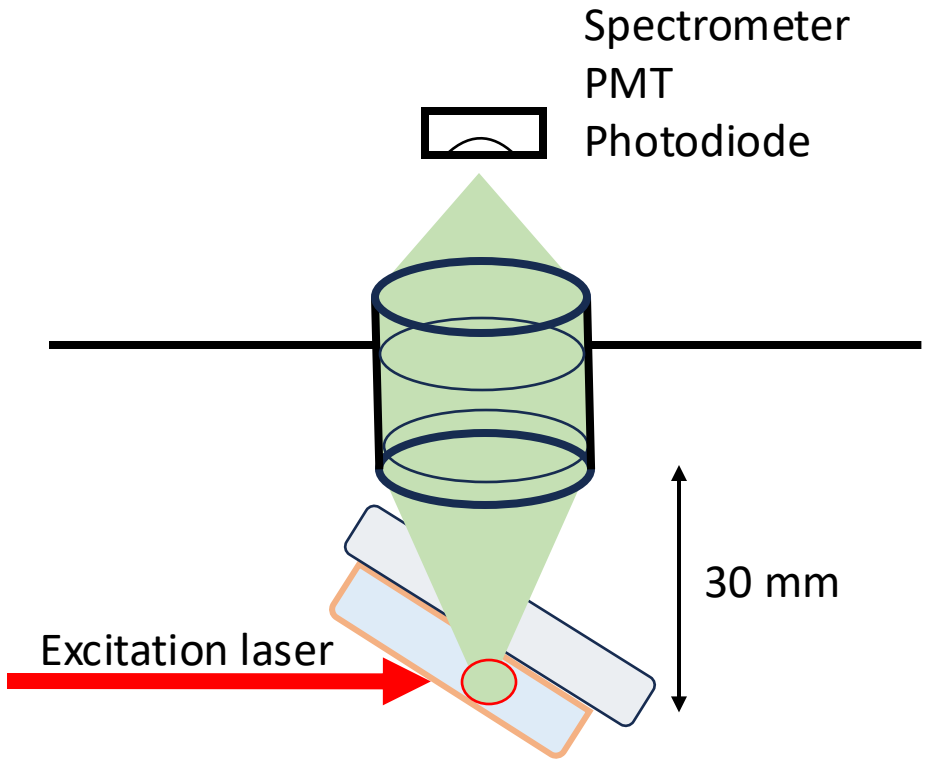
CF4

ecc

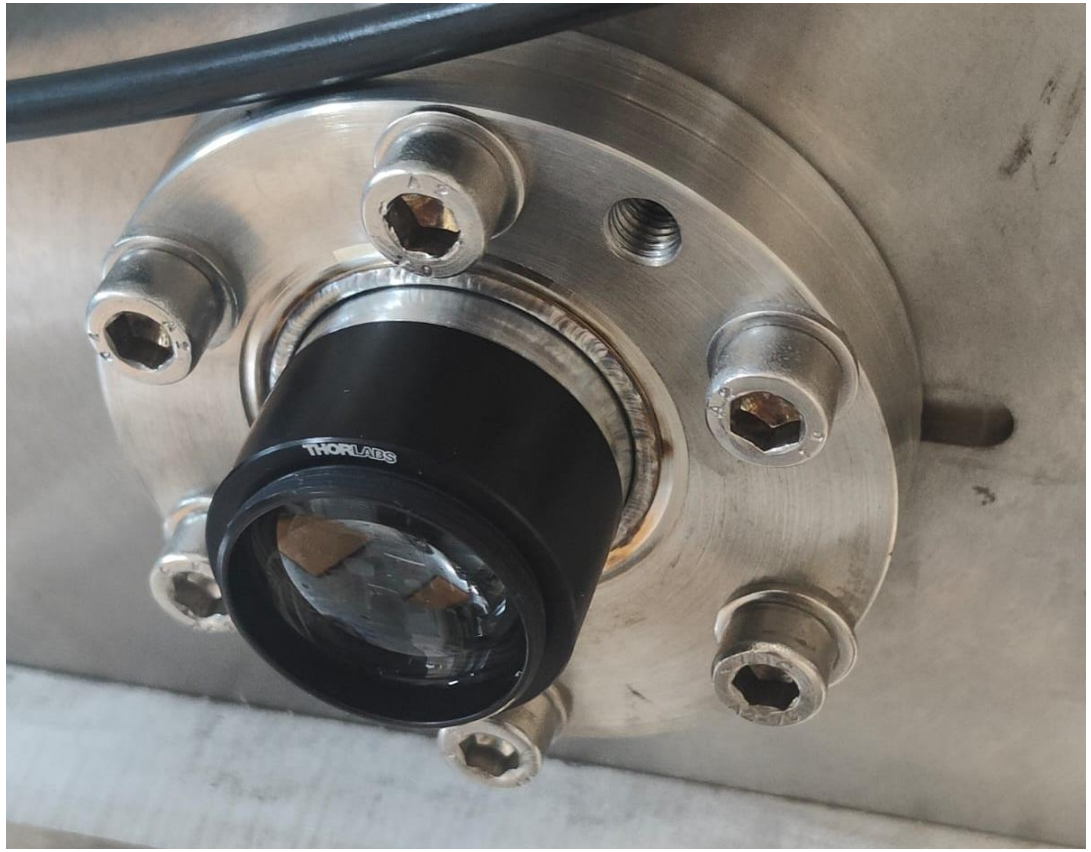




