# Database (Atomic targets)

- 706 collision cases (44 projectiles and 73 targets),
- 36544 experimental data points.
- 1190 publications covering the period 1928-2023.

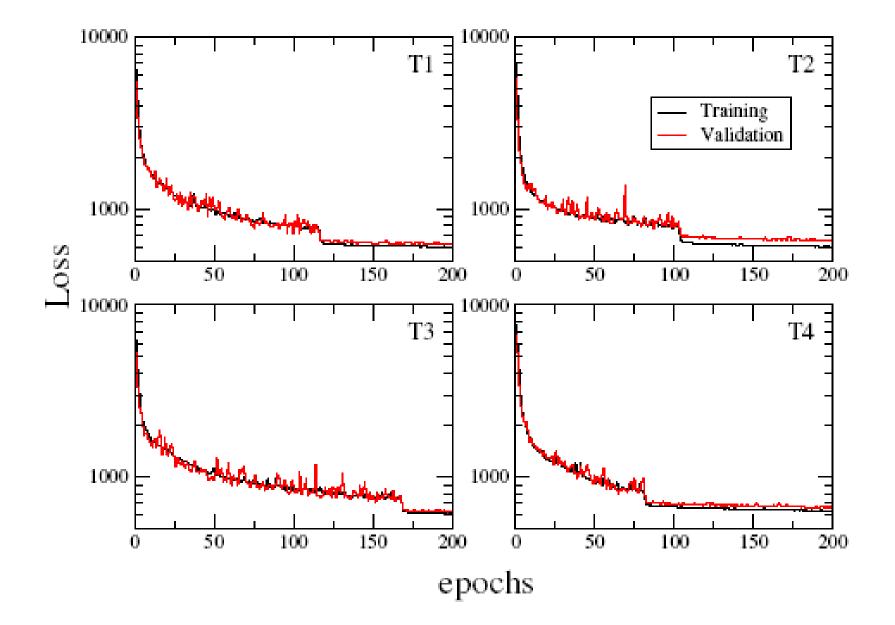
# Preliminary preparation

• Significant effort was devoted to reorganizing the database, unifying the units, and arranging the data in a standard (csv) format

# Cleaning criterions

- Experimental errors were not considered (The raw data show much larger discrepancies).
- The clustering-based algorithm reduced the original 36000 data points to 28000 values.

#### Learning curve for training and validation



## Comparison with "Random Forest" NN (2020)

$$MAPE \equiv \frac{100}{n} \sum \left| \frac{y_{true} - y_{pred}}{y_{true}} \right|$$

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Ions	Test			
	$\mathbf{RF}$	ESPNN		
Н	12	4.5		
He	9.1	4.1		
Li	25	7.7		
$\operatorname{Be-U}$	12	7.1		
All	23	5.7		

MAPE: mean absolute percentage error

## Comparison with SRIM (2013)

# Predictive MAPE of the SRIM code and the Neural Network ESPNN model trained only with data collected before 2013.

	>2013		>2015		>2017		>2019	
Ions	ESPNN	SRIM	ESPNN	SRIM	ESPNN	SRIM	ESPNN	SRIM
Η	7.0	19.2	4.6	15.3	6.6	13.3	3.5	7.1
He	8.4	10.6	9.3	10.1	9.3	10.1	5.5	8.3
Be-U	6.2	6.6	5.4	6.5	5.3	6.3		
all	7.0	11.4	6.0	9.8	6.8	8.9	4.1	7.4

The Stopping and Range of Ions in Matter