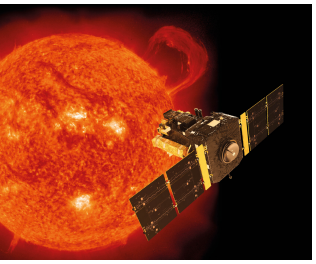
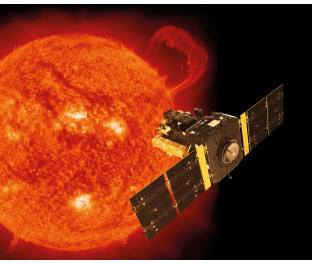


SOHO joint operations with other solar missions

Jean-Claude Vial
under the supervision of J.W. Leibacher

Institut d'Astrophysique Spatiale
Orsay



SOHO at L1: telemetry problem solved by DSN but still limited (200 kbps) as compared to needs (first use of 2D detectors).
Remember: Spacelab2 (1985) used film.

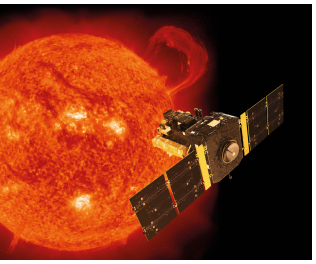
9 remote sensing instruments:
helioseismology, outer solar atmosphere*, heliosphere

* observations of the same features (or extensions) and the same event
easy when the FOV covers the whole Sun or heliosphere,
difficult when the spectrograph slits cover less than 10^{-5} of the solar surface

3 in-situ instruments:

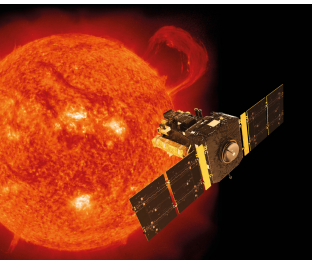
no such strong constraints but want to know, at least, where and when an event occurred

Crucial issue of coordinated pointing(s) => careful observations planning and checking between SOHO instruments and other missions (space and GBO)



Planning between SOHO instruments and with other missions (space and GBO)

Central role of EOF at GSFC: planning, commanding, observing, analysis (EAF)



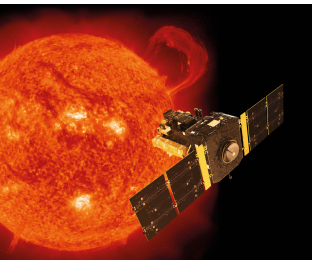
Planning between SOHO instruments and with other missions (space and GBO)

An ancillary center in Europe:
Call issued by ESA for an ESDOC, won by IAC
… after some episodes, call declared unsuccessful

MEDOC (Multi-Experiment Data and Operations Center *and also Bordeaux wine*) at Orsay, proposed with Alan Gabriel

Funded by C.N.E.S., CNRS, Université Paris-Sud, Essonne Region

https://www.ias.u-psud.fr/medoc-OLD/operations/cmp4/pictures/



Planning between SOHO instruments and with other missions (space and GBO)

Preparation of a MEDOC campaign: overall plan submitted to the SWT (1)

Proposed Campaigns :

Campaigns # 5 in May 2000 (weeks 18, 19, 20), # 6 in October (weeks 40, 41, 42)

May Campaign

Weeks 18, 19, 20 (1 - 21 May 2000)

Joint Observations with VTT and THEMIS (THEMIS starts a 8 months Campaign)

Scientific program

THEMIS-related :

JOPs 17/107 (B. Schmieder and Co) (P. Heinzel at MEDOC)

JOP 38 (Vial and Co) (use of the MTR mode of THEMIS)

Prominence long T oscillations (Régnier)

Others :

Sunspot studies : O. K-Moe (T. Fredvik at MEDOC)

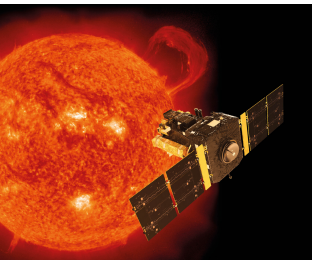
Morphology of polar coronal holes : UK (B. Bromage) Team ?

Quiet Sun studies: KPVT joint observations (SOHO-TRACE coordinations)

J. Leibacher

Coordination with UVCS/CASSINI/GALILEO : SUMER (S. Habbal) : 9-17 May

Intercal001 : ?



