



Research at
UPMC

UPMC
PARIS UNIVERSITAS
www.upmc.fr

UPMC, a research intensive university in Science and Medicine

- ▶ 8% of the French science production
- ▶ 6 000 publications per year
- ▶ 1st French university, 7th European

UPMC: Université Pierre et Marie Curie

- ▶ Strong links with Ecole Normale Supérieure (ENS), Paris Observatory, Curie Institute, ESPCI...
- ▶ A privileged partner to national research institutions:

116 research units [Labs]

- **77** with CNRS [all fields]
 - **28** with INSERM [medical research]
 - **5** with IRD [development]
 - **3** with INRA [agriculture]
 - **4** units et **9** groups UPMC
- A research budget of 250 million euro



Research is organized in 4 «poles»

To enhance exchange and collaborations and interdisciplinary research

Pole 1
Modeling
And engineering

Pole 2
Energy Mater
Universe

Pole 3
Live earth
environment

Pole 4
Life and health

Pole 1 Modeling and Engineering

- ▶ Mathematics: fundamental, applied and finance
- ▶ Statistics
- ▶ Computer science
- ▶ Mechanic
- ▶ Robotics and Electronic
- ▶ Engineering and bio or medical imaging

- Jussieu Chevaleret Quai
Kennedy Saint Cyr l'Ecole Orsay
Cordeliers Pitié-Salpêtrière

17 research units

4 Doctoral schools

970 PhD students

UFR 919 Engineering

UFR 929 Mathematics

860 researchers and professors, lecturers...

170 technical and administrative staff

Pole 2 Energy Mater Universe

- ▶ Astronomy, Astrophysics, Cosmology
- ▶ Nano-sciences and new materials
- ▶ Mater under extremes of pressure and temperature
- ▶ Energy
- ▶ Plasma and non-linear physics, microfluidics
- ▶ Quantum physics
- ▶ Physical Chemistry
- ▶ Chemistry for sustainable development and new molecules for life sciences and medicine
- ▶ New analytical strategies and new instrumentations

-
- Jussieu ENS, X, IAP, Collège de France, Observatoire Ivry Boucicaut Thiais, ESPCI, ENSCP, SOLEIL

33 research unites

7 doctoral schools

700 Ph.D. students

UFR 925 Physics

UFR 926 Chemistry

1050 researchers and professors, lecturers,...

590 technical and administrative staff

Pole 3 Living earth environment

- Atmosphere, meteorology
- Terrestrial and marine environment, hydrology
- ▶ Earth sciences and tectonic
- Paleo-biodiversity et paleo-environment
- Ecology, biodiversity, biology of organisms
- ▶ and ecosystems
- Evolution, adaptation, taxonomy, phylogenetics...

- Jussieu ENS, X, Museum Grignon
Roscoff Banyuls Villefranche-sur-
mer

21 research units

3 doctoral schools

520 Ph.D. students

UFR 918 Earth environment biodiversity

840 researchers and professors, lecturers, ... **740**

technical and administrative staff

Pôle 4 Vie et santé

- neurosciences, déficits sensoriels
- development, longevity
- integrative biology (physio-pathology, nutrition, metabolism, endocrinology, nephrology)
- hart-muscle-vessels
- Immuno-infectious pathologies, AIDS, southern countries
- Public health
- Engineering and medical imaging (with pole 1)

-
- Jussieu, Ivry Cordeliers
 - Pitie-Salpêtrière Saint-Antoine
Tenon Trousseau Quinze-Vingts
Institut Pasteur Institut Curie
Collège de France IBPC Gif

45 research units

6 doctoral schools

820 Ph.D. students

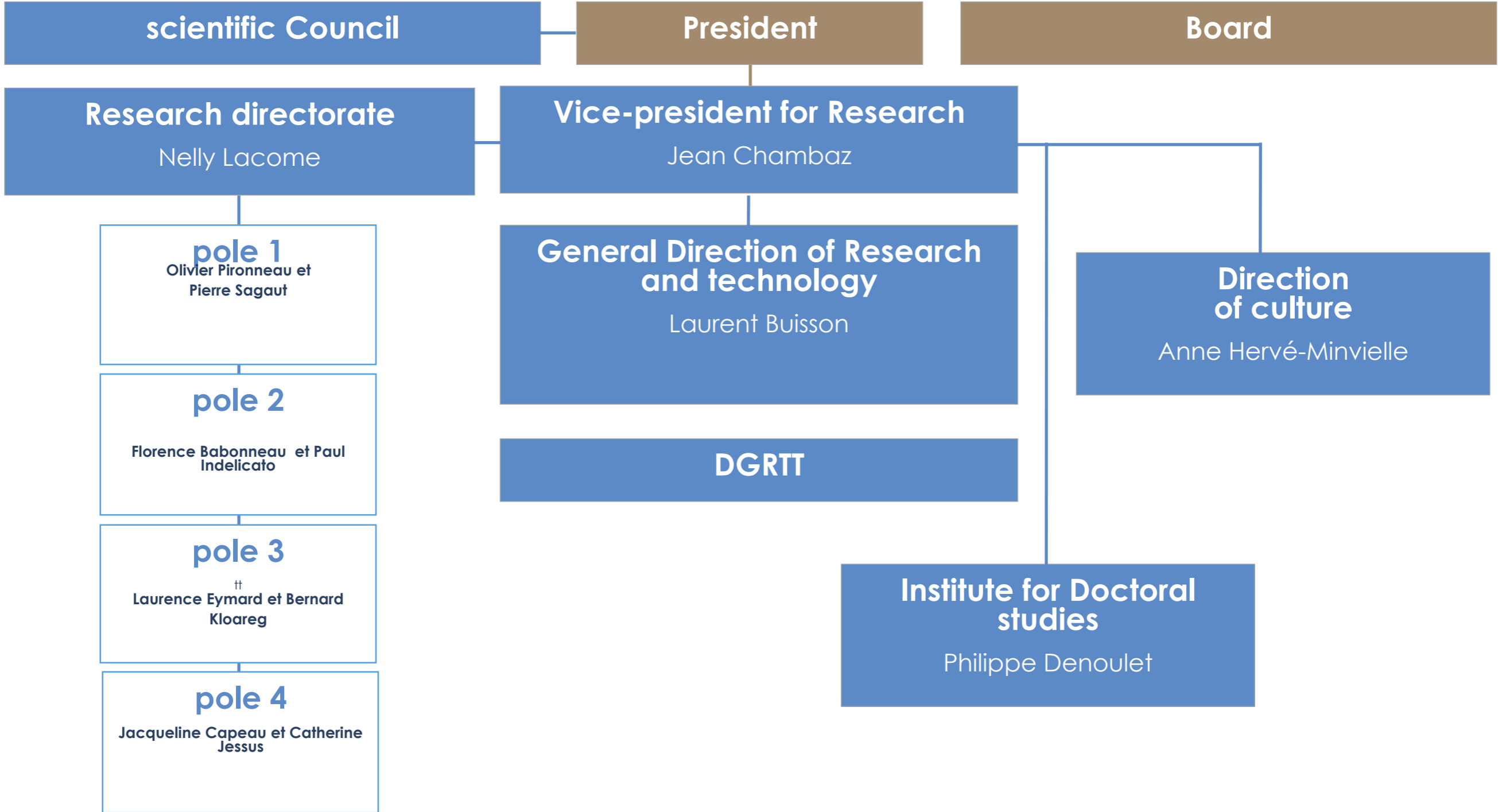
UFR 927 Life sciences

UFR 967 medicine

1150 researchers and professors, lecturers, ... **700**

technical and administrative staff

An organization for research



Ph.D. and habilitation



A new structure: **institute for doctoral studies**,

On the Cordeliers campus

All services dedicated to PhD students :

- ▶ Administration, formation and careers
- ▶ Quality control, databases, follow-up on alumni's career

Diffusion of scientific culture art

- UPMC as a place for creation of knowledge and culture:
- Cycles of conferences, exhibitions, debates
- Contribute to improve working conditions and culture of students and staff
- Spectacles, concerts, exhibitions,
- Valorization of the scientific and medical heritage and history of UPMC



Physics Highlights

A privileged partner of the Synchrotron radiation facility SOLEIL:

- UPMC researchers are responsible of several beam lines
- A UPMC high-pressure lab on site
 - ▶ Institut de Crystallographie et de Physique de la Matière Condensée (IMPIC)
 - ▶ Physico-chemistry (Mater and radiation) laboratory (LCP-MR)
 - ▶ Laboratoire de Dynamique, Interactions et Réactivité
 - ▶ Institut des Nano-sciences de Paris (INSP)
 - ▶ Laboratoire de Réactivité de Surface
 - ▶ Laboratoire de Chimie de la Matière Condensée
 - ▶ Institut Parisien de Chimie Moléculaire

