New aspects on structure and dynamics of spider dragline silk.

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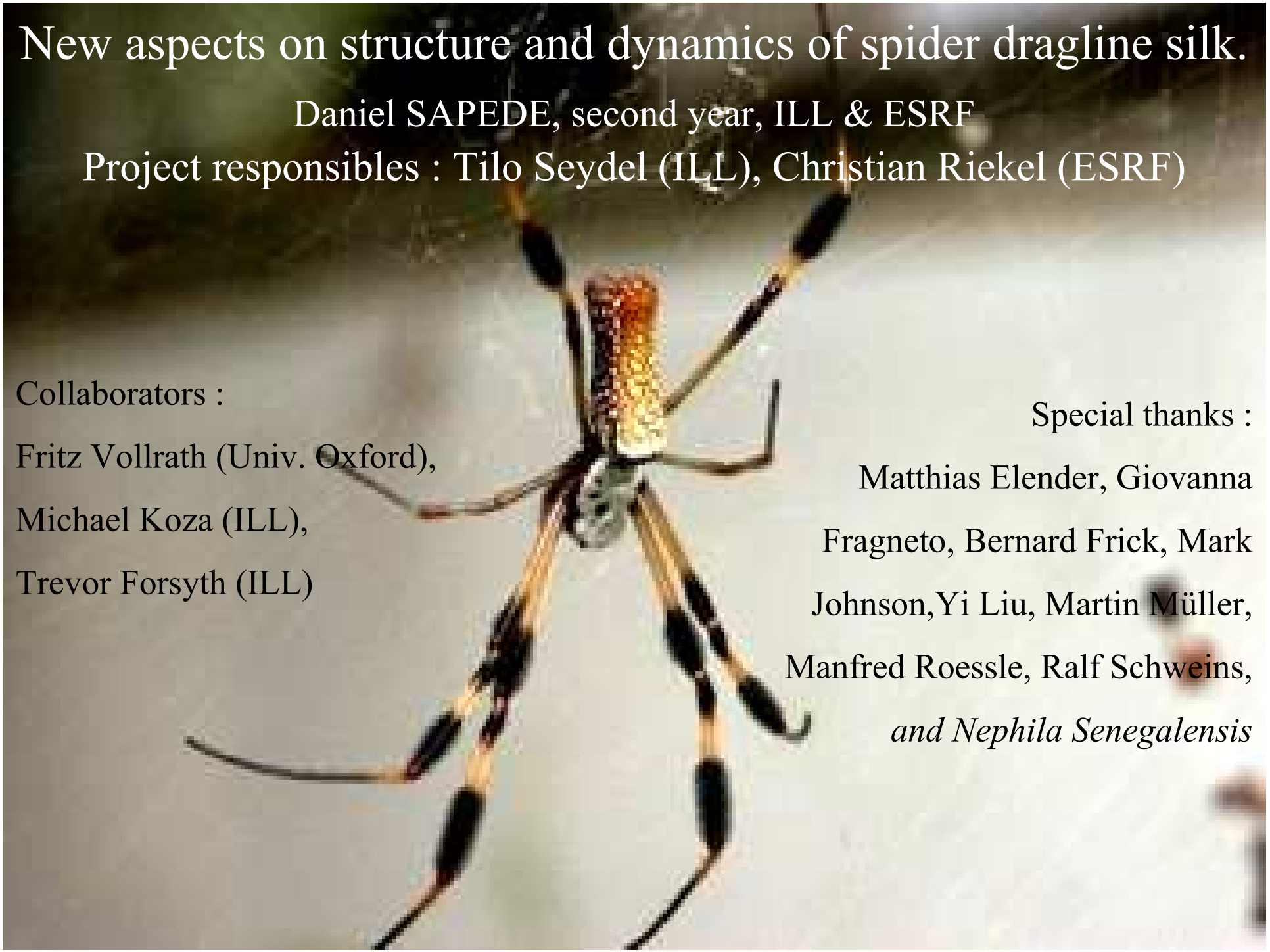

