



eeFACT22 Close-up

M.E. Biagini

65th ICFA BD Workshop on High Luminosity e^+e^- Factories

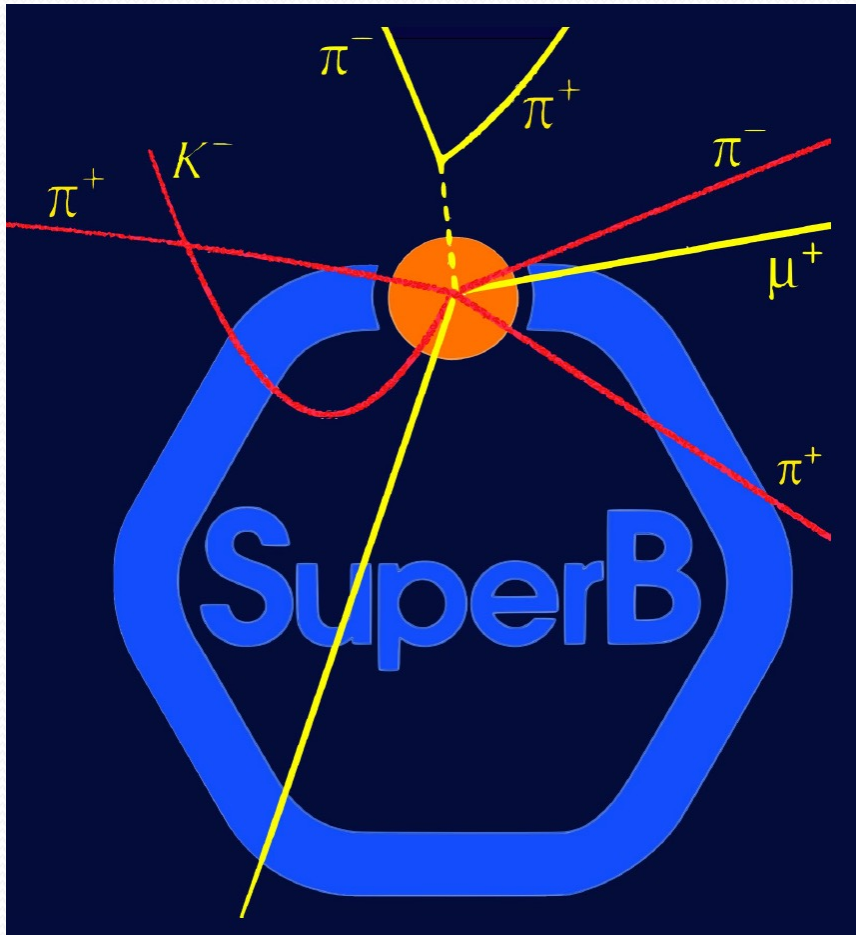
Frascati, September 15th 2022

Remembering Roberto Petronzio and *SuperB*



- Roberto Petronzio (1949 - 2016) was INFN President, and the main motor and the leader of the *SuperB Factory project* proposed by INFN in 2006
- *SuperB*, to be built in the Tor Vergata campus (3Km from LNF) was the source of many new ideas, most of all the *Crab-Waist collision* scheme by P. Raimondi, verified at DAΦNE
- The *SuperB* studies were carried on from 2006 to 2012, when, unfortunately, were stopped due to lack of funding
- *SuperB* was an example of ample collaboration between countries that actively contributed to its design: Italy, US, Russia, UK, France, CERN, Japan (85 Institutions)
- The *SuperB* legacy is living in all present and planned circular e^+e^- colliders

The birth of *SuperB* & crab-waist scheme



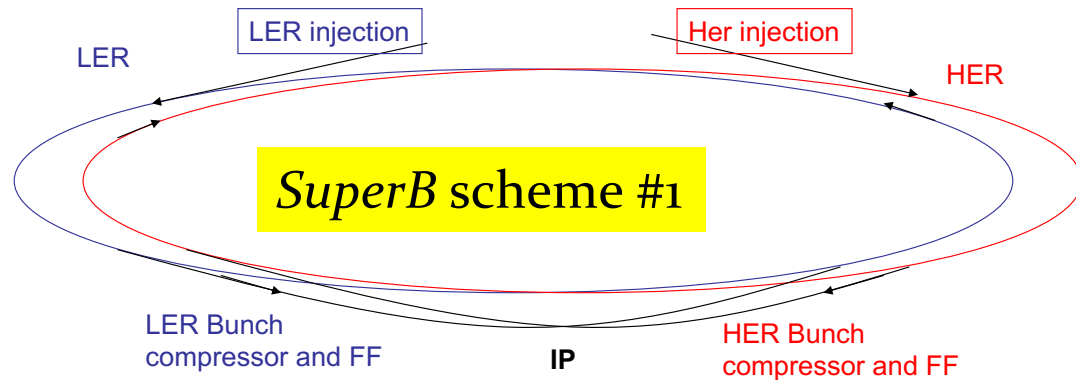
- All following slides are taken from the talk:

«Status on SuperB effort»

by P. Raimondi

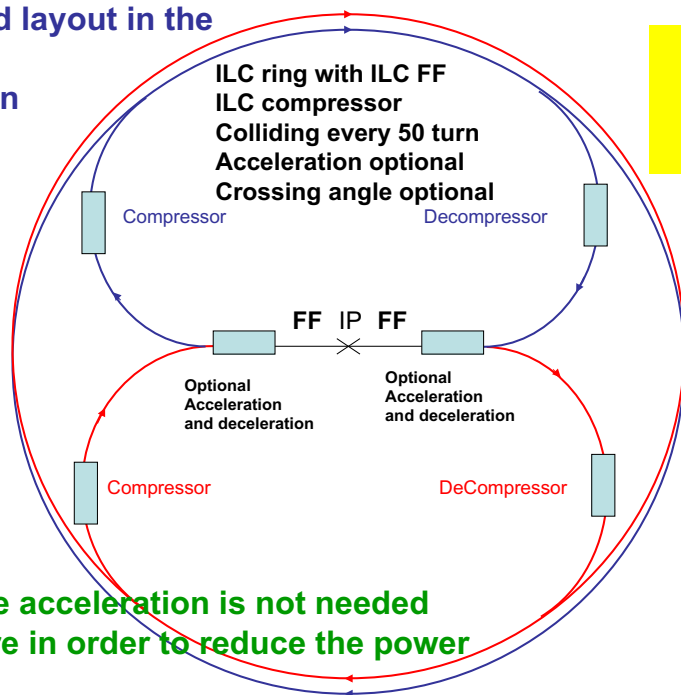
Frascati, March 16, 2006

LinearB scheme



Overall rings length about 6Km,
Collision frequency about $120\text{Hz} \times 10000\text{bunch_trains} = 1.200\text{MHz}$
Bunch train stays in the rings for 8.3msec, then is extracted, compressed and focused. After the collision is reinjected in its ring

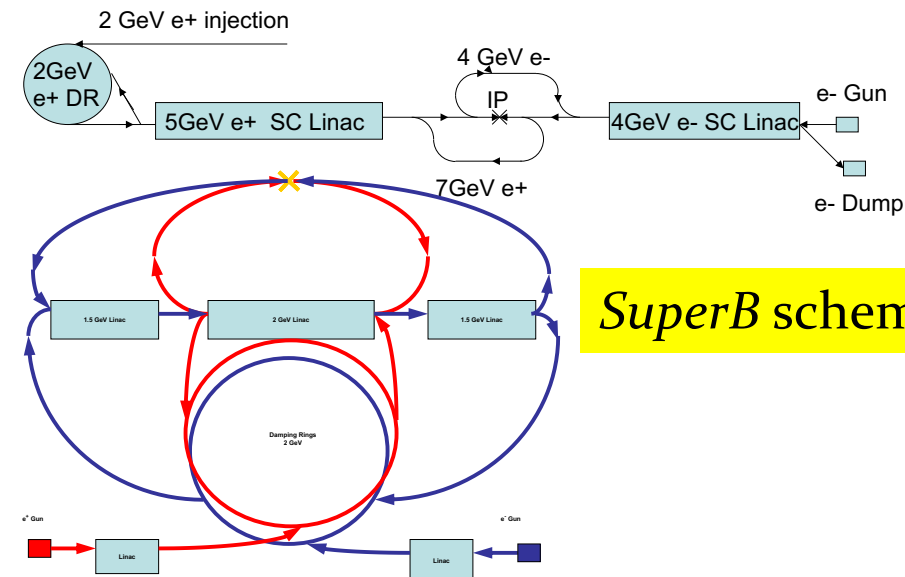
Simplified layout in the Small Disruption Regime



Now the acceleration is not needed anymore in order to reduce the power

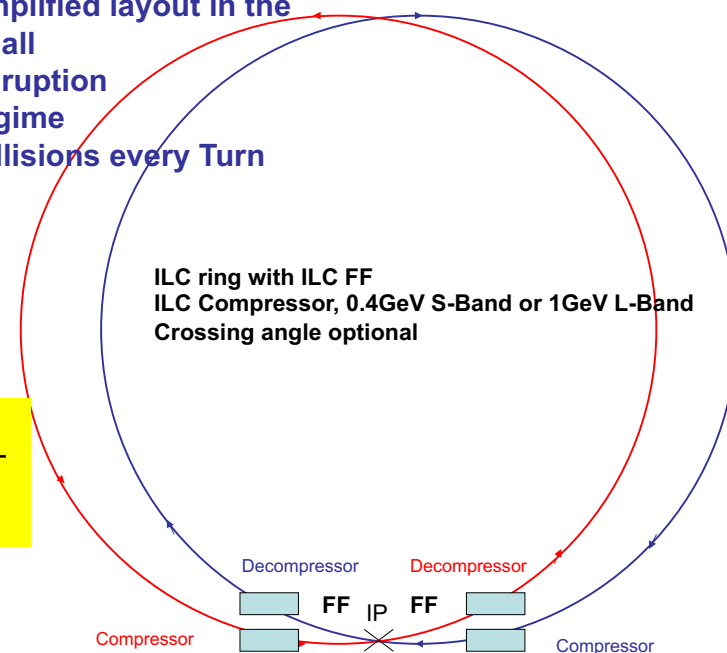
SuperB scheme #3

Linear Super B schemes with acceleration and energy recovery



SuperB scheme #2

Simplified layout in the Small Disruption Regime Collisions every Turn



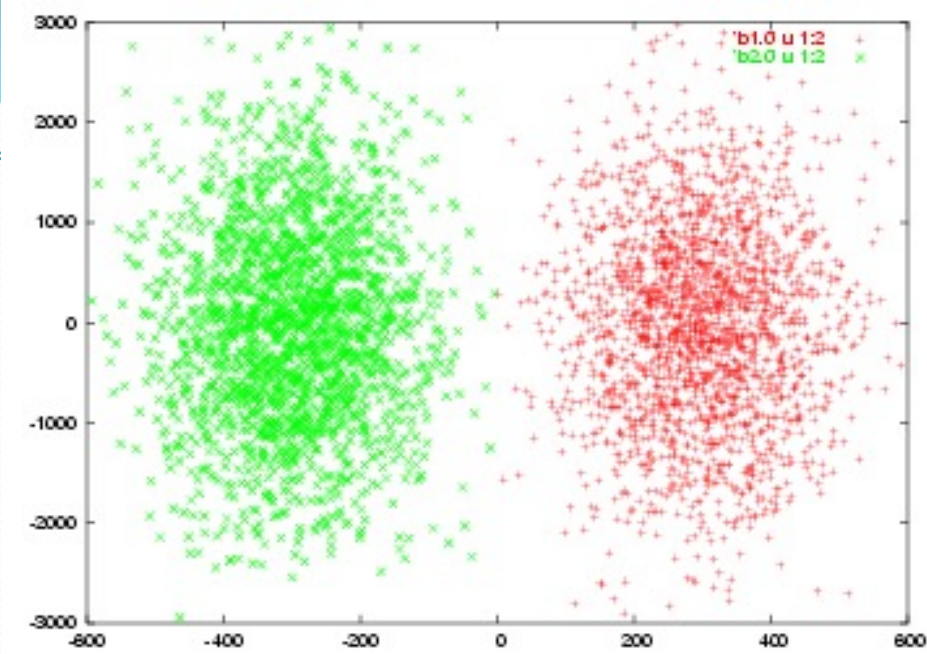
SuperB scheme #4 (final)

How to reduce the power (1st attempt)

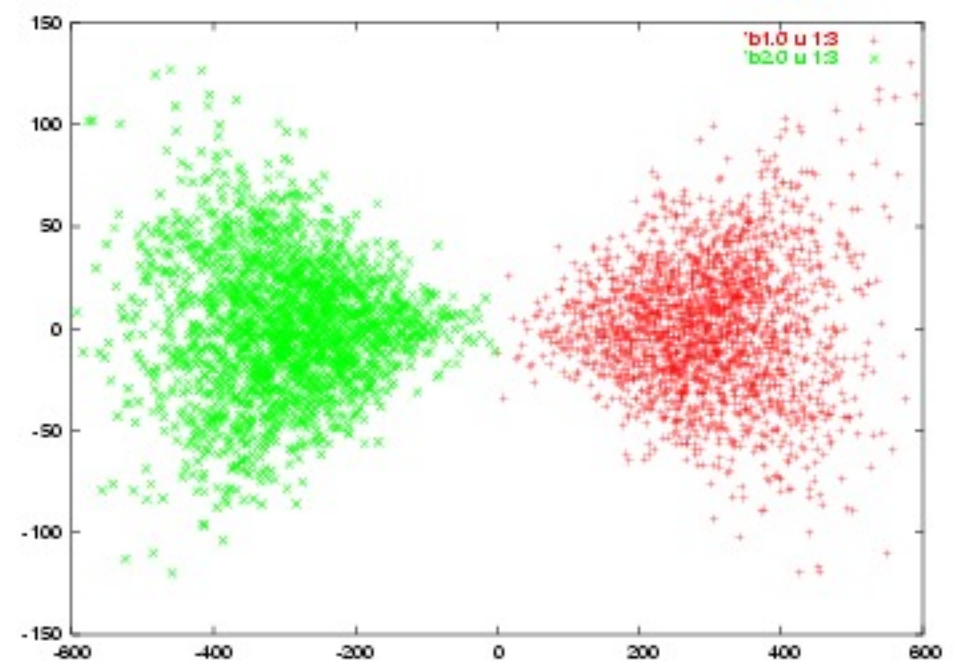
Already concerned by power

- Use SC linacs to recover energy
- Use lower energy damping rings to reduce synchrotron radiation
- No electron damping ring
- Make electrons fresh every cycle
 - Damping time means time to radiate all energy
 - Why not make a fresh beam if storage time is greater than 1 damping time

J. Seeman proposal



Horizontal Collision



Vertical collision

SuperB scheme #1

Effective horizontal size during collision about 10 times smaller, vertical size 10 times larger

First attempt

Simulation by D.Schulte

Crabbed waist:

- All components of the beam collide at a minimum betay
- The 'hour glass' is reduced and the geometric luminosity is higher
- The bb effect in the section where the beams do overlap is reduced
- The bb effect in the sections where the beams do not overlap is greatly reduced

From tracking, the blowup at the equilibrium goes down to just a factor 2!!!, with a luminosity of about $0.8 \cdot 10^{36}$

Very first mention of CW

Crabbed y_{waist} is easily achieved by placing a sextupole upstream the IP (and symmetrically downstream) in a place in phase with the IP in the horizontal plane and at $\pi/2$ in the vertical plane (much easier than the longitudinal travel focus).

Very handy solution that requires just the ILC DR, and the ILC FF.

No compression needed

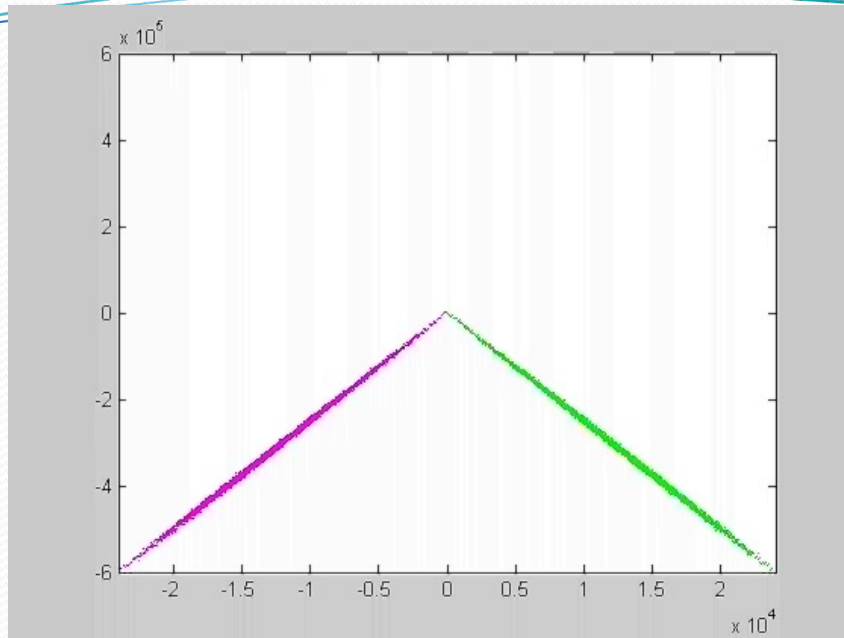
Only natural energy spread in the beams

Angular divergences about $150\mu\text{rad}$ in both planes

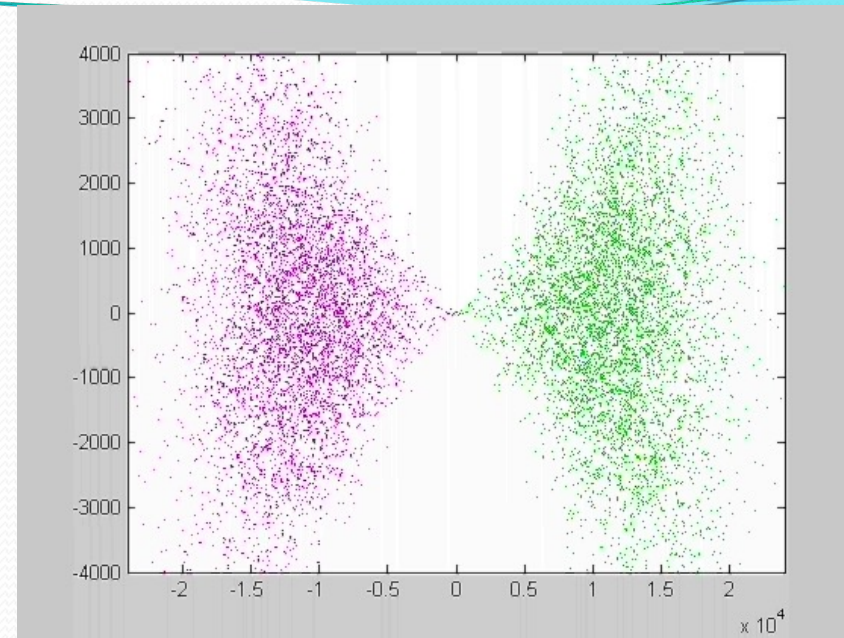
Crossing angle so large makes the IR (and the FF) design very easy

Low energy spread makes the FF very easy

Beam currents around 1.5Amps, possible better trade off current \leftrightarrow damping time



Horizontal Plane



Vertical Plane

Collisions with uncompressed beams

Crossing angle = $2 \times 25 \text{ mrad}$

**Relative Emittance growth per collision about 1.5×10^{-3}
($E_{\text{after_collision}}/E_{\text{before_collision}}=1.0015$)**

Conclusions (4)

P. Raimondi, 2006

- Possible fall back on the existing factories
- The crabbed waist seems to be beneficial also for the current factories
- Potential to simultaneously boost the performances of the existing machines and do SuperB R&D

YES !!!!!!!!!!!!!

First CW experiment at DAΦNE (2009)

PRL **104**, 174801 (2010)

PHYSICAL REVIEW LETTERS

week ending
30 APRIL 2010

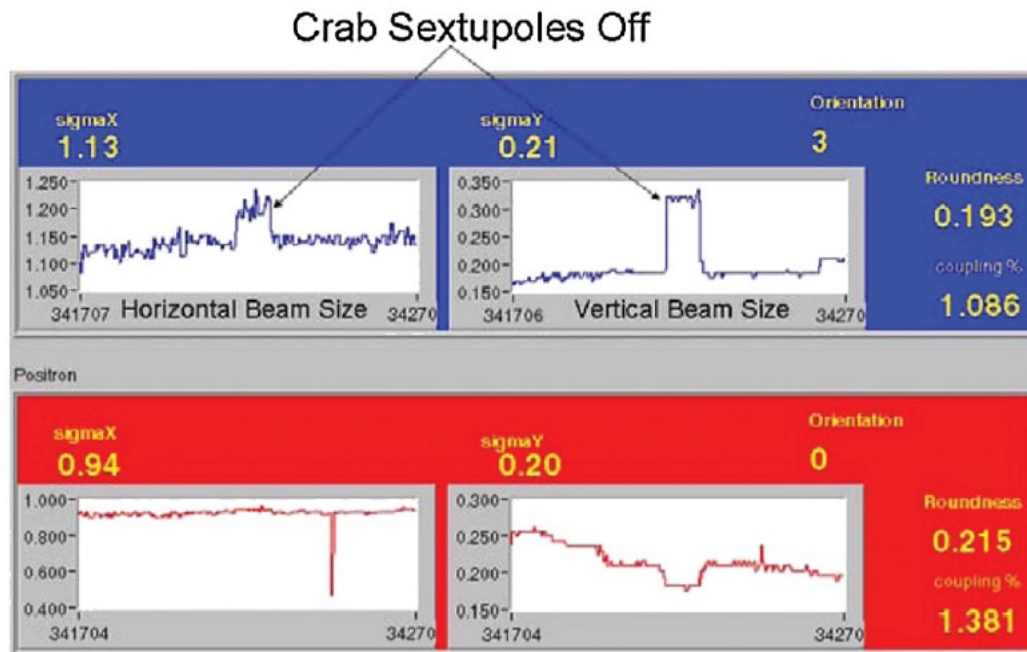


FIG. 3 (color). Transverse beam sizes at the synchrotron light monitors (electrons: blue windows, positrons: red windows).

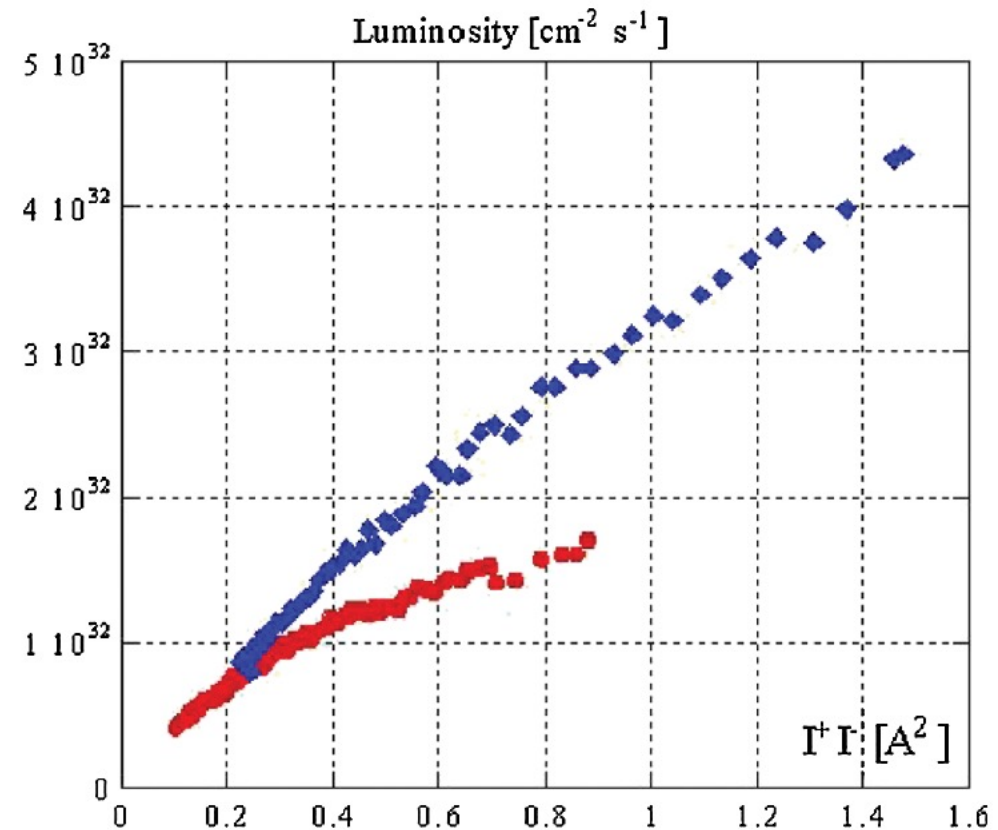


FIG. 4 (color). Measured luminosity as a function of beam current product for crab sextupoles on (blue) and off (red).

Coming to the end

- This was the 4th of the recurrent series of workshops previously held in Beijing (2014), Daresbury (2016), and Hong Kong (2018)
- It is extremely important to keep this workshop alive → next one in 2024, where? Tsukuba?
- See you in two years (if no pandemic stops us), we might be joined with the [muon collider community](#)?
- **Don't forget to submit your paper before October 31st**
- **Instructions for the authors are on the web page**

This is the
place to
make
progress !



Marcus
Tullius
Cicero,
106-43 BC



Tusculanae Disputationes, 45 BC: series of dialogues that take place during **five days** at Cicero's villa at **Tusculum** (now the **town of Frascati** near Rome) – Might the Frascati eeFACT'22 proceedings (5 days of talks!) become equally famous?!

Thanks to all participants, in person and remotely,
to all speakers, and to the Conveners for the
interesting agenda

Special thanks to Francesca Casarin and Manuela
Giabbai, without them this workshop would not
have been possible



Thanks to Massimiliano
Iungo for his help with the
proceedings and parallel
sessions



Goodbye and travel safe!