Accelerator Science Group

8 academics + coordinators

>40 members

Mostly at CI

But also:
- CERN
- GSI/FAIR

Unique partnership model

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QUASAR Group Research

- ## Frontier Accelerators
  - Particle Colliders (e.g. LHC and its upgrades); Antimatter R&D – in particular: AEgIS; PERLE, CLARA and RUEDI: Design, optimization and R&D into underpinning technologies
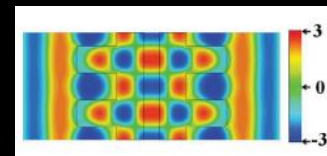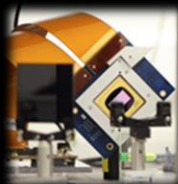
- ## Novel Accelerators
  - Plasma wakefield accelerators (AWAKE and EuPRAXIA), ultra-compact dielectric laser and carbon nanotube accelerators: Numerical studies and advanced diagnostics R&D

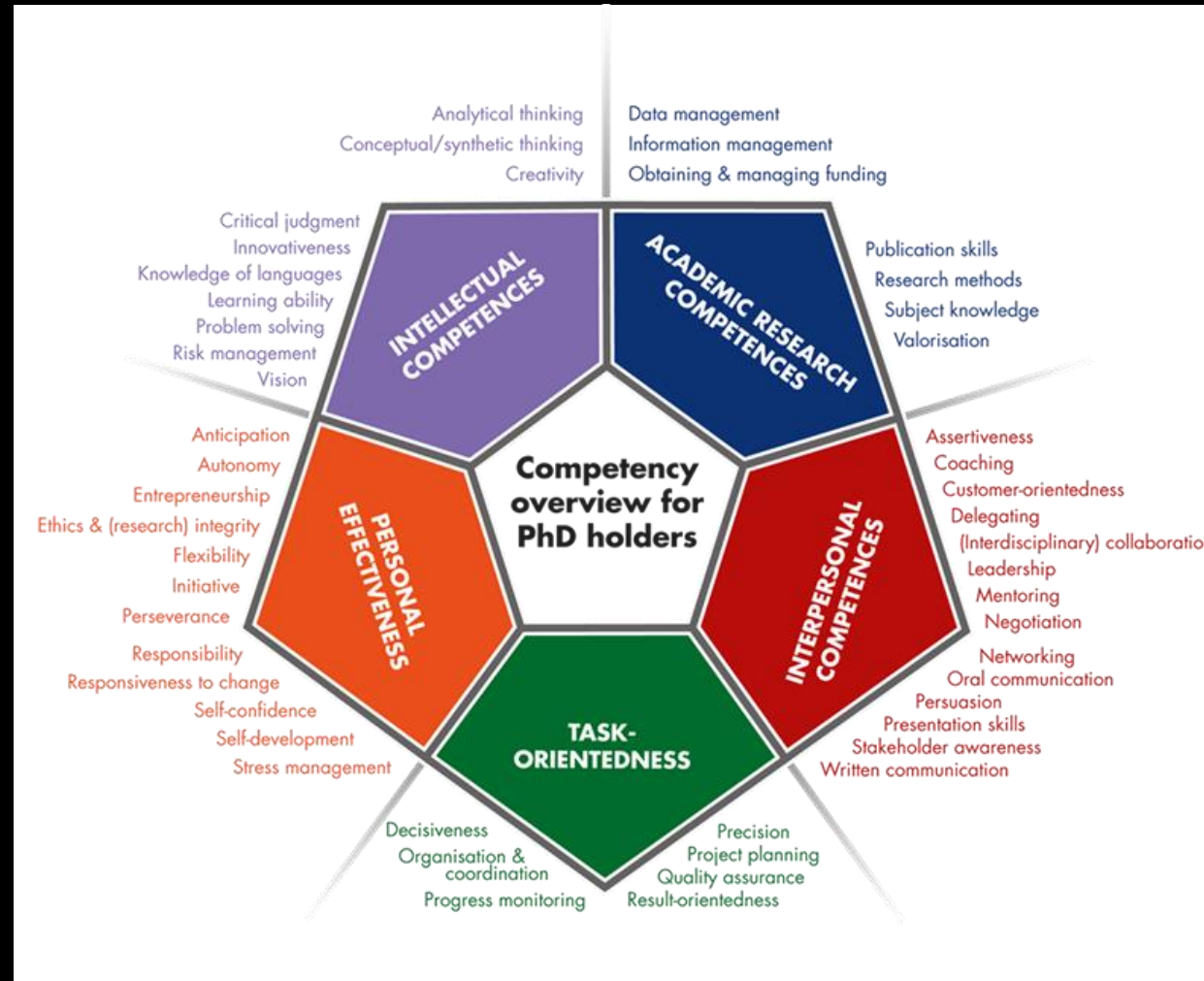- ## Accelerator Applications
  - Medical Applications, commercialization of our R&D: Imaging, treatment, sensors
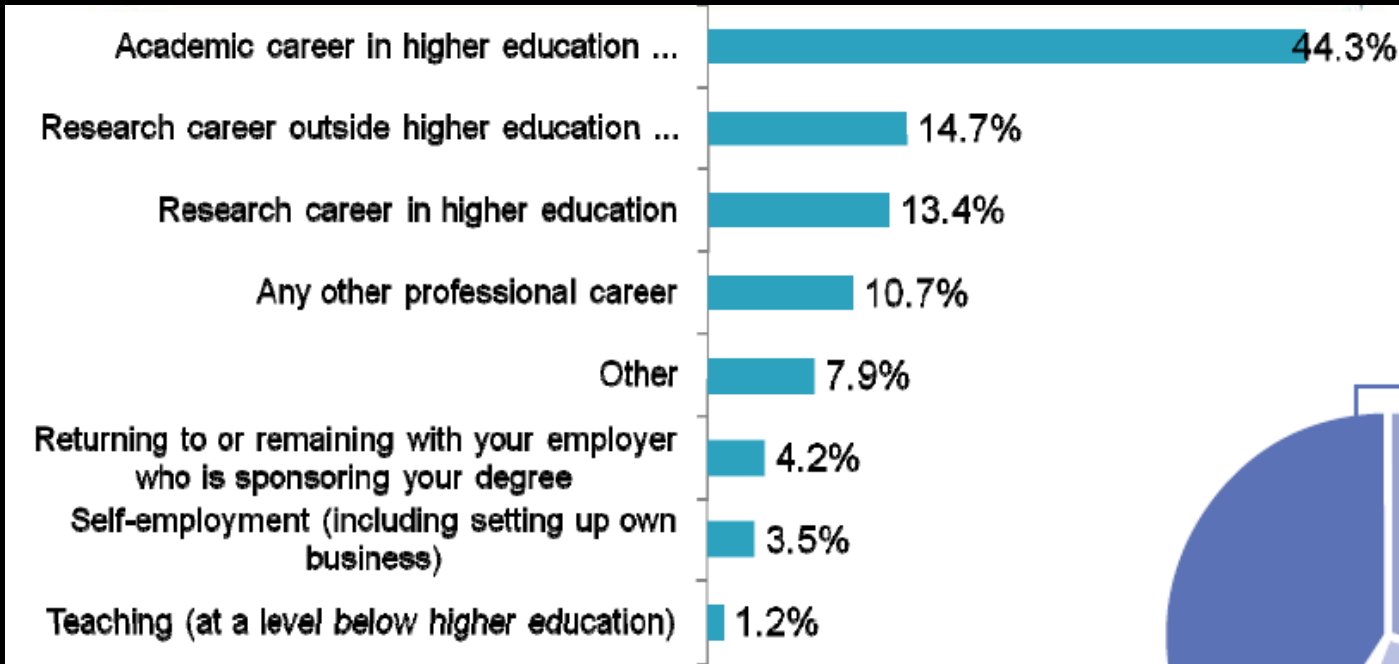
Underpinning everything: Data Science

Postgraduate Training

- MSc standard;

- PhD part of training in most countries;

- Broad skills;

- Blue sky research vs. applied physics.