Physics Highlights

Physics Highlights



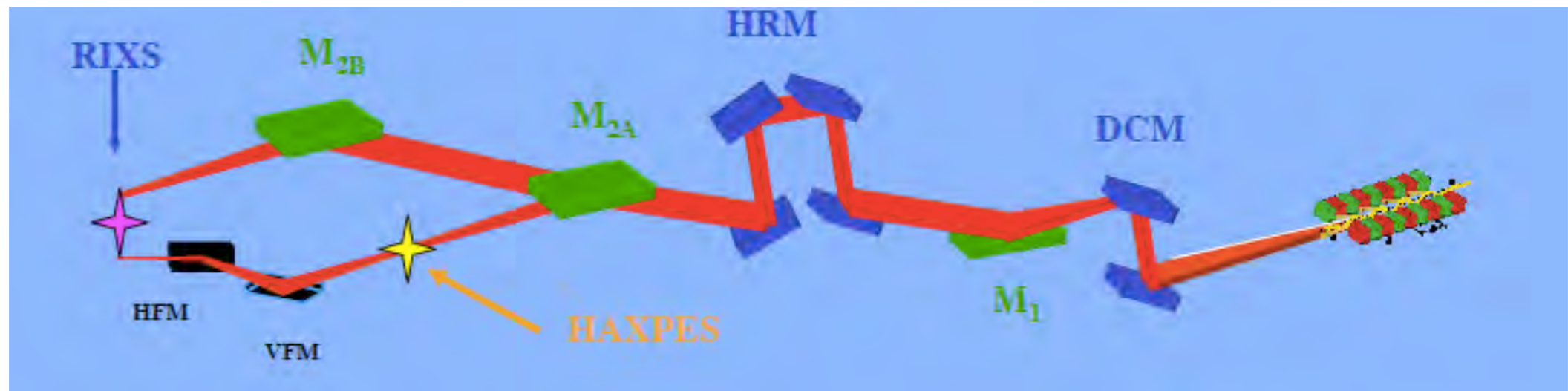
Physics Highlights

Physics Highlights

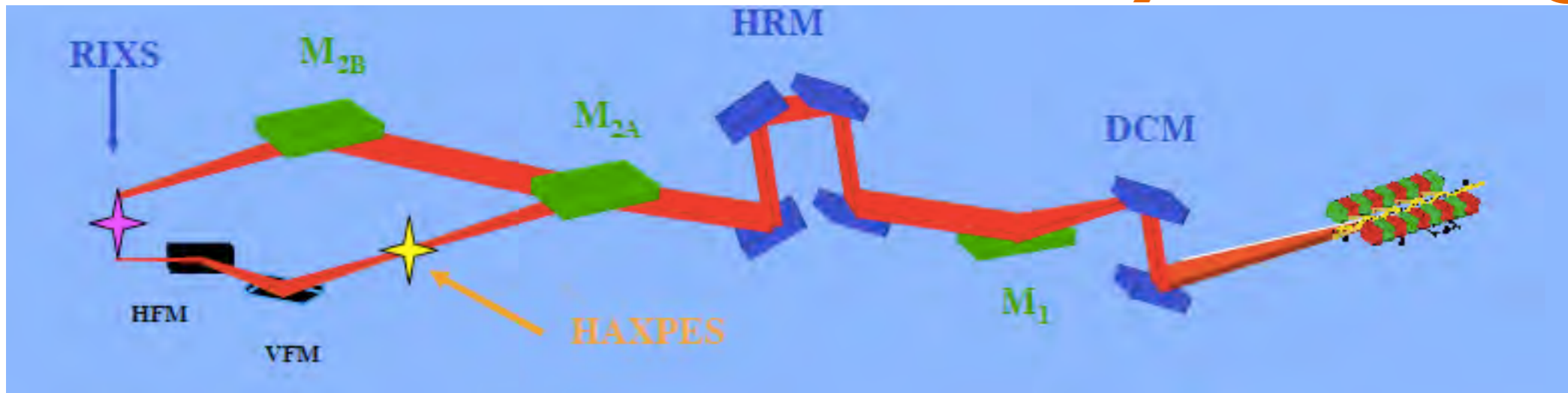


Physics Highlights

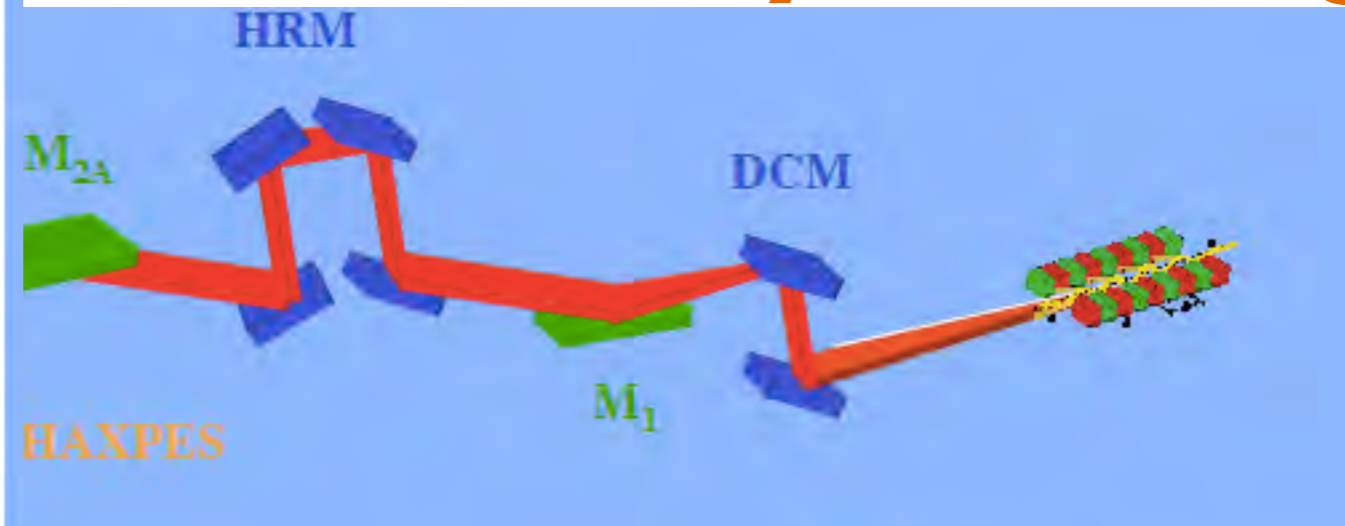
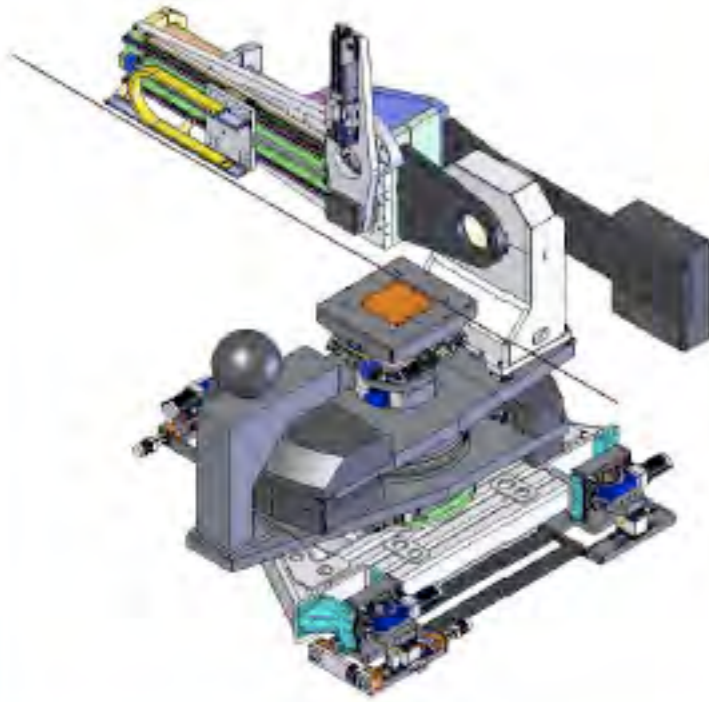
Physics Highlights



Physics Highlights

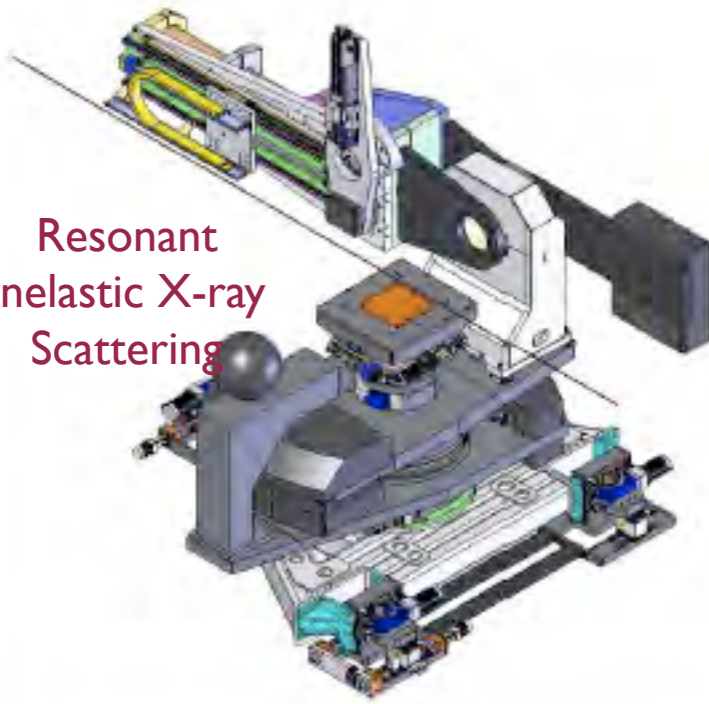


Physics Highlights

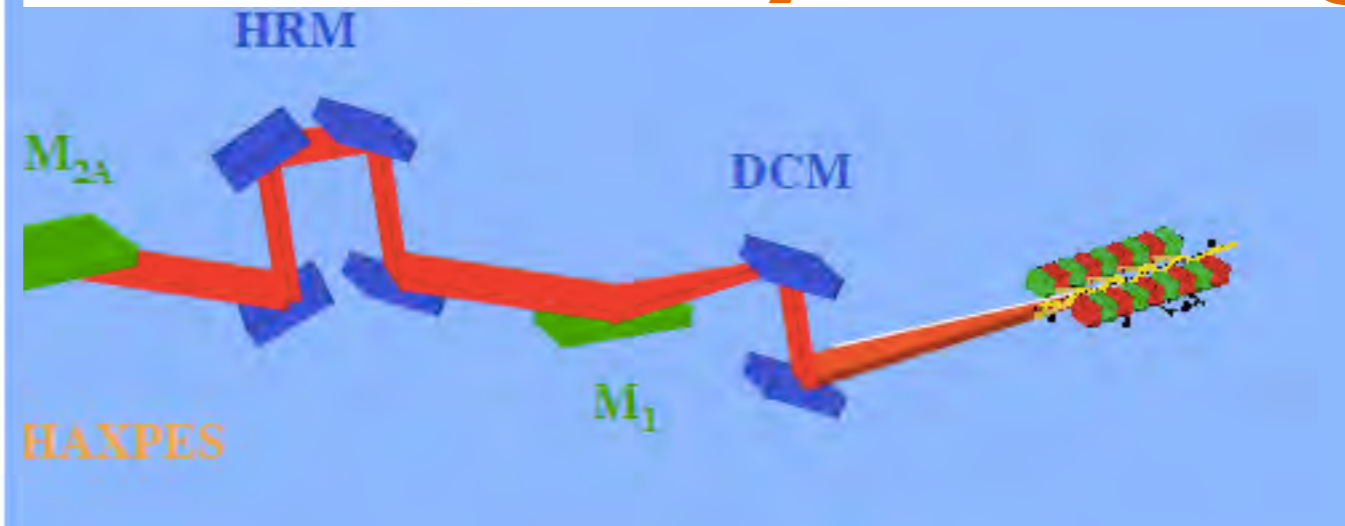
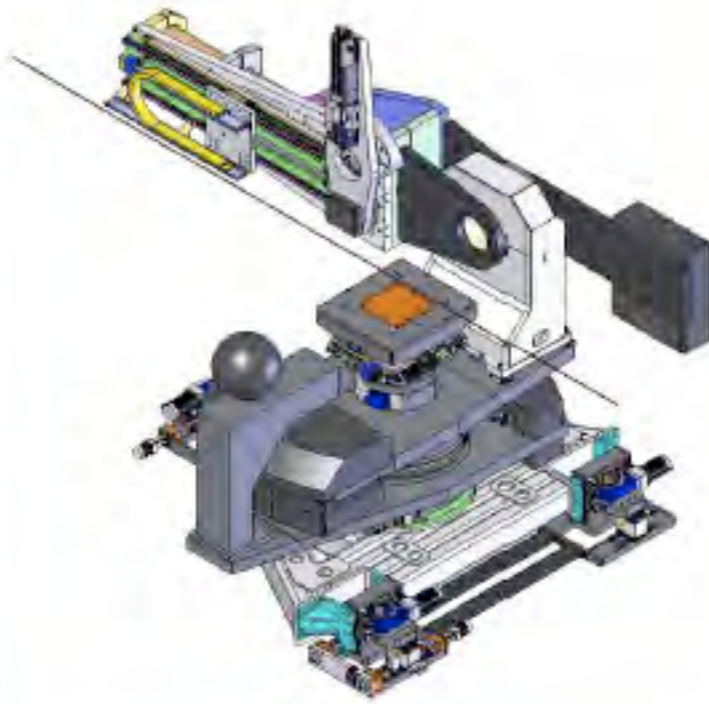


Physics Highlights

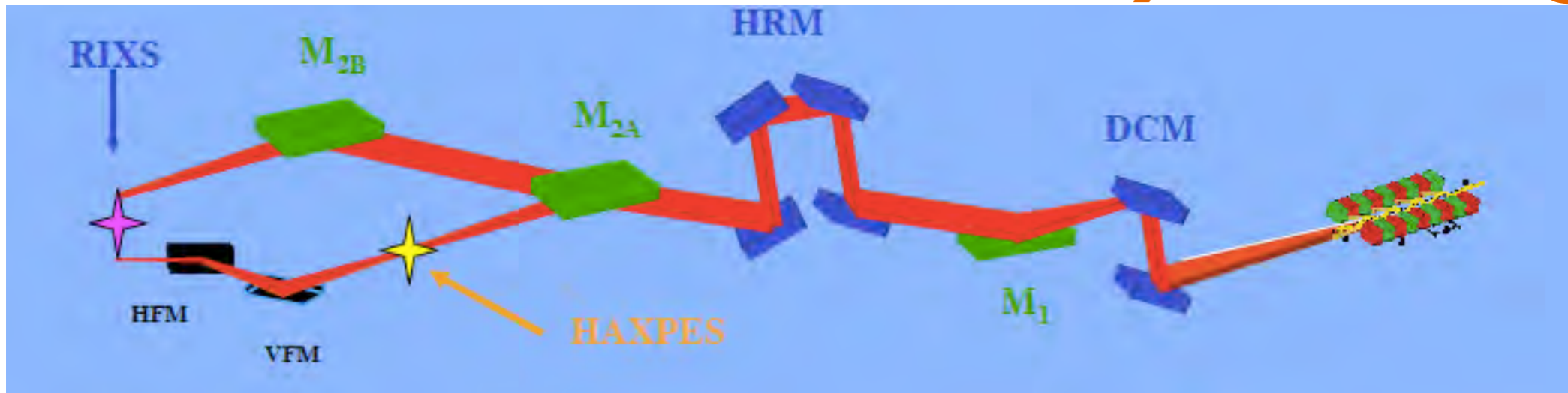
Resonant
Inelastic X-ray
Scattering



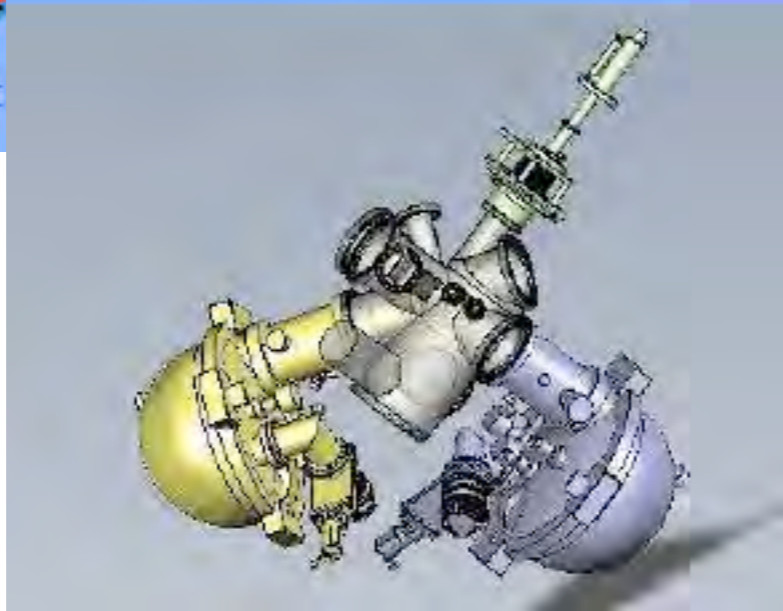
Physics Highlights



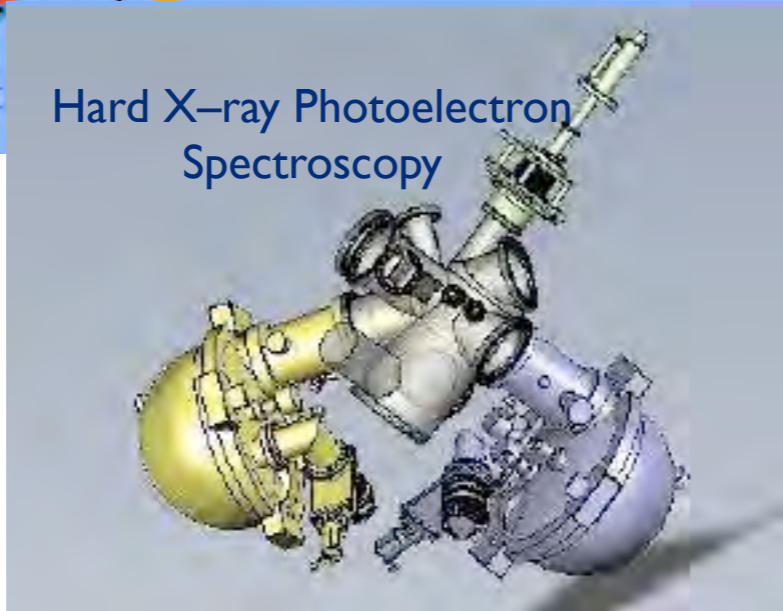
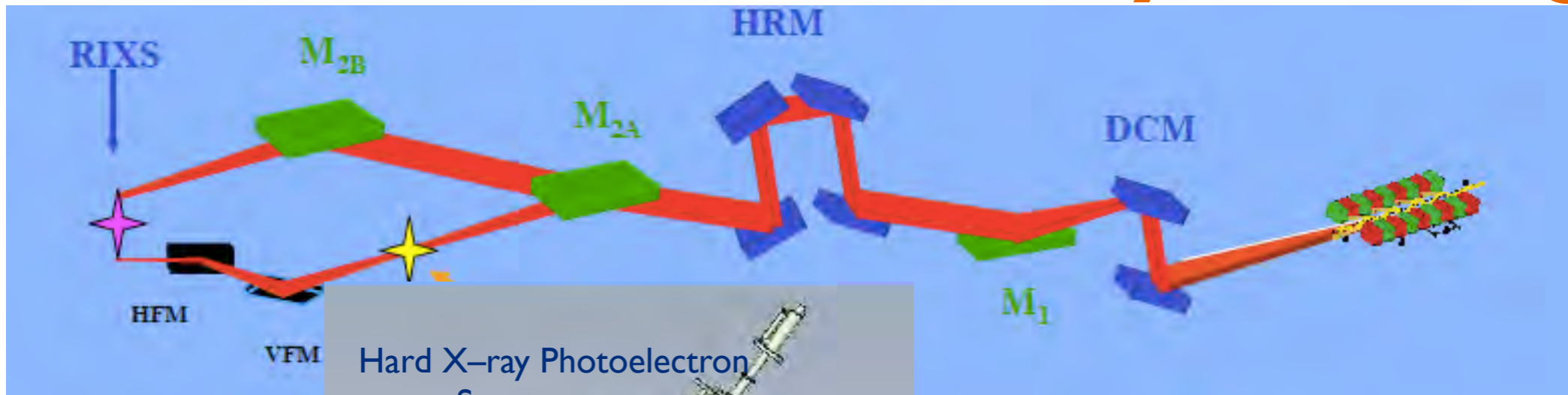
Physics Highlights



