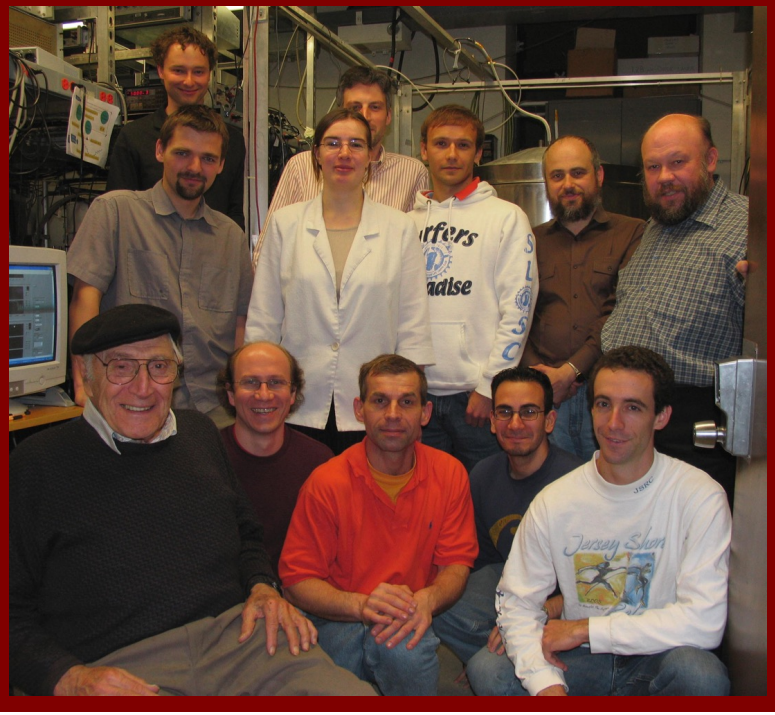
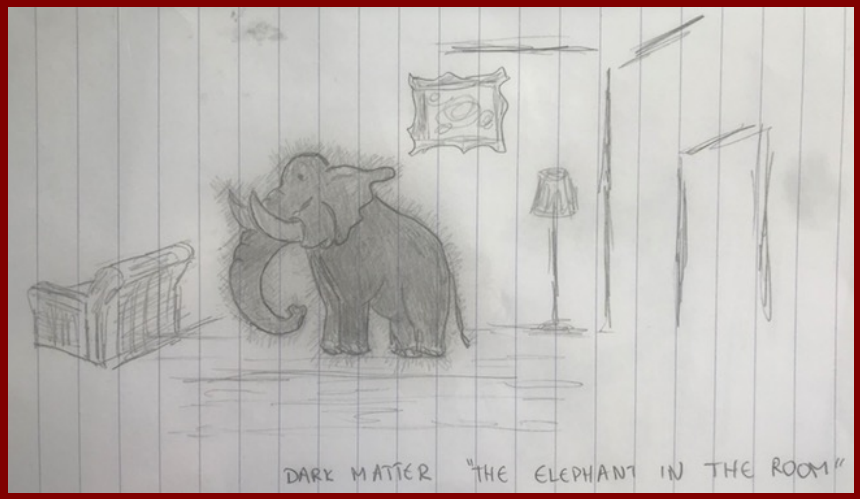
What is a quantum sensor ?

A "quantum sensor" is a device, the measurement (sensing) capabilities of which are enabled by our ability to manipulate and read out its quantum states



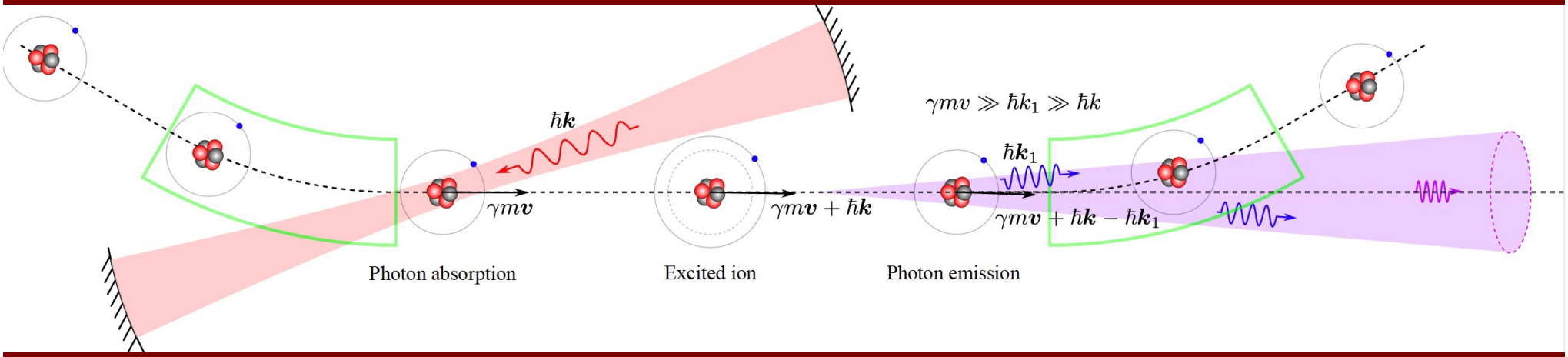
Quantum Science and Technology
Focus on Quantum Sensors for New-Physics Discoveries
Editors Marianna Safronova and Dmitry Budker



All kinds of quantum sensors…

- NMR in search of **DM** (CASPEr)
- Spin-based sensors **for DM:** GNOME, masers, spin amplifiers
- Spin-based sensors for fifth-force searches
- Gravimeters, atomic spectroscopy (WRESL), antimatter …
- New (or very old) sensors: levitated magnets
- Gamma Factory @ CERN: "table-top" physics with the LHC ?