Planning between SOHO instruments and with other missions (space and GBO)

Preparation of a MEDOC campaign: overall plan submitted to the SWT (2)

Instruments involved at MEDOC:

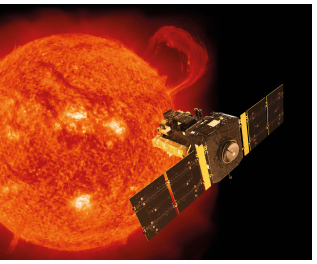
SUMER: planification, data quick-look and commanding (including NRT); slit position seems OK
CDS: planification (EAPs sent to CDS/EOF) and data quick-look
EIT: planification (JOPs)
UVCS: very busy with coordinated Cassini and Galileo observations
TRACE : C. David planner at MEDOC
Daily contact with MDI, LASCO

Operations :

Weekly meetings on Fridays April 28, May 5 and 12
Weekly and daily meetings at MEDOC around 10.30 local time
Weekly and daily reports sent to EOF before 15.00 local time (9.00 GSFC time)
Target : all SUMER commands loading before 18 U.T. …..

Technical capabilities: unchanged

MEDOC-EOF dedicated line operational
Telemetry software operational
Access to summary, synoptic data operational
Commanding capability (SUMER) unchanged
Other functions (IAP, KAP files exchange, ..): unchanged



Planning between SOHO instruments and with other missions (space and GBO)

MEDOC campaigns as coordinated with EOF (3)

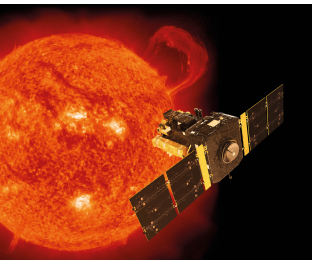
Joint science programs run during 3 weeks of campaign

MEDOC Driven

* JOP017: Dynamics of Arch Filament Systems, THEMIS/VTT/CDS/SUMER/EIT/MDI
* JOP022: Network Evolution, SUMER/CDS/EIT/MDI/TRACE/THEMIS/VTT
* JOP038: Diagnostic of Coronal Bright Points, SUMER/CDS/EIT/MDI
* JOP040: Transition Region Network Thickness, SUMER/MDI/TRACE,
* JOP057: Limb Studies, Pic du Midi/EIT/TRACE/LaPalma
* JOP096: Emerging Active Regions, SUMER/CDS/MDI/TRACE
* JOP101: Doppler Shifts and Line Widths of Helium Lines and their Relation to the Line Formation, SUMER/Tenerife VTT/TRACE/CDS/EIT/MDI
* JOP102: Structure of Coronal Holes with Plumes, CDS/MDI/TRACE/SUMER/EIT
* JOP103: Transition Region Moss,MDI/TRACE/Yohkoh SXT/SVST/La Palma
* JOP104: X-ray jets from limb active regions, CDS/SUMER/TRACE/Yohkoh SXT/Tenerife
* JOP105: Low corona diagnostic EIT/CDS/Mauna Loa
* JOP107: Lyman lines series in prominences and Lyman continua, CDS/SUMER/Wroclaw/Ondrejov/Meudon.
* Active Region Filament Study, CDS/SUMER
* Wave Flux from photosphere to transition region, TRACE/SUMER/Kitt Peak
* Off-limb Studies, CDS/SUMER
* Ionization degree in cool structures, SUMER/CDS/EIT
* Moreton Waves Program, EIT/Pic-du-Midi
* Spicules, SUMER/Tenerife VTT

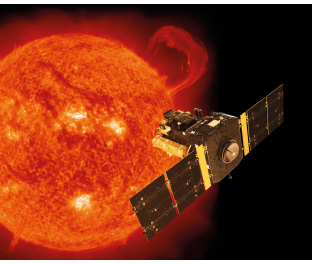
Non-MEDOC Driven

* Coordinated observations of solar wind in inner corona, UVCS/Sac Peak/SUMER
* UVCS/Ulysses Coordinated observations
* IPS measurements, MERLIN/LASCO/EISCAT/TRACE
* JOP100: Active Region DEM for Heating and Magnetography Studies CDS/VLA/TRACE/Sac Peak



The (happy) daily meeting

Karine, new MEDOC Director, taking notes…; after Isabelle Scholl, a new manager: Gilles Poulleau; after JL Orcesi a new command guy: Stéphane Caminade



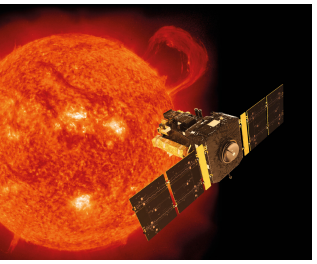
Planning between SOHO instruments and with other missions (space and GBO)

After 30 years:

11000 papers with SOHO in abstract and keywords (ADS)
More than half of them in coordination with other missions and GBO?

https://www.esa.int/Science_Exploration/Space_Science/SOHO/Sun-watcher_SOHO_celebrates_thirty_years

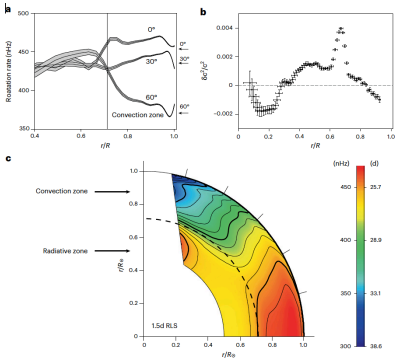
+ Review article in Nature Astronomy
https://doi.org/10.1038/s41550-025-02687-4
SOHO's 30-year legacy of observing the Sun
Daniel Müller, Jack Ireland, Anik De Groof, George Dimitoglou & Bernhard Fleck