Physics Highlights



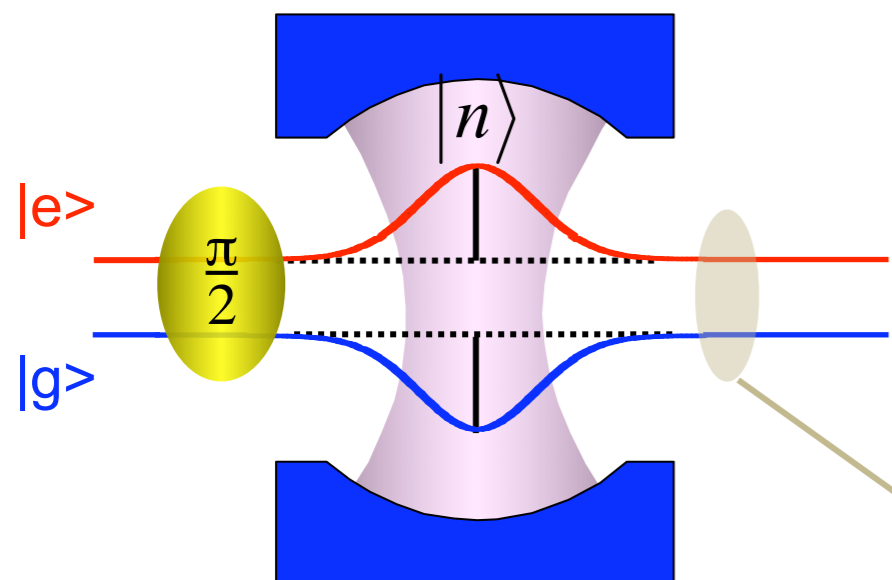
Physics Highlights



Physics Highlights

Controlling the Quantum world

- Laboratoire Kastler Brossel (LKB)
- Laboratoire Pierre Aigrain (LPA)
- Institut des Nanosciences de Paris (INSP)
- SYRTE (Système Référence Temps-Espace)

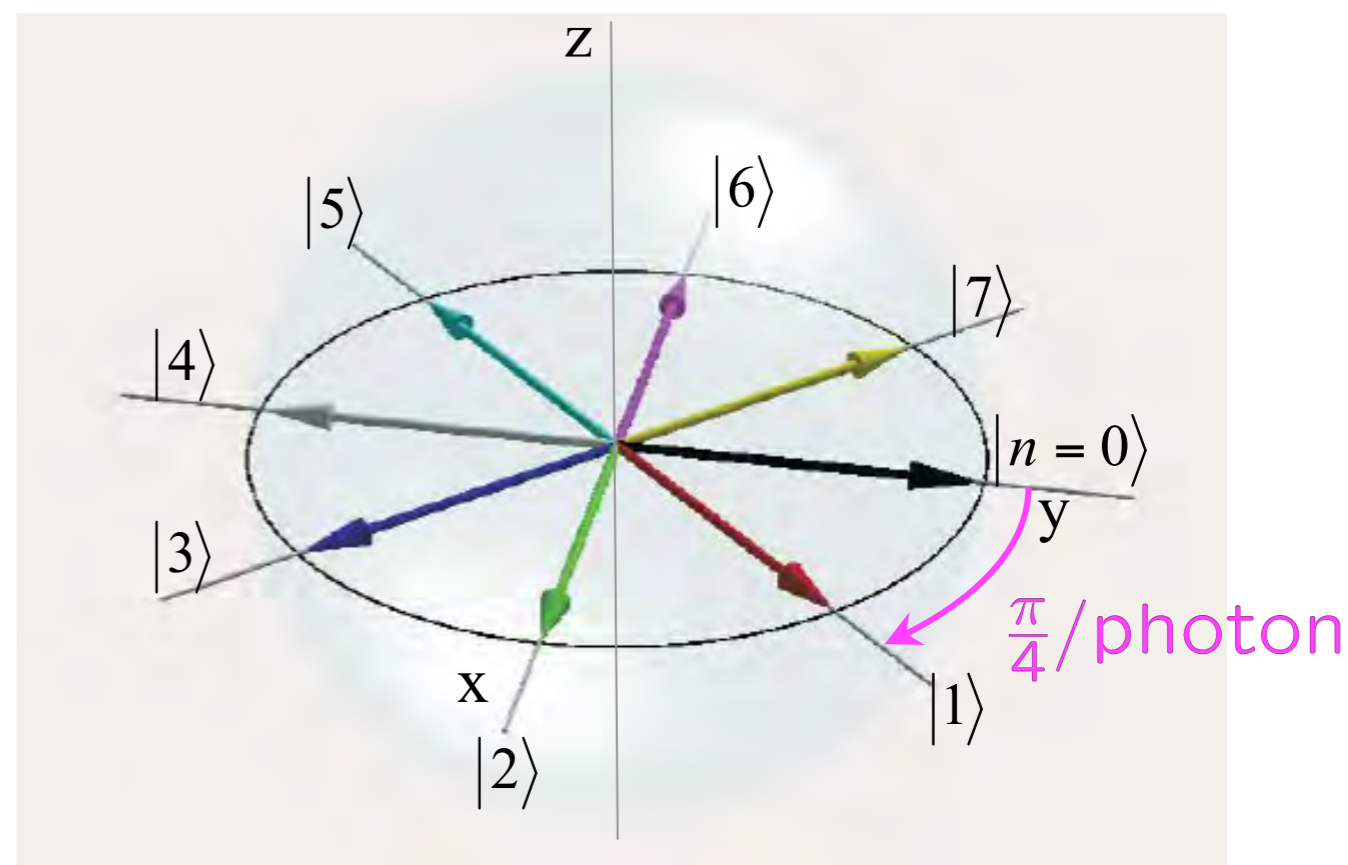


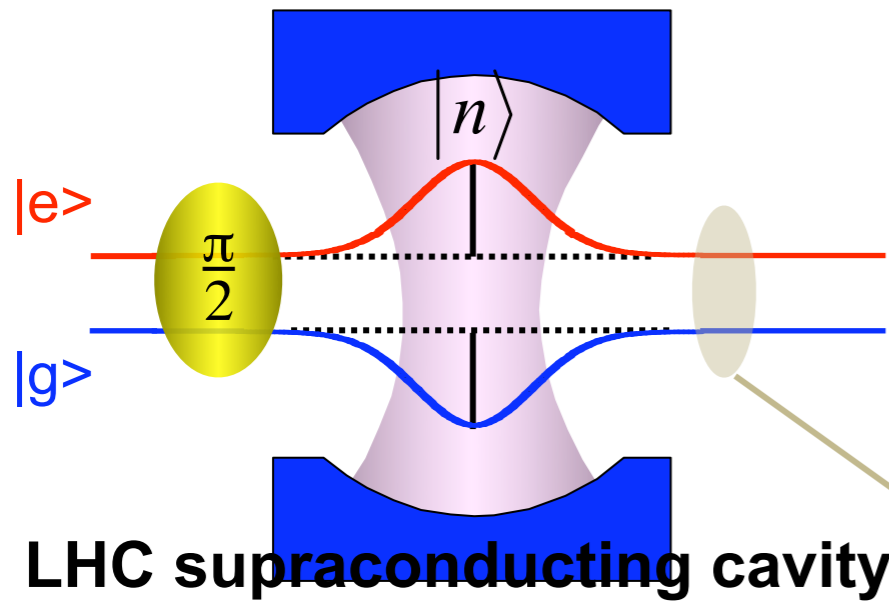
- Microwave photons stored in a high Q superconducting cavity: $T_c = 0.13$ s
- Dispersive interaction with Rydberg atoms used as non-absorbing probes

Single-photon-induced atomic phase-shift

Photon numbers from 0 to 7 correspond to 8 different final positions of the atomic spin

