

Analysis of experimentally measured Nd III spectra for the measurement of transition probabilities

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Precise atomic parameters of rare-earth elements are critical for astrophysical research [1]. We employ a custom made hollow cathode lamp to measure Nd III transition probabilities of some selected transitions reported in [2,3]. In this poster, we present the details of the experiment, the workflow used to shortlist transitions and the challenges faced while analysing the spectra.

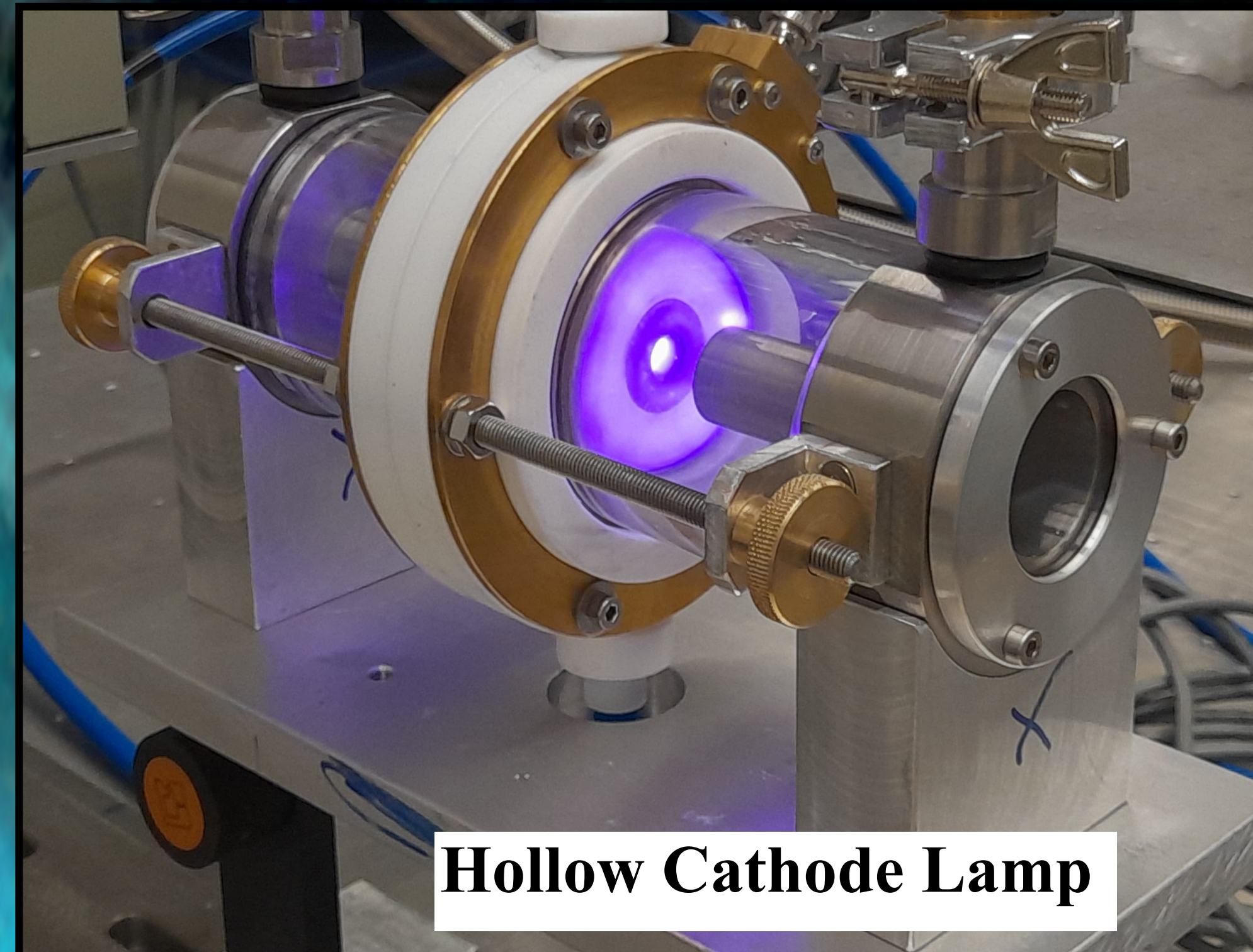
Experimental setup

The custom-made hollow cathode lamp was operated under the following conditions:

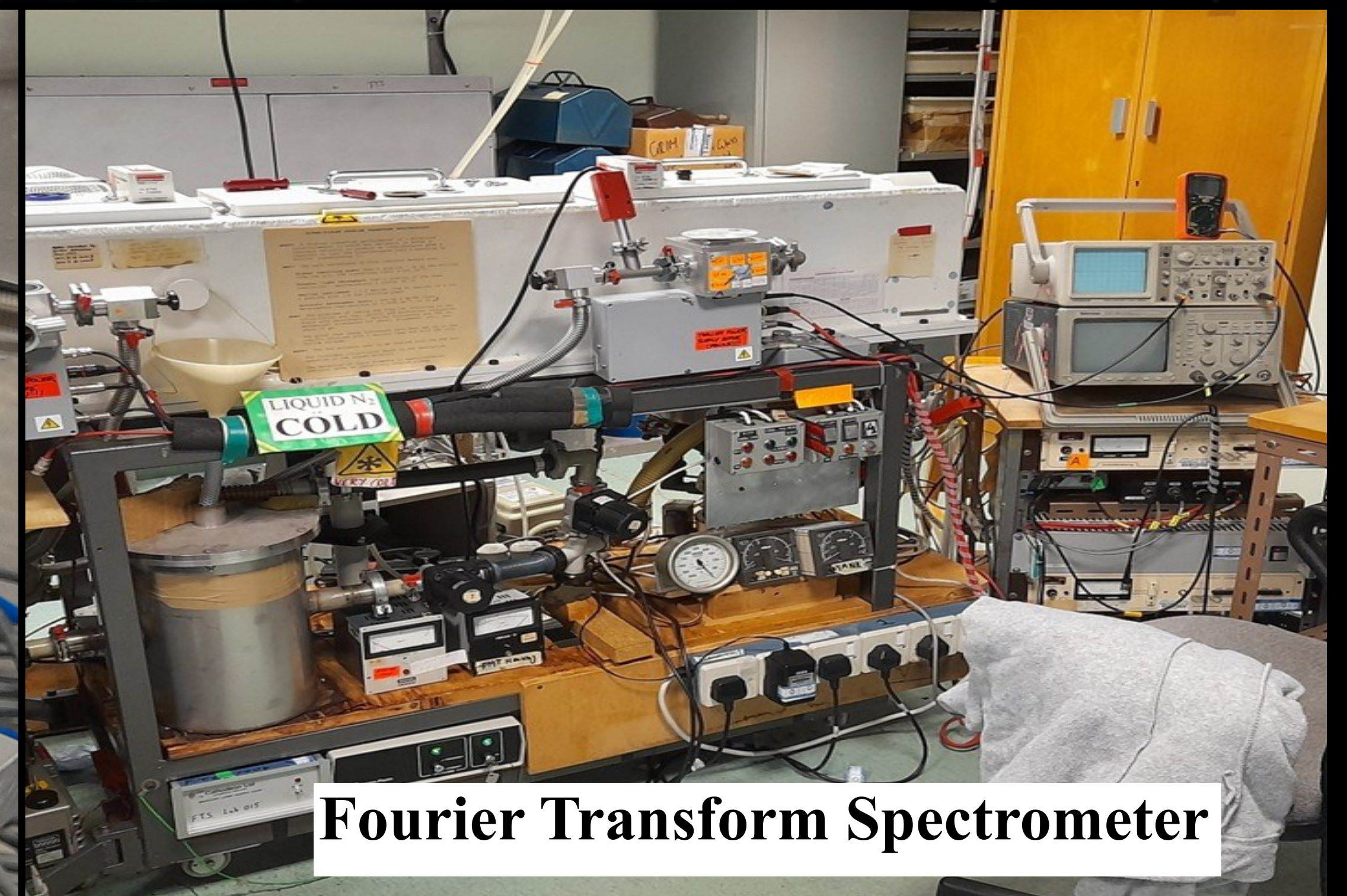
- Current: 450 mA
- Pressure: 0.43 mbar

The emitted radiation was recorded using the Imperial College Fourier transform spectrometer:

- Spectral range: 320–850 nm
- Resolving power: 2,000,000 at 200 nm

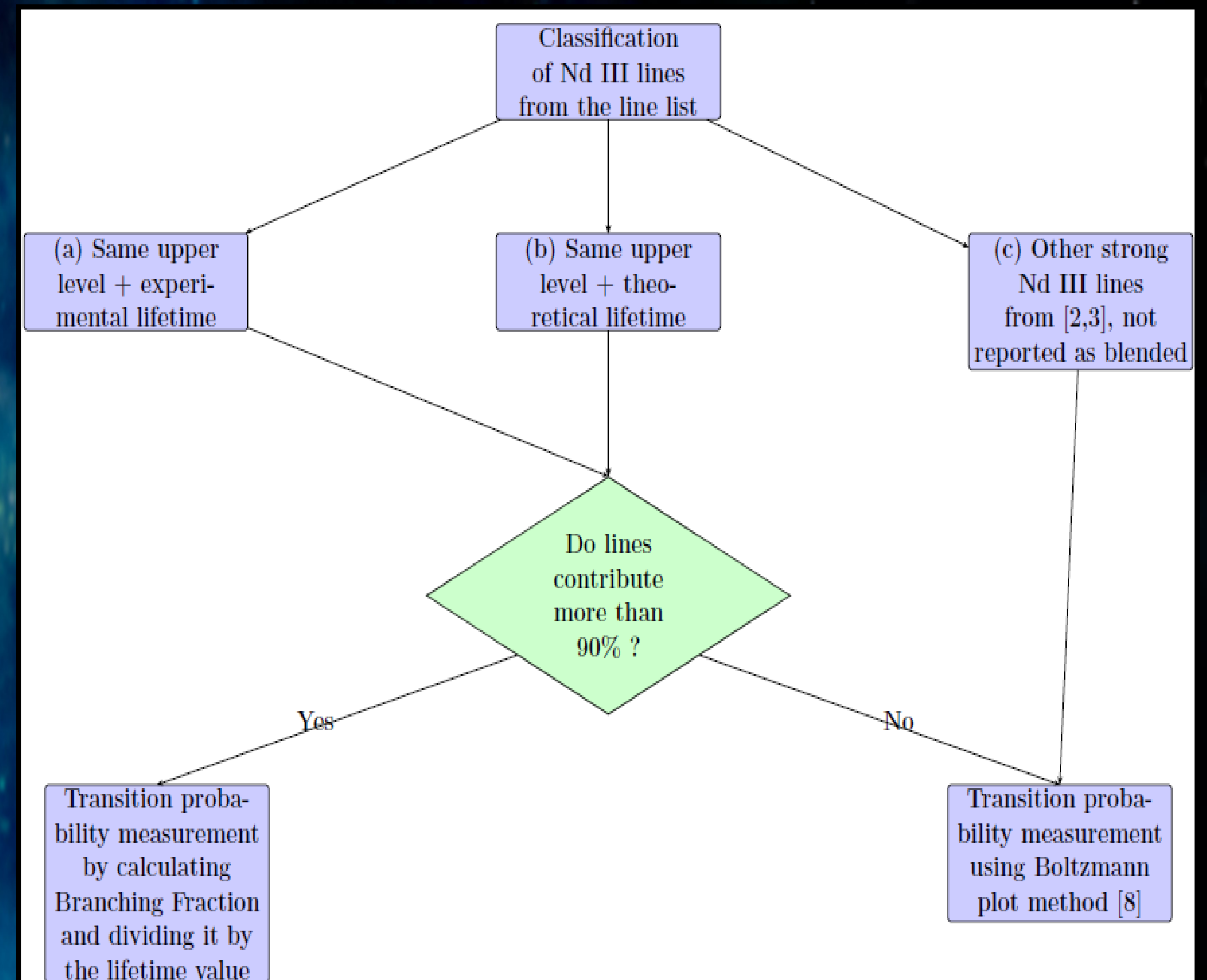
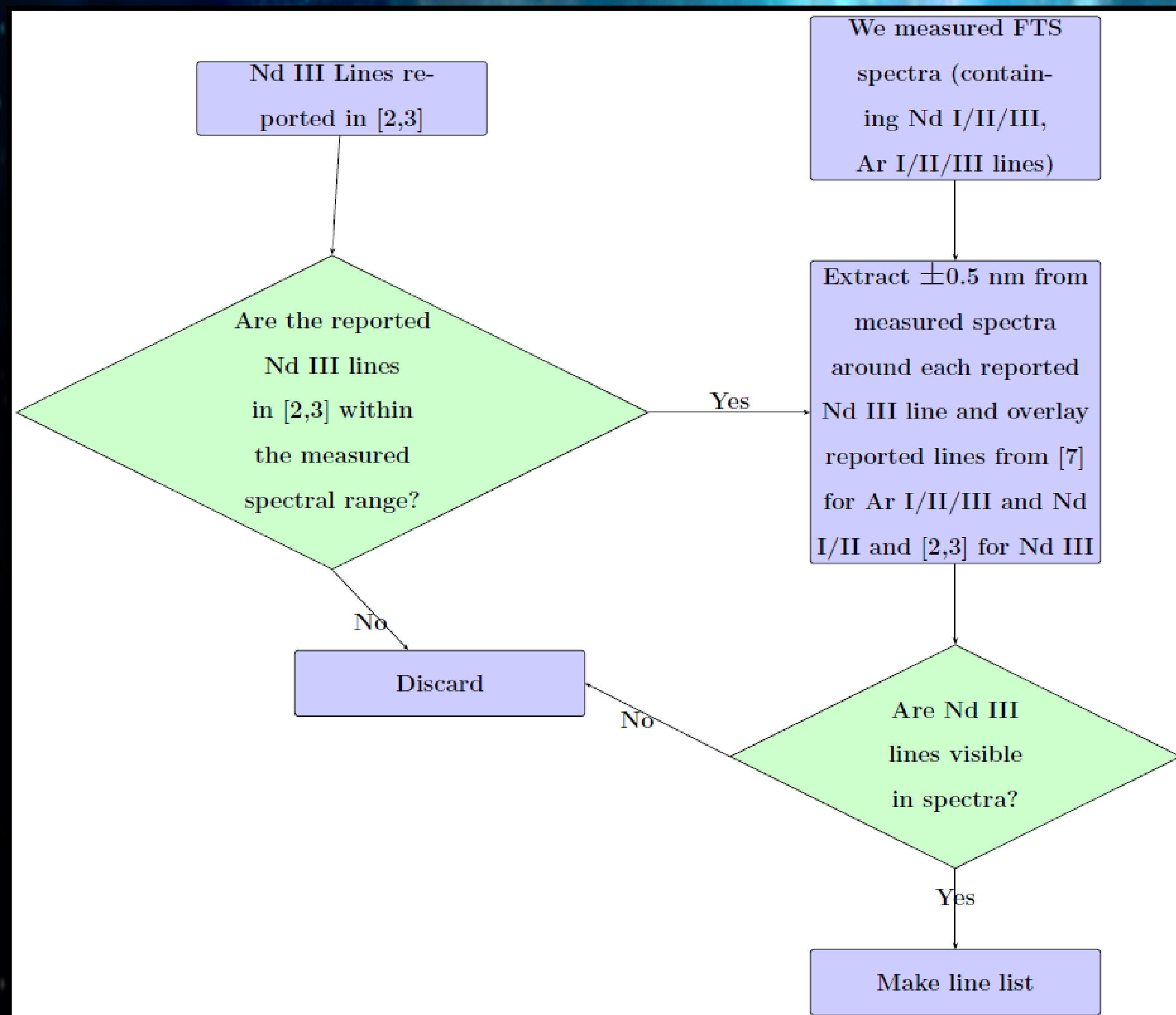