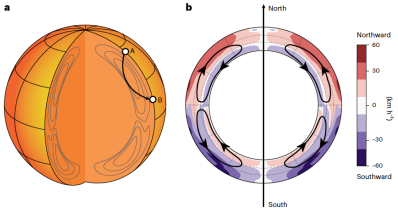


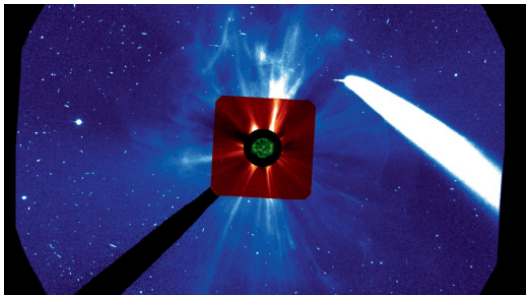
Planning between SOHO instruments and with other missions (space and GBO)

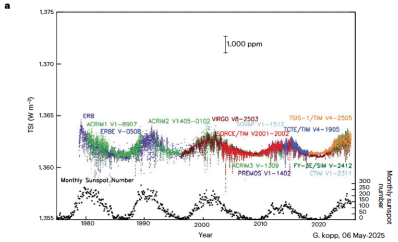
After 30 years:

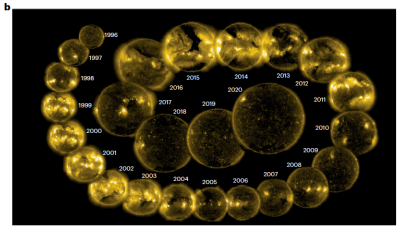
SOHO's 30-year legacy of observing the Sun, Muller et al. 2025

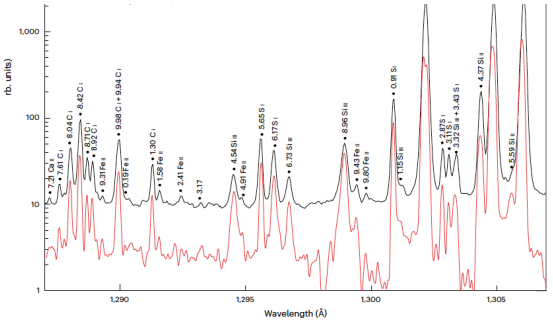


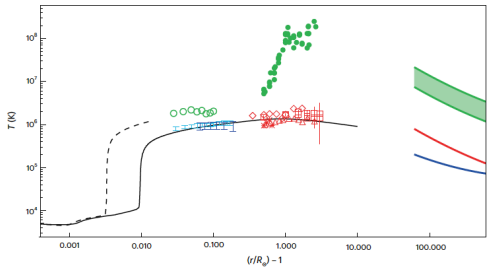




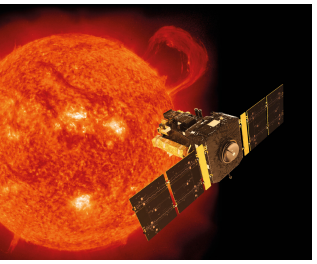








But where are the prominences? Fortunately, some people care …

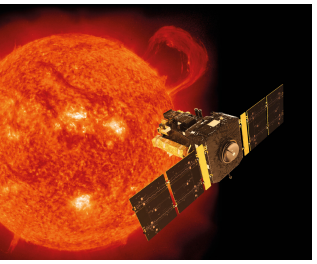


March-April 2017 joint campaign between different (space and ground-based) instruments (1)

IRIS, SDO/AIA, SDO/HMI, Hinode/SOT/SP, Hinode/XRT, Hinode/EIS, SUMER/SOHO
GBOs: Fuxian Solar Observatory (Yunnan China): NVST (1 m), ONSET, Catania, Lomnicky (Slovakia), Bialkow (Wroclaw),
Ondrejov: Flare spectrograph (5 lines),
ROB: USET (including "ludicrous mode"), PROBA2: SWAP & LYRA;
Humain radiospectrograph
Meudon Observatory: MSDP
Pic-du-Midi: CLIMSO coronagraphy + imagery
Canary Islands: SST: CHROMIS, CRISP
Canary Islands: GREGOR, HiFI + Chro Tel, GRIS +, GFPI

Integration of all plans in HOP 334, 27 March-4 April
Various objectives:
Prominences: diagnostic, mass flows, bubbles, plumes, eruptions
Spicules: fine structure, mass flow, …
Active Regions (AR): Ellerman bombs, flux emergence, … etc

SUMER: swan's song, preferably in the Lalpha line



March-April 2017 joint campaign between different (space and ground-based) instruments (2)

SUMER pointing: "mission impossible » ?