Measuring a sample of ~ 100 atoms amounts to a QND measurement of n



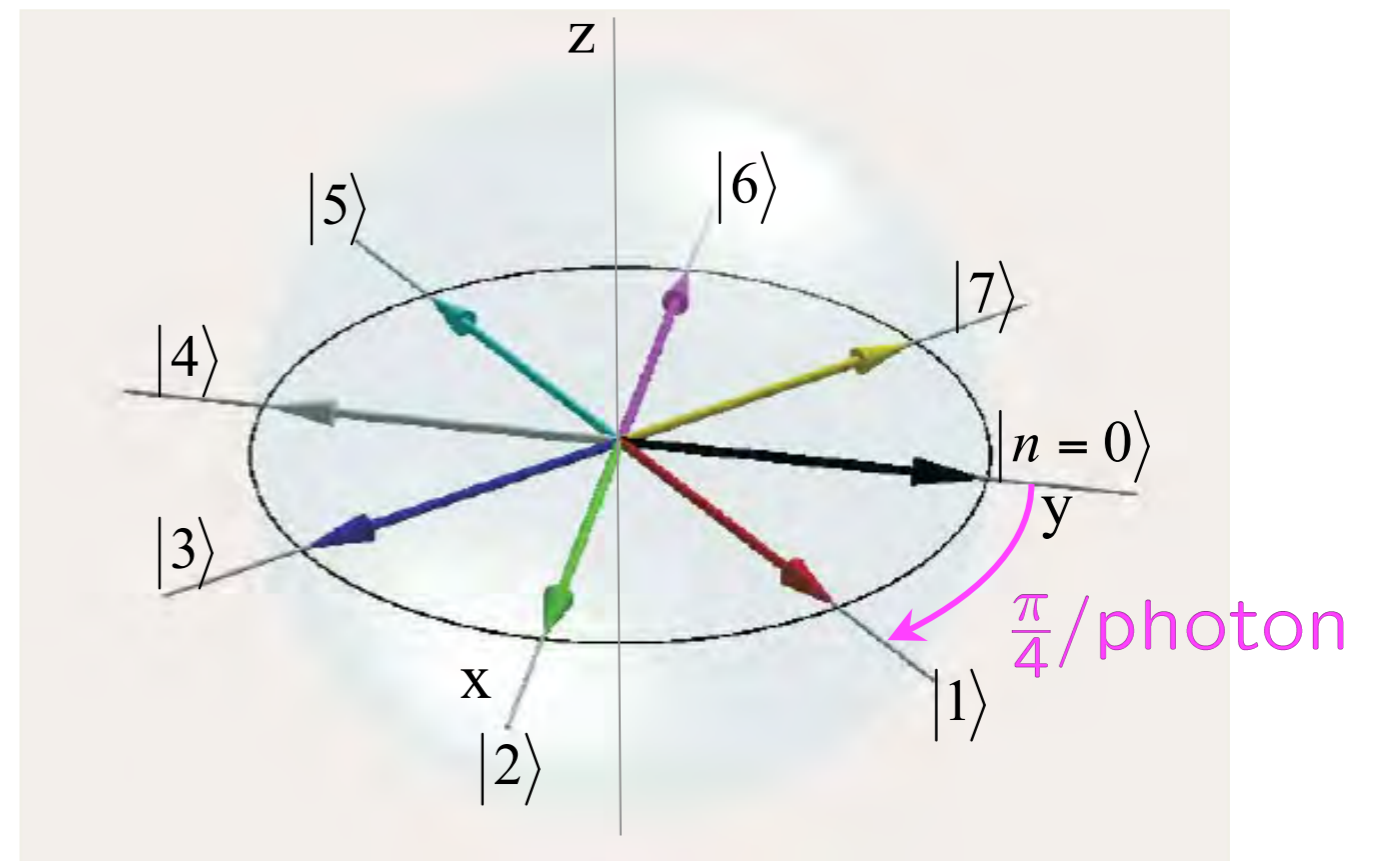


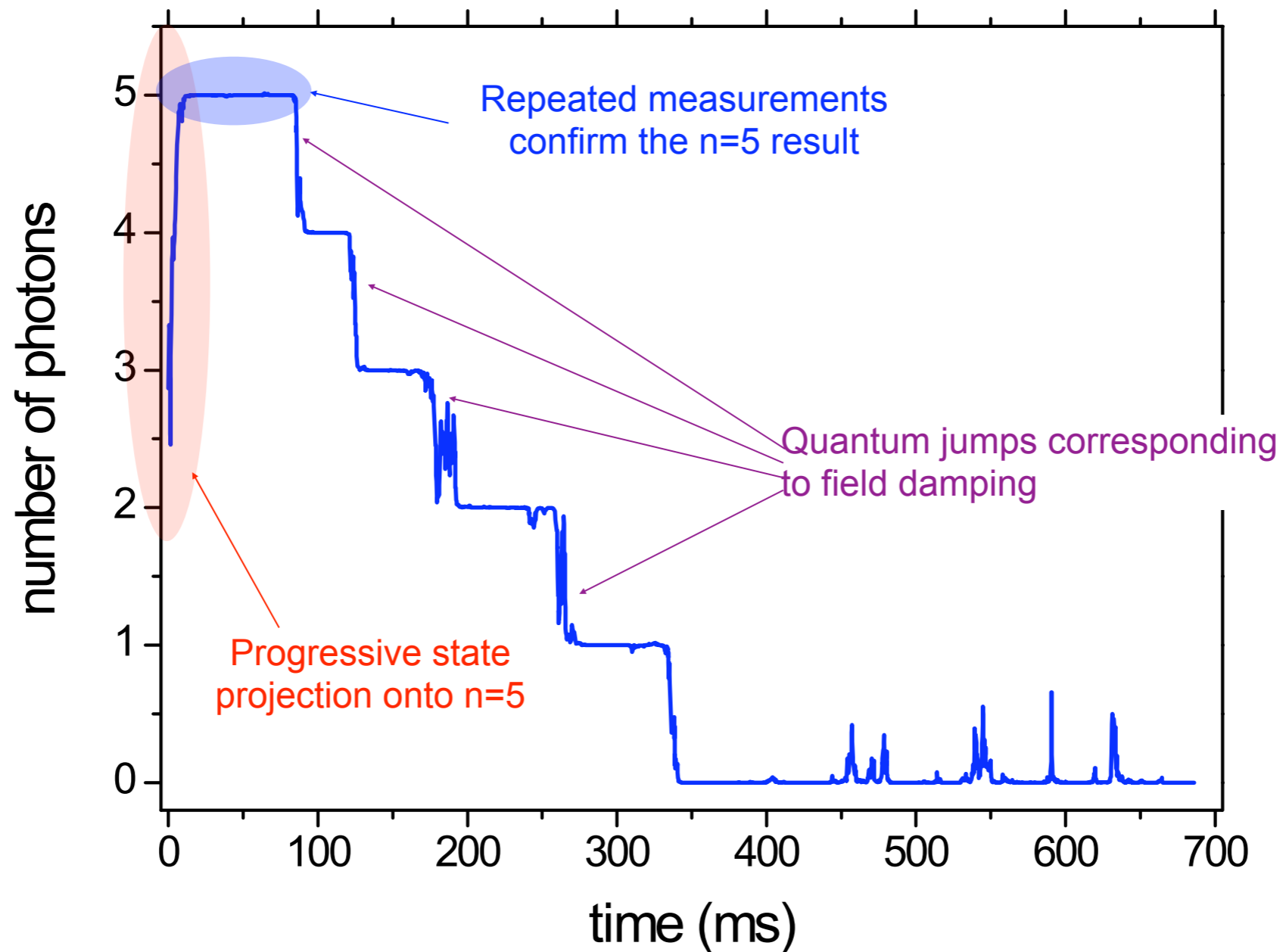
- Microwave photons stored in a high Q superconducting cavity: $T_c = 0.13$ s
- Dispersive interaction with Rydberg atoms used as non-absorbing probes

↳ Single-photon-induced atomic phase-shift

Photon numbers from 0 to 7 correspond to 8 different final positions of the atomic spin

Measuring a sample of ~100 atoms amounts to a QND measurement of n





Exhibits all features of quantum theory of measurement:

State collapse, statistical results, and repeatability

C. Guerlin *et al.*, *Nature* **448**, 889 (2007)

Physics Highlights

PHARAO/ACES

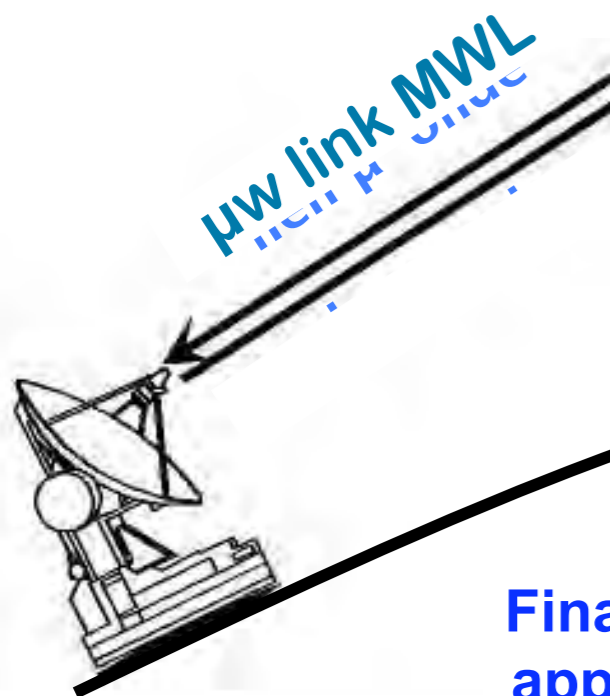
- Laboratoire Kastler Brossel (LKB)
- SYRTE (Système Référence Temps-Espace)

ACES on the International Space Station



Cs atomic clock (FR)

H-maser (CH)



Final step of the project approved by CNES and ESA in december 2008

Planned launch date : end of 2012
Mission duration : 18 months to 3 years

Long term ground clock comparisons @ 10^{-17} on a worldwide basis

Time metrology : contribution to TAI

Search for the variation of fundamental constants

Relativistic geodesy

...

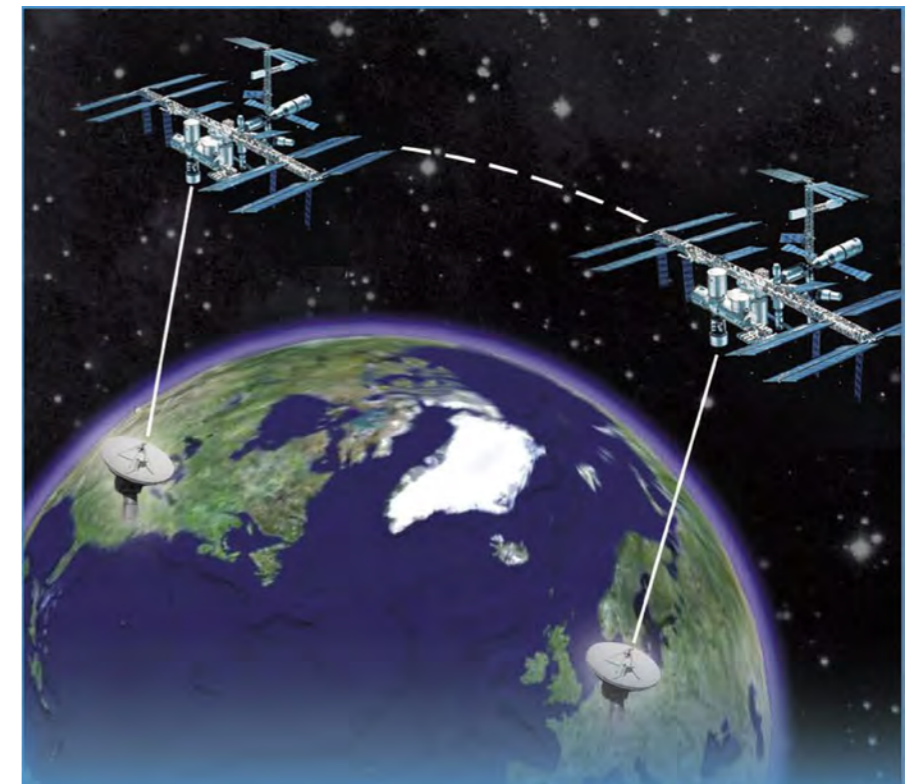
Factor 20 gain over current GPS

Common view



Error < 0.3ps over 300 s

Non common view



Error < 3ps over 3000 s

Clock comparisons

Long term ground clock comparisons @ 10^{-17} on a worldwide basis

Time metrology : contribution to TAI

Search for the variation of fundamental constants

Relativistic geodesy

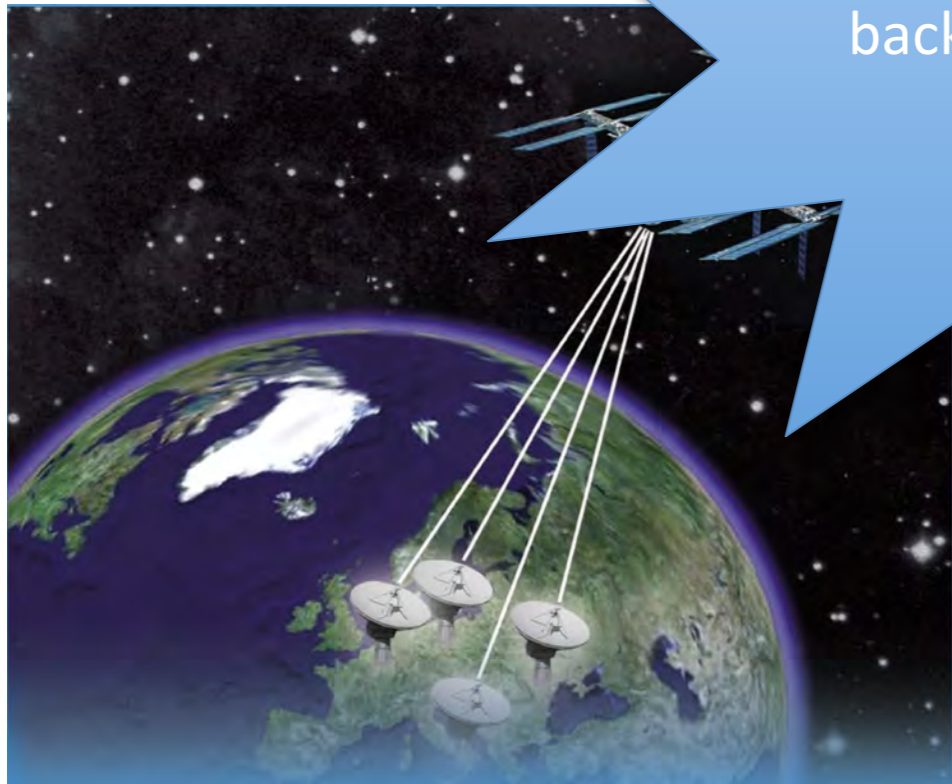
...

for 20 gain over current GPS

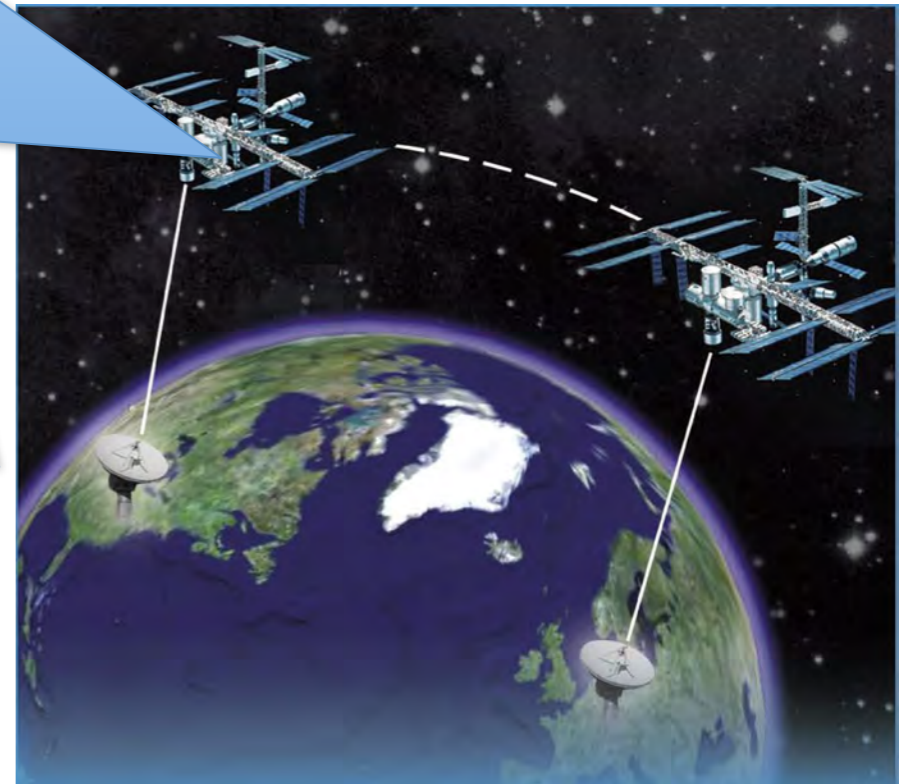
Common view

Combine with local and medium scale comparisons using the RENATER internet backbone and dedicated optical fibers

Non common view



Error < 0.3ps over 300 s



Error < 3ps over 3000 s

Search for the variation of fundamental constants

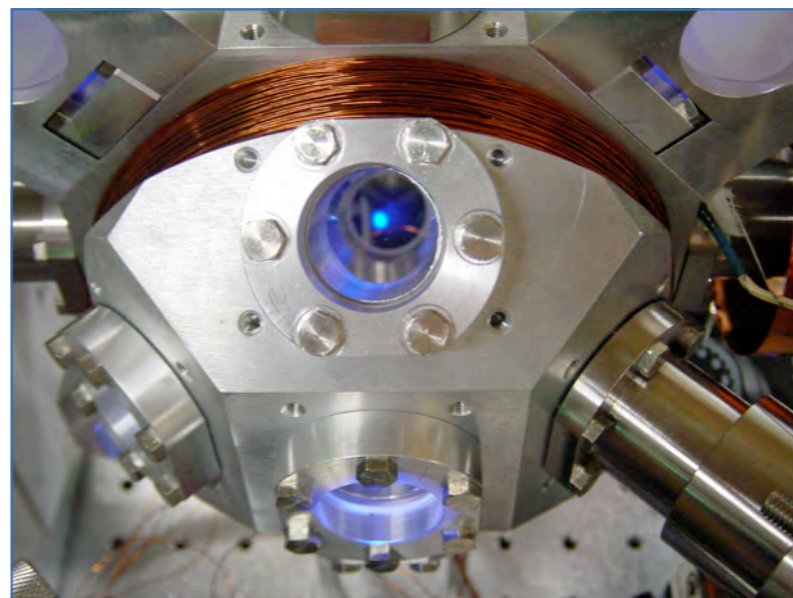
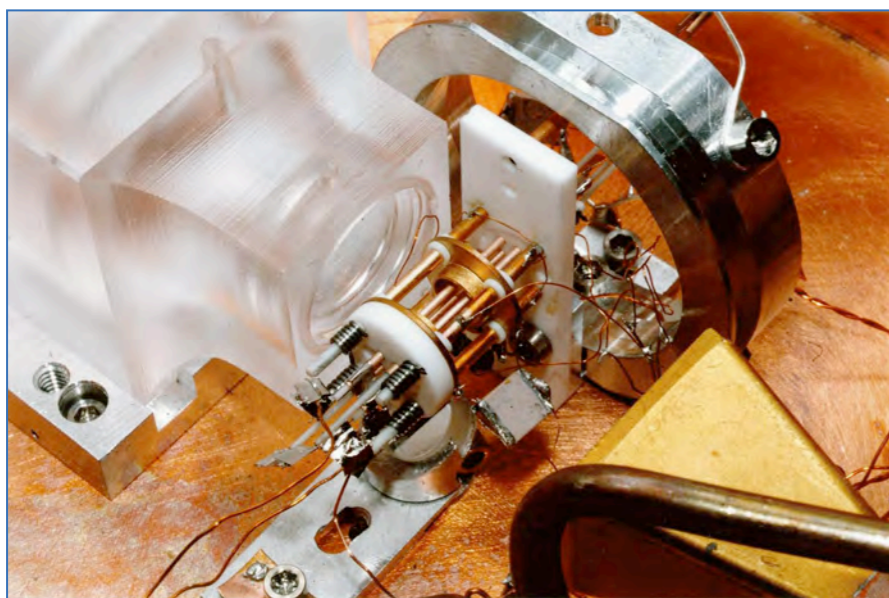
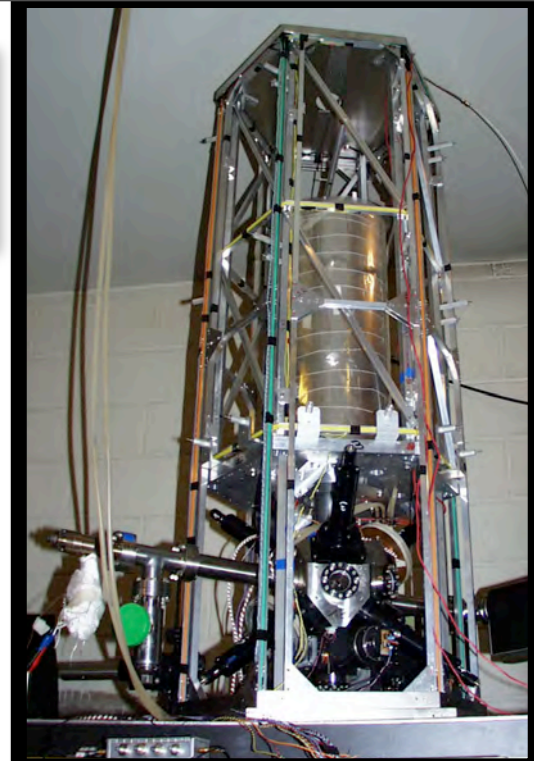
Principle : Compare clocks of different nature as a function of time, for example :