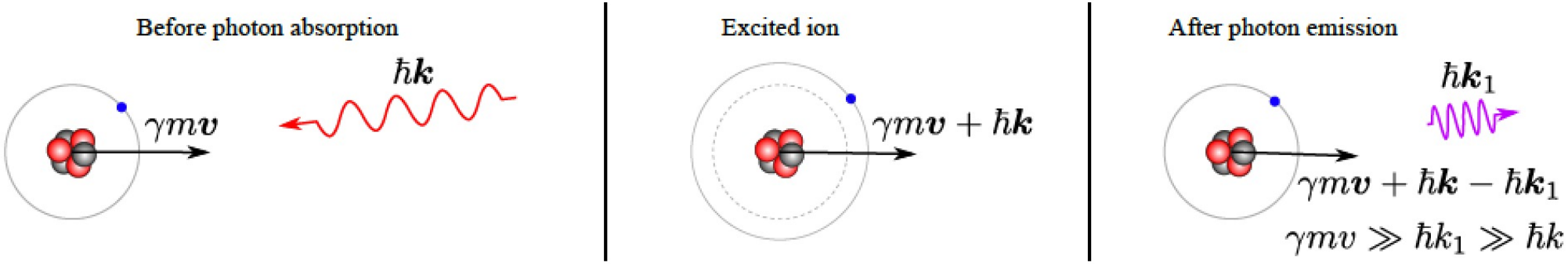
Gamma Factory @ CERN



- Proposal: M. W. Krasny (2015)
- Up to 10^{17} photons/s with energies up to 400 MeV
- Physics with primary, secondary, and tertiary beams
- "Table-top" physics with the LHC ?

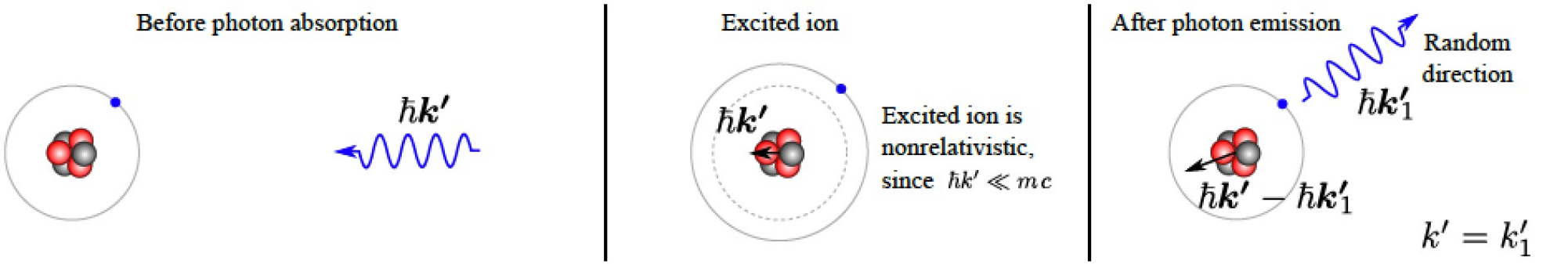
Photon scattering on relativistic ions

In the laboratory reference frame:



Photon-energy boost: $2\gamma_L \times 2\gamma_L$
backward emission angle: $1/\gamma_L$

In the initial ion reference frame:



Photon-energy boost: $2\gamma_L$

PSI @ LHC

Is this possible?

A major news from CERN! (July 2018)

During a special one-day run, LHC operators injected lead "atoms" containing a single electron into the machine (Image: Maximilien Brice/Julien Ordan/CERN)

Protons might be the Large Hadron Collider's bread and butter, but that doesn't mean it can't crave more exotic tastes from time to time. On Wednesday, 25 July, for the very first time, operators injected not just atomic nuclei but lead "atoms" containing a single electron into the LHC. This was one of the first proof-of-principle tests for a new idea called the Gamma Factory, part of CERN's Physics Beyond Colliders project.

Gamma Factory PBC study group

90 scientists
35 institutes
>10 countries

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Prof. Dr.
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GF group is open to everyone willing to contribute to this initiative!

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Atomic Physics Studies at the Gamma Factory at CERN

Dmitry Budker, José R. Crespo López-Urrutia, Andrei Derevianko, Victor V. Flambaum, Mieczyslaw Witold Krasny, Alexey Petrenko, Szymon Pustelny, Andrey Surzhykov, Vladimir A. Yerokhin, and Max Zolotorev*

duality

Light Source ↔ Giant Ion Trap