W. Curdt:

... **Unreliability of the azimuth drive => sequence needed for exact pointing during non contact hours without real-time telemetry employing onboard hardware encoders.**

Uncertainty of the azimuth position of the slit better than 5 arcsec.

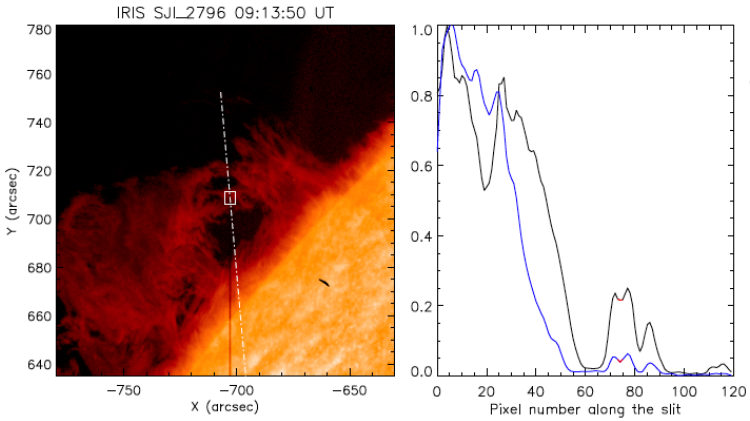
The slit crossed the target prominence between 08:31 and 10:18 UT and was pointed at the east limb in the North-South direction with about one third of the full length on disk.

Slit not aligned to the NS-direction since the SoHO roll is not re-adjusted anymore.

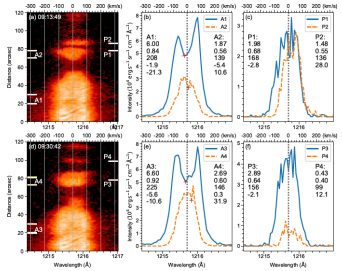
Because of the high photon flux, the aperture door had to be partially closed prior to the observation (cf., Curdt et al. (2008) for details). Thus, the incoming photon flux of the bright line was reduced to a level of about 20% as accurately determined post factum by two disk exposures in the Lyman continuum around 880 Å before and after re-opening of the aperture door.

The duty cycle of the detector had to be reduced, to avoid overheating of the channel plate.

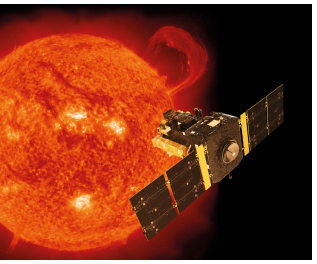
With a duty cycle of 57% the entire observation with 69 cycles took 107 minutes.



Latest spectral observations of a prominence in the L-alpha line



Xue, J., et al.: A&A, 703, A145 (2025)



Planning between SOHO instruments and with other missions (space and GBO)

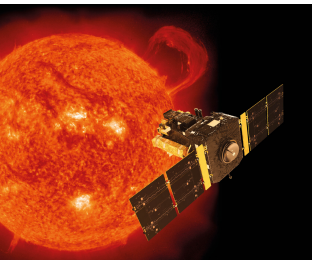
Central role of EOF at GSFC: planning, commanding, observing, analysis (EAF)

11.000 papers with SOHO in abstract or keywords (ADS)

Perhaps half of them in coordination with other missions and GBO?

MEDOC added-value: easier access for European and non-European scientists (including some US colleagues …)

A unique experience for all participants: "hands-on" science, Solar Physics school, workshops, collaboration, cooperative science, visitors, career-long collaborations



Merci!

Adventures of a MEDOC Campaigner

Laura Roberts and Jean-Claude Vial

We arrive in Orsay …!