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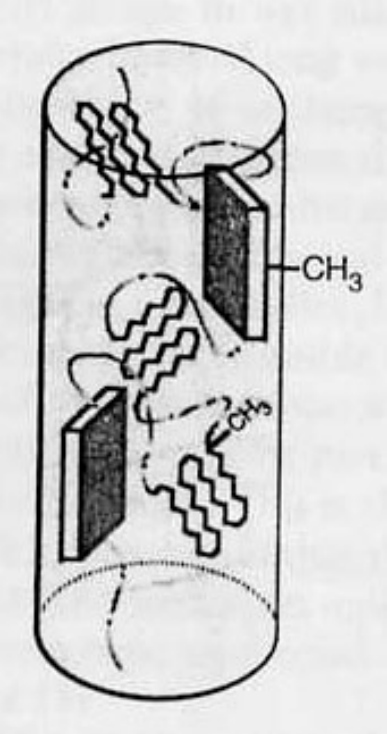
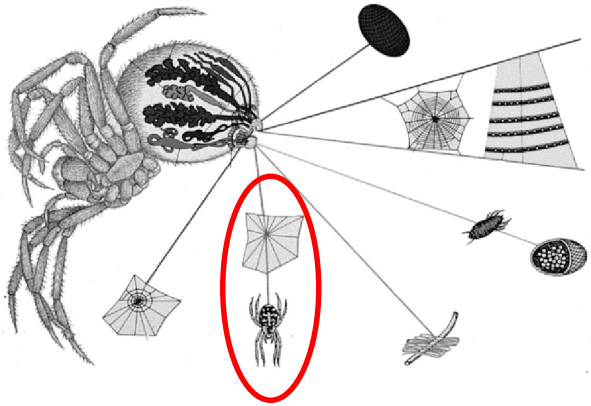
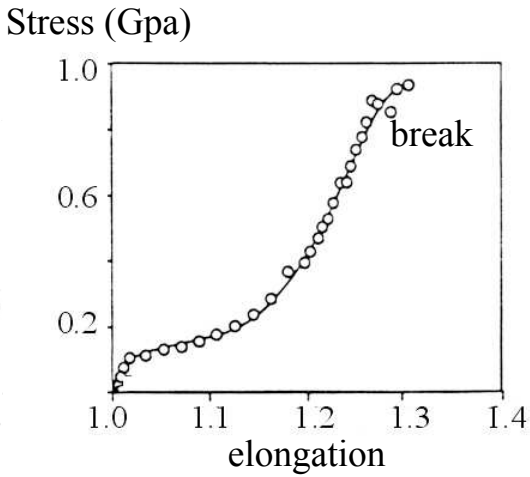
General introduction



- Bio-polymer made of proteins
- Different kind of silks
- Impressive mechanical properties
- Cheap, recyclable fiber, etc.

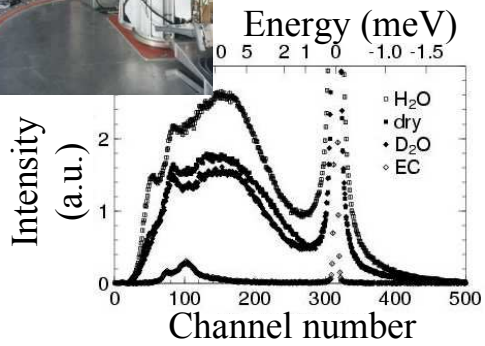


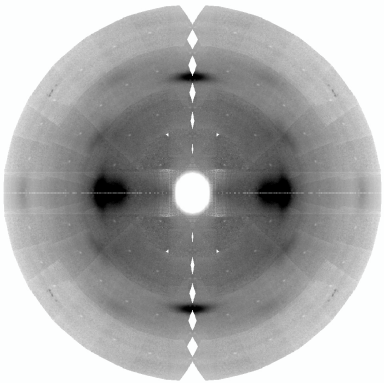


Material	Strength (GPa)	Extensibility (%)	Toughness (MJ m^{-3})
Nephila dragline	1.15	39	200
Kevlar 49	3.6	2.7	50

Methods used during the thesis project :