Microwave clock/Microwave clock

Rubidium and Cesium

Microwave/Optical clock

Optical Clock/Optical clock



The ovens and electrodes of the NPL strontium ion end-cap trap.

Principle : Compare clocks of different nature as a function of time, for example :

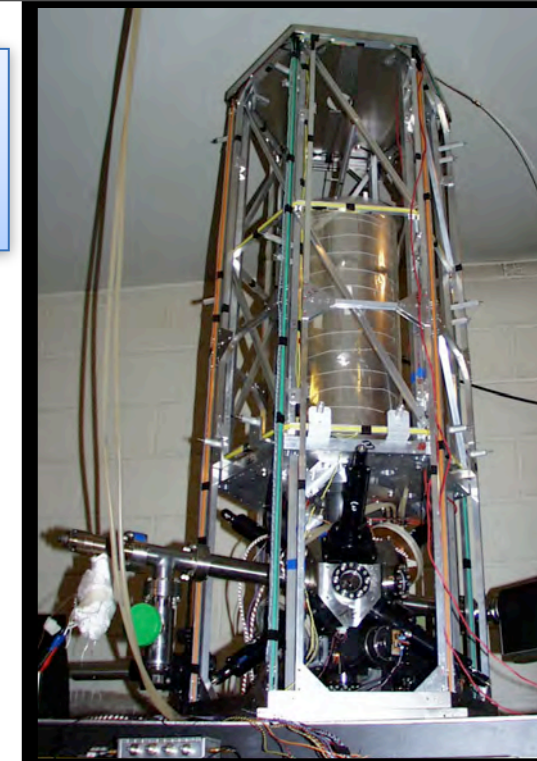
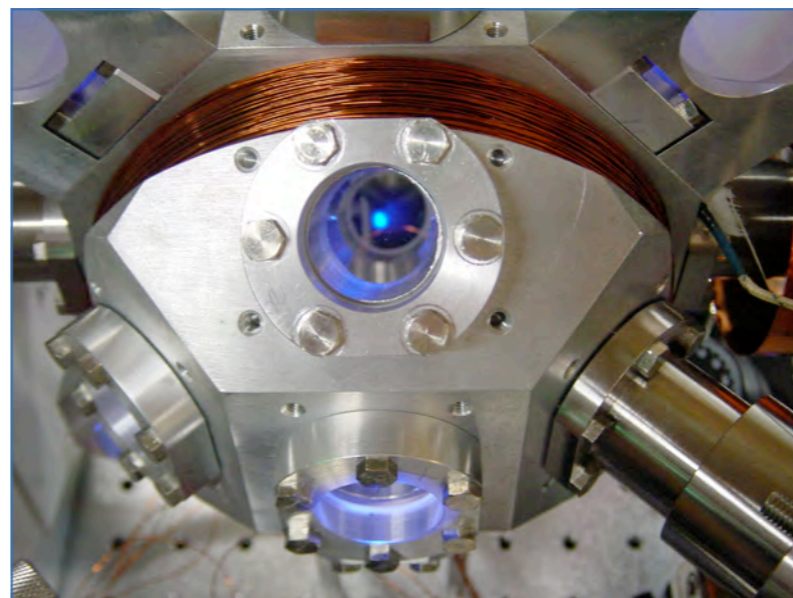
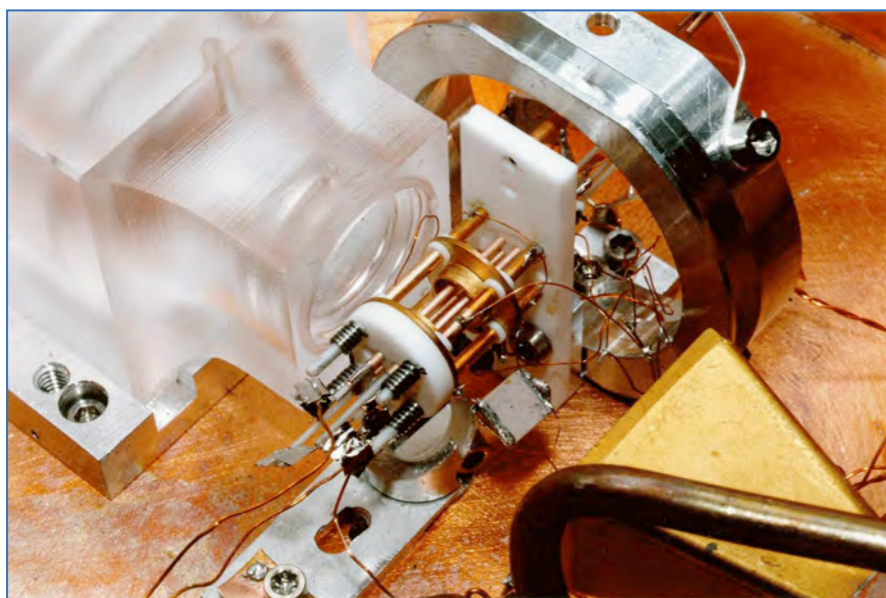
Microwave clock/Microwave clock

Rubidium and Cesium

Microwave/Optical clock

Optical Clock/Optical clock

→ Stringent limits on variations of α_{elm} , α_{strong} , m_e/m_p



The ovens and electrodes of the NPL strontium ion end-cap trap.

Physics Highlights

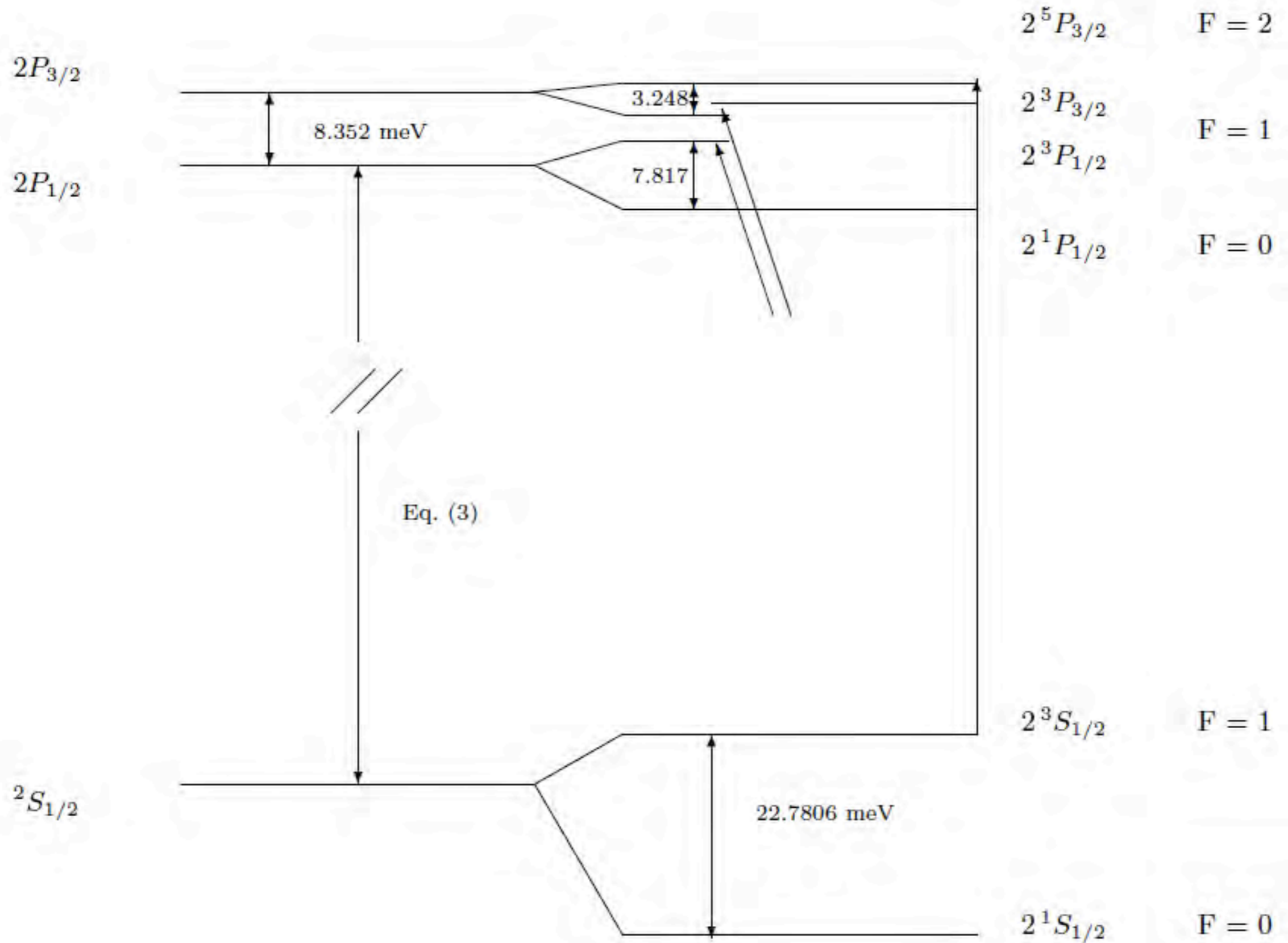
Exotic atoms: proton radius and other particles properties

- **Laboratoire Kastler Brossel (LKB)**

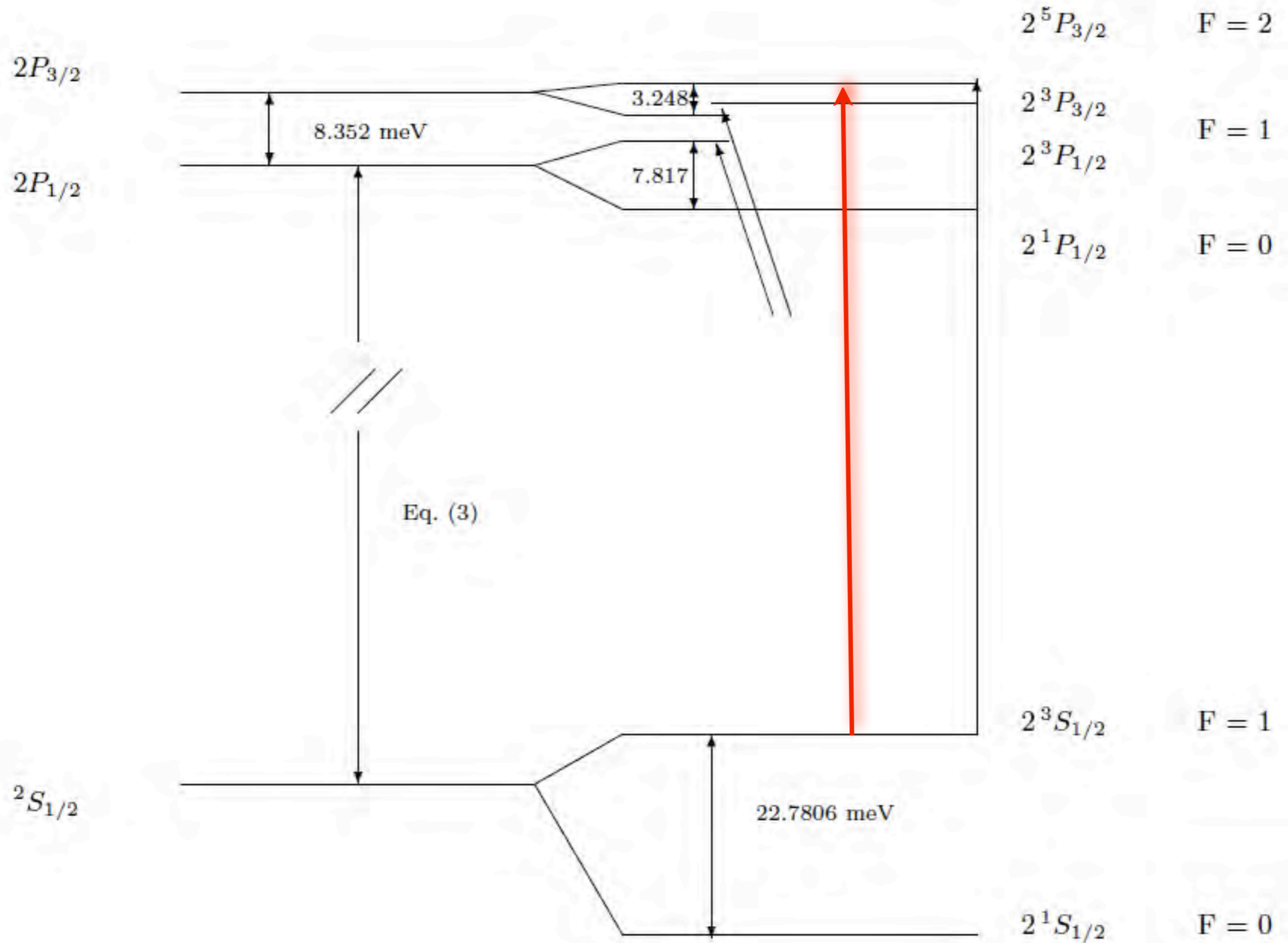
Paul Scherrer Institute, Max Plank Institute for Quantum Optics (Garching), Univ. Coimbra, FZ-Jülich

