

## Discrimination of pituitary neuroendocrine tumours by Raman spectroscopy

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### Background

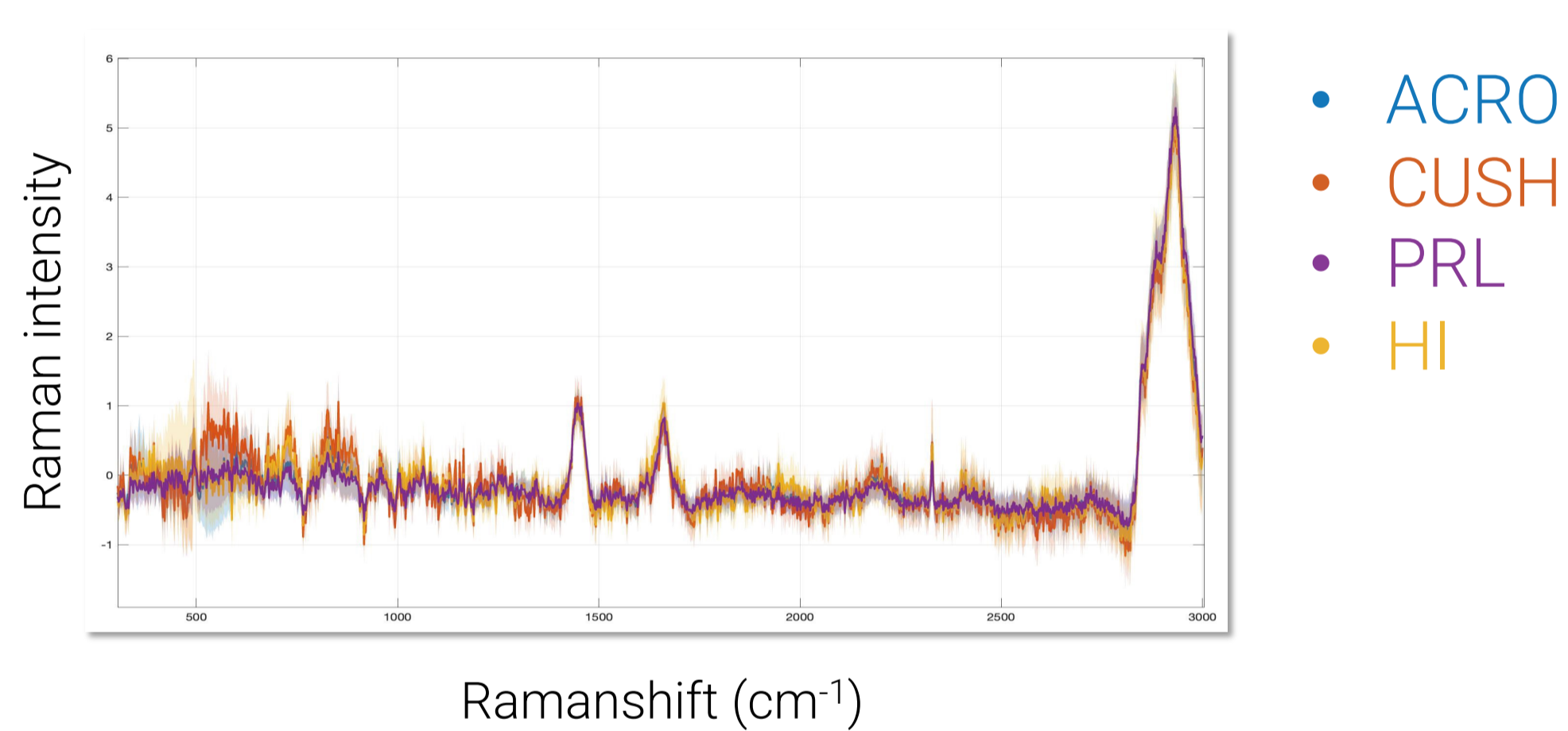
- Current techniques to provide exact location and identification of pituitary neuroendocrine tumours (PitNETs) for surgery are imprecise (pre-operative MRI) or time-consuming (surgical pathological tissue analysis).
- Raman spectroscopy is a non-invasive, non-destructive and quick technique that can determine the biochemical composition and discriminate between tissue types (e.g. cancerous vs. healthy) without requiring tissue processing and histopathological analysis.