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Career – Aspirations vs Reality

Academic career in higher education …	44.3%
Research career outside higher education …	14.7%
Research career in higher education	13.4%
Any other professional career	10.7%
Other	7.9%
Returning to or remaining with your employer who is sponsoring your degree	4.2%
Self-employment (including setting up own business)	3.5%
Teaching (at a level below higher education)	1.2%

Source: HEA - STEM

57.8 %

Universities, research centres, etc.
41 %

Industry
30 %

Service Industry
26 %

Others
3 %

Source: DPG

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‚Classic' PhD training

- Focus on academic career path;

- Scientific papers as key quality indicator;

- Training through (often blue sky) research;

- Very little training in complementary skills – researchers often need to be (re)trained on the job;

- Students or researchers?

Evolution: Doctoral networks and Centers for Doctoral Training

Marie Curie networks

- Introduced in EU Framework Programme
- 2016: 100,000 Marie Curie researchers (!)
- Currently around 15,000 active Fellows
- Provides support for early career and experienced researchers (young Postdocs).

Goals:

- Improve employability of researchers;
- Better training through demonstrated international mobility;
- Maintain Europe's leadership position in R&D.

Centers for Doctoral Training

- Funded by STFC through bespoke calls

- Liverpool one of the few universities that were successful in getting a data science CDT awarded – twice (!)

- We are training ~80 PhD students in total

- Mandatory 6-month industry placement part of every project

Goals:

- Improve cross-sector mobility

- Prepare for current career challenges – „the 100-year life"

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Accelerator Beam Diagnostics

‹‹ novel **DI**agnostic **T**echniques for future particle **A**ccelerators: A Marie Curie Initial Training **NET**work ››

Unique track record

MSCA Networks

- Beam Diagnostics *2008 - 2012*
  - **21 Fellows**, 32 partners www.liv.ac.uk/ditanet
- Laser Applications *2011 - 2015*
  - **19 Fellows**, 38 Partners www.la3net.nu
- Accelerator Optimization *2011 - 2015*
  - **23 Fellows**, 35 Partners www.opac-project.eu
- Medical Applications *2016 - 2020*
  - **15 Fellows**, 33 Partners www.oma-project.eu
- Antimatter R&D *2017 - 2021*
  - **16 Fellows**, 35 Partners www.ava-project.eu
- EuPRAXIA-DN *2023 - 2026*
  - **12 Fellows**, 23 Partners www.eupraxia-dn.org

Centres for Doctoral Training

- Data Intensive Science 2017 - *present*
  - ~80 PhD students, 2 universities + industry
  - www.livdat.org and www.livinno.org

‚Success stories' (EC)

- Fellow R&D

- Researcher skills training

- Dissemination and Outreach

- Project Coordination & Management

Last week: Synergies!

⟹ Also recognized as ‚best practice' by HEA, UKRO, etc.

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What is EuPRAXIA-DN?

- MSCA Doctoral Network with a budget of 3.2M €;

- 12 high-level Fellowships *(10 Fellows will be funded by the EU, another two by the UKRI guarantee funds)*;

- Interdisciplinary and cross-sector plasma accelerator research and training program carried out between universities, research centres and industry;

- Allows for organizing (large) number of events;