Physics Highlights

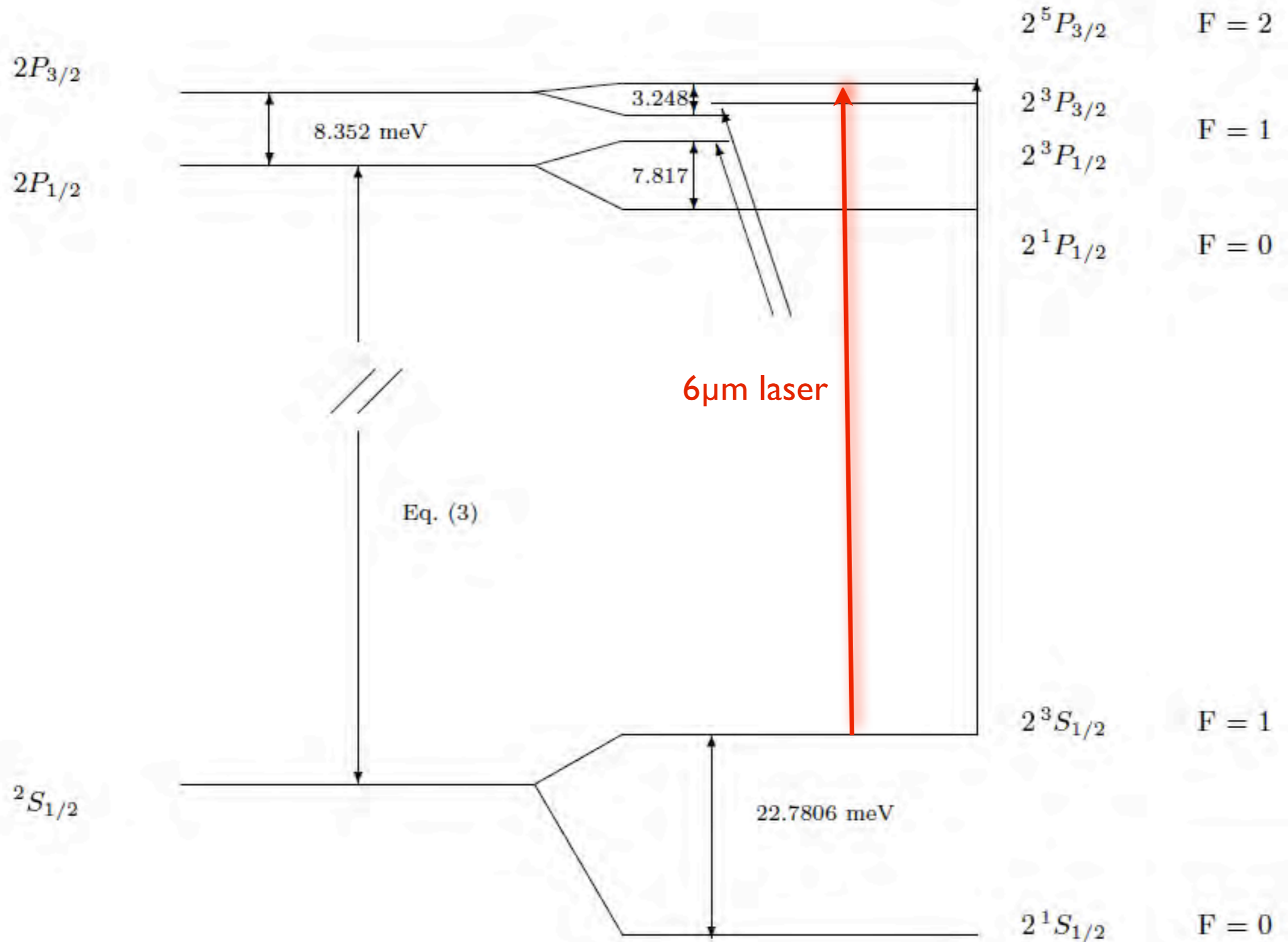
Physics Highlights



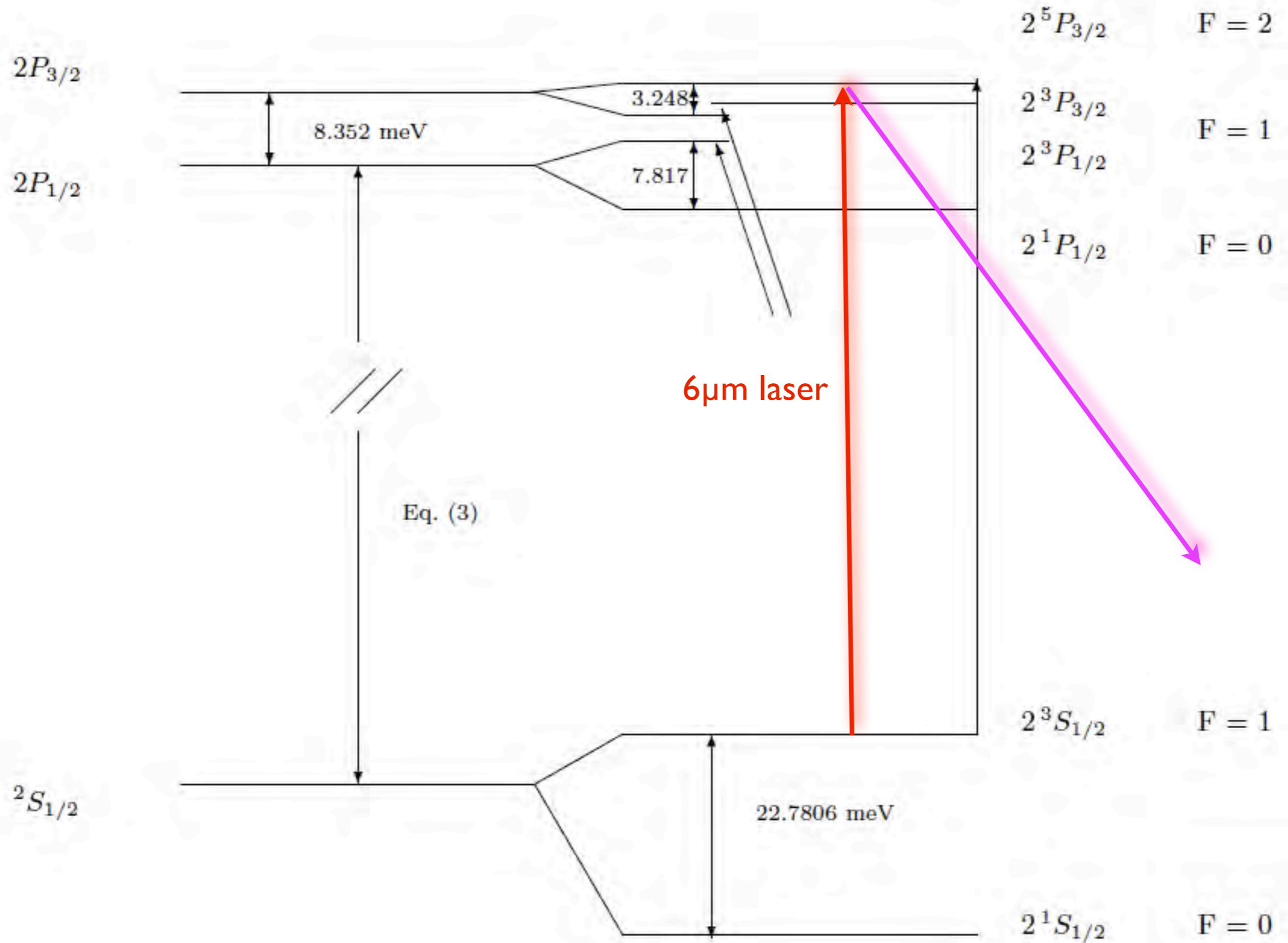
Physics Highlights



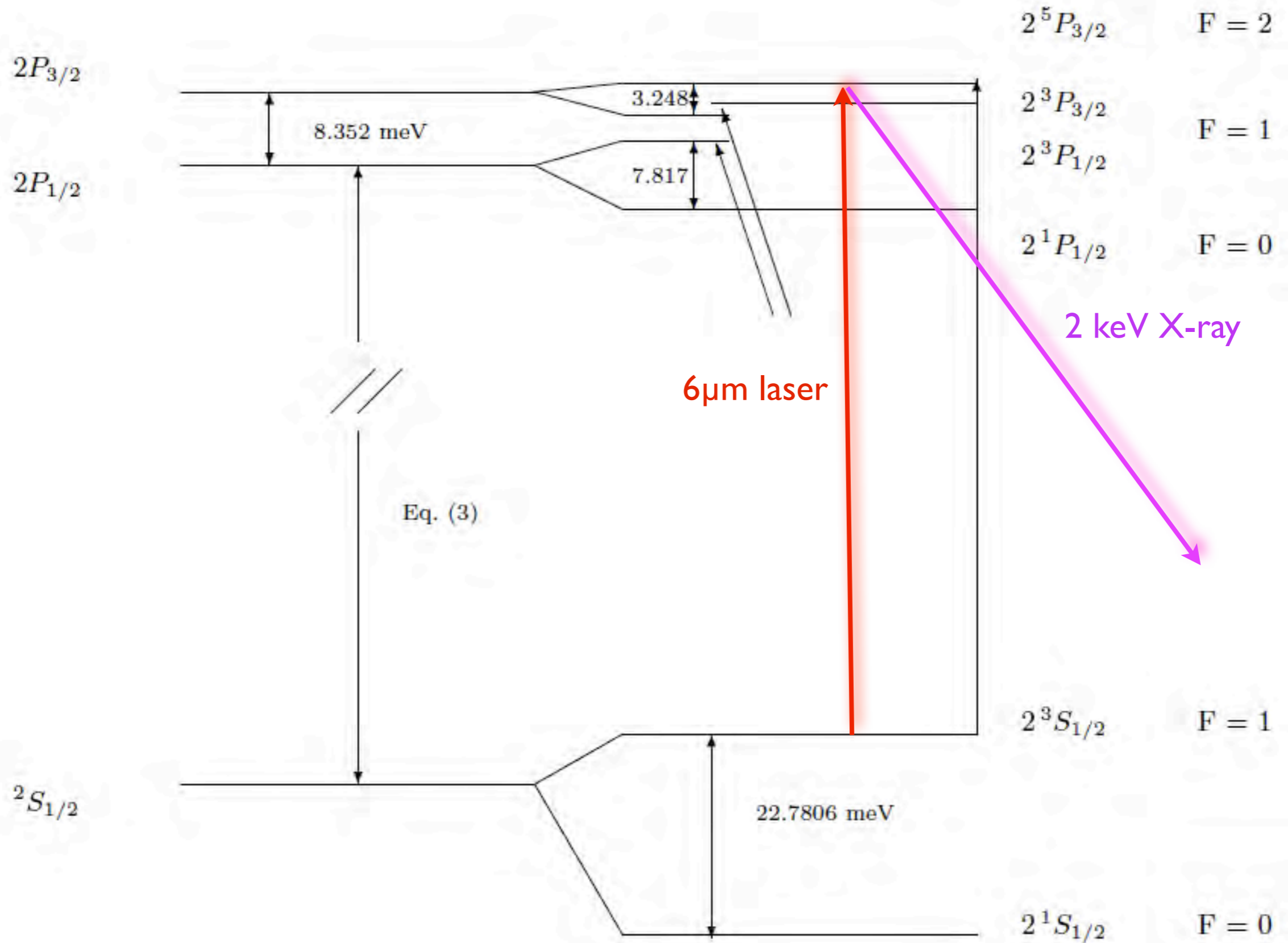
Physics Highlights



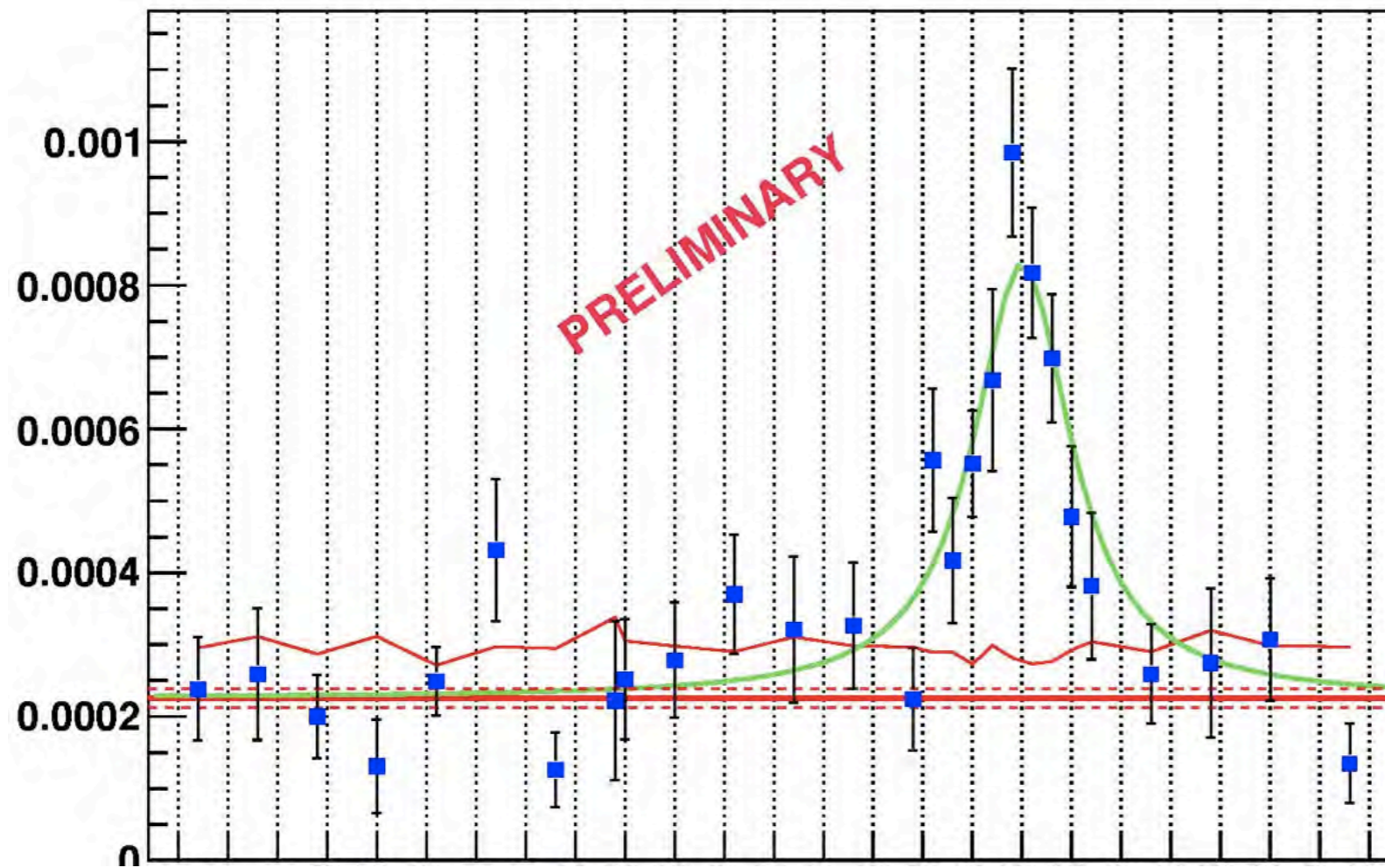
Physics Highlights



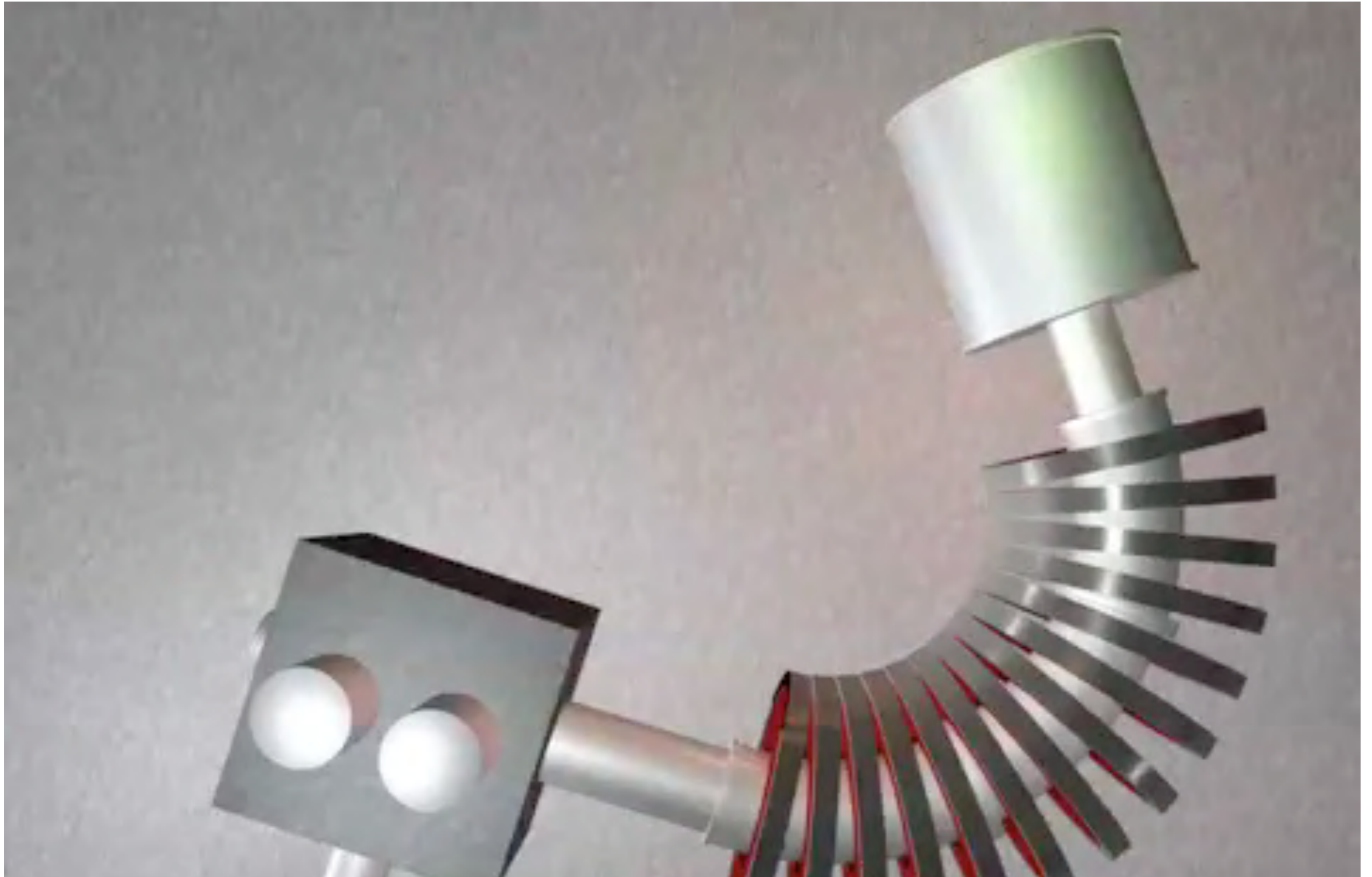
Physics Highlights



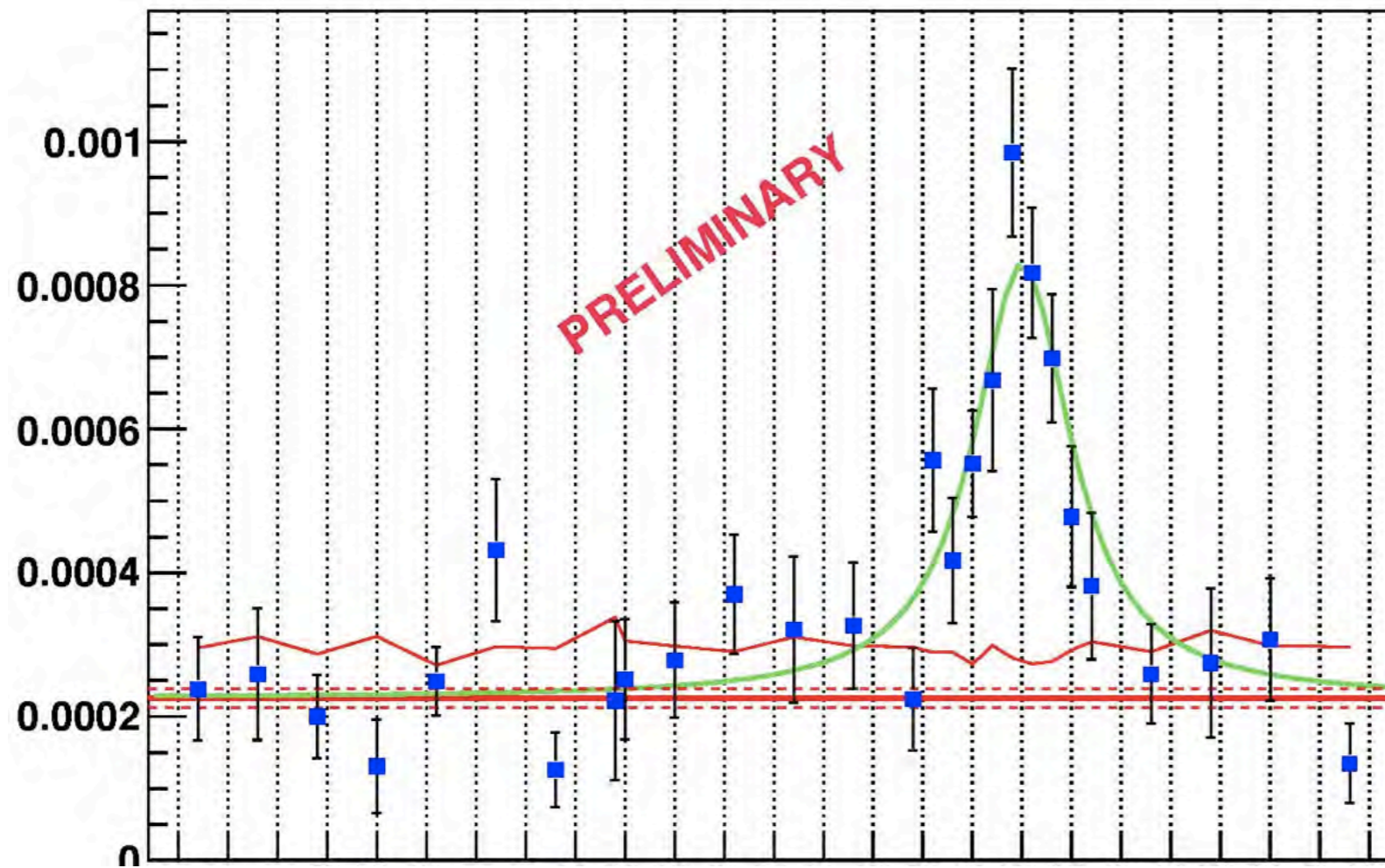
Physics Highlights



Physics Highlights



Physics Highlights



