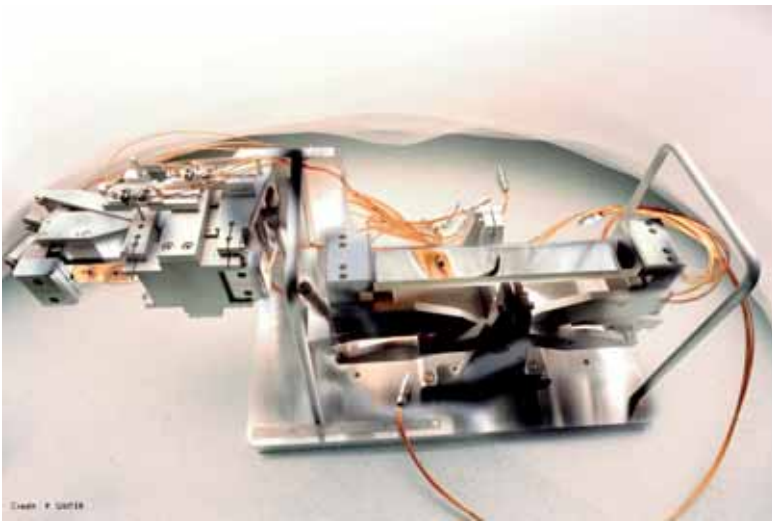



## KB system for micro-focusing

A proven quality customised system



- Proven reliability and stability
- High quality optics
- Sub-micron spot size
- Fully characterised with LTP
- High stability version with Invar®
- Operation under inert gas, air at atmospheric pressure or down to  $10^{-6}$  mbar pressure
- Stand alone unit or integration into the end-station area
-  licence

This fully integrated micro-focusing system enables a stable, submicron spot size to be obtained while maintaining optimal compactness, allowing simple sample zone integration.

The **KB system** is commercialised by IRELEC under ESRF licence, and has demonstrated its high reliability and efficiency on many ESRF beamlines for more than ten years.

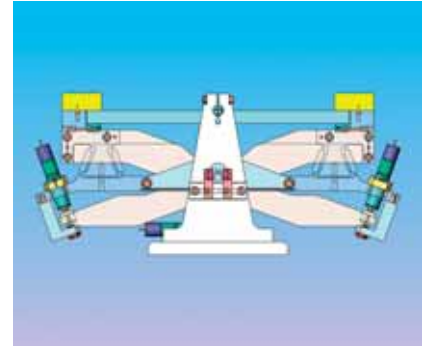
## Mirrors

IRELEC integrates high quality X-ray mirrors with a state-of-the-art roughness and flatness. A variable radius of curvature from 50 km to 50 m is achievable for both horizontal and vertical focusing mirrors.

Flat silicon mirrors can be contoured from rectangular to trapezoidal or torpedo shape, in order to accurately match the optical requirements of the beamline.

## Bending principles

This bending system, based on a flexural hinge virtual pivot point design, is EDM machined from a single monolithic block. This design has been optimised to minimise parasitic forces which could cause unwanted deformation during bending. Two high resolution microjacks generate, via the flexural hinge structure and optically ground clamps, a pure bending moment at each extremity of the mirror.



## Adjustment stages

For an efficient operation with beam and to simplify accurate alignment, the KB system offers 4 degrees of freedom : mirrors incidence adjustments plus two translations (perpendicular to the optical surface).

In order to preserve compactness and angular stability, linear and angular adjustments are obtained by combining two flexure pivot rotational stages actuated by precision microjacks.

## Actuator

All degrees of freedom, including the bending moments, are actuated using microjack. These consist in a stepper motor drive, a low backlash reduction gear and a precision screw – nut system.

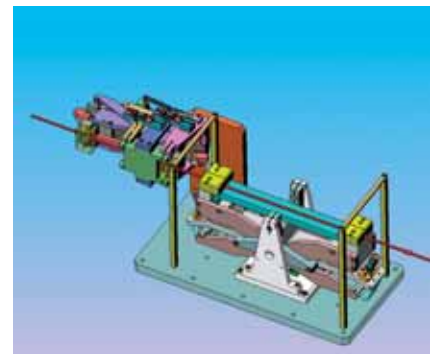
## Custom integration

Upon request, IRELEC performs the 3D study for integration of the system in the experimental environment.

A stand alone version of the system, with its own supporting structure (granite or metal stand) is also available.

A protected cover box could be supplied, for operation in clean conditions. A dedicated vacuum environment including vessel, supports, feedthroughs, windows, etc..., is also available for applications down to  $10^{-6}$  mbar.