### Aim of the study

- Obtain Raman spectra from different histological PitNET subtypes and classify using a trained classifier

### Results

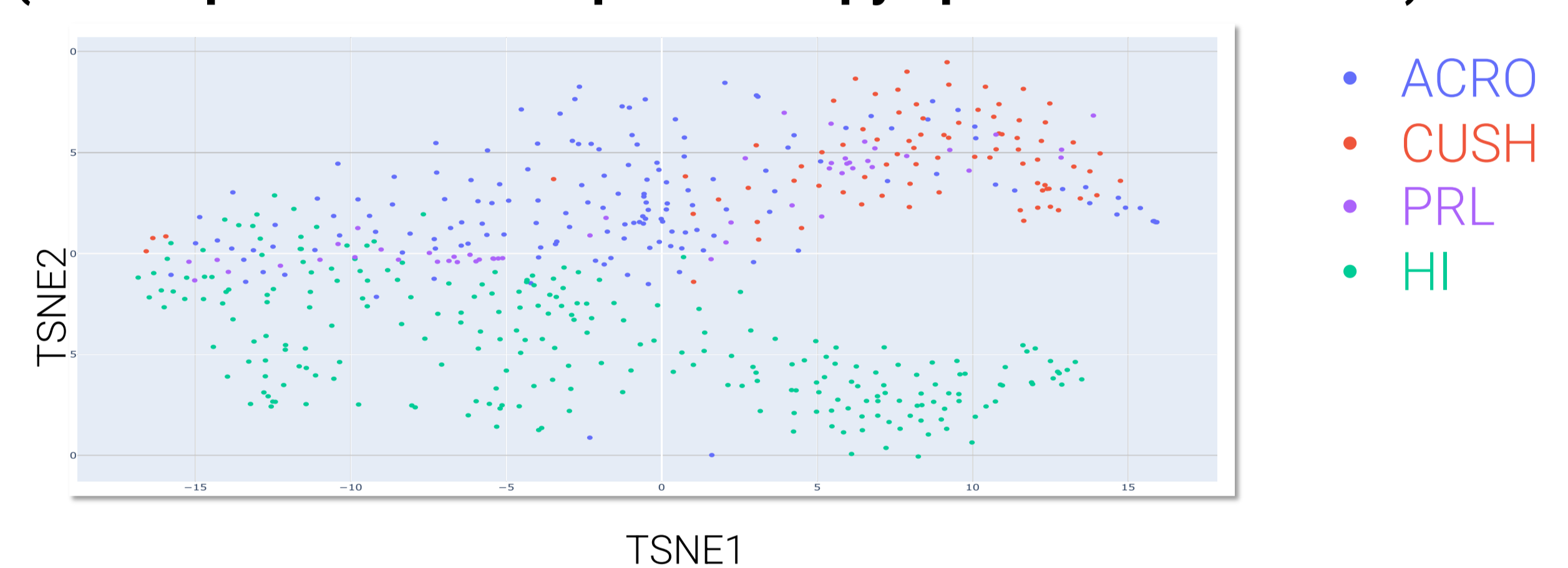
#### PitNET Raman spectra grouped according to clinical diagnosis



### Samples and methods

- 56 PitNETs from patients with:
  - Acromegaly (15: 11 somatotroph, 3 lactosomatotroph, 1 plurihormonal) (ACRO)
  - Cushing's disease (5 corticotroph) (CUSH)
  - Prolactinoma (2) (PRL)
  - Hormone inactive (34, including 1 silent corticotroph) (HI)
- 1 normal pituitary from brain donor autopsy (NP)
- 527 spot measurements (Solais™, Synaptive®) with 785nm laser source - acquisition 1602 values/spectrum - wavenumber scale 314-2994cm<sup>-1</sup> - number of acquisitions per scan 30-60 - exposure time 1-2s; data split in training and verification sets
- Data analysis and Statistics: T-distributed stochastic neighbour embedding (T-SNE) - trained SVM classifier; Mann-Whitney test

#### PitNETs with different clinical diagnoses show distinct clusters (T-SNE plot of Raman spectroscopy spot measurements)



#### Binary classifier achieves high accuracy distinction between different PitNET subtypes (HI vs. ACRO)

		Misclassification Ratio		
True	ACRO	35	0	0.000
	HI	2	72	0.027
		ACRO	HI	
		Predicted		

- Confusion matrix of binary classifier (numbers are patient balanced spot measurements for verification)
- 98% accuracy
- Confirms distinction predicted by T-SNE
- Feature importance ~ 81% for the 10 most important features in the classification of HI against active PitNET (ACRO, CUSH, PRL)

#### Multiclass classifier accurately distinguishes between different PitNET and normal pituitary

		Misclassification Ratio				
True	ACRO	19	10	1	0	0.368
	CUSH	7	16	0	0	0.305
	HI	0	0	69	0	0.000
	NP	0	0	1	7	0.125
		ACRO	CUSH	HI	NP	
		Predicted				

- Confusion matrix of multiclass classifier HI vs. CUSH vs. ACRO vs. NP (numbers are patient balanced spot measurements for verification)
- 85% accuracy

### Conclusion

- Raman spectroscopy achieves very good distinction between different PitNET types and normal pituitary
- Potential for intraoperative Raman spectroscopy to determine PitNET margins and distinguish tumour from healthy pituitary tissue

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