Hollow Cathode Lamp

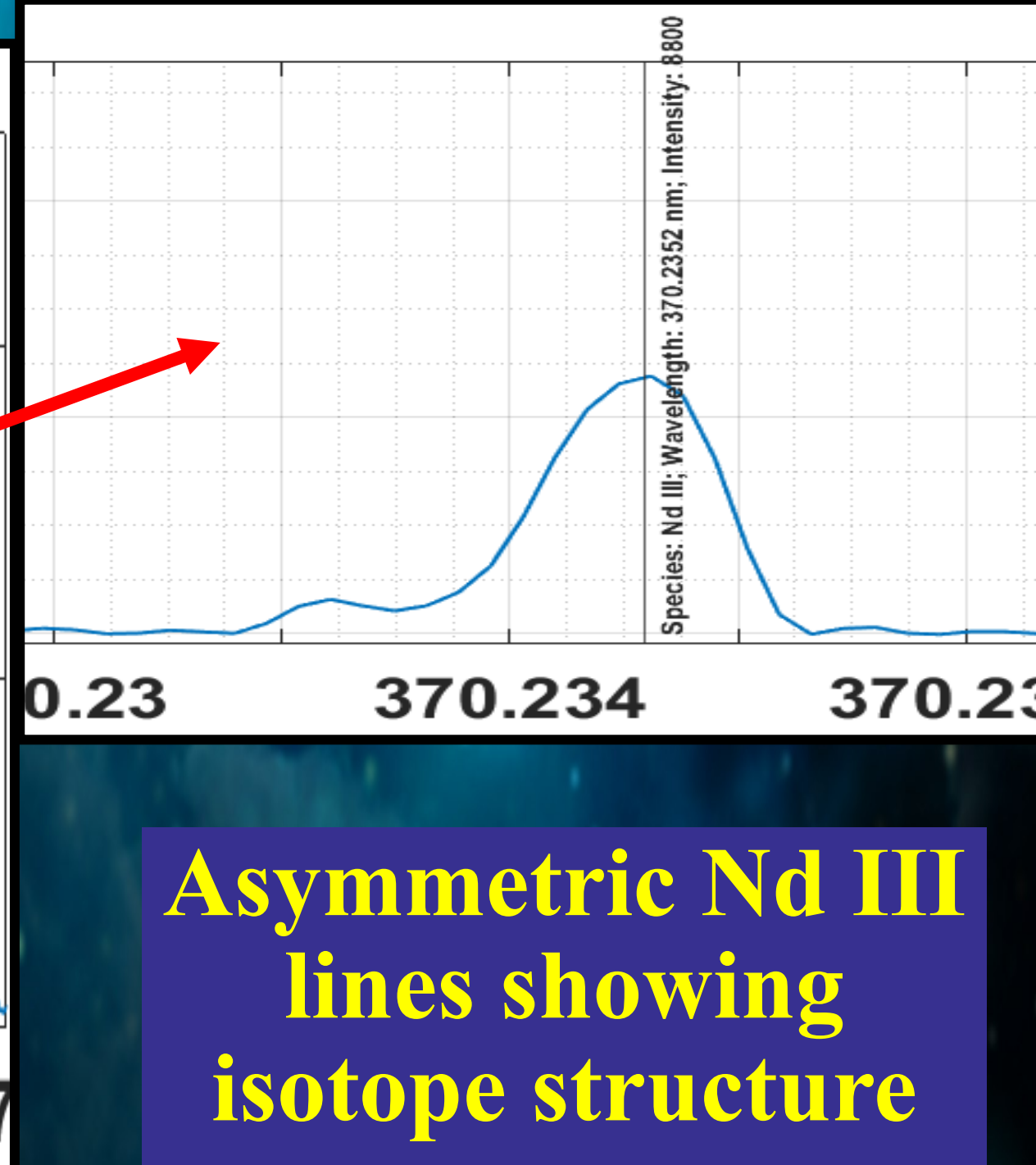
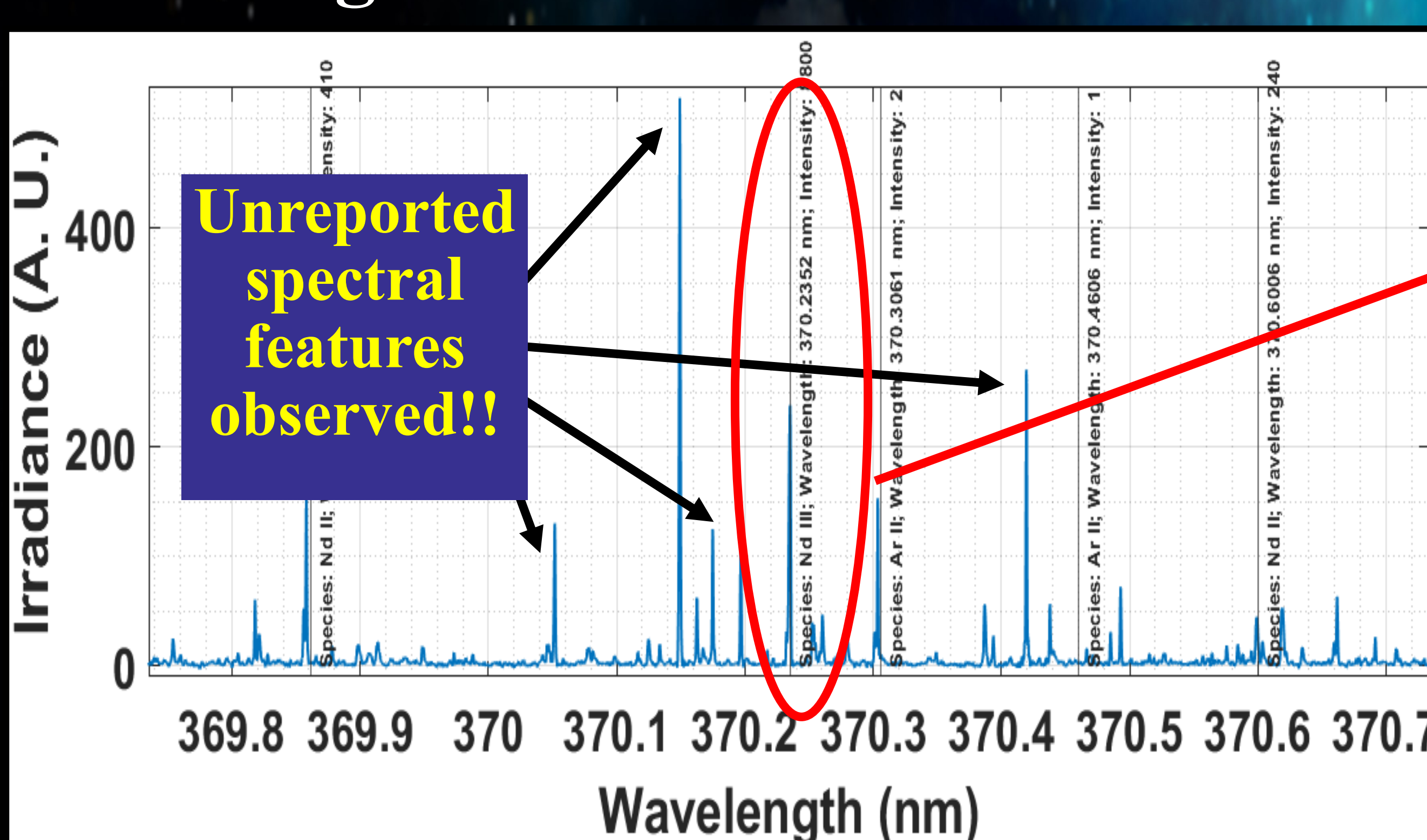


Fourier Transform Spectrometer

Work Flow



Challenges Faced



- Experimental lifetimes are available for only **five** upper energy levels of which **three** are **wrongly identified!**
- Crowded spectra with unreported features complicate identification of Nd III lines from [2,3].
- **Asymmetric line shapes of Nd III lines** poses challenge in fitting lines using standard Voigt profiles.
- We developed a fitting approach to **detect blends with unreported features** and to model asymmetric profiles, as detailed in Cob et al.

References

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- [3] Ding, M., et al. 2024. A&A, 692, p.A33.
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- [6] Kramida, A., et al., 2024. NIST ASD (ver. 5.12) <https://physics.nist.gov/asd>
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Conclusions

- The fact that unreported spectral features are visible and few experimental lifetimes are available, points towards the need of experimental spectral analysis of Nd.
- In spite of the difficulties, we have shortlisted approximately 50 Nd lines. We determine line intensities by integrating the area under each spectral feature (process detailed in Cob et al.).
- Using these intensities, we obtain transition probabilities.

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