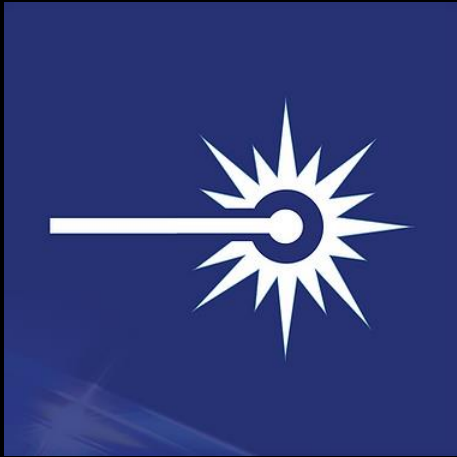- Recognized importance of plasma accelerator R&D at European level!
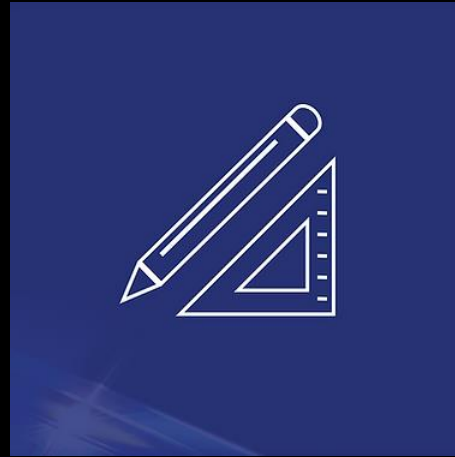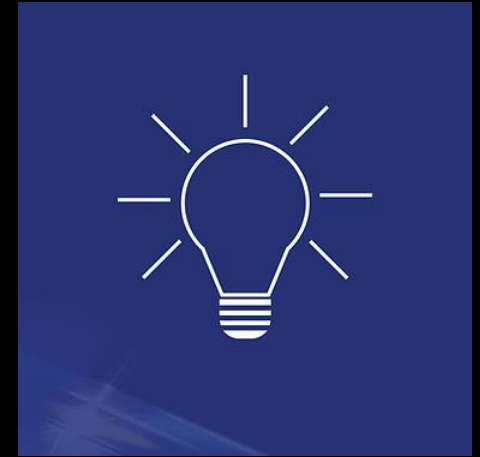
Beneficiaries

Partner Organizations

Research

Laser & Plasma

Facility Design & Optimization

Applications

The network's main scientific and technological objectives are split into three closely interlinked work packages.

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Training & Events

- International school on plasma accelerators;

- EuPRAXIA camps on focused research topics – always across the different project work packages;

- Researcher skills training designed to prepare all Fellows for their future careers and make them attractive for employers in academia and industry;

- Final conference and outreach symposium to present project results.

Events are open to all fellows and wider community !

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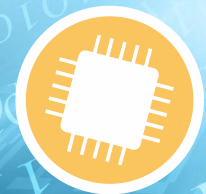
Your training timeline

Year 1	Year 2	Year 3	Year 4

	Taster placements		Industry placements	
Complementary Skills School Canvas course Data Science			School on Data Science and Applications	Advanced Skills School
Data Science School			Outreach Symposium	Careers Workshop
PGCert in Big Data			Data Science in Healthcare Workshop	
Cohort visit to the STFC Hartree Centre	LIV.INNO Student Seminars			
PGR training courses by clusters and LIV.INNO Virtual Seminars				
Specialist courses by Hartree and Nvidia		*DataAid*		
Development Needs Analysis/CDP, *updated quarterly*				

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Research environment

- LIV.INNO will focus on innovation in STFC science and industry applications.

- Perfectly aligned with <u>institutional DIGITAL research themes</u>, benefiting from Virtual Engineering Centre, new £12M Digital Innovation Facility, and LJMU's robotic telescope.

- <u>Wider impact</u> through placements, outreach symposium, and *"DataAid"*.

- LIV.INNO Research & Impact Board will support responsible research and translation.

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Career Development Plan
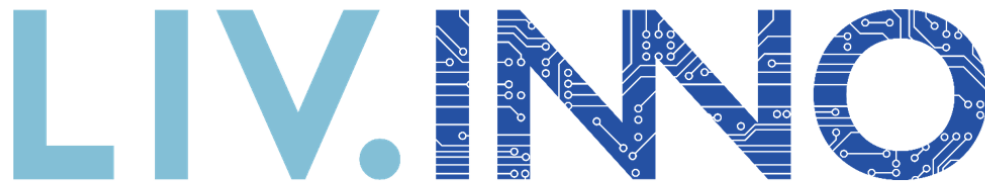
Career Development Plan (CDP)

Name of Student: Qiyuan Xu

Name of Supervisors: Professor Carsten Welsch; Drs Alex Hill, Hao Zhang, Federico Roncarolo and Dr Georges Trad.