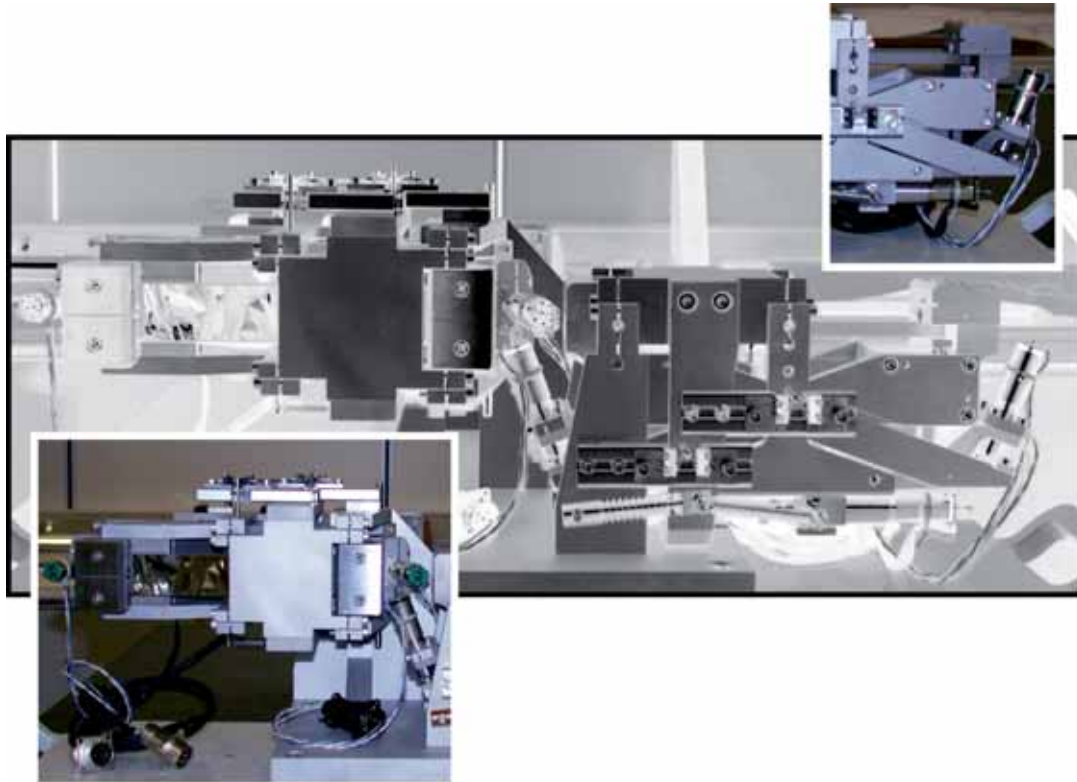
The compactness and versatility (relative position of the optics, number of degrees of freedom, ...) of the system enable a customised integration to the experimental station area.



## Control system

Actuators in the KB systems are fully compatible with the electrical requirements of all major synchrotrons, and can be easily interfaced with most command control standards (EPICS, TANGO,...)

Upon request, IRELEC can supply the whole control system of the KB unit.



**Performances**

| Mirrors                                       |   |
|---|---|
| Substrate                                     | Silicon single crystal<br>Preferential orientation upon request |
| Optical length                                | 135 or 240 mm   |
| Optical width                                 | Up to 10 mm   |
| Tangential slope error (unbent)               | Typically < 0.5 $\mu$ rad rms                                   |
| Sagittal slope error                          | Typically < 10 $\mu$ rad rms                                    |
| Roughness                                     | < 2 $\text{\AA}$ rms  |
| Initial radius of curvature                   | > 50 km   |
| Coatings                                      | Rh, Pt, Au, Ir, ... contact us for special request              |
| Bending actuator                              |   |
| Bending jack lever arm                        | 220 mm or 320 mm  |
| Resolution                                    | 80 nm   |
| Reproducibility                               | < 0.4 $\mu$ m   |
| Resolution on bending radius ( $\Delta R/R$ ) | < 0.05 %  |
| Tangential slope error (bent)                 | < 1 $\mu$ rad rms   |
| Bending radius                                | Down to 50 m  |

**Options**

- The following options are available :
- Vacuum vessel for operation down to  $10^{-6}$  mbar
  - High stability option using Invar® mechanics
  - Supporting structure
  - 3D integration study
  - On-site commissioning and training

**References**

- L. Zhang , R. Hustache, O. Hignette, E. Ziegler and A. Freund « Design optimization of a flexural hinge-based bender for X-ray optics » - J. Synchrotron Rad. (1998). 5, 804-807
- P.J. Eng, M. Newille, M.L. Rivers and S.R. Sutton « Dynamically Figured Kirkpatrick Baez X-Ray Micro-Focusing Optics » - SPIE Vo. 3449-0277-786X/98
- O. Hignette, G. Rostaing, P. Cloetens, A. Rommeveaux, W. Ludwig and A. Freund « Submicron focusing of hard X-rays with reflecting surfaces at the ESRF » - SPIE Vol. 4499 (2001) – 0277- 786X/01

## A world-wide experience

IRELEC offers world-wide service for installation, on-site survey, commissioning and training



IRELEC already supplied complete beamlines and beamline components to all new generation synchrotron light sources (ALBA, ASP, DLS, Soleil,...)



# IRELEC

Engineering company for scientific and industrial equipment

Offers components and turnkey systems for:  
synchrotron beamlines, neutron instruments, particle accelerators,  
high-voltage equipment, industrial applications

IRELEC is member of the PIB Group – [www.groupe-pib.com](http://www.groupe-pib.com)

20 rue du Tour de l'Eau – BP 316  
38407 ST MARTIN D'HERES Cedex – France  
Phone + 33 4 76 44 12 96 – Fax + 33 4 76 63 19 68

E-mail [irelec@irelec.fr](mailto:irelec@irelec.fr) – Web [www.irelec-pib.com](http://www.irelec-pib.com)