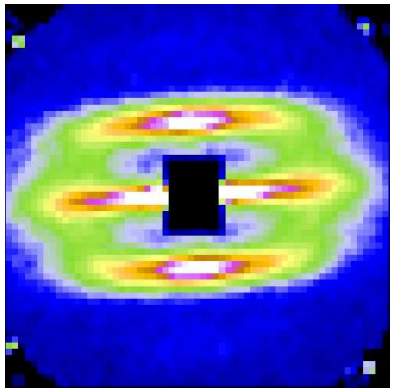
Neutron spectroscopy

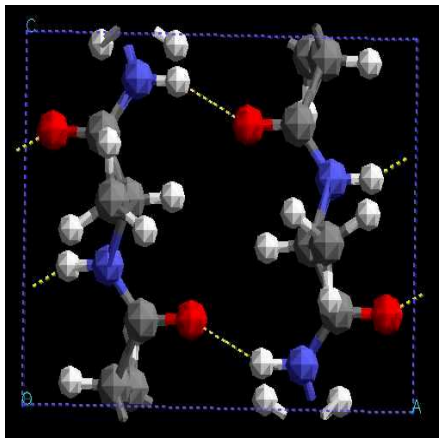




X-ray and neutron diffraction

Small-angle neutron scattering

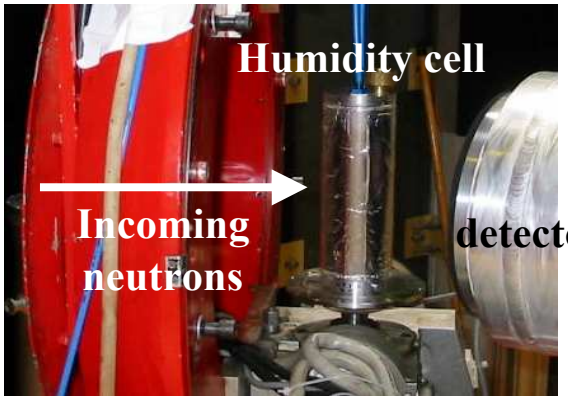




modeling

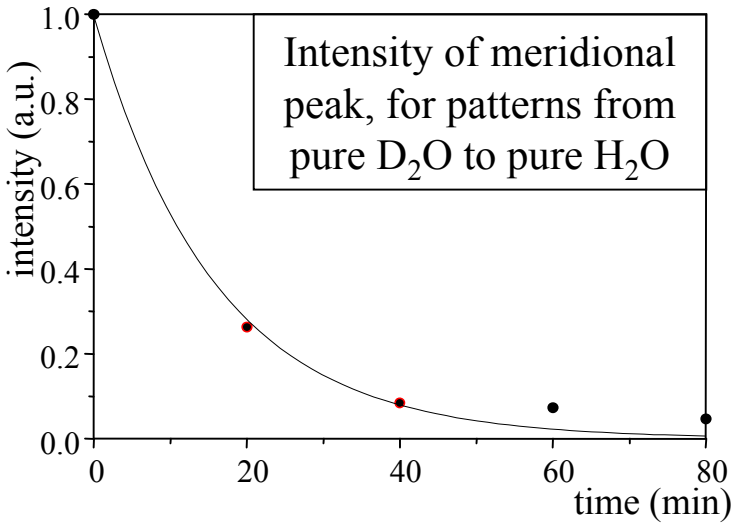
Small Angle Neutron Scattering experiments overview

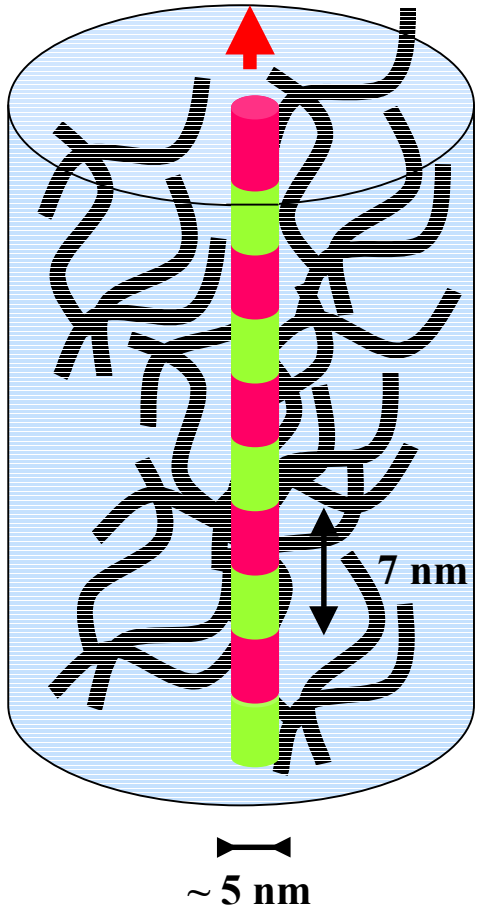
D16 setup



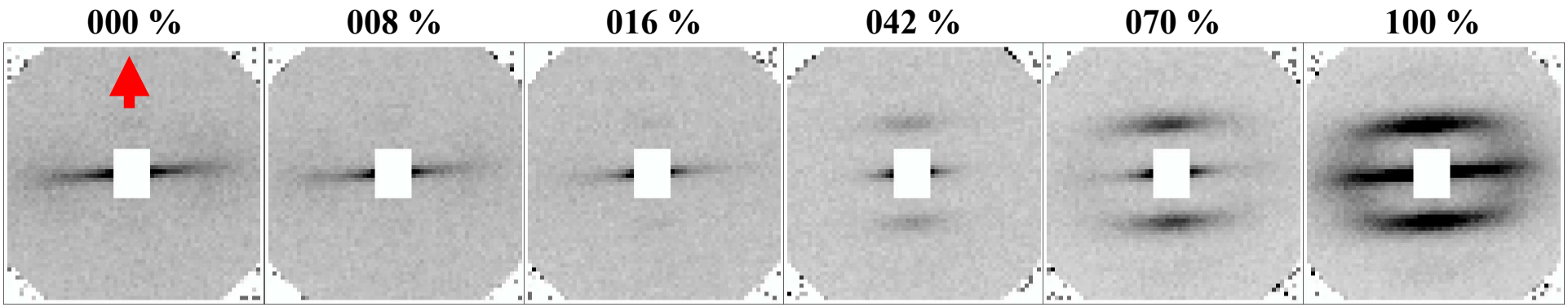
• the experiment : Silk humidified through a continuous flow of humid air.