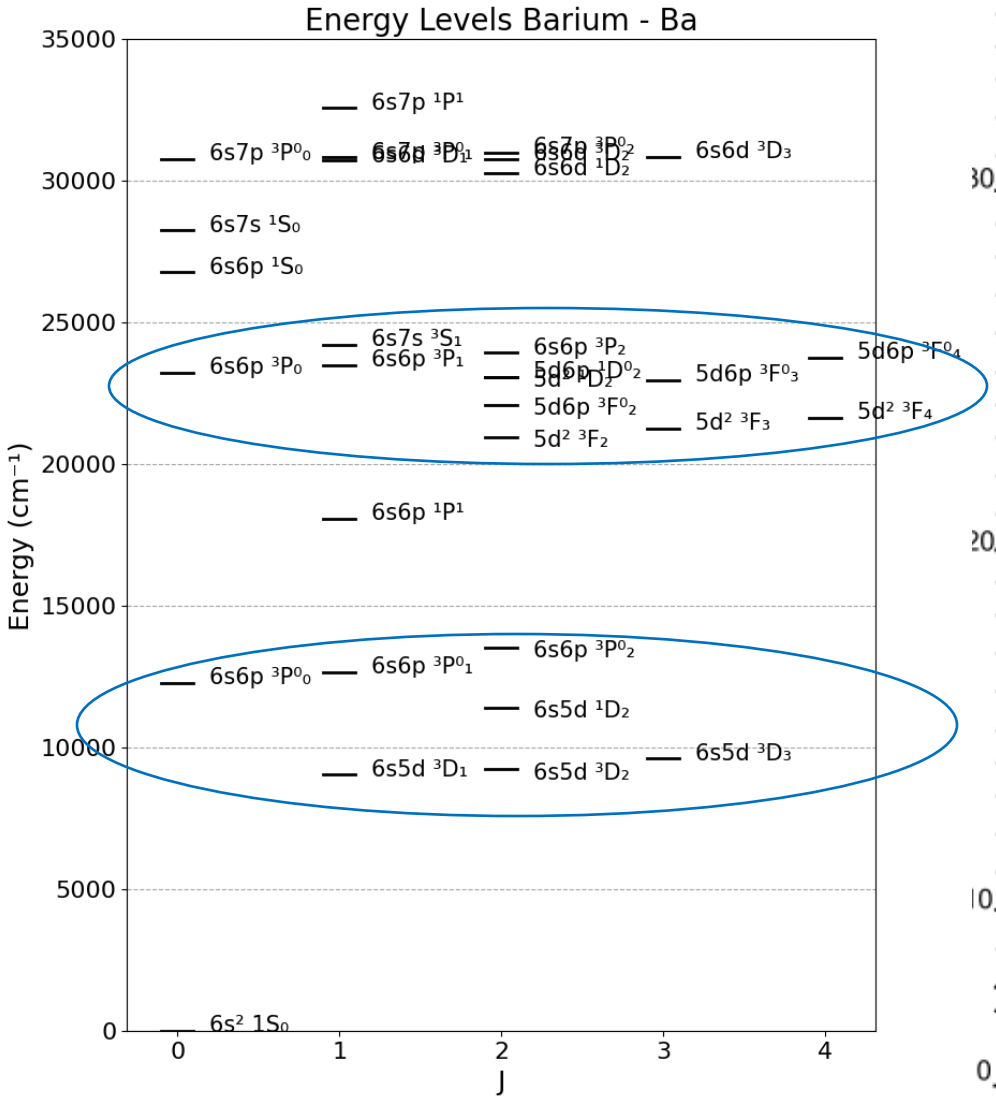
Fluorescence