Start Date: 1 October 2023

Date of CDP Review: 7 November 2023

Brief overview of research project and major accomplishments expected

This project is focused on improving the measurement of transverse beam distribution at CERN by using advanced machine learning and data science methods. Due to the discontinuation production of the radiation hard tube previously used for this purpose, a new approach needs to be designed and evaluated. A preliminary experiment test with laser point has demonstrated the possibility of using an optical fiber bundle with two lenses relaying the image signal away from the radiation area to CMOS camera [1]. Although the irradiation experiment result shows acceptable imaging resolution, the non-uniform degradation of optical fiber due to radiation and the loss of light signal during transmission would require further image reconstruction.

Career Development Plan

Name of EuPRAXIA-DN Fellow: Ana Maria Guisao Betancur

Name of Supervisors: Dr Joseph Wolfenden and Professor Carsten P Welsch

Date: 06/10/2023

Brief overview of research project and major accomplishments expected

Ultra-short Bunch Length Measurements with Femtosecond Resolution are required to fully characterize the beams in EuPRAXIA. DC4 at ULIV will work with INFN and DBEAM to develop a new technique that provides excellent time resolution whilst being non-invasive. Currently, longitudinal diagnostics with such resolution is limited to only a handful of solutions [1]–[3].

Training

- Local training by host:

- CDT and network-based schools;

- Researcher secondments to partner organizations;

- Secondments to partners from industry;

- Training in career skills

⇨   Motivation: *Ideal* Training.

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Training – at each Host

Example: CNA/U Seville, Spain – Z.A. Haidar

Workshops

- Oct 2008 : Workshop on Electronics for Novel Nuclear Physics Detectors at CNA

- Dec 2009 : Workshop on Hadron therapy at CNA

Doctoral Courses

- Dec 2008 : Nuclear Structure (1 week)

- Jan 2008 : Applied Nuclear Physics (1 week)

- Feb 2008 : Experimental Nuclear Physics (1 week)

- Mar 2009 : Nuclear Reactions (1 week)

- May 2009 : Intermediate Energies (1 week)

Schools, Mini Courses and Conferences

- Mar 2009 : 2 day course on Gas Ionization detectors : principles and recent developments

- July 2009 : International School of La Rabida on Basic concepts in Nuclear Physics: theory, experiments and applications (Poster participation: Development of a Tracking System of Exotic Nuclear Beams for FAIR)

- Sept 09 : Biennial of Physics (Spanish Royal Society of Physics) (Poster participation: Development of a Tracking System of Exotic Nuclear Beams for FAIR)

Other

- Tested and learned about several electronics equipments for detectors and data acquisition systems

- 2 semesters of Spanish courses (level 1 and level 2)

- Participated in a contribution to the GSI Annual Report of 2009 : "Fast timing with DSSSD detectors"

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Network-wide Training

2 Diagnostics **School**
Stockholm, Sweden – March
Indico: 112220
> 80 participants and lecturers

8 Topical **Workshops**
CI, France, Slovenia, Seville, Hamburg
Indico: 145063, 145066, 145070, 135829, 154172
~ 40 participants each

Diagnostics **Conference** and **Symposium**
Seville, Spain – CNA
Indico: 135831
Proceedings + PRST-AB special edition

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PGR Training - Evolution

- Complementary Skills (2010)

	Monday	Tuesday	Wednesday	Thursday	Friday
8:30 9:30		Project Management I Fistral: Paul Lyden	Working Within an International Network Guided Discussion	Time Management Ruth Bass	Scientific Writing ThinkWrite: Pete Moore
9:30 10:30			Building the Bridge to the Industry Sector Carsten Welsch + speakers		
11:00 12:00		Presentation Skills II Carsten Welsch	Project Management II Fistral: Paul Lyden	Problem Solving Techniques Ruth Bass	Scientific Writing ThinkWrite: Pete Moore
12:00 13:00				Self Management Ruth Bass	Conclusion Carsten Welsch
14:00 15:00 15:00 16:00	Welcome/Introduction of participants Carsten Welsch	Small groups: Presentation Skills *Individual assessment of participants through 5 min. short talks*	Visit to CI / Daresbury	General Patent Issues and Intellectual Property Right Marks-Clerk: Peter Roberts	
16:30 17:30		Presentation Skills I Carsten Welsch		Work/Life Balance Ruth Bass	

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Course Structure

- ## Project-specific part
  - Presentation skills
  - Scientific writing
  - Project management

- ## Generic skills through outreach project
  - Team working
  - Proposal writing
  - Peer review
  - Working under (time) pressure

Time	Monday	Tuesday	Wednesday	Thursday	Friday
9.00	**Introduction** Paired Introductions	**Introduction to Project Management:** Stakeholder analysis Milestones Deliverables Task schedule Risk assessment Breakdown structure/network diagrams/Gantt chart Applying these to your PhD/research project	**Presentation skills** Participants give 10-minute presentation in small groups about their PhD project All presentations will be video recorded Feedback by: (1) presenter, (2) fellow students, (3) Tutor	Independent team work: Outreach project **Mental health awareness** **Independent team work cont'd**	**The Presentation** *(Followed by Questions)* **Peer Review preparation** **Peer Review** Teams present assessment and feedback **Forward Planning of own PhD project**
10.30 – Break					
11.00 – 12.30	**Presentation skills** Basics of research presentations – an introduction to the Do's and Don'ts of research presentations				
12.30 – 13.30	Lunch				
	Science Communication Focus on writing for the general public • The writing process and structure • Thinking about the audience • Tips	**Independent Teamwork (Team rooms)** Teams to work on their outreach projects applying project management methodologies.	Visit to Cockcroft Institute *Tour of facilities*	**Managing your PhD** **Independent team work** Produce proposal Prepare presentation By 17:00 – submit outreach project proposal	
15.00 – Break					
15.30 – 17.00	**Outreach project – introduction**	**Introduction to Peer Review**	*Social activity*	*Special dinner*	

Symposium

10 July 2026

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Visual Identity

Start and end of Appointment

- EuPRAXIA-DN - your institute: Declaration of Mobility within 20 days;

- Everyone:
  - Project info, grant agreement, rules and regulations –SharePoint
  - First Career Development Plan to project manager
  - CV type photo, project description and info to comms officer for website

You will also need to complete a confidential questionnaire at the end with:
  - Background, career plans, etc
  - Nationality, age, gender, discipline
  - Assessment of the time spent in the network and of training received

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Wednesday

- Whole day at Daresbury Laboratory

- Bus will leave from Liverpool – train back

- Presentation skills training
    - Bring your talk
    - Meeting in 4 break-out rooms
    - 10 minutes per talk; strict limit!
    - Review video and feedback:
        - Speaker
        - Group
        - Tutor
   - More details later today

- Site visit

Race time!

- Bring an ID card

- Can be chilly (dress in layers ?!)

- Suitable footwear

- Grand prix event will last around 2 hours – everyone gets to drive twice!

- Up to 40 mph, large track (850 m!), multi-level

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Formal dinner @ Revolucion de Cuba

- Leave from hotel at 18:30

- Reception from 19:00

- Dinner from 20:00

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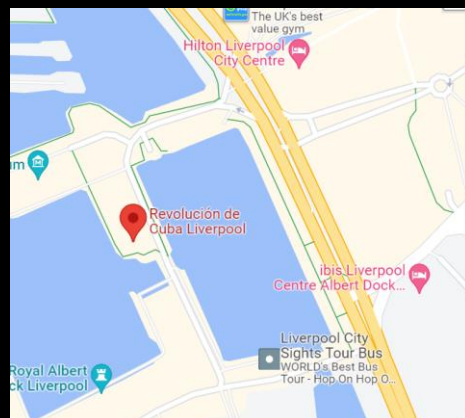
First steps...

- Find an (unknown) interview partner;

- Find out as much as possible about your interview partner *(15 minutes);*

- Exchange sides;

- Prepare a poster representing your interview partner – avoid text! *(~30 minutes);*

- Include one lie!

- Present your interview partner.

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