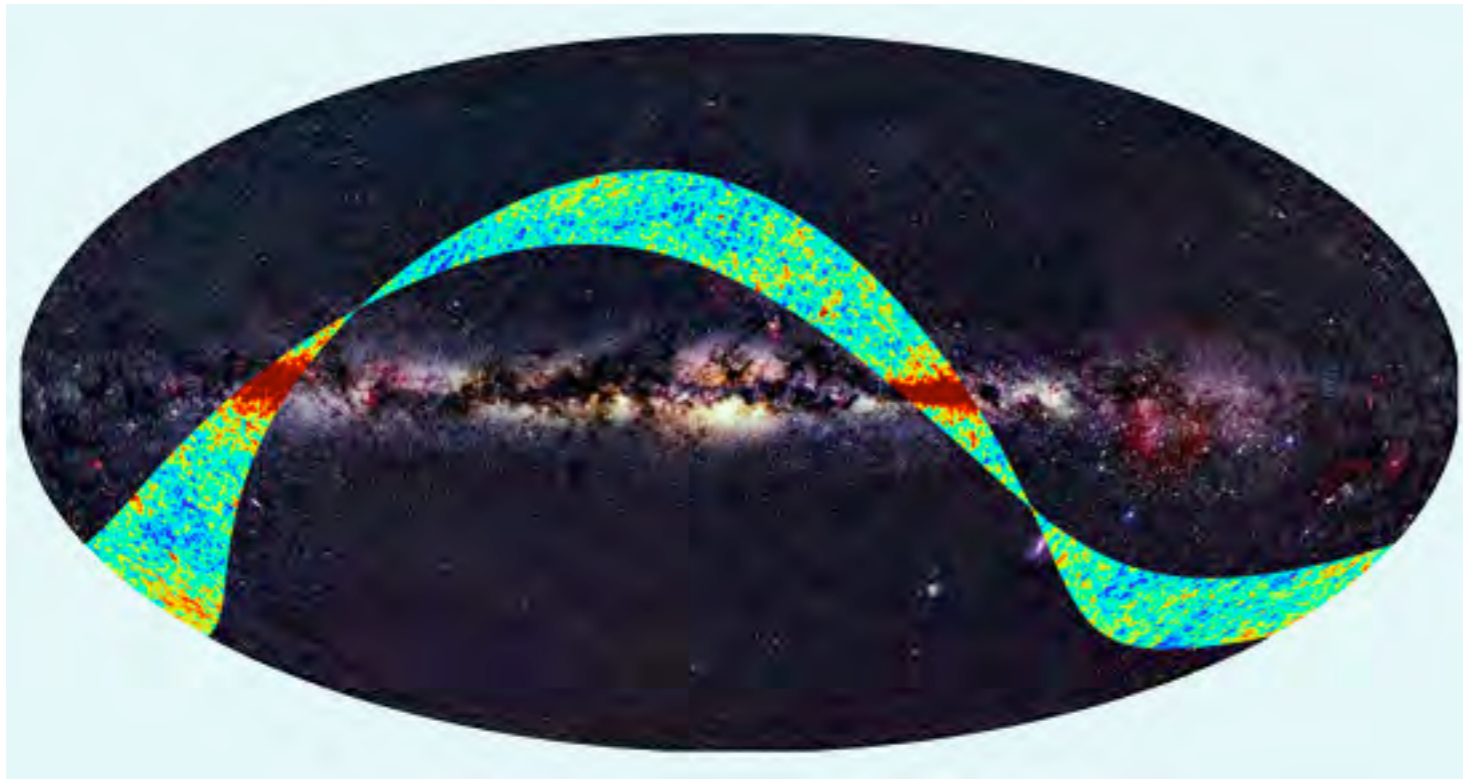
Physics Highlights

Cosmology, astroparticles

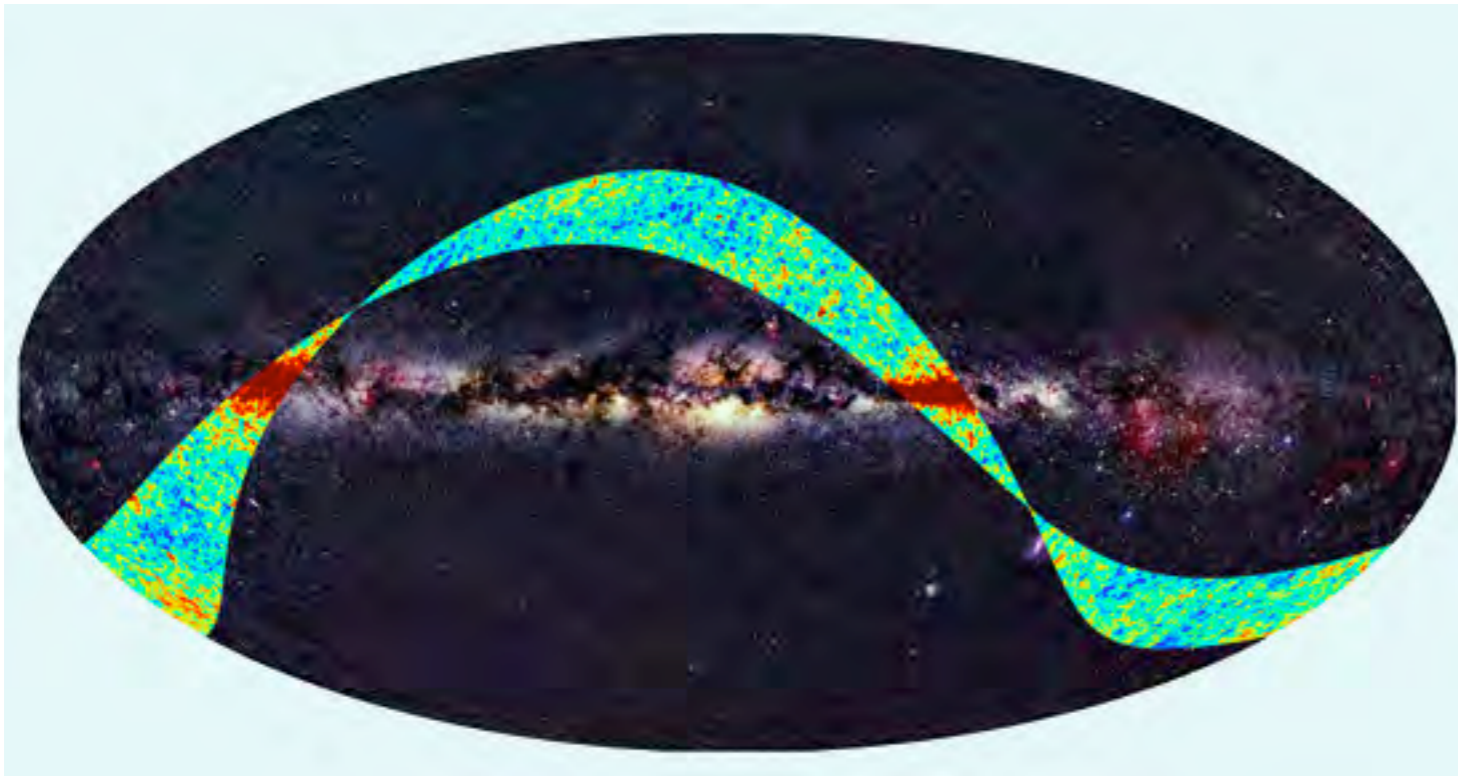
- Institut d'Astrophysique de Paris (IAP)
- Laboratoire de Physique Nucléaire et Hautes Énergies (LPNHE)
- Laboratoire d'Etude du Rayonnement et de la Matière en Astrophysique
 - LERMA
 - Laboratoire de Physique Théorique des Hautes Énergies (LPTHE)
 - Laboratoire de Physique Théorique de l'ENS

Physics Highlights