measurement setup

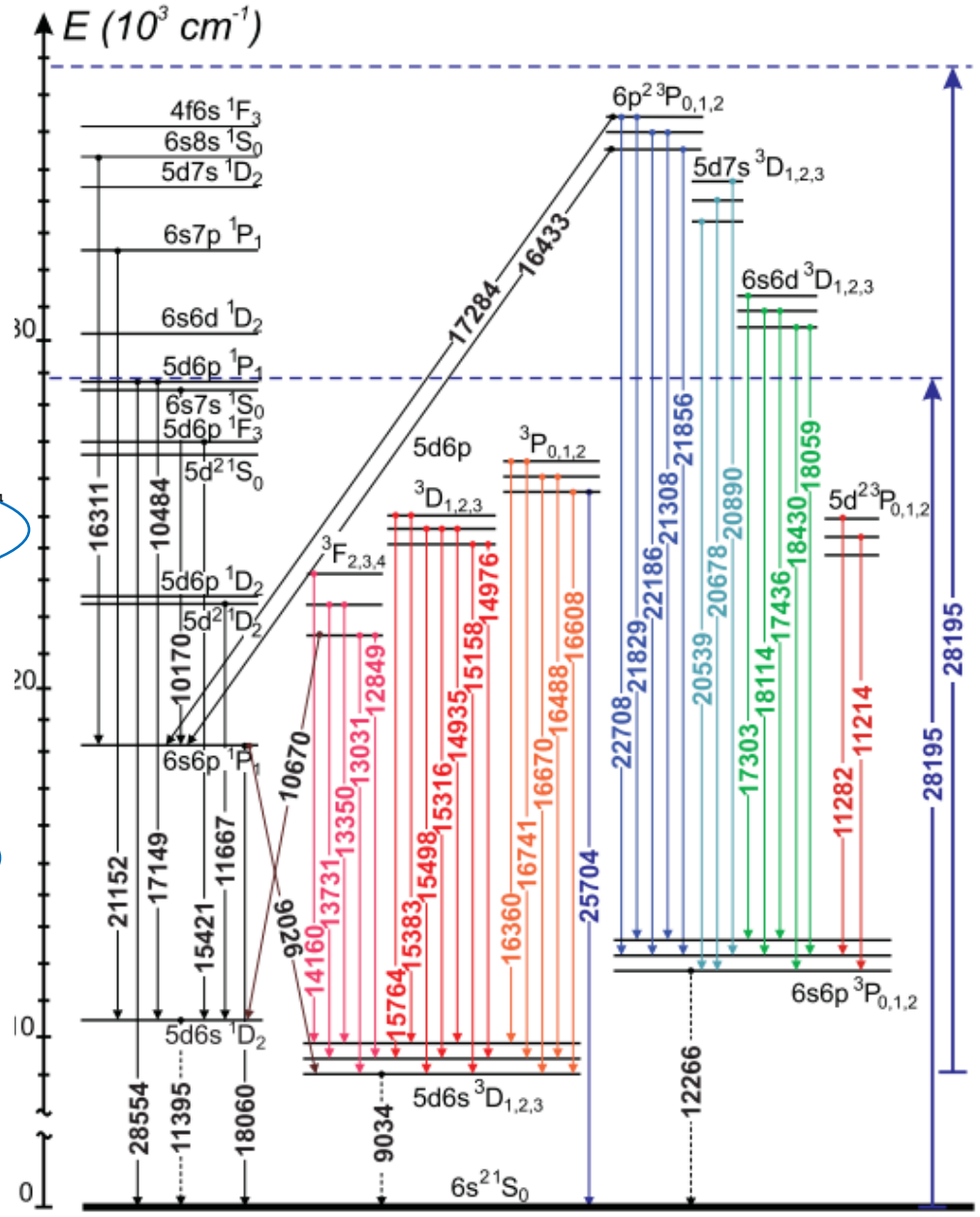


$r = 1$ mm; typical