• Different ratios of D_2O/H_2O are used. Kinetic of both humidification and H/D exchange appear to be fast.

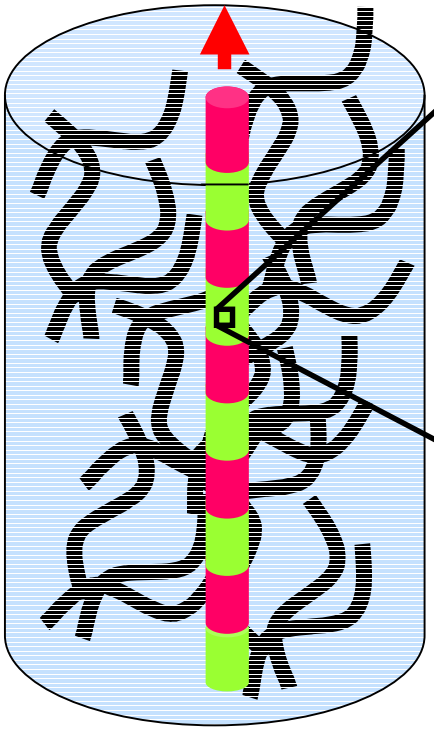


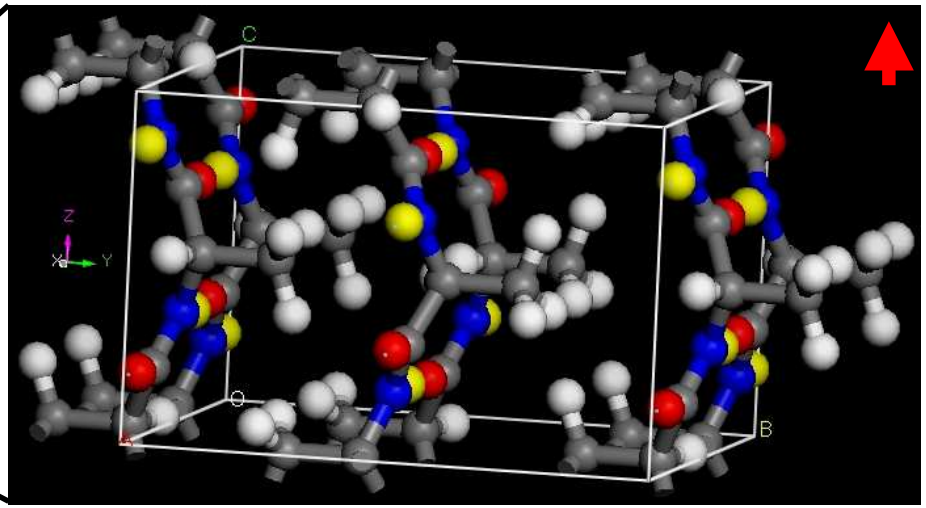


Ratio of D_2O/H_2O (D11) :



Modeling overview



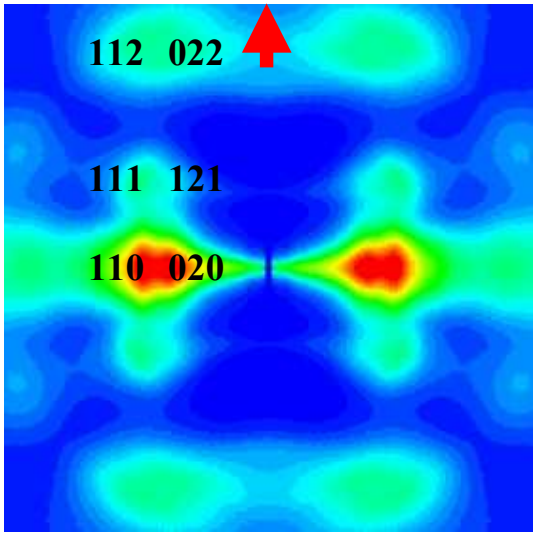


Marsh & Pauling model

gray : carbon
blue : nitrogen
red : oxygen
white : hydrogen

Yellow are exchangeable hydrogen atoms

- Check different models with new information obtained with neutrons
- Possibility to simulate the H/D exchange.



Simulated patterns for

left : neutron, N-H

right : neutron, N-D

=> comparison with experiment