Physics Highlights

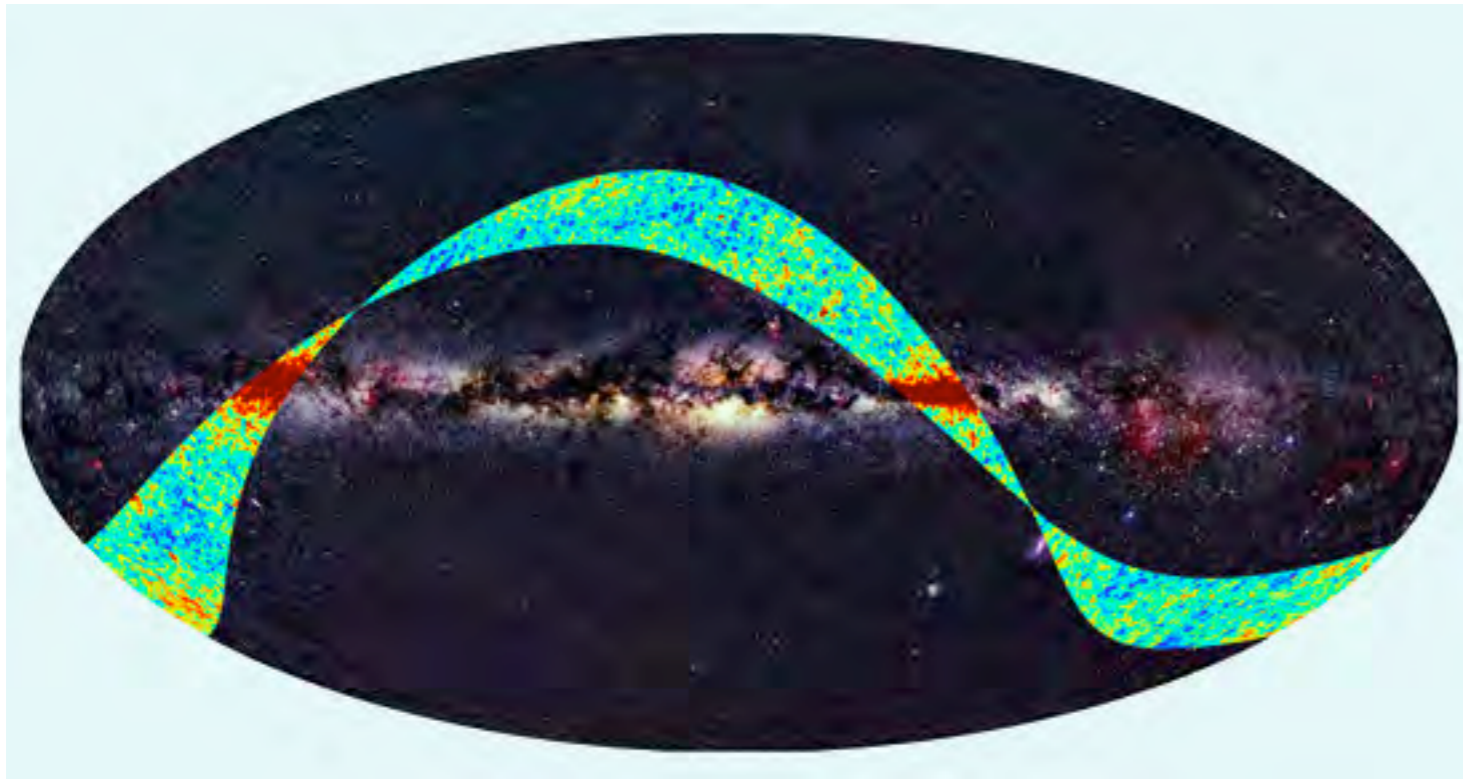


Physics Highlights

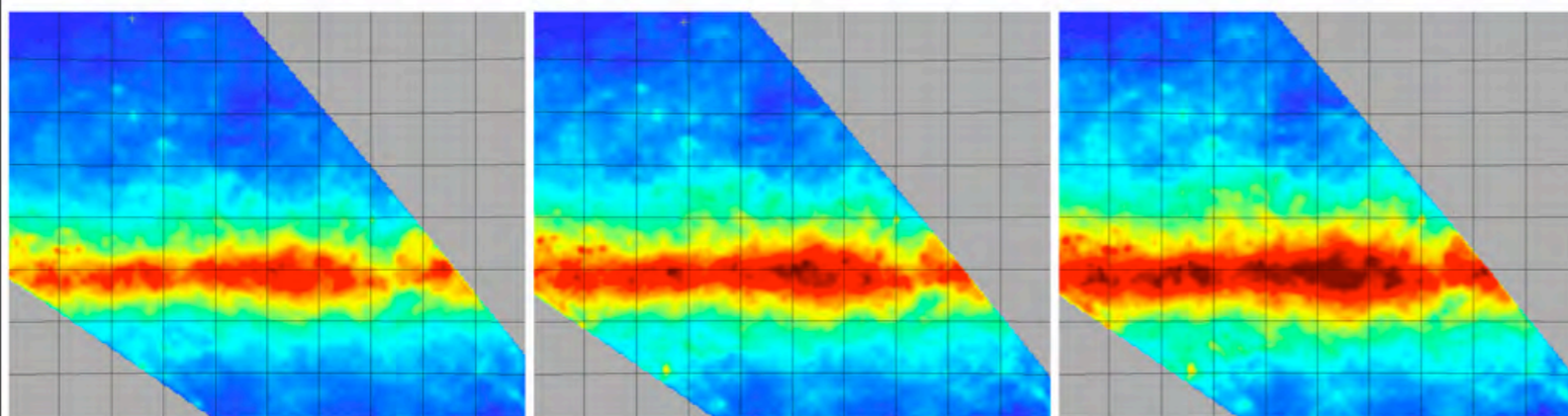
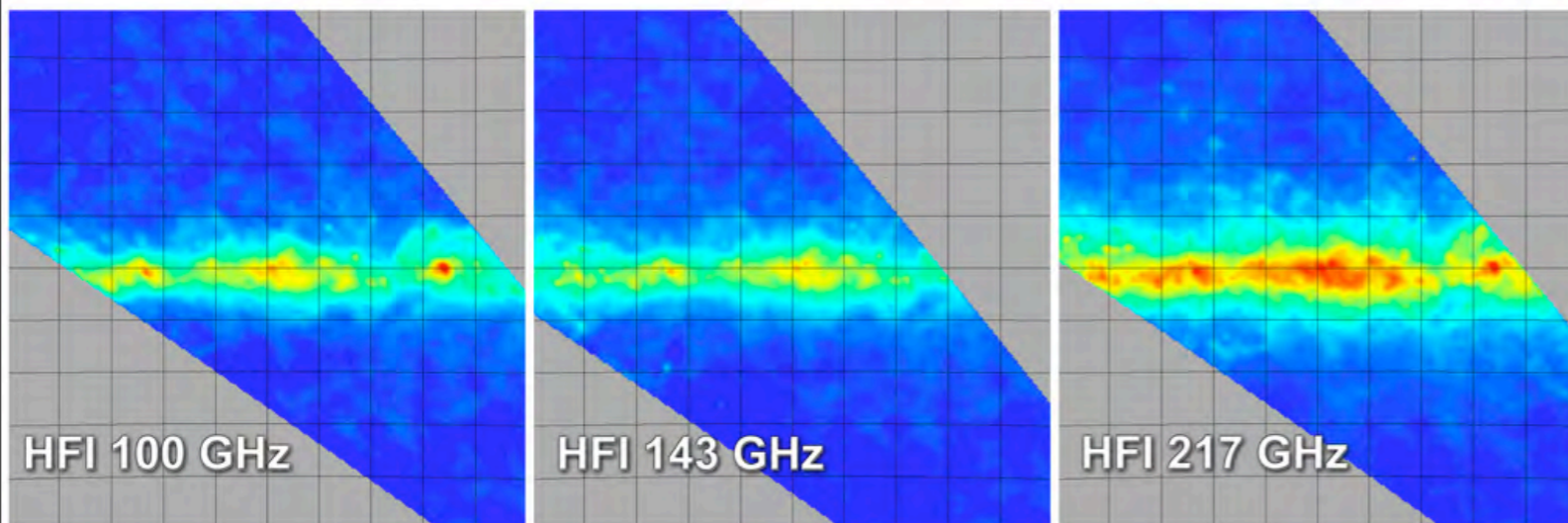
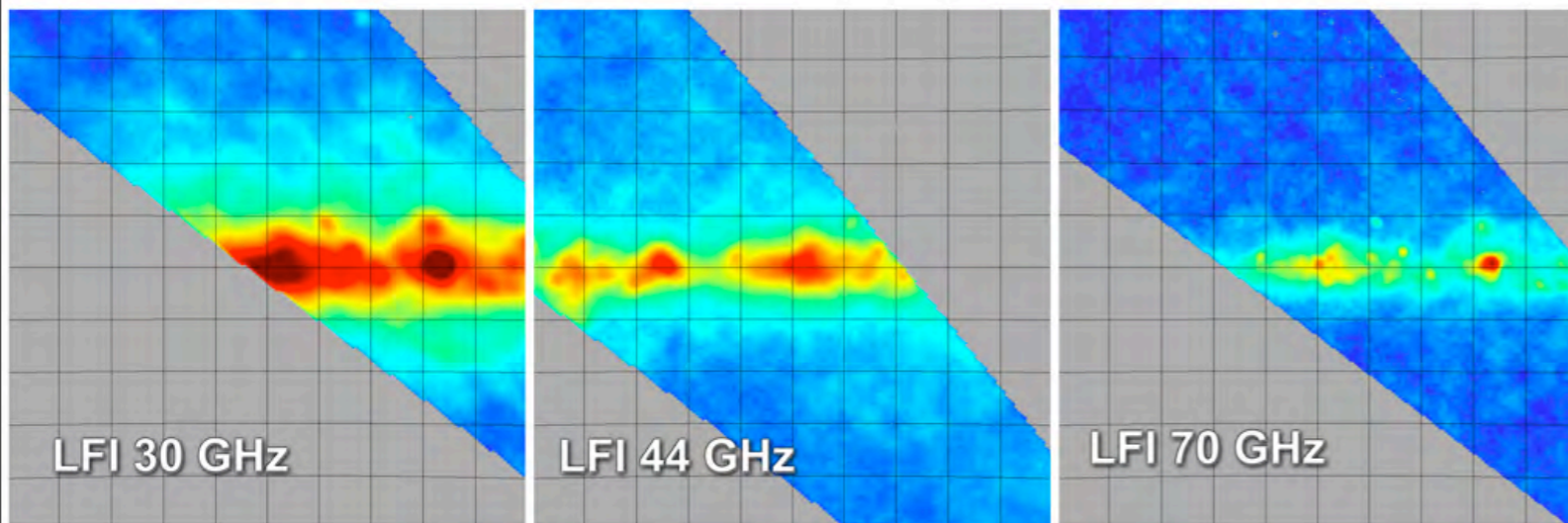


First sky band observed with the Planck/HFI detector

Physics Highlights



Physics Highlights



Welcome to the Cordelier Campus of UPMC

**I wish you all a productive conference and a good stay in
Paris**







UPMC
PARIS UNIVERSITAS