power 40 mW



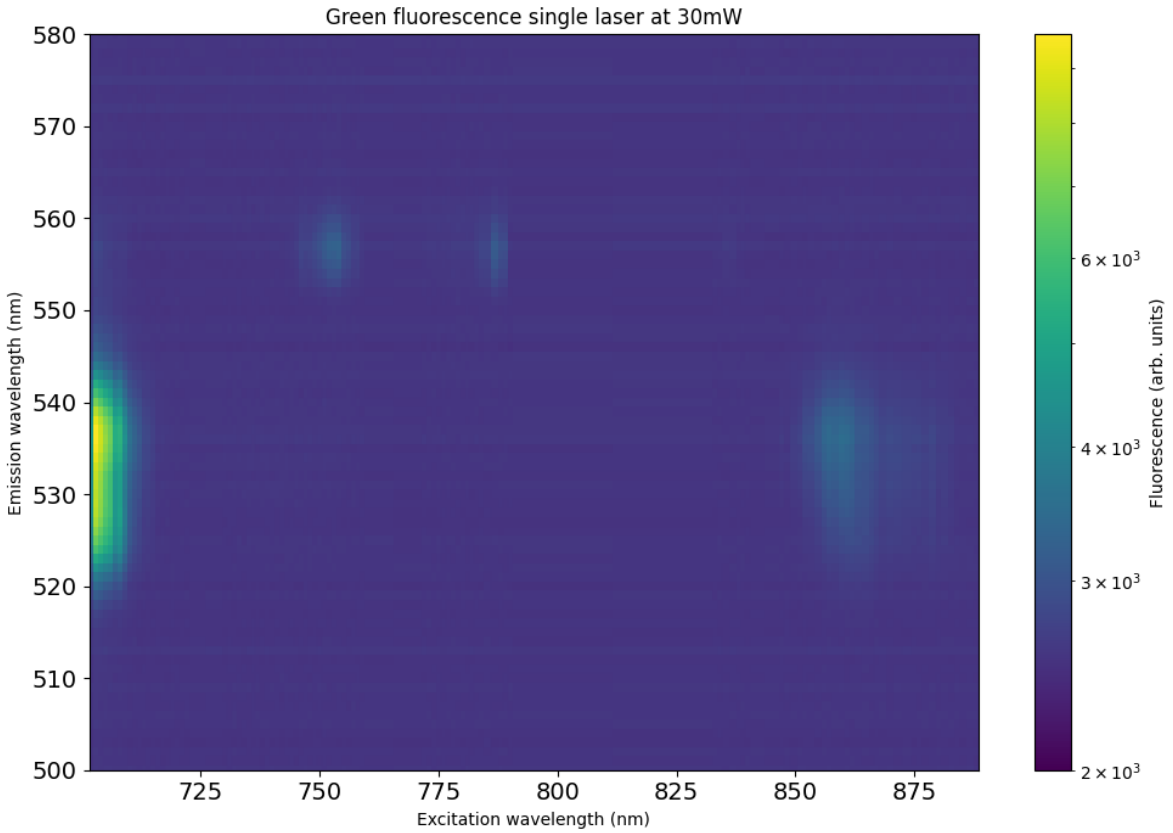
Energy levels of Ba – pumping scheme

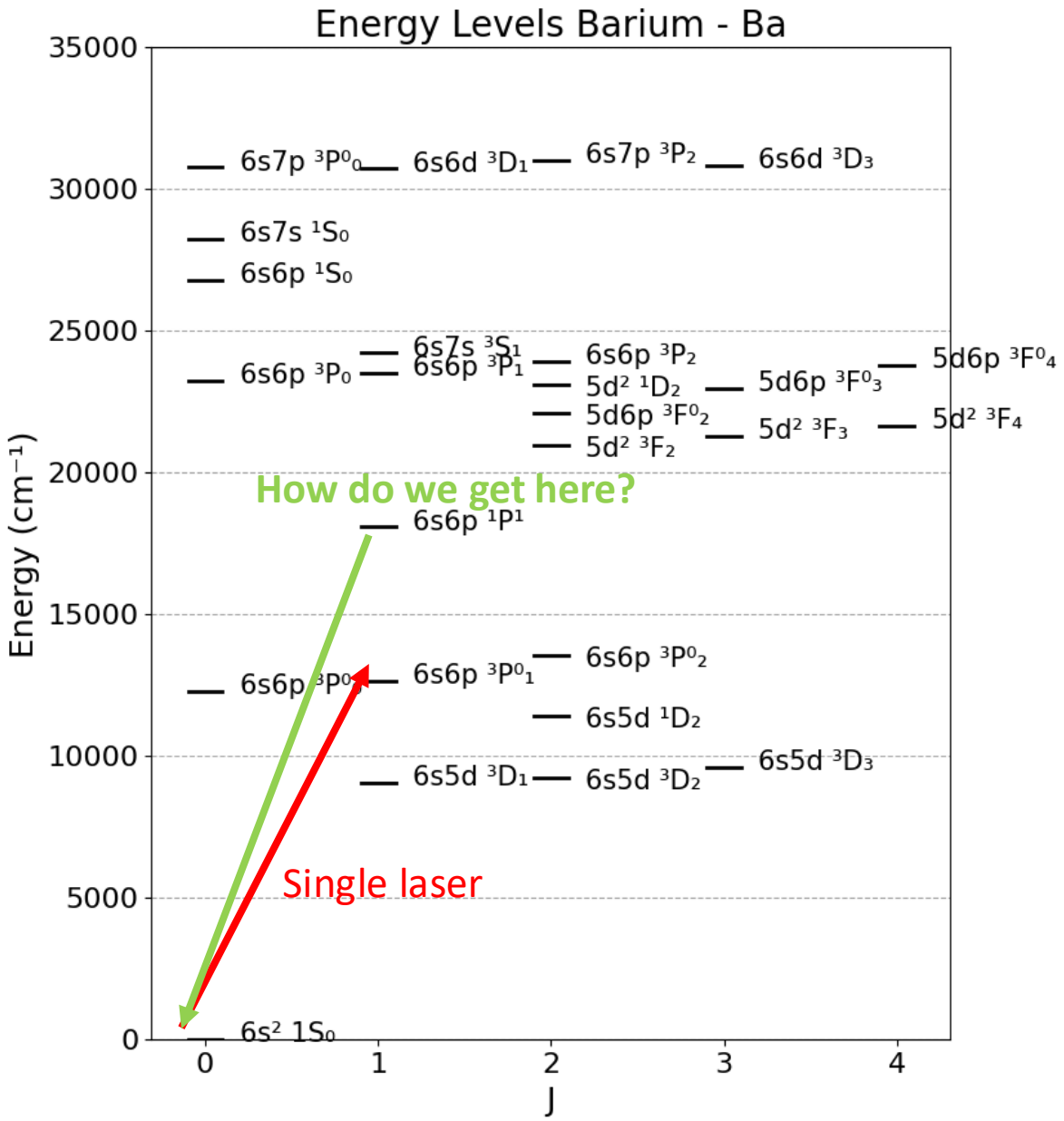