Follow the signs

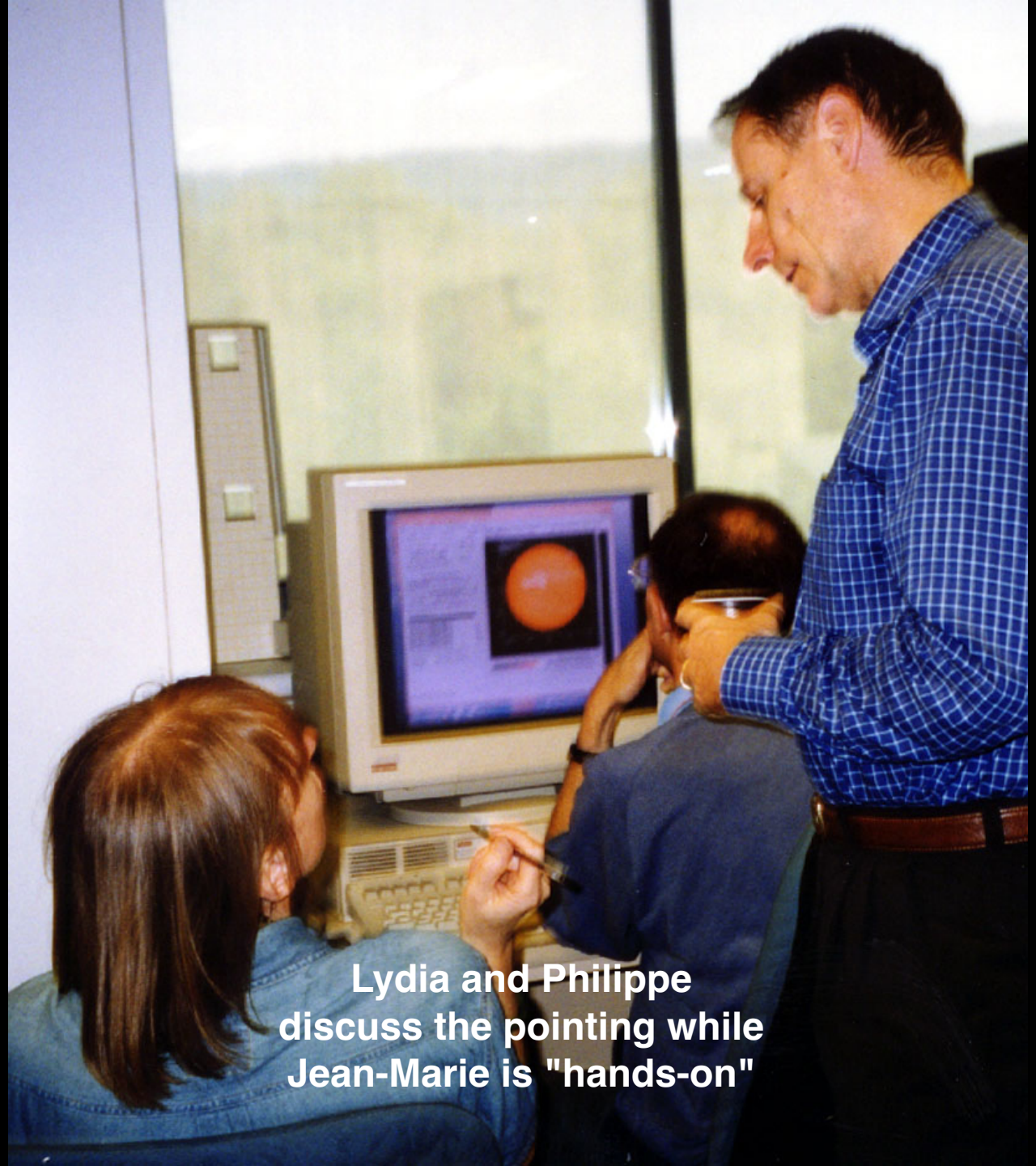

....to arrive at the building

GOLF qualification model, MEDOC
plant (badly in need of water) and near real-time
display of SOHO and Meudon images


Spiros gives a full
lecture on solar physics,
Brigitte Schmieder
seems convinced ..

