we are considering electrons or muons[5]:

$$\text{electron:}\quad |M_{ee} - M_{Z'}| \; < \; \max\left(\frac{\Gamma_{Z'}}{2},\, \left(0.16\sqrt{\frac{M_{Z'}}{\text{GeV}}}\text{GeV} + 0.04\frac{M_{Z'}}{\text{GeV}}\right)\text{GeV}\right), \tag{17}$$

$$\text{muons:}\quad |M_{\mu\mu} - M_{Z'}| \; < \; \max\left(\frac{\Gamma_{Z'}}{2},\, \left(0.017\% \left(\frac{M_{Z'}}{\text{GeV}}\right)^2\right)\text{GeV}\right). \tag{18}$$

The selection of an invariant mass window centred at the $Z'$ boson mass is comparable to the standard experimental analysis, as in Ref. [4] (the electron channel at DØ), where signal and background are integrated from $M_{Z'} - 10\Gamma_{Z'}$ (where $\Gamma_{Z'}$ is the $Z'$ boson width obtained by rescaling the SM-$Z$ boson width by the ratio of the $Z'$ to the $Z$ boson mass) to infinity. Since the background (in proximity of the narrow resonance) can be reasonably thought of as flat, while the signal is not, the procedure we propose enhances the signal more than the background and it is expected to be more sensitive. Reference [5] applies a different strategy and figure 3a shows that our procedure is comparable, although less involved. A Bayesian approach is being used at the LHC [29], similar to the CDF case. Hence, we present our results for a comparison 'a posteriori'.

In our analysis we use a definition of signal significance $\sigma$, as follows. In the region where the number of both signal ($s$) and background ($b$) events is "large" (here taken to be bigger than 20), we use a definition of significance based on Gaussian statistics:

$$\sigma \equiv s/\sqrt{b}. \tag{19}$$

Otherwise, in case of smaller statistics, we used the Bityukov algorithm [30], which basically uses the Poisson distribution instead of the approximate Gaussian one.

Finally, as in [10, 17], we used CTEQ6L [31] as default Parton Distribution Functions (PDFs), evaluated at the scale $Q^2 = M_{\ell\ell}^2$. The leading order (LO) cross sections are multiplied by a mass independent $k-$factor of 1.3 [2], both for the cross sections evaluated at the Tevatron (as in Refs. [4–6]) and at the LHC (as in Ref. [29][6]), to get in agreement with the Next-to-Next-to-Leading-Order (NNLO) QCD corrections.

Typical detector resolution has effectively been taken into account by our procedure, that consists in counting all the events that occur within the window (in invariant mass)

[5] We take the DØ di-electron [28] and the CDF di-muon [5] mass resolutions as a typical Tevatron environment, in accordance with the most up-to-date limits.

[6] Notice that in Ref. [29] the k-factor used was mass-dependent. Here we use the average value.