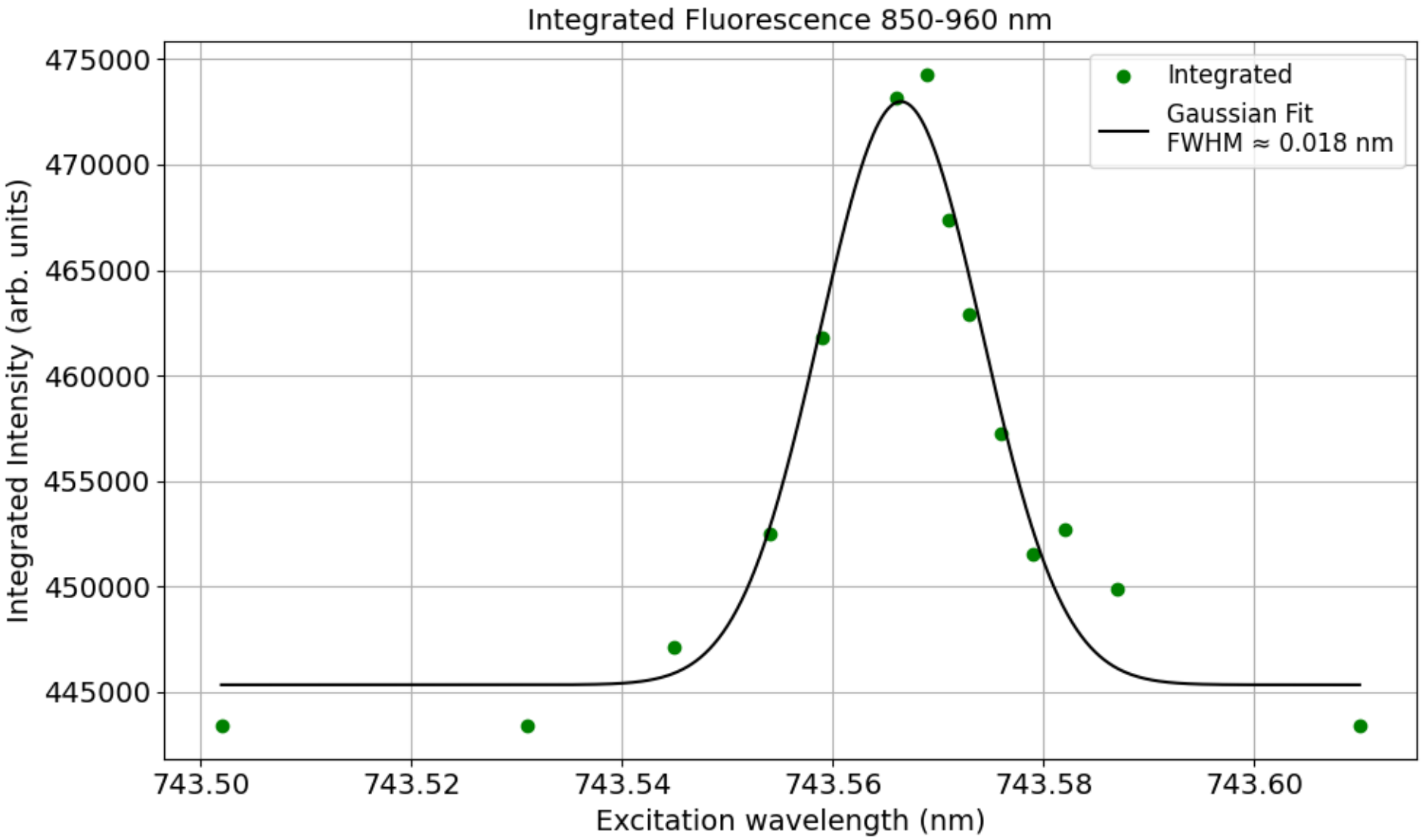
3rd harmonic of 1064nm pulsed laser Pumping scheme