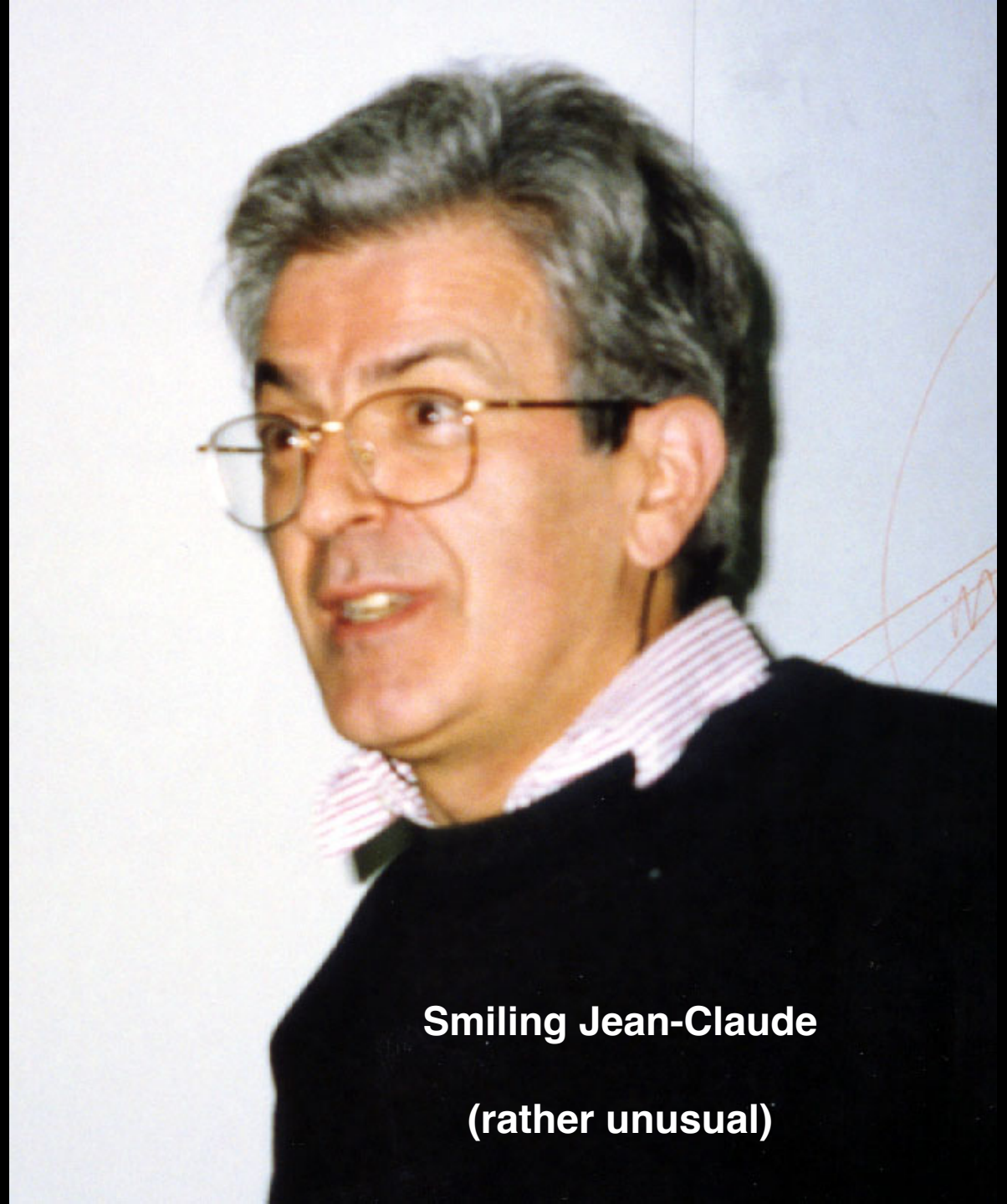
The SOL ..
Daniele Spadaro,
agrees

A meeting room
with windows !!



Lydia and Philippe
discuss the pointing while
Jean-Marie is "hands-on"

Lisa Maccari (UVCS) and
Dave Pike (CDS) hard at work..

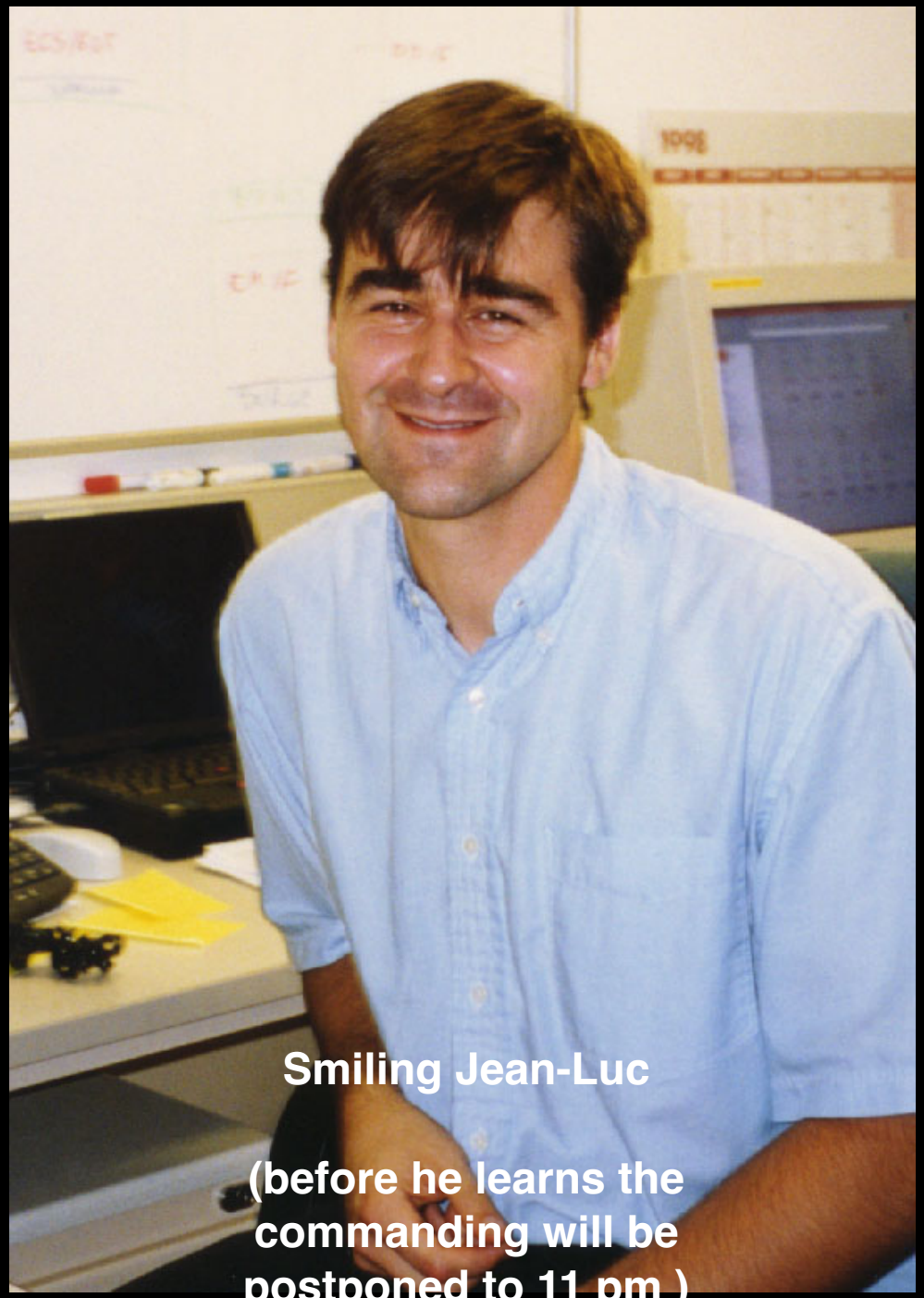


Smiling Jean-Claude

(rather unusual)

Smiling Isabelle

(in her office)



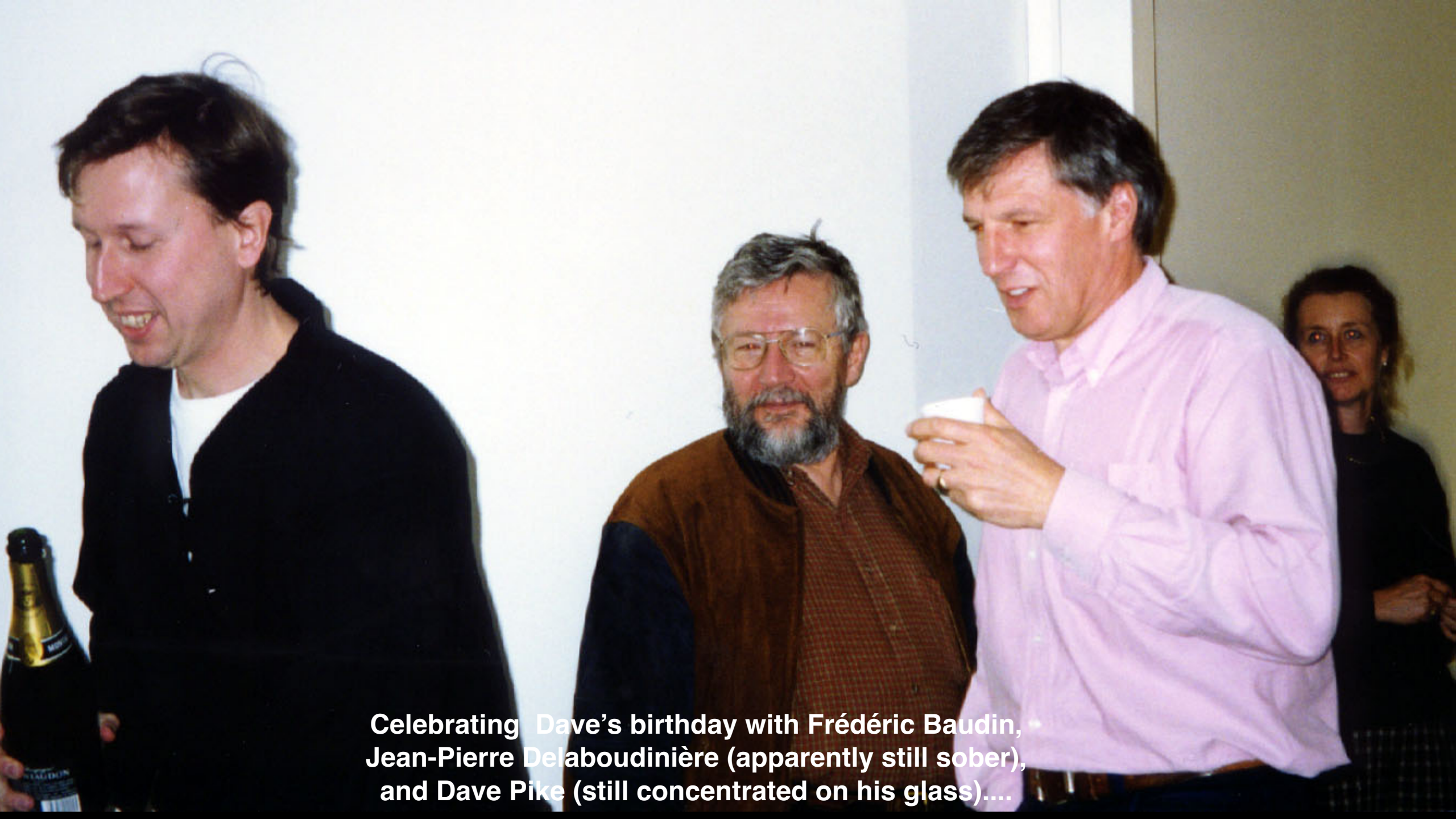
Smiling Jean-Luc

(before he learns the commanding will be postponed to 11 pm)