Single laser

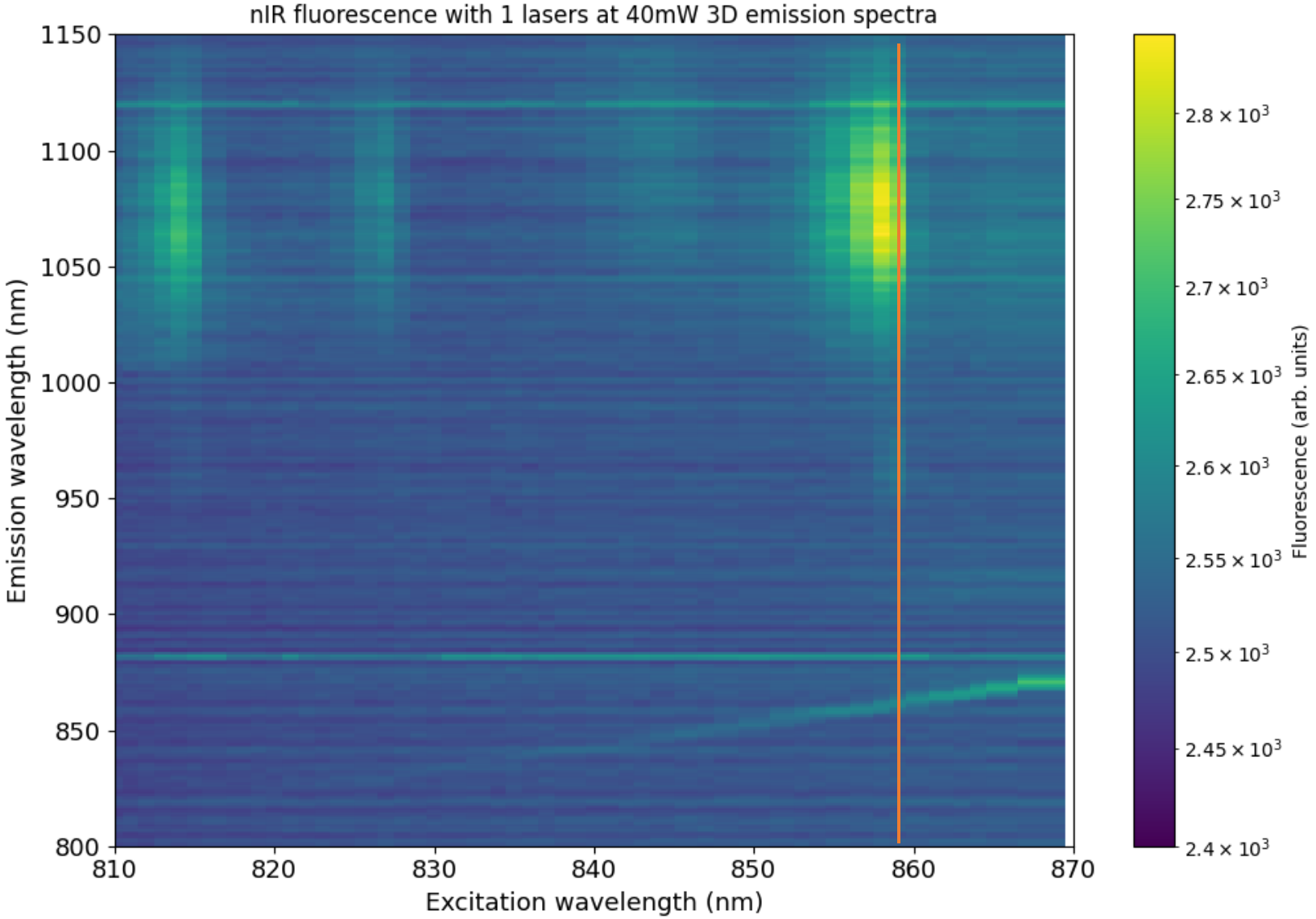


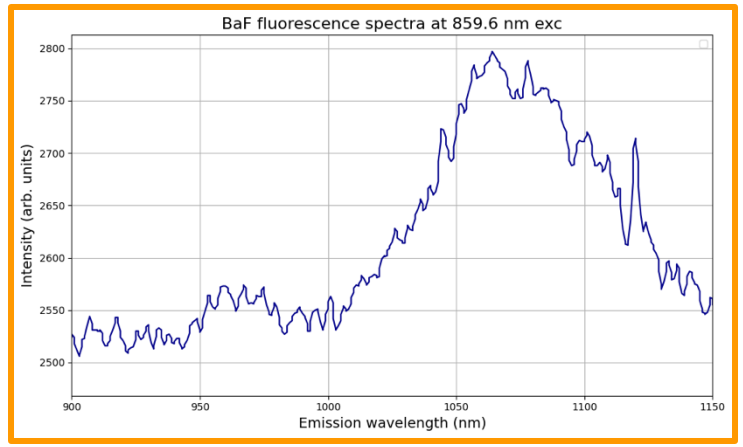


Narrow excitation lines



BaF in matrix – preliminary results





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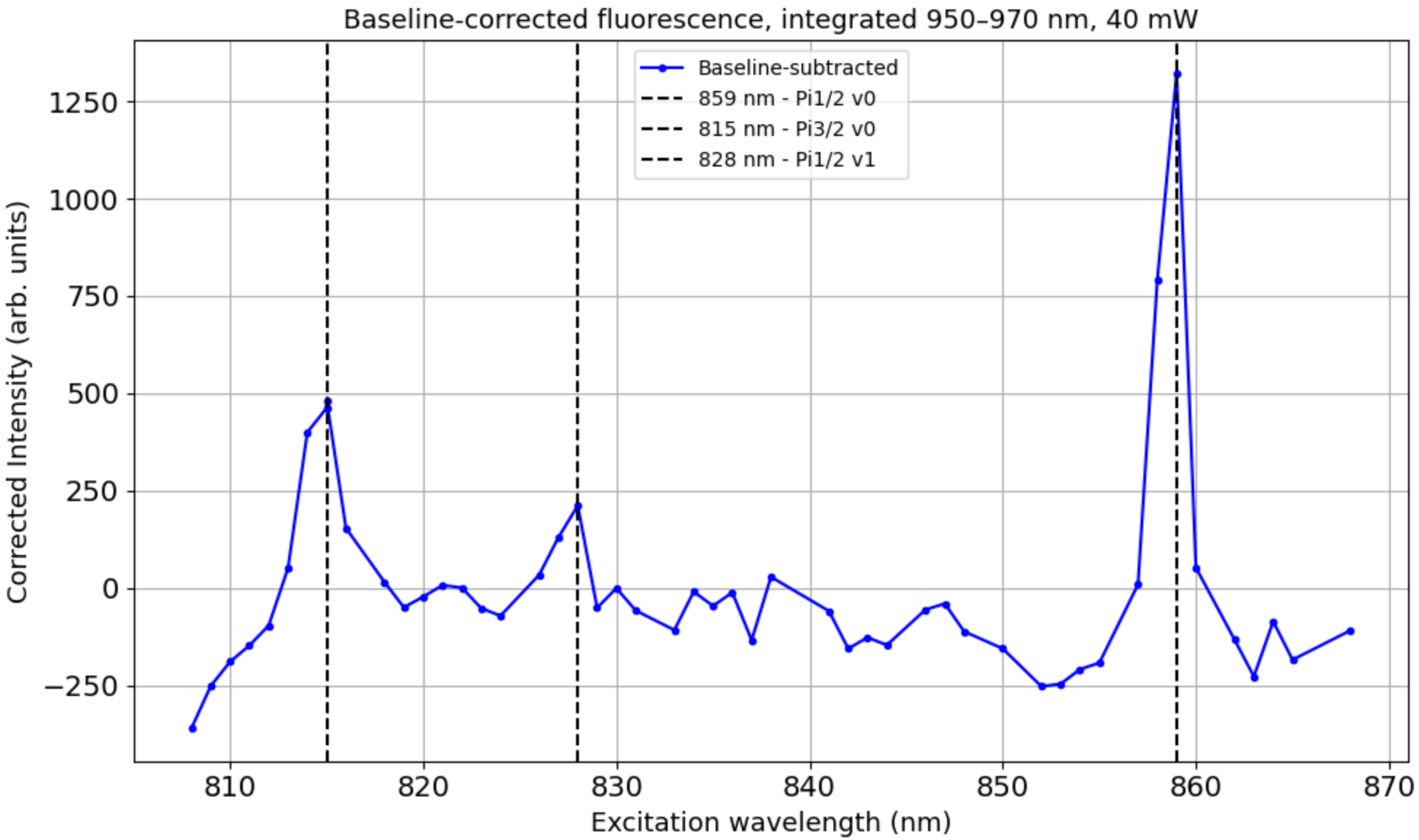

DOCET

Sezioni INFN partecipanti all'esperimento: **Padova, LNL, Ferrara**

- Resp. Naz.: **Giovanni Carugno**

- **COSTRUZIONE E PRESA DATI ESPERIMENTO @ LNL**

- **FTE-PD-2023 = 3,3 FTE (Carugno 40% ,Borghesani 100% , Gasparini 20%, Zanetti 15% , Pazzini 15%, Gonella 30%,Benettoni 10%, Messineo 100%, Madiha 100%, Chiossi 100%)**

- **Richiesta Denari INFN : 60 Keuro**

- **Richiesta Servizi : 10 M.U. OM , 8 M.U. STGE , 1 M.U. OE, 1 M.U. Uff.Tec.**