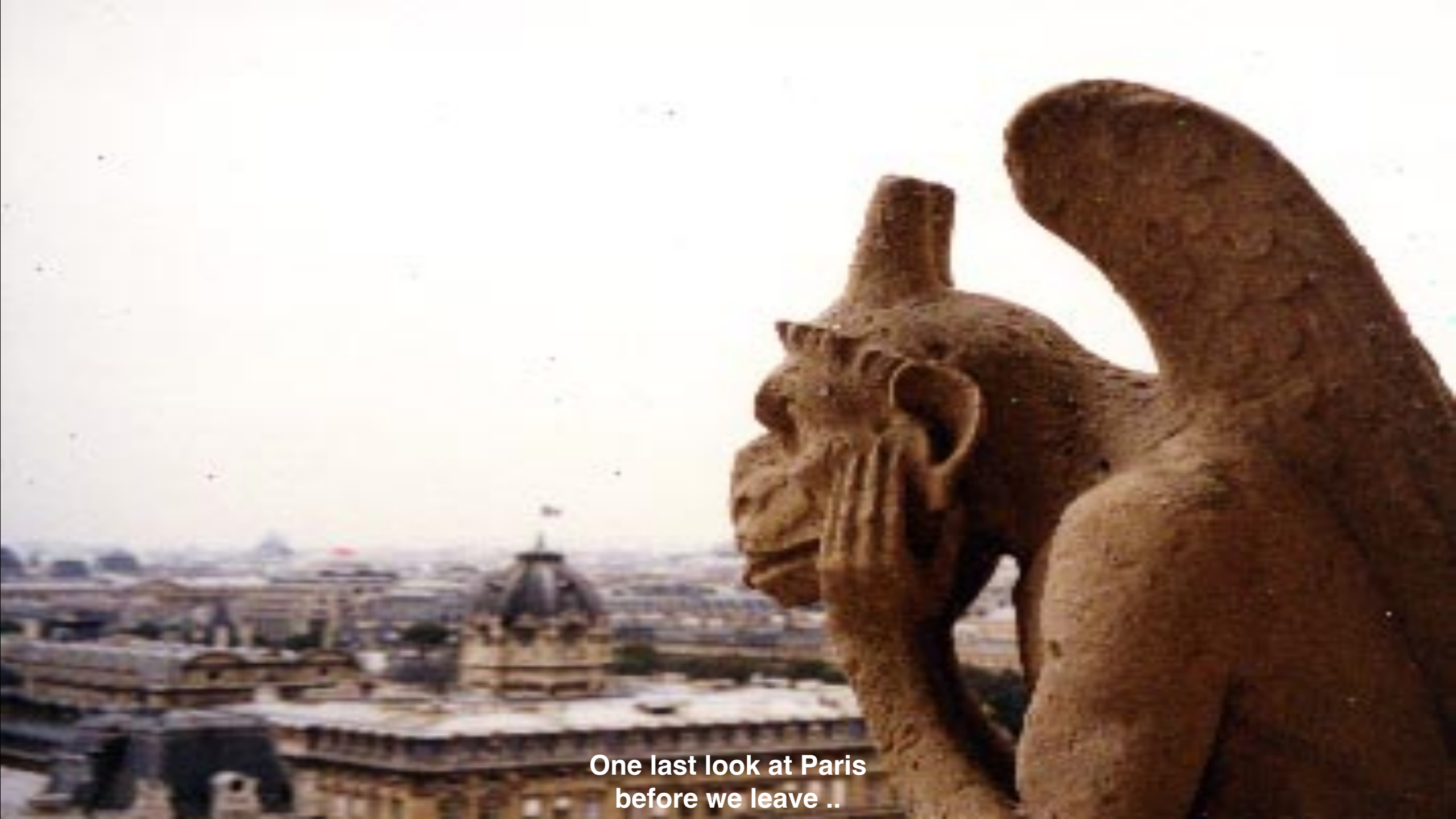
MEDOC #4 Participants

MEDOC #4 Participants Part 1

MEDOC #4 Participants Part 2



Celebrating Dave's birthday with Frédéric Baudin,
Jean-Pierre Delaboudinière (apparently still sober),
and Dave Pike (still concentrated on his glass)....


One last look at Paris
before we leave ..

... and even Mona contemplates
the next MEDOC Campaign